

Food Poisoning: Illness Ranges from Relatively Mild Through To Life Threatening

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ABSTRACT

Food poisoning is an unpleasant illness which is caused by eating contaminated food. This includes food which has been poorly prepared, cooked at the wrong temperature or as a result of poor hygiene. It can also occur if raw food is stored next to cooked food. This contamination includes bacteria, viruses, toxins or parasites. This is a common illness which ranges from relatively mild through to serious, even life threatening conditions. The degree of severity of food poisoning will depend upon the cause. Whatever the extent, food poisoning is a horrible illness which most of us have experienced at some point in our lives. According to the Food Standards Agency (FSA) there are nearly 900, 000 cases of food poisoning each year. However, this figure may be higher due to the fact that not every case of food poisoning is reported.

INTRODUCTION

Food poisoning is not only a common illness but one which appears to be on the increase.

There are two reasons for this:

- Changing lifestyles
- Global food market

Changing Lifestyles

Our lifestyles have changed over the last few years which include an increasing reliance on ready prepared meals, eating out rather than cooking and taking more holidays abroad. We all lead busy lives and as a result of that tend to spend less time preparing and cooking food. People often cook several meals in advance and freeze them for a long period of time or buy convenience food which only has to be put in a microwave oven.

Another popular option is buying takeaway meals. It is a quick option with the minimum of fuss and offers a wide variety of choice. But with this increased choice and flexibility comes an increase in health risks. Food poisoning occurs if food is not stored in the refrigerator at the correct temperature or is kept past its 'sell by' date. Another problem is when food is reheated even though it is not designed to be or is not cooked for the right amount of time. This applies to food bought for consumption at home, from a local fast food outlet or a restaurant. Another factor is that women as well as men go out to work which means that they have less time (and inclination!) to cook a meal. At one time the woman stayed at home and had a meal ready for her family once they arrived home from work and school but that is less common nowadays.

If you are tired after a long day at work then the last thing you want to do is to spend hours preparing a meal when it is so much easier to put something in the microwave. This combined with the fact that cookery is not as widely taught as it used to be has led to a decrease in basic cooking skills.

However, there has been a swing back to what are considered old fashioned cooking skills which is largely due to the current economic climate. People are having to cut back and are looking at ways of reducing their outgoings which often includes staying in and cooking rather than eating out or buying readymade meals. This may reduce the number of food poisoning cases [1-20].

Global Food Market

Another reason is our 'global village': we are able to access a greater range of foods than before which are flown in from all parts of the world. But these foods are often from countries which have different standards of food safety from the UK which means that it is easy for bacteria to quickly spread from one host to another.

Many of us have become accustomed to purchasing foods 'out of season', for example strawberries which be bought in winter rather than the summer. We expect to walk into a supermarket and purchase these foods whenever we want and don't always give this a second thought. But whilst it is ideal to have a wide range of choice there is an increased risk of contracting food poisoning due to variable food standards.

However there is a trend towards buying locally produced food or foods which are in season which might help alleviate this problem. Plus this also supports local growers which is beneficial for the economy. Knowing where your food is sourced from and the standards of care and safety that have been applied may help to reduce the incidences of food poisoning [21-25].

WHAT CAUSES FOOD TO BECOME CONTAMINATED?

Many cases of food poisoning can be attributed to poor food hygiene. Food which has not been properly prepared, cooked or stored becomes a ripe breeding ground for bacteria which multiply and then release toxins which are absorbed by the body. These toxins cause the characteristic symptoms of food poisoning which are nausea, stomach pains, vomiting and diarrhoea. These symptoms develop quickly, often within 48 hours.

Contamination and cross-contamination are the two main causes of food poisoning. Food can also be contaminated by viruses and pesticides. Viruses, for example norovirus are known for causing food poisoning, especially in areas where large numbers of people congregate, e.g. on board a cruise ship. Pesticides are substances sprayed onto crops to protect them against pests, for example insects or weeds. However, there are risks to health from using these which includes symptoms of food poisoning. To summarise: most but not all cases of food poisoning are caused by infected food. However, food poisoning can be caused by viruses spread by person to person contact or close proximity to an infected animal. Food poisoning also occurs from drinking water which has been infected with bacteria or parasites such as giardia. So whilst contaminated food is the most likely cause of food poisoning, do not discount the possibility of it being caused by a virus, parasite or toxin [26-30].

FOOD POISONING OR GASTROENTERITIS

Food poisoning and gastroenteritis are two types of illness whose symptoms are very similar to each other. This means that it can be difficult to determine which of these illnesses you have.

FOOD POISONING

Food poisoning develops as a result of eating or drinking something which is contaminated, usually by bacteria, although this can include toxins and parasites. Symptoms such as nausea, vomiting and diarrhoea often occur within 48 hours of this consumption.

GASTROENTERITIS

Gastroenteritis or 'stomach flu' is caused by a viral infection which accounts for the majority of cases. Other cases are caused by bacterial infection and parasites. This can also be caused by contaminated food and water.

Gastroenteritis causes an inflammation of the digestive tract, specifically the stomach and intestines. If the stomach is affected, the illness is known as 'gastritis': similarly if the intestines are infected it is known as 'enteritis'. If both the stomach and intestines are infected then it is known as gastro-enteritis. Symptoms of gastroenteritis are very similar to those of food poisoning –which may account for the confusion –and include fever, nausea, stomach bloating and diarrhoea. What needs to be borne in mind is that gastroenteritis is not caused by a flu virus. It is often referred to as 'stomach or gastric flu'but it is caused by either a viral or bacterial infection or NOT the influenza virus. It may be easier to think of gastroenteritis as a 'stomach bug'. This is entirely understandable. These toxins can be absorbed by the body which may cause problems elsewhere. So, food poisoning occurs due to the bacteria in the contaminated food and the toxins produced [31-35].

ASPECTS OF GASTROENTERITIS

1. Caused by an infection (viral or bacterial)
2. Spread by personal contact although it can be transmitted through food or water.
3. Causes fever, bloated abdomen, watery diarrhoea, aches and pains and vomiting.
4. May lead to dehydration in serious cases
5. Gastroenteritis develops when a virus or bacteria, such as norovirus, enters the digestive system. Once there it negatively interacts with organs such as the intestines, causing side effects such as diarrhoea.

This virus or bacteria can react with food which passes through the digestive tract which results in an infection. A further reaction is where toxins are released into the digestive tract which can cause damage to the internal organs. One sign of this is an inflammation of the stomach or gastritis. So, gastroenteritis occurs as a result of a viral or bacterial infection within the digestive system (stomach and intestines). We hope that this helps to clear up any confusion between these two similar illnesses. But contact your GP if you are unsure.

HIGH RISK FOR FOOD POISONING

Anyone can get food poisoning but there are groups of people who are at increased risk of doing so. These include:

- The elderly
- Babies and children under 5
- People with a serious illness or disease e.g. diabetes
- People with a compromised immune system, e.g. HIV
- People suffering from a blood disorder such as sickle cell anaemia.
- People whose job involves handling raw food
- People with special needs or learning difficulties
- Health care staff whose jobs involve serving food and drink to vulnerable patients.
- Pregnant women
- People who are taking medication such as steroids, antibiotics or antihistamines.
- People who travel frequently (e.g. business travel)

If you or anyone you know falls into any of these categories then ask for advice on reducing the risk of food poisoning. This site can help as can your local environmental health department.

It is important for anyone within a 'high risk' group to take precautions to prevent food poisoning as they are at greater risk of complications.

For example, pregnant women run the risk of passing on the effects of food poisoning to their unborn baby.

Some of these high risk groups are discussed separately within this guide, for example, teenagers and the elderly. However we have provided a short overview of the dangers of food poisoning in any of these groups ^[36-45].

THE ELDERLY

Older people are at risk of food poisoning, mainly due to the fact that their immune systems are less capable at dealing with illness and disease. Plus older people often suffer from a chronic disease (or diseases) which then increase the risk of food poisoning. There is also the fact that our stomachs produce less acid as we age which allows more bacteria to enter our digestive systems. These bacteria can then cause an illness such as food poisoning or an infection ^[46].

BABIES AND CHILDREN UNDER 5

Babies and young children are at a higher risk of food poisoning which is usually a result of an underdeveloped immune system and a tendency to put anything in their mouths irrespective of whether it is edible or not. Young children like to explore their surroundings and will handle any object that is within their grasp. The risk with this is that the object in question may be a carrier for germs or bacteria which then enter the child's digestive system. Once there they thrive and infect this area which leads to illnesses such as food poisoning. If you have a serious condition such as diabetes or kidney failure then you are at an increased risk of food poisoning. The reason for this is a weakened immune system which has occurred as a result of your condition and leaves you vulnerable to viruses and bacteria. These viruses and bacteria can cause a whole range of diseases and infections which include food poisoning. What is especially problematic for diabetics is the effect of food poisoning on their blood sugar

levels and the ability to regulate this. If you have diabetes –either type 1 or type 2 then seek medical advice if you get food poisoning in order to reduce any complications with maintaining your blood sugar levels ^[47-60].

PEOPLE WITH A COMPROMISED IMMUNE SYSTEM

When we say ‘compromised’ we mean people who have a weakened immune system as a result of a chronic condition, autoimmune disease or have undergone cancer treatment such as chemotherapy.

This means that their immune systems are less able to fight off bacteria and viruses which cause diseases and infections. One example of these is the salmonella bacteria which develop in contaminated food such as chicken. This type of food poisoning is serious even life threatening for this group of people.

PEOPLE WHOSE JOB INVOLVES HANDLING RAW FOOD

If you work in an environment in which you are required to handle raw food then be aware that this places you at a greater risk of developing food poisoning. This is particularly prevalent in places where raw food is prepared in close proximity to cooked food (both of which need to be kept separate). A good example of this is poultry. If you handle raw chicken on a regular basis then ensure that you wash your hands and any surfaces the poultry has been on. Doing so will prevent the risk of chicken food poisoning which is one of the most common types of food poisoning.

Food poisoning is a risk with this group of people as they may be less aware of the dangers of this when preparing or cooking food. They may not realise the importance of using food before it reaches its ‘sell by’ date or storing it at the right temperature. It may be the case that this group of people, who are learning skills such as, shopping or cooking in order to become independent, require advice and guidance on food safety. This means educating them to the risks of food poisoning and supervising them to start with to ensure that they understand these risks. Plus it is important to stress the importance of personal hygiene, for example, remembering to wash one’s hands after visiting the bathroom. This also includes washing the hands before and after they have handled food.

Health care staff whose jobs involve serving food and drink to vulnerable patients. Any person who works in the health service or caring professions and is required to serve food and drink to vulnerable patients is at risk of food poisoning. If this applies to you then you will probably be aware of the need for strict hygiene in order to prevent the risk of food poisoning spreading to sick or frail patients. One example of this is nursing homes. If one resident becomes ill with food poisoning then it is very easy for this to spread to the other residents. This is particularly dangerous in this situation as these residents will have weakened immune systems which leaves them open to the risk of complications. Another factor is if a member of staff has contracted food poisoning and carries on working before the symptoms appear. He or she has acted as a carrier albeit unknowingly and has passed this illness on via person to person contact ^[61-80].

PREGNANT WOMEN

If you are pregnant then what you eat during this time is of vital importance. This means eating foods which are healthy and nutritious and are likely to be beneficial to you and your unborn baby.

But as well as what you eat, it is also important to be aware of how you prepare, cook and store food in order to reduce the risk of food poisoning. If you get food poisoning as a result of contaminated food then the bacteria from this will affect your baby which can result in birth defects.

PEOPLE WHO ARE TAKING MEDICATION SUCH AS STEROIDS OR ANTIHISTAMINES

People who are taking prescribed medication such as antihistamines, steroids or antibiotics are more susceptible to food poisoning and other gastrointestinal illnesses. This may be due to the fact that these drugs can affect the digestive system which increases this risk. For example, an upset stomach is one of the side effects from taking antihistamines. Immunosuppressant drugs and steroid medication impact upon the body’s immune system which reduces its ability to fight off bacteria and viruses. This leaves the body open to infections such as gastroenteritis and food poisoning.

PEOPLE WHO TRAVEL FREQUENTLY

Anyone who travels on a regular basis, either on vacation or business is at risk of contracting food poisoning or any form of gastro-intestinal illness. This is due to varying standards of food hygiene and safety in many countries coupled with the risk of inadequate sanitation. If you are a frequent traveler then take a few precautions such as drinking bottled water, avoid raw foods, e.g. salads, choose food which has been freshly prepared and cooked and take anti-diarrhea medication with you just in case. To reiterate: if you or anyone you know fits into any of these high risk groups then you/they will need to take extra care in regard to food safety. They are at greater risk of food poisoning than others but this does not automatically mean that they will develop this. It just means that they need to be aware of this risk and take steps to prevent them from getting this illness.

TYPES OF FOOD POISONING

Food poisoning is caused by food and water which has become infected by bacteria, or viruses, parasites or toxins. This results in different types of food poisoning although they share the same symptoms, for example abdominal pain, vomiting and diarrhea.

THE MOST COMMON TYPES OF FOOD POISONING

Chicken food poisoning appears to be the most well-known type of food poisoning but there are several others which are discussed within this section of the guide.

These include:

- Chicken food poisoning
- Beef food poisoning
- Pork food poisoning
- Fish food poisoning
- Bacterial food poisoning
- Viral food poisoning
- Parasites
- Toxins

The bacterial and viral food poisoning sections contain individual subsections which discuss these in more detail. For example, there is a subsection about E coli bacteria.

Chicken, beef, pork and fish food poisoning are all caused by different strains of bacteria. However, fish can also be infected by parasites or toxins found within seawater which build up inside. One example of this is shellfish such as mussels.

The causes of food poisoning can be categorized into the following two groups:

- Infectious causes
- Toxic causes

Infectious causes or 'agents' include bacteria, parasites and viruses and are the most common causes of food poisoning. This refers to food which has been contaminated by bacteria or other organisms that causes an infection after consumption. These cause symptoms of food poisoning which are confined within the digestive system, e.g. abdominal pain. Toxic causes or 'agents' are the least likely cause of food poisoning. These highly potent toxins are found within food and once ingested, attack the body and in some cases, overwhelm the immune system.

This type of food poisoning affects the entire body, the symptoms of which include dizziness, rapid heartbeat and a skin rash.

Chicken Food Poisoning

This is probably the most well-known type of food poisoning. Many of us have either experienced this first hand or know someone who has suffered from this nasty illness. Yet chicken is one of the most popular foods around. There can't be many people who do not enjoy roast chicken on a Sunday, chicken sandwiches or barbecued chicken. This includes children as well as adults who both enjoy the taste and versatility of chicken. But the fact still remains that chicken is one of the worst offenders when it comes to food poisoning.

Poultry and Food Poisoning

The term 'poultry' includes turkey, duck and goose as well as chicken but it is usually chicken which accounts for the majority of cases of food poisoning. Food poisoning occurs because poultry such as chicken or turkey has not been allowed to defrost thoroughly before use or cooked for the correct length of time. Another factor is allowing raw poultry to come into contact with other foods.

Causes of chicken food poisoning

Chicken food poisoning is caused by two types of bacteria:

Campylobacter

Salmonella

Both of these bacteria are found in red meat, unpasteurized milk, poultry, e.g. chicken and eggs.

Campylobacter and salmonella bacteria live in the intestines of poultry and other livestock found on farms. These bacteria can be transmitted via their faeces into the human food chain. They can also pass into humans after the bird or animal has been slaughtered.

How does chicken food poisoning occur?

This occurs as a result of poor food preparation and/or hygiene. For example:

- The juices from raw chicken being allowed to drop onto cooked poultry or other types of foods.
- Chicken which has not been cooked at the correct temperature.
- Chicken which has not been allowed to cook for the right length of time.
- Failure to allow chicken to defrost thoroughly
- Using the same chopping board for raw and cooked chicken
- Eating chicken after the 'sell by' date

Another cause is washing chicken before cooking. Many people do this in the belief that it will remove germs and bacteria but what this does do is to spread these around worktops and the rest of the kitchen. This increases the risk of food poisoning.

Symptoms

The period of time from when the contaminated food is eaten to when the symptoms appear is called the 'incubation period'. In most cases of food poisoning the symptoms appear between 24 and 48 hours.

These include:

1. Fever
2. Abdominal pains
3. Upset stomach
4. Nausea
5. Vomiting
6. Diarrhea

If you have a medical condition, a weakened immune system (e.g. as a result of cancer treatment) or a job which requires you to handle raw poultry then you are at increased risk of this type of food poisoning.

How long does chicken food poisoning last

This very much depends upon the severity of your symptoms. The more serious your bout of food poisoning the longer it will last. Most cases of food poisoning clear after a few days but serious cases will require medical treatment. Severe cases of food poisoning are usually treated in hospital.

Treatment for chicken food poisoning

Mild cases can be treated at home. This means plenty of fluids and bed rest. There are special re-hydration sachets you can take which replace any electrolytes and other important fluids lost through vomiting and/or diarrhoea. These re-hydration sachets are available from a pharmacist. If your symptoms worsen or persist then see your GP. He or she may prescribe antibiotics as this type of food poisoning is usually caused by a bacterial infection. Your GP will recommend admittance to hospital if you are dehydrated, have developed complications such as seizures or are vomiting/passing blood.

Preventing chicken food poisoning

This type of food poisoning can be prevented by following a few simple procedures which include:

1. Washing hands before and after handling poultry
2. Checking cooking instructions and following these thoroughly
3. Ensuring that any frozen chicken has been completely defrosted before use.
4. Storing chicken at the right temperature in the fridge
5. Placing leftover chicken in small containers in the fridge
6. Keeping cooked and raw chicken separate.
7. Beef food poisoning
8. This type of food poisoning refers to beef and meat products in general, e.g. beef burgers. It also includes pates, sausages and sliced cooked meats.

Red meat is a good source of protein, vitamins and minerals and is highly versatile as well. It can be grilled, roasted, barbecued and fried although in the latter case it is better to grill than fry for health reasons. Some cuts of meat are high in saturated fat. This also applies to meat based products such as sausages, pates and sliced meats such as salami. Plus sausage rolls and pies which are also high in saturated fat. So, from a health perspective it is a good idea to choose lean cuts of meat whenever possible and limit your consumption of pies, sausages, pates and cooked meats. But another health issue is that of food poisoning.

Meat and Food Poisoning

When we use the term 'meat' we mean red meat in the form of steaks, burgers, sausages and meat related products such as pies and pasties. Chicken food poisoning is one of the most common forms of food poisoning but it is closely followed by meat food poisoning. And this type of food poisoning is as equally as unpleasant.

The main problem why meat such as beef causes food poisoning is due to a failure to cook it thoroughly. Meat needs to be cooked to the extent that the inside is pink rather than red, and any juices from it run clear.

The only exception to this rule applies to steaks which can be eaten whilst still red inside –known as 'rare', but the outside of these will have been sealed at a high temperature. This will have killed any bacteria which live on the outer surface of the meat. Cooked meat such as beef needs to be kept separate from raw meat to prevent cross contamination. If it has been frozen beforehand then it needs to be allowed to completely thaw out before cooking and cooked at the correct temperature.

Causes of beef food poisoning

Meat food poisoning is caused by any number of bacteria which include:

Campylobacter
Listeria
Salmonella
E coli

Campylobacter and salmonella are both found in raw meat. Listeria occurs in meat products such as pates and cooked meats, e.g. salami. E coli can be found in undercooked beef. These types of food poisoning occur as a result of meat which has been contaminated by bacteria. However, there is another type of food poisoning –that which develops due to parasites –called 'toxoplasmosis'. Toxoplasmosis is rare especially in the UK but is likely to be the cause of any cases of parasitical food poisoning. This type of parasite lives in the digestive system of animals for example cats and can easily be passed to humans. This happens as a result of eating undercooked beef which contains this parasite or food or water which has been in contact with infected animal faeces.

Rinsing or washing meat before cooking is another cause of food poisoning. This is seen as mistakenly, a way of removing germs and bacteria but in fact, it can cause these to spread around the kitchen which results in food

poisoning. Many people do this with chicken but this is as equally as risky. Do not, under any circumstances, wash poultry or meat before use.

Symptoms of beef food poisoning

The symptoms of beef food poisoning appear within the first 48 hours after consumption.

They include:

1. Stomach pains/upset stomach
2. Fever
3. Vomiting
4. Diarrhoea
5. Nausea
6. Bloating
7. Aches and pains
8. General feeling of being unwell

You have a higher than normal risk of contracting food poisoning if you have a poorly functioning immune system, an underlying medical condition or are in a high risk group, e.g. elderly. The symptoms of food poisoning develop rather quickly which often distinguishes them from other similar gastrointestinal illnesses. If these symptoms worsen and lead to dehydration or persist for more than a week then seek medical advice.

Treatment for beef food poisoning

In the vast majority of cases this can be treated at home. This means getting plenty of rest and replacing fluids lost as a result of this illness. It is important to do so to prevent dehydration. If your symptoms show any sign of worsening, for example you are unable to keep anything down (and that includes fluids) for more than a day then speak to your GP.

Preventing beef food poisoning

The advice given here refers to all forms of meat based food poisoning. As in any case of food poisoning, prevention is better than cure. This means care and attention paid to the preparation, cooking and storing of food, and ensuring that utensils and work surfaces are kept clean. Another important factor is cross contamination. This means ensuring that cooked and raw meats are kept separate, in containers, so that they do not infect one another [81-90].

Pork Food Poisoning

You may not connect pork with food poisoning but there are a couple of types of food poisoning, one of which is known as 'trichinosis'. The other type occurs as a result of the 'yersinia enterocolitica' bacteria.

Most of us are familiar with chicken or meat food poisoning and have either suffered from it ourselves or know of people who have done. But how many people do you know who have suffered from food poisoning caused by contaminated pork? When food poisoning cases are reported in the media they have often been caused by people eating infected chicken or meat. The reasons for these include food which has not been cooked according to instructions, unhygienic handling or cross contamination. This equally applies to pork.

Trichinosis

Trichinosis occurs when pork is infected by a parasite known as 'roundworms'. These roundworms live as a series of cysts (which contain larvae) within raw or undercooked pork and are able to pass into the human body when this pork is eaten. These cysts pass through the digestive system where stomach acid causes them to hatch out the larvae which then develop into fully grown roundworms. These roundworms are harmful to the digestive system, but in particular, they infect bodily tissues which cause a whole range of problems within the body. These problems can last for up to two months following the initial consumption. These roundworms will eventually leave the body via the gastrointestinal tract but will cause a range of health problems before they do so.

Symptoms of trichinosis

These appear in two stages: the first stage starts almost straight after eating the infected pork but the second stage takes anything from two to 8 weeks to appear. In the first stage, symptoms include severe abdominal pain, nausea and diarrhoea. This diarrhoea usually lasts for a couple of days before clearing up by itself. These initial symptoms occur as a result of the roundworms entering the digestive system and infecting the tissues within that system. This is known as the 'gastro-intestinal stage'. The second stage is characterized by fever, aches and pains in the muscles and joints, chills and itching. This occurs 2 to 8 weeks later and as a result of the roundworms infecting skeletal muscle cells. This is known as the 'muscle stage'. In some cases, these roundworms can cause a shortness of breath and an inflammation of the heart muscle –known as 'myocarditis'.

Diagnosing trichinosis

This is not always easy to diagnose, especially in the first stage unless the person concerned mentions that they have eaten pork. If they have and are suffering from stomach pains, vomiting and diarrhoea then a diagnosis can be made. But, this depends upon the person seeking help in the first place. Some people may decide to do nothing in the hope that these symptoms will ease by themselves after a couple of days. They may only seek help when they enter the second stage of the disease and experience chills, joint pains and itching. A GP will look for signs of pain and tenderness in the joints and muscles as well as any past history of problems in these areas. He or she will also check to see if there any signs of bleeding under the fingernails or within the eyes ^[91-100].

This will be followed by a series of laboratory tests, e.g. blood tests.

Treating trichinosis

Most cases of trichinosis resolve themselves. This means that they do not usually require any treatment unless the symptoms are severe or complications have developed. Medication can be prescribed to destroy the roundworms within the digestive system or any inflammation within body tissues caused by these parasites.

Complications of trichinosis

The vast majority of trichinosis cases clear up without any complications. However, there are a few situations in which serious conditions such as myocarditis or lung or nervous system problems have occurred which require medical treatment. These complications may take 6 months to several years to clear.

Yersinia Enterocolitica Bacteria and Pork Food Poisoning

This type of food poisoning is caused by the yersinia enterocolitica bacteria which live inside raw pork. It is not caused by the actual pork itself but by this strain of bacteria which also causes gastroenteritis. This bacterium is able to access meats such as pork, beef and lamb due to poor food hygiene and handling. It also occurs if these meats are not stored correctly and at the right temperature. The problem with this form of bacteria is that it can survive even after being stored within a fridge. But it can be destroyed through cooking so it is important to ensure that pork is well cooked. Ignore recipes which call for pork to be lightly cooked or undercooked.

The symptoms

Symptoms of this type of food poisoning are very similar to those for Crohn's disease or appendicitis which may result in an incorrect diagnosis. The main symptom is a severe form of diarrhoea which is accompanied by other symptoms such as stomach cramps, pain and fever. Many of the symptoms are those caused by gastroenteritis and include nausea, vomiting and a loss of appetite.

The Diagnosis

Your GP will examine you and will ask you about your medical history. He or she may refer you for tests if your condition warrants this. The aim is to determine if your illness is food poisoning or gastroenteritis. In both cases the symptoms are very similar so he/she will ask you about the types of foods you have recently eaten which will include pork.

The treatment

If you have a mild form of food poisoning then this can be treated by yourself. This means drinking plenty of fluids to replace those lost as a result of vomiting and/or diarrhoea. There are sachets you can purchase which act as a fluid replacement. These contain electrolytes and any other important vitamins/minerals which will replace those lost during your illness. These sachets are available from a local high street pharmacy or online. Antibiotics are only prescribed where food poisoning has a bacterial cause. Babies and young children usually require hospital treatment.

Complications

These occur in a small percentage of cases. They include joint pains, skin rash and a possible spread of the infection into the bloodstream.

Preventing pork food poisoning

The best advice we can give here is to avoid eating raw or undercooked pork, prevent cross contamination with other foods and to wash your hands before and after handling pork ^[55].

Fish Food Poisoning

The most common cases of food poisoning which involve fish usually occur as a result of eating contaminated prawns or other shellfish. A good example of this is oysters which some people enjoy consuming whilst raw. But these often contain bacteria which are likely to cause food poisoning and other similar conditions. These fish filter seaweed or algae from the water surrounding them but bacteria live in this water and enter the fish during their filtration process. These bacteria then take root inside the fish.

It is easy to think of food poisoning as something which you get if you eat contaminated chicken, beef or pork but unfortunately, it includes fish as well.

There are two types of fish food poisoning which are:

- Ciguatera poisoning
- Scombroid poisoning

Both of these are discussed as individual subsections within this guide.

Fish as Part of a Healthy Lifestyle

Fish is good for us and we are encouraged to include it as part of a healthy diet. In particular, oily fish which contains high levels of omega 3 fatty acids which are good for 'heart health'. There is a wide range of fish to choose from and experts recommend that we eat at least a couple of portions a week. But as with anything in life, moderation is the key. Girls and women are advised to eat no more than 2 portions of oily fish a week due to the presence of pollutants within the fish which can build up in the body over time.

So, if a girl or woman decides to have a baby at some point in the future then these pollutants may affect its development. Another problem and one which applies to adults of both sexes is that of high levels of mercury within certain types of fish. Swordfish, marlin and shark contain mercury and it is advised that people limit their consumption of these to one portion only each week. That is the healthy side of fish but there is downside which is food poisoning.

Fish and Food Poisoning

So what can go wrong?

The same rules about food safety and preparation apply to fish as with any other food product. If fish is left out on a work surface for any period of time then it will decay (or 'go off') very quickly. Raw and cooked fish must not come into contact with each other due to the risk of cross contamination. This means using separate utensils and chopping boards for raw and cooked fish and wiping them down after use.

Fish needs to be cooked thoroughly and at the correct temperature. One exception to this is sushi. Sushi is a popular Japanese dish which consists of raw fish, e.g. salmon, rolled in rice and seaweed. This is available in restaurants and as ready prepared packs in supermarkets.

Generally, this is safe to eat as long as the fish used has been cooked or if raw, has been frozen beforehand in order to kill off any parasites.

Causes of fish food poisoning

This type of food poisoning is caused by fish which has been contaminated by:

- Parasites
- Toxins
- Bacteria, e.g. E coli
- Viruses, e.g. norovirus

Fish which can be eaten raw such as oysters or mussels are always a risky choice as well as being a likely candidate for food poisoning. So, if you enjoy the taste of oysters, especially a raw one then be aware that the odds of getting food poisoning are quite high.

Parasites: Food poisoning caused by parasites is rare, especially in countries such as the UK. It occurs as a result of eating raw fish which has been contaminated with any of the following parasites:

- Clonorchis sinensis
- Anisakis
- Diphylobothrium

These are all names for different types of 'fish tapeworms' which enter the gastrointestinal tract during consumption. Once there they cause a range of problems which includes abdominal pain, nausea, vomiting and diarrhoea.

Toxins: There is a wide range of toxins present in seawater which are produced by any number of agents such as marine plankton and algae. These are capable of a range of health problems such as ciguatera poisoning although this is uncommon.

Bacteria: A well-known example of this is E coli. This bacterium is present in nearly all types of shellfish as a result of contact with water contaminated by raw sewage.

Viruses: The virus in this case is the norovirus which is spread via contaminated food and water, and personal contact with someone who is already infected. There are two types of foods which often cause an outbreak of the norovirus: salads and shellfish. In the latter case it usually occurs due to insufficient heating of shellfish before consumption.

Symptoms of fish food poisoning

These are similar to symptoms for other types of food poisoning and include:

- Nausea
- Vomiting
- Diarrhoea
- Upset stomach
- Stomach pains
- Muscle/joint pains
- Headache

These symptoms develop within 48 hours of eating contaminated fish. The severity of these symptoms will vary between individuals. Some people will have a much worse experience than others which may depend upon how much contaminated fish they have eaten. There are groups of people who for a variety of reasons, are at a greater risk of getting this type of food poisoning. These include people with a poorly functioning immune system, are currently suffering from a medical condition or work in an environment where they handle raw fish. If any of this applies to you then take a few extra precautions to reduce the risk of this happening.

Treatment for fish food poisoning

This depends upon the extent of your illness. If your food poisoning is relatively mild then you can treat it at home. This means bed rest and plenty of liquids. If you are worried about the risk of dehydration then replace any essential vitamins and minerals lost as a result of your food poisoning. Drink plenty of fluids, e.g. water but add a sachet of re-hydration salts to it which will replace these as well as ensuring that you are properly hydrated. Dehydration is a major risk of food poisoning and is something to avoid if possible. But if you do become dehydrated then you will require hospital treatment. This means re-hydration via an intravenous drip.

Preventing fish food poisoning

Can you prevent yourself from getting food poisoning from fish?

You can reduce the likelihood of this happening by applying a few common sense measures. These include:

- Ensuring fish has been properly cooked or if eaten raw (e.g. sushi) has been frozen beforehand.
- Do not store fish especially shellfish in water
- Separate raw fish from cooked fish
- Wash your hands before and after handling fish. Also wipe down any chopping boards, utensils and kitchen worktops afterwards.
- Store fish in the fridge as soon as possible after purchase [23].

Bacterial Food Poisoning

This is one of the biggest – if not the biggest cause of food poisoning. It is used as an umbrella term to include a wide range of infections caused by various bacteria. These include salmonella, campylobacter and E coli.

These bacteria live inside certain foods, for example, chicken, which, once they are consumed by a person, trigger a range of symptoms which we know as food poisoning. These bacteria and their effect upon the human body are discussed individually as follows:

- E coli
- Staphylococcus aureus
- Salmonella
- Clostridium botulinum
- Listeria
- Shigella
- Campylobacter jejuni
- Vibrio parahaemolyticus
- Vibrio cholerae
- Bacillus cereus
- Clostridium perfringens
- Yersinia enterocolitica
- Enterobacter sakazakii

How do they trigger a bout of food poisoning?

What happens is this: you eat a food product, for example a piece of chicken or a beef burger which has, unbeknown to you, a type of bacteria which is known to cause food poisoning. As you consume this food, the bacteria enter your body via your digestive system: or to be more precise your gastrointestinal tract. This is the part of the body where the symptoms of food poisoning develop. Note: your gastrointestinal tract refers to your stomach and intestines. The bacteria pass through the lining of the stomach and then attach themselves to soft tissues which line the wall of the intestines. Once there they proceed to multiply and destroy the cells which live within these walls. They do this either by overwhelming these cells or by releasing a toxin which in some cases, can spread into the bloodstream. If it does so then there is the risk of it causing damage to other areas of the body.

Basically, some bacteria will remain in the intestines; others will produce a toxin which is absorbed into the bloodstream but some may access deep tissues within the body.

You can have two situations here:

- Food is contaminated by bacteria which release toxins and cause food poisoning after consumption.
- Toxins are produced by bacteria inside food whilst it is growing.

So, you can either ingest bacteria which then proceed to release toxins inside your intestines. This will result in symptoms of food poisoning appearing within 24 to 48 hours;

OR

You consume food which already contains toxins that have been produced whilst the food was still growing. If this happens then the symptoms of food poisoning will appear that much quicker.

Ideal conditions for bacteria to grow

Bacteria love warm, moist environments. They respond to this by reproducing themselves, e.g. a single bacterium divides into two, and two bacteria divide into four and so on. So as you can imagine, these bacteria can multiply into millions within a very short space of time. Let's relate this to food: if a piece of meat or chicken is left standing

on a kitchen worktop overnight instead of being stored in the fridge then by the morning, it will have become contaminated by millions of bacteria. Anyone who picks up this tainted food and eats it will develop food poisoning – even from just a single mouthful. But, this can be prevented. Bacteria do not like cold, dry places, e.g. a fridge, so storing food in this cold environment and at the correct temperature will stop these bacteria from multiplying.

The role of friendly bacteria

What are ‘friendly bacteria?’ You may have heard of this term but are wondering what these types of bacteria are and how they function. One example you may be familiar with is a series of television advertisements which talk about friendly bacteria in relation to a brand of yoghurt drink. Friendly bacteria occur naturally inside the body, in the large intestine and a section of the small intestine which lies furthest away from the stomach.

The reason they are not usually found in the stomach, esophagus and initial section of the small intestines is due to gastric acid plus enzymes. These deter any growth of bacteria. Friendly bacteria are kind to the body. They aid with digestion but more importantly, they act as a form of protection against unfriendly or harmful bacteria – such as those which cause food poisoning. These harmful bacteria invade the lining of the intestinal walls, destroying the cells within which leads to an infection.

Examples of friendly bacteria include:

- Bacteroides
- Lactobacillus (used in probiotic yoghurt)
- Fusobacteria

Another type of friendly bacteria is E coli. This surprises many people who think of it in terms of causing food poisoning, but, there is more than one type of E coli bacteria. Many of these are harmless and are considered friendly bacteria. However, there is one strain of E coli which is anything but harmless and can cause a variety of illnesses which includes food poisoning. This is the ‘E coli O157:H7’ strain of bacteria.

These friendly bacteria can be thrown off balance. This results in a situation in which there is a high proportion of one type of bacteria as compared to the others. Antibiotics are a cause of this as they do not tend to discriminate between the different types of bacteria. Certain medical conditions can reduce the number of friendly bacteria or cause one species to dominate at the expense of others. An imbalance can be resolved by the person ingesting probiotic supplements, such as yoghurt, which will correct this imbalance as well as adding a layer of protection. You may be interested to know that friendly bacteria can be found inside the mouth and on the surface of the skin.

Parasites

Food poisoning can be caused by parasites although this tends to be rare. The main cause of transmission is through drinking untreated water or eating contaminated food. This type of food poisoning is more likely to occur in developing countries than industrialized nations. However, there is one particular type of parasite – known as ‘toxoplasma’ which causes food poisoning in the UK.

This parasite and others are discussed individually within this guide. They are as follows:

Toxoplasma

Giardia

Cryptosporidium

Entamoeba histolytica

What is a parasite?

A parasite is a type of germ (or microbe) which lives on or within any living thing, for example human beings. They are often found in the digestive systems of many animals, for example cats, pigs, cattle etc but are also found in water based environments such as lakes, ponds and rivers. These parasites are single cell organisms or a type of tapeworm which consume blood or other nutrients within the small intestine, resulting in an inflammation within that area.

Symptoms of parasitical food poisoning

These include:

Mild diarrhoea

Bloating

Weight loss

Abdominal cramps
Blood in the faeces (possibly pus as well)
Tiredness
Flu like symptoms (occur with toxoplasmosis)

These symptoms vary according to the parasite but they will appear as a result of any type of parasitical food poisoning. At the end of the day, any food which has not been properly prepared, cooked or stored at the right temperature is at risk of contracting bacteria, viruses and parasites. Any of these are liable to cause food poisoning.

Toxins

Food poisoning can be caused by toxins although these are the least common cause. If this illness is caused by toxins then it is usually due to inadequate food preparation or poor choice of foods. Note: when we say 'poor choice of foods' we are referring to wild mushrooms, berries etc. Many people enjoy foraging for these but if you considering doing this then make sure that you know which varieties to pick and which to leave well alone.

A toxin is defined as 'a poisonous substance produced by a living organism' although it can also include 'man-made' substances. Toxins are designed to cause harm to anyone or anything which comes into contact with them. In regard to food poisoning: the types of toxins this guide deals with include:

Mushroom toxins
Red kidney bean toxins
Shellfish toxins
Pesticides

Many of the bacteria which cause food poisoning release toxins once they have penetrated cells within the human intestine. These toxins can spread within the gastrointestinal tract or travel to other parts of the body via the bloodstream.

Natural toxins

But as well as these toxins there are others, produced by certain types of foods, which are known to cause food poisoning. These foods contain 'natural toxins' which act as a form of protection for these foods against bacteria, strong sunlight and the weather. In other cases, the toxin is a type of pesticide which helps to fight off insect attacks.

Foods which contain natural toxins include:

1. Courgettes
2. Red kidney beans
3. Seeds within certain fruits, e.g. apples or peaches
4. Rhubarb
5. Sweet potatoes/potatoes
6. Another group of toxins found in fish are 'marine toxins'.

Marine toxins

These toxins are found in fish such as tuna, mackerel, prawns and oysters and are responsible for several types of food poisoning which include scombroid poisoning, ciguatera poisoning and neurotoxic poisoning. These toxins are found within various seaweeds and algae or occur when fish starts to decompose (or has 'gone off').

Pesticides

These are often sprayed over crops in fields to protect them from insects, bacteria, parasites etc. Examples of these include fruits and vegetables. However, they have been linked with some forms of bacteria which are known to cause food poisoning. These include the e coli, salmonella and listeria bacteria which often multiply after contact with pesticides. Children appear to be a greater risk of poisoning from pesticides than adults which may be due to their greater exposure, for example handling and playing with soil; or because they are more vulnerable to the

effects. Food poisoning caused by toxins tends to be rare but it is useful to know what the risks are and how these can be prevented [67-69].

Viral Food Poisoning

Most cases of food poisoning are bacterial in nature but there are incidences of food poisoning which have been caused by a particular type of virus.

There are in fact, several groups of viruses responsible for food poisoning which include:

1. Noroviruses
2. Rotavirus
3. Adenovirus

Viral food poisoning occurs as a result of contact with someone who is already infected; sharing food with an infected individual; inadequate washing of the hands after contact with food or water which is contaminated by infected faeces, touching a surface which has become infected by a virus and then touching your mouth.

Where are viruses found?

Viruses can be found in humans and the environment. Examples of these include soil, air, animals, lakes, streams, food and other people who are already infected.

How do you contract a virus?

Viruses can spread via airborne contact (e.g. sneezing), person to person contact or from eating contaminated food or drinking infected water. Norovirus and rotavirus are transmitted through contact with an infected individual; touching a contaminated surface or object or the consumption of infected food and/or water.

Seasonal viruses

Viral infections are seasonal: you are more likely to contract norovirus or rotavirus in the winter months than any other time of the year. A good example of this is an increase in the number of norovirus cases each January which is known as the 'winter vomiting bug'. However, it is possible to get this illness at any time in the year. One way of approaching this is to assume that you can contract viral food poisoning at any time in the year.

CONCLUSION

Food poisoning occurs when a food product is consumed which is contaminated by bacteria. These bacteria attach themselves to the lining of the intestines and start to multiply. Toxins are then released which attack cells within this lining that results in the symptoms described above. It is argued that the main difference is that food poisoning is an illness caused by infected (contaminated) food whereas gastroenteritis is caused by a viral/bacterial infection. But because the symptoms of these illnesses are similar, many people assume that they have food poisoning when in fact they have gastroenteritis.

REFERENCES

1. Comtois KA and Linehan MM. Psychosocial treatments of suicidal behaviors: A practice-friendly review. *J Clin Psychol.* 2006;62:161-170.
2. Wax PM. History. In: Goldfrank LR, Flomenbaum NE. *Toxicologic Emergencies* (Ed 6th) New York, McGraw- Hill. 1998:1-14.
3. Akkose S, et al. Epidemiology of Poisoning in Adults: A 5 Year Study. *Turkish Journal of Emergency Medicine.* 2003;3:8-10.
4. Yavuz S and Aydin S. The profile of the poisoned cases. *The Turkish Journal of Toxicology.* 2003;1:47-52.
5. Senol V, et al. An Epidemiology of Homicide and Suicide Cases in Emergency Department. *Tr J Emerg Med.* 2002;2:18-23.
6. Chirasirisap K, et al. A study of major causes and types of poisoning in Khonkaen. Thailand. *Vet Hum Toxicol.* 1992;34:489-492.

7. <http://www.acilveilkoyardim.com> Erisim tarihi 05. 07.2007
8. Tintinalli EJ, et al. Emergency Medicine A Comprehensive Study Guide. 5th ed. USA: McGraw-Hill, 1999:1057-1063.
9. Pekdemir M, et al. Evaluation of Poisoning Cases Presented to Our Emergency Department. *Tr J Emerg Med.* 2002;2:36-40
10. Serinken M, et al. Hospital Costs of Managing Deliberate Self-Poisoning in Turkey. *Med Sci Monit.* 2008;14:152-158.
11. Kaygusuz K, et al. The Retrospective Analysis of the Cases that were Observed with the Diagnosis of Acute Drug Intoxication in the Intensive Care Unit of Cumhuriyet University Medical Faculty Hospital Between 1998-2004 Years. *Cumhuriyet Med J.* 2004;26:161-5.
12. CDC Health Disparities and Inequalities Report. United States. 2013.
13. Pinar A, et al. Acute Poisoning in Izmir, Turkey- A Pilot Epidemiologic Study. *J Toxicol Clin Toxicol.* 1993;31:593-601.
14. Ozkose Z and Ayoglu F, Etiological And Demographical Characteristics Of Acute Adult Poisoning İn Ankara, Turkey. *Human & Experimental Toxicology.* 1999;18:614-618.
15. Kurt Đ, et al. Epidemiology of adult poisoning at Adnan Menderes University. *Journal of Adnan Menderes University.* 2004;5:37-40.
16. Kekec Z, et al. An analysis of 682 adult poisonings in central Anatolia of Turkey. *Vet Hum Toxicol.* 2004;46:335-336.
17. Herbert LN. History of Lead poisoning in the world. In: Abraham M George (Eds). *Proceedings of the international conference on lead poisoning, prevention and treatment.* 1999;17-25.
18. Pandya CB, et al. Environmental lead exposure as a health problem in India. *J Environ Biol* 1983;4:127-148.
19. Needleman H, et al. Health effects of lead on children and adults. In Abraham M George (Eds). *Proceedings of the International conference on Lead poisoning, prevention and treatment.* 1999;65-77.
20. Yamin VS. The impact of lead poisoning on the workforce and society. In: Abraham M George (Eds). *Proceedings of the international conference on lead poisoning, prevention and treatment.* 1999;41-45.
21. Eracal N, et al. Toxic metals and oxidative stress Part-I: Mechanisms involved in metal induced oxidative damage. *Current topics in medicinal chemistry.* 2001;1:529-539.
22. Ernest B, et al. Improved method for the determination of blood glutathione. *J Lab Clin Med* 1963;61:883-887.
23. Beauchamp C and Fridovich I. Superoxide dismutase: Improved assays and an assay applicable to acrylamide gels. *Anal Biochem.* 1971;36:307-309.
24. Brannan TS, et al. Regional distribution of catalase in the adult rat brain. *J Neurochem* 1981;36:307-309.
25. Rahman I and Mac Nee W. Regulation of redox glutathione levels and gene transcription in lung inflammation. *Free Radic Biol Med.* 2000;28:1405-1420.
26. Persijn and Vander SW. A new method for the determination of gamma glutamyl transferase in serum. *J Clin Biochem.* 1976;14:421-427.
27. Stocks J and Dormany TL. The autooxidation of human red cell lipids. *Br J Haematol.* 1971;20:95-111.
28. Kartha VNR and Krishnamoorthy S. Effect of hypervitaminosis A on hemolysis and lipid peroxidation in the rat. *J Lipid Res.* 1978;332-334.
29. Sun X, et al. Analysis of differential effects of lead on PKC isozymes. *Toxicol Appl Pharmacol* 1999;156:40-45.

30. Ding Y, et al. Lead promotes hydroxyl radical generation and lipid peroxidation in cultured aortic endothelial cells. *Am J Hypertens*. 2001;13:525-555.
31. Costa CA, et al. Correlation between plasma 5-aminolevulinic acid concentration and indicator of oxidative stress in lead exposed workers. *Clin Chem*. 1997;43:1196-1202..
32. Wasowicz W, et al. Blood concentration of essential trace elements and heavy metals in workers exposed to lead and cadmium. *Int J Occup Med Environ Health*. 2001;14:223-229.
33. Froom P, et al. Lead exposure in battery workers s not associated with anemia. *J Occu Environ Med*. 1999;41:120-123.
34. Stohs SJ and Bagchi D. Oxidative mechanisms in the toxicity of metal ions. *Free Rad Biol Med*. 1995;18:321-336.
35. Ravin HA. An improved colorimetric enzymatic assay of ceruloplasmin. *J Lab Clin Med*. 1961;58:161.
36. Sugawara E, et al. Lipid peroxidation and concentration of glutathione in erythrocytes from workers exposed to lead. *Br. J Ind Med*. 1991;48:239-242.
37. Adonaylo VN and Oteiza I. Lead intoxication : Antioxidant defences and oxidative damage in rat brain. *Toxicol*. 1999;135:77-85.
38. Sandhir R and Gill KD. Effect on lipid peroxidation in liver of rats. *Biol Trace Elements Res*. 1995;48:91-97.
39. El-Missiry MA. Prophylactic effect of melatonin on lead induced inhibition of heme biosynthesis & deterioration of antioxidant systems in male rats. *J Bio chem Mol Toxicol*. 2000;14:57-62.
40. Mylorie AA, et al. Erythrocyte SOD activity & other parameters of copper status in rats ingesting lead acetate. *Toxicol Appl Pharmacol*. 1986;82:512-520.
41. Kasperczyk S, et al. Activity of SOD and catalase in people protractedly exposed to lead compounds. *Ann Agric Environ Med*. 2004;11:291-296.
42. Farmand F, et al. Roberts, Ram KS. Lead induced disregulation of SOD, catalase, GSH-Px and guanylate cyclase. *Environ Res*. 2005;98:33-39.
43. Eracal N, et al. A role for oxidative stress suppressing serum immunoglobulin levels in lead exposed Fisher rats. *Arch Environ Contam Toxicol*. 2000;39:251-256.
44. Gurer H, et al. Antioxidant role of alpha lipoic acid in lead toxicity. *Free Radic Biol Med*. 1999;27, 75-81.
45. Anavekar NS, et al. Relation between renal dysfunction and cardiovascular outcomes after myocardial infarction. *N Engl J Med*. 2004;351:1285-1295.
46. Go AS, et al. Chronic kidney disease and the risks of death, cardiovascular events, and hospitalization. *N Engl J Med*. 2004;351:1296-1305.
47. Karayakali M, et al. Contrast-induced nephropathy:focused on risk factors. *Acta Med Anatol*. 2014;2:34-36.
48. Kurt H, et al. The relationship of ABO Blood groups with chronic renal failure. *Eur J Health Sci*. 2015;1:109-113.
49. Vanholder R, et al. European Uremic Toxin Work Group. Review on uremic toxins: Classification, concentration, and interindividual variability. *Kidney Int*. 2003;63:1934-1943.
50. Liabeuf S, et al. Protein-bound uremic toxins: New insight from clinical studies. *Toxins (Basel)*. 2011;3:911-919.
51. Schramm A, et al. Spasticity treatment with onabotulinumtoxin A:data from a prospective German real-life patient registry. *J Neural Transm*. 2014;121:521-530.
52. Bigalke H and Frevert J. Botulinum toxin A:dose and immune response. *Int J Rehabil Res* 2012;35:93.

53. Santamato A, et al. Safety and efficacy of incobotulinum toxin type A (NT 201-Xeomin) for the treatment of post-stroke lower limb spasticity: A prospective open-label study. *Eur J Phys Rehabil Med.* 2013;49:483-489.
54. Cioncoloni D, et al. Meaningful improvement in walking performance after Botulinum neurotoxin A (BoNT-A) in chronic spastic patients. *Neuro Rehabilitation.* 2014;34:185-192.
55. Picelli A, et al. Botulinum toxin injection into the forearm muscles for wrist and fingers spastic overactivity in adults with chronic stroke: A randomized controlled trial comparing three injection techniques. *Clin Rehabil.* 2014;28:232-242.
56. Alam NH, et al. Efficacy and safety of oral rehydration solution with reduced osmolarity in adults with cholera: A randomized double-blind clinical trial. *Lancet.* 1999;354:296-299.
57. Ali M, et al. The global burden of cholera. *Bull World Health Organ.* 2012;90:209-218.
58. Baemner AJ, et al. Biosensor for dengue virus detection: Sensitive, rapid and serotype specific. *Anal Chem.* 2002;74:1442-1448.
59. Barzilay EJ et al. Cholera surveillance during the Haiti epidemic—the first 2 years. *N Engl J Med.* 2013;368:599-609.
60. Brouwers AH, et al. Tc-99m-PEG-Liposomes for the evaluation of colitis in Crohn's disease. *J Drug Target.* 2000;8:225-233.
61. Aladag I, et al. Seroprevalence of Helicobacter pylori infection in patients with chronic nonspecific pharyngitis: Preliminary study. *J Laryngol Otol.* 2008;122:61-64.
62. Park JG, et al. Updates on definition, consequences, and management of obstructive sleep apnea. *Mayo Clin Proc* 2011;86:549-554.
63. Unal M, et al. The seroprevalence of Helicobacter pylori infection in patients with obstructive sleep apnea: preliminary study. *Clin Otolaryngol Allied Sci.* 2003;28:100-102.
64. Ye XW, et al. Helicobacter pylori seroprevalence in patients with obstructive sleep apnea syndrome among a Chinese population. *Saudi Med J* 2009;30:693-697.
65. Iber C, et al. 1st edn. Westchester, IL: American Academy of Sleep Medicine. The AASM manual for the scoring of sleep and associated events: rules, terminology and technical specifications. 2007.
66. Young T, et al. The occurrence of sleep-disordered breathing among middle-aged adults. *N Engl J Med* 1993;328:1230-1235.
67. Dagan Y, et al. Body Mass Index (BMI) as a first-line screening criterion for detection of excessive daytime sleepiness among professional drivers. *Traffic Inj Prev.* 2006;7:44-48.
68. Dzhumabaev MN, et al. The Interdependence between smoking, alcohol, tooth pathology and prevalence of Helicobacter pylori among ethnic groups in Kyrgyzstan. *Eksp Klin Gastroenterol.* 2015;16-20.
69. Brenner H, et al. Relation of smoking and alcohol and coffee consumption to active Helicobacter pylori infection: cross sectional study. *BMJ.* 1997;315:1489-1492.
70. Oshima T, et al. Association of Helicobacter pylori infection with systemic inflammation and endothelial dysfunction in healthy male subjects. *J Am Coll Cardiol.* 2005;45:1219-1222.
71. Perri F, et al. Serum tumour necrosis factor-alpha is increased in patients with Helicobacter pylori infection and CagA antibodies. *Ital J Gastroenterol Hepatol.* 1999;31:290-294.
72. Crabtree JE, et al. Mucosal tumour necrosis factor alpha and interleukin-6 in patients with Helicobacter pylori associated gastritis. *Gut.* 1991;32:1473-1477.
73. Roussos A, et al. Respiratory diseases and Helicobacter pylori infection: Is there a link. *Respiration.* 2006;73:708-714.
74. Graham DY, et al. Effect of H.pylori infection and CagA status on leukocyte counts and liver function tests: extra-gastric manifestations of *H. pylori* infection. *Helicobacter.* 1998;3:174-178.

75. Nadeem R, et al. Serum inflammatory markers in obstructive sleep apnea: a meta-analysis. *J Clin Sleep Med*. 2013;9:1003-1012.
76. Inancli HM, et al. Obstructive sleep apnea syndrome and upper airway inflammation. *Recent Pat Inflamm Allergy Drug Discov*, 2010;4:54-57.
77. Hatipoğlu U, et al. Inflammation and obstructive sleep apnea syndrome pathogenesis: a working hypothesis. *Respiration*. 2003;70:665-671.
78. Vgontzas AN, et al. Sleep apnea and daytime sleepiness and fatigue: relation to visceral obesity, insulin resistance, and hypercytokinemia. *J Clin Endocrinol Metab*. 2000;85:1151-1158.
79. Kariya S, et al. An association between *Helicobacter pylori* and upper respiratory tract disease: fact or fiction? *World J Gastroenterol*. 2014;20:1470-1484.
80. Basoglu OK, et al. Obstructive sleep apnea syndrome and gastroesophageal reflux disease: The importance of obesity and gender. *Sleep Breath*. 2015;19:585-592.
81. Rubin JS, et al. The prevalence of *Helicobacter pylori* infection in benign laryngeal disorders. *J Voice*. 2002;16:87-91.
82. Us D and Hascelik G. Seroprevalence of *Helicobacter pylori* infection in an Asymptomatic Turkish population. *J Infect* 1998;37:148-150.
83. Griffin D. The Quest for Extraterrestrial Life: What about the Viruses? *Astrobiology*. 2013;13:774-783.
84. Hoyle F, et al. *Evolution from Space*. Simon & Schuster Inc., London. 1981;3:35-49.
85. Joshi S. *Origin of Life: The Panspermia Theory*. Helix Magazine, Science in Society Publ. 2008.
86. Mautner M. Life in the cosmological future: Resources, biomass and populations. *J. Br Interplanet. Soc*. 2005;58:167-180.
87. Northcote-Smith E. The ecology of tardigrades. *The Plymouth Student Scientist*. 2012;5:569-580.
88. Persson D, et al. Extreme stress tolerance in tardigrades—Surviving space conditions in low Earth orbit. In H. Greven, K. Hohberg, and R. O. Schill (eds). *The International Symposium on Tardigrada. Conference guide*, Tübingen, Germany. 2009.
89. Santelices B, Correa J, Avila M. 1983. Benthic algal spores surviving digestion by sea urchins. *J. Exp. Marine Biol. Ecol*, 70:263-269.
90. Santelices B and Correa J. Differential survival of macroalgae to digestion by intertidal herbivore molluscs. *J Exp Marine Biol Ecol*. 1985;88:183-191.
91. Santelices B and Ugarte R. Algal life-history strategies and resistance to digestion. *Marine Ecol*. 1987;5:267-275.
92. Vicente F, et al. Observations on *Pyxidiumtardigradum* (Ciliophora), a protozoan living on Eutardigrada: Infestation morphology and feeding behavior. *Parasitol Res*. 2008;103:1323-1331.
93. Wickramasinghe J, et al. *Comets and the Origin of Life* (World Scientific, Singapore. 2010;6:137-154.
94. Xiong WY, et al. HPLC analysis of podophyllotoxin content in *Sinopodophyllum emodi*. *Chinese Trad Patent Med*. 2010;32:875-878.
95. We R. DNA topoisomerases as targets for cancer therapy. *Biochem Pharmacol* 1985;34:4191-4195.
96. Shang MY, et al. Study on pharmacodynamics of Chinese herbal drug Guijiu and its lignan. *Chinese Trad Herbal Drugs*. 2002;33:722-724.
97. Liu CJ and Hou SS. Current research status of Podophyllum Lignans. *Nat Product Res Dev*. 1997;9:81-88.
98. Jackson and Dewick PM. Aryltetralin lignans from *podophyllum hexandrum* and *podophyllum peltatum*. *Phytochemistry* 1984;23:1147-1152.
99. Imbert TF. Discovery of podophyllotoxins. *Biochimie* 1998;80:207-222.