

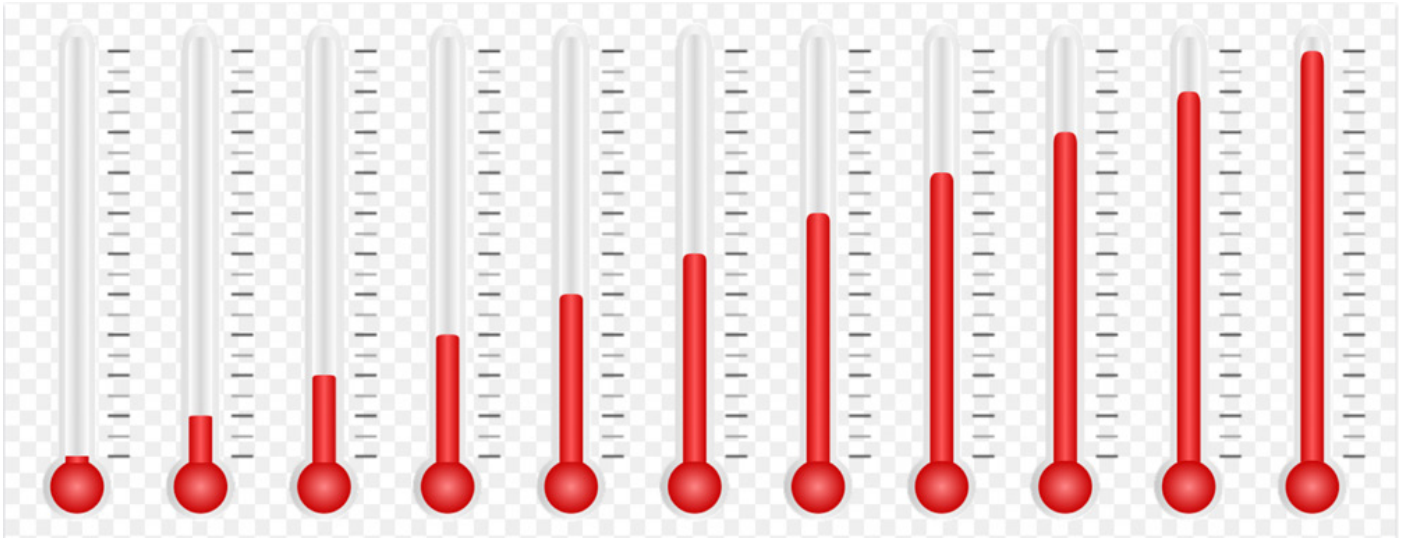
Everything you want to know about FEVER



Source:
Johns Hopkins University
<https://www.hopkinsmedicine.org/health/conditions-and-diseases/fever>
March 1, 2020

Wikipedia
<https://nl.wikipedia.org/wiki/Koorts>
March 1, 2020

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1. What is fever?

Fever is the condition when the body temperature rises. In almost all cases the cause of the fever is an infection.

If we look in more detail a fever is being caused by chemicals that are called pyrogens that are flowing in the bloodstream of the patient's body. These pyrogens influence the hypothalamus. This is the part of the brain that regulates the body temperature. The actual rise in body temperature happens when the pyrogens bind to certain receptors in the hypothalamus.

2. What causes a fever?

When a person attracts a fever this almost always means they have an infection.

So, what causes infections? An infection is caused by either bacteria and viruses. There are no specific differences between a fever caused by bacteria and fevers that are the result of a virus.

Although in almost all cases an infection is the cause of a fever, there are other causes of fever:

- heat exhaustion
- inflammatory conditions such as rheumatoid arthritis
- a malignant tumor
- the use of certain medication like drugs to treat high blood pressure or seizures
- some immunisations such as diphtheria, tetanus and acellular pertussis or pneumococcal vaccine

In very few cases it remains unknown what causes or caused a fever.

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3. What are the symptoms of a fever?

The normal body temperature is 37 °C or 98.6 °F. When a person attracts a fever his or her body temperature is elevated. These are the symptoms of a fever:

- a person starts to sweat
- he or she has chills and begins to shiver
- headache
- muscle aches
- loss of appetite
- irritability
- dehydration
- general feeling of weakness



In some cases, children between 6 months and 5 years old might experience fever-induced convulsions or febrile seizures.

4. Are all fevers the same?

No, they are not. Although many people talk about ‘fever’ in very general terms there are actually 5 types of fever:

- intermittent fever
- remittent fever
- continuous or sustained fever
- hectic fever
- relapsing fever

With intermittent fever the temperature is elevated but falls back to normal (in other words 37 °C or 98.6 °F or lower) each day.

A remittent fever is a fever where the temperature is elevated and falls back each day, but not to the level of a normal body temperature.

When a person has a continuous or sustained fever this means this person has an elevated body temperature while at the same time there is little change (0,3°C or F or less) in the elevated temperature during a 24-hour period.

A hectic fever means a person has an elevated body temperature with wide swings in temperature.

When a person is suffering from a relapsing fever symptom are recurrent febrile episodes with headache, myalgia, and vomiting lasting 3 to 5 days, separated by intervals of apparent recovery.



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5. When someone has a fever is there a difference between their body temperature in the morning and evening?

Fever-range temperatures occur about half as common during mornings as during evenings. That is one of the conclusions researchers come to in a study called 'Fever Are Rarest In The Morning: Could We Be Missing Infectious Disease Cases by Screening for Fever Then?'. In the study researchers have retrospectively investigated fever-range temperatures ($\geq 100.4^{\circ}\text{F}$ or $\geq 38,0^{\circ}\text{C}$) during seasonal influenza outbreaks and the 2009 H1N1 (swine flu) pandemic. These same data sets have recently been used as preparatory models for the COVID-19 pandemic. The analyses included data from a nationally representative sample of records from adult visits to US emergency departments and data from a Boston based emergency department.

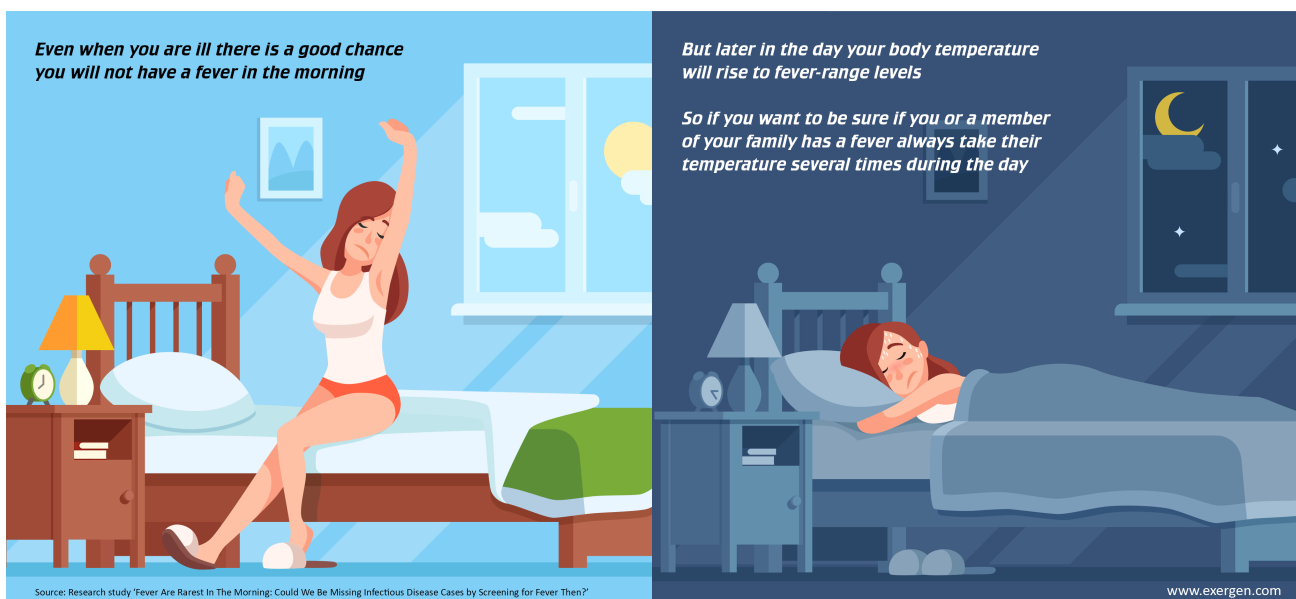
During epidemics or pandemics fever screening is often used as an early warning procedure. Oftentimes it is recommended to take an individuals temperature once daily at morning arrival. But this study suggests this might not be enough. The morning hours might even be "the worst time" for screening visitors and employees for fever, the researchers state in a discussion of their results. They suggest a new procedure might be necessary where people are being measured at both start and end of their shift or workday. During extended shifts we should look at taking temperature at least every 12 hours.

The same approach is useful for longer flights. For airlines and railroad companies a procedure where temperature is being measured before departure and after arrival might help catch previously undetected cases.

The first measurement in the morning would make it possible to screen and detect cases before the shift or workday starts. The second screening would help catch cases previously missed.

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Big difference between body temperature in the morning and evening



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6. What is the difference between light fever and high fever?

The normal body temperature of a healthy person is a constant 37 °C or 98.6 °F. Per person and also during the day the actual body temperature can differ slightly.

When the body temperature of a person rises to 38 °C or 100.4 °F we call this a slight fever.

A body temperature that increases to 39,5 °C or 103.1 °F counts as a high fever.

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What is the difference between a light fever and a high fever?

The normal body temperature of a person (young or old) is 37 °C or 98.6 °F

A light fever: 38 °C or 100.4 °F

A high fever: 39,5 °C or 103.1 °F or higher

Is a fever dangerous? In general: no.
Fever may lead to complications, especially with children between 6 months and 5 years old.
So always call a doctor when you child has a fever of 38 °C or 100.4 °F or higher

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7. How long does a fever typically last?

The number of days before the elevated body temperature returns to a normal level of 37 °C or 98.6 °F is very much dependent on the type of infection.

- Fevers that are caused by viruses can last as little as 2 or 3 days. But at the same time, it can take 2 weeks before the body temperature returns to normal.
- A fever that is the result of a bacterial infection requires a treatment with antibiotics. The length of time before the body temperature returns to a normal level depends on the timing of the treatment with antibiotics. In other words, if untreated a fever caused by a bacterial infection can continue indefinitely.



8. So how does this work?

A fever helps fight an infection by helping immune cells crawl along blood-vessel walls so that they are able to attack the invading viruses or bacteria.

So how this work?

By elevating the body temperature immune cells start producing Hsps which stands for heat-shock proteins. These are proteins that protect cells against stress. These Hsps bind to membrane proteins in cells called integrin. The formation of integrin makes it possible for immune cells to crawl along blood-vessel walls to the location of the invading microbes.

Fevers are not a byproduct of the immune system. Actually, it is the other way around. The elevated body temperature triggers mechanisms in the human body that ensures the immune system to take the appropriate actions against the causes of the infection. The change in body temperature switches on (or off) the activity of certain proteins that in turn switch on or off genes responsible for the immune response off the human body.



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9. Why does catching a fever make people feel miserable?

It may sound counter-intuitive but having a fever is not always a bad thing. Because when a person's body temperature is elevated it actually means the immune system of this person is doing its job.

But this comes with a side effect: people feel bad, their energy level drops, and they feel weak. In other words: they feel sick.

When having a fever every part of the body is affected. The heart rate is up and every bodily function responds to a faster pulse. So, the kidneys work faster, the elimination of waste products is faster. All because the metabolism of a person with a fever is speeding up.

So having a fever in itself is not dangerous. It is a defense mechanism of the human body. What might be dangerous though is the cause of the fever.

10. Is fever dangerous to young children?

Please note: When a child under 6 months attracts a fever the parent or caretaker should ALWAYS consult with a doctor. People rightfully worry about the effect of fever on young children.

In general: it may be harmless BUT it may lead to complications. Because children between 6 months and 5 years can in some cases experience fever-induced convulsions or febrile seizures. They usually involve loss of consciousness and shaking of the limbs. These conditions are very alarming to parents, but the majority of febrile seizures cause no lasting effects.

1 in 3 children who have experienced a febrile seizure will experience another one - often within 12 months.

What should a parent or caretaker do when a child suffers from a febrile seizure?

- Lay the child on his or her side or on their stomach on the floor or ground
- Remove any sharp objects near the child
- Loosen tight clothing
- Hold the patient to prevent injury
- Do not put anything in the mouth of the child
- Do not try to stop the seizure

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11. Can we prevent attracting a fever?

In general, a person can try to prevent a fever by reducing exposure to infectious diseases.

Here are some tips:

- Wash hands often before eating, after using the toilet, after spending time in a crowd or around someone who is sick, after petting animals and during travel on public transportation.
- Parents and caretakers should teach these preventive actions to their children as well.
- Show children how to wash their hands properly: cover both front and back of each hand with soap and rinse completely under running water.
- Carry hand sanitizer for times when there is not access to soap and/or water.
- Avoid touching the nose, mouth and eyes as much as possible because these are the main ways viruses and bacteria enter the body and cause infections.
- Cover the mouth when coughing; teach this to children as well.
- Cover the nose when sneezing; teach this to children as well.
- Avoid sharing cups, water bottles and utensils.



12. How do we diagnose the cause of a fever?

Answering the following questions give a good first indication of the cause of a fever:

- What is the measured body temperature?
- Does this person suffer from other symptoms like coughing, abdominal pain, vomiting, diarrhea or pain when urinating?
- Did the person recently undergo any treatments like surgery or suffer from injuries?
- Was the person recently vaccinated?
- Is the person taking new medication?
- Did the person recently travel (abroad)?



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13. How do we best treat a fever?

In general, the following steps will help a person with an elevated body temperature feel better. A person should:

- drink plenty of fluids to help cool the body and prevent dehydration
- eat light food that is easy to digest
- get plenty of rest
- take ibuprofen, naproxen, acetaminophen or aspirin to help relieve head and body aches and lower the body temperature; BUT PLEASE READ BELOW WHEN IT COMES TO CHILDREN
- take a slightly warm but NOT cool bath or apply damp cloths to the forehead and wrists
- dress lightly

BUT BE CAREFUL because we should make a distinction between children and adults.

When a child under 6 months attracts a fever the parent or caretaker should ALWAYS consult with a doctor. They should never give ibuprofen to kids under 6 months. Older children and teens should avoid using aspirin.

14. When should we seek emergency care?

When to call a doctor when a person has a fever?

Infants

- 0 - 3 months - if the body temperature is 38 °C or 100.4 °F or higher.
- 3 - 6 months - if the body temperature is 38,9 °C or 102 °F or the child is unusually irritable, lethargic or uncomfortable.
- 6 - 24 months - if the body temperature is higher than 38,9 °C or 102 °F and the fever lasts longer than 1 day but the infant shows no other symptoms. If the infant has other signs as well like a cold, cough or diarrhea consider calling a doctor sooner.

Children

- If the child has a fever but is responsive, is making eye contact and respond to facial expressions and is drinking fluids and playing there is probably no cause for alarm.

Please call a doctor if the child

- is listless or irritable and/or vomits repeatedly.
- has severe headaches or stomachache.
- has other symptoms that cause significant discomfort.
- has a fever after being left in a hot car.
- has a fever that lasts longer than 3 days.
- appears listless and has poor eye contact with the parent or caretaker.

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Adults

if the body temperature is 39,4 °C or 103 °F or higher and at the same time the person suffers from:

- a severe headache
- unusual skin rash
- unusual sensitivity to bright light
- stiff neck and pain when the person bend his for her head forward
- mental confusion
- persistent vomiting
- difficulty breathing or chest pain
- abdominal pain or pain when urinating
- convulsions and seizures

15. Thermometers: understanding the options

The best way to measure a person's body temperature is by using a thermometer. There are many types, brands and products available. So, what are the options and what are the pros and cons of these options?

First of all, please be aware that in many parts of the world the old mercury-based thermometer is no longer in use and selling them is forbidden. They can easily break, and its fluid is toxic.

There are 3 main types of thermometers:

- Generic digital thermometers
- Digital ear thermometers
- Temporal artery thermometers

Generic digital thermometers

This type of thermometer uses an electronic heat sensor to record the body temperature. They can be used in the rectum, mouth or armpit.

Using the armpit to measure the body temperature is seldom a good idea because these measurements are not very accurate.

Rectal measurements are often seen as the most accurate option. BUT, they have negative side-effects such as being invasive and threatening to children and even adults. Very uncomfortable as you have to undress the patient and position them to make it less discomforting. Last but not least, you need to rinse it well as it is invasive and therefore, could be contagious if you use it on another patient without the appropriate cleaning methods.

Oral measurements are often accurate but are highly subject to proper procedure. For example, not closing the mouth when performing a measurement has a negative impact on accuracy as has eating or drinking right (warm/cold) before performing a measurement.

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Which part of your body do you trust the most when you want to measure your body temperature?

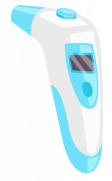
Rectal

- ✓ Accurate measurement of the body temperature
- ✗ Very invasive and intimidating
- ✗ Each measurement requires a relatively long period of time
- ✗ Not practical when the patient is asleep
- ✗ If done wrong rectal thermometers may lead to injuries
- ✗ Requires a lot of handling and cleaning
- ✗ Not practical during mass screenings



In-ear (or tympanic)

- ✓ Less invasive than rectal thermometer
- ✗ Patient with fever, headache or head trauma will feel intimidated by the idea of a thermometer being push into the ear
- ✗ Difficulty of positioning the thermometer in the ear canal has a highly negative impact on accuracy and comfort
- ✗ Less accurate than rectal or temporal artery measurement; a measurement might be off $\pm 0,5^\circ$ or more
- ✗ The patient needs to sit or lie very still, which is often difficult, especially for children
- ✗ Hard to use in a mass screening



Forehead (using IR gun)

- ✓ Non-invasive
- ✗ Very easy to perform a faulty measurement because only one spot on the forehead is used to perform a measurement
- ✗ Easy to measure the temperature of the skin instead of the blood, so not accurate enough for medical applications
- ✗ High probability of false positives and false negatives, especially in mass screenings



Forehead (using the Temporal Artery Thermometer)

- ✓ Very easy to use because all it takes to perform a very accurate measurement is a gentle swipe across the forehead
- ✓ Very accurate - same or better than rectal
- ✓ Very fast as performing a very accurate measurement requires just a few seconds
- ✓ Non-invasive and very comfortable, so even young children will not feel intimidated, which is very helpful to speed up measurements
- ✓ Very easy to perform measurements when patients are asleep
- ✓ Very hygienic because all it takes to switch from one patient to the other is placing a new removable protective cap on the sensor head or wipe the sensor head clean with a soft cloth with some medical alcohol
- ✓ Green because no throw-away cap is required, although they are available for those situations where a protective cap is required or improves productivity



www.exergen.com

The pros of generic digital thermometers:

- When using proper procedure digital thermometers are accurate and fast

The cons of generic digital thermometers:

- invasive and threatening to both children and adults
- when measuring orally we should wait 15 minutes after eating or drinking before performing a measurement
- feverish children and adults may find it hard to keep their mouth closed during a measurement

Digital ear or tympanic thermometers

This type of thermometer uses infrared technology in the ear canal to perform a measurement. Accuracy depends very much on the proper positioning of the thermometer relative to the ear canal.

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The pros of in-ear thermometers:

- quick measurement when positioned properly

The cons of in-ear thermometers:

- not recommended for newborn babies
- when patient are feverish, measurement in the ear canal may be painful
- earwax or a curved ear canal may impact the measurement

Temporal artery thermometer

Scanning the forehead over the temporal artery with a temporal artery thermometer is fast and very accurate. This type of thermometer is also not invasive or threatening to children or adults because the actual measurement is done by swiping the thermometer gently across the forehead of the patient.

The pros of temporal artery thermometers:

- fast
- very accurate
- as accurate as rectal measurement
- considered non-invasive by both children, teens and adults
- recommended for use with children 0-3 months

The infographic is a comparison chart titled "5 reasons why IR guns are NOT the right choice during the COVID-19 pandemic". It is divided into two columns by a central "VS" label. The left column, labeled "IR guns", lists five disadvantages, each preceded by a red "X" icon. The right column, labeled "Temporal Artery Thermometer", lists five advantages, each preceded by a green checkmark icon. At the bottom of each column is an illustration of a person being measured: a woman for IR guns and a man for the TAT. The Exergen logo is in the top left corner, and the website "www.exergen.com" is at the bottom center.

IR guns	VS	Temporal Artery Thermometer
✗ IR guns measure the skin temperature		✓ The Temporal Artery Thermometer (TAT) measures the temperature of the blood
✗ Not able to compensate for ambient influences		✓ Features advanced algorithms that were specifically designed to nullify external influences
✗ IR guns were originally designed for industrial use		✓ TATs were designed from the ground up for highly accurate medical applications
✗ IR guns produce a lot of false positives/negatives because they measure one spot		✓ TATs are very accurate thanks to the swipe across the forehead
✗ IR guns are not able to compensate for an elevated body temperature because of running		✓ TATs have a far better accuracy under all circumstances

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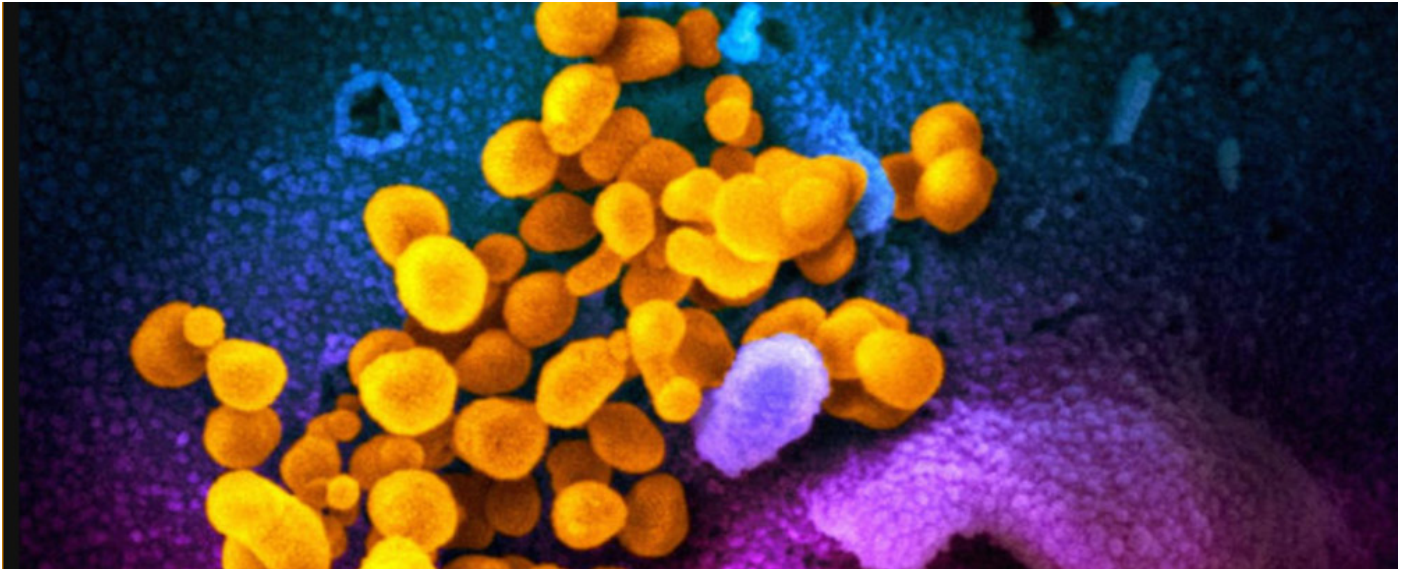
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16. Fever and the Corona virus

What is a virus and how do they work?

A fever is almost always caused by an infection that is the result of either a virus or bacteria. With the current outbreak of the Corona family or viruses in China and other parts of the world it is good to understand what a virus is and how it 'operates'.

First let's discuss what a human cell is. A cell is a stand-alone living entity that is able to grow and eat and reproduce. That applies to human cells in a person's body, but also to bacterial cells.

A virus is something completely different. They are about a thousand times smaller than bacteria, where bacteria are already much smaller than human cells. A virus consists of:

- Nucleic acid - this is a set of generic instructions (DNA or RNA).
- A coat or protein to surround and protect the DNA or RNA.
- A lipid membrane sometimes surrounds the protein coat.

Viruses come in all sorts of shapes and forms. None have enzymes on board. Enzymes are what we might call the chemical machinery a human cell or a bacterial cell uses to perform chemical reaction and live. A virus has only 1 or 2 enzymes on board and need a host cell to live and make more viruses. Without a host cell they cannot function. Such a host cell might be a human cell or a cell in an animal.

Tell me more about the Corona virus

Actually, there is no such thing as 'the' Corona virus. The Corona virus is a family of viruses that can cause illnesses such as the common cold, SARS (Severe Acute Respiratory Syndrome) and Middle East Respiratory Syndrome or MERS.

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Signs and symptoms

The recent outbreak that started in Wuhan, China is called COVID-19 and is caused by the 2019-nCoV virus. This virus is very new, and little is known about it so far. But these are the signs and symptoms of infection that will appear 2 - 14 (28?) days after exposure to the virus:

- fever
- coughing
- shortness of breath or difficulty breathing

Facts we know so far

Although little is known about the 2019-nCoV virus here are some of the facts that we know so far:

- incubation time is 2 - 14 (28?) days
- severity ranges from mild to severe and even death
- most people with severe illness have been of older age or had other severe existing medical conditions
- it is unclear how contagious the new virus actually is
- it appears to be spreading from person to person among those in close contact
- it may spread via respiratory droplets released when an infected person coughs or sneezes
- it is unknown if a person can catch the virus when touching a surface an infected person has touched and then putting his or her hand to the mouth
- we should try to avoid close contact with persons who recently travelled in China or are residents of China
- we should also try to avoid other countries or regions like certain parts of South Korea, Italy and Iran

Prevention

Are there ways to prevent getting infected?

- wash hands often with water and soap or use a hand sanitizer based on alcohol
- cover mouth and nose when coughing or sneezing
- avoid touching eye, nose and mouth if hands are not clean
- avoid close contact with anyone who is sick
- avoid sharing dishes, cups, glasses and other household items
- clean and disinfect surfaces that are often used
- stay home from work, school and public areas when sick, contact a doctor immediately

Travel

- Anyone planning on traveling internationally should always check travel advisories issued by governments.
- Anyone suffering from health conditions that might make a person more susceptible to respiratory infections or complications should always consult a doctor first.

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Changing the way the world takes temperature

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