Explainer: What is the immune system?

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The immune system is often the reason we feel unwell when we have an infection. Credit: Flickr/uneduex

The immune system is an integral part of our body, keeping us safe from diseases – from the common cold to more severe illnesses such as cancer.

The immune system is often the reason we feel unwell when we have an infection, but is the reason we recover from that same infection. It can also malfunction, causing illness such as allergies and autoimmune

diseases.

There are two interwoven components of the immune system: the innate and adaptive immune systems. Both are essential in preventing disease and function in very different ways.

Innate immune system

The first line of defence against an infection, the innate immune system consists of tissues such as skin and the lining of our gastrointestinal system. These are a physical barrier, which help to stop infectious pathogens from entering our body.

The innate immune system also has specialised cells that attack any pathogen that enters our body. Cells, including neutrophils, macrophages and dendritic cells, are all able to ingest pathogens and kill them inside the cell.

The innate immune system acts quickly; these cells are present throughout the body and can act within minutes to kill invading microbes and limit the damage that they can cause to the body.

But the innate immune system cannot always rid the body of pathogens. That's where the second, more specialised, line of defence comes into play.

Adaptive immune system

The adaptive immune system is more evolved than the innate immune system, which responds the same way to all pathogens. The adaptive immune system uses different techniques to destroy different microbes.

There are three major cell types associated with the adaptive immune system: B cells, helper T cells and killer T cells.

B cells make antibodies. Antibodies are small chemicals that are able to bind to some microbes and prevent them entering cells, or bind to the toxins that some pathogens produce and neutralise their effect. Antibodies also "flag" microbes so innate cells can more easily destroy them.

Antibodies are also able to pass through the placenta and through breast milk and help protect babies from disease until their own immune system matures.

Helper T cells, as the name implies, help other cells of the immune system. They allow innate cells to see and kill pathogens and help B cells make the right type of antibody to most appropriately deal with a pathogen.

Killer T cells secrete chemicals to directly kill virally infected cells. Viruses cannot reproduce outside of a cell, so they invade our cells. Antibodies cannot get inside the cell so instead, the killer T cells kill the whole cell, preventing the virus from reproducing. After the cell has been killed, cells of the innate immune system will come and clean up the debris.

The adaptive immune system can remember pathogens, so the second, or subsequent, exposure to the same pathogen results in a much quicker and stronger immune response. Often you won't even know you've been exposed to a pathogen. This is why you generally only get diseases like the measles once and it's the same system we exploit through vaccinations.

Vaccinations expose your immune system to parts of pathogens in a way

that won't make you sick, but will prime your immune system to recognise the pathogen. When you're exposed to that same pathogen "for real", the adaptive immune system reacts so quickly you won't get sick.

Vaccines are just one way to improve your immune system. There is increasing evidence that a diet high in fibre will also influence your immune system. However the effect of vitamin supplements, such as Vitamin C or D, on the immune system is poorly understood.

When the immune system goes wrong

Sometimes the immune system responds inappropriately. Allergies, such as allergic rhinitis (hay fever), allergic conjunctivitis, allergic asthma or allergic eczema (also known as atopic dermatitis), are caused by an immune response to an invader that won't cause disease.

Autoimmune diseases, such as lupus, multiple sclerosis and type 1 diabetes, occur when the immune system recognises cells of our own body as foreign and mounts an immune response against them. That is the irony – our anti-sickness system becoming the actual cause of sickness!

Understanding the immune system is crucial in medicine; new vaccines are being designed that will improve our immune response against pathogens, cancer treatments that use the immune system to destroy cancer cells are being developed, newer treatment of serious allergies and autoimmune diseases aim to manipulate and dampen specific aspects of the immune system without hindering our ability to respond to dangerous pathogens.

Everyday, our knowledge of the immune systems increases, opening even more doors to treatments and cures for a variety of diseases.