

Unit 2 — Pathogens and Diseases

Topic Note (learner self-study edition)

Before you start: this unit builds on Unit 1 (Classification of living things). You should already be comfortable with the five kingdoms — Monera, Protocista, Fungi, Plantae and Animalia — because the organisms that cause disease in this unit are drawn from several of those kingdoms, plus viruses, which do not fit into any kingdom at all.

This note covers four connected ideas: how a disease-causing organism moves from one host to the next (2.1), the main groups of organisms that cause disease and how each one operates (2.2), how a laboratory narrows down exactly which bacterium it is dealing with (2.3), and the difference between diseases you can catch and diseases you cannot (2.4).

2.1 Pathogens and Their Mode of Transmission

Core overview

A pathogen is any organism that causes disease in another living thing. To succeed, a pathogen has to do four things in order: get into a host, overcome the host's defences for long enough to survive, multiply, and then get out again to reach a new host. Almost every symptom you associate with being sick — fever, swelling, a runny nose, diarrhoea — is actually a side-effect of the struggle between the pathogen and your body's immune system, not something the pathogen does on purpose.

Vocabulary

Pathogen — a living thing that causes disease — i.e. it makes another organism sick.

Host — the organism that a pathogen lives in or on while causing disease.

Reservoir — the natural home of a pathogen where it survives between infections — i.e. where it "lives" when it is not currently making anyone sick.

Vector — an animal, usually an arthropod, that carries a pathogen from one host to another.

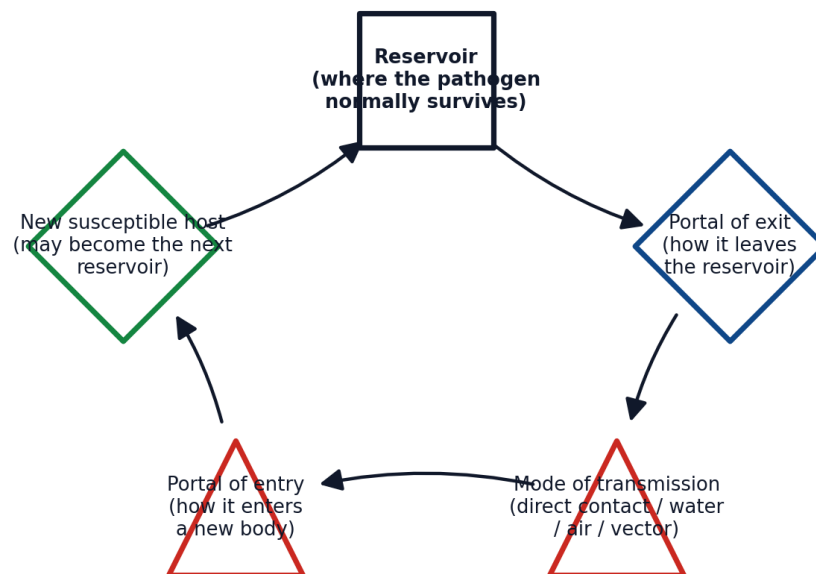
Main concepts and details

Category of pathogen	What makes it that category	How to recognise it
Obligate pathogen	Cannot complete its life cycle outside a living host — i.e. it dies quickly once it leaves a body.	It is never found thriving in soil, dust or open water for long periods; it needs a host almost constantly.
Opportunistic pathogen	Normally present in or on the body without causing harm; only causes disease once the host's immune defences are weakened.	It "waits for an opportunity" — outbreaks of it are linked to malnutrition, HIV infection, chemotherapy or extreme fatigue.
Accidental pathogen	Normally infects a different host species altogether, but occasionally strays into humans and causes disease there too.	It is usually named after the animal it normally infects, and human cases are described as "rare" or "occasional" in health reports.

Modes of transmission

- **Direct physical contact** — the pathogen passes straight from one body surface to another, for example a skin fungus spreading between players who share a single training jersey.

- **Through food or water** — the pathogen contaminates something that is then eaten or drunk, for example roundworm eggs on unwashed vegetables that were watered from an open, unprotected well.
- **Through the air** — the pathogen rides on droplets released by coughing, sneezing or even talking, and is then inhaled by someone nearby; this spreads fastest in crowded, poorly ventilated rooms such as a packed minibus or a classroom with the windows shut.
- **Vector transmission** — an animal carries the pathogen between hosts. This can be *mechanical* (the vector simply carries the pathogen on its body without being infected itself, the way a housefly that has walked on rubbish later walks on your food) or *biological* (the pathogen actually multiplies inside the vector before being passed on, the way it does inside a mosquito).



Shapes mark the role, not just colour: square = reservoir, diamond = exit/entry point, triangle = the moving pathogen.

Fig. 2.1 — A pathogen's journey has five links; breaking any single link stops the chain.

Demonstration: The Flour-Hand Chain

Type: Demonstration (it models how transmission spreads through a group; it does not test a hypothesis).

What you need: a small amount of plain flour or fine chalk dust, and at least six people.

What to do:

- One volunteer lightly coats both palms with flour — this person is the "reservoir".
- Everyone then shakes hands with one other person, once, in a chain — person 1 shakes hands with person 2, person 2 then shakes hands with person 3, and so on.
- After the chain is complete, ask everyone to look at their palms under good light.
- Count how many people ended up with visible flour on their hands, even though only one person touched flour on purpose.

What it shows: a pathogen does not need every person to touch the original source directly — physical contact transmission can pass it several links down the chain before anyone even notices. Discuss: at which handshake could the chain have been stopped, and how?

Key takeaways and common pitfalls

- A pathogen is defined by what it does (causes disease), not by which kingdom it belongs to — the five groups of pathogens cut across several kingdoms plus viruses.

- **Common pitfall:** students often assume all pathogens can survive for a long time outside a host. This is only true of some (spore-forming bacteria, some worm eggs); most obligate pathogens die within minutes to hours in the open air.
- **Common pitfall:** "vector" and "reservoir" are often confused. A reservoir is where the pathogen normally survives; a vector is what carries it — a swamp can be a reservoir for cholera bacteria, but the mosquito is a vector for malaria, not a reservoir.

Leveled practice

[Easy] Define the term pathogen in your own words.

Answer: A pathogen is a living organism that causes disease in another organism by entering it, overcoming its defences, and multiplying.

[Medium] A particular fungus normally grows harmlessly in soil and only causes a skin infection in people whose immune systems are already weak from illness. Which category of pathogen is this, and why?

Answer: It is an opportunistic pathogen. It does not normally cause disease in a healthy host; it only does so when the host's defences are already reduced, which is exactly the definition of "waiting for an opportunity".

[Hard (multi-step reasoning)] A village well becomes contaminated after floodwater mixes with a latrine pit. Trace the chain of infection from that moment to a second family falling ill, naming the reservoir, the mode of transmission, and the portal of entry at each step, and suggest one point where the chain could realistically be broken in a low-resource village setting.

Answer: Reservoir: the contaminated well water. Mode of transmission: waterborne (the pathogen travels in drinking water). Portal of entry: the mouth, when the water is drunk or used to wash food. Once inside the new host it multiplies in the gut, causing symptoms, and can exit again in faeces, re-contaminating water sources if sanitation is poor — completing a new cycle. The chain is most realistically broken by boiling or chemically treating the water before drinking it, since rebuilding the well or the latrine may not be immediately possible.

Research and discussion

- Ask an older relative or neighbour how drinking water was made safe in your area before piped or bottled water was common. Compare their method with the water-treatment methods in section 2.4.
- Look at where standing water collects near your home after rain (puddles, blocked drains, old containers). Which mode of transmission from this section is most likely to be encouraged by that standing water, and why?

2.2 Disease-Causing Organisms

Core overview

Pathogens fall into five broad groups: viruses, bacteria, protozoa, fungi and parasitic worms (helminths). Fungi as disease-causing organisms are less common in the human body than the other four groups and were already introduced structurally in Unit 1, so this section concentrates on viruses, bacteria, protozoa and worms — the four groups you are most likely to be examined on.

(a) Viruses

A virus is not a cell at all. It is a strand of genetic material (DNA or RNA) wrapped in a protective protein coat, and sometimes an outer envelope. Because it has no ribosomes, no cytoplasm and no way to generate its own energy, a virus cannot reproduce by itself — it must take over the machinery of a living cell and force that cell to make new copies of it.

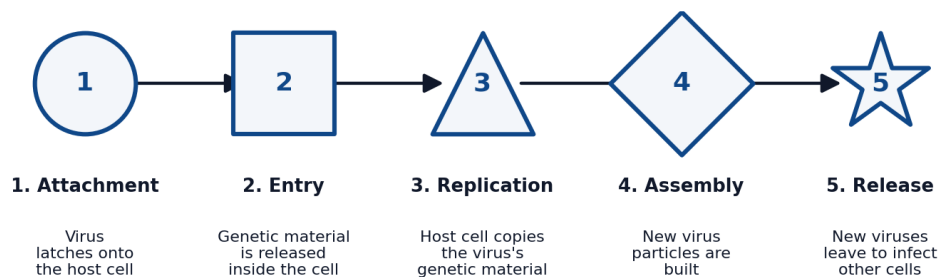


Fig. 2.2 — The five general stages every virus goes through inside a host cell.

One well-known example is the Human Immunodeficiency Virus (HIV), which specifically attacks a type of white blood cell that coordinates the body's immune response. As more of these cells are destroyed over months and years, the body gradually loses the ability to fight off infections it would normally handle easily — this advanced stage is called Acquired Immune Deficiency Syndrome (AIDS). HIV is transmitted through contact with infected blood or body fluids, and from an infected mother to her baby during birth or breastfeeding. There is still no cure for HIV, but daily antiretroviral medication can keep the virus suppressed for a normal lifespan, and mother-to-child transmission can be greatly reduced with the right medication and infant feeding choices.

(b) Bacteria

Unlike viruses, bacteria are complete, living cells and can reproduce on their own once inside a suitable environment. Two examples show how differently two bacterial diseases can behave. *Vibrio cholerae* survives naturally in warm, brackish or contaminated water; when swallowed, it multiplies rapidly in the small intestine and releases a toxin that causes the gut to lose enormous amounts of fluid, leading to cholera's severe watery diarrhoea. Because the bacteria are shed in large numbers in the diarrhoea itself, one poorly managed case can contaminate a whole water source. *Mycobacterium tuberculosis*, by contrast, is spread through the air in droplets from coughing and needs prolonged, close contact to pass from person to person; it settles in the lungs and can remain dormant there for years before becoming active tuberculosis, particularly if the host's immunity later drops.

Pathogenic bacterium	Disease	Transmission	Key sign
Corynebacterium diphtheriae	Diphtheria	Airborne droplets	Severe sore throat with a grey membrane in the airway

Pathogenic bacterium	Disease	Transmission	Key sign
<i>Clostridium tetani</i>	Tetanus	Enters through a deep wound	Muscle spasms starting in the jaw
<i>Shigella dysenteriae</i>	Bacterial dysentery	Contaminated food/water	Diarrhoea containing blood and mucus
<i>Neisseria gonorrhoeae</i>	Gonorrhoea	Sexual contact	Painful urination; often no symptoms in women
<i>Treponema pallidum</i>	Syphilis	Sexual contact	A painless sore at the site of infection
<i>Rickettsia</i> spp.	Typhus	Louse or flea bite (vector)	Rash, high fever, severe headache

(c) Protozoa

Protozoa are single-celled but, unlike bacteria, they are eukaryotic — their genetic material sits inside a nucleus. *Plasmodium* species cause malaria: a female Anopheles mosquito picks up the parasite while feeding on an infected person, the parasite develops and multiplies inside the mosquito, and is then injected into a new person the next time the mosquito feeds. Inside the human body the parasite first multiplies in the liver, then invades red blood cells, where further multiplication eventually bursts the cells open — this bursting, happening in waves, is what produces malaria's classic pattern of recurring fever and chills. *Trypanosoma* species cause sleeping sickness in a similar vector-based way, but through the bite of a tsetse fly rather than a mosquito, and the parasite eventually invades the nervous system rather than the blood cells. A third example, *Entamoeba histolytica*, does not need a vector at all — it is swallowed directly in contaminated food or water and causes amoebic dysentery by invading the wall of the large intestine.

(d) Parasitic worms (helminths)

The blood fluke that causes bilharzia (schistosomiasis) has one of the most complicated life cycles in this unit because it needs two different hosts to complete it. Eggs leave an infected person in urine or faeces and, if they reach fresh water, hatch into a free-swimming larval stage that must find and enter a particular species of water snail — its *intermediate host*. Inside the snail the parasite multiplies and eventually produces a different free-swimming stage that leaves the snail and can penetrate human skin directly on contact with the water, without needing to be swallowed. Once inside a person — its *definitive host*, where it reaches adulthood and reproduces — the worms mature in the blood vessels around the bladder or intestine, and the cycle begins again when their eggs are released. Hookworms follow a simpler pattern: their larvae live in warm, moist soil contaminated by faeces and penetrate bare skin, most often through the soles of the feet, which is why footwear is such an effective single-step prevention measure.

Vocabulary

Intermediate host — an organism a parasite must develop inside before it can infect its final host — without this host, the parasite cannot complete its life cycle.

Definitive (final) host — the organism in which a parasite reaches adulthood and reproduces sexually.

Vector-borne disease — a disease that depends on an animal, usually an insect, to carry the pathogen between hosts.

Experiment: Comparing Microbial Life in Still and Flowing Water

Type: Experiment (it tests a hypothesis with an observable result).

Hypothesis: stagnant water contains more visible microscopic life than flowing water from the same source.

What you need: two small, clean, clear containers, a hand lens or a school microscope if one is available, a sample of standing water (a puddle, a stagnant ditch) and a sample of flowing water (a stream, a tap) collected the same day.

What to do:

- Label the two containers "Still" and "Flowing" and collect one sample of each.
- Let both samples settle for ten minutes, then place a drop from each onto a separate slide, or simply observe closely against light using the hand lens.
- Count and record how many moving specks or organisms you can see in each sample in one minute.
- Repeat with a fresh pair of samples on a different day to check whether your result holds.

What it shows: still water is generally a friendlier reservoir for many protozoa and bacteria because it is warmer, has more decaying organic matter, and is not being constantly diluted and carried away. This is one reason why standing water near homes is treated as a health risk even before mosquitoes are considered.

Key takeaways and common pitfalls

- Viruses need a living host cell to reproduce at all; bacteria and protozoa can reproduce independently once inside a suitable environment.
- **Common pitfall:** "vector" and "intermediate host" are often used as if they mean the same thing. A vector (like a mosquito) usually just carries and sometimes helps develop a pathogen before passing it on; an intermediate host (like the bilharzia snail) is a required stage in the parasite's own life cycle, not just a delivery method.
- **Common pitfall:** assuming every worm infection needs a vector. Hookworm needs no animal carrier at all — direct skin contact with contaminated soil is enough.

Leveled practice

[Easy] State one structural feature that a virus lacks which prevents it from reproducing on its own.

Answer: A virus lacks its own ribosomes (or cytoplasm/energy-generating machinery) — it has no way to build new proteins or copies of itself without borrowing a host cell's equipment.

[Medium] Explain why bilharzia cannot be caught by drinking contaminated water, even though the eggs are released in urine and faeces into water sources.

Answer: The eggs must first hatch and pass through a developmental stage inside a specific species of water snail (the intermediate host) before they become the infective stage. That infective stage enters humans by penetrating the skin directly on contact with water, not by being swallowed, so drinking the water does not complete the required life cycle stage.

[Hard (multi-step reasoning)] A community relies on a single stream both for washing clothes at the bank and for a downstream fishing spot. Bilharzia cases begin appearing among people who wash clothes but almost none among people who only fish downstream from a boat. Using what you know about the blood fluke's life cycle, explain this pattern and suggest one practical change that would reduce new cases without stopping either activity completely.

Answer: The infective stage released by the snail swims in the water and penetrates human skin on direct contact — people washing clothes at the bank have their hands, arms and legs submerged for long periods in the shallow water where snails live, while people fishing from a boat have far less skin contact with the water itself. A practical change would be moving the washing point to a stretch of the stream without snail habitat (fast-flowing, rocky sections rather than slow, weedy shallows), or using a raised platform so skin does not need to enter the water directly.

Research and discussion

- Ask at a nearby health post or clinic which of the pathogens in this section they see most often in your area, and why they think that particular one is common locally.
- Look at containers, tyres or gutters around your home that collect rainwater. Which of the transmission routes in this section could these encourage, and what would it cost — in time, not money — to empty them once a week?

2.3 Identifying Bacteria Using Biochemical Tests

Core overview

Two bacteria can look identical under a microscope and still cause very different diseases, need different antibiotics, or need none at all. Biochemical tests solve this by exploiting the fact that different bacteria have different enzymes and different chemical abilities. Instead of relying on shape alone, a laboratory technician gives the bacteria something to react with and reads the pattern of the reaction — effectively a chemical fingerprint.

Vocabulary

Biochemical test — a laboratory procedure that identifies a microorganism from the chemical reaction it produces, rather than from its shape alone.

Enzyme — a biological catalyst — a substance that speeds up a chemical reaction inside a living thing without itself being used up.

Fermentation — the breakdown of a sugar by a microorganism without using oxygen, often producing acid and sometimes gas as by-products.

The catalase test

Catalase is an enzyme that some bacteria use to break down hydrogen peroxide — a compound that would otherwise damage their cells — into harmless water and oxygen gas. If a sample of bacteria is touched with a drop of hydrogen peroxide and bubbles form immediately, the bacteria produce catalase and the test is positive. No bubbles means the test is negative. *Staphylococcus* species are catalase positive; *Streptococcus* species are catalase negative, which is one of the very first ways a laboratory distinguishes between these two genera when a patient's throat swab looks suspicious.

The starch hydrolysis (iodine) test

Starch molecules are too large to pass through a bacterial cell wall, so a bacterium that wants to use starch as food must first secrete an enzyme — amylase — outside its own cell to break the starch down into smaller, absorbable glucose units. To reveal whether this has happened, iodine is added to the agar around the bacterial growth. Iodine reacts with intact starch to form a dark brown-black colour; wherever the starch has already been broken down, no colour change occurs and a clear zone appears instead.

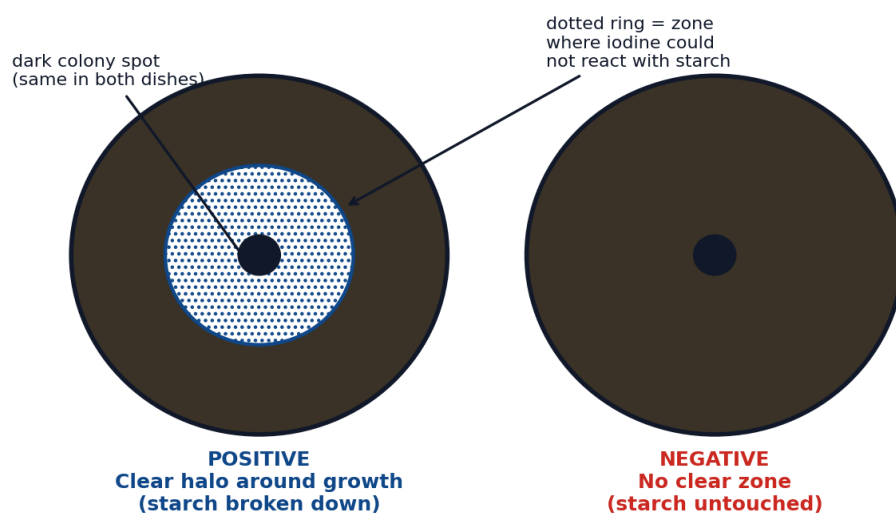


Fig. 2.3 — A clear zone around the colony means the starch nearby has already been hydrolysed by the bacterium's own amylase.

Fermentation-based identification (Gram-negative bacteria)

A different family of tests looks at which sugars a bacterium can ferment. In one widely used medium, glucose is provided in a very small amount and lactose in a much larger amount. Every organism that can ferment sugar at all will use up the small glucose supply within hours, turning the medium acidic. What happens next separates the bacteria into two useful groups: those that can also ferment the much larger lactose supply keep producing acid and the medium stays acidic throughout, while those that cannot ferment lactose are forced to switch to breaking down proteins instead, which produces an alkaline by-product and reverses the colour change. *Escherichia coli* is a common lactose-fermenting example; *Shigella dysenteriae*, a more serious pathogen of the gut, is lactose-negative — this single difference is often the first clue a laboratory has that a sample deserves closer attention.

Experiment: Does Cooking Destroy Catalase?

Type: Experiment (it tests a hypothesis with an observable result).

Hypothesis: heat destroys the catalase enzyme, so cooked plant tissue will not bubble when hydrogen peroxide is added, while raw tissue from the same plant will.

What you need: a raw potato (or pawpaw, or liver if available), a second piece of the same food that has been boiled for five minutes and cooled, a small amount of hydrogen peroxide solution (available cheaply from most pharmacies), and two small cups or dishes.

What to do:

- Cut a small, similarly sized piece of the raw food and a piece of the cooked food.
- Place each piece in its own labelled dish.
- Add a few drops of hydrogen peroxide to each piece at the same time.
- Observe and record which one bubbles, how quickly, and for how long.

What it shows: living plant and animal tissue contains catalase just as many bacteria do, which is why this is a safe, ingredient-only way to observe the same reaction used in the bacterial catalase test. Cooking denatures (destroys the shape of) the enzyme, which is why the cooked piece should show little or no bubbling.

Key takeaways and common pitfalls

- A biochemical test result is only meaningful when compared against a known pattern for known organisms — a single bubbling reaction on its own does not name a species; it narrows down the possibilities.
- **Common pitfall:** confusing "no colour change happened" with "the test failed". In several of these tests, the absence of a reaction is itself a valid, informative result (a negative), not an error.
- **Common pitfall:** assuming a positive catalase or hydrolysis test always signals a dangerous organism. Many harmless, everyday bacteria are catalase-positive or can hydrolyse starch; the test identifies, it does not automatically diagnose danger.

Leveled practice

[Easy] What gas is produced in a positive catalase test, and what causes the bubbling?

Answer: Oxygen gas is produced. The bubbling happens because the enzyme catalase breaks down hydrogen peroxide into water and oxygen, and the oxygen escapes as gas bubbles.

[Medium] Two bacterial colonies are grown on starch agar and flooded with iodine. Colony A shows a clear ring around it; Colony B shows no clear ring at all. Which colony produces amylase, and how do you know?

Answer: Colony A produces amylase. The clear ring shows that the starch near the colony has already been broken down (hydrolysed) before the iodine could react with it, which only happens if the bacterium secreted amylase into the surrounding agar.

[Hard (multi-step reasoning)] A laboratory technician tests an unknown gut bacterium on a glucose/lactose medium. The whole tube turns and stays acidic (yellow) throughout the incubation period. A second, different unknown sample produces a tube where only the upper slant turns alkaline (red) while the lower portion stays acidic. Explain what each organism is doing metabolically, and state which of the two is more likely to be a concerning gut pathogen like *Shigella*.

*Answer: The first organism ferments both glucose and lactose — it uses up the small glucose supply quickly and then continues fermenting the much larger lactose supply, keeping the whole tube acidic throughout. The second organism ferments only the small glucose supply; once that is exhausted it cannot use lactose, so it switches to breaking down proteins in the upper, more oxygen-exposed slant, producing an alkaline reaction there while the lower portion (where the earlier glucose fermentation happened) stays acidic. The second organism, which cannot ferment lactose, is the one more likely to be a concerning pathogen such as *Shigella*, since serious gut pathogens are often lactose-negative while normal, harmless gut flora tend to ferment lactose easily.*

Research and discussion

- Visit or ask about the nearest health facility with a laboratory. Find out whether they run any of these biochemical tests themselves, or whether samples have to be sent elsewhere — and what that means for how quickly a patient gets a diagnosis.
- Hydrogen peroxide is sold in South Sudan as a household antiseptic. Look at a bottle at home or at a shop and see what concentration is printed on the label. Why do you think a much weaker solution is used on skin than would be used in a laboratory test?

2.4 Communicable and Non-Communicable Diseases

Core overview

A communicable disease is caused by a pathogen and can pass from one living thing to another, using one of the transmission routes covered in section 2.1. A non-communicable disease cannot be "caught" from another person at all — it develops from a combination of factors such as diet, genetics, environment, age or lifestyle acting on the body's own processes.

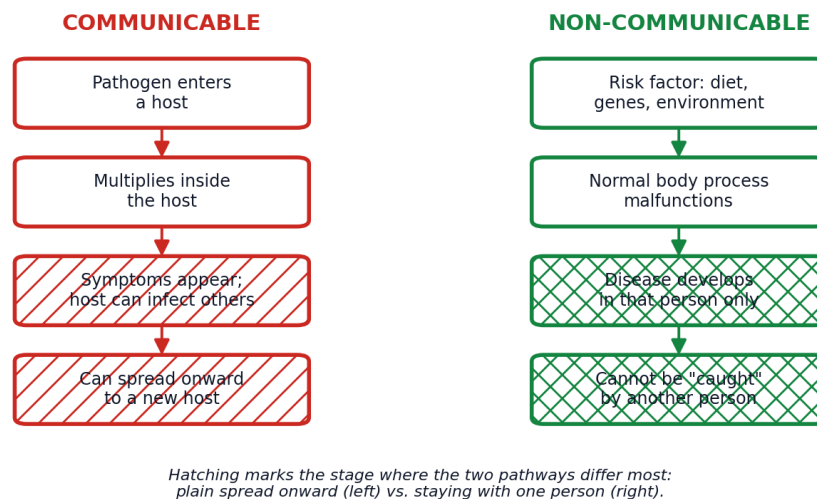


Fig. 2.4 — The two pathways only look similar at first glance; they diverge completely at the point where a communicable disease can move on to someone else.

(a) Controlling communicable diseases

Because a communicable disease depends on completing the chain of infection from section 2.1, every prevention method works by breaking that chain at a specific point rather than by some single universal trick.

Method	Which link in the chain it breaks
Natural body barriers (skin, mucus, stomach acid, white blood cells)	Portal of entry — stops the pathogen getting past the body's own defences even after contact.
Water treatment (boiling, chlorination)	Reservoir/mode of transmission — kills the pathogen in the water before it can be swallowed.
Personal and environmental hygiene (handwashing, washing produce)	Mode of transmission — removes the pathogen from hands or food before it can be transferred.
Food preservation (drying, salting, refrigeration, smoking)	Reservoir — stops the pathogen multiplying in stored food.
Drug therapy (antibiotics, antimalarials)	Multiplication inside the host — clears an infection that has already started.
Immunisation	New susceptible host — trains the immune system in advance so the pathogen cannot establish itself even after entry.
Avoiding overcrowding; covering the mouth when coughing	Mode of transmission — reduces the chance of airborne spread between people in close contact.

(b) Non-communicable diseases

Diabetes. The body normally keeps blood glucose within a narrow range using the hormone insulin, produced by the pancreas. In diabetes mellitus, the pancreas produces too little insulin, or the body's cells

stop responding to it properly, so glucose builds up in the blood (hyperglycaemia) instead of being taken into cells for energy. This is why untreated diabetes mellitus causes frequent urination, constant thirst, weight loss and poor wound healing — the body is effectively trying to flush out the excess glucose through the kidneys, taking large amounts of water with it. A separate and much rarer condition, diabetes insipidus, has nothing to do with insulin at all: it happens when the pituitary gland fails to release enough of the hormone that tells the kidneys to reabsorb water, so the kidneys let far too much water pass straight through as urine.

Cancer. Ordinary growth in the body happens because cells divide by mitosis in a controlled way. Cancer begins when a mutation damages the genes that control this process, so a group of cells starts dividing without the usual limits, forming a mass called a tumour. A benign tumour stays in one place and does not invade surrounding tissue; a malignant tumour spreads into nearby tissue and can travel to other parts of the body, which is what makes it dangerous. Leukaemia, a cancer that begins in the bone marrow and affects white blood cell production, and skin cancer, strongly linked to ultraviolet exposure and far more common in people with less melanin in their skin, are two examples with very different causes but the same underlying process of uncontrolled cell division.

Known risk factors for cancer include tobacco smoke, excessive alcohol, prolonged radiation exposure, certain chronic viral infections (for example, long-term Hepatitis B infection raises the risk of liver cancer, and Human Papillomavirus raises the risk of cervical cancer), and inherited genetic factors. Cancer screening means checking for early signs of cancer before symptoms appear, which improves the chance of successful treatment. Palliative care is specialised medical support focused on relieving pain and improving quality of life for someone with a serious or terminal illness, rather than attempting to cure the underlying disease.

Vocabulary

Communicable disease — a disease caused by a pathogen that can spread from one host to another.

Non-communicable disease — a disease that is not caused by a pathogen and cannot spread from person to person.

Tumour — an abnormal mass of tissue formed by cells dividing without the usual controls.

Malignant — describes a tumour that invades surrounding tissue and can spread to other parts of the body.

Experiment: Which Handwashing Method Removes the Most "Germs"?

Type: Experiment (it tests a hypothesis with an observable result).

Hypothesis: washing hands with soap and water for at least 20 seconds removes more "germs" (represented here by cooking oil mixed with a little chalk dust or glitter) than rinsing with water alone.

What you need: a small amount of cooking oil mixed with chalk dust or fine glitter (this stands in for pathogens because it is visible and sticks similarly to skin), soap, and access to water.

What to do:

- Rub a small amount of the oil-and-dust mixture evenly over one hand.
- Rinse that hand with water only for 20 seconds and check under good light how much residue remains.
- Apply a fresh coating of the mixture to the same hand.
- This time wash with soap and water for at least 20 seconds, then check again under the same light.
- Compare how much residue remained after each method and record your observations.

What it shows: soap does not "kill" the marker material any more than water does — what it does is break down oils and loosen particles that plain water leaves stuck to the skin, which is exactly how soap also physically lifts many pathogens off the hands rather than simply diluting them.

Key takeaways and common pitfalls

- Every method for controlling a communicable disease works by breaking one specific link in the chain of infection — there is no single measure that works for every disease in every situation.
- **Common pitfall:** assuming non-communicable diseases have nothing to do with the environment. Diet, pollution and lifestyle are all environmental factors that strongly influence conditions like diabetes and several cancers, even though the disease itself cannot spread person to person.
- **Common pitfall:** confusing benign and malignant tumours. Only a malignant tumour spreads to other tissues; a benign tumour can still be harmful if it grows large enough to press on important structures, but it does not invade or travel.

Leveled practice

[Easy] State one difference between a communicable and a non-communicable disease.

Answer: A communicable disease is caused by a pathogen and can spread from one person to another; a non-communicable disease is not caused by a pathogen and cannot spread between people.

[Medium] Explain, in terms of insulin, why a person with untreated diabetes mellitus passes large amounts of glucose in their urine.

Answer: Without enough working insulin, glucose cannot be taken up efficiently into body cells, so it accumulates in the blood at an abnormally high level. The kidneys filter more glucose than they can reabsorb back into the blood, so the excess is excreted in the urine along with extra water, which is also why urination becomes frequent.

[Hard (multi-step reasoning)] A community health worker plans two separate campaigns: one to reduce cases of bacterial dysentery, and one to reduce cases of diabetes mellitus. Using the ideas in this section, explain why a campaign built entirely around handwashing and safe water would work for the first disease but achieve almost nothing for the second, and suggest what kind of message the second campaign should focus on instead.

Answer: Bacterial dysentery is a communicable disease that depends on completing a chain of infection through contaminated water or food, so breaking that chain with handwashing and safe water directly prevents new cases. Diabetes mellitus is a non-communicable disease with no pathogen and no chain of infection to break — it develops from the body's own insulin production or response failing, often influenced by diet, weight and genetics. A campaign against it would achieve far more by focusing on diet, physical activity, and early screening for high blood glucose, since these address the actual risk factors rather than a transmission route that does not exist for this disease.

Research and discussion

- Ask three adults you know whether anyone in their family has ever had diabetes or high blood pressure, and what changes, if any, a doctor advised them to make. Compare the advice across the families you asked.
- Look at the handwashing facilities available at your school or in your home compound. Based on this section, suggest one realistic improvement that would make correct handwashing easier for everyone who uses it.