

Influenza

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THE STORY IN ONE SENTENCE

Flu is a virus that attacks the wet lining inside your nose, throat, and lungs, causing sudden fever, body aches, and cough — and high-risk people can get pneumonia fast.

“Start antiviral medicine within 48 hours for anyone over 65, pregnant, under 5, or with heart/lung/diabetes trouble. Get your flu shot every fall.”

Normal anatomy — the body's job

The wet lining inside your nose, throat, and breathing tubes (the respiratory epithelium) traps germs in sticky mucus, and tiny waving hairs called cilia sweep that mucus up and out before viruses can multiply.

BODY'S JOB

Every breath you take pulls in dust, pollen, and germs. The mucus layer catches them like flypaper, and the cilia (think of millions of tiny oars) beat in waves to push the mucus up to your throat where you swallow it into stomach acid. At the same time, immune cells patrol the lining, ready to tag and kill any virus that tries to attach. This one-two defense — trap-and-sweep plus immune patrol — stops most respiratory viruses before they ever start copying.

1. You breathe in air loaded with millions of particles, including flu virus.
2. The virus lands on the wet lining of your nose, throat, or breathing tubes.
3. Normally, sticky mucus traps it immediately.
4. Cilia (tiny hair-like structures on the surface cells) wave back and forth about 12 times per second, pushing the mucus and trapped virus up toward your throat.
5. You swallow the mucus into your stomach, where acid destroys the virus.
6. Meanwhile, immune cells in the lining (like macrophages and dendritic cells) patrol, grabbing and killing any virus that tries to attach to a cell.

7. Result: the virus never gets a chance to copy itself, so you stay healthy.

What breaks

Influenza A or B virus breaks through the mucus trap and punches into the cells of the wet airway lining, hijacking each cell to make thousands of copies, then bursting it open and spreading to neighbors — that upstream break triggers all the fever, aches, cough, and risk of pneumonia you see downstream.

CLINICAL TERM

Influenza A or B virion binds to sialic acid receptors on respiratory epithelial cells, enters via endocytosis, releases viral RNA into the cytoplasm, hijacks the host nucleus to replicate, and lyses the cell to release 10^3 – 10^4 new virions per infected cell within 6–8 hours, causing diffuse epithelial tissue death (necrosis), inflammatory cytokine storm (IL-6, TNF- α , IFN- γ), and loss of mucociliary clearance.

How the body compensates

The body turns up fever to slow viral copying, coughs to clear dead cells and mucus, and shifts blood flow to vital organs — but these moves buy only 24 to 48 hours in high-risk people before the lungs can fill with fluid or bacteria and tip into respiratory failure.

1. The hypothalamus (the brain's thermostat in the base of the brain) raises core temperature to 102–104°F because heat slows viral replication and speeds up immune cell activity — that is why you spike a high fever within hours of infection.
2. The cough reflex fires repeatedly to blast out mucus, dead epithelial cells, and viral debris from the airways — it feels exhausting, but it is the body trying to clear the infection physically.
3. The liver ramps up production of acute-phase proteins (like C-reactive protein) and the bone marrow pumps out more white blood cells to fight the virus — you feel bone-tired because this immune work burns calories and amino acids at triple the normal rate.
4. The autonomic nervous system shunts blood away from skin and muscles toward the heart, lungs, and brain to protect oxygen delivery — that is why you feel cold and shivery even though your core temperature is high.
5. The danger zone: in high-risk patients (age >65, pregnancy, age <5, asthma, COPD, heart failure, diabetes, immunosuppression), the virus spreads faster than the immune system can clear it, or the damaged airway lining lets bacteria seed the alveoli, and within 24–72 hours the lungs fill with pus and fluid (pneumonia), oxygen drops, and the patient tips into hypoxemic respiratory failure requiring hospital oxygen or ventilation.

6. Once secondary bacterial pneumonia or ARDS sets in, the window to reverse the process closes fast — that is why antiviral treatment (oseltamivir 75 mg twice daily or baloxavir 40–80 mg once) must start within 48 hours of symptom onset to cut viral load before complications begin.

Domino effect

1. Influenza A or B virus lands on the wet lining of your nose, throat, or airways and punches into epithelial cells. — The virus hemagglutinin protein latches onto sialic acid receptors on the cell surface like a key in a lock, the cell pulls the virus inside, and the viral RNA hijacks the nucleus to copy itself thousands of times in 6 to 8 hours.
2. Infected cells burst open, releasing waves of new virus particles that spread to neighboring cells, and the dead cell debris piles up. — Each infected cell makes 1,000 to 10,000 new virus copies before it ruptures, so the infection spreads exponentially across large patches of airway lining within 12 to 24 hours.
3. The immune system floods the area with cytokines (alarm chemicals like interleukin-6, tumor tissue death (necrosis) factor-alpha, and interferon-gamma), which enter the bloodstream and reach the hypothalamus in the brain. — The hypothalamus reads the cytokine surge as a major threat and cranks up your core temperature (fever, often 102–104°F) to slow viral copying and speed immune cell activity — that is why flu fever hits suddenly and hard.
4. The cytokines also trigger muscle protein breakdown and fatigue as the immune system burns huge amounts of energy. — Fighting a viral infection takes as much energy as running a marathon, so your muscles ache (especially back and legs), you feel bone-tired, and you lose your appetite because the body is redirecting all fuel to immune cells.
5. The airway lining sits raw, swollen, and stripped of its protective cilia for 5 to 14 days, even after the virus is cleared. — The cilia that normally sweep mucus and bacteria out are destroyed when the epithelial cells die, so mucus pools and bacteria that live harmlessly in your throat (like *Streptococcus pneumoniae* or *Staphylococcus aureus*) can drift down into the lungs and start a second infection — that is secondary bacterial pneumonia, which causes a new fever spike and shortness of breath 1 to 2 weeks after flu starts.
6. In high-risk patients (over 65, pregnant, under 5, asthma, COPD, heart disease, diabetes, weak immune system), the virus can spread directly into the alveoli (tiny air sacs) and trigger massive inflammation, fluid leak, and respiratory failure (ARDS) within 24 to 72 hours. — These patients cannot mount a fast enough immune response to stop the virus before it reaches the deep lungs, or their baseline lung/heart reserve is too low to handle the extra work, so oxygen levels drop and they need hospital care fast.

7. Antiviral medicine (oseltamivir or baloxavir) started within 48 hours cuts viral replication, shortens symptom duration by 1 to 2 days, and halves the risk of pneumonia in high-risk groups. — The drugs block neuraminidase (the enzyme that cuts new viruses free from infected cells) or cap-dependent endonuclease (the enzyme that starts viral RNA copying), so fewer new viruses are made, the immune system catches up faster, and the airway lining has time to heal before bacteria can invade.
8. The yearly flu vaccine trains your immune system to recognize that season's influenza strains so it can neutralize the virus at the door, before it ever punches into cells. — The vaccine contains inactivated pieces of hemagglutinin and neuraminidase proteins from the predicted circulating strains; your B cells learn to make antibodies against those proteins, so when real flu virus lands on your airway lining months later, the antibodies tag it immediately and your immune system destroys it before it can infect a single cell — no infection, no fever, no pneumonia.

Symptoms · what the patient feels, and why

- Sudden high fever (usually 100–104°F): The influenza virus invades cells in your nose and throat. Your immune system fights back by releasing chemicals called cytokines (messengers that call in your body's defense team). These cytokines reset your body's thermostat in the hypothalamus (the brain's temperature control center) to a hotter setting, cooking the virus and speeding up your immune cells.
- Dry cough: The flu virus damages the lining of your airways (the tubes that carry air to your lungs). Your body tries to clear out the dead cells and mucus by coughing. Early on, there's not much mucus yet, so the cough stays dry and harsh.
- Muscle and body aches (myalgia): Those same cytokines (immune messengers) that cause fever also make your muscles sore and achy. They're trying to keep you still so your body can focus all its energy on fighting the virus instead of moving around.
- Severe fatigue and weakness: Fighting the flu is like running a marathon inside your body. Your immune system uses huge amounts of energy, and the cytokines signal your brain to make you feel exhausted so you rest and heal instead of pushing through.
- Headache: The cytokines (chemical messengers fighting the virus) cause blood vessels in your brain to swell slightly and send pain signals. The fever and dehydration from sweating also trigger headache pain.
- Chills and sweats: When your brain's thermostat (the hypothalamus) pushes your temperature up to fight the virus, your body shivers to make heat. Later, when the fever breaks, you sweat to cool back down. This cycle repeats as your immune system battles the infection.

- **Sore throat:** The flu virus directly attacks and kills cells lining your throat. The raw, irritated tissue becomes inflamed (red, swollen, and painful) as your immune system rushes in white blood cells to clean up the damage.
- **Stuffy or runny nose:** The lining of your nose swells up (inflamed) as it fights the virus and makes extra mucus to trap and wash away virus particles. This clogs your nasal passages and causes drainage.
- **Shortness of breath or chest discomfort:** The virus damages the airways leading to your lungs, causing inflammation and sometimes spreading deeper into lung tissue. Swollen, irritated airways make it harder to move air in and out smoothly.
- **Confusion or severe drowsiness (especially in young children or older adults):** High fever, dehydration (losing too much water from sweating and not drinking enough), and severe infection can all reduce oxygen or sugar delivery to the brain. In bad cases, the infection itself may inflame brain tissue or trigger sepsis (the body's overwhelming, dangerous response to infection).

Focused exam

- **Sudden high fever (101–104°F / 38.3–40°C), starts fast within hours:** Influenza viruses land in the airway lining and multiply fast — in 1 to 2 days you go from feeling fine to very sick. The sudden fever means your brain's thermostat (the hypothalamus, the control center at the base of the brain) turned the heat up high to slow the virus down and call in white blood cells. A gradual fever over days points more toward bacteria or a cold virus.
- **Dry cough (little or no mucus at first):** The influenza virus invades the cells lining the airways — the trachea (windpipe) and bronchi (the big tubes into the lungs). When those cells die, the raw airway lining gets swollen and angry, which triggers the cough reflex. Dry cough means the lining is irritated but not yet infected with bacteria (bacteria make thick, colored mucus).
- **Severe muscle aches and body pain (myalgia):** When influenza virus spreads, your immune cells release cytokines (chemical alarm signals such as interleukin-6 and tumor tissue death (necrosis) factor) into the bloodstream. These cytokines cause pain and fatigue all over — not because the virus is in the muscles, but because the alarm signals reach every tissue. This is why flu feels worse than a cold.
- **Headache and extreme tiredness (fatigue):** The same cytokines (alarm chemicals) that cause muscle pain also reach the brain and drain your energy. Your body is using enormous resources to make new white blood cells and fever, so you feel wiped out. The headache comes partly from fever (blood vessels in the brain widen) and partly from the cytokines themselves.

- Shortness of breath, fast breathing, or chest pain: This means the virus damaged the airway lining so badly that bacteria (such as *Streptococcus pneumoniae* or *Staphylococcus aureus*) landed on the raw tissue and started a secondary bacterial pneumonia, or the virus itself spread deep into the lung air sacs (alveoli). Either way, oxygen cannot cross into the blood well. This is the main reason people die from flu.
- Mild sore throat (not the main complaint): Influenza infects the entire airway lining, including the throat (pharynx). The throat gets red and sore, but usually less than with strep throat. If the sore throat is the worst part and there is not much cough or fever, it is more likely strep or a cold virus.

Diagnostics · every test answers a question

- Rapid influenza diagnostic test (RIDT) — nasal or throat swab → Is influenza virus present in the airway right now?
- RT-PCR (reverse transcription polymerase chain reaction) for influenza A and B — nasal swab → Is influenza virus present, and which type (A or B)?
- Chest X-ray (posteroanterior and lateral views) → Is there pneumonia (infection filling the air sacs in the lungs)?
- Pulse oximetry (oxygen saturation, SpO₂) → Is enough oxygen getting from the lungs into the blood?
- Complete blood count (CBC) with differential → Is the body fighting a virus or bacteria, and is the immune system holding up?
- Blood culture (two sets from separate sites) if pneumonia or sepsis is suspected → Are bacteria in the bloodstream (bacteremia or sepsis)?

Treatment logic

- Oseltamivir 75 mg by mouth twice daily for 5 days (or baloxavir 40–80 mg single dose, or zanamivir 10 mg inhaled twice daily for 5 days) → Oseltamivir blocks neuraminidase (a protein on the flu virus surface that cuts the virus free from infected airway cells). Without neuraminidase, new virus particles stay stuck and cannot spread to new cells. This shortens illness by about 1 day and cuts the risk of pneumonia and hospitalization if started within 48 hours of symptom onset. Baloxavir blocks a different step (the virus copying its RNA inside the cell) and works in one dose.
- Isolation at home for at least 5 days from symptom onset AND until fever is gone for 24 hours without medicine; wear a mask around others → Influenza spreads through respiratory droplets (when you cough, sneeze, or talk) and can hang in the air briefly in closed rooms. Keeping the sick person away from others breaks the chain of transmission. Most viral shedding (releasing virus) happens in the first 3–5 days of illness.

- Antibiotics (amoxicillin-clavulanate 875/125 mg twice daily, or ceftriaxone 1-2 g IV daily, or levofloxacin 750 mg daily) if secondary bacterial pneumonia develops → When the flu virus damages the airway lining, bacteria (especially *Streptococcus pneumoniae*, *Staphylococcus aureus*, *Haemophilus influenzae*) can land on the raw tissue and multiply, causing bacterial pneumonia 5-14 days after flu starts. Antibiotics kill these bacteria and stop the infection from spreading into the bloodstream (sepsis).
- Acetaminophen 650-1,000 mg every 6 hours or ibuprofen 400-600 mg every 6 hours, plus encourage oral fluids (water, broth, electrolyte drinks) → Fever happens because cytokines (alarm chemicals like interleukin-1) tell the hypothalamus (the brain's thermostat) to raise body temperature. Acetaminophen and ibuprofen block prostaglandins (the chemical messengers that carry out the fever signal), so the thermostat resets to normal. Fluids replace water lost through sweating and keep blood pressure and kidney function steady.
- Annual influenza vaccination (inactivated injectable vaccine or live-attenuated nasal spray, given in fall before flu season) → The vaccine contains pieces of the flu virus surface proteins (hemagglutinin and neuraminidase) from the 3-4 strains predicted to circulate that year. Your immune system makes antibodies and memory T cells against those proteins. If the real flu virus arrives later, your immune system recognizes it immediately and stops it before you get very sick. Reduces flu illness by 40-60% and severe outcomes (hospitalization, death) by 50-80% in most years.
- Supplemental oxygen (nasal cannula or face mask) if $\text{SpO}_2 < 90\%$, titrate to keep $\text{SpO}_2 \geq 90-92\%$ → When pneumonia or lung damage blocks oxygen from crossing into the blood, the heart and brain do not get enough oxygen (hypoxia). Giving extra oxygen raises the oxygen pressure in the lungs so more can diffuse across even damaged air sacs. This buys time while antivirals and antibiotics work.
- IV fluids (normal saline or lactated Ringer's) if the patient is dehydrated or cannot drink → High fever and sweating cause fluid loss. If the patient cannot drink (too tired, nauseous, or confused), blood volume drops and blood pressure falls (hypovolemia). IV fluids restore blood volume so the heart can pump well and kidneys keep working.

Medications

Oseltamivir (Tamiflu) · Neuraminidase inhibitor

Oseltamivir blocks neuraminidase, an enzyme (a tiny chemical tool) that the flu virus uses like scissors to cut itself free from an infected cell. Without it, new virus copies get stuck and cannot spread to more cells in your airways. This stops the infection from getting worse and shortens how long you feel sick.

1. You swallow the pill; your liver changes it into the active form (oseltamivir carboxylate).
2. The active drug travels through your blood to the infected airways.

3. It locks onto neuraminidase on the virus surface, blocking the enzyme's cutting action.
4. New virus copies cannot break free from the cell they were made in, so they clump together and cannot infect nearby cells.
5. Fewer cells get infected, so the flu stops spreading inside you and symptoms get better faster (usually 1 day sooner).

SAFETY WATCH

Nausea and vomiting (happens in about 1 in 10 people; taking it with food helps). · Rare reports of confusion, unusual behavior, or hallucinations, especially in children and teens; watch closely and call your doctor if you see sudden strange behavior. · Safe in pregnancy and for children over 2 weeks old when flu risk is high.

Baloxavir (Xofluza) · Cap-dependent endonuclease inhibitor

Baloxavir blocks cap-dependent endonuclease, an enzyme the flu virus uses to steal a special cap from your cell's own messenger molecules (mRNA). The virus needs that stolen cap to make its own proteins and copy itself. When baloxavir blocks this theft, the virus cannot build new copies, so the infection stops spreading.

1. You swallow one dose; the drug enters your bloodstream and reaches infected airway cells.
2. Inside those cells, baloxavir locks onto the cap-dependent endonuclease enzyme on the virus.
3. The virus can no longer steal the cap it needs from your cell's messenger molecules.
4. Without the cap, the virus cannot make its proteins or copy its genetic instructions.
5. Virus replication stops within hours, and symptoms improve faster (about 1 day sooner than no treatment).

SAFETY WATCH

Diarrhea and headache (mild, in a small number of people). · Resistance mutations can emerge quickly, especially in children under 12, making the drug less effective. · Safe for ages 5 and older and for people at high risk; not enough data yet for pregnancy, so oseltamivir is preferred if you are pregnant.

Zanamivir (Relenza) · Neuraminidase inhibitor (inhaled)

Zanamivir blocks the same neuraminidase enzyme as oseltamivir, trapping new virus copies so they cannot spread. You breathe it in as a powder, so it goes straight to your airways where the flu virus is multiplying. This stops the infection from getting worse and shortens how long you are sick.

1. You inhale the powder through a special device; it lands on the cells lining your airways.

2. Zanamivir binds to neuraminidase on the virus surface, blocking its cutting action.
3. New virus particles get stuck on the infected cell and cannot escape to infect nearby cells.
4. The flu stops spreading inside your airways, and symptoms improve about 1 day sooner.

SAFETY WATCH

Can trigger wheezing or tightness in the chest, especially if you have asthma or chronic lung disease; NOT recommended if you have asthma or COPD. · Keep your rescue inhaler (like albuterol) nearby if you have lung problems and your doctor decides to use zanamivir anyway. · Safe for ages 7 and older.

Peramivir (Rapivab) · Neuraminidase inhibitor (intravenous)

Peramivir blocks neuraminidase just like oseltamivir, trapping new flu virus copies so they cannot spread. It is given as a one-time injection into a vein, so it is used when someone is too sick to swallow pills or needs hospital-level care.

1. A nurse or doctor injects peramivir into your vein over 15–30 minutes.
2. The drug travels through your blood to your respiratory tract.
3. It binds to neuraminidase on the virus surface, blocking the enzyme.
4. New virus particles cannot break free and spread, stopping the infection from getting worse.
5. Symptoms improve and the risk of complications drops.

SAFETY WATCH

Diarrhea is the most common side effect. · Rare serious skin reactions (Stevens-Johnson syndrome) and confusion or unusual behavior have been reported; tell your doctor right away if you notice a rash or strange thoughts. · Safe for ages 6 months and older; can be used in pregnancy when benefits outweigh risks.

Acetaminophen (Tylenol) or Ibuprofen (Advil, Motrin) · Antipyretic and analgesic (fever reducer and pain reliever)

Acetaminophen lowers fever by acting on the hypothalamus (the brain's thermostat) to turn down your body's heat set-point. Ibuprofen does the same and also blocks COX enzymes, which make prostaglandins (chemicals that cause pain, fever, and swelling). Both ease the aches, headache, and fever that come with the flu, but they do NOT fight the virus itself.

1. You swallow the pill; it enters your bloodstream.
2. Acetaminophen reaches the hypothalamus and lowers the fever set-point, so you stop shivering and your temperature drops.

3. Ibuprofen blocks COX-1 and COX-2 enzymes, stopping prostaglandin production, which reduces pain, fever, and inflammation.
4. You feel less achy, your headache eases, and your fever comes down, making you more comfortable while your immune system fights the virus.

SAFETY WATCH

Acetaminophen: Too much can damage your liver; never take more than 3,000–4,000 mg in 24 hours (including any in combination cold medicines). Avoid alcohol. · Ibuprofen: Can upset your stomach; take with food. Avoid if you have kidney problems, ulcers, or are on blood thinners without asking your doctor. Do NOT give aspirin to children or teens with flu (risk of Reye syndrome, a serious brain and liver problem). · Both are safe when used as directed; follow dosing on the label or your doctor's instructions.

Influenza vaccine (flu shot or nasal spray) · Inactivated or live-attenuated vaccine (prevention, not treatment)

The flu vaccine teaches your immune system to recognize pieces of the flu virus (either killed virus proteins in the shot or a weakened live virus in the nasal spray). Your body makes antibodies and memory cells against those pieces. If the real flu virus shows up later, your immune system recognizes it instantly and attacks before it can make you sick, or at least makes the illness much milder.

1. You get the shot in your arm or the spray in your nose.
2. Immune cells (dendritic cells and macrophages) pick up the vaccine pieces and carry them to nearby lymph nodes.
3. B cells learn to make antibodies (Y-shaped proteins) that stick to the flu virus and mark it for destruction.
4. T cells learn to recognize and kill cells already infected by flu.
5. Memory cells stay in your body for months, ready to respond fast if you meet the real virus, preventing infection or making it much shorter and milder.

SAFETY WATCH

Sore arm, mild fever, or tiredness for a day or two after the shot (normal immune response). · The nasal spray can cause runny nose or mild congestion. · Serious allergic reactions are extremely rare (about 1 in a million); symptoms include hives, swelling, trouble breathing within minutes to hours—get emergency help if this happens. · Safe for almost everyone 6 months and older; talk to your doctor if you have severe egg allergy (though most can still get the shot safely). Pregnant women should get the shot, not the nasal spray. Get it every year because flu strains change.

Red flags

- Trouble breathing, fast breathing, or chest pain when breathing
- Confusion, severe drowsiness, or trouble waking up
- Symptoms improve for a day or two, then suddenly get worse with new high fever or cough (may signal bacterial pneumonia on top of flu)
- Severe weakness or dizziness that makes it hard to stand
- In children: bluish lips or face, not drinking enough fluids, or being so irritable they don't want to be held

Nursing priorities

1. Check oxygen saturation with pulse oximeter and breathing rate every 4 hours — Flu virus damages the air sacs (alveoli) in lungs where oxygen enters the blood. Oxygen below 94 percent or breathing faster than 20 breaths per minute means pneumonia is starting and the patient needs more oxygen or hospital transfer.
2. Start oseltamivir 75 mg by mouth twice daily within 48 hours of symptom start — Oseltamivir (antiviral medicine) blocks the enzyme (neuraminidase) that lets flu virus spread to new cells. It works best in the first two days. After 48 hours it helps less, but still give it to very sick patients or those with chronic disease.
3. Keep the patient in a single room and require masks for anyone entering for 5 days from symptom start — Flu spreads through droplets (tiny wet particles) when the patient coughs or talks. The virus stays contagious (able to infect others) for five days. Isolation stops the virus from reaching people with weak immune systems.
4. Give acetaminophen 650 mg or ibuprofen 400 mg by mouth every 6 hours for fever above 100.4°F — High fever (above 102°F) makes the heart beat fast and pulls water from the body through sweat. Fever-reducing medicine (antipyretics) lowers body temperature and makes patients comfortable enough to drink fluids.
5. Push oral fluids to 2 liters per day and watch urine output and color every shift — Fever and fast breathing cause insensible losses (water leaving through skin and lungs you cannot see). Dehydration makes blood thick, kidneys shut down, and confusion starts. Clear or pale yellow urine means hydration is good.
6. Teach the patient to watch for worsening shortness of breath, chest pain, confusion, or return of high fever after day 3 — Secondary bacterial pneumonia happens when bacteria (like *Streptococcus pneumoniae* or *Staphylococcus aureus*) grow in lungs damaged by flu virus. This usually shows up in week two and needs chest X-ray and antibiotics fast.

7. Do not give aspirin to anyone under 18 years old with flu symptoms — Aspirin during viral infections triggers Reye syndrome (rare brain and liver swelling) in children and teens. The syndrome causes vomiting, confusion, seizures, and liver failure. Use acetaminophen or ibuprofen instead.

Sources

- CDC seasonal influenza guidelines
- IDSA clinical practice guideline for seasonal influenza (2018)
- WHO influenza surveillance and monitoring
- Cochrane systematic reviews on influenza diagnosis and treatment

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