



The Science Behind the Shot: What's in Vaccines and Why It Matters



Vaccines protect against viral or bacterial infection by introducing **antigens** to our body's immune system. **Antigens** are the "active ingredients" contained in any vaccine. There are several mechanisms for introducing **antigens** in vaccine formulations, including¹⁻³:

Whole Virus or Bacterium-Containing Vaccines

May be **inactivated** (killed or inactive) or **live attenuated** (weakened versions)

Inactivated Vaccines

Contain **killed viruses or bacteria**

Examples: **flu shots, inactivated polio vaccine (IPV)**

- ✓ **Safe** for people with weakened immune systems
- ✗ Immunity often short-term → may need **2-3 doses**
- 🕒 **Slower** to manufacture

Live Attenuated Vaccines

Contain **weakened versions** of virus/bacteria

Examples: **MMR (measles, mumps, rubella), varicella (chickenpox)**

- ✓ Mimic natural infection → usually **long-lasting immunity**
- ⚠ **Not** for people with weakened immune systems (eg, **pregnant, immunocompromised**)

Subunit (Pathogen Particle) Vaccines

Contain **only pieces** of the virus or bacterium

Examples: **many childhood immunizations (eg, whooping cough), vaccines for pneumococcal and meningococcal diseases**

- ✓ **Safe** for people with weakened immune systems (including pregnant or immunocompromised people)
- 🎯 Trigger a strong immune response to the targeted germ
- ⚠ Usually require boosters/repeated doses for lasting protection

Toxoid Vaccines

Use **inactivated toxins**

Examples: tetanus, diphtheria, pertussis

- ✓ **Safe** for most people, including those who are pregnant or immune compromised
- 🎯 Trigger immune protection against toxin-mediated diseases
- ⚠ **Booster shots** needed to keep immunity strong over time

Viral Vector Vaccines

Use a **modified, harmless virus** as a delivery system

Examples: **some COVID-19 vaccines, Ebola vaccine**

- ✓ **Safely** carry subproteins from the target virus or bacteria; train the body to build strong immunity
- ⚠ Often require just **1 dose** for lasting protection

Vaccines That Utilize Genetic Materials From Pathogens

Contain a **piece/section** of a pathogen's genetic material (DNA or RNA) and teaches our immune system to recognize that protein

Examples: **COVID mRNA vaccines**

- ✓ **No risk** of causing the disease they protect against
- 🕒 **Faster** to manufacture

What about other vaccine ingredients?^{1,4-8}

In addition to the antigen component, vaccines often contain other ingredients to ensure their safety, stability, and efficacy. Some examples of other types of ingredients found in vaccines include **adjuvants, stabilizers, and preservatives**.



Adjuvants⁶

- **Boost the immune response** to help vaccines work better
- **Safely used for decades** in many vaccines
- **Common examples:** aluminum salts and monophosphoryl lipid A

Preservatives^{7,8}

- **Prevent contamination** once a vial is opened
- Common in **multidose vials** used for more than 1 person
- **Examples:** 2-phenoxyethanol, thimerosal
- Thimerosal has been **safely used for decades; no link to autism**

Stabilizers⁷

- **Protect vaccines** from heat and environmental effects
- Keep vaccines **safe and effective** during production, shipping, and storage
- **Common stabilizers:** sugars, amino acids, proteins (like gelatin)

References

1. who.int/news-room/feature-stories/detail/how-are-vaccines-developed. 2. hhs.gov/immunization/basics/types/index.html. 3. Pollard. Nat Rev Immunol. 2021;21:83. 4. chop.edu/vaccine-education-center/vaccine-safety/vaccine-ingredients/types-of-vaccine-ingredients. 5. cdc.gov/pinkbook/hcp/table-of-contents/front-matter.html. 6. cdc.gov/vaccine-safety/about/adjuvants.html. 7. fda.gov/vaccines-blood-biologics/safety-availability-biologics/common-ingredients-fda-approved-vaccines. 8. cdc.gov/vaccine-safety/about/thimerosal.html.