PREVENTIVE VS THERAPEUTIC VACCINES

VACCINES

Currently exist for
20+
infectious diseases, including:

- Mumps
- Pneumococcal
- Polio (Poliomyelitis)
- Rotavirus
- Rubella (German Measles)
- Shingles (Herpes Zoster)
- Tetanus (Lockjaw)
- Whooping Cough (Pertussis)
- Chickenpox (Varicella)
- Diphtheria
- Flu (Influenza)
- Hepatitis A
- Hepatitis B
- Hib (Haemophilus *influenzae* type b)
- HPV (Human Papillomavirus)
- Measles
- Meningococcal disease

IMMUNIZATION

saves approximately
4–5 million
lives each year, according to the World Health Organization

EXAMPLES OF VACCINE COVERAGE GLOBALLY

Source: The World Health Organization.

Historically, vaccines have been designed to stimulate the immune system to recognize a pathogen, activate the appropriate immune response and prevent the pathogen from establishing an infection.

Preventive

However, some vaccines are designed to treat, rather than prevent, diseases – or to slow their progression.

Therapeutic

This infographic will provide a visual overview of the key differences between preventive and therapeutic vaccines.

PREVENTIVE VACCINES – HOW DO THEY WORK?

Vaccine

1. The vaccine contains a harmless form of the disease-causing pathogen, which triggers an immune response without making you sick.
2. The immune system attacks the pathogen by producing antibodies and in some cases other immune cells, like T cells.
3. The immune system remembers this fight and if you encounter the pathogen again, it is primed with antibodies to prevent an infection developing.

THERE ARE DIFFERENT TYPES OF PREVENTIVE VACCINES:

Viral vector vaccines
Use a modified version of an alternative virus as a vector, such as measles, influenza and adenovirus.
Example: Oxford–AstraZeneca COVID-19 vaccine.

Live-attenuated vaccines
Use a weakened (attenuated) form of the pathogen.
Example: Measles, mumps and rubella (MMR combined vaccine).

Messenger RNA (mRNA) vaccines
mRNA encoding a protein (antigen) from the pathogen is delivered into the body. mRNA is transcribed and the resulting protein triggers an immune response.
Example: Pfizer–BioNTech COVID-19 vaccine – first mRNA vaccine to be authorized for human use.

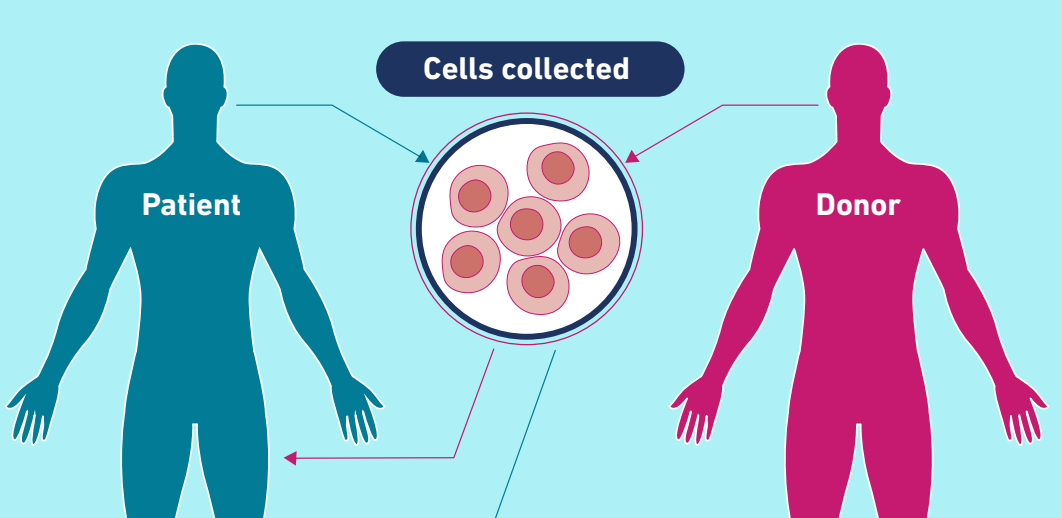
Subunit, recombinant, polysaccharide and conjugate vaccines
Utilize a specific component of a pathogen – like a sugar, capsid or protein – to trigger an immune response.
Example: HPV (Human papillomavirus) vaccine.

Inactivated virus
A "dead" form of the pathogen is used to trigger an immune response. Several doses may be required, compared to a live-attenuated vaccine, to increase duration of immunity.
Example: Hepatitis A vaccine.

THERAPEUTIC VACCINES

Instead of immunizing to prevent a disease, therapeutic vaccines utilize a patient's own immune system to fight an existing disease, by stimulating it to target specific diseased or infected cells.

THERAPEUTIC VACCINES CAN BE CATEGORIZED AS:



Autologous vaccines
Cells from a person's **own body** are harvested to make a vaccine for that individual.

Allogenic vaccines
Cells are harvested from a donor and engineered in a lab for insertion into the patient.

TYPES OF THERAPEUTIC VACCINES INCLUDE:

THERAPEUTIC VACCINES

Molecular-based vaccines
Use peptides, proteins, RNA or DNA to help the immune system identify diseased cells and trigger a targeted immune response.
- Protein/peptide-based vaccines
- DNA vaccines
- RNA vaccines

Cell-based vaccines
Use cells as a source of antigens (e.g., diseased cells extracted from the body and modified) or to deliver antigens (e.g., using immune cell types).
- Whole cell vaccines
- Genetically modified tumor cell vaccines
- Dendritic cell vaccines

Vector-based vaccines
Use naturally immunogenic or engineered microoganisms to present, or express, antigen transgenes.
- Viral vector vaccines
- Live-attenuated bacteria vaccines
- Yeast-based vaccines

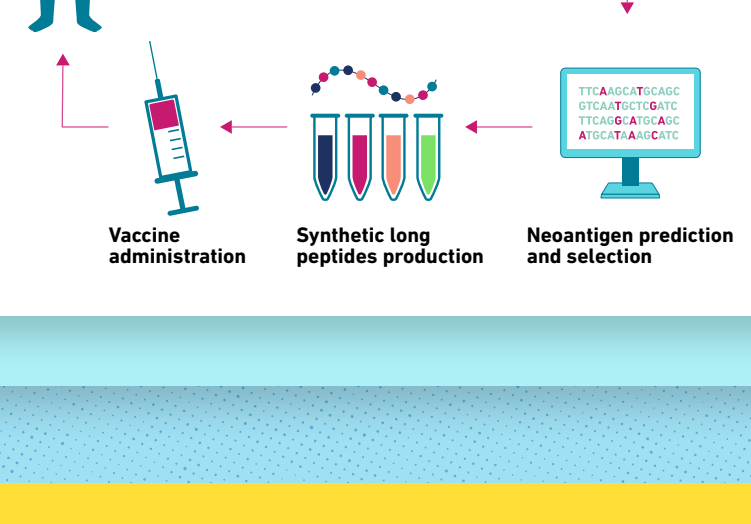
LET'S TAKE A CLOSER LOOK AT SOME EXAMPLES...

This is an example of how a peptide vaccine could be generated for a cancer patient, using sequencing methods to understand the molecular biology of their tumor and generate synthetic peptides.

PEPTIDE VACCINES

Peptides, typically 20—30 amino acids in length, are synthesized to create an immunogenic molecule that represents a specific epitope of an antigen.

Peptide vaccines are dependent on adjuvants and specific delivery systems to be effective as they can be poorly immunogenic.

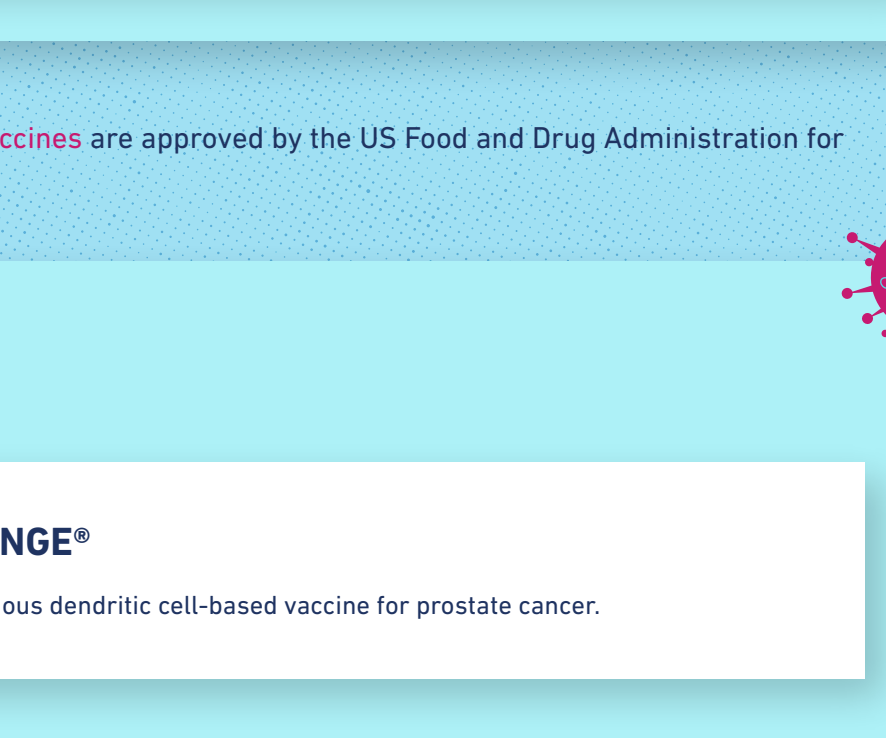


Here is an example of how *in vivo* DC-targeted vaccines are produced.

DENDRITIC CELL VACCINES

Dendritic cells (DC) are the most potent antigen-presenting cells in the immune system.

DC-based vaccines can be broadly grouped into: *In vivo* DC-targeted vaccines and *Ex vivo* antigen-loaded vaccines



Currently, three therapeutic vaccines are approved by the US Food and Drug Administration for cancer treatment:

PROVENGE®
An autologous dendritic cell-based vaccine for prostate cancer.

TheraCys®
A live-attenuated vaccine for bladder invasive cancer.

Imlygic™
A genetically modified oncolytic viral therapy for advanced oncolytic melanoma.

However, a number of therapeutic vaccines are in preclinical and clinical development for various types of cancer, including:

- Glioblastoma
- Cervical cancer
- Lung cancer
- Breast cancer
- Cervical cancer
- Pancreatic cancer

Cancer treatment isn't the only field of medicine set to benefit from therapeutic vaccines...

THERAPEUTIC HIV VACCINES

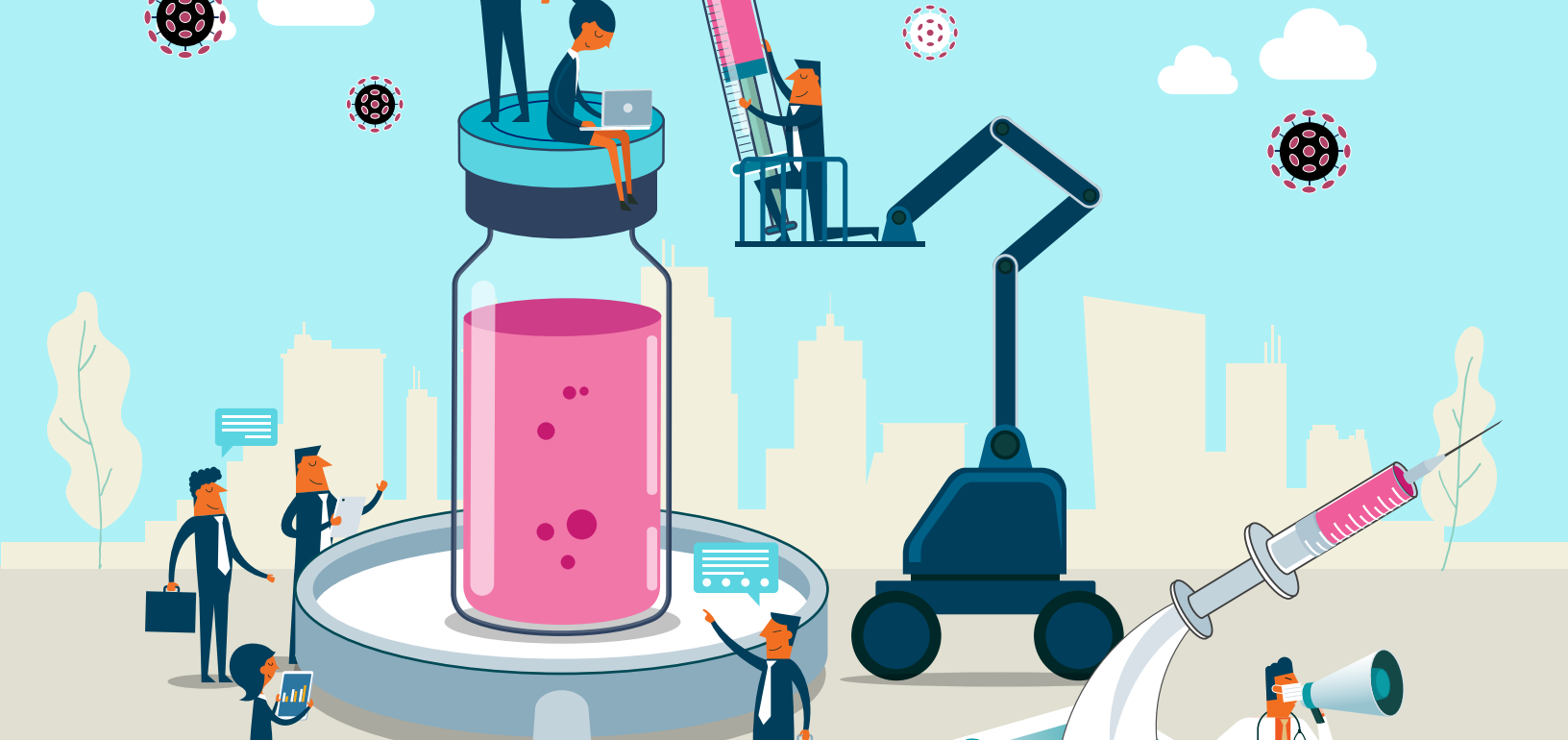
A therapeutic HIV vaccine would be utilized in patients diagnosed with HIV to:

- **Slow down or precent the progression of HIV to acquired immundefiency syndrome (AIDS)**
- **Reduce viral load such that it is undetectable without the need for regular antiretroviral therapy (ART)**
- **Help to prevent transmission of HIV**

To date, a therapeutic HIV vaccine has not been approved for human use. However, a number of ongoing clinical trials are testing different modalities: DNA, protein, peptide, viral vectors and DC-based vaccines – the latter offering the most promising results so far.

FUTURE HORIZONS FOR VACCINE R&D

The COVID-19 pandemic demonstrated the importance of vaccines for protecting and improving human health, injecting a renewed sense of energy for vaccine R&D. What does the future look like?



Accelerated timelines
A preventive vaccine was developed against SARS-CoV-2 in 326 days. Global health authorities have agreed that the next pandemic vaccine will be delivered in 100 days. Several vaccine developers are exploring strategies for achieving this aim.

Increased funding for R&D and vaccine access
Coalition for Epidemic Preparedness Innovations (CEPI) recently announced its $3.5 billion pandemic preparedness strategy, where funds will be allocated to late-stage clinical trials, the continuation of vaccine development for priority pathogens and other R&D endevors. Over the next five years, The Global Fund for Children's Vaccines will give > $150 million worth of vaccines to improve immunization programs in Africa, Asia and Latin America.

Novel modalities
Following several decades of research, the first mRNA vaccine was authorized for human use in 2020. In the coming years we will likely see an increase in the application of mRNA technology for both preventive and therapeutic vaccines across different disease areas.