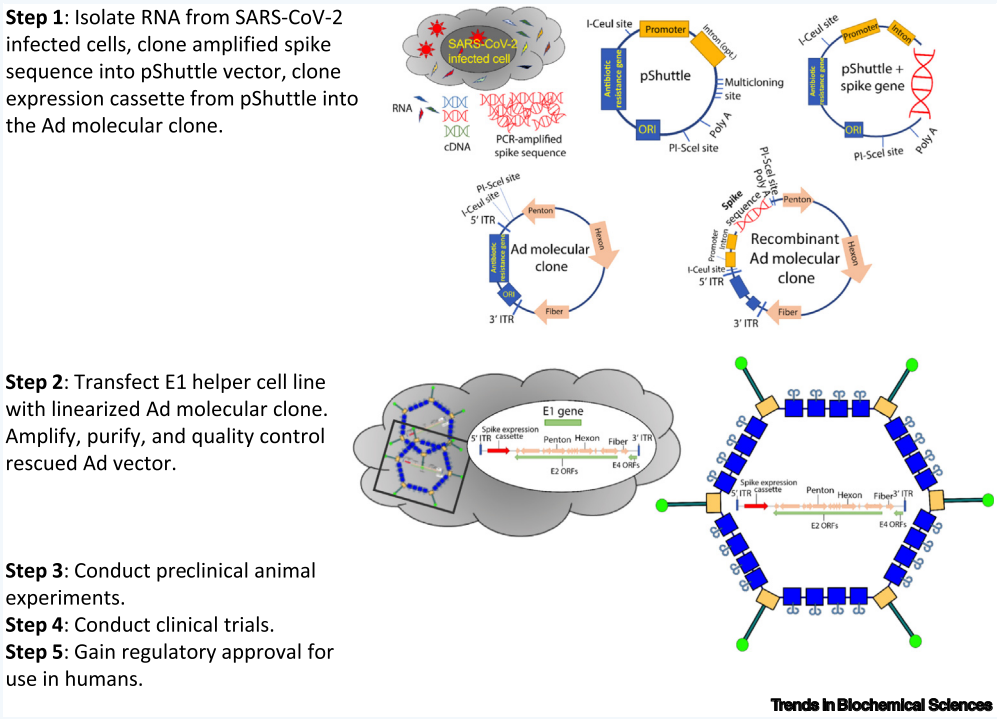
Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Trends in Biochemical Sciences | Technology of the Month

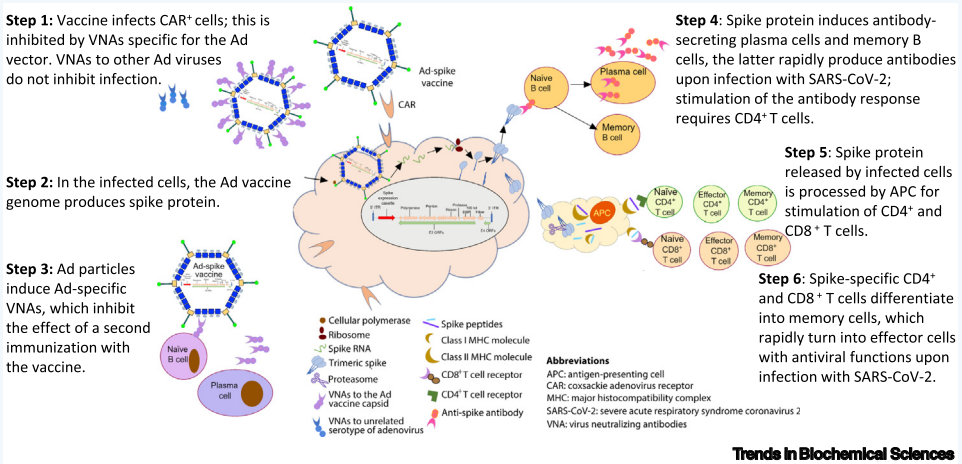
COVID-19 Vaccines Based on Adenovirus Vectors

Mohadeseh Hasanpourghadi,[1] Mikhail Novikov,[1] and Hildegund C.J. Ertl[1,*]

[1]Wistar Institute, 3601 Spruce Street, Philadelphia, PA, USA



Adenovirus (Ad) vectors are produced from molecular clones (MC) of the Ad genome. E1 and E3 domains are deleted; removal of E1 prevents virus replication. The genome is cloned into a plasmid vector. Infected cells provide viral RNA, for example, spike of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). Spike sequences are amplified and cloned into a shuttle vector from where the expression cassette is excised and inserted into an Ad MC. Ad MC transfection of E1$^+$ helper cells rescues the vaccine, which is expanded, tested, and ready for good manufacturing practice (GMP) production and clinical trials.



Ad vaccines infect coxsackie adenovirus receptor (CAR$^+$) cells. They produce spike protein, which induces antibody-secreting plasma cells and memory B cells. Antigen-presenting cells take up and process spike to bind to MHC antigens for stimulation of CD4$^+$ or CD8$^+$ T cells, which help activation of other cells or have antiviral functions. Ad vaccines induce virus neutralizing antibodies (VNAs) to Ad, which inhibit Ad vaccines; VNAs to different Ad serotypes have no effect.

ADVANTAGES:

Ad MCs for different human (AdHu) or chimpanzee Ad (ChAd) viruses are available, which allows for production of experimental spike vaccines within 3–4 weeks.

Procedures for large-scale GMP production and release testing have been developed.

Ad-spike vaccines were shown to be safe in humans.

Ad-spike vaccines induce potent and sustained T and B cell responses to the spike protein in young and aged individuals.

Ad-spike vaccines tested thus far have provided protection against coronavirus disease 2019 (COVID-19): Sputnik V, Gamaleya (AdHu26 prime/AdHu5 boost): 91.4%; AZD155, AstraZeneca (ChAdOx1, 2X): 62.1–90.0%, both vaccines completely protect against severe disease; Johnson & Johnson (AdHu26, 1X): 66%, 85% protection against severe disease.

Ad-spike vaccines can be based on different Ad serotypes, which allows for heterologous prime-boost immunizations, which are more effective than repeated use of the same Ad vector.

Ad-spike vaccines can be stored at 4°C.

Ad-spike vaccines are relatively inexpensive.

CHALLENGES:

Neutralizing antibodies to common human serotypes of Ad viruses reduce vaccine immunogenicity.

Neutralizing antibodies to the Ad vector induced by the first immunization reduce immune responses to a second immunization with the same Ad vector.

Antigen encoded by the Ad vaccine persists for a period of time, which delays transition of lymphocytes into memory, potentially requiring extended intervals between two vaccine doses.

*Correspondence:
ertl@wistar.org (H.C.J. Ertl).

  https://doi.org/10.1016/j.tibs.2021.03.002

Declaration of Interests

No interests are declared.

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