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.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.
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.

**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, Gamalsiya (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).*
Declaration of Interests
No interests are declared.

Literature