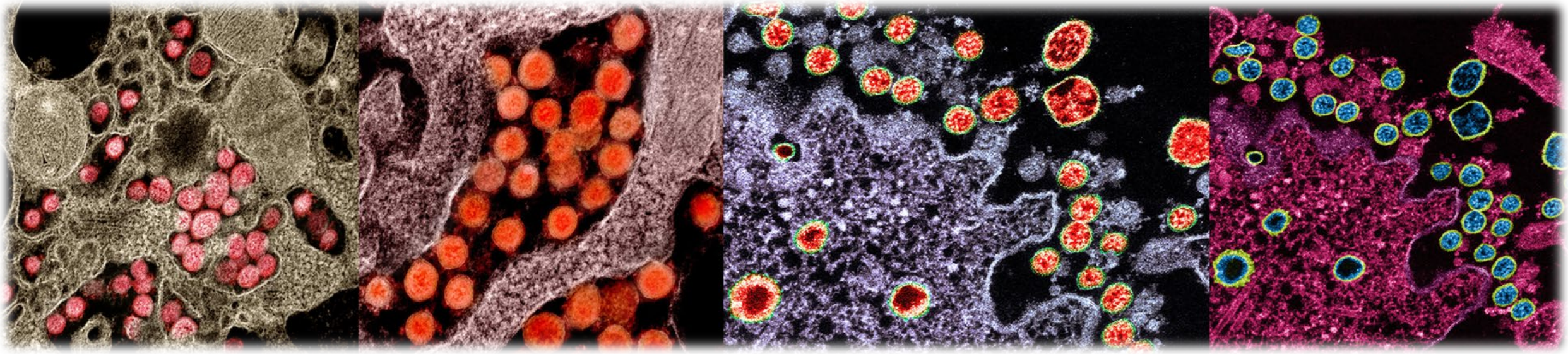
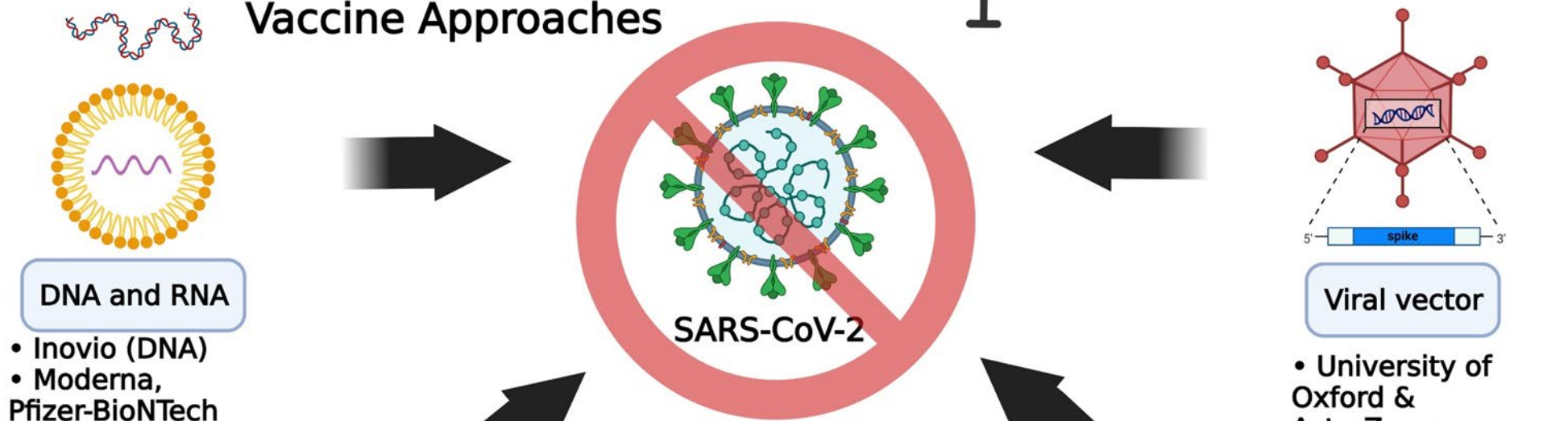


Advancement of viral vector-based COVID-19 vaccines in Thailand

NAC2022
17th NSTDA Annual Conference
การประชุมวิชาการประจำปี สวทช. ครั้งที่ ๑๗

Anan Jongkaewwattana, Ph.D.
National Center for Genetic Engineering and Biotechnology (BIOTEC)
National Science and Technology Development Agency (NSTDA)

Types of CORONAVIRUS Vaccine Approaches



DNA and RNA

- Inovio (DNA)
- Moderna, Pfizer-BioNTech (RNA)

Viral vector

- University of Oxford & AstraZeneca
- CanSino Biologics
- Johnson & Johnson
- Gamaleya

NASTVAC

Inactivated

- Sinovac
- Sinopharm
- Covaxin

Live attenuated

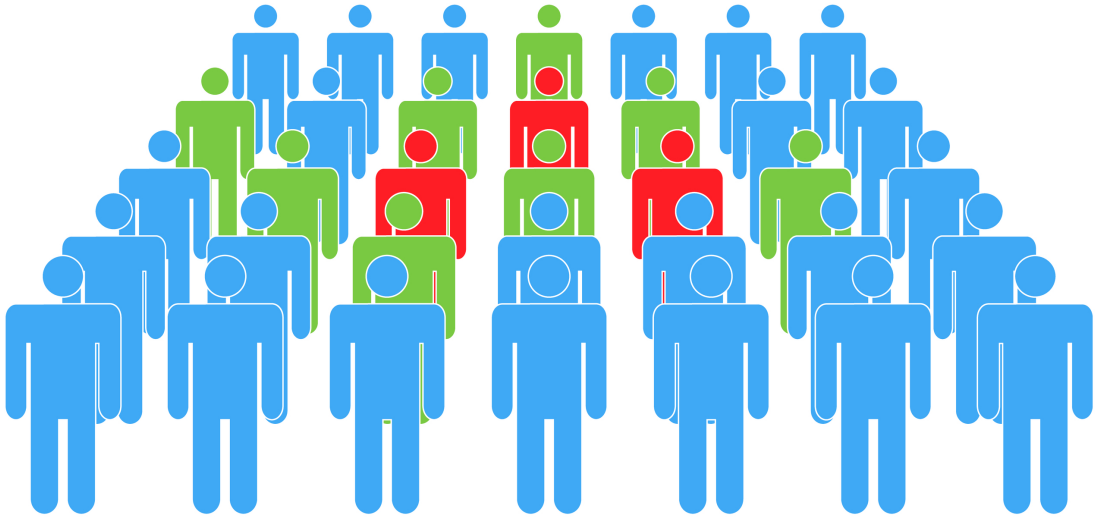
- Codagenix
- Indian Immunologicals Ltd.

Subunit

- Novavax
- AdaptVac

HERD IMMUNITY

COVID-19



INFECTIOUS AGENT PASSES FREELY FROM CONTAGIOUS TO SUSCEPTIBLE

CONTAGION CANNOT FREELY PASS VIA IMMUNISED TO SUSCEPTIBLE

Credit: Narayana Health

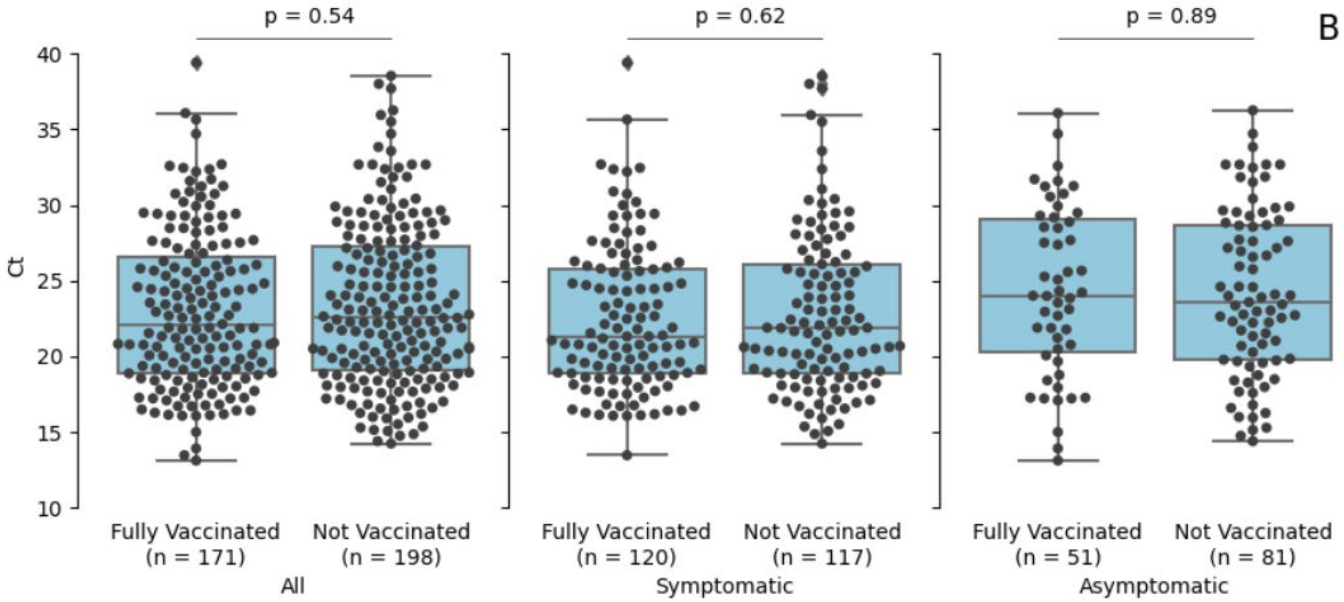
HOME > SCIENCE

CDC: COVID-19 outbreak among 346 fully vaccinated people shows those 'infected with Delta can transmit the virus'

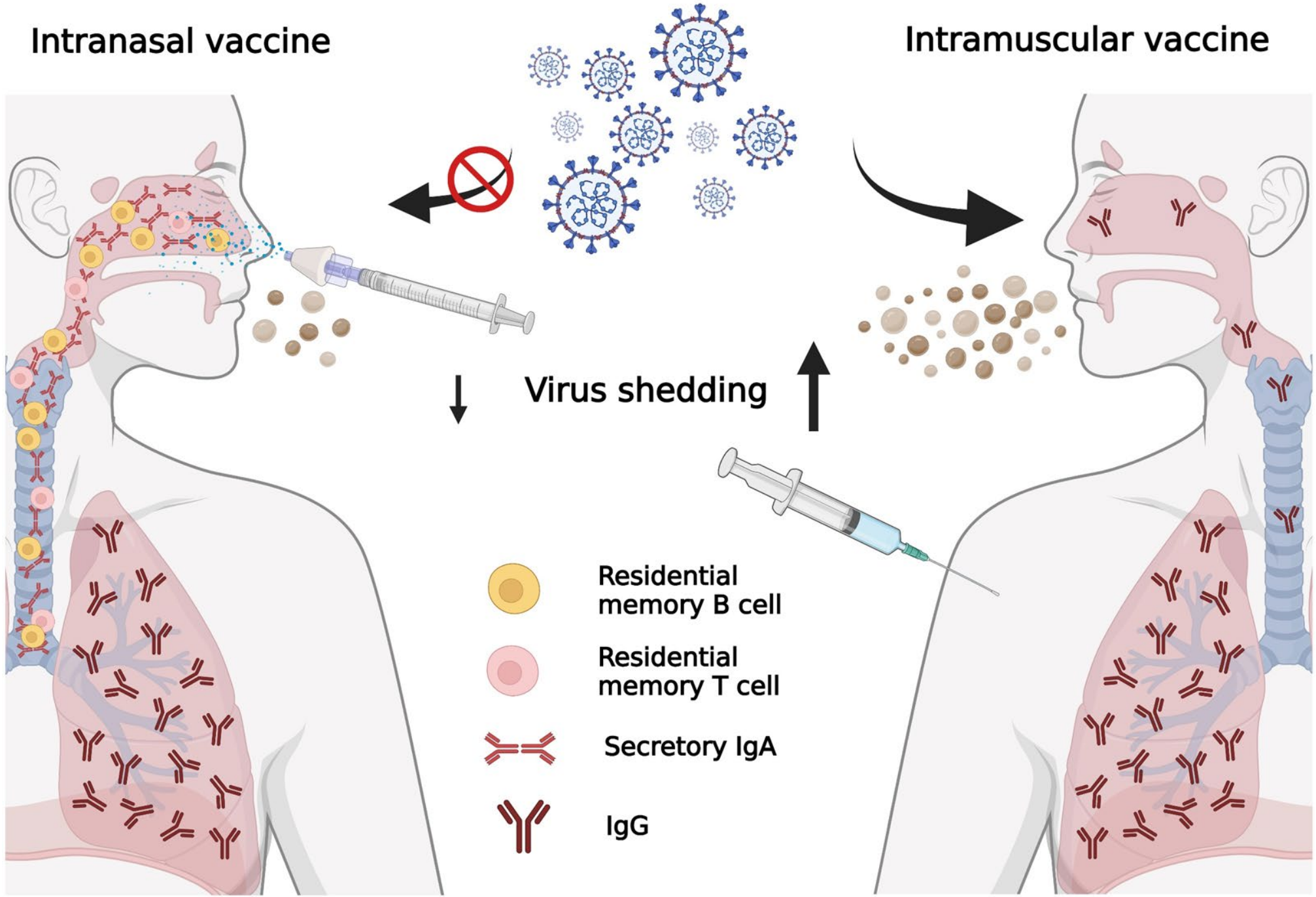
Hilary Brueck 10 hours ago

- A CDC study of a COVID outbreak suggests vaccinated people may spread the Delta variant as easily as the unvaccinated.
- Almost all the symptomatic vaccinated people in the study had mild symptoms like headaches and sore throats.
- The study was a major factor in the CDC's new mask guidance for vaccinated people.

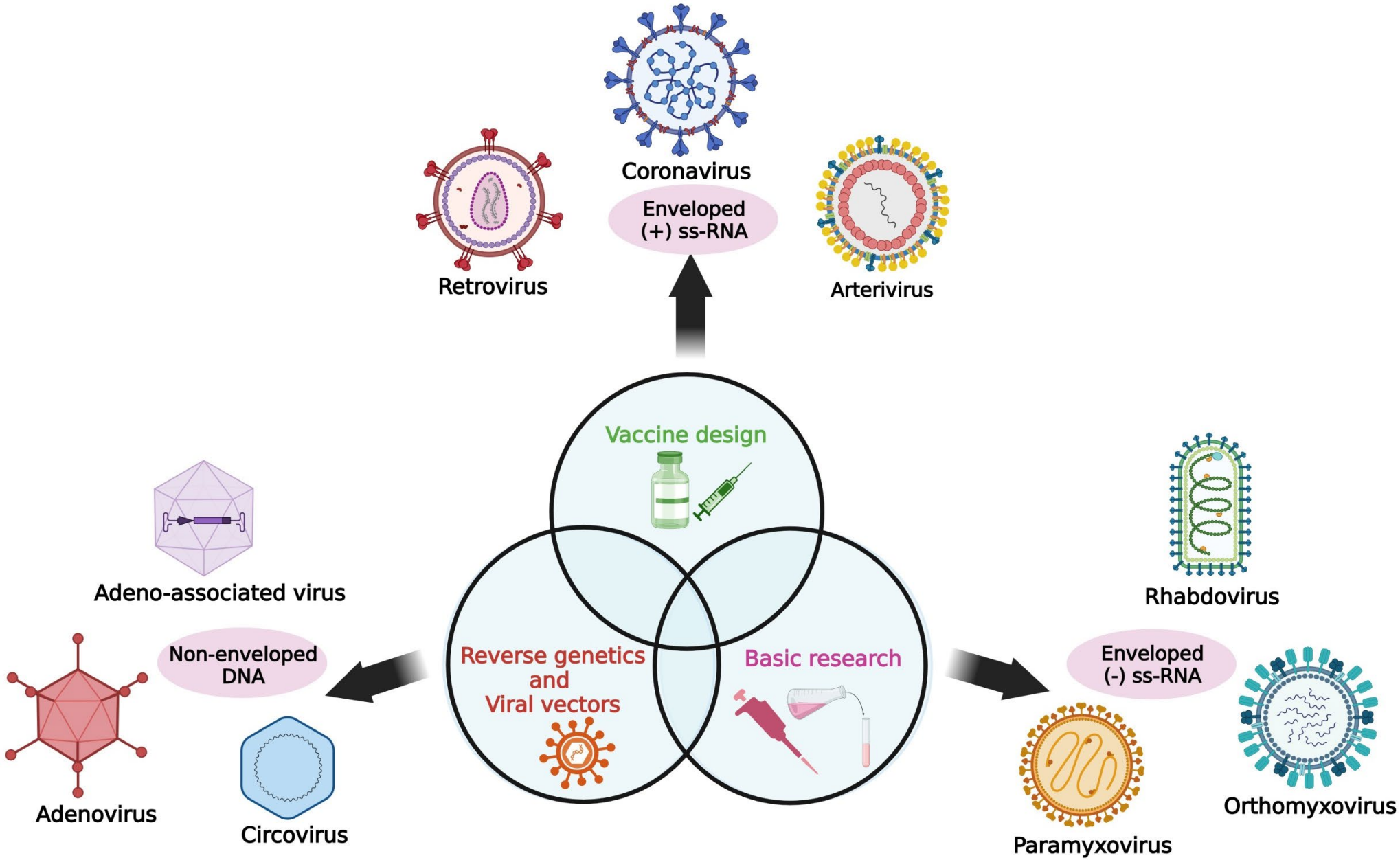
Vaccinated individuals can transmit the virus



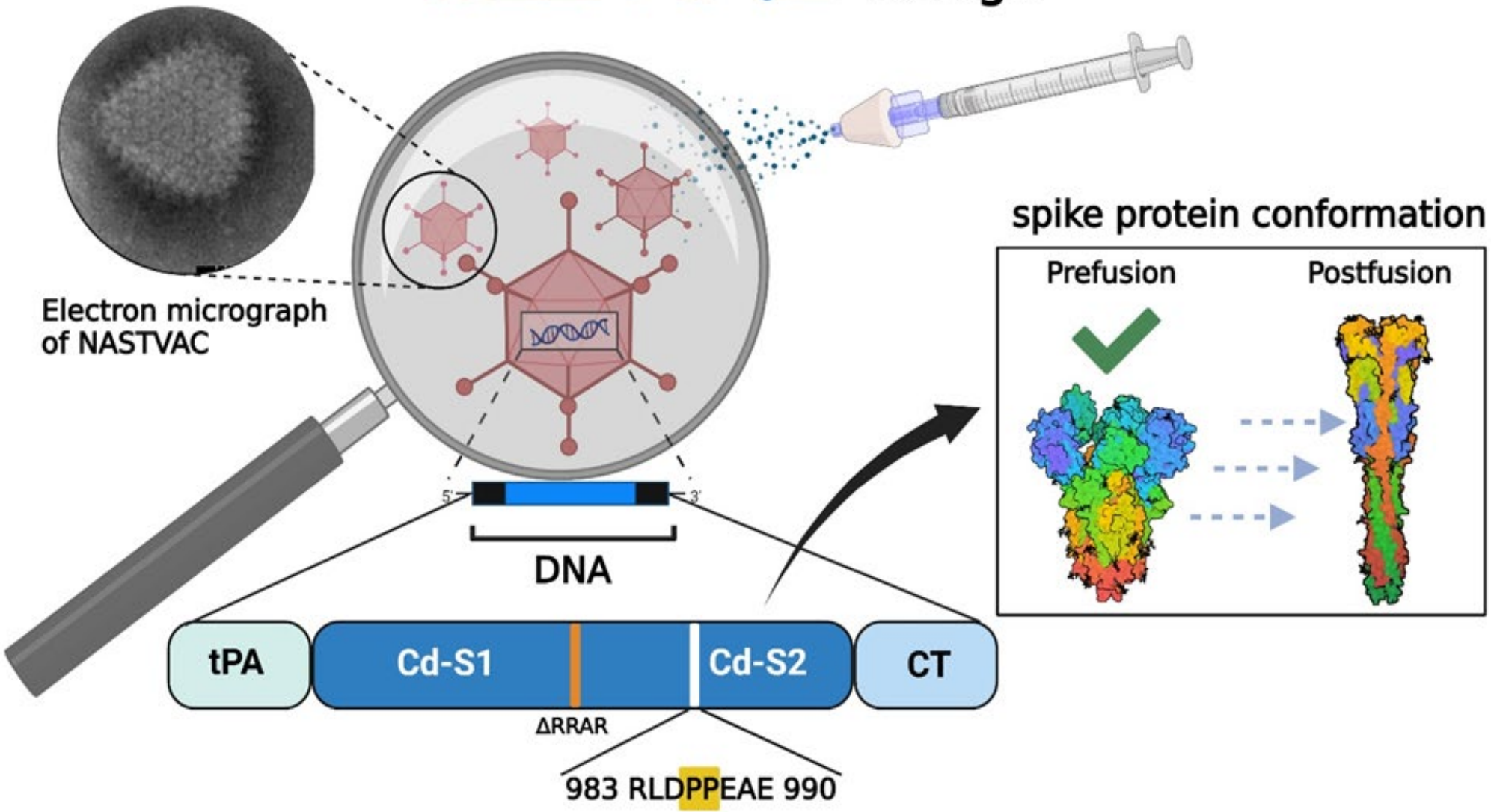
https://doi.org/10.1101/2021.09.28.21264262

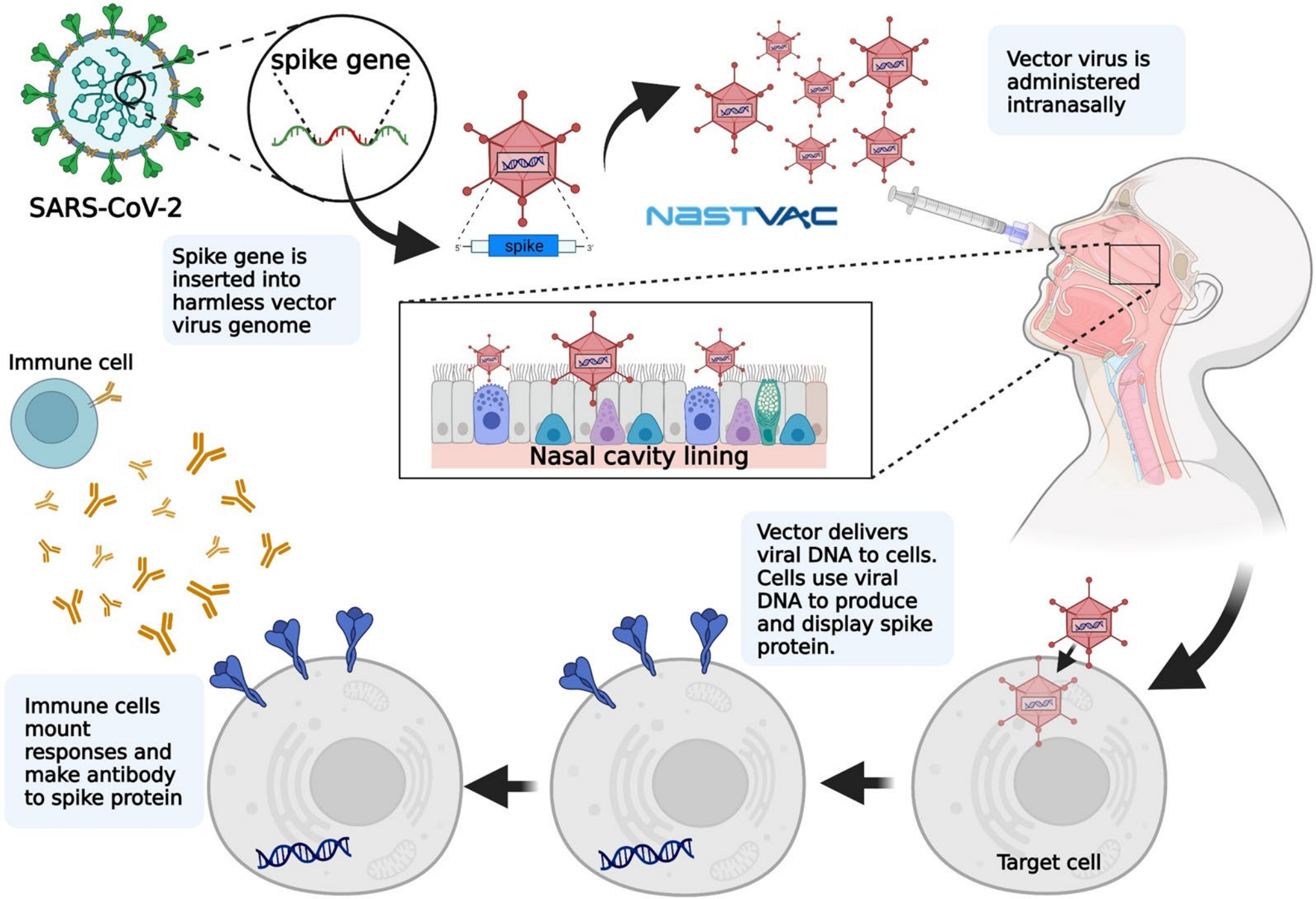

Intranasal vaccine
Intramuscular vaccine
Virus shedding
Residential memory B cell
Residential memory T cell
Secretory IgA
IgG

Viral vector platforms developed at VVCT NSTDA



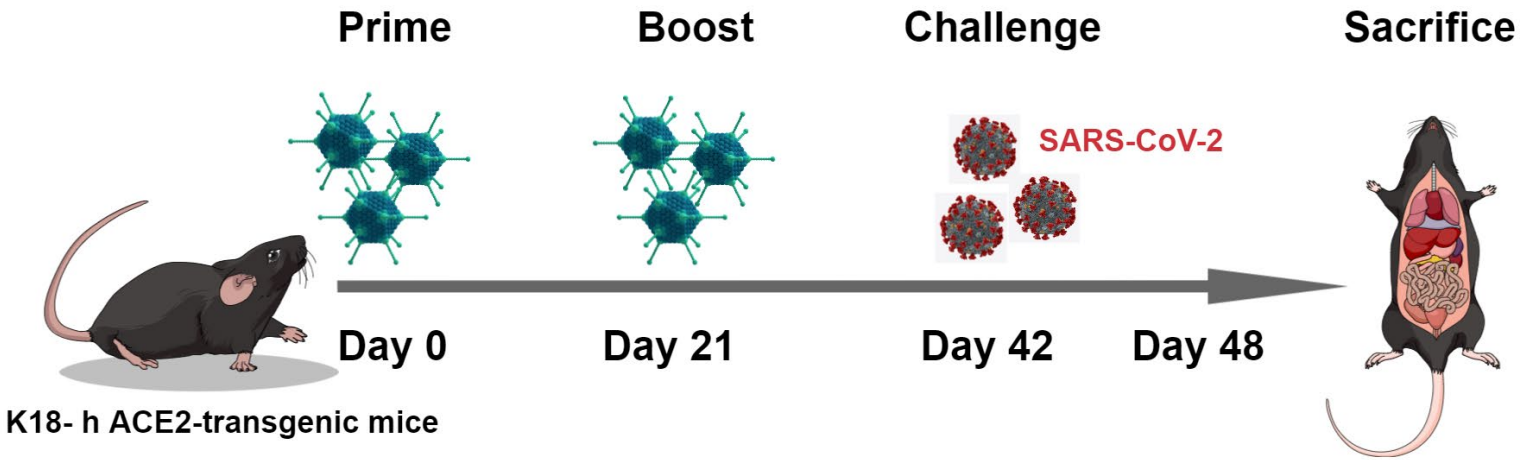
NASTVAC Design



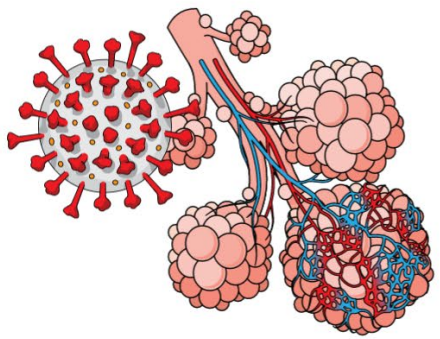

SARS-CoV-2
spike gene
spike
5'
3'
NASTVAC
Vector virus is administered intranasally
Spike gene is inserted into harmless vector virus genome
Nasal cavity lining
Immune cell
Vector delivers viral DNA to cells. Cells use viral DNA to produce and display spike protein.
Target cell
Immune cells mount responses and make antibody to spike protein

Groups

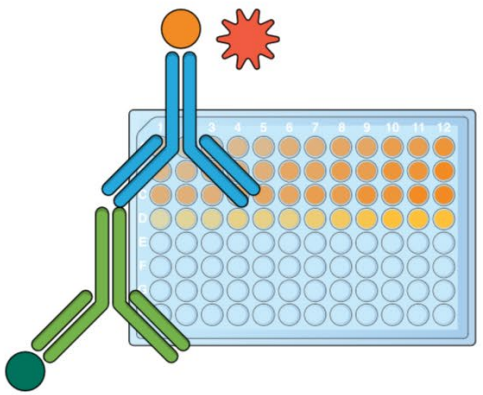
- Ad5-GFP IM/IM
- Ad5-GFP IN/IN
- Ad5-SPP IM/IM
- Ad5-SPP IN/IN
- VLP-SM1 IM/IM
- Ad5/VLP-SM1



Weight
Behavior
Clincal signs



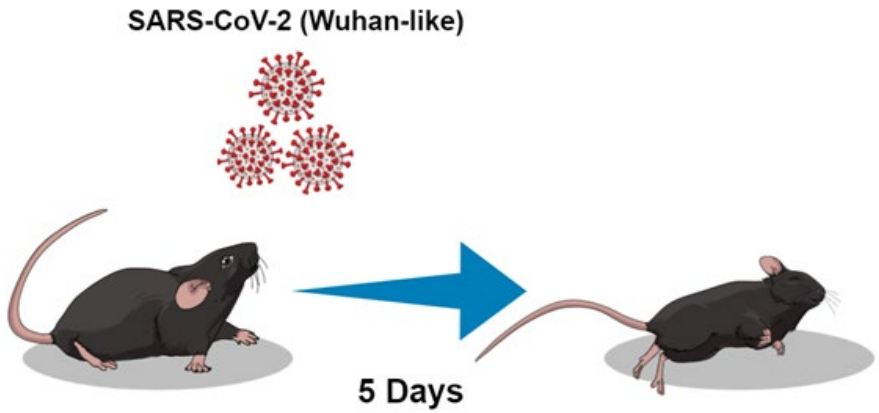
Viremia
Lung titer
Presence in tissue



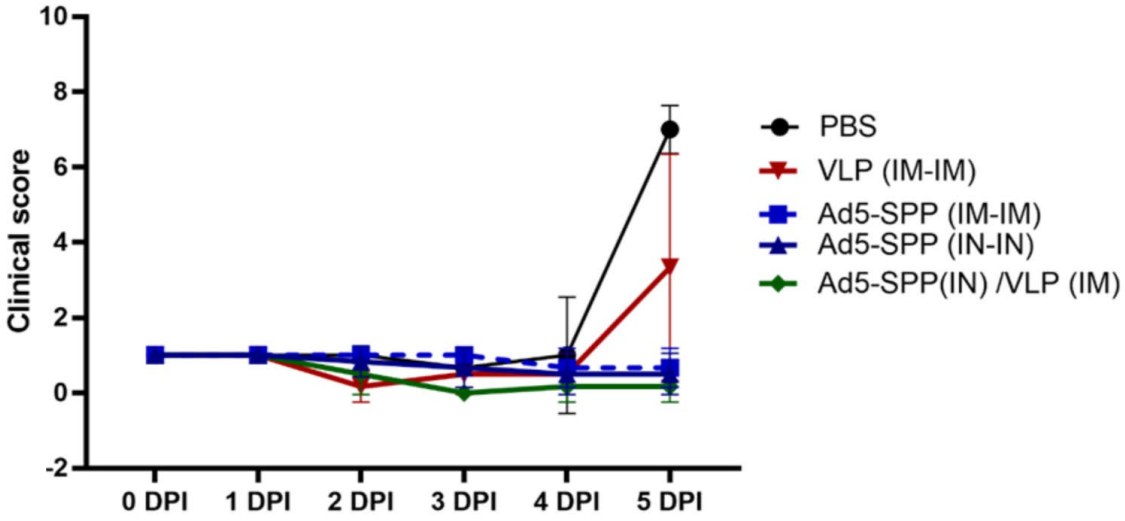
Serum IgG
Lung IgA, IgG
Neutralizing Antibodies

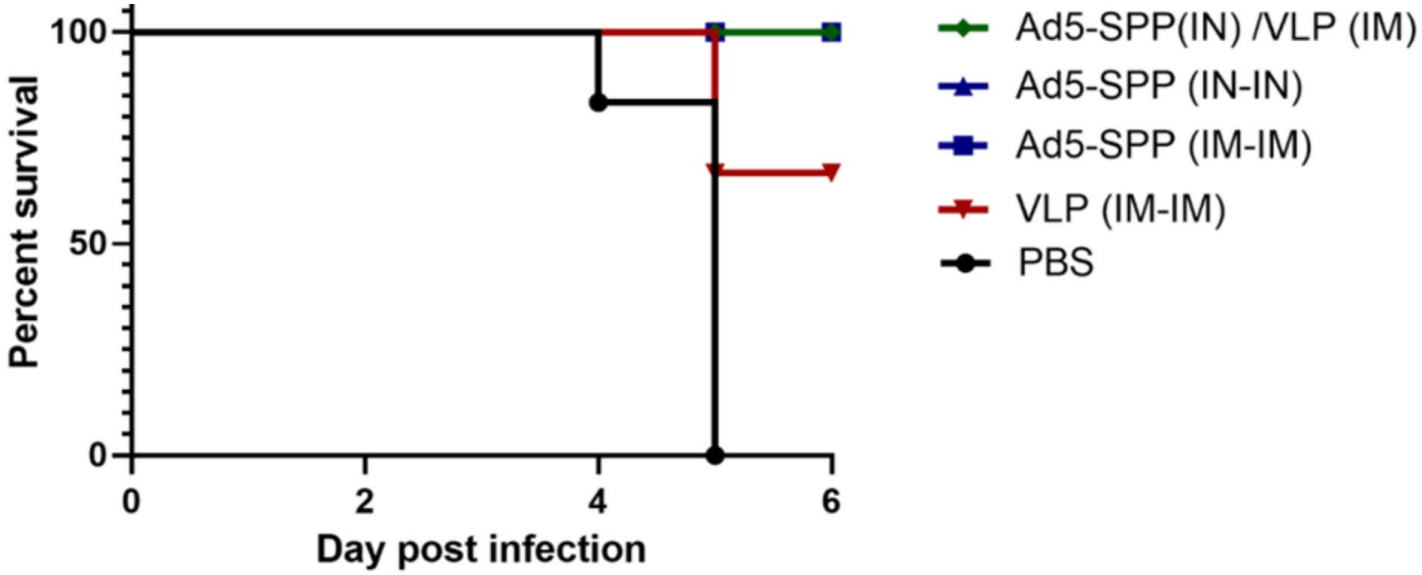
IFN-gamma
T cell response
Th1/Th2 cytokine

NASTVAC could protect K-18 mice from the SARS-CoV-2 challenge

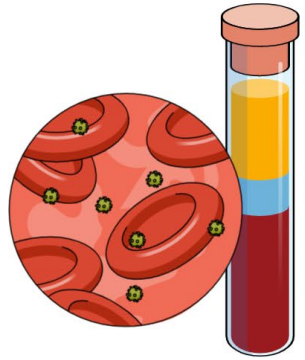


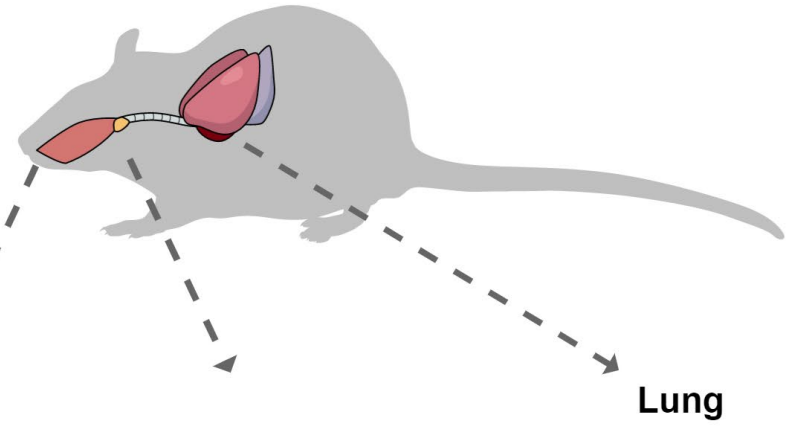
NASTVAC-vaccinated mice

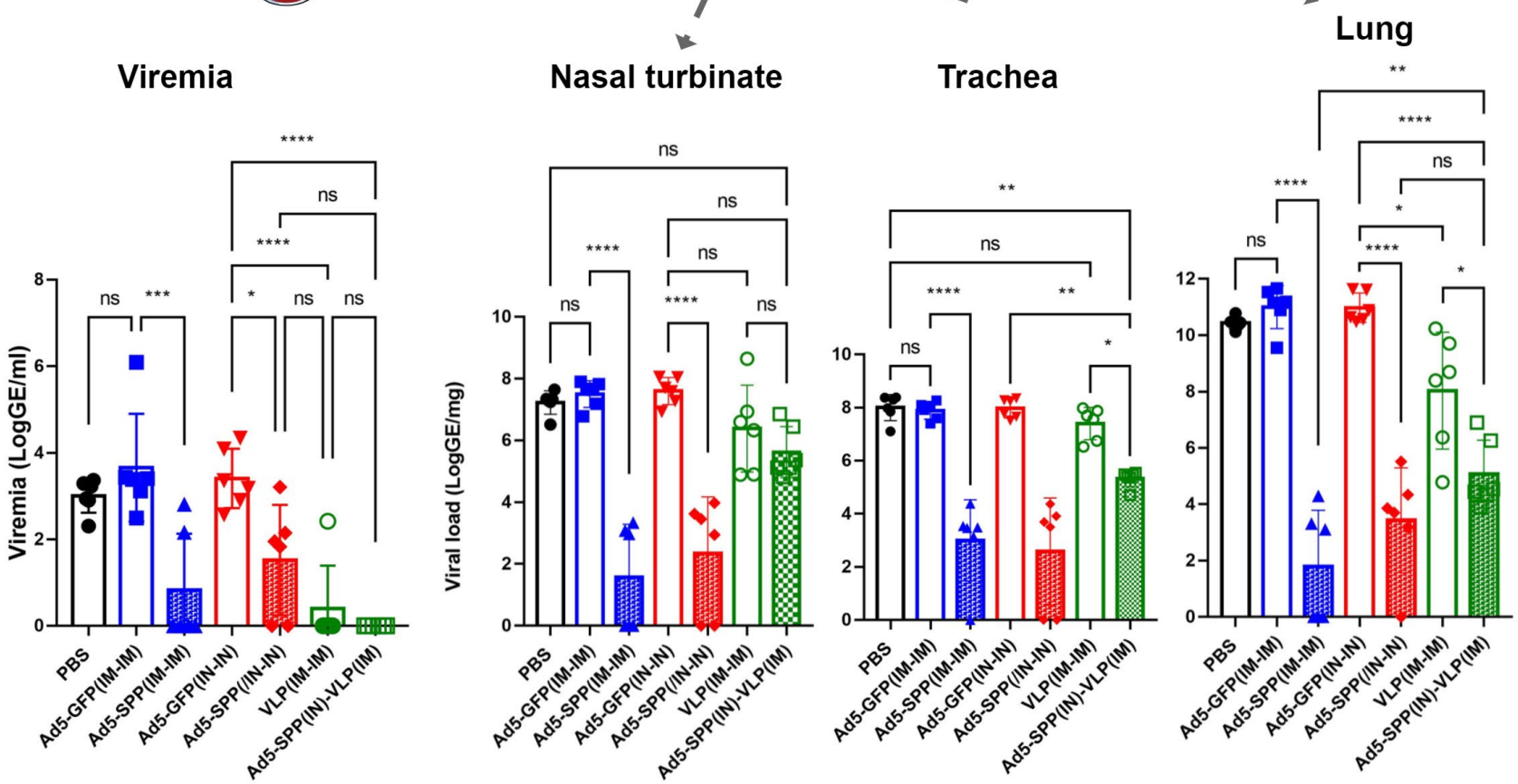




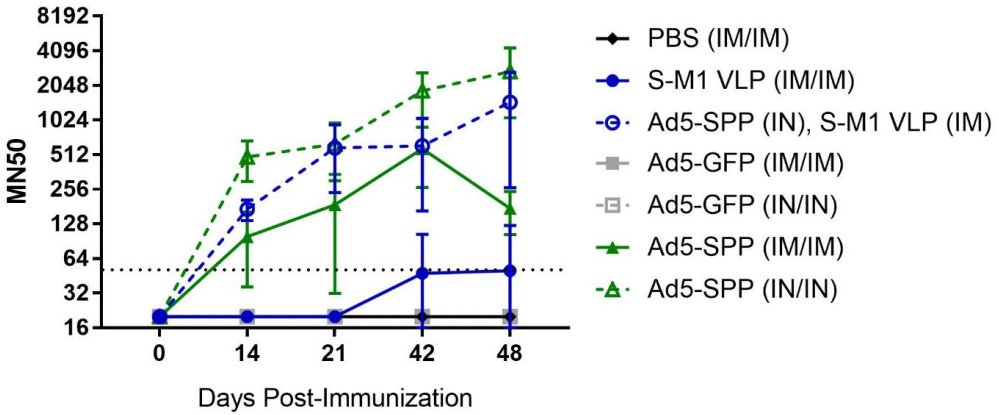
NASTVAC could substantially suppress viral load in challenged mice

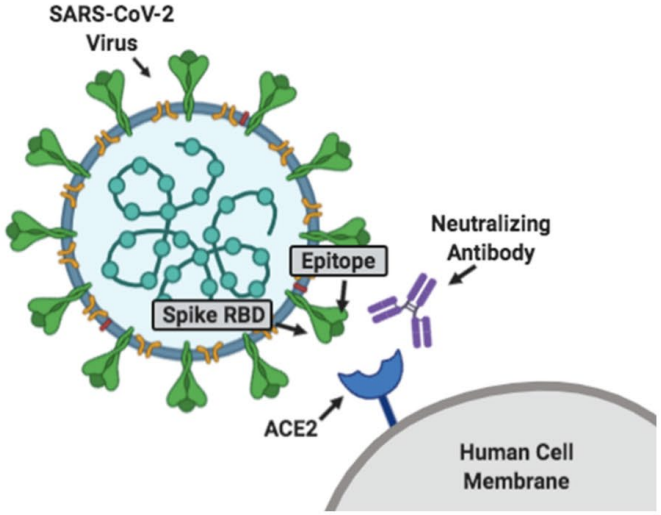


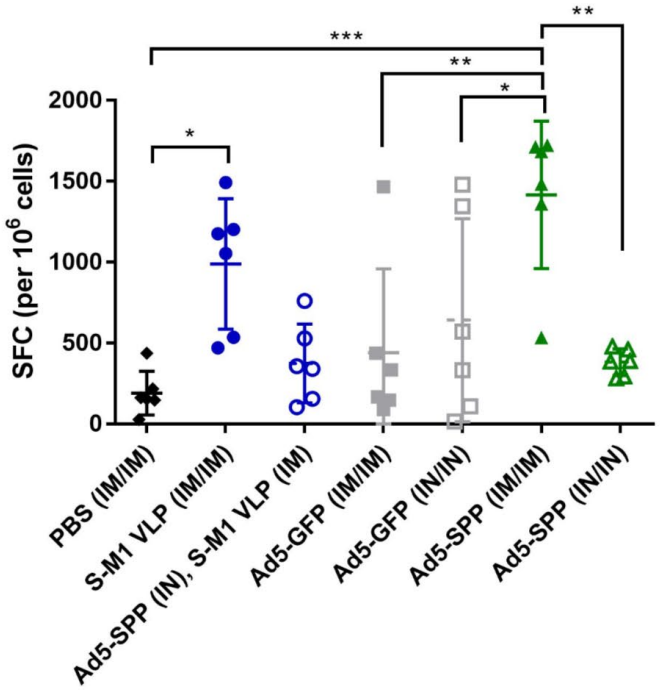


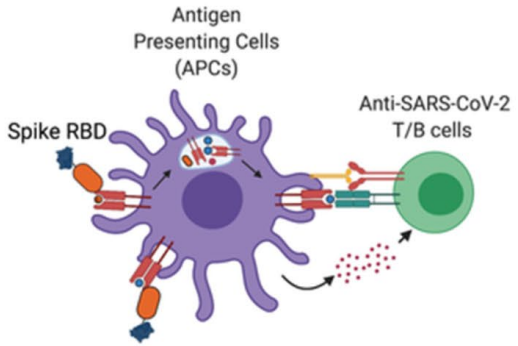


Humoral and cell-mediated immune responses in NASTVAC-vaccinated mice

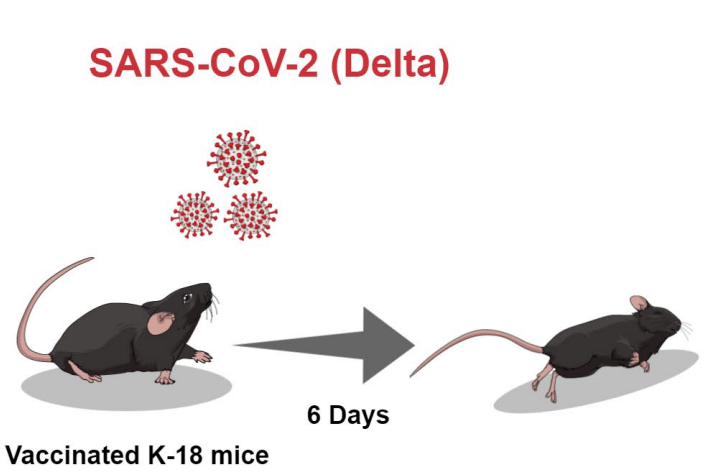


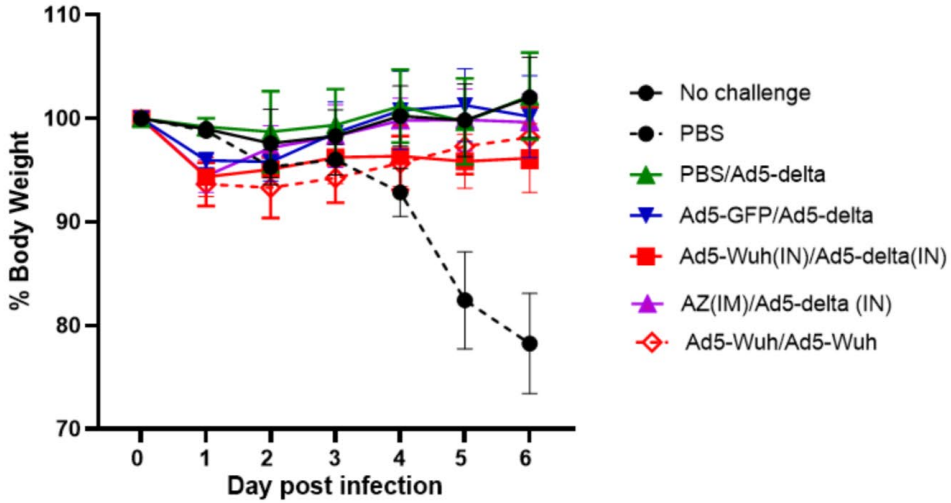


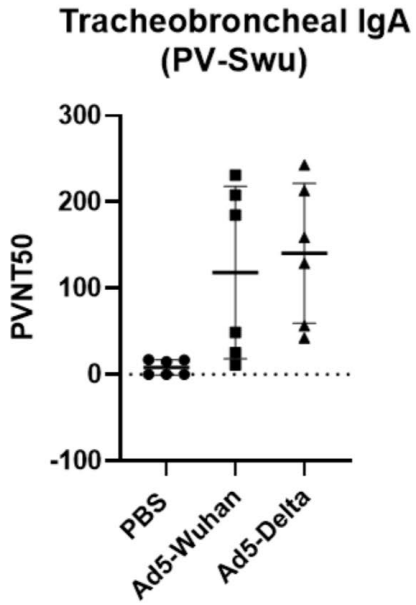


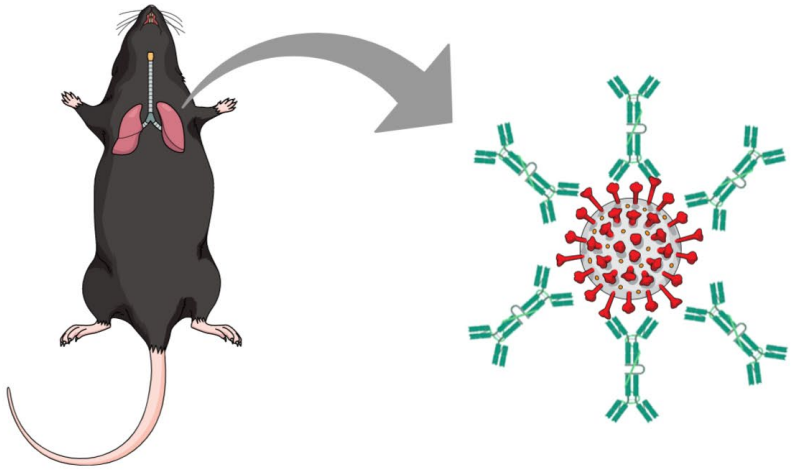


NASTVAC could protect K-18 mice from the Delta challenge



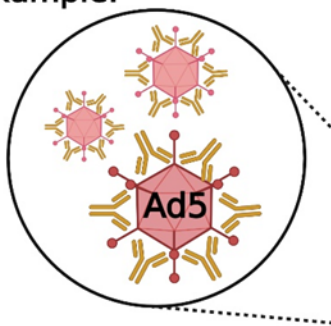


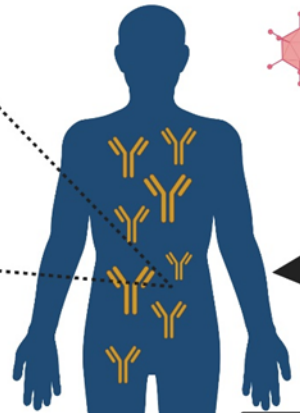


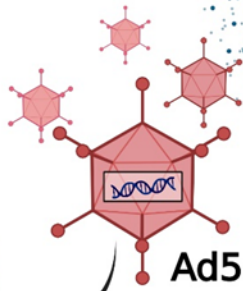


Challenges of NASTVAC

Example:





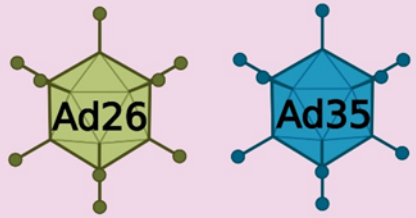


Virus vector neutralized by pre-existing vector immunity

1. Pre-existing vector immunity
- Neutralizing antibodies
- T cell immunity
- Other factors

(Disease associated immunity, infections)

Solution:

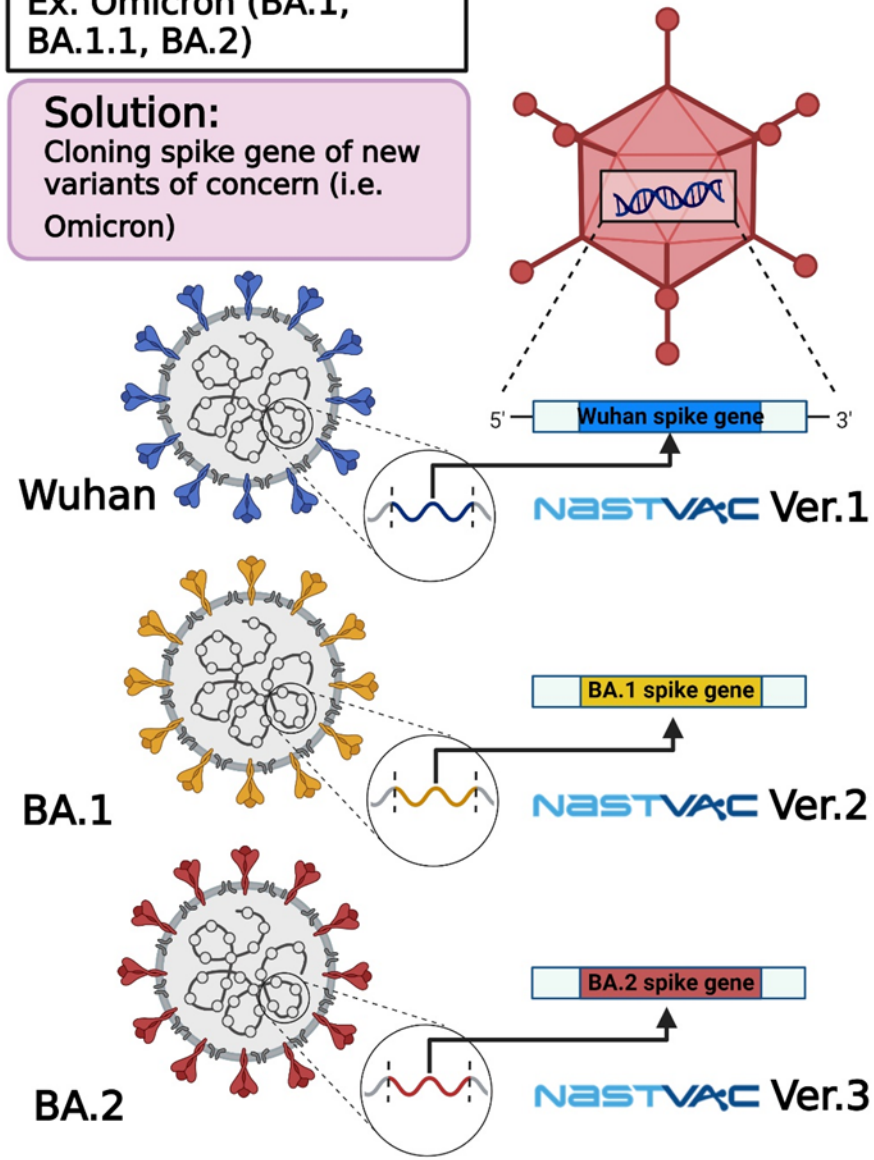


Reduced transduction of target cells

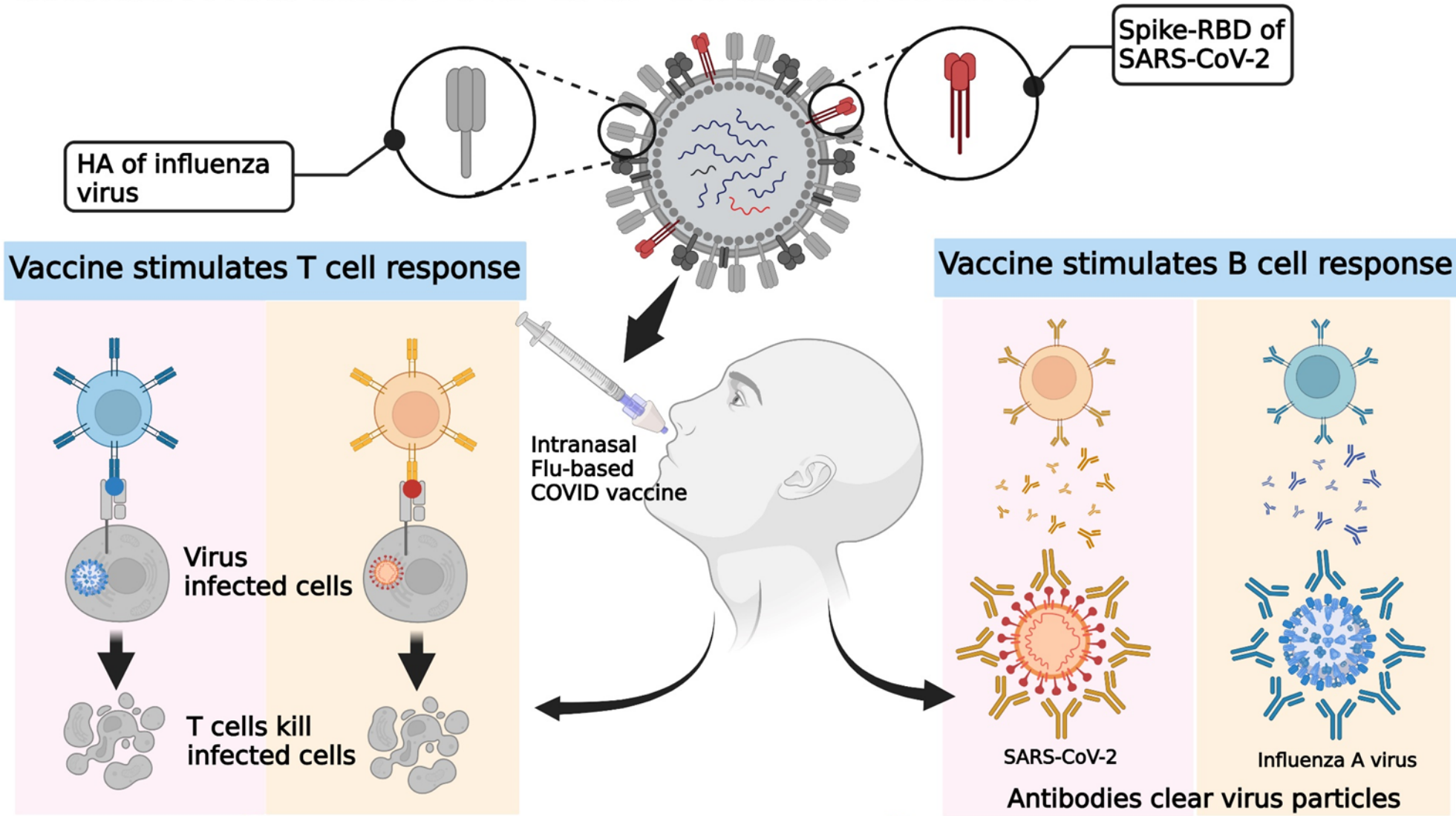
Lower levels of antigen specific immune responses

2. Emergence of new variants of concern
Ex. Omicron (BA.1, BA.1.1, BA.2)

Solution:
Cloning spike gene of new variants of concern (i.e. Omicron)



Influenza A virus-based COVID-19 as "Bivalent vaccines"

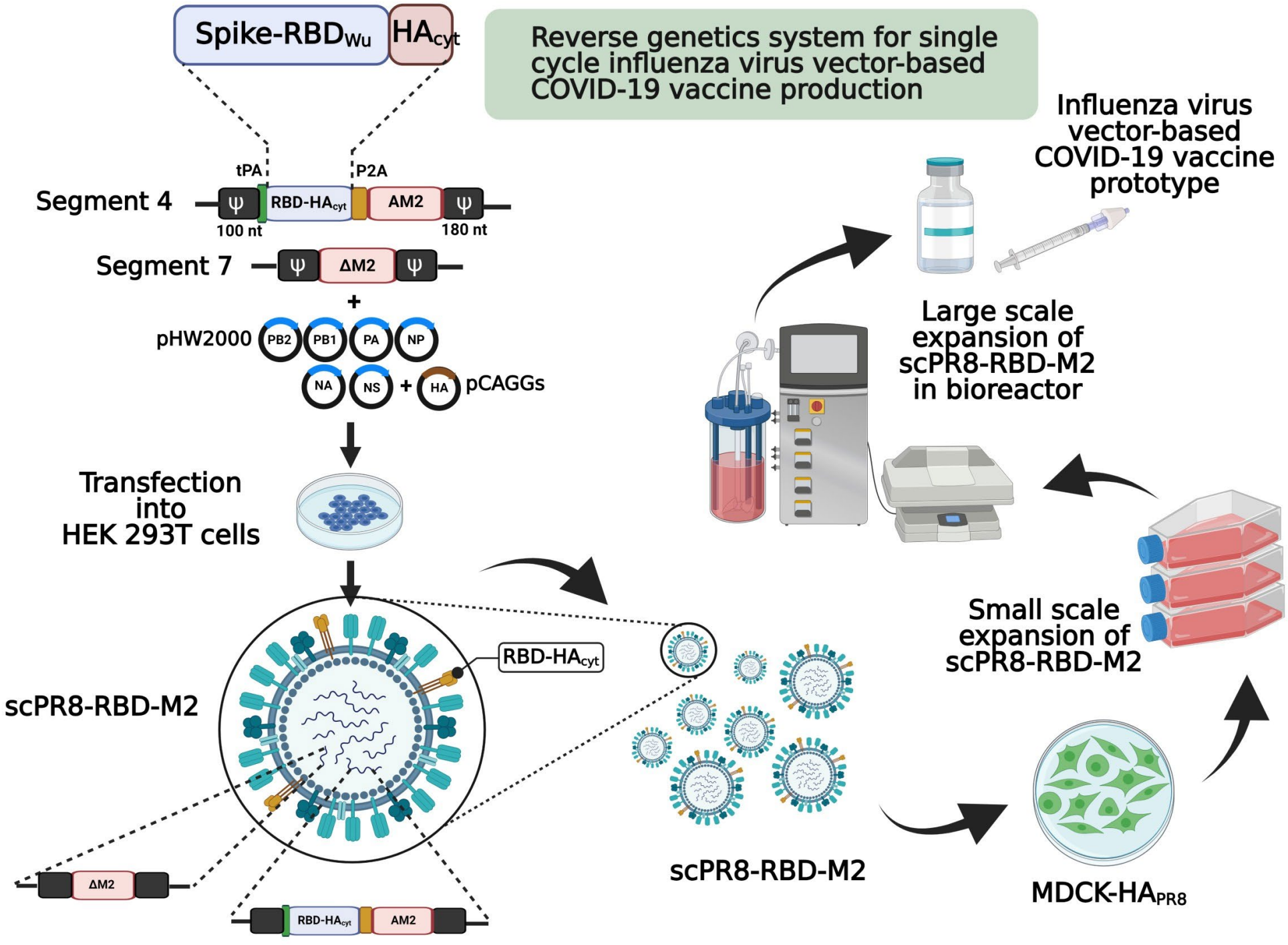


Benefits & Drawbacks

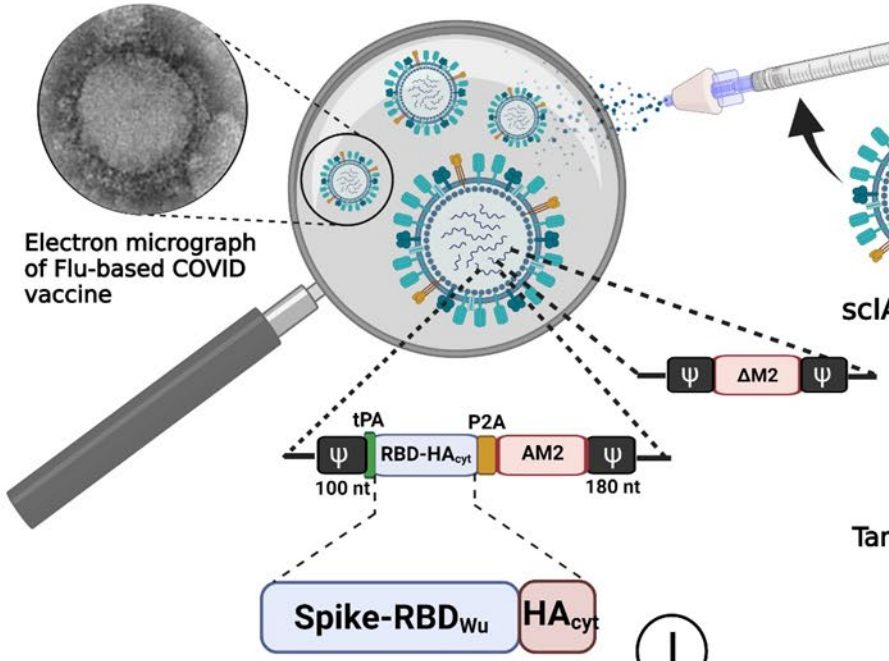
- Vaccines can be readily updated to keep up with the emergence of new variants
- Can potentially be used as "Bivalent vaccine for prevention of both COVID-19 and Flu.
- Efficient in induction of both humoral and cell-mediated immune responses

- Technology is still early in its development
- Genetic instability of inserted construct in viral vector genome

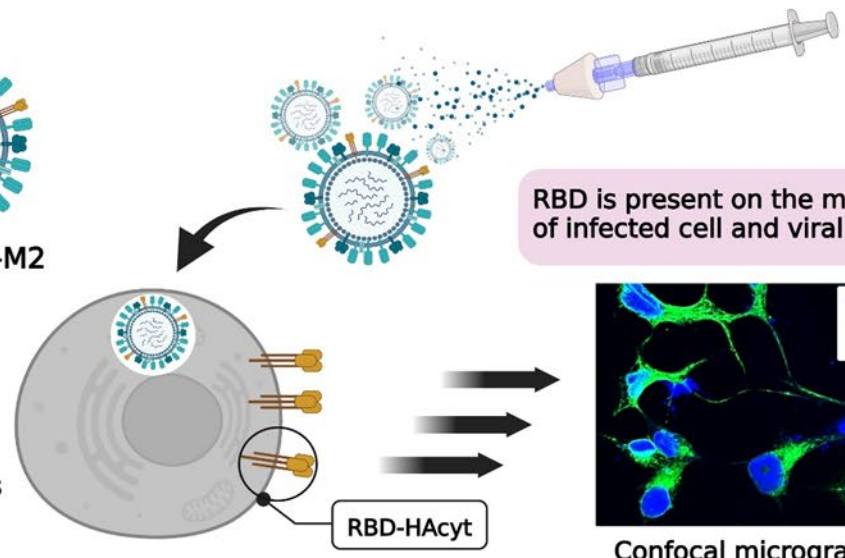
Reverse genetics system for single cycle influenza virus vector-based COVID-19 vaccine production



Influenza A virus vector-based (Flu-based) COVID vaccine design



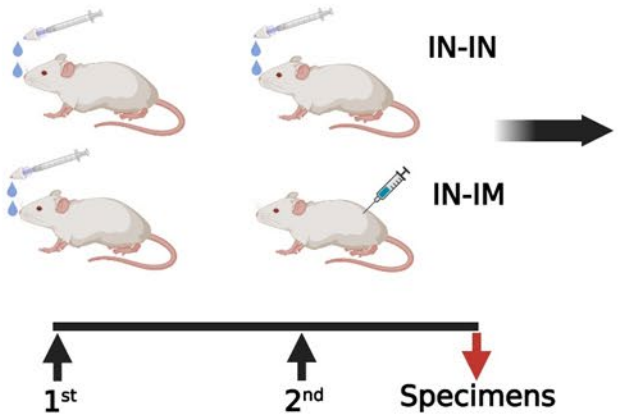
SARS-CoV-2 spike RBD is expressed in the target cells



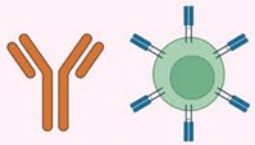
RBD is present on the membrane of infected cell and viral particle

Confocal micrograph of target cells

Immunogenicity study

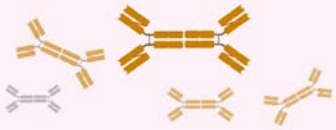


1 Immunized mice mount immune responses to both influenza virus and SARS-CoV-2

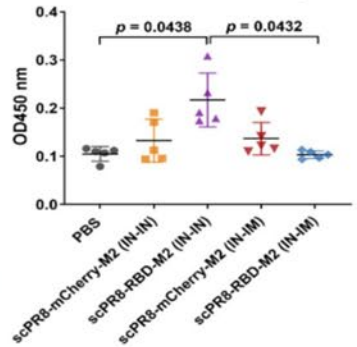


- Anti-influenza and SARS-CoV-2 antibodies
- Cell-mediated immunity to influenza and SARS-CoV-2

2 Intranasally Immunized mice mount secretory IgA against SARS-CoV-2 spike-RBD

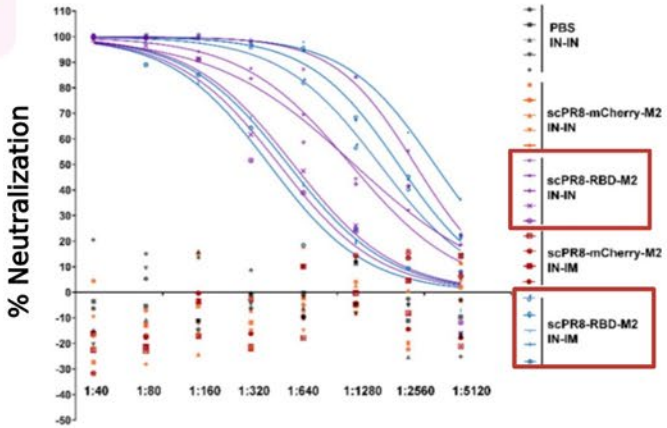


Bronchoalvelolar IgA



3 scIAV-RBD-M2 induces neutralizing antibody against SARS-CoV-2

Percentage of neutralization activity of mouse sera against Wuhan virus



nature COMMUNICATIONS

ARTICLE

https://doi.org/10.1038/s41467-021-26506-2 OPEN

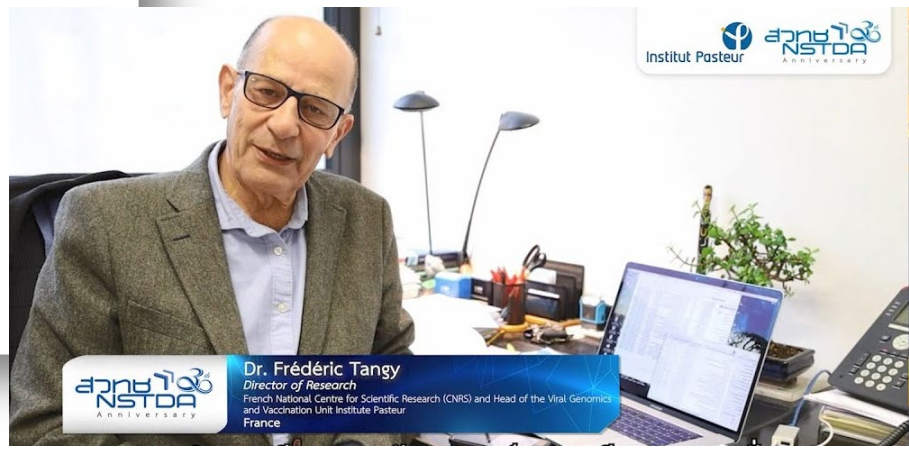
Check for updates

A live measles-vectored COVID-19 vaccine induces strong immunity and protection from SARS-CoV-2 challenge in mice and hamsters

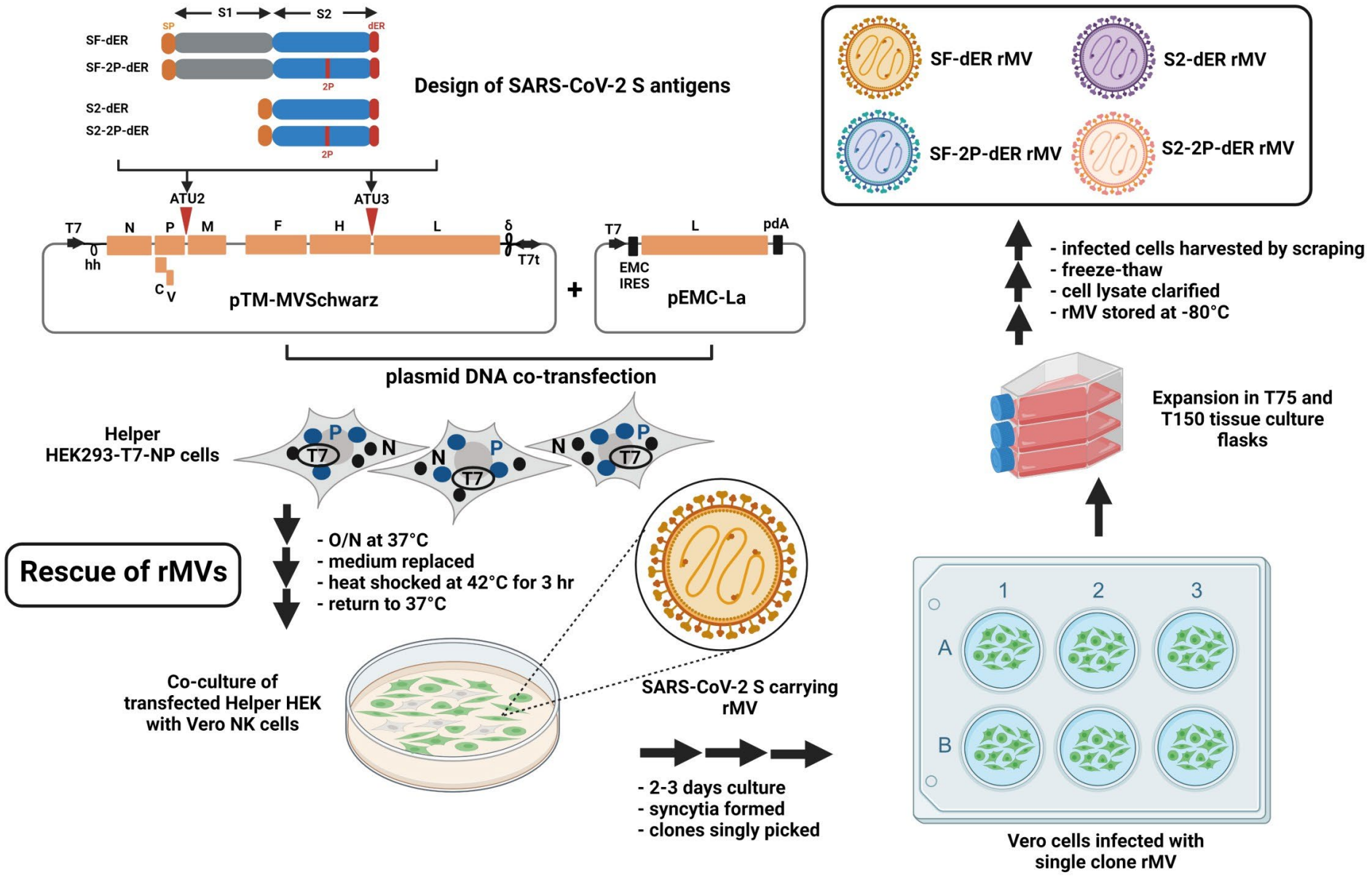
Phanramphoei N. Frantz[1,2], Aleksandr Barinov[1,3], Claude Ruffié[1], Chantal Combredet[1], Valérie Najburg[1], Guilherme Dias de Melo[4], Florence Larrous[4], Lauriane Kergoat[4], Samaporn Teeravechyan[2], Anan Jongkaewwattana[2], Emmanuelle Billon-Denis[5], Jean-Nicolas Tournier[5], Matthieu Prot[6], Laurine Levillayer[6], Laurine Conquet[7], Xavier Montagutelli[7], Magali Tichit[8], David Hardy[8], Priyanka Fernandes[9], Hélène Strick-Marchand[9], James Di Santo[9], Etienne Simon-Lorière[6], Hervé Bourhy[4] & Frédéric Tangy[1]✉

BIOTEC a member of NSTDA

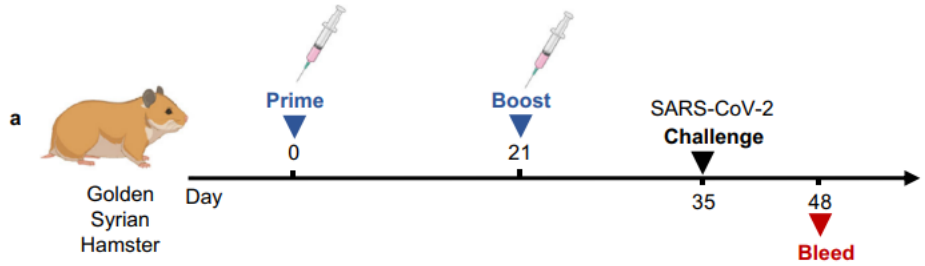
Institut Pasteur

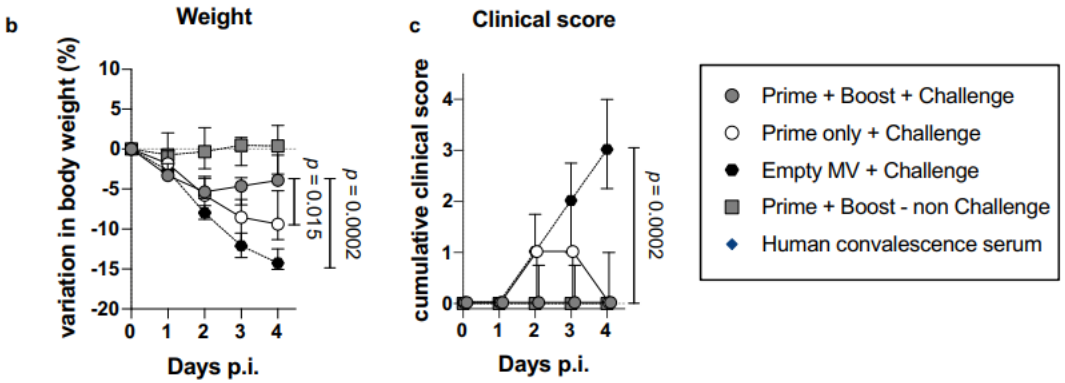


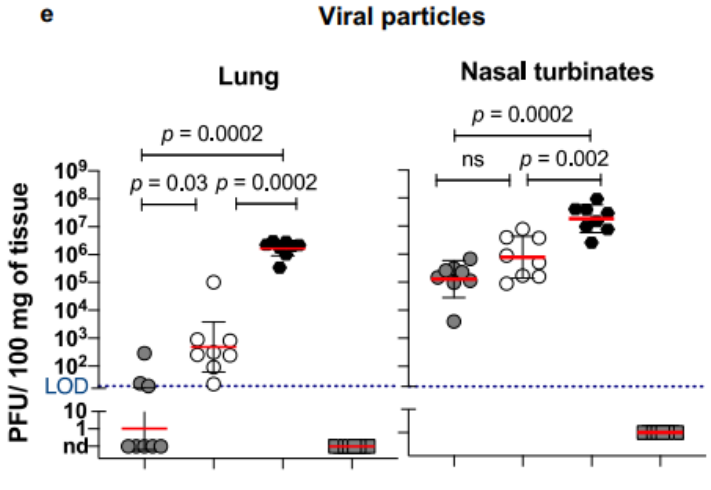
Measles virus vector-based COVID-19 vaccines

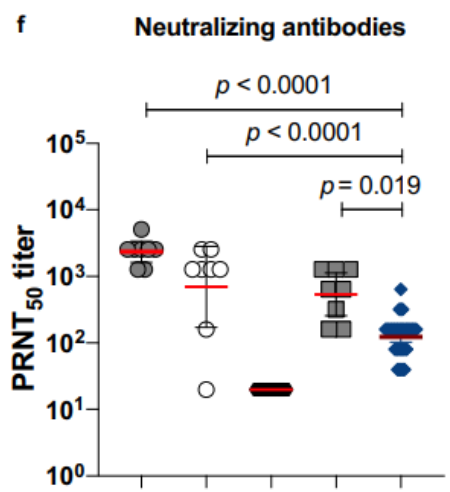


Measles virus -vectored COVID-19 could protect hamsters from SARS-CoV-2 challenge









Collaboration with Huazhong Agricultural University on Reverse Genetics of Coronaviruses and Flaviviruses

BIOTEC a member of NSTDA

HUAZHONG AGRICULTURAL UNIVERSITY 1898

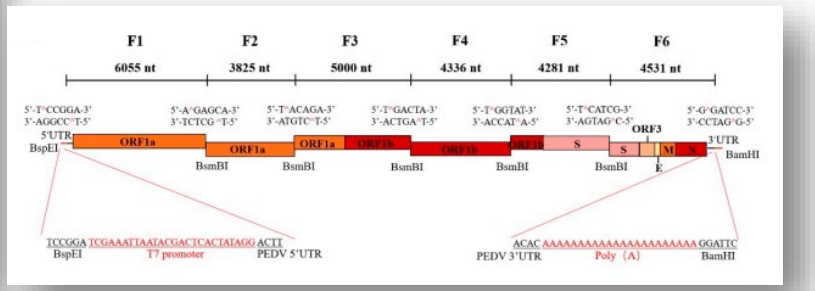
PEDV

viruses — MDPI

Article

Construction of a Recombinant Porcine Epidemic Diarrhea Virus Encoding Nanoluciferase for High-Throughput Screening of Natural Antiviral Products

Wan Li [1,2], Mengjia Zhang [1,2], Huijun Zheng [1,2], Peng Zhou [1,2], Zheng Liu [3], Anan Jongkaewwattana [4], Rui Luo [1,2,*] and Qigai He [1,2]



PDCoV

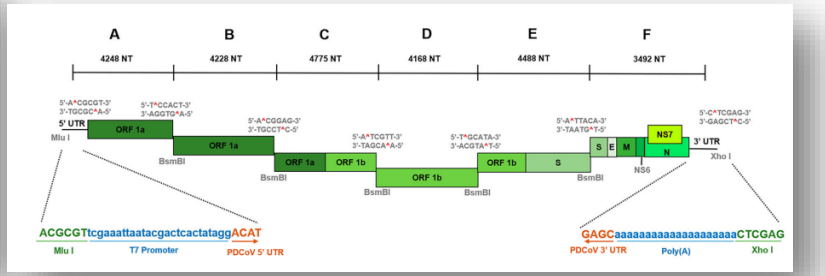
Emerging Microbes & Infections
2020, VOL. 9
https://doi.org/10.1080/22221751.2019.1701391

EMi — Taylor & Francis Taylor & Francis Group

OPEN ACCESS Check for updates

Genetic manipulation of porcine deltacoronavirus reveals insights into NS6 and NS7 functions: a novel strategy for vaccine design

Mengjia Zhang[a,b], Wan Li[a,b], Peng Zhou[a,b], Dejian Liu[a,b], Rui Luo[a,b], Anan Jongkaewwattana[c] and Qigai He[a,b]



Duck Tembusu virus

VIRULENCE
2021, VOL. 12, NO. 1, 2400–2414
https://doi.org/10.1080/21505594.2021.1974329

Taylor & Francis Taylor & Francis Group

RESEARCH PAPER

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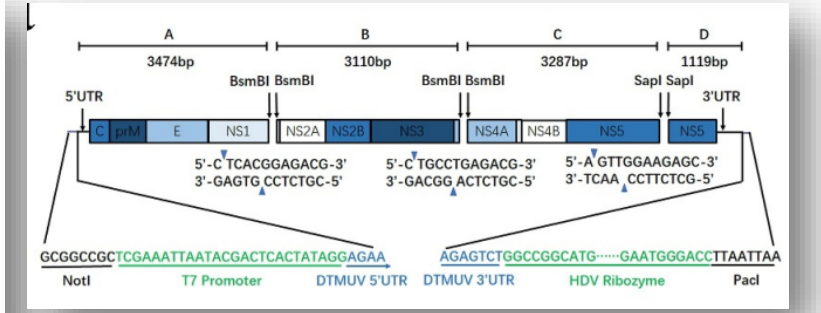
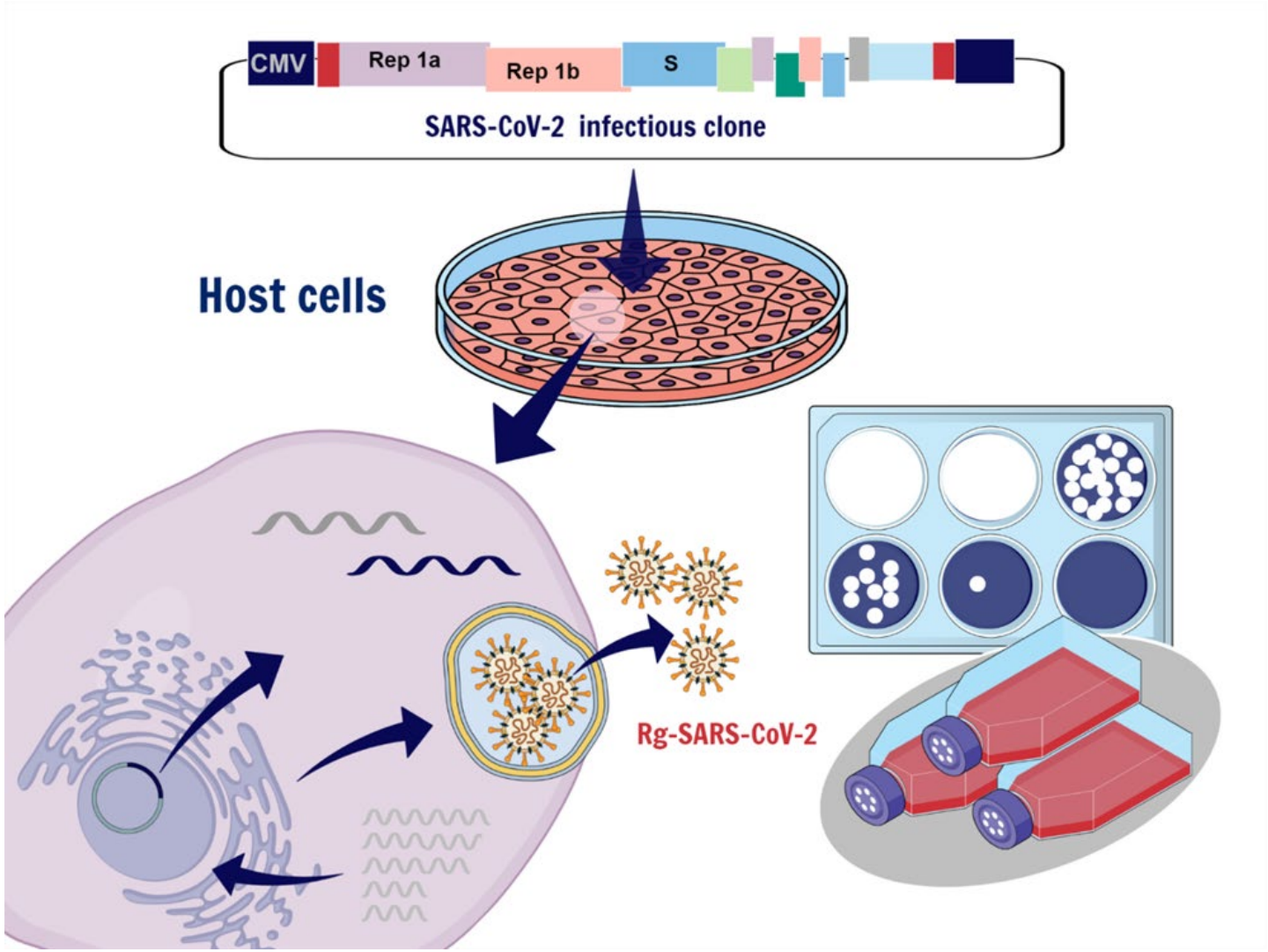
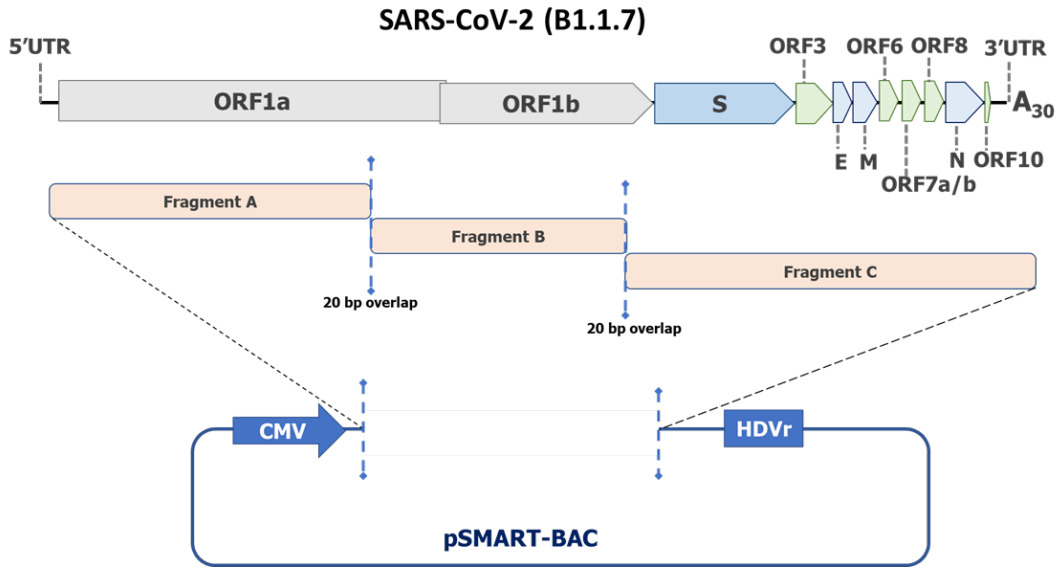
Glycosylation on envelope glycoprotein of duck Tembusu virus affects virus replication *in vitro* and contributes to the neurovirulence and pathogenicity *in vivo*

Dejian Liu[a,b], Xuyao Xiao[a,b], Peng Zhou[a,b], Huijun Zheng[a,b], Yaqian Li[a,b], Hui Jin[a,b], Anan Jongkaewwattana[c], and Rui Luo[a,b]

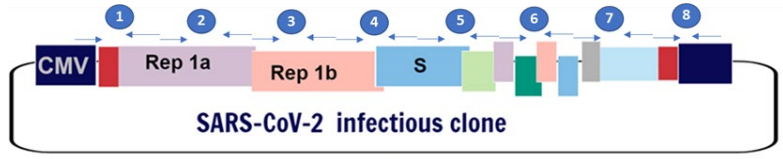


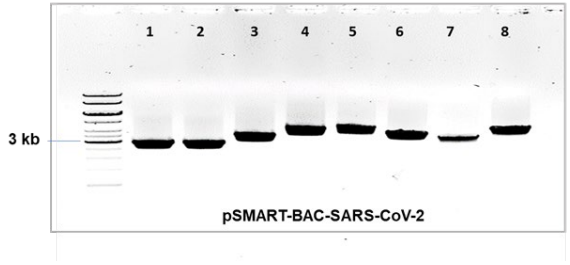
Development of the Reverse Genetics System of SARS-CoV-2



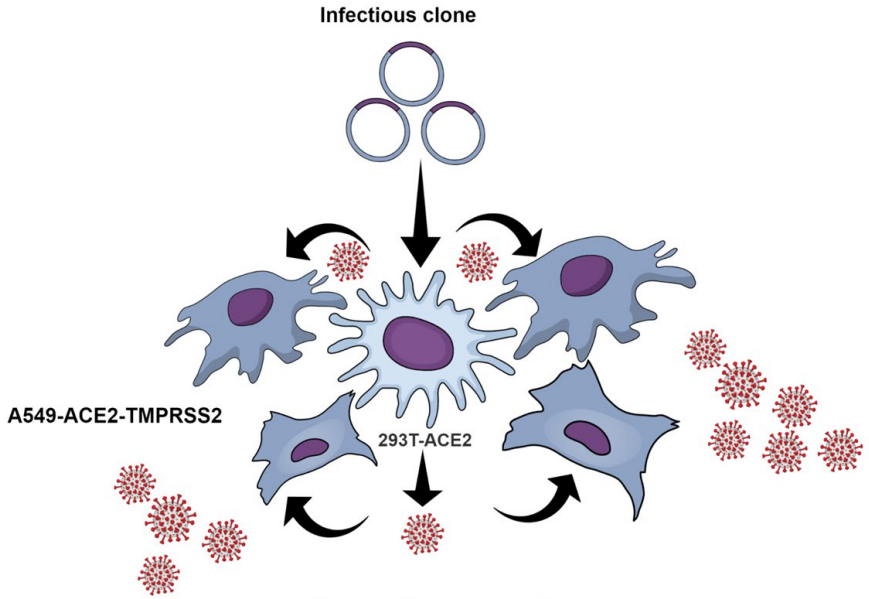


Verification of the infectious clone

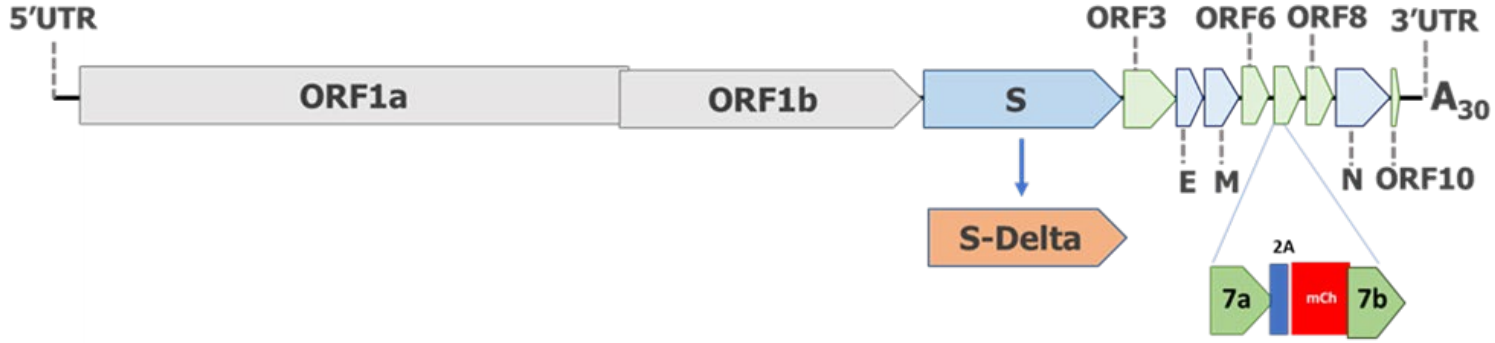




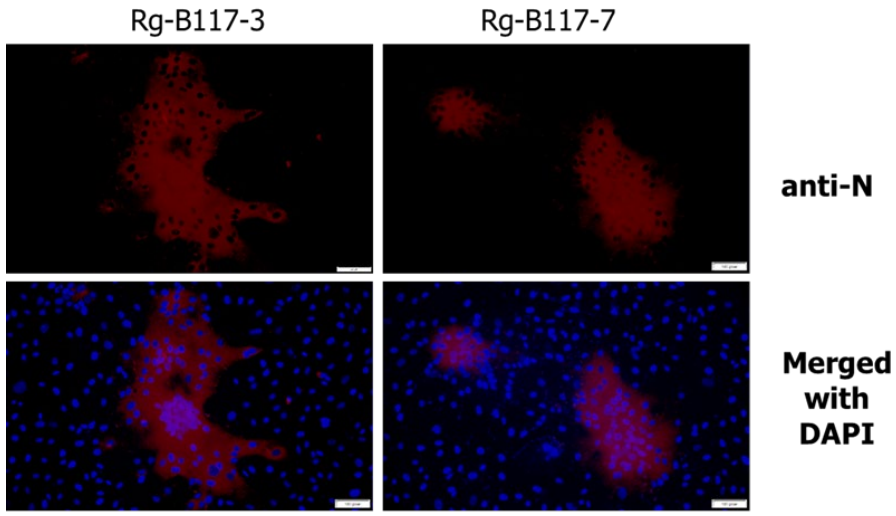
Genetic manipulation of the SARS-CoV-2 genome



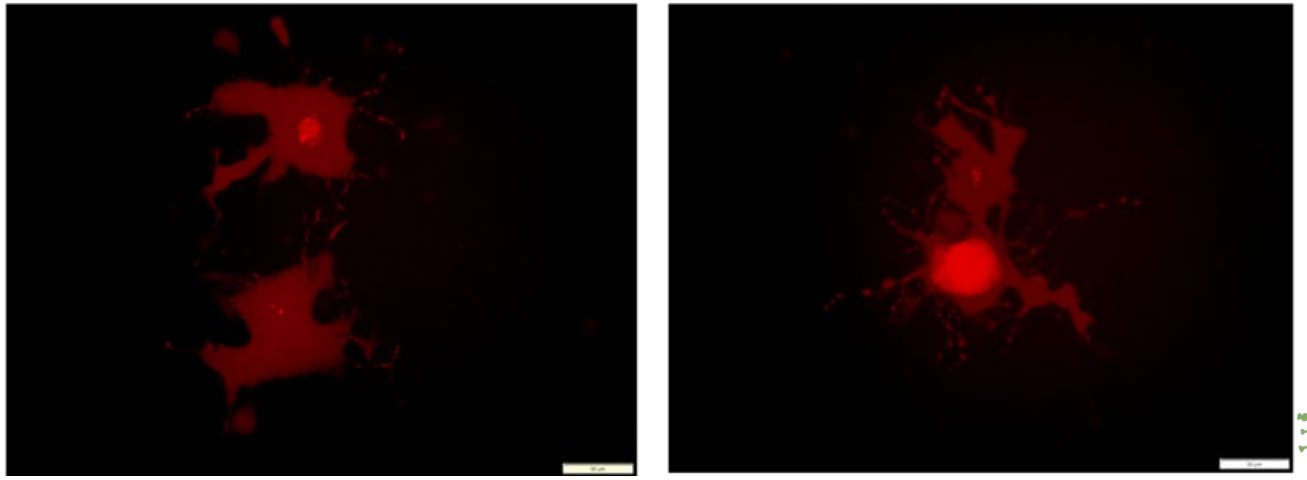
Co-culture system



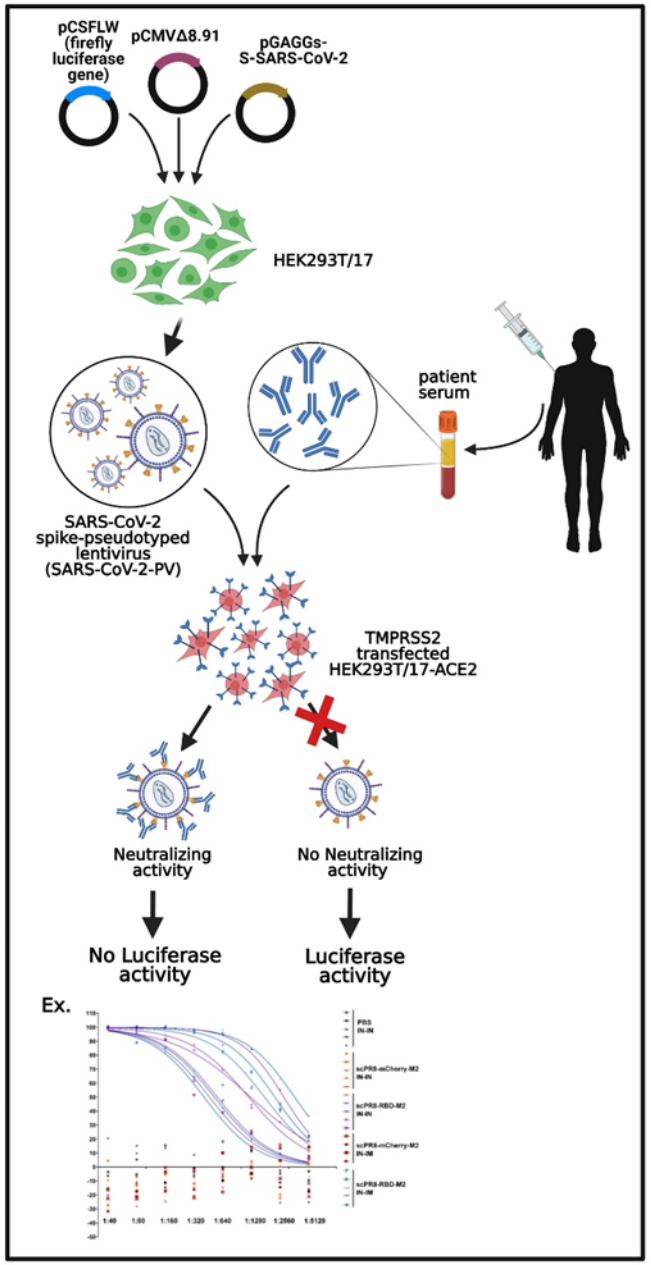
A549-ACE2-TMPRSS2

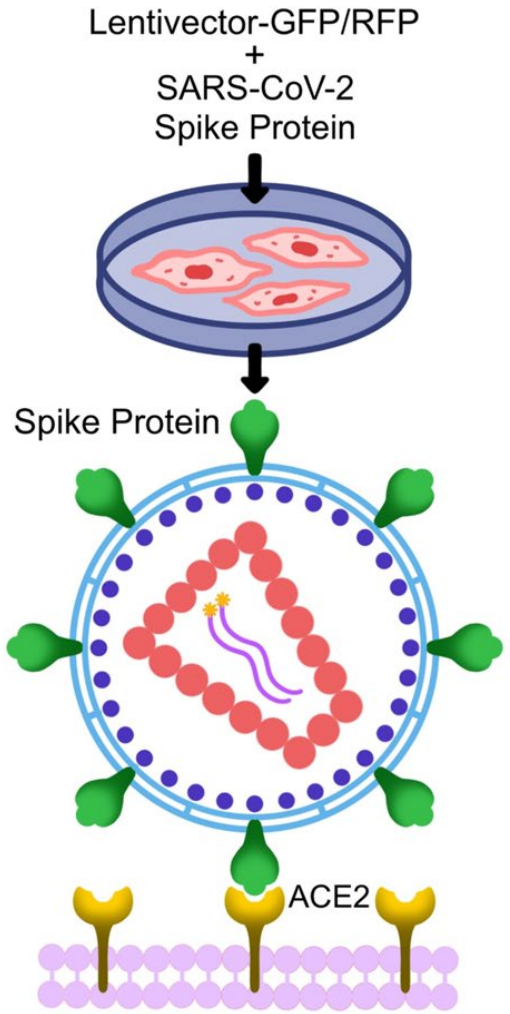


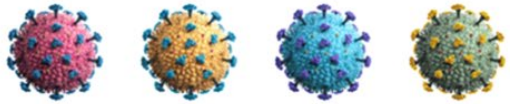
Rg-S_{Delta}-mCherry



SARS-CoV-2 spike-pseudotyped lentivirus production for vaccine efficacy assessment







- Wuhan
- Alpha
- Beta
- Gamma
- Delta
- Delta-Plus
- Kappa
- Lambda
- Mu
- C2.1
- Omicron (BA.1, BA1.1, BA.2)
- Bat CoV
- Pangolin CoV

Acknowledgment

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สำนักงานพัฒนาวิทยาศาสตร์และเทคโนโลยีแห่งชาติ สวทช.

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