Immune response to SARS CoV2 and vaccines
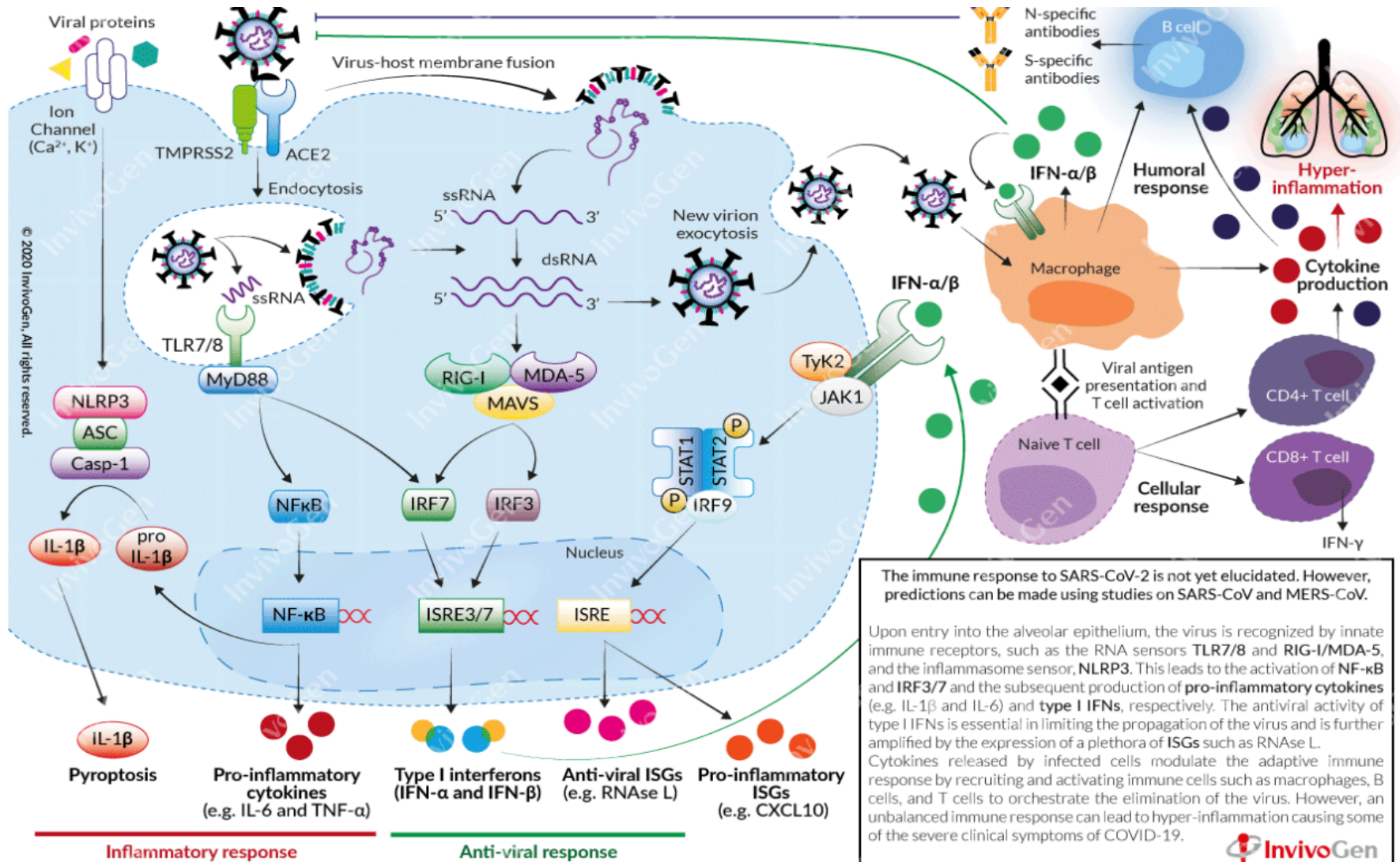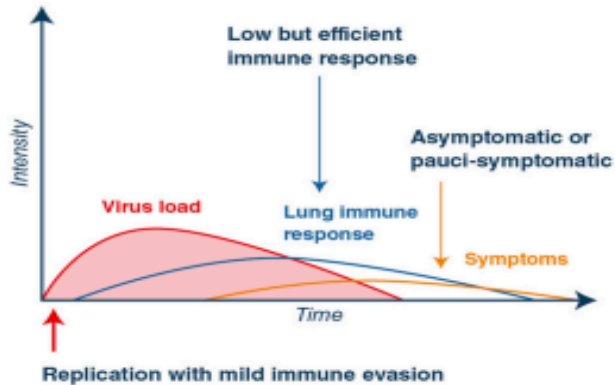
Immune response to SARS CoV2
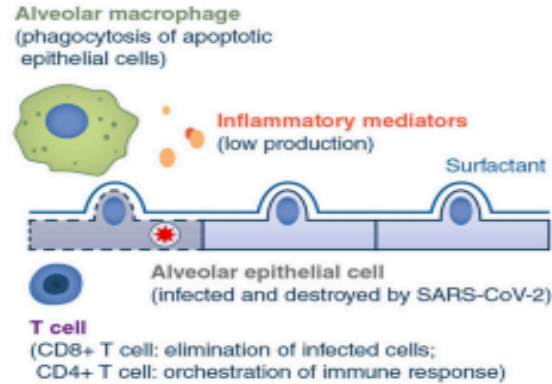
COVID-19 disease

No disease/mild disease

Lung chronology of events	Host/SARS-CoV-2 interaction in lungs	Immunosuppressive therapy

Lung chronology of events

Low but efficient immune response

Asymptomatic or pauci-symptomatic

Virus load

Lung immune response

Symptoms

Intensity

Time

Replication with mild immune evasion

Host/SARS-CoV-2 interaction in lungs

Alveolar macrophage (phagocytosis of apoptotic epithelial cells)

Inflammatory mediators (low production)

Surfactant

Alveolar epithelial cell (infected and destroyed by SARS-CoV-2)

T cell
(CD8+ T cell: elimination of infected cells; CD4+ T cell: orchestration of immune response)
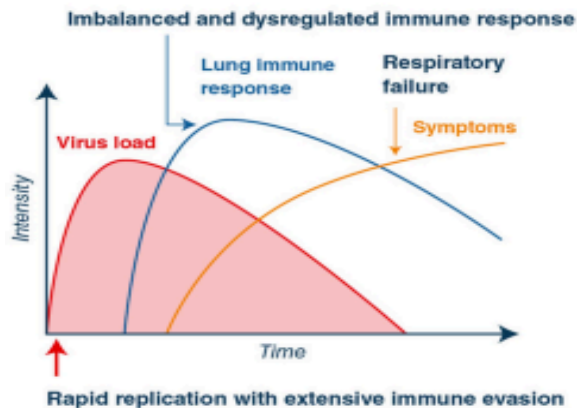
Immunosuppressive therapy

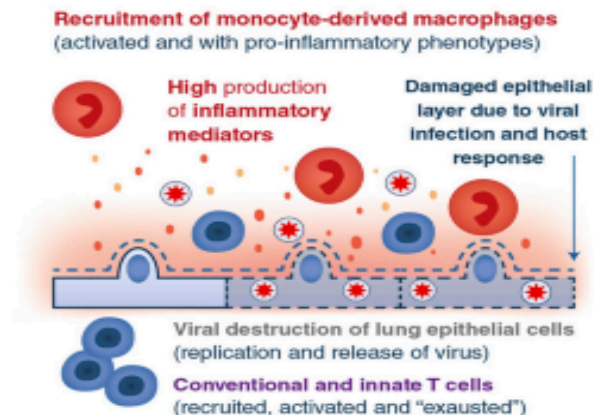may prevent the worsening of the symptoms

and/or

may facilitate viral replicator

Critically ill COVID-19 patients

Lung chronology of events	Host/SARS-CoV-2 interaction in lungs	Immunosuppressive therapy

Lung chronology of events

Imbalanced and dysregulated immune response

Lung immune response

Respiratory failure

Symptoms

Virus load

Intensity

Time

Rapid replication with extensive immune evasion

Host/SARS-CoV-2 interaction in lungs

Recruitment of monocyte-derived macrophages (activated and with pro-inflammatory phenotypes)

High production of inflammatory mediators

Damaged epithelial layer due to viral infection and host response

Viral destruction of lung epithelial cells (replication and release of virus)

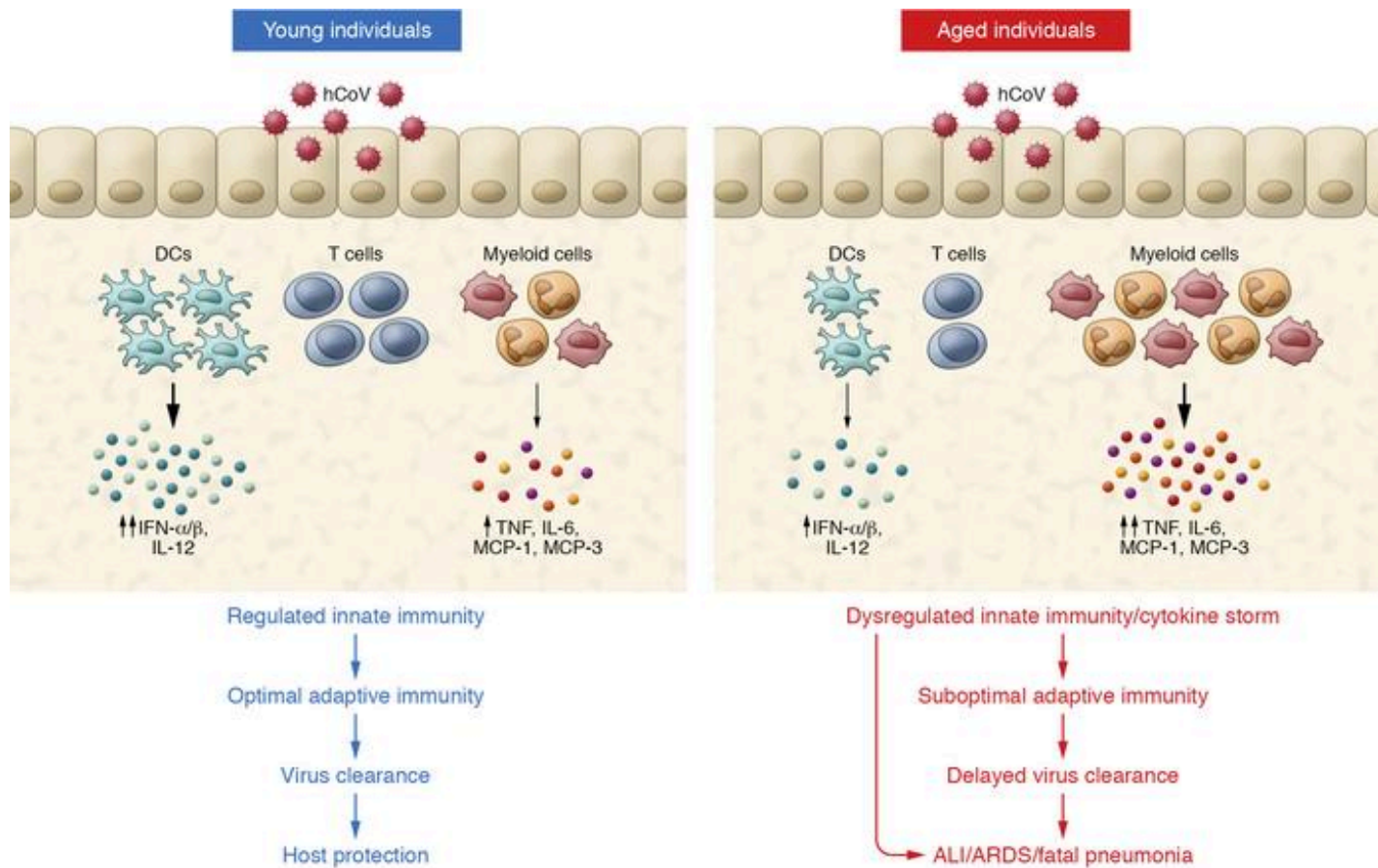Conventional and innate T cells (recruited, activated and "exausted")

Immunosuppressive therapy

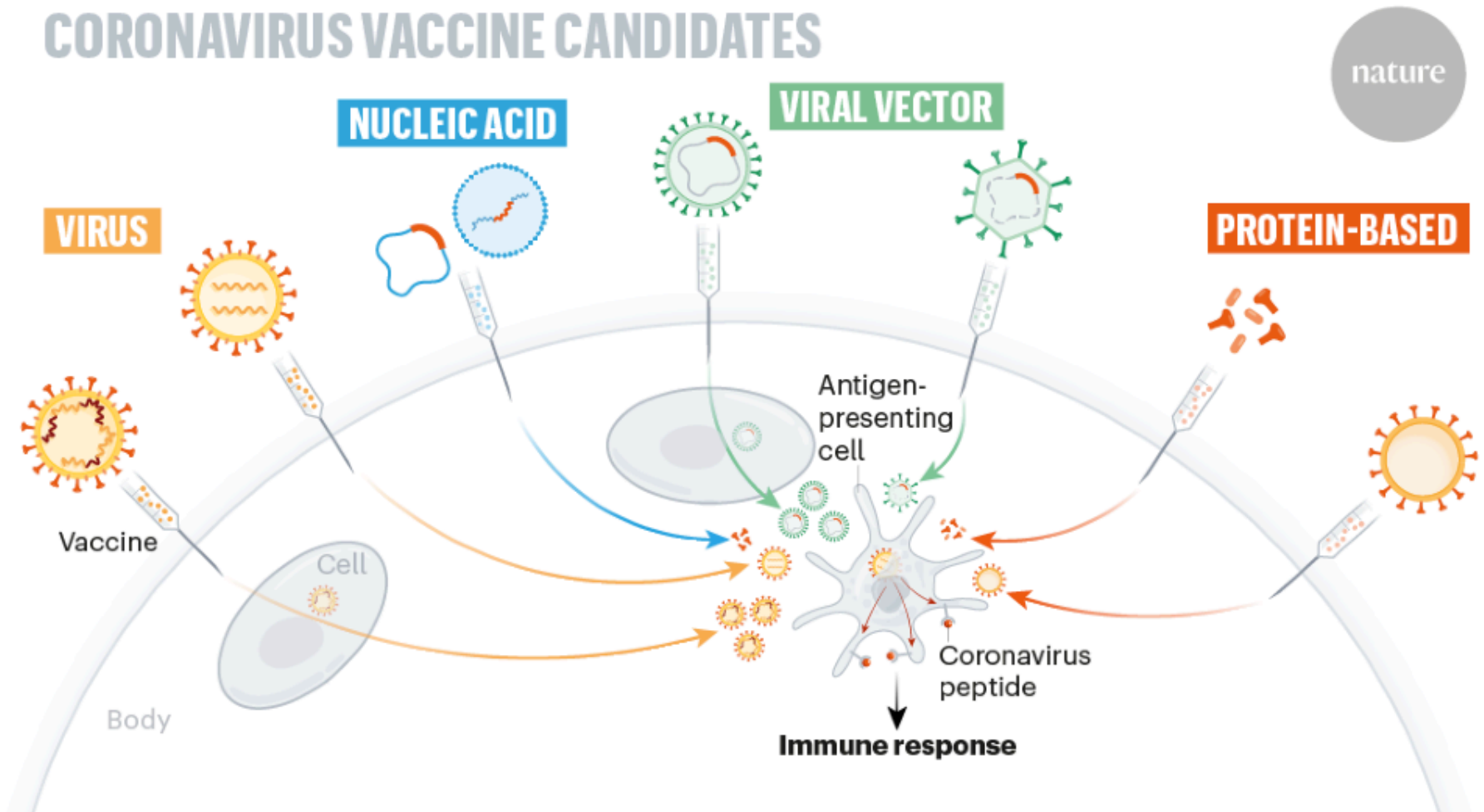may improve the severity of the symptoms and the outcome

and/or

may facilitate viral replication with epithelial injury

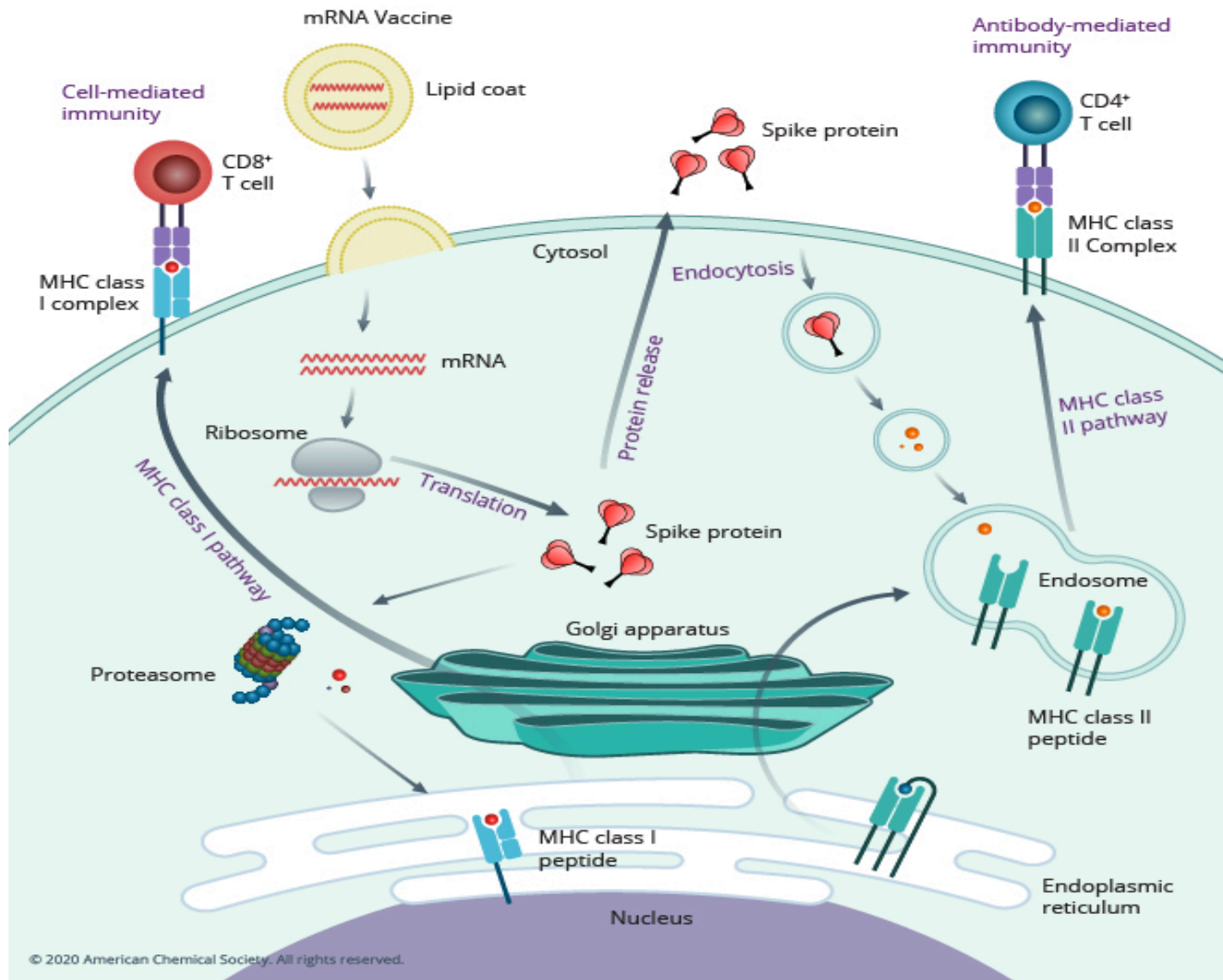# Why COVID-19 is more severe in older individuals?

SARS CoV2 vaccine strategies

mRNA vaccines: Pfizer, Moderna
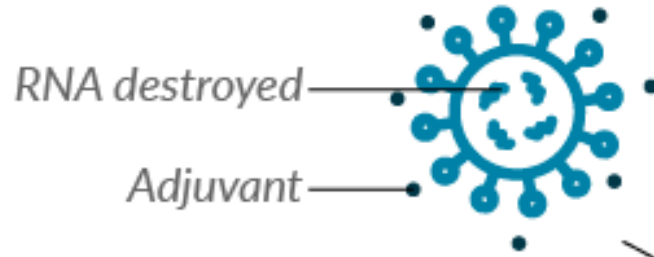
Inactivated virus vaccines
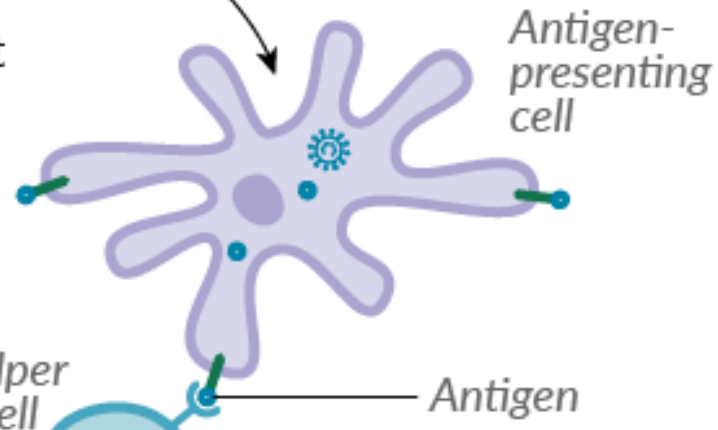
Wuhan laboratories-Sinovac

RNA destroyed

Adjuvant

In inactivated virus vaccines, the genetic material of the virus has been **destroyed**.

The inactivated virus cannot replicate inside the body, so higher doses are needed, typically alongside an **adjuvant** to strengthen the immune response.
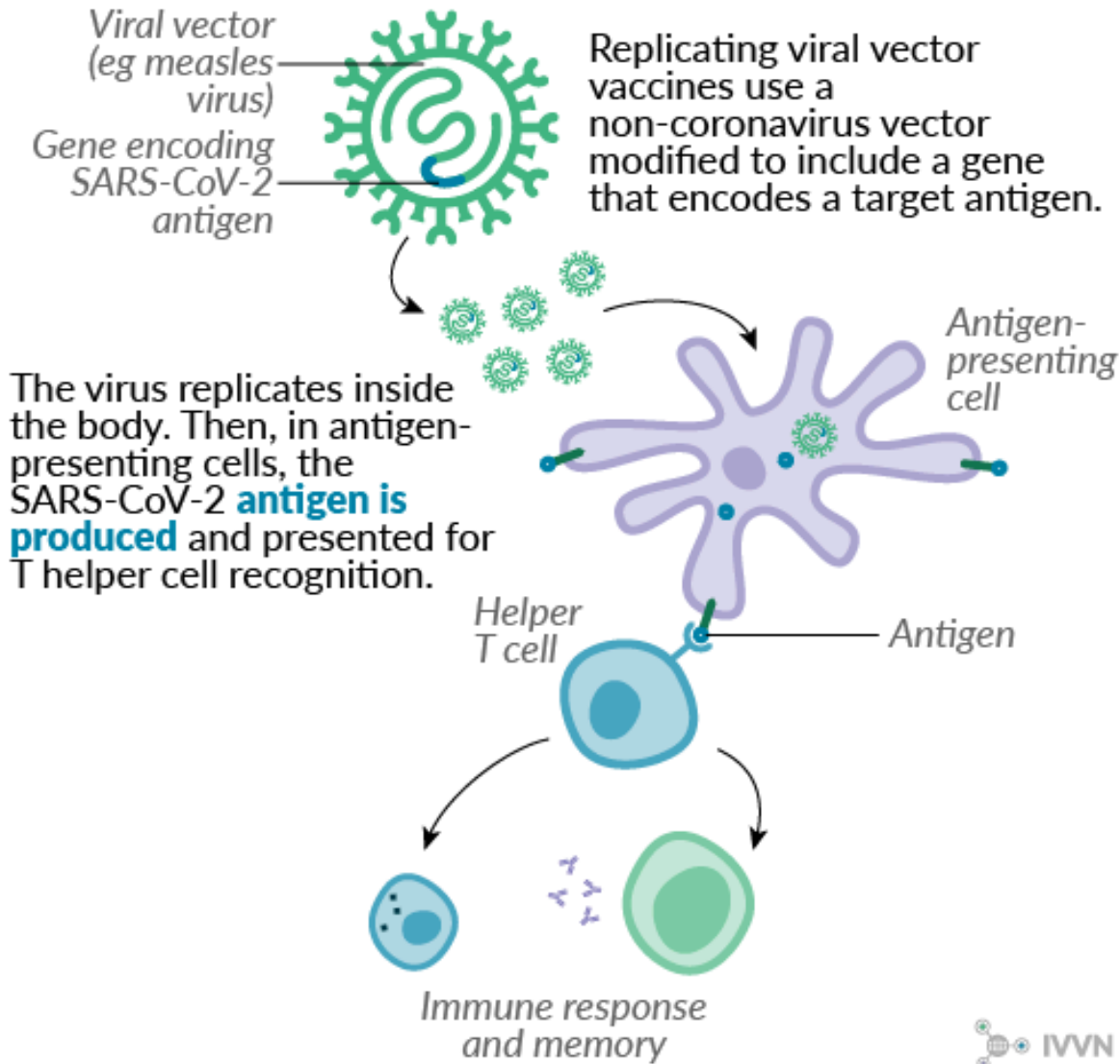
Antigen-presenting cell

Helper T cell

Antigen

Inactivated virus vaccines generally only induce **antibody-mediated immunity** (not cell-mediated).

Antibody-mediated immune response and memory

IVVN

Viral vector vaccines (replicating)

Viral vector (eg measles virus)

Gene encoding SARS-CoV-2 antigen

Replicating viral vector vaccines use a non-coronavirus vector modified to include a gene that encodes a target antigen.

Antigen-presenting cell

The virus replicates inside the body. Then, in antigen-presenting cells, the SARS-CoV-2 **antigen is produced** and presented for T helper cell recognition.

Helper T cell

Antigen

Immune response and memory

IVVN

Oxford vaccine- Astra Zeneca, Johnson&Jonhson

Gamaleya Center- Sputnik vaccine

Viral vector vaccines (non-replicating)

Viral vector (eg adenovirus)

Gene encoding SARS-CoV-2 antigen

Non-replicating viral vector vaccines work in a similar way to replicating vectors ...

... except that they **cannot replicate** inside the body and so require higher doses to be effective.

Antigen-presenting cell

Helper T cell

Immune response and memory
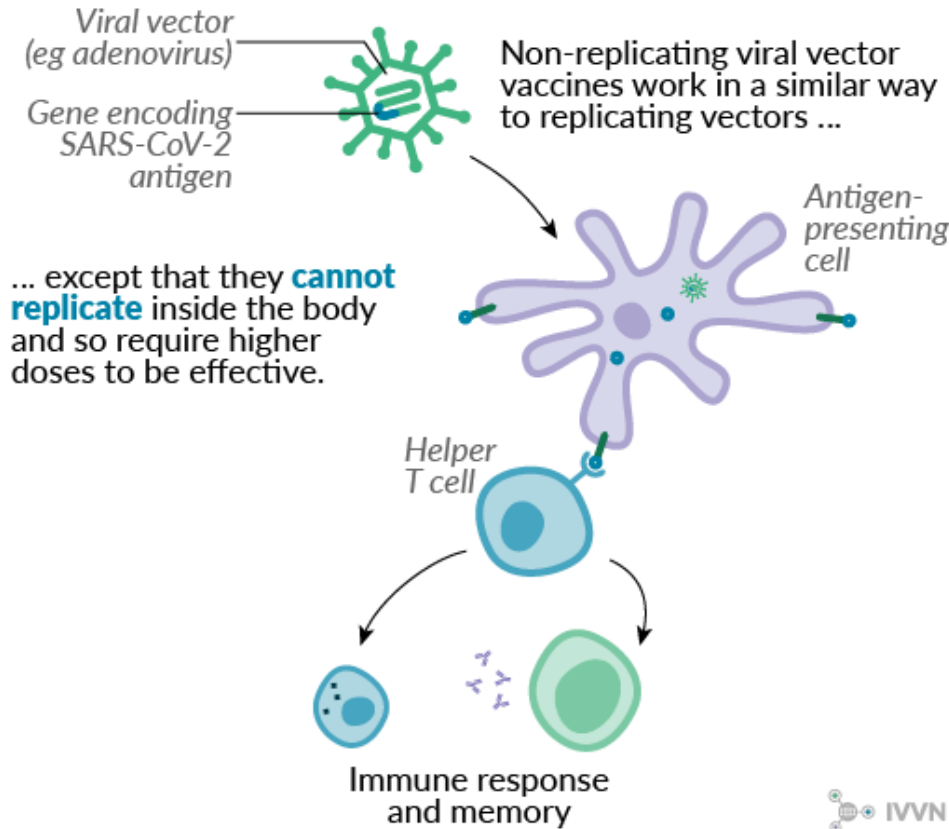
First vaccination

Vector with a gene coding S protein of coronavirus gets into a cell

CELL

AD26

GENE CODING S PROTEIN

ANTIBODIES
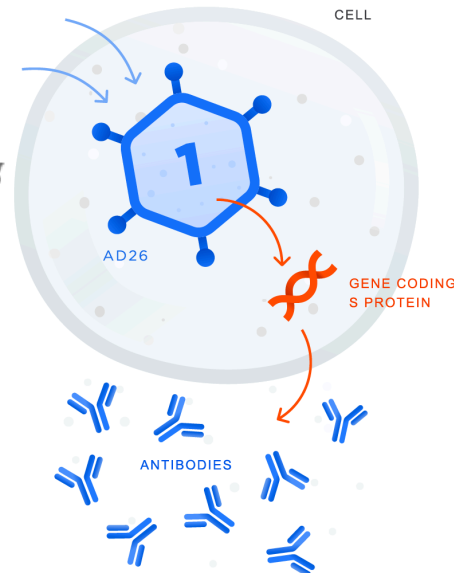
The body synthesizes S protein, in response, the production of immunity begins

Second vaccination

Repeated vaccination takes place in 21 days

CELL

AD5

GENE CODING S PROTEIN

ANTIBODIES
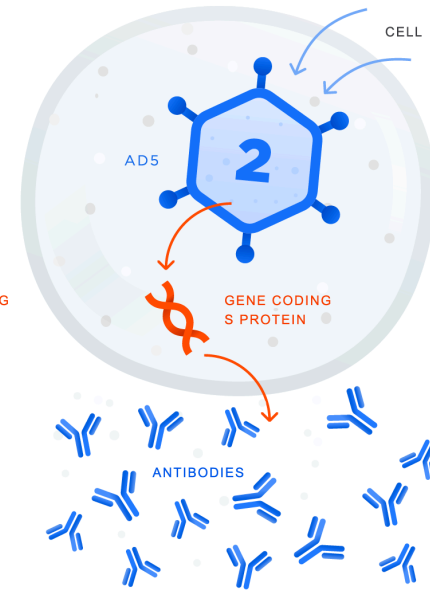
The vaccine based on another adenovirus vector unknown to the body boosts the immune response and provides for long-lasting immunity

IVVN

Subunit vaccines

SARS-CoV-2 antigen
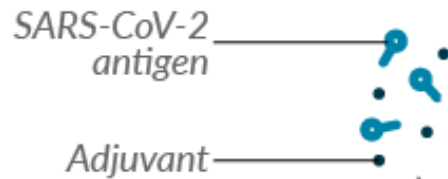
Adjuvant

Subunit vaccines use the antigen of the virus without any genetic material, usually with an **adjuvant** to give a better immune response.

Antigen-presenting cell

With the help of antigen-presenting cells, the antigens are recognised by T helper cells as with a real viral infection.

Helper T cell

Antigen

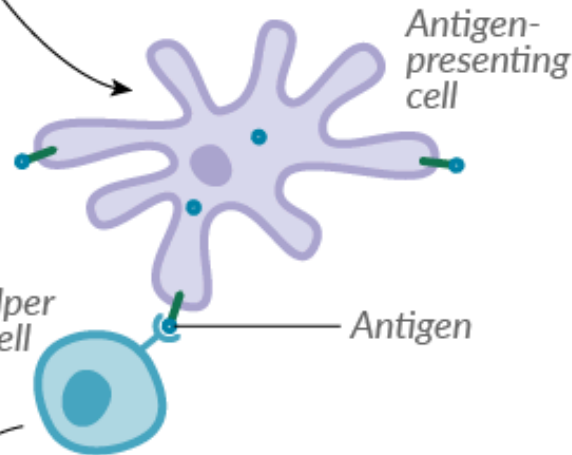Subunit vaccines generally only induce **antibody-mediated immunity** (not cell-mediated).

Antibody-mediated immune response and memory

IVVN
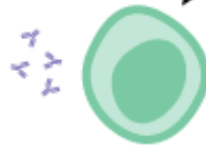
Virus-like particle vaccines

SARS-CoV-2 protein shell (no RNA)

Virus-like particles (VLPs) mimic real viruses, but contain no genetic material.

Antigen-presenting cell

When the VLP is engulfed by antigen-presenting cells, the antigens are presented for recognition.

Helper T cell

Antigen

Immune response and memory

IVVN

DNA vaccines

DNA plasmid

Gene encoding
SARS-CoV-2
antigen

DNA vaccines are bacterial-derived **DNA plasmids** that have been modified to include a gene that encodes a viral antigen.

Cell

Nucleus

mRNA

Once inside cells, the DNA is transcribed and translated to **produce the antigen**.

Antigen

Antigen-presenting cell

The antigen is recognised by the immune system in the same way as if it had entered the body as part of a virus.

Helper
T cell

Antigen

Immune response
and memory

IVVN