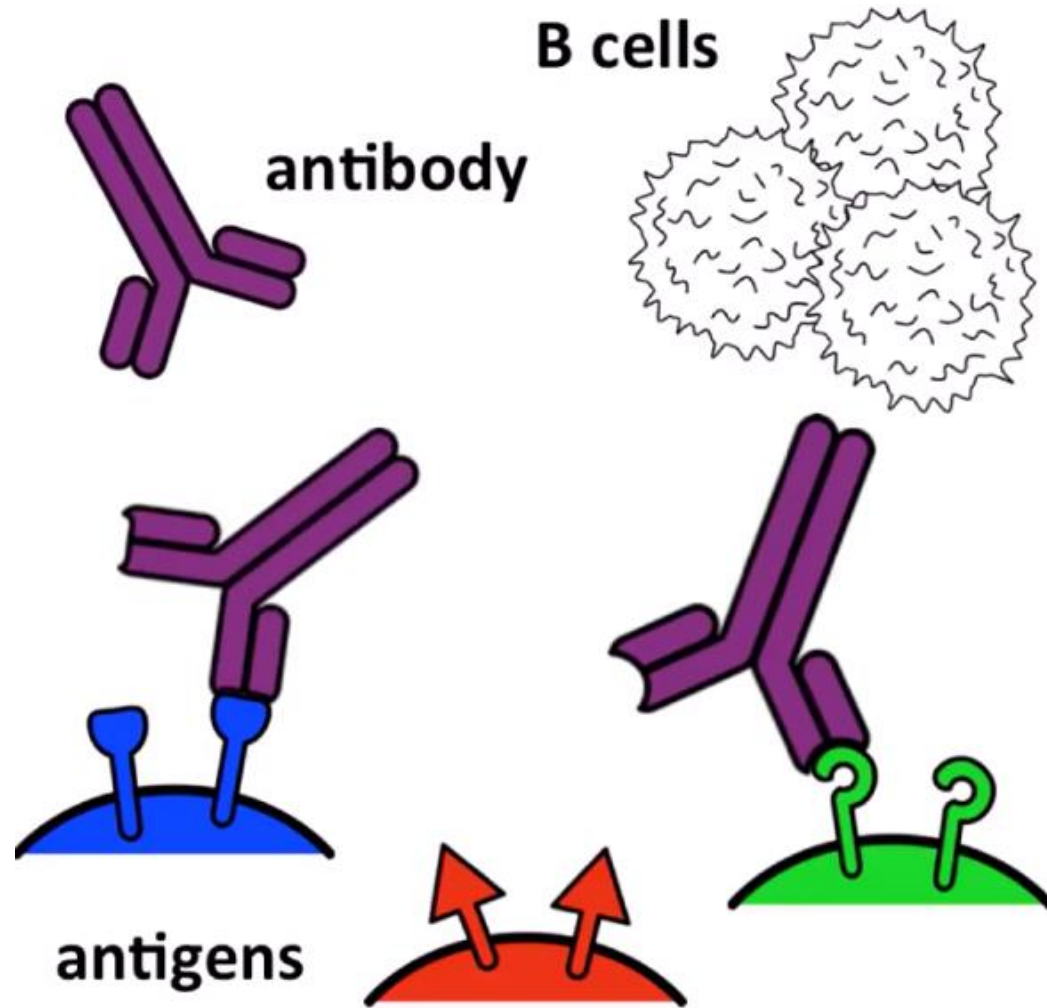


Vaccination  
against  
coronavirus

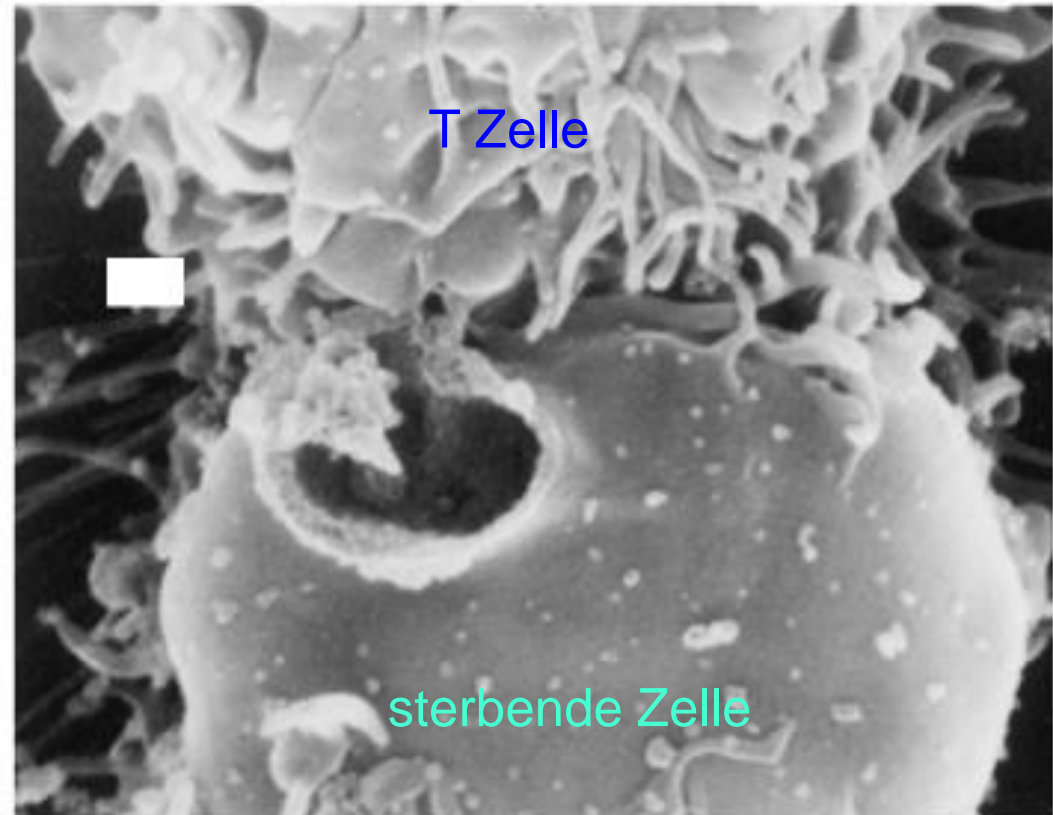
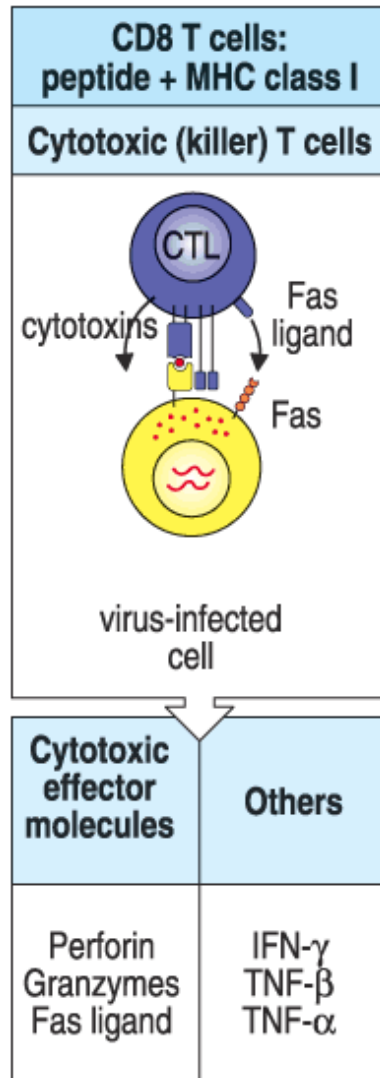
Prof. Daniel Speiser,  
University Hospital Lausanne,  
Switzerland

Antibodies (produced by B cells) bind to antigens on microbes.

They block microbes and/or mediate their destruction by other immune cells



# CD8<sup>+</sup> T Zellen (Killer Zellen) → Zerstören von infizierten Zellen

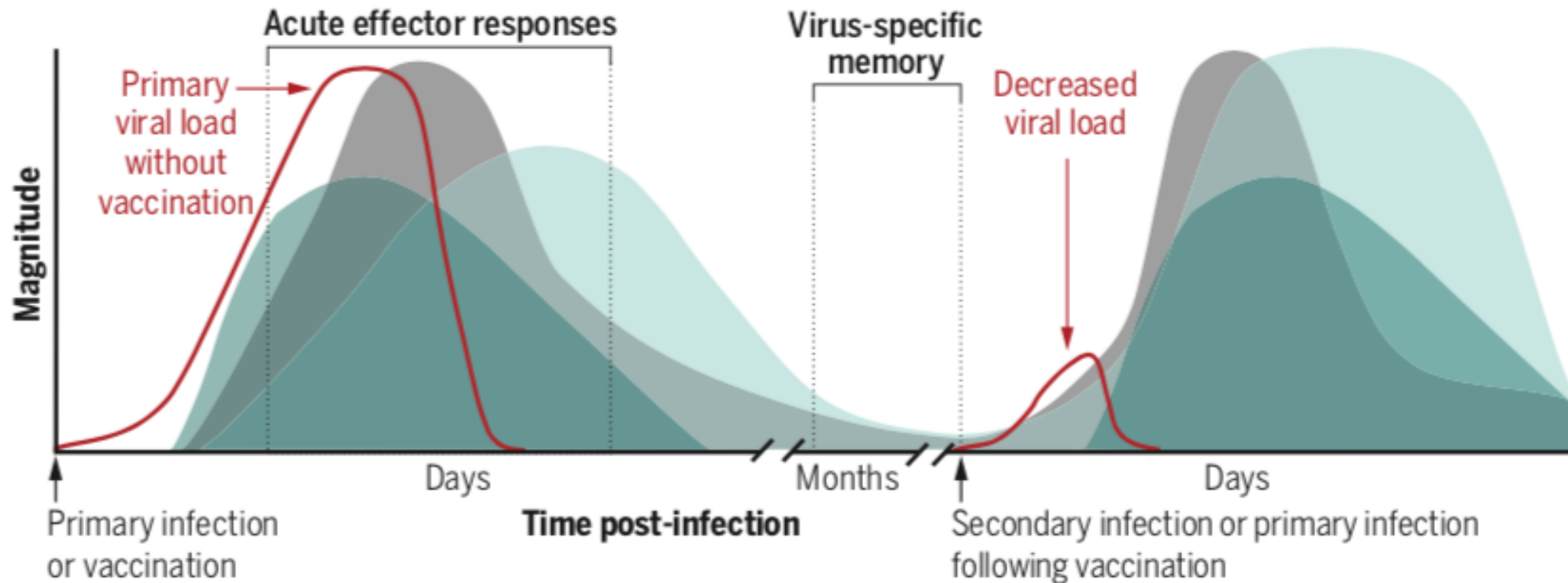


Cytotoxizität (Killing)

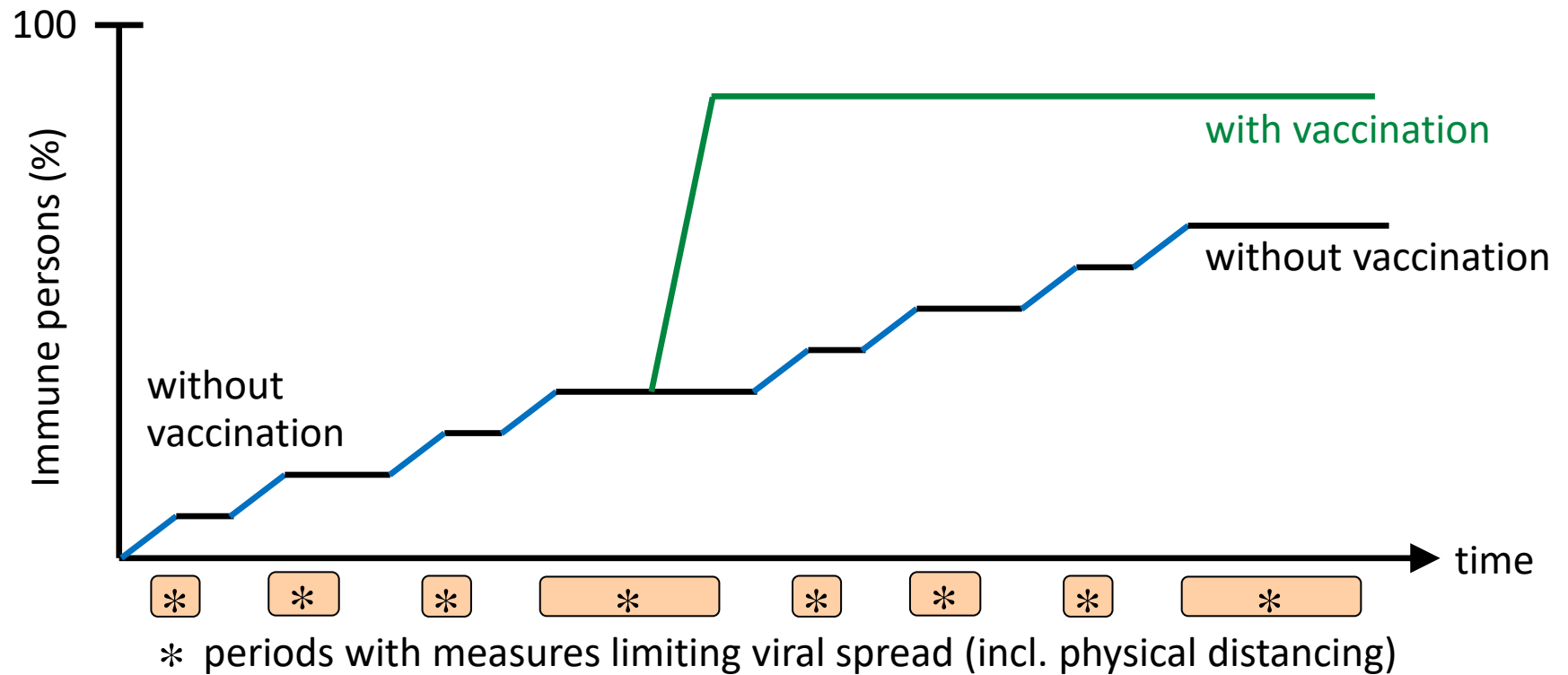
# Adaptive immune responses to viral infections

Adaptive immune responses control and eliminate viral infections that have outpaced innate immune control. Days after infection, virus-specific cytotoxic CD8<sup>+</sup> T cells migrate to the site(s) of infection, where they kill virally infected cells. Early-responding B cells produce and release virus-specific immunoglobulin M (IgM) antibodies; CD4<sup>+</sup> T helper cells promote class-switching of germinal center B cells from IgM to IgG or IgA virus-specific antibody production. After virus clearance, a pool of memory IgG/IgA B cells and T cells remain (virus-specific memory) and are rapidly reactivated upon reinfection with the same virus. Vaccination aims to generate protective adaptive immune memory without the need for a bona fide primary infection.

● CD4<sup>+</sup> and CD8<sup>+</sup> T cells    ● IgM antibodies    ● IgG/IgA antibodies



# Population immunity induced by infection and vaccination



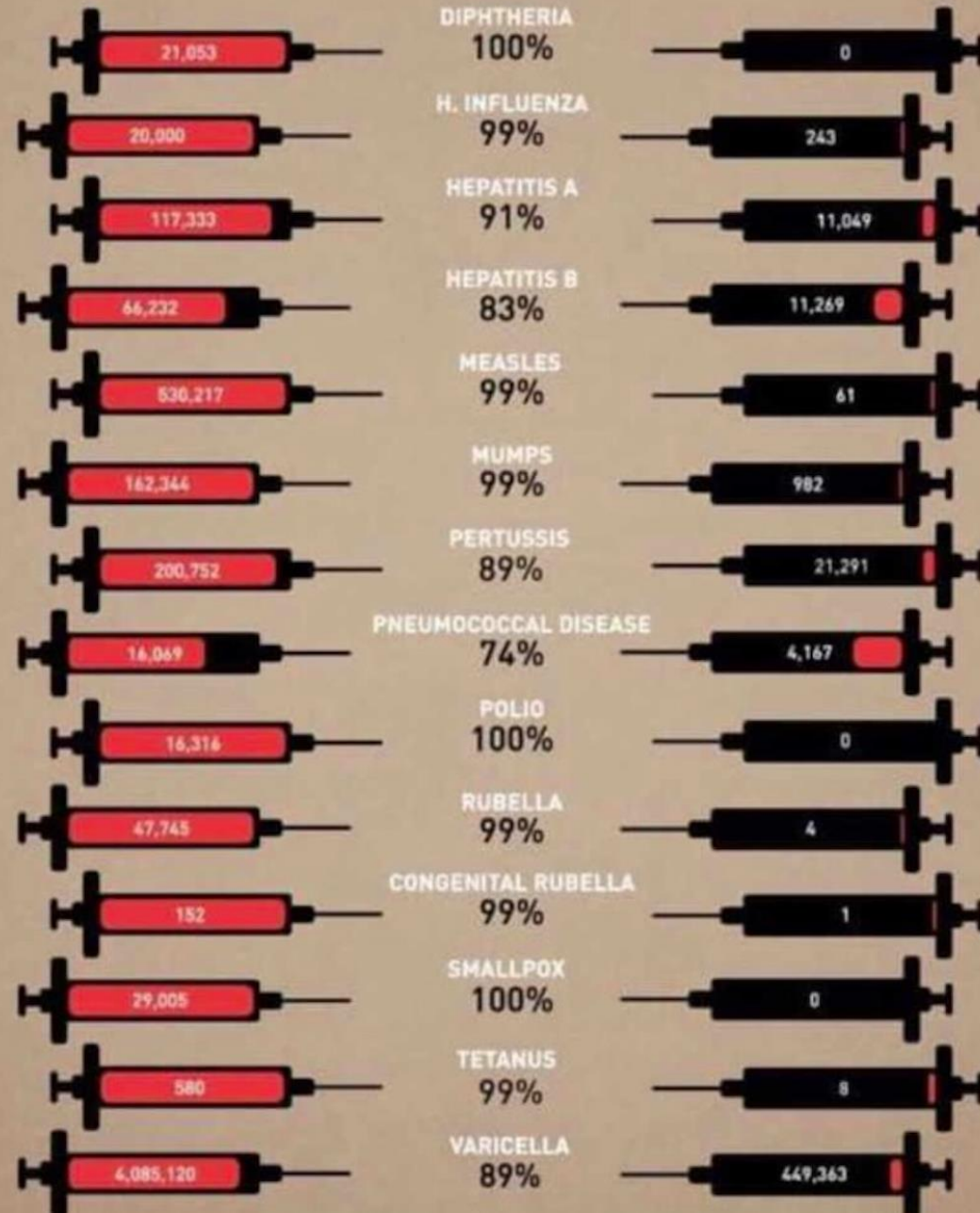
Vaccines have enormous merits in avoiding wide-spread dangerous diseases

PRE-VACCINE ERA  
ESTIMATED ANNUAL  
MORBIDITY IN THE U.S.

%

MOST RECENT  
REPORTS OF  
CASES IN THE U.S.

DECREASE



# Coronavirus Vaccine Tracker

By Carl Zimmer, Jonathan Corum and Sui-Lee Wee Updated Sept. 13, 2021



Researchers are currently testing **104 vaccines** in clinical trials on humans, and 33 have reached the final stages of testing. More than 75 preclinical vaccines are under active investigation in animals.

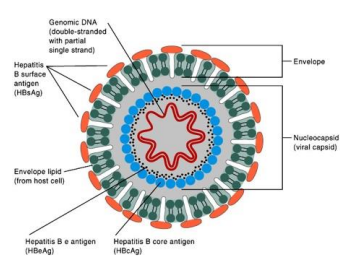
<https://www.nytimes.com/interactive/2020/science/coronavirus-vaccine-tracker.html>

COVID-19 information of Swissmedic:

<https://www.swissmedic.ch/swissmedic/de/home/news/coronavirus-covid-19.html>

# Vaccination: active immune therapy against COVID-19

## Protein Vaccine



Genomic DNA (double-stranded with partial single strand)

Envelope

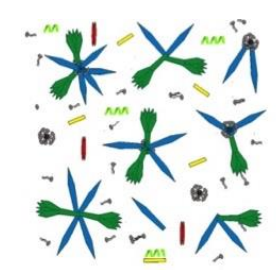
Hepatitis B surface antigen (HBsAg)

Nucleocapsid (viral capsid)

Envelope lipid (from host cell)

Hepatitis B e antigen (HBeAg)

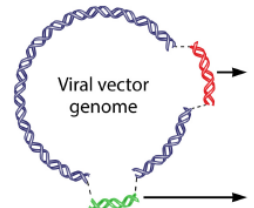
Hepatitis B core antigen (HBcAg)



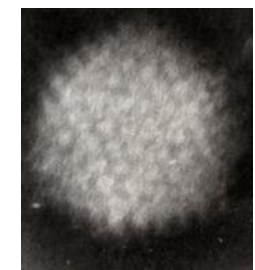
HBV, Influenza  
Tetanus

Novavax

## Vector



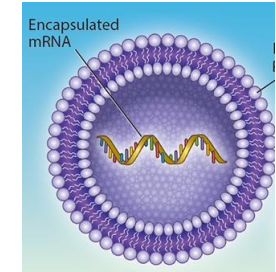
Viral vector genome



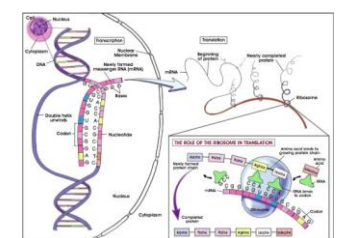
Ebola

Oxford/AstraZeneca  
Johnson & Johnson  
Harvard/Janssen

## mRNA Vaccine



Encapsulated mRNA



SARS-CoV-2

Moderna  
BioNTech/Pfizer



# COVID-19 vaccines in Switzerland

Type: mRNA vaccine

19.12.2020: Swissmedic approval of Comirnaty® (BioNTech/Pfizer)

12.01.2021: Swissmedic approval of Spikevax® (Moderna)

Vaccination by two intramuscular injections, with ca 4 week interval

Aim: Rapid protection from the pandemic virus

Long-term protection is secondary, it may require additional 'booster' injections

Protection: 95% (as of day 7-14 after second injection)

Duration of protection:

At least 9 months (Phase 1/2), at least 6 months (Phase 3)

No formal information on long-term protection



# An Uncertain Public — Encouraging Acceptance of Covid-19 Vaccines

*N Engl J Med* 2021 384:1483

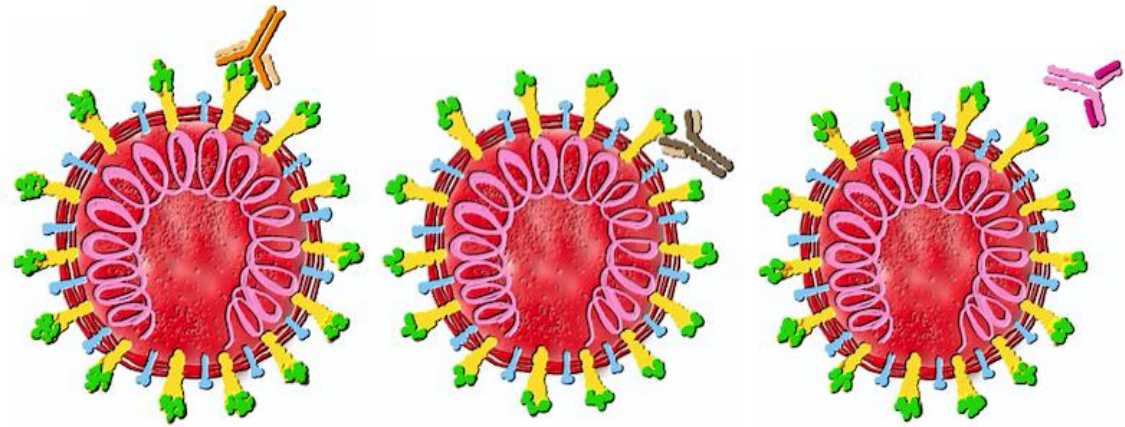
Gillian K. SteelFisher, Ph.D., Robert J. Blendon, Sc.D., and Hannah Caporello, B.A.

Trust in Sources of Vaccine Information	Percentage of Respondents
How much do you trust each of the following sources for information about coronavirus vaccines? A great deal/Quite a bit	
Health professionals, including doctors, nurses, and pharmacists	58
Dr. Anthony Fauci	48
CDC	46
FDA	41
HHS	38
WHO	36
Joe Biden	33
Pharmaceutical companies	20
Donald Trump	16
News media	16

Data from 39 US nationally representative, randomized polls (8.2020-2.2021)

Convincing people to get vaccinated: clinical physicians, rather than pharmaceutical companies, political leaders, or even medical scientists, should be at the fore of education and outreach strategies.

# Antibody binding and virus neutralization



Antibody specific for  
can bind the virus  
can neutralize the virus

$S_{\text{RBD}}$   
+  
+

$S_{\text{other}}$   
+  
+/-

N  
-  
-

## Lost immunity: 2 possible principle reasons

1. After infection, one may lose the antibodies relatively quickly (within about one year), such that re-infection becomes possible.

*This is likely the case for SARS-CoV-2.  
It applies to all known coronaviruses.*

2. The virus mutates so strongly that the immune memory becomes useless (“immune escape”).

*Complete immune escape is unlikely for coronaviruses,  
but some mutations can nevertheless lead to partial immune escape.*

# Variants of SARS-CoV-2

## Variants of Concern

B.1.1.7

alpha

B.1.351

beta

P.1

gamma

B.1.617.2

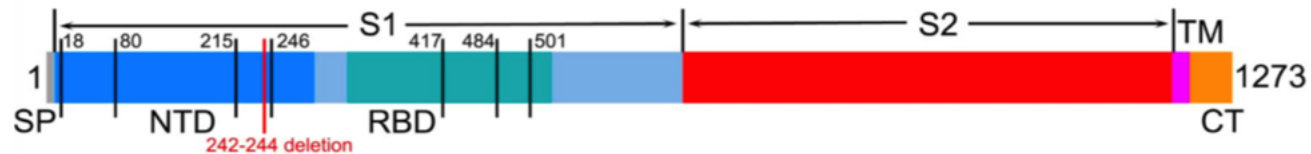
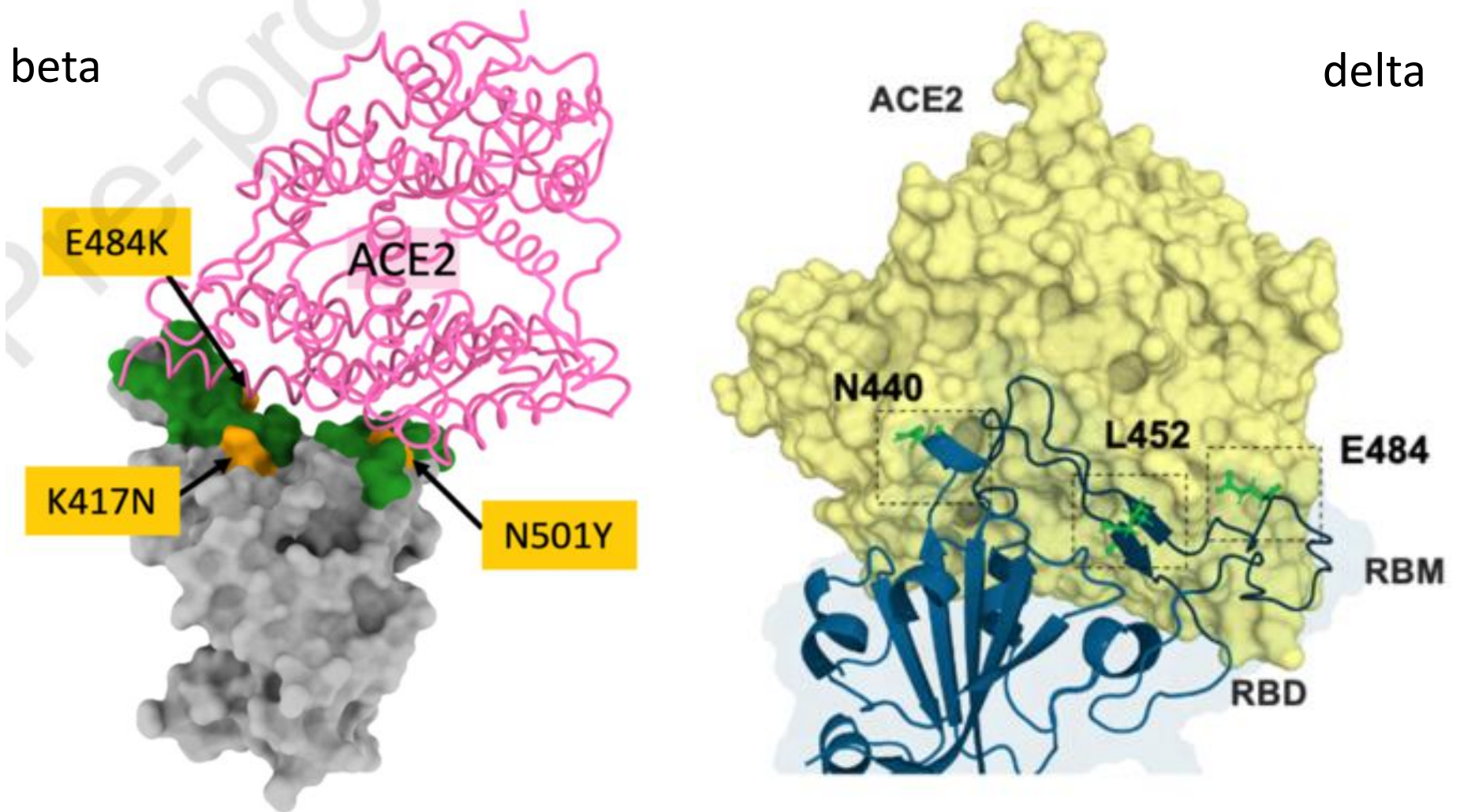
delta

## Variants of Note

A.23.1

B.1.525

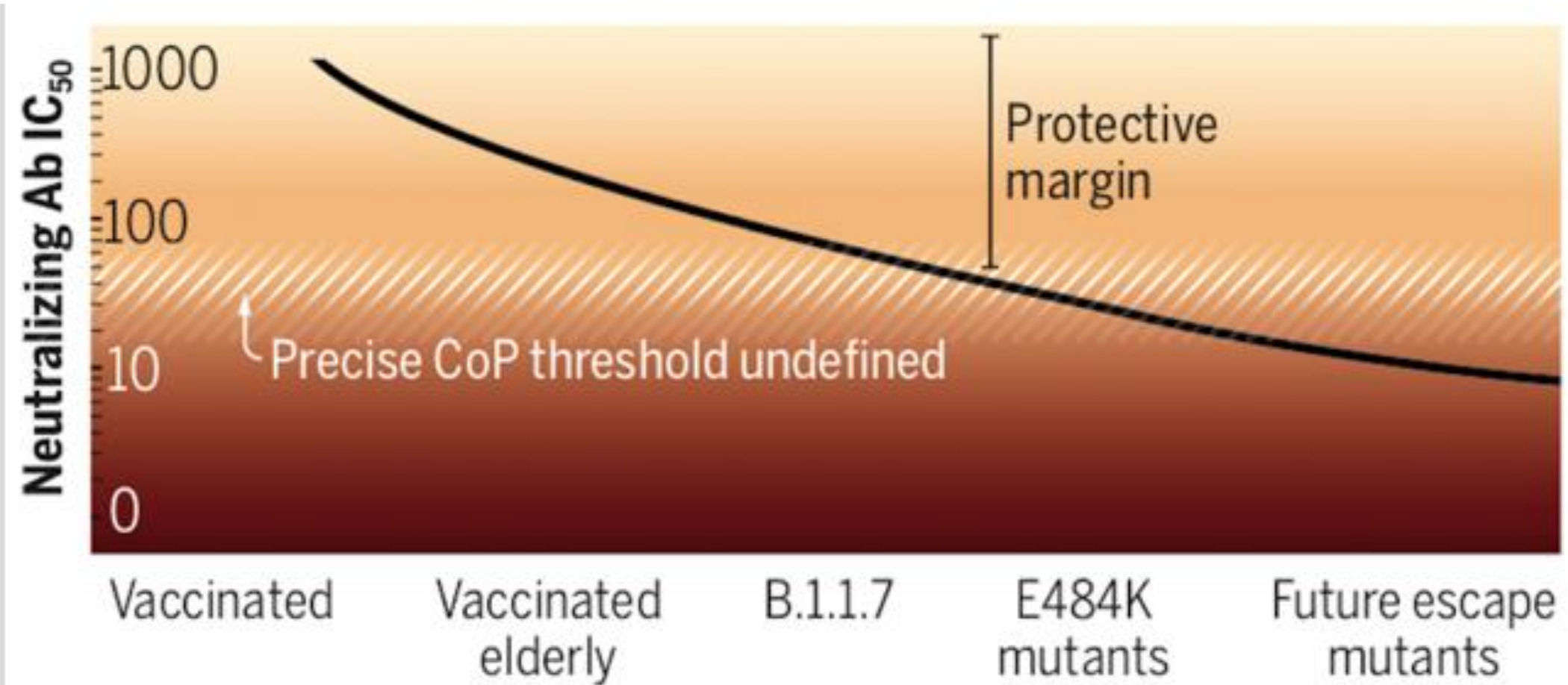
# Mutations in the receptor binding domain (RBD) of SARS-CoV-2 variants



# Decreasing neutralizing antibodies – decreasing protection

Current vaccination ok

Additional vaccination needed



Thank you!

To all the countless  
dedicated people who  
help reducing the  
pandemic damage

For your attention