



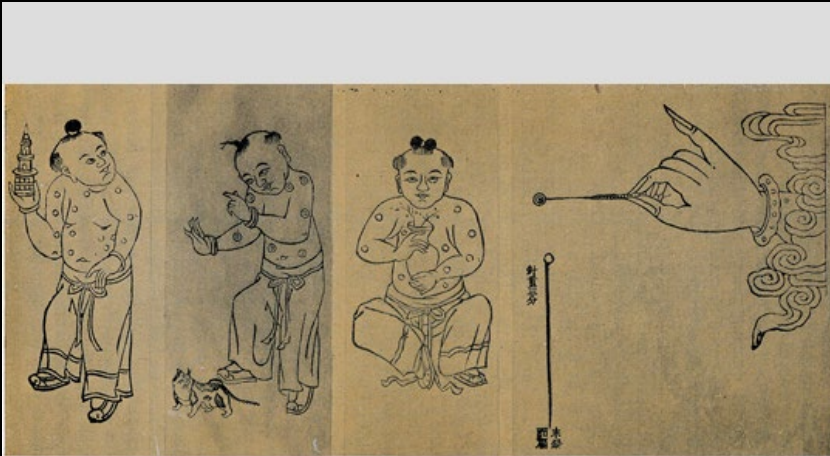
# Innovations in vaccine discovery

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**RI** Ragon  
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MASS GENERAL | MIT | HARVARD

# Vaccine innovations have been in development for 1000 years



FIGURES SHOWING VACCINATION PUSTULES  
From a Chinese work on Vaccination



**China (~10th Century CE)- Inhalation**

**Method:** Dried smallpox scabs were ground into a fine powder which was blown into the nostrils.

**India (~1000 CE) – Skin Scarification**

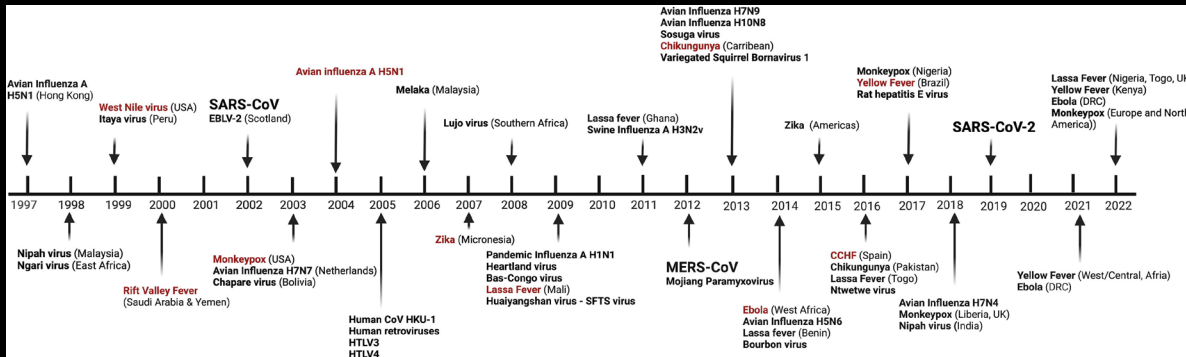
**Method:** Smallpox pus or scabs were collected from an infected person and placed into small scratches or punctures on the skin.

**The Ottoman Empire (~17th Century) – Skin**

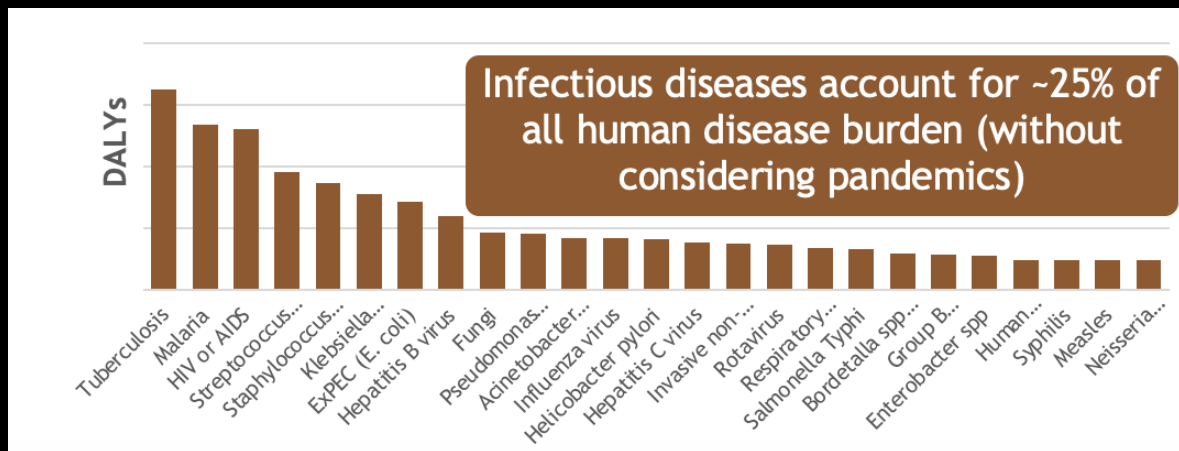
**Incision Method:** Small cuts were made in the skin to which pus or scabs from a mild smallpox case were inserted.

# Epidemics/Pandemics are on the **rise**.... New technologies are needed to arm the globe against disease

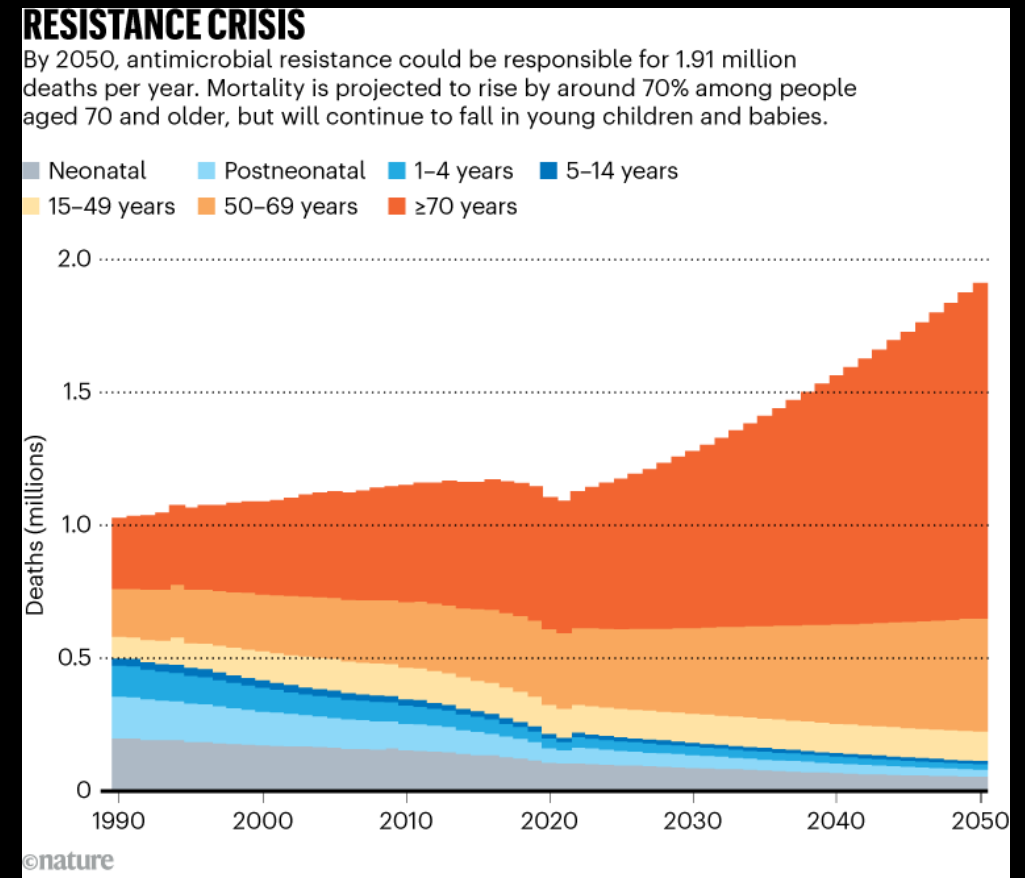
## Epidemics are on the rise



## Infectious Disease continue to cause a large burden of morbidity and mortality



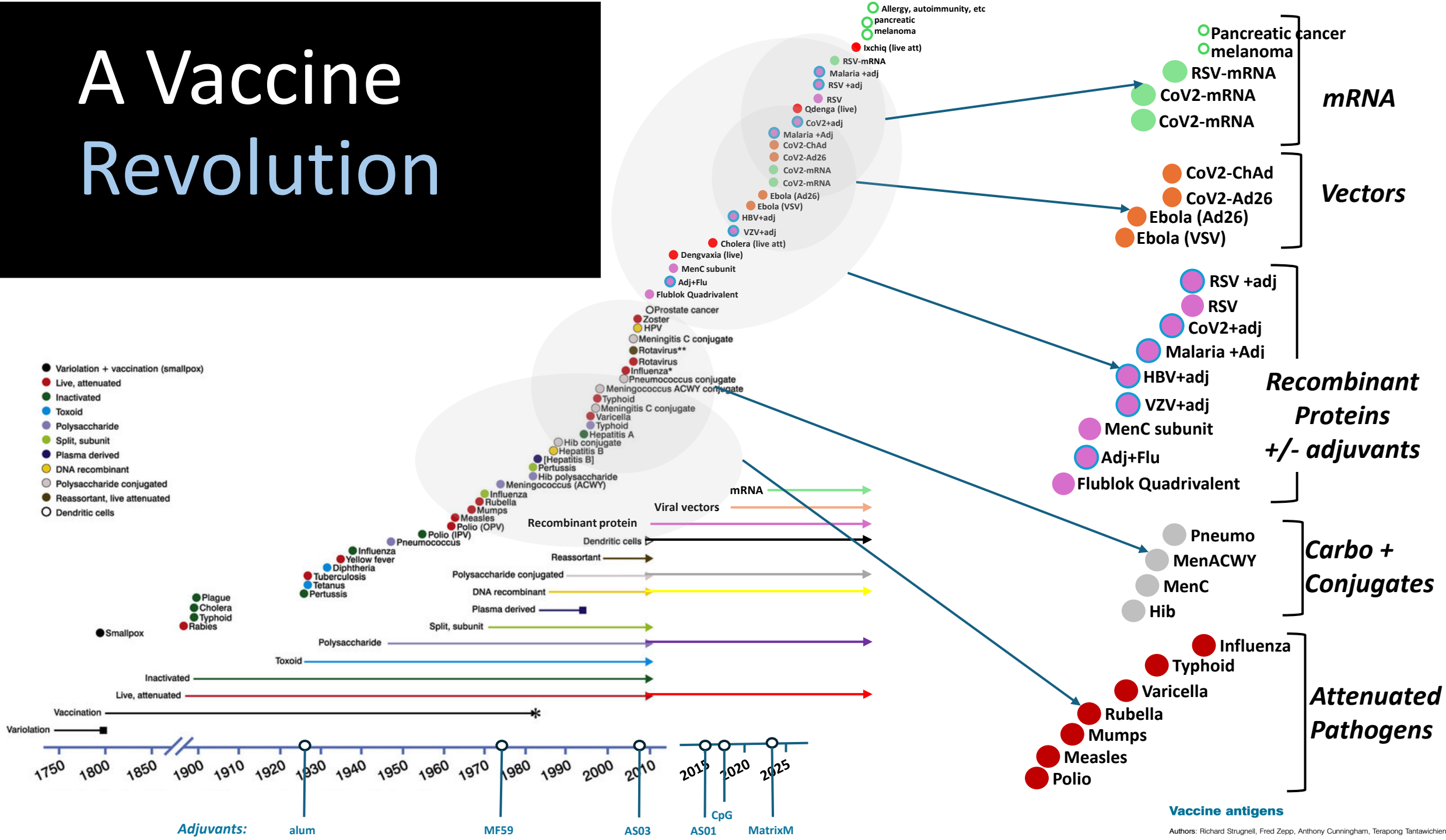
## Antibiotic resistance is on the rise



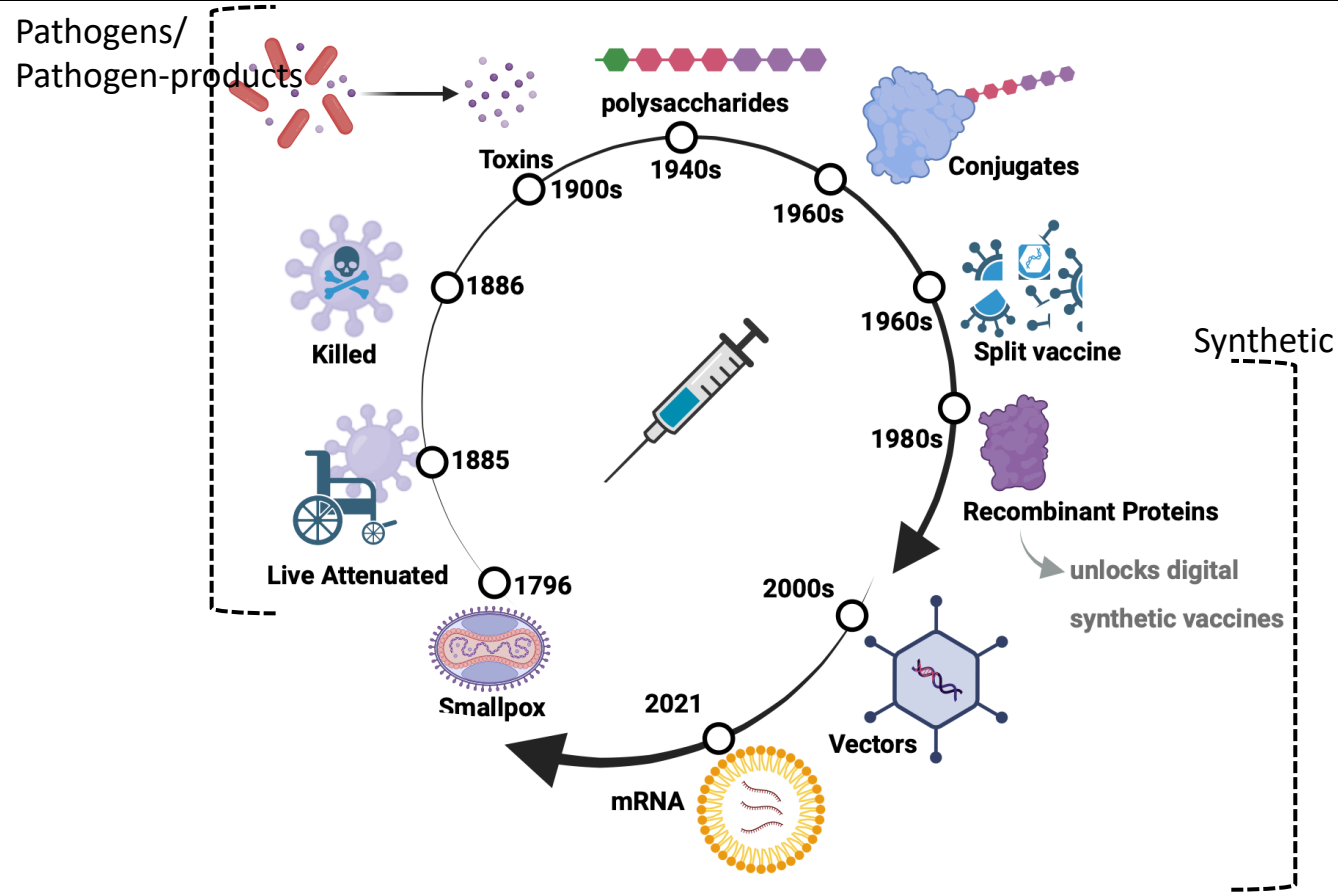
→ Need safe, durable solutions across populations for infectious threats



# A Vaccine Revolution



# The staggering pace of vaccine innovation

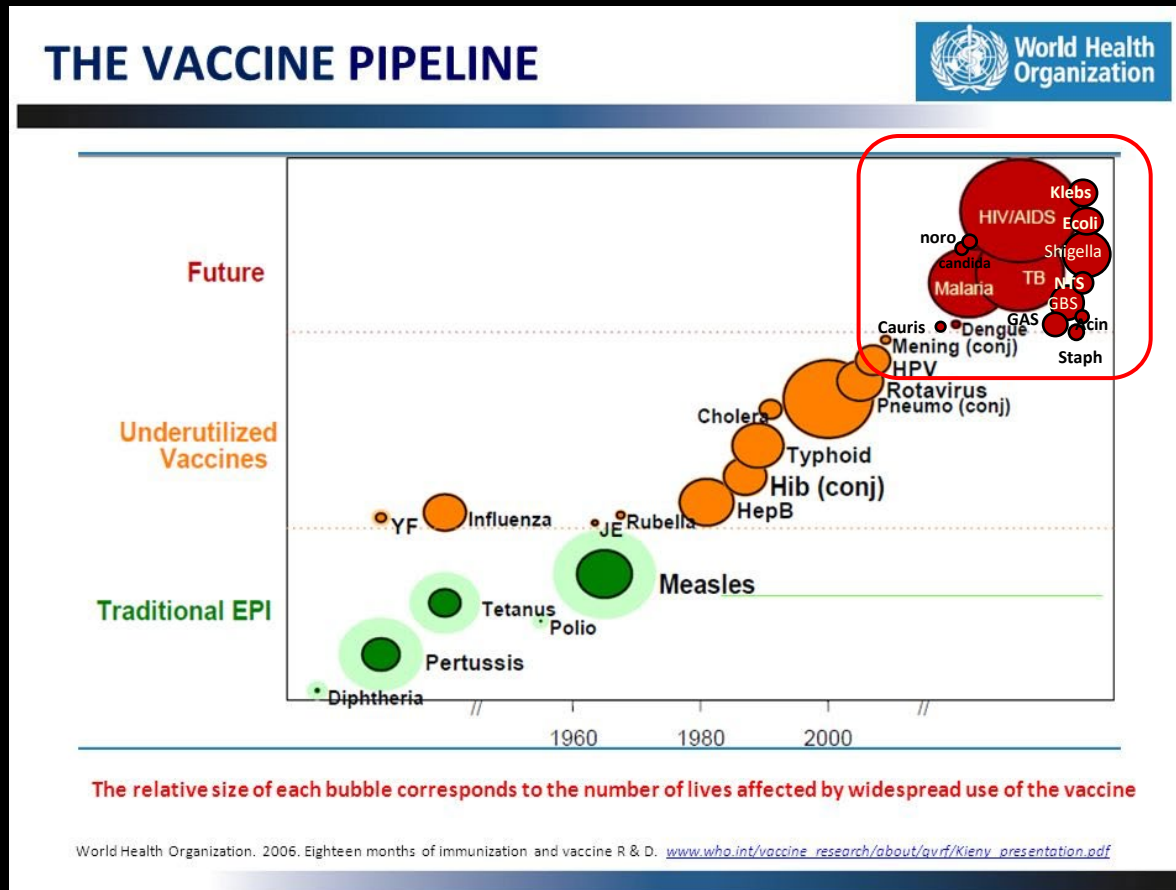


From **early efforts** to attenuate or kill vaccines, the evolution of purification techniques enabled immune exposure to the most critical pathogen antigens.

The development of **synthetic** antigen manufacturing enabled rapid response and manufacturing of new vaccines.

**New synthetic platforms**, including mRNA, vectors, nanoparticles, adjuvants, exosomes, etc. have the capacity not only to deliver the key antigen to the immune system – but also deliver immune signals that are key to program the durability and quality of the immune response.

# Great successes... but many challenges remain

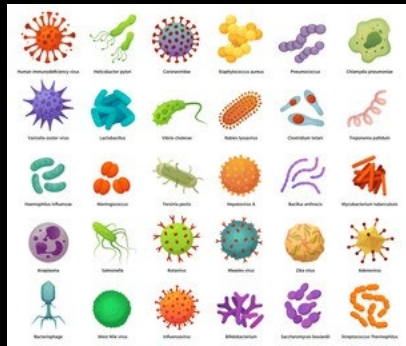


Vaccines against “simpler” pathogens have been successful.

Vaccines against more evasive/complicated pathogens remain elusive. What are we missing? What don’t we understand?

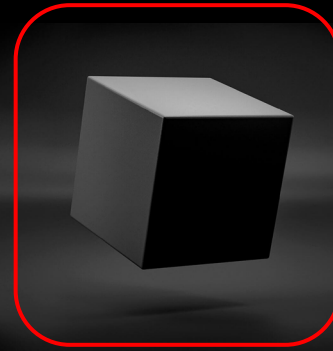
How can we make better 2.0 vaccine versions?

# What is missing in **traditional** vaccine design?



Biorender

Identify pathogen

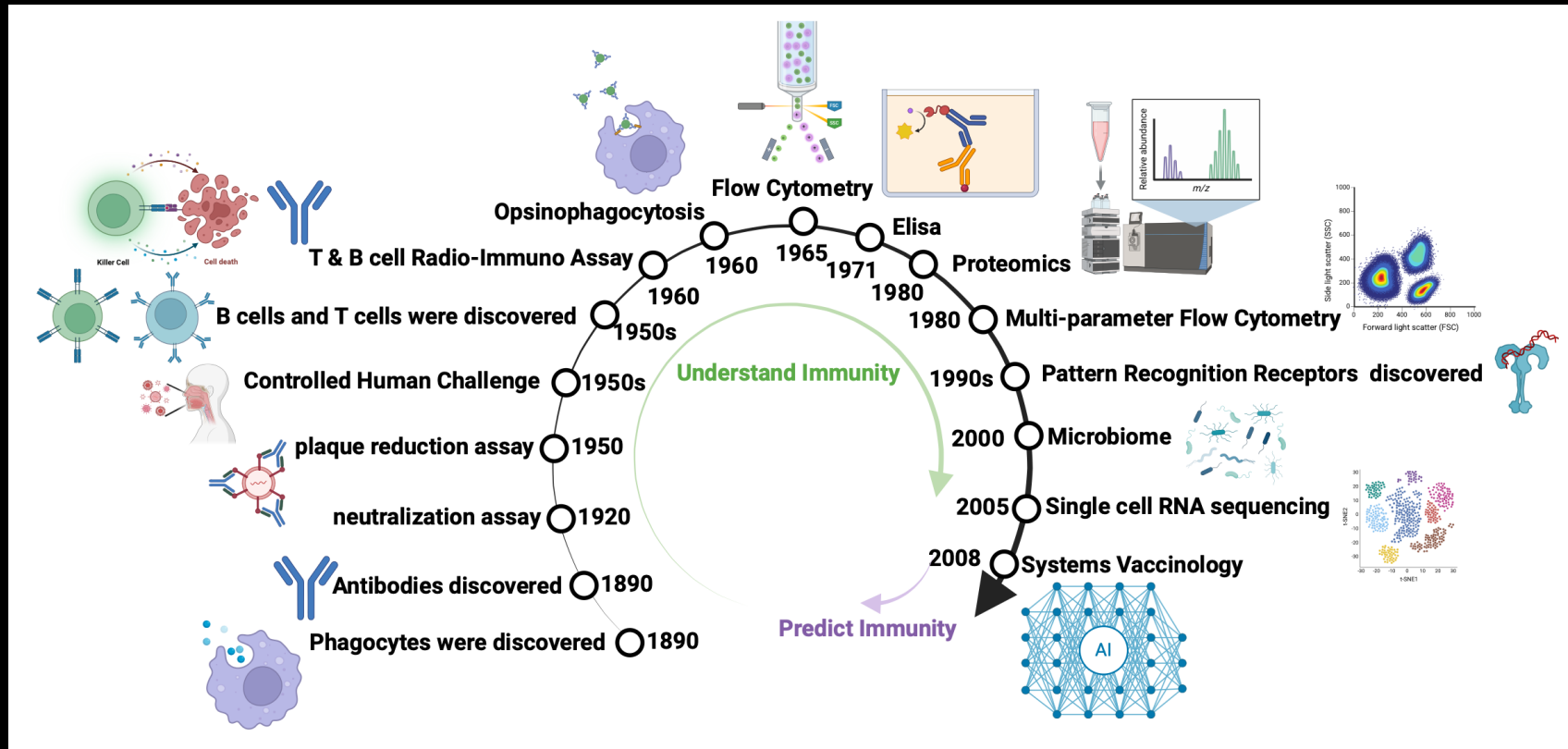


Immune Response



Save billions of lives

# Immune tools have proliferated in parallel to vaccine technologies



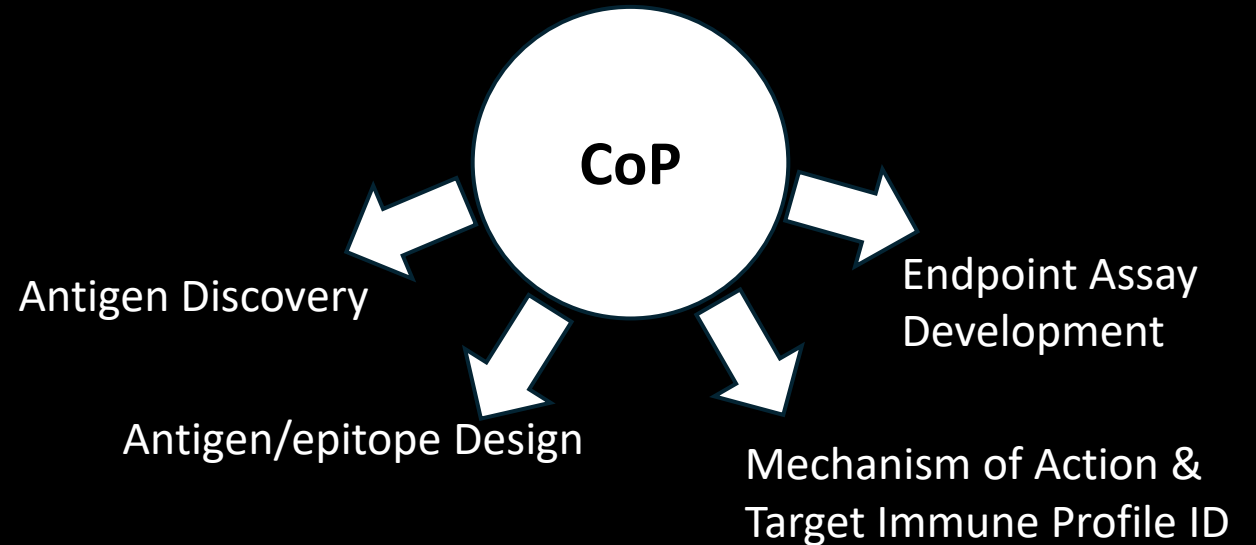
→ Unique moment in vaccine history- tools not only define protective correlates but can now drive the design of smarter trials, platform selection, and vaccine improvements/designs.



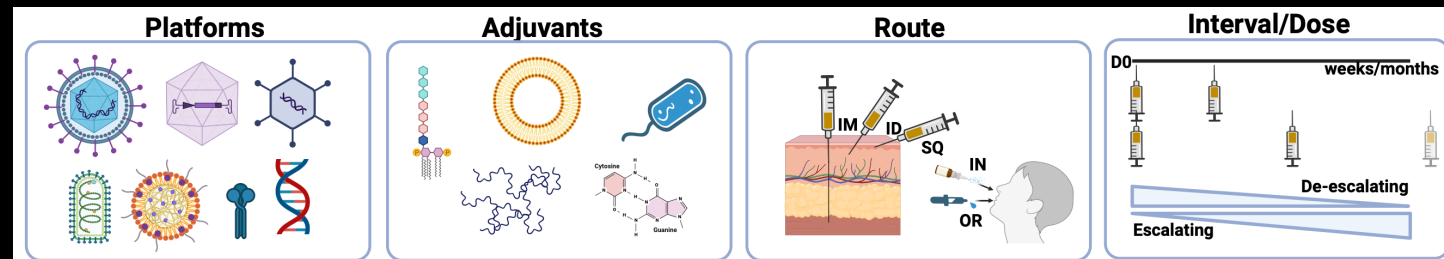
# Unlocking the pandora's box of Immune Correlates to **define & drive** vaccine development



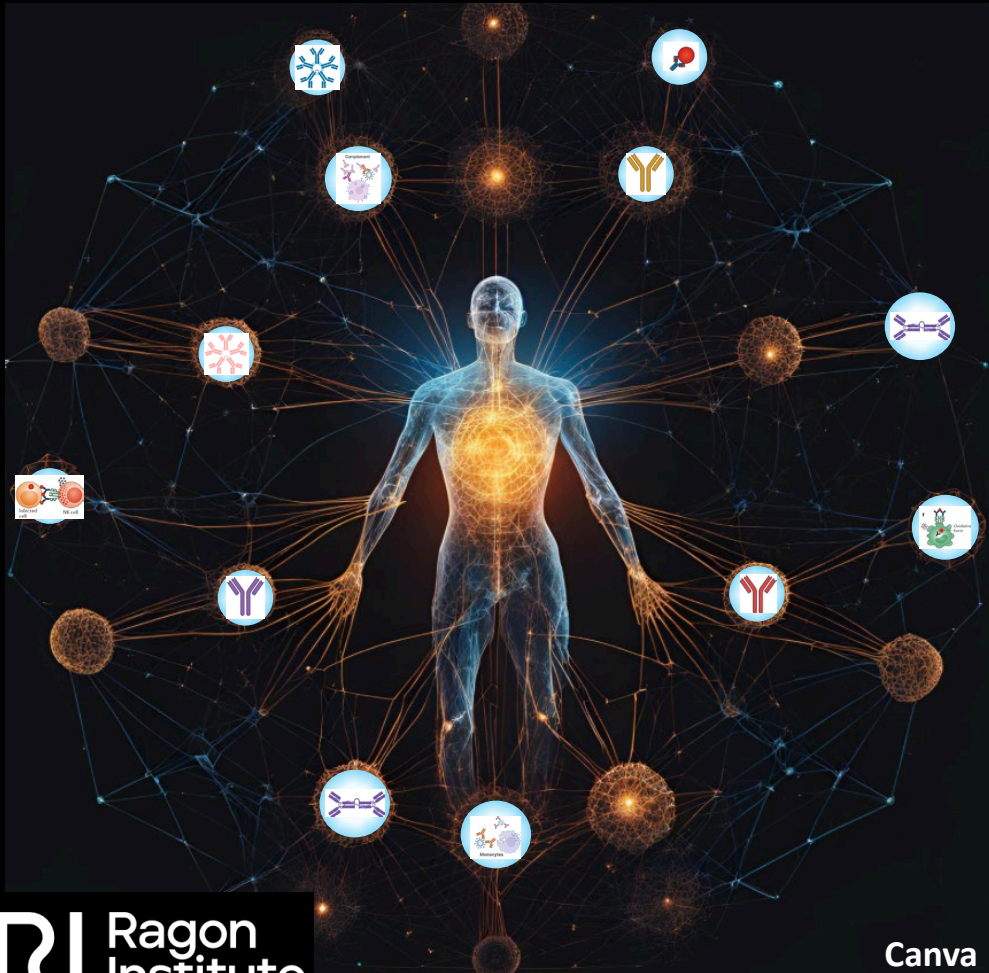
Canva



## Approaches to modify the quality of the humoral immune response



# Unlocking CoPs provides a path to iterative vaccine design and/or Regulatory Innovation



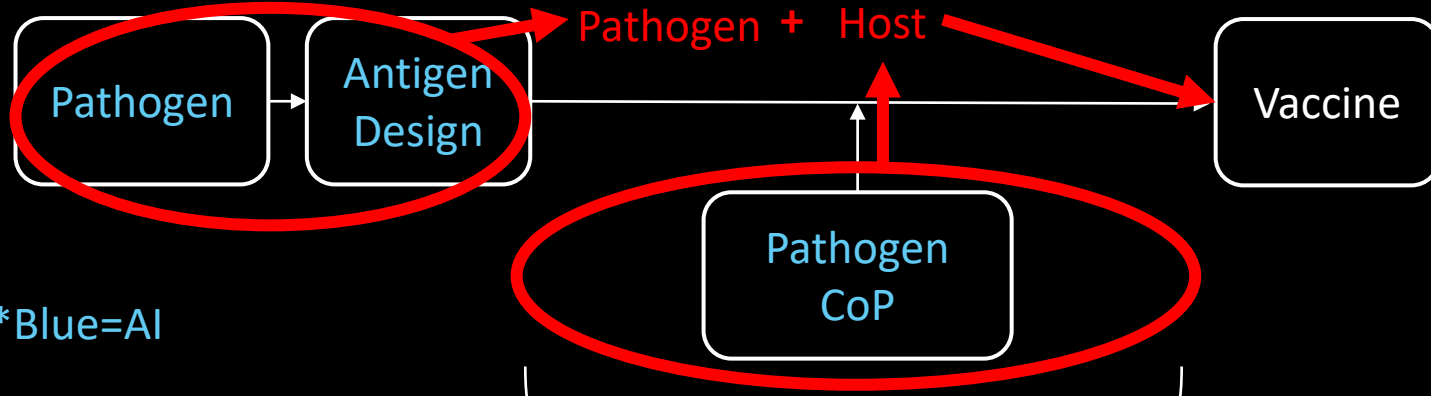
## Old School



## New School

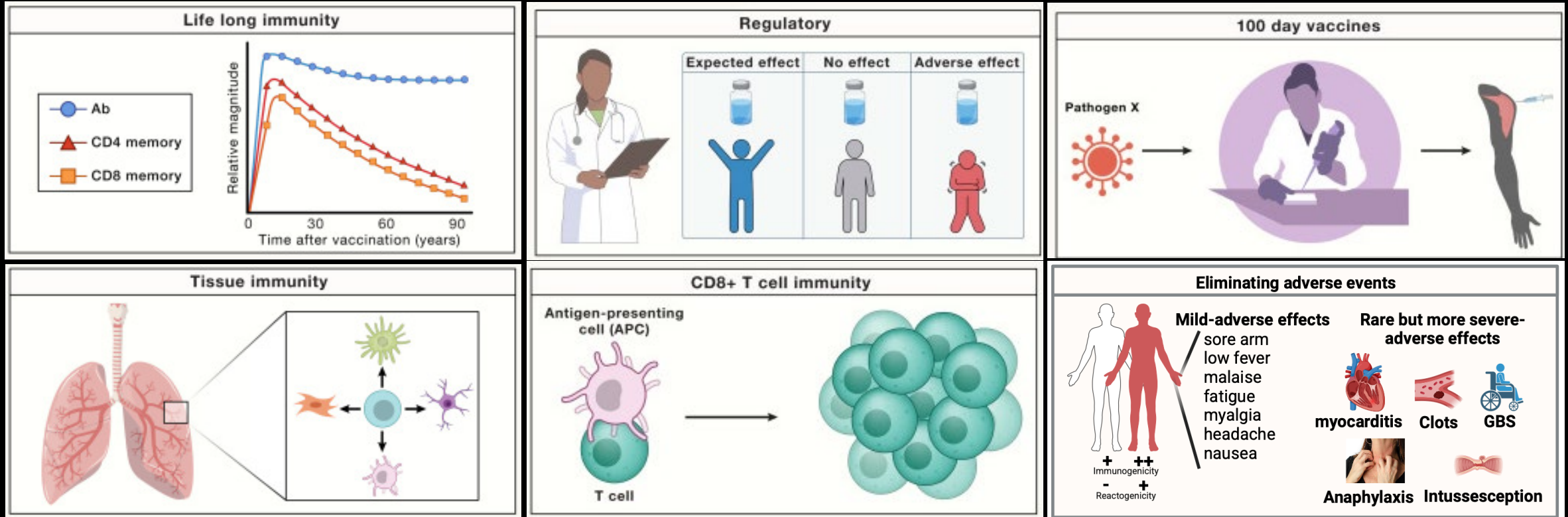


## Next-Generation



*Inspire Iterative re-design and regulatory discussions*

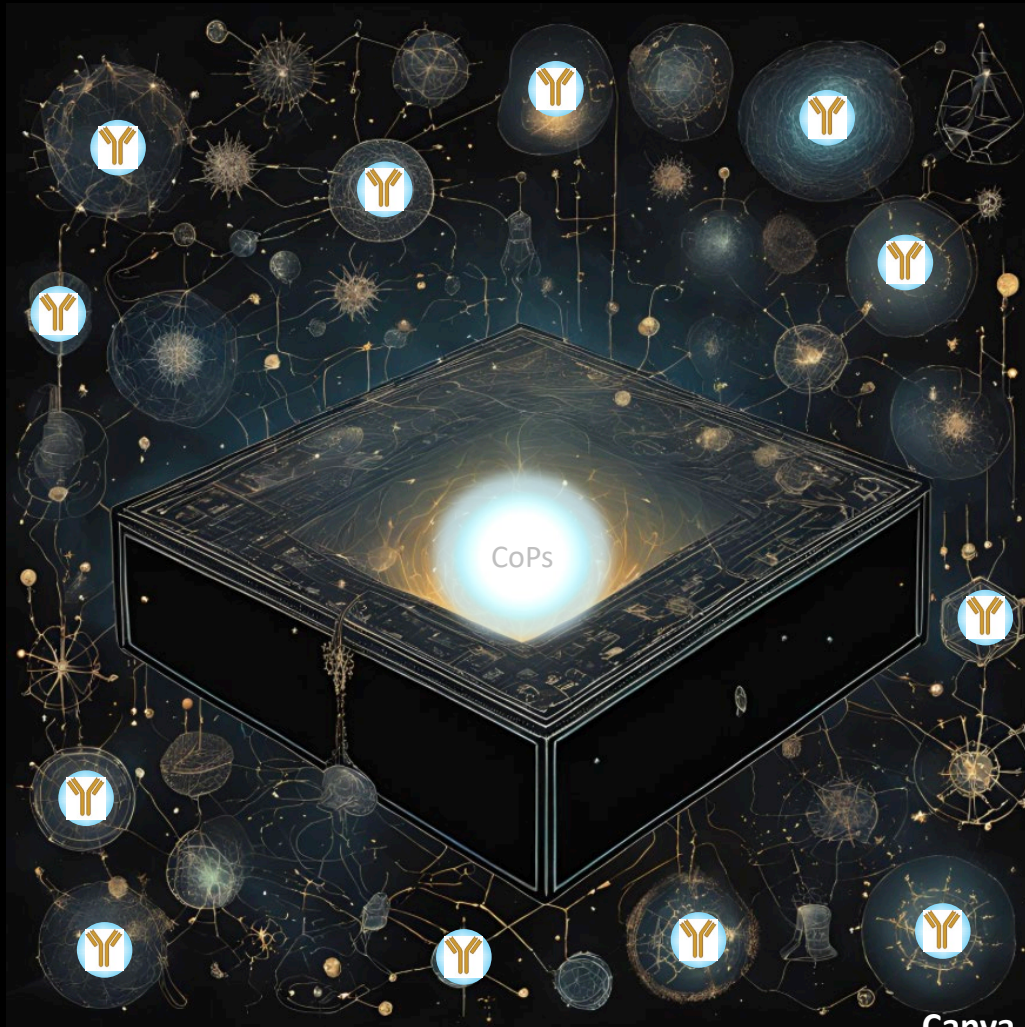
# Remaining Challenges



→ Deeper **understanding of immunity** following infection or vaccination can help unlock technologies to make durable, more effective, and very safe vaccines – faster- in the future.



# Thank You!



Canva



Rino Rappuoli



Bali Pulendran



Stanley Plotkin



Doug  
Lauffenburger



Carla Vinals  
Lingyi Zheng



Florian  
Schoedel



Dan  
Barouch



Andy  
Pollard



John Bell

Gf

