

# Vaccines for COVID-19. Where Do We Stand?

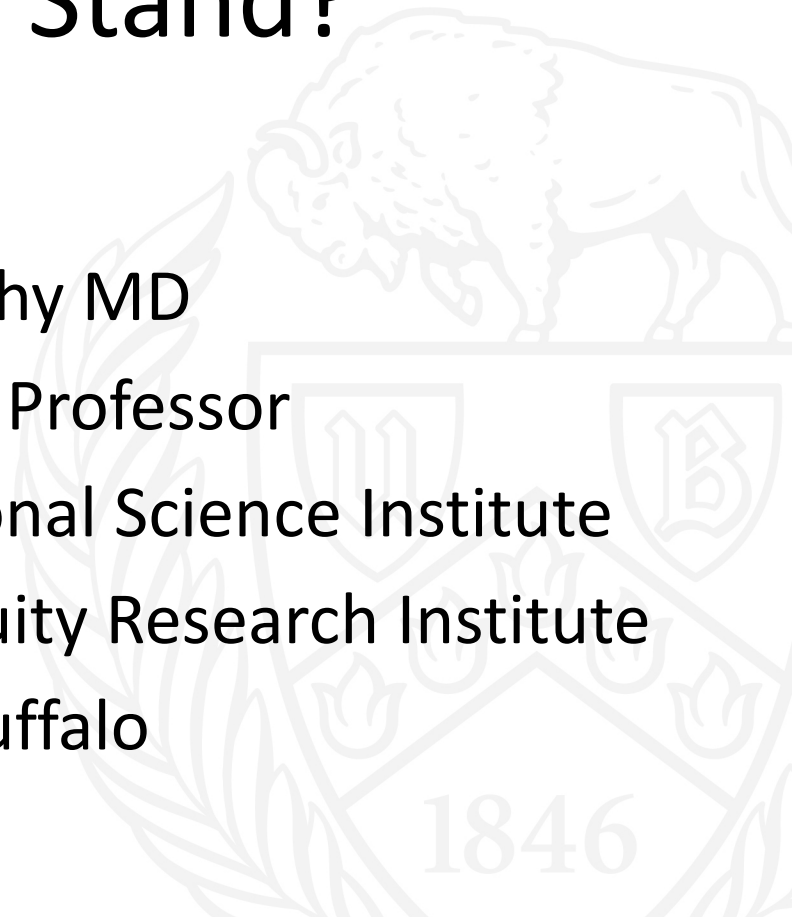
Timothy F. Murphy MD

SUNY Distinguished Professor

Director, Clinical and Translational Science Institute

Director, Community Health Equity Research Institute

University at Buffalo



# Objectives

- Basic principles of clinical trials for vaccines
- Vaccines currently in clinical trials globally and how they work
- Passive and “trained” immunity approaches



# Clinicaltrials.gov

NIH U.S. National Library of Medicine

*ClinicalTrials.gov*

Find Studies ▾

About Studies ▾

Submit Studies ▾

Resources ▾

About Site ▾

[Home](#) > Search Results

[Modify Search](#)

[Start Over](#)



127 Studies found for: **vaccine | COVID**

Also searched for **SARS-CoV-2, Vaccination, and Immunization.** [See Search Details](#)

Your search included: **COVID**

Learn more about clinical studies related to COVID-19:

- **ClinicalTrials.gov:** [Federally-funded clinical studies related to COVID-19](#)
- **WHO Trial Registry Network:** [COVID-19 studies from the ICTRP database](#)
- **NIH:** [COVID-19 Treatment Guidelines](#)

List

By Topic

On Map

Search Details

Hide Filters

Download

Subscribe to RSS

Show/Hide Columns

Filters

Showing: 1-10 of 127 studies 10 studies per page

Apply

Clear

Status

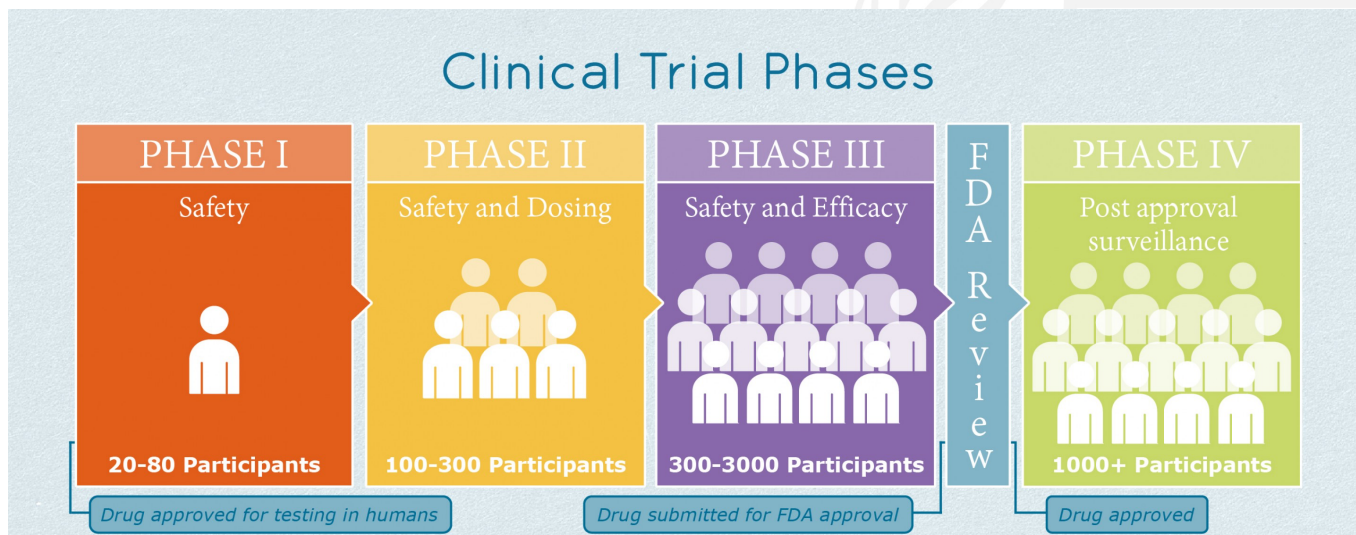
Recruitment ⓘ :

- ☐ Not yet recruiting
- ☐ Recruiting
- ☐ Enrolling by invitation

| Row | Saved                    | Status                    | Study Title  | Conditions                                | Interventions                        | Locations  |
|-----|--------------------------|---------------------------|--|---|--------------------------------------|--|
| 1   | <input type="checkbox"/> | Not yet recruiting<br>NEW | <a href="#">Therapeutic Vaccine Trial of COVID-19 for Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) Infection</a> | • COVID                                   | • Biological: Covax-19™              |  |
| 2   | <input type="checkbox"/> | Recruiting                | <a href="#">Safety and Immunity of Covid-19 aAPC Vaccine</a>   | • Treat and Prevent<br>Covid-19 Infection | • Biological: Pathogen-specific aAPC | • Shenzhen Geno-immune Medical Institute<br>Shenzhen, Guangdong, China |

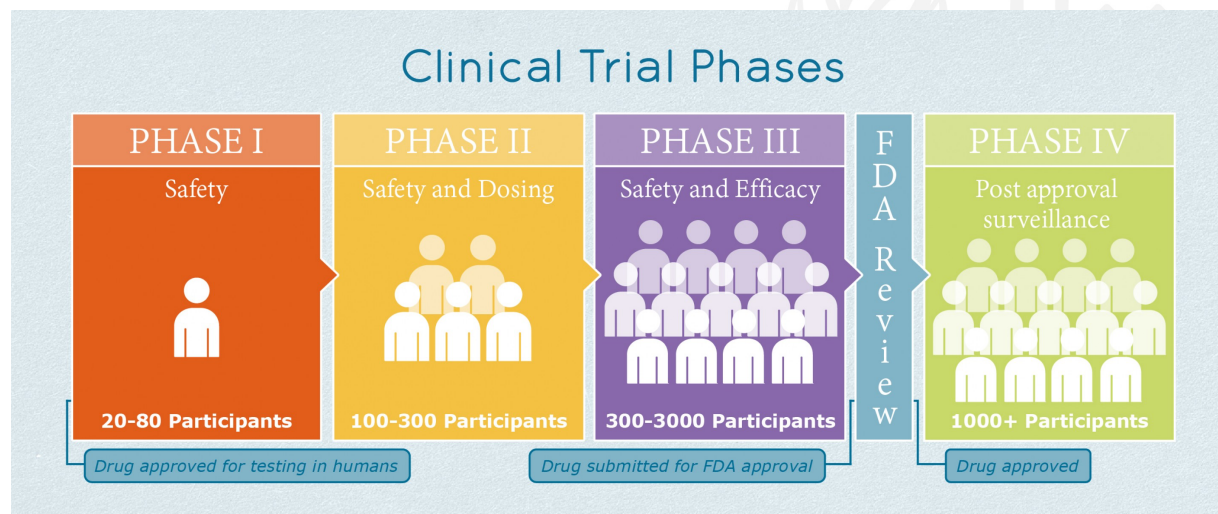
# Clinical Trials

- Phase I Clinical Trial
  - Healthy volunteers, primarily safety testing, escalating doses, 20 to 100 participants
- Phase II Clinical Trial
  - Test for side effects and preliminary efficacy; therapeutic doses; 100 - 300 participants with specific disorder

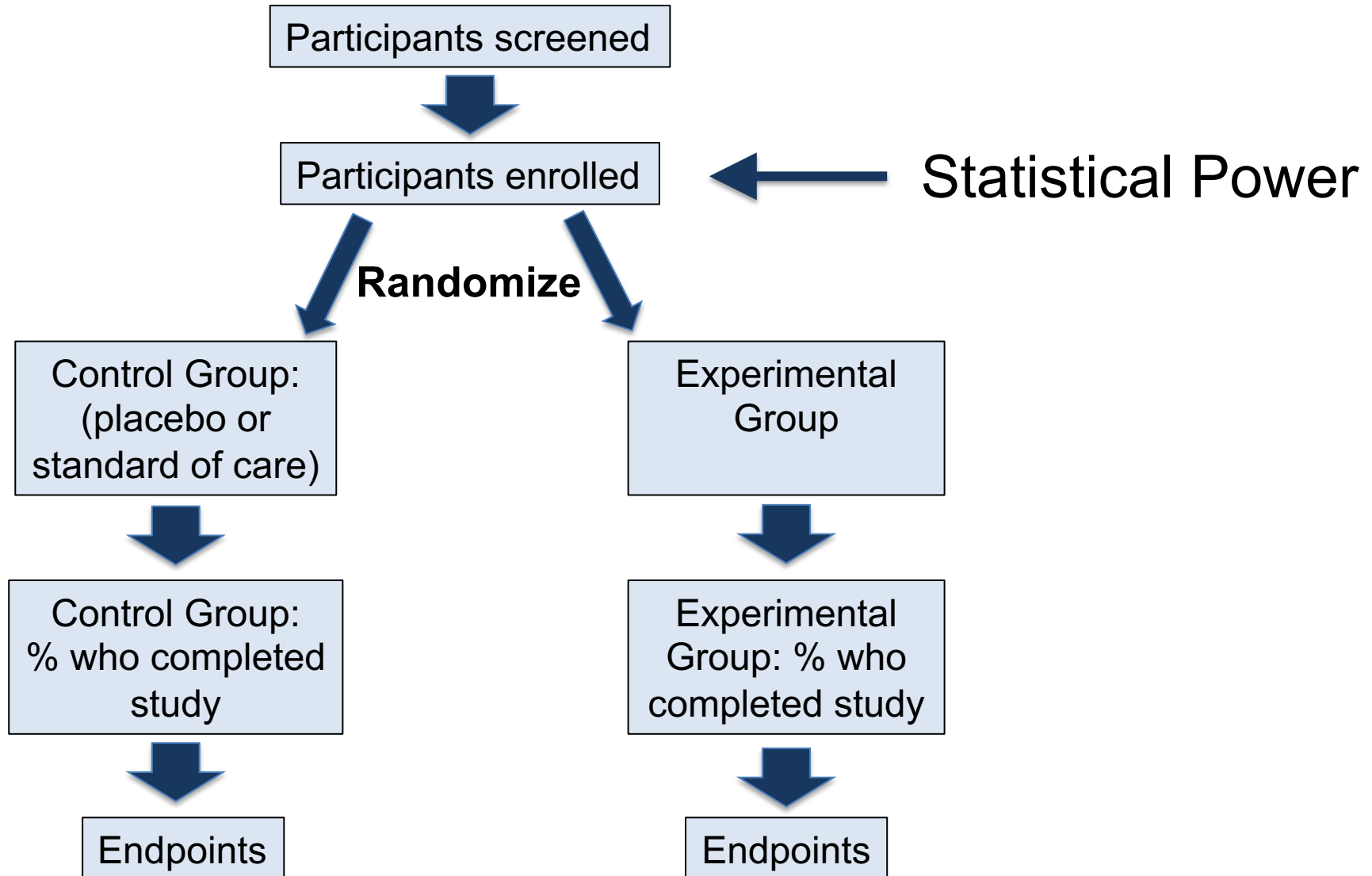


# Clinical Trials

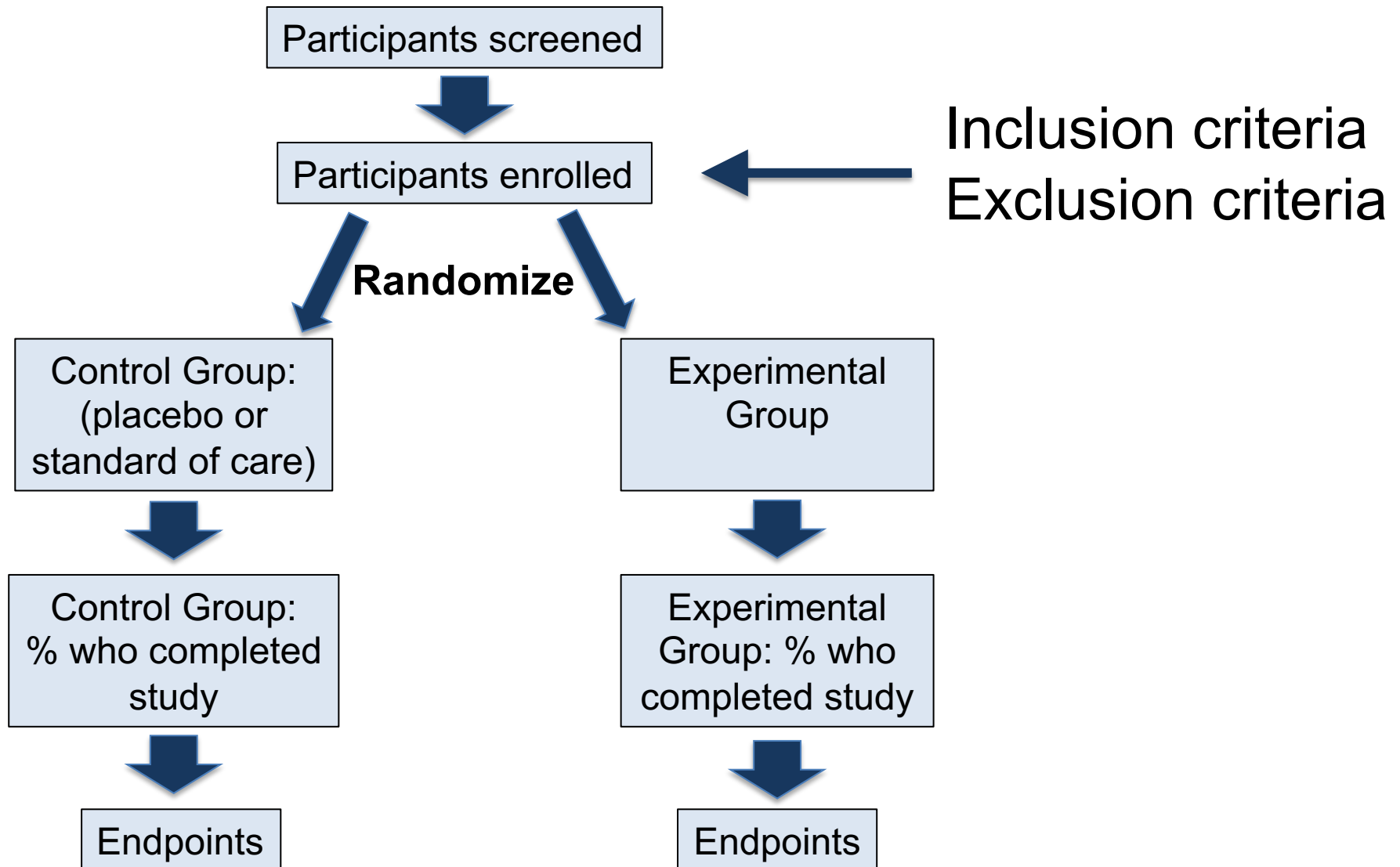
- Phase III Clinical Trial
  - Assess efficacy, effectiveness and safety; 300 to 3,000 participants with specific characteristics
  - Randomized, double-blind, placebo-controlled clinical trial is the gold standard for determining efficacy
- Phase IV Clinical Trial
  - Post marketing surveillance; assess long term effects including effectiveness and safety



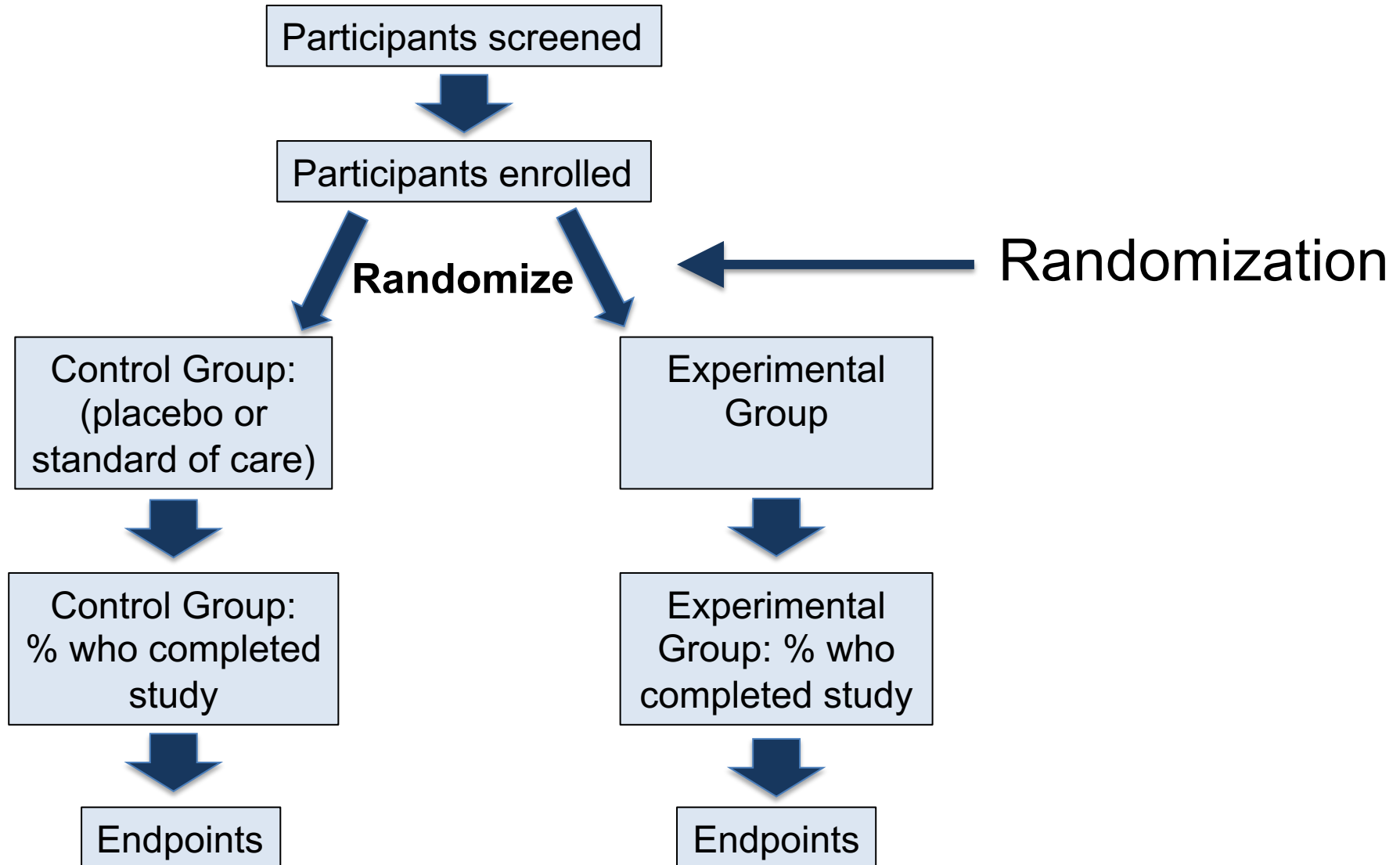
# Randomized double-blind placebo-controlled clinical trial



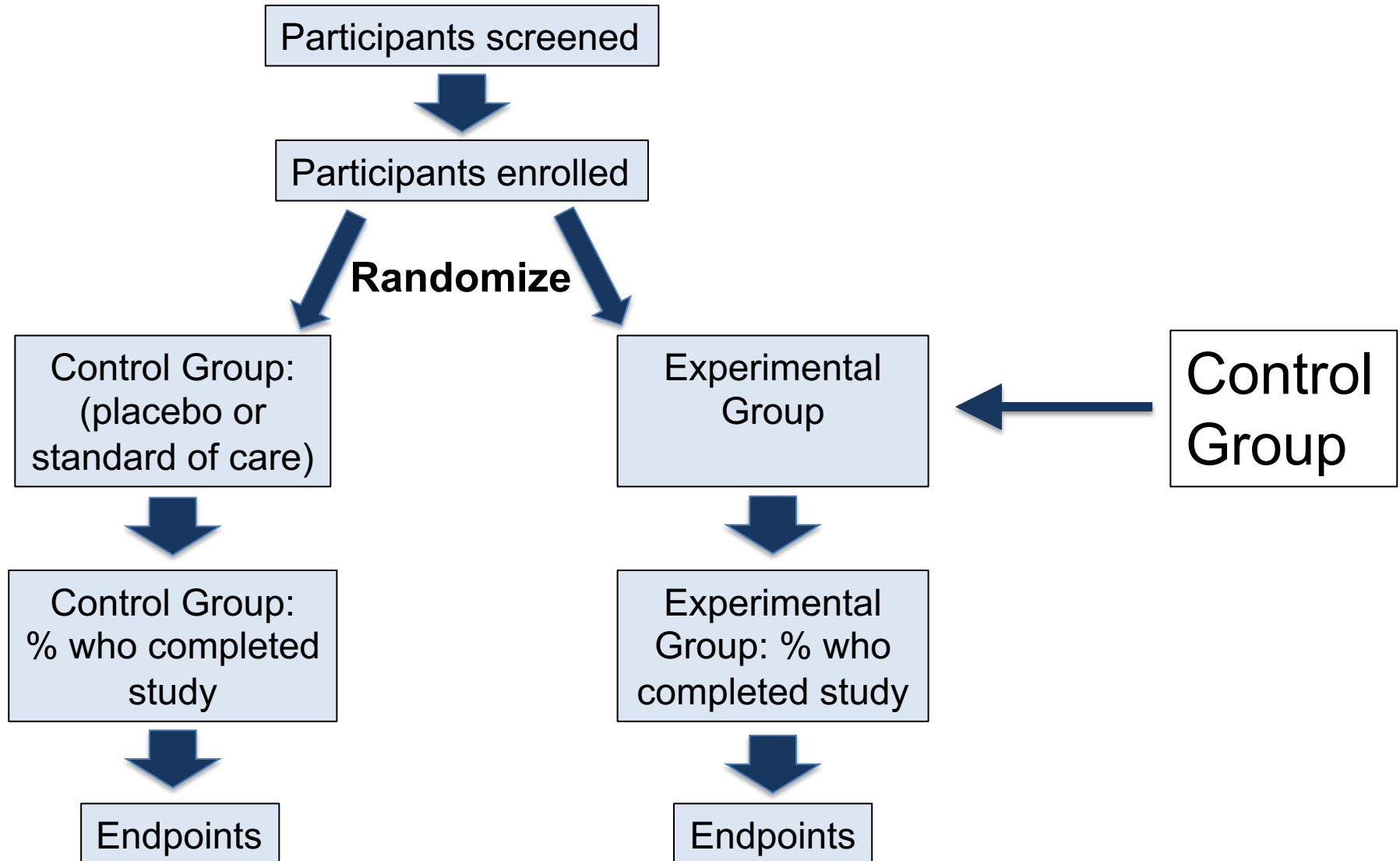
# Randomized double-blind placebo-controlled clinical trial



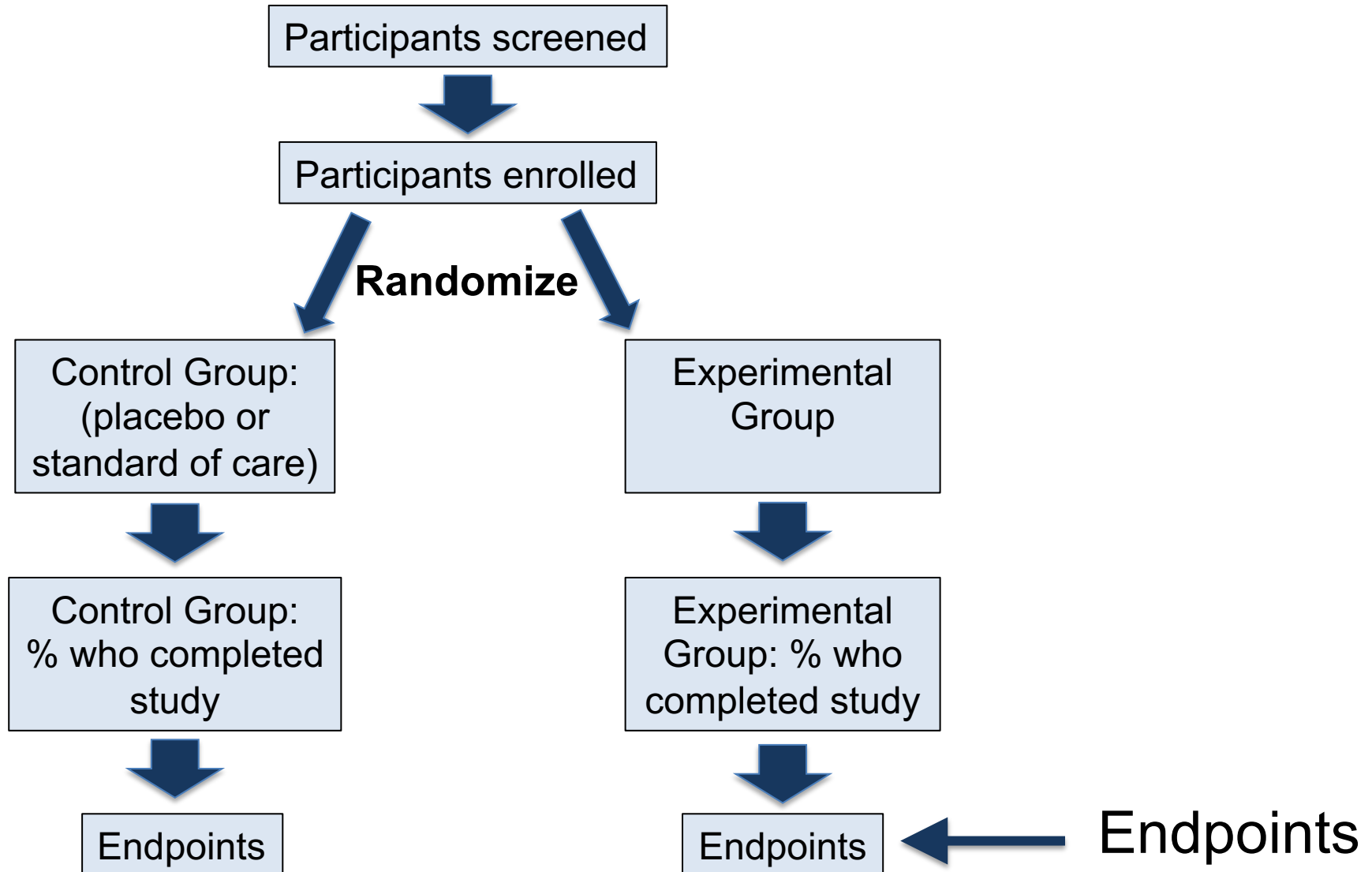
# Randomized double-blind placebo-controlled clinical trial



# Randomized double-blind placebo-controlled clinical trial



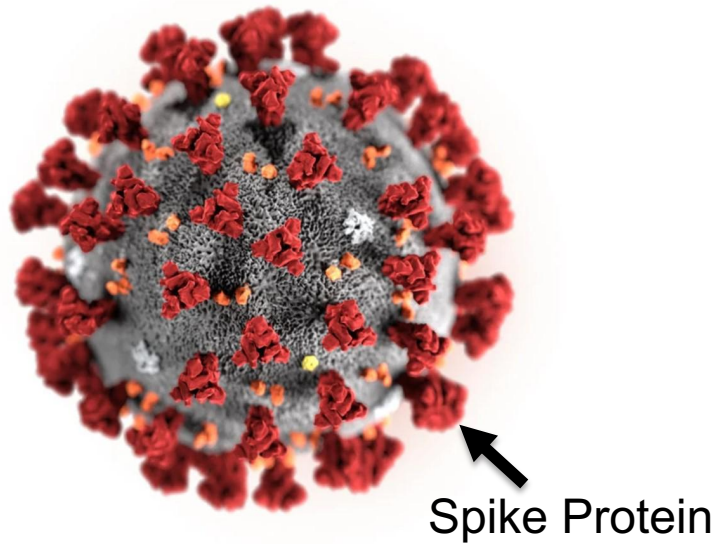
# Randomized double-blind placebo-controlled clinical trial



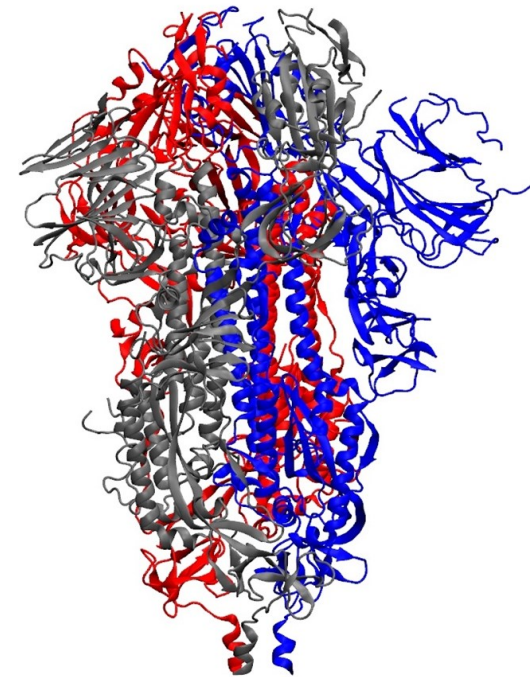
# Vaccines



# Coronavirus



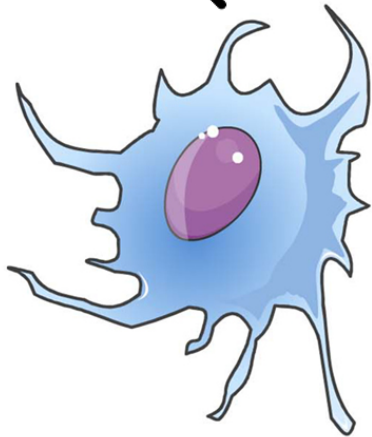
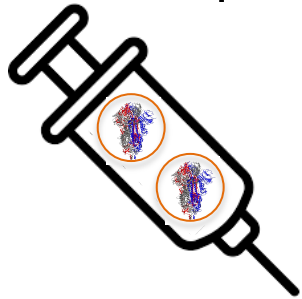
Coronavirus



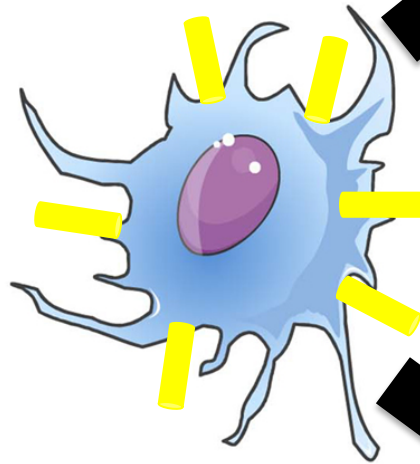
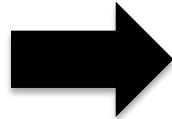
Spike Protein  
Molecular Model

# Protein Vaccine

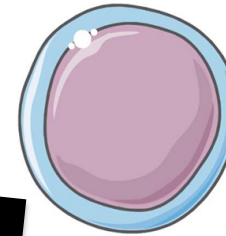
Spike protein



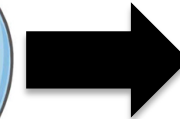
Antigen  
presenting cell



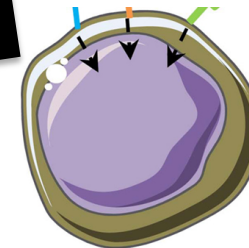
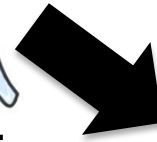
Antigen presenting  
cell expresses  
vaccine antigen



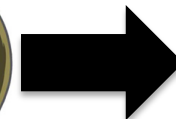
B lymphocyte



Antibody  
mediated  
immunity

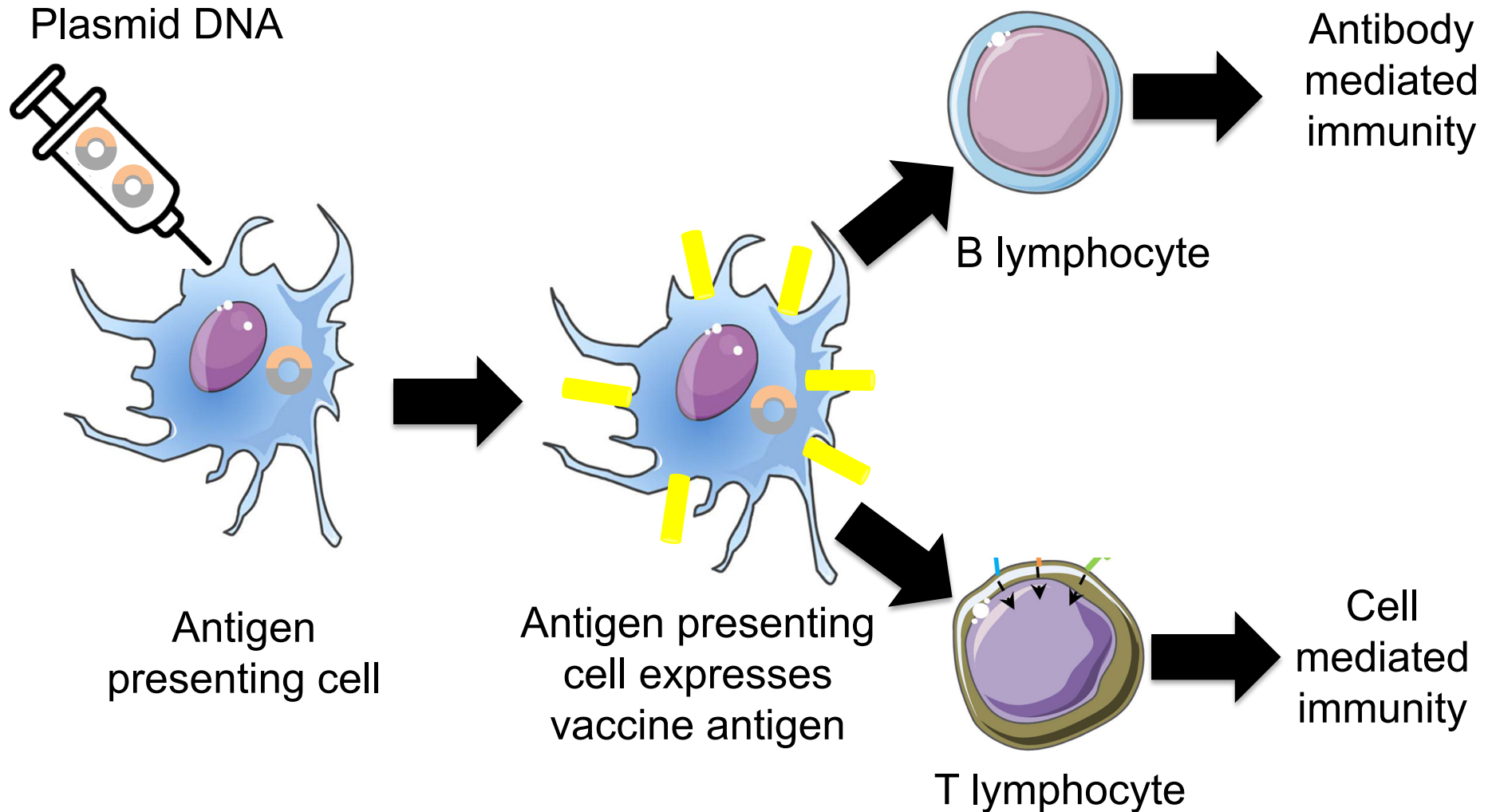


T lymphocyte



Cell  
mediated  
immunity

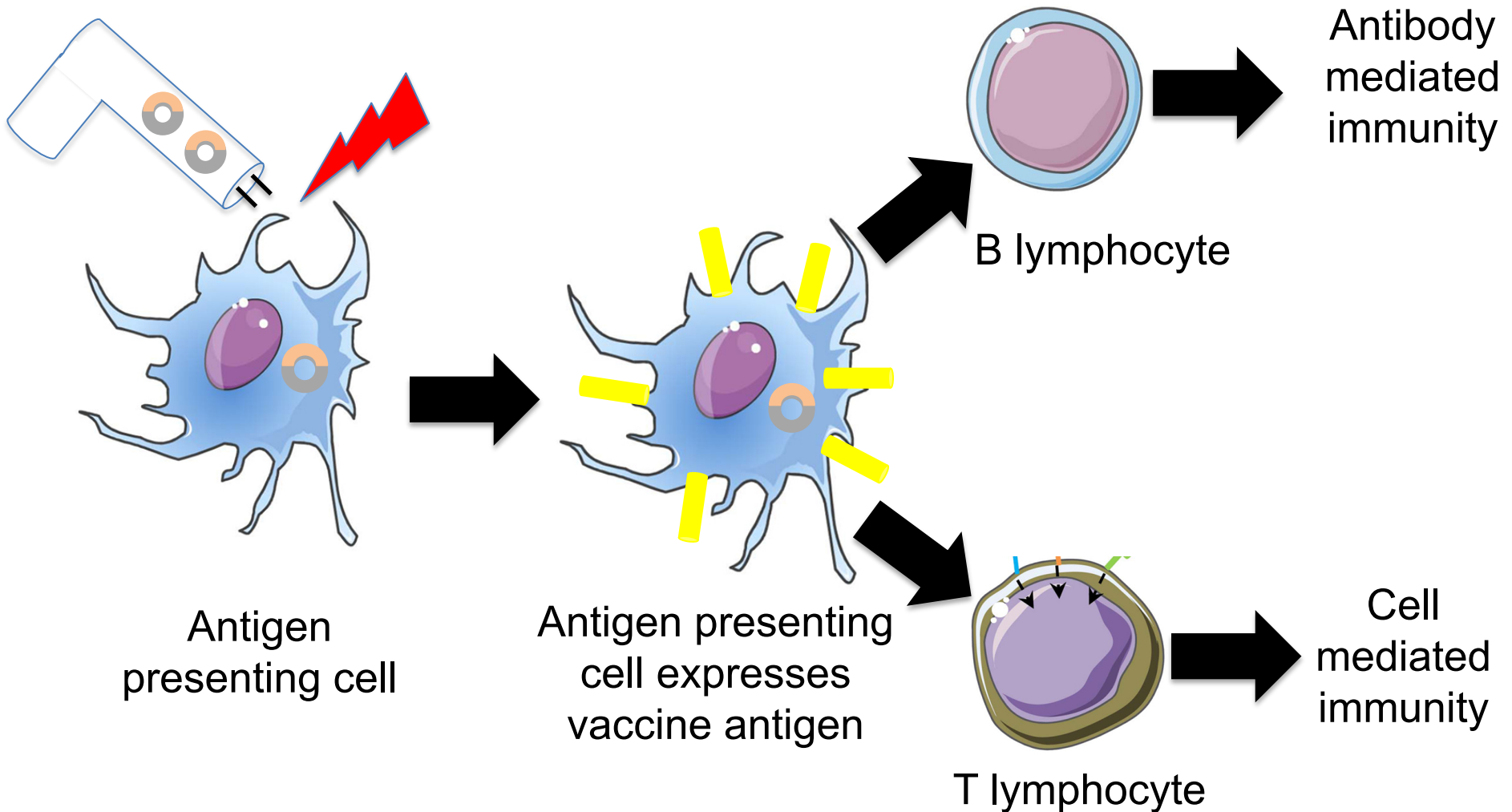
# DNA Vaccine



# COVID-19 Vaccine Trials

| Clinical Trial                          | Sponsor                         | Antigen                                 | Carrier / Delivery                          | Participants            |
|---|---------------------------------|---|---|-------------------------|
| 2019 coV Vaccine (mRNA-1273)            | NIAID, Moderna, USA             | Spike protein                           | Novel lipid nanoparticle                    | 45 Healthy volunteers   |
| RNA Vaccine Candidates against COVID-19 | BioNtec, Germany<br>Pfizer, USA | 4 Spike protein formulations, 2 domains | Lipid nanoparticle                          | 8640 Healthy volunteers |
| INO-4800 for COVID-19                   | Inovio Pharm., PA, USA          | Proprietary                             | DNA vaccine, Celectra® device, intra-dermal | 40 Healthy volunteers   |

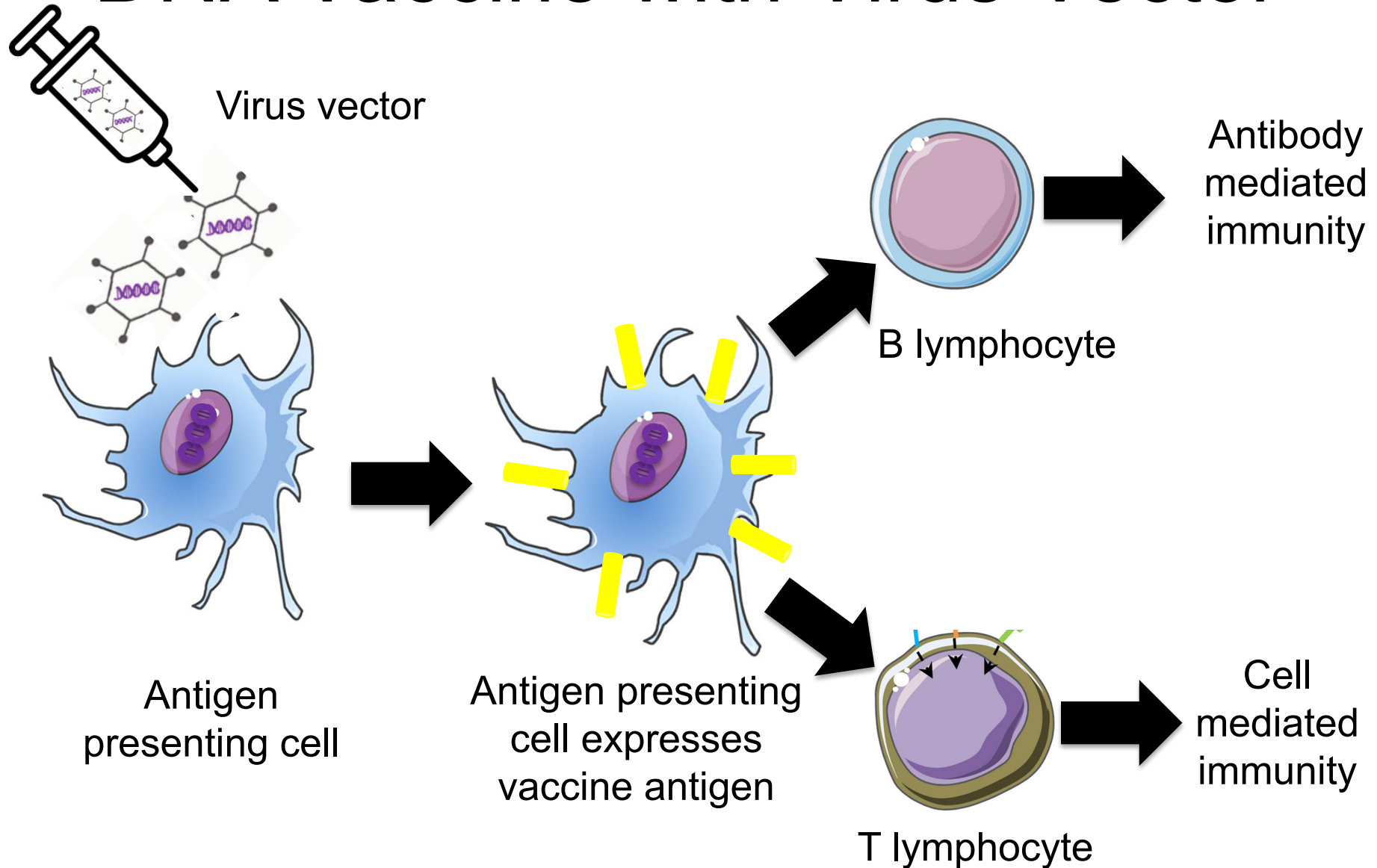
# DNA Vaccine with Electroporation



# COVID-19 Vaccine Trials

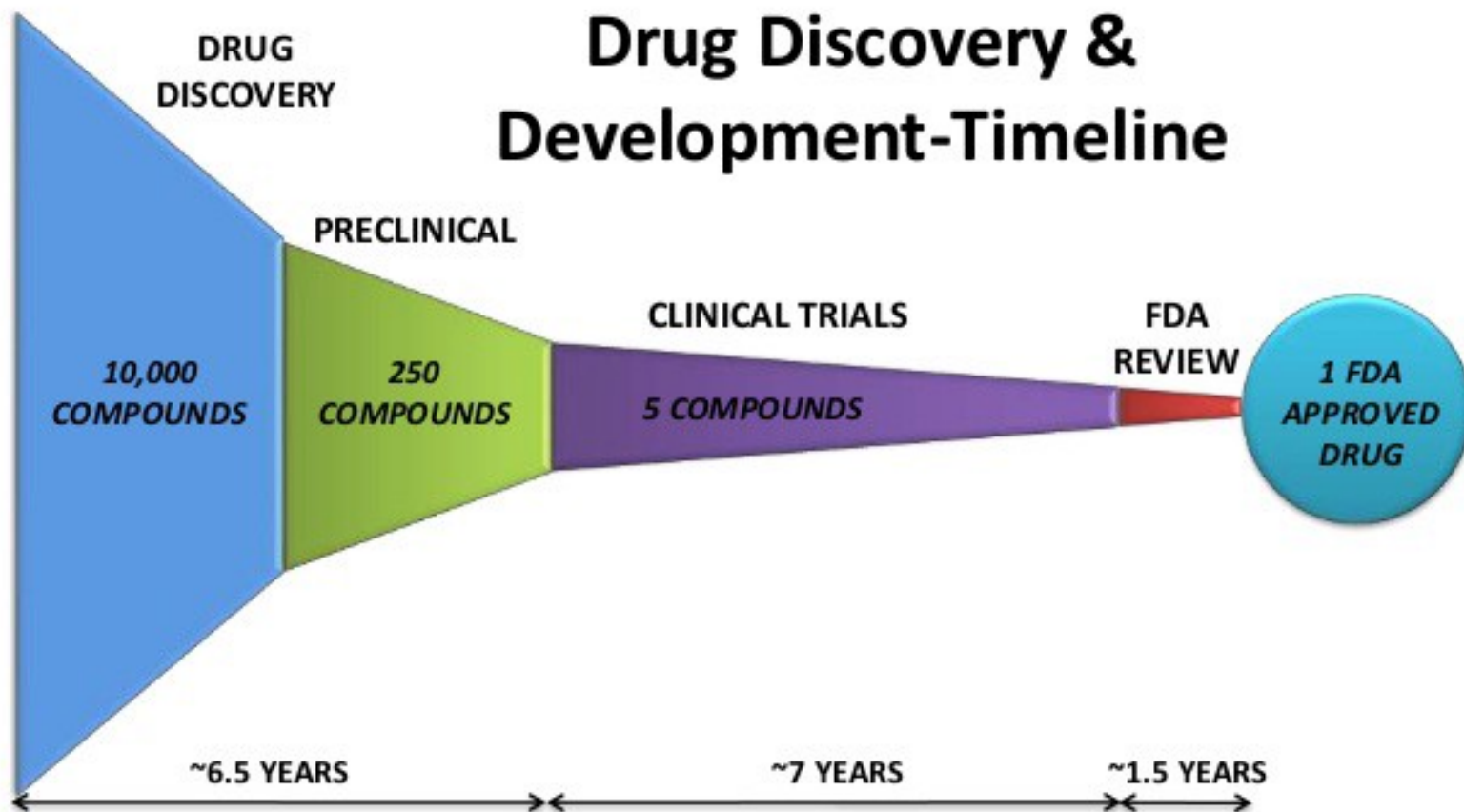
| Clinical Trial                        | Sponsor                                     | Antigen                         | Carrier / Delivery                            | Partici-pants                  |
|---------------------------------------|---|---------------------------------|---|--------------------------------|
| COVID-19 Vaccine ChAdOx1 nCoV-19      | Oxford University UK                        | Spike protein                   | Adenovirus vector                             | 1112 Healthy volunteers        |
| Recombinant Novel Coronavirus Vaccine | Academy of Military Medical Sciences, China | Spike protein                   | Adenovirus vector                             | 500 Healthy volunteers         |
| Covid-19 aAPC Vaccine                 | Shenzhen Geno-Immune Inst, China            | DNA of viral proteins, protease | Lentivirus, antigen presenting cells          | 100 Healthy volunteers         |
| Covid-19 Synthetic Minigene Vaccine   | Shenzhen Geno-Immune Inst, China            | DNA of viral proteins, protease | Lentivirus, antigen presenting cells, T cells | 100 Covid-19 infected patients |

# DNA Vaccine with Virus Vector



# COVID-19 Vaccine Trials

| Clinical Trial                               | Sponsor                     | Antigen                      | Carrier / Delivery      | Participants           |
|--|-----------------------------|------------------------------|-------------------------|------------------------|
| Inactivated Vaccine for SARS CoV-2 Infection | Sinovac Biotech, China      | Chemically inactivated virus | Intramuscular injection | 744 Healthy volunteers |
| Inactivated SARSoCoV-2 Vaccine               | Chinese Academy of Sciences | Inactivated virus            | Intramuscular injection | 942 healthy volunteers |



**\$1 to \$2 billion**

Collins. Science Translational Med 3:1, 2011  
Munos. Nat Rev Drug Discov 8:959, 2009  
Paul et al. Nat Rev Drug Discov 9:203, 2010

- Passive Immunity
  - Convalescent plasma
  - Monoclonal antibodies to spike protein
- “Trained” Immunity
  - BCG
  - Oral poliovirus vaccine
  - Measles vaccine



# ACTIV Partnership

Accelerating CCOVID-19 Therapeutic  
Interventions and Vaccines



# Getting Involved

- Buffalo Research Registry
- [www.buffalo.edu/ctsi/brr](http://www.buffalo.edu/ctsi/brr)
- Participate in Research portal
- [www.buffalo.edu/ctsi/pir](http://www.buffalo.edu/ctsi/pir)

## Participate in Research

Search and volunteer to participate in these available studies at UB. Your participation in research doesn't just benefit you, it helps advance healthcare for our entire community.

Be an Informed Participa...

### Highlighted Searches

**Healthy Volunteer**

**COVID-19 and  
Infectious Diseases**

**Mental & Behavioral  
Health**

**Dental Health**

**Lung & Respiratory  
Health**

**Diet / Obesity / Weight  
Loss**

**Multiple Sclerosis**

**Show More**

### Search Clinical Trials


Filter on any fields below

**Keyword** 

i.e. asthma



### Enrollment Update

Due to COVID-19, new enrollment in research studies will be greatly limited. If you are interested in a study, there may be a longer waiting period to receive a response to your inquiry. View the [guidance for research participants](#)  for additional information.

# Sources of Reliable Information

Clinical Trials

<https://clinicaltrials.gov>

Erie County Department of Health

<https://www2.erie.gov/health/>

New York State Department of Health

<https://health.ny.gov>

US Center for Disease Control

<https://www.cdc.gov>

Johns Hopkins Coronavirus Resource Center

<https://coronavirus.jhu.edu/map.html>