Vaccine Development & Approval:
Safety & Efficacy of Covid-19 Vaccines

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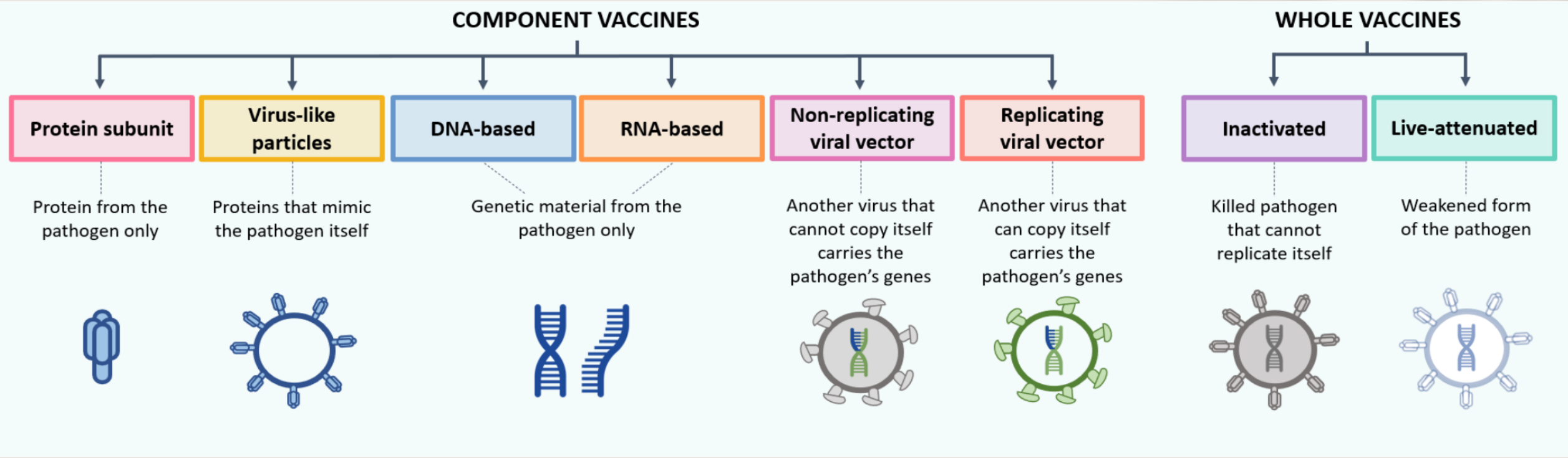
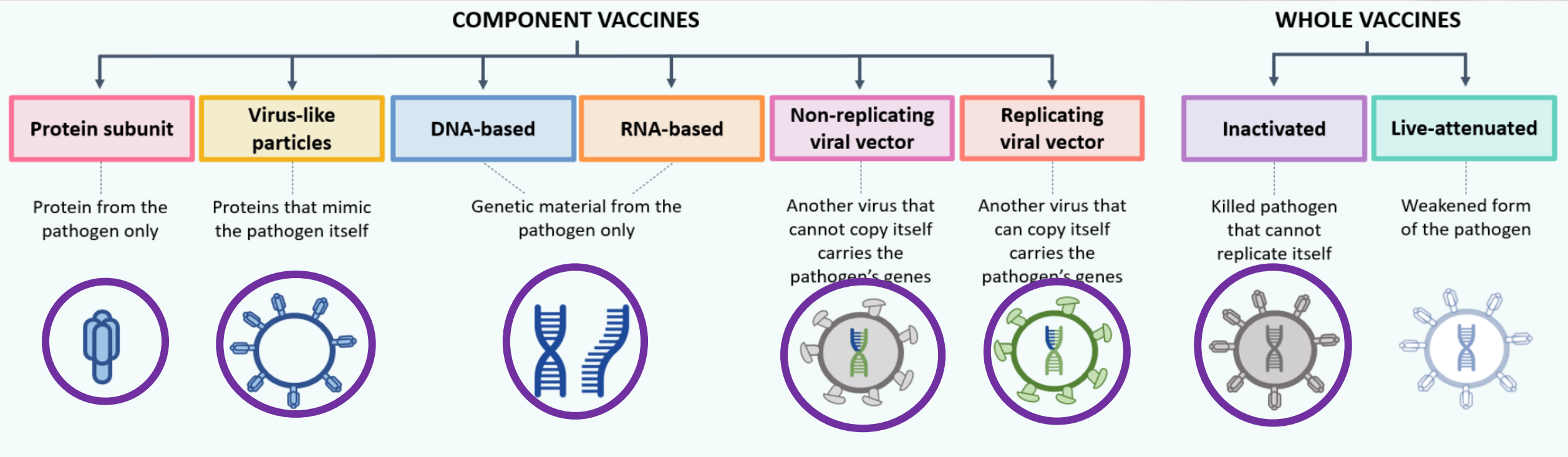
Vaccines – Types



https://covid19.trackvaccines.org/how-do-vaccines-work/#types

Vaccines – Types



= Covid-19 vaccine of this type currently in use or in Phase 3 clinical trials

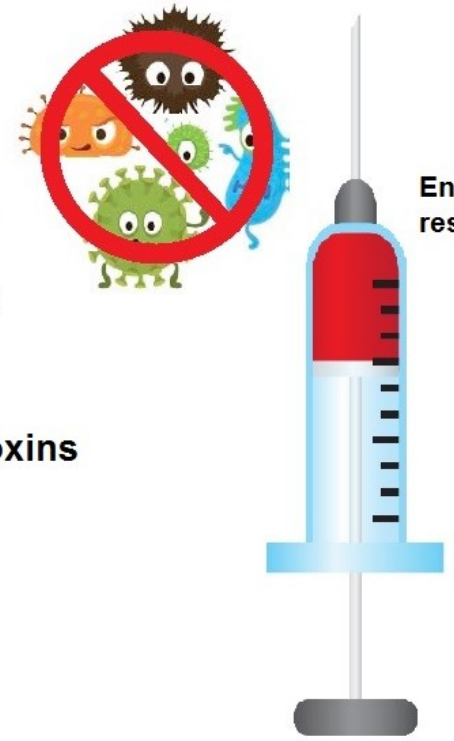
https://covid19.trackvaccines.org/how-do-vaccines-work/#types

Vaccine Components -

ACTIVE COMPONENT

Antigen

- Weakened microbes
- Inactivated microbes
- Parts of microbes
- Modified microbial toxins



EXCIPIENTS

Adjuvants

Enhance body's immune response towards antigens

Stabilizers

Protect vaccine from harsh processing conditions

Preservatives

Prevent contamination during use of multiple-dose preparations

Antibiotics

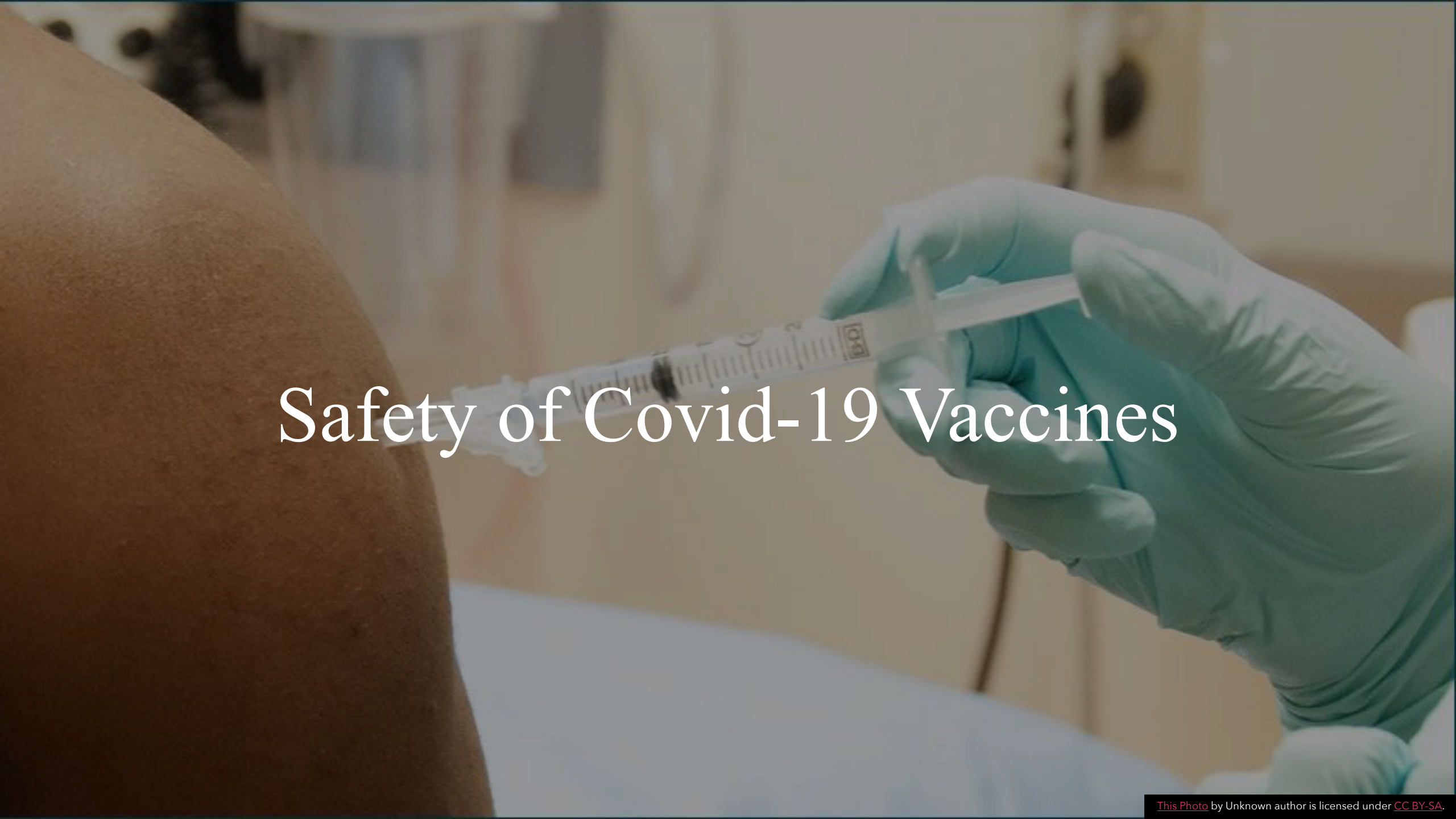
Prevent microbial contamination during manufacture

Used to inactivate microbes in toxoid vaccines

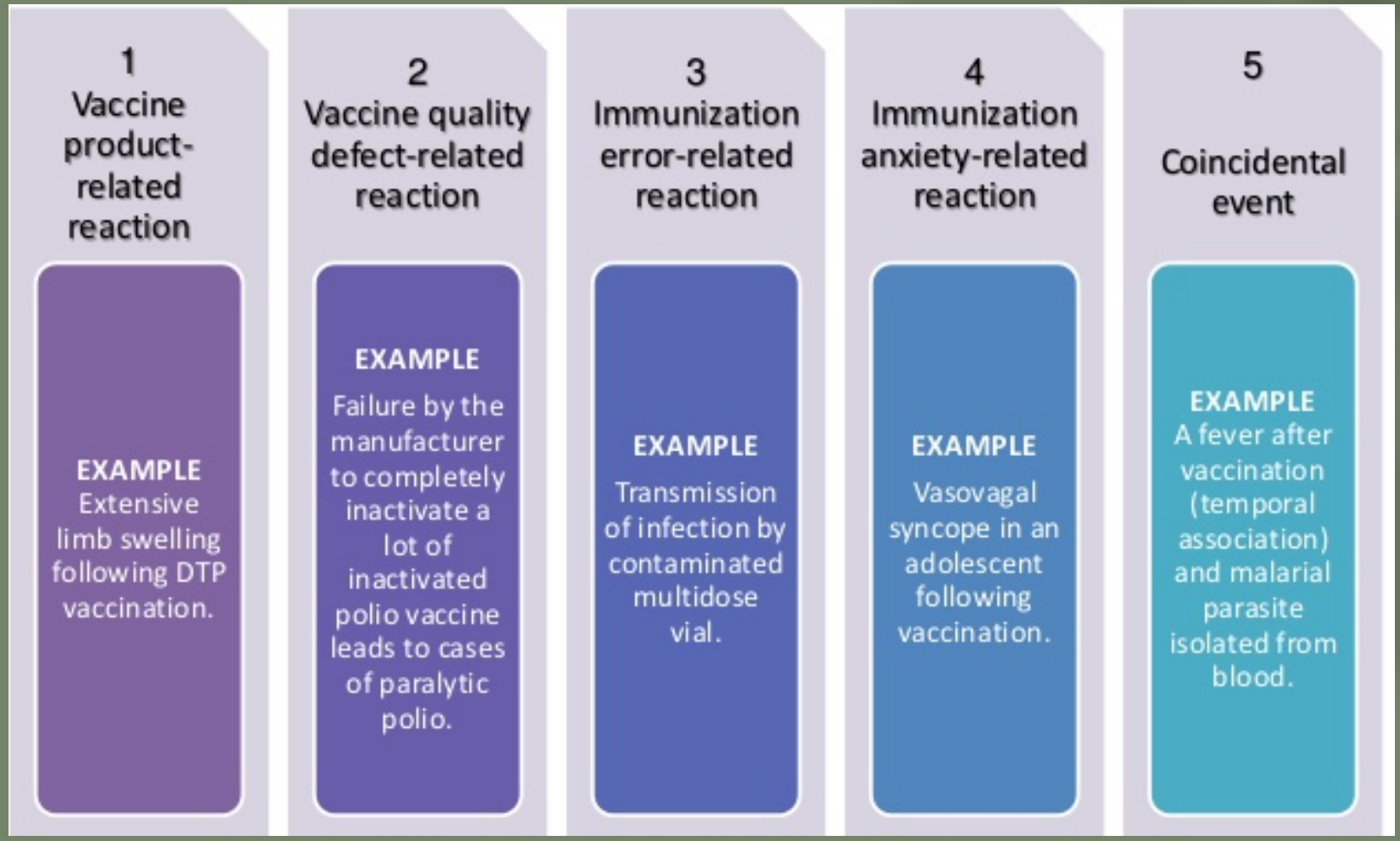
Trace Components

Minute quantities of residual components used during manufacture
(ie: inactivating agents, antibiotics, egg proteins etc)

Safety of Covid-19 Vaccines



Safety :
Adverse Event Following Immunisation (AEFIs)



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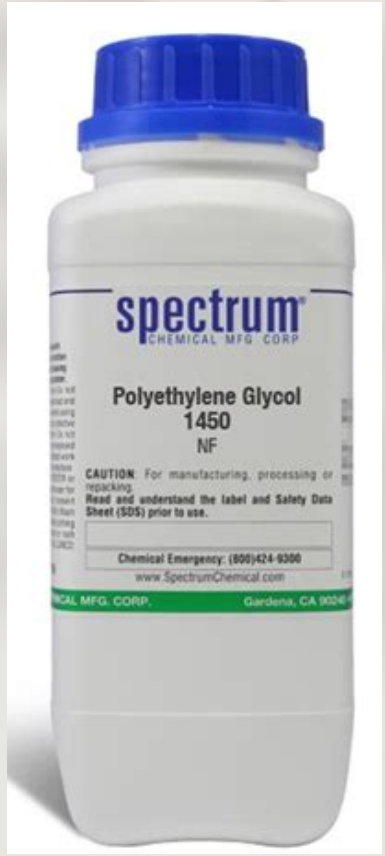
Vaccine Components - Safety



- **ANY** vaccine component may cause an AEFI.

  - Polyethylene Glycol (PEG) used in both Pfizer and Moderna vaccines as part of the packaging of the mRNA.
  - Polysorbate – closely related to PEG
  - Allergy-like reactions by vaccinated persons have been linked to both compounds.

CLINICAL TRIALS: How Do They Work?

	Activity	Sample Size
Pre-Clinical Trial	Immunogenicity & efficacy testing on research animals	
Clinical Trial Phase I	Safety and immunogenicity of a vaccine candidate in low-risk individuals - Tolerability	10 - 100
Clinical Trial Phase II	Monitor safety, potential side effects, immune response & determine optimum dosage and schedule	100-1000
Clinical Trial Phase III	Address clinical efficacy in disease prevention and provide further safety information from more heterogenous populations & longer observation times	1000-10000
Submission	Vaccine application is submitted to regulatory authorities for approval to market	
Introduction	Vaccine made available for public usage	
Post-licensure & Clinical Trial Phase IV	Assessing AEFIs, number & timing of doses and other demographics	

Covid-19 Vaccines – That was Quick!!!

Increased funding for vaccine development

Previous research on vaccines for coronaviruses

Worldwide co-operation and sharing of scientific knowledge

Steps conducted in parallel vs sequentially

Appointed committee members conduct independent data reviews

Covid-19 Vaccines – Approved (thus far)

Name (Country of Origin)	Platform	# of Countries approved	Stage of Development
BioNTech/Pfizer (Germany)	mRNA	55	Phase IV
Moderna (USA)	mRNA	37	Phase IV
Gamaleya/Sputnik (Russia)	Non-replicating Viral Vector	14	Phase III
Oxford/AstraZeneca (UK)	Non-replicating Viral Vector	11	Phase IV
Sinopharm/BBIBP-CorV (China)	Inactivated	8	Phase III
Sinovac/CoronaVac (China)	Inactivated	5	Phase III
Covishield/Serum Institute of India (India)	Non-replicating Viral Vector	4	Phase III
Sinopharm/Inactivated (China)	Inactivated	2	Phase III
Covaxin/Bharat Biotech (India)	Inactivated	1	Phase III
CanSino (China)	Non-replicating Viral Vector	1	Phase III
EpiVacCorona (Russia)	Protein Subunit	1	Phase I/II
Janssen/Johnson & Johnson (USA)	Non-replicating viral vector	0	Phase III

Covid-19 Vaccines – AEFIs (thus far)

Vaccine	Side Effects	Anaphylaxis	Recovery
Pfizer	Pain, fatigue, headache, myalgia, chills, fever, swelling, joint pain, nausea	**21** cases - 1.1 x 10^{-5} % 71% - occurred in 1st 15 mins	All recovered
Moderna	Pain, fatigue, headache, my algia, chills, fever, swelling, joint pain, nausea No VAERD	**10** cases -2.4 x 10^{-6} % 90% - occurred in1st 15 mins	All recovered
Oxford	Pain, myalgia, headache, fatigue	Not Known	
Sputnik	Pain, myalgia, headache, fatigue	Not Known	

Vaccine Efficacy

Vaccine Efficacy vs Vaccine Effectiveness

- **Vaccine Efficacy**
  - The percentage reduction of a disease in a group of vaccinated persons in a clinical trial
- **Vaccine Effectiveness**
  - The measurement of how well a vaccine works when given to the community outside of clinical trials

https://www.medicalnewstoday.com/articles/what-is-vaccine-efficacy

Covid-19 Vaccines – Efficacy

Name	Efficacy	Demographics
BioNTech/Pfizer	≥16 yrs: 95% after 2 doses	Racially diverse – 41% Upper age – 85 yrs
Moderna	≥ 18 yrs: 94.1% after 2 doses	Racially diverse – 18% Upper age – 95 yrs
Gamaleya/Sputnik	≥ 18 yrs: 91.6% after 2 doses	Racially diverse – 1% Upper age – 80+
Oxford/AstraZeneca	≥ 18 yrs: 70.4% after 2 doses	Racially diverse – 17% Upper age 79+
Janssen/Johnson & Johnson	≥ 18 yrs: 66% after single dose 72% in USA; 66% in South America; 57% in South Africa N.B. - 85% prevention of severe disease	Racially diverse – 41% Upper age – 80+

Variants – A new dilemma?

- Three new variants identified:
  - B.1.1.7 - UK – 23 mutations – several in S protein – spreads more easily and quickly - may increase risk of death
  - B.1.351 - South Africa – multiple mutations in S protein
  - P.1 - Brazil – 17 mutations – 3 mutations in S protein – may be less vulnerable to Abs generated by previous infection or vaccination
- Early laboratory studies

Conclusion

Next ?

Continuous vaccination worldwide

- Important role in emergence of variants

Approval of new vaccines

- 20 in Phase III
- 36 in Phase II
- 23 in Phase I

Data generation, collection and analysis

Advancement of new vaccine protocols

- Mixing of vaccines to improve efficacy

THANK YOU