Global Review of Neutralisation Assays against Omicron

Ioannis Sitaras

WHO Consultation on COVID-19 Vaccines

14th of February, 2022

INTERNATIONAL VACCINE ACCESS CENTER

World Health Organization

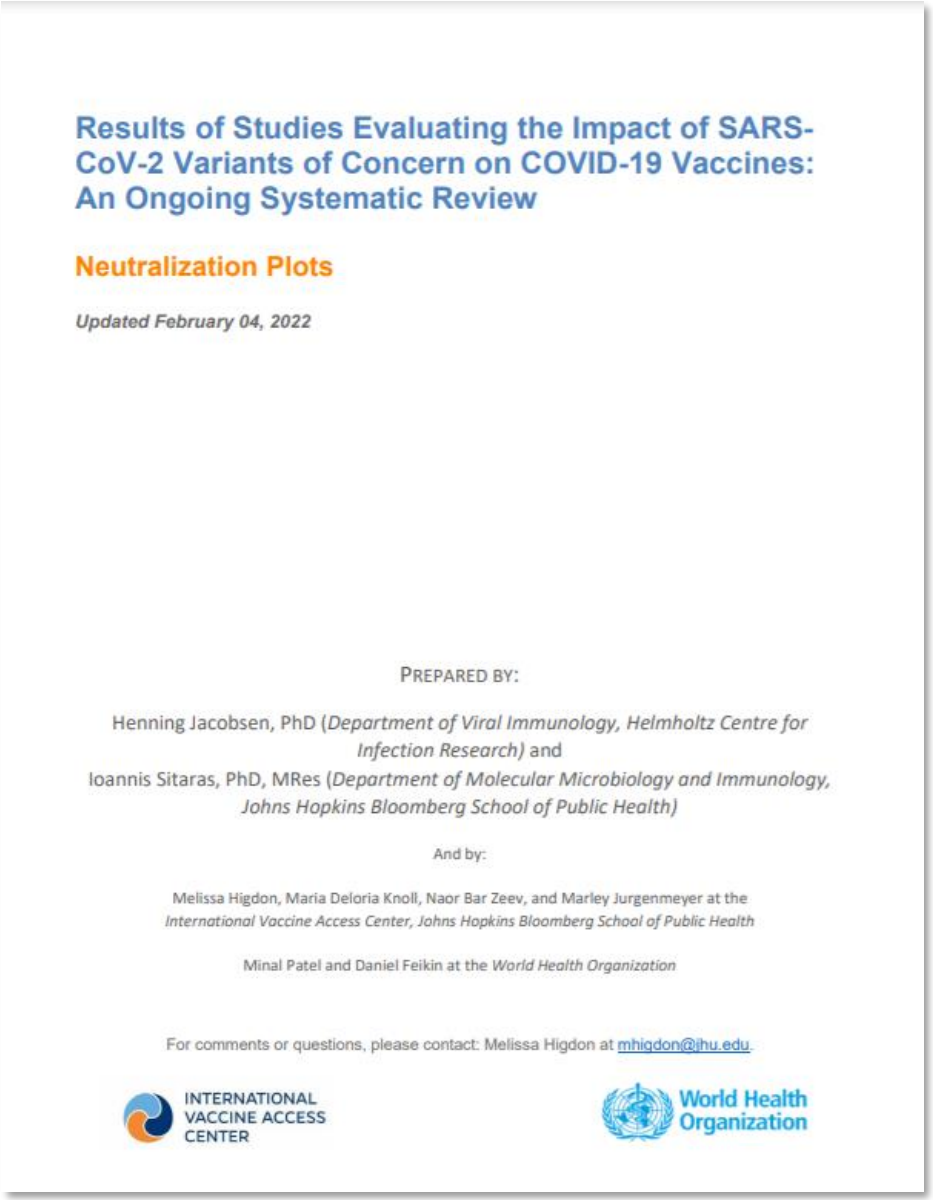
CEPI

WHO Working Group on SARS-CoV-2 Variants and Neutralisation

- Tasked to screen, summarise, and report to WHO literature on NT assays using post-vaccination sera against VoCs and VoIs.
- Hundreds of papers screened.
- Collection and analysis of all available NT data.
  - Live vs pseudo-viruses
  - Vaccine platform
  - Individual vaccines
  - Vaccine combinations

Neutralisation Data: Global Summary

https://view-hub.org/resources


Results of Studies Evaluating the Impact of SARS-CoV-2 Variants of Concern on COVID-19 Vaccines: An Ongoing Systematic Review

Neutralization Plots

Updated February 04, 2022

PREPARED BY:

Henning Jacobsen, PhD (*Department of Viral Immunology, Helmholtz Centre for Infection Research*) and
Ioannis Sitaras, PhD, MRes (*Department of Molecular Microbiology and Immunology, Johns Hopkins Bloomberg School of Public Health*)

And by:

Melissa Higdon, Maria Deloria Knoll, Naor Bar Zeev, and Marley Jurgenmeyer at the *International Vaccine Access Center, Johns Hopkins Bloomberg School of Public Health*

Minal Patel and Daniel Feikin at the *World Health Organization*

For comments or questions, please contact: Melissa Higdon at mhigdon@jhu.edu.

INTERNATIONAL VACCINE ACCESS CENTER

World Health Organization

INTERNATIONAL VACCINE ACCESS CENTER

World Health Organization

CEPI

Inclusion/Exclusion Criteria

- Published papers and pre-prints (no press releases).
- Studies in which the vaccine-seed strain (or similar) was included in the comparison.
- Sera collected from vaccinated uninfected individuals (full primary series or booster).
- Sera collected ≥7 days, ≤6 month post final dose.
- Sera from subjects that are not immunocompromised or suffer from conditions known to affect vaccination-induced immunity.
- Only pseudoviruses that carry the full complement of Spike mutations characteristic of Omicron.

Overview of Vaccines and Dataset

Primary Vaccination Series				
Type of Vaccination	**Platform**	**Vaccine**	**N Obs**	**No. of Sera**
Homologous	Inactivated	BBIBP-CorV	4	325
		CoronaVac	4	135
	mRNA	mRNA-1273	13	263
		Comirnaty	31	769
	Vector	Vaxzevria	7	204
		Sputnik V	2	26
		Ad26.COV2.S	6	115
Heterologous	Vector + mRNA	Vaxzevria + mRNA-1273	1	11
		Vaxzevria + Comirnaty	1	15
		Total	**69**	**1863**
Booster				
Homologous	Inactivated	BBIBP-CorV (3 doses)	4	408
		CoronaVac (3 doses)	2	70
	mRNA	mRNA-1273 (3 doses)	7	74
		Comirnaty (3 doses)	19	418
	Protein subunit	Anhui ZL (3 doses)	3	44
	Vector	Sputnik V + Sputnik Light	1	6
		Ad26.COV2.S (2 doses)	1	20
Heterologous	Inactivated + Protein subunit	BBIBP-CorV + Anhui ZL	2	20
	Inactivated + mRNA	CoronaVac + Comirnaty	2	85
	mRNA + mRNA	mRNA-1273 + Comirnaty	1	4
		Comirnaty + mRNA-1273	1	4
	mRNA + Vector	Comirnaty + Ad26.COV2.S	2	61
	Vector + mRNA	Ad26.COV2.S + Comirnaty	1	20
	Vector + Protein subunit	Vaxzevria + MVC-COV1901	1	73
		Total	**47**	**1307**

INTERNATIONAL VACCINE ACCESS CENTER

World Health Organization

CEPI

Sitaras, Jacobsen, Higdon, *et al.*, In preparation (2022)

Overview of Vaccines and Dataset

Primary Vaccination Series				
Type of Vaccination	**Platform**	**Vaccine**	**N Obs**	**No. of Sera**
Homologous	Inactivated	BBIBP-CorV	4	325
		CoronaVac	4	135
	mRNA	mRNA-1273	13	263
		Comirnaty	31	769
	Vector	Vaxzevria	7	204
		Sputnik V	2	26
		Ad26.COV2.S	6	115
Heterologous	Vector + mRNA	Vaxzevria + mRNA-1273	1	11
		Vaxzevria + Comirnaty	1	15
		Total	**69**	**1863**
Booster				
Homologous	Inactivated	BBIBP-CorV (3 doses)	4	408
		CoronaVac (3 doses)	2	70
	mRNA	mRNA-1273 (3 doses)	7	74
		Comirnaty (3 doses)	19	418
	Protein subunit	Anhui ZL (3 doses)	3	44
	Vector	Sputnik V + Sputnik Light	1	6
		Ad26.COV2.S (2 doses)	1	20
Heterologous	Inactivated + Protein subunit	BBIBP-CorV + Anhui ZL	2	20
	Inactivated + mRNA	CoronaVac + Comirnaty	2	85
	mRNA + mRNA	mRNA-1273 + Comirnaty	1	4
		Comirnaty + mRNA-1273	1	4
	mRNA + Vector	Comirnaty + Ad26.COV2.S	2	61
	Vector + mRNA	Ad26.COV2.S + Comirnaty	1	20
	Vector + Protein subunit	Vaxzevria + MVC-COV1901	1	73
		Total	**47**	**1307**

INTERNATIONAL VACCINE ACCESS CENTER

World Health Organization

CEPI

Sitaras, Jacobsen, Higdon, *et al.*, In preparation (2022)

Overview of Vaccines and Dataset

Primary Vaccination Series				
Type of Vaccination	**Platform**	**Vaccine**	**N Obs**	**No. of Sera**
Homologous	Inactivated	BBIBP-CorV	4	325
		CoronaVac	4	135
	mRNA	mRNA-1273	13	263
		Comirnaty	31	769
	Vector	Vaxzevria	7	204
		Sputnik V	2	26
		Ad26.COV2.S	6	115
Heterologous	Vector + mRNA	Vaxzevria + mRNA-1273	1	11
		Vaxzevria + Comirnaty	1	15
		Total	**69**	**1863**
Booster				
Homologous	Inactivated	BBIBP-CorV (3 doses)	4	408
		CoronaVac (3 doses)	2	70
	mRNA	mRNA-1273 (3 doses)	7	74
		Comirnaty (3 doses)	19	418
	Protein subunit	Anhui ZL (3 doses)	3	44
	Vector	Sputnik V + Sputnik Light	1	6
		Ad26.COV2.S (2 doses)	1	20
Heterologous	Inactivated + Protein subunit	BBIBP-CorV + Anhui ZL	2	20
	Inactivated + mRNA	CoronaVac + Comirnaty	2	85
	mRNA + mRNA	mRNA-1273 + Comirnaty	1	4
		Comirnaty + mRNA-1273	1	4
	mRNA + Vector	Comirnaty + Ad26.COV2.S	2	61
	Vector + mRNA	Ad26.COV2.S + Comirnaty	1	20
	Vector + Protein subunit	Vaxzevria + MVC-COV1901	1	73
		Total	**47**	**1307**

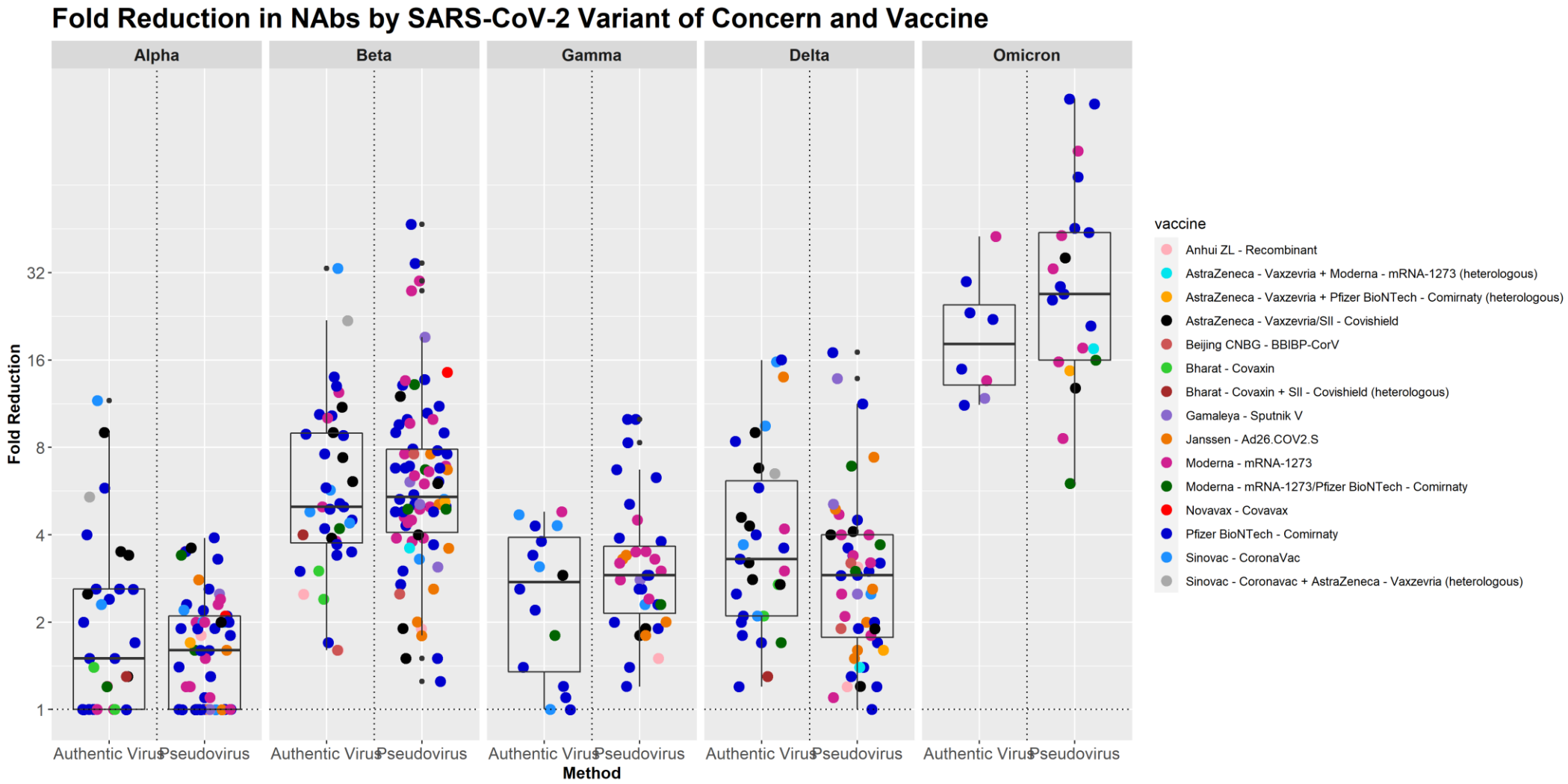
INTERNATIONAL VACCINE ACCESS CENTER

World Health Organization

CEPI

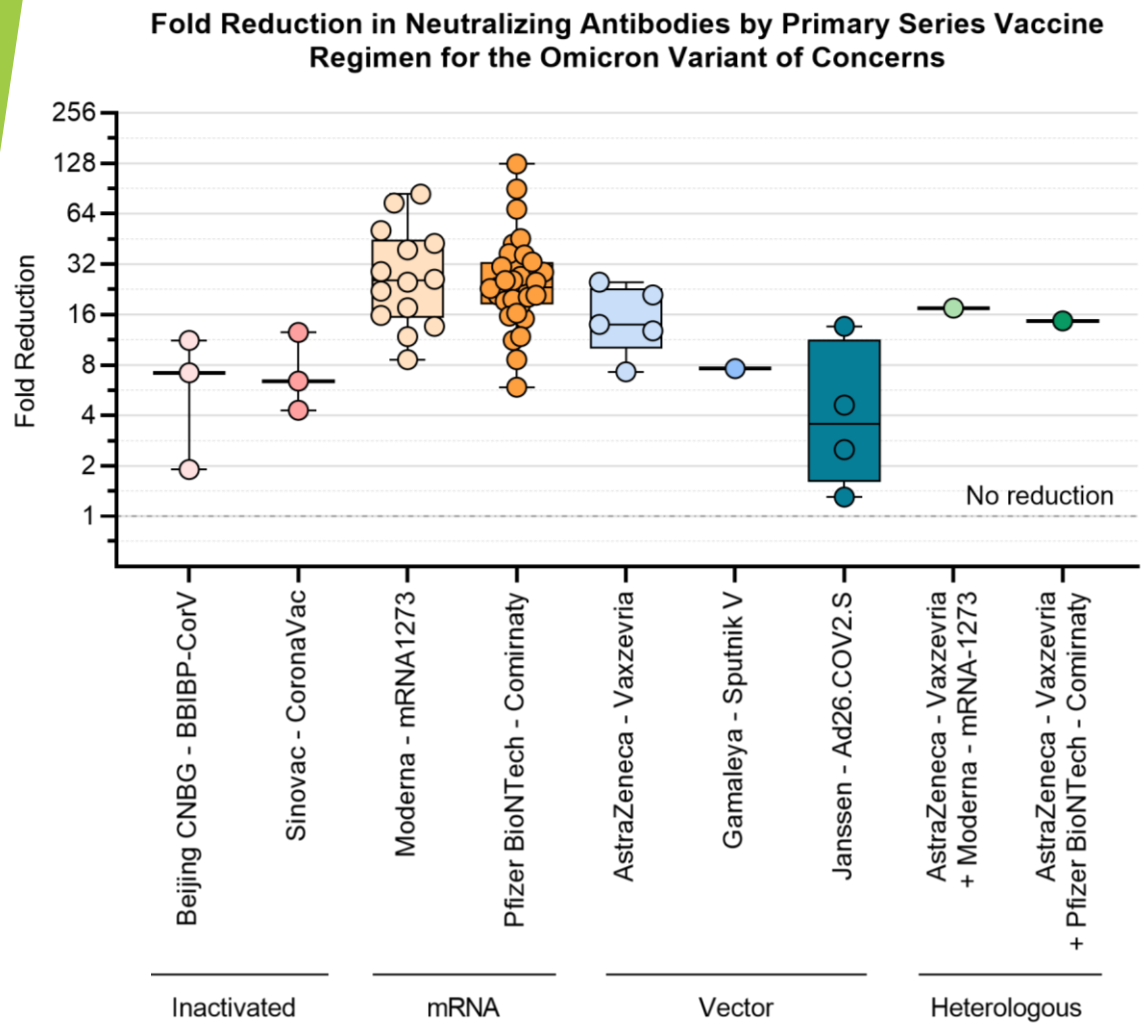
Sitaras, Jacobsen, Higdon, *et al.*, In preparation (2022)

Live vs Pseudo-viruses



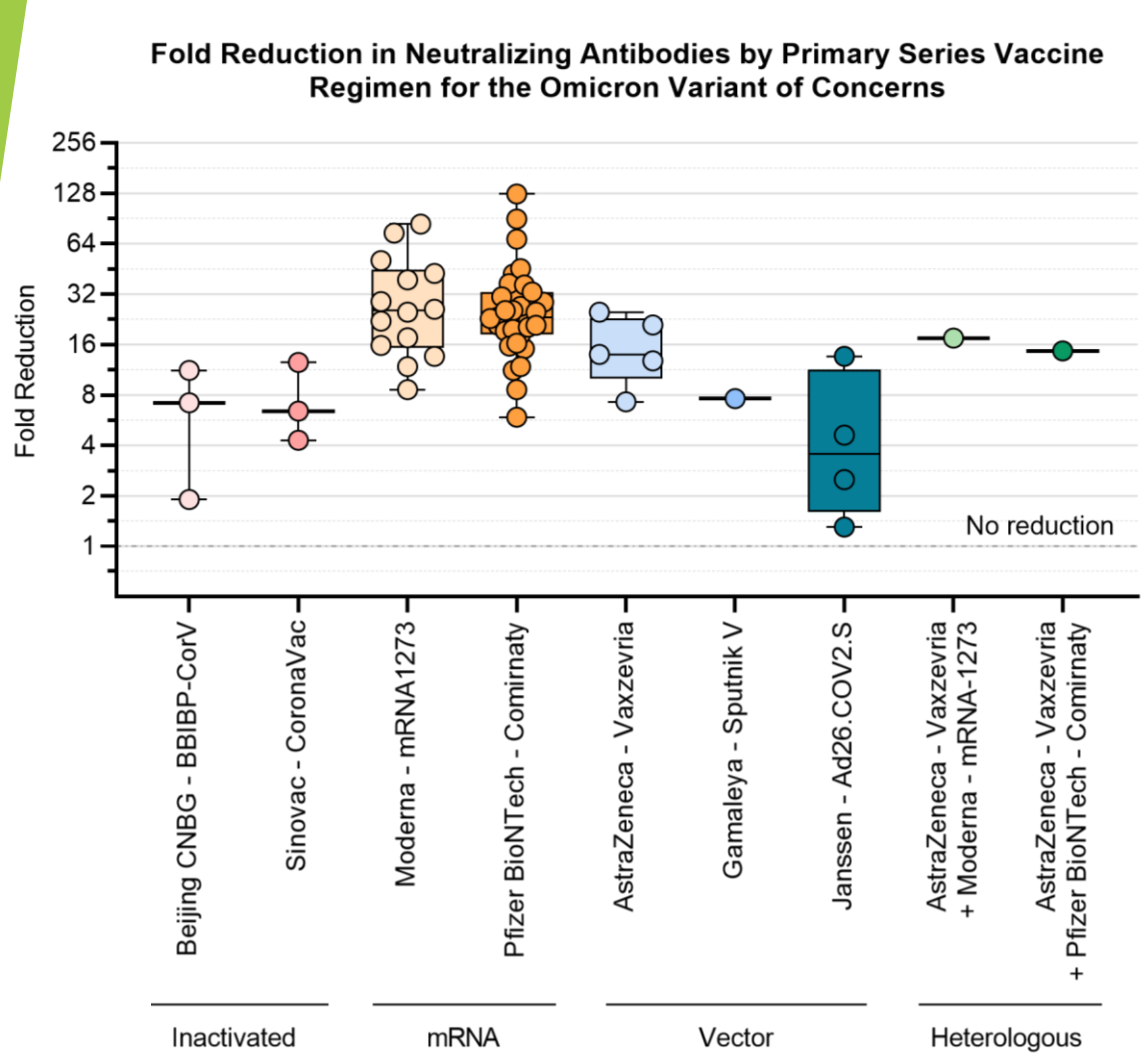
Sitaras, Jacobsen, Higdon, *et al.*, In preparation (2022)

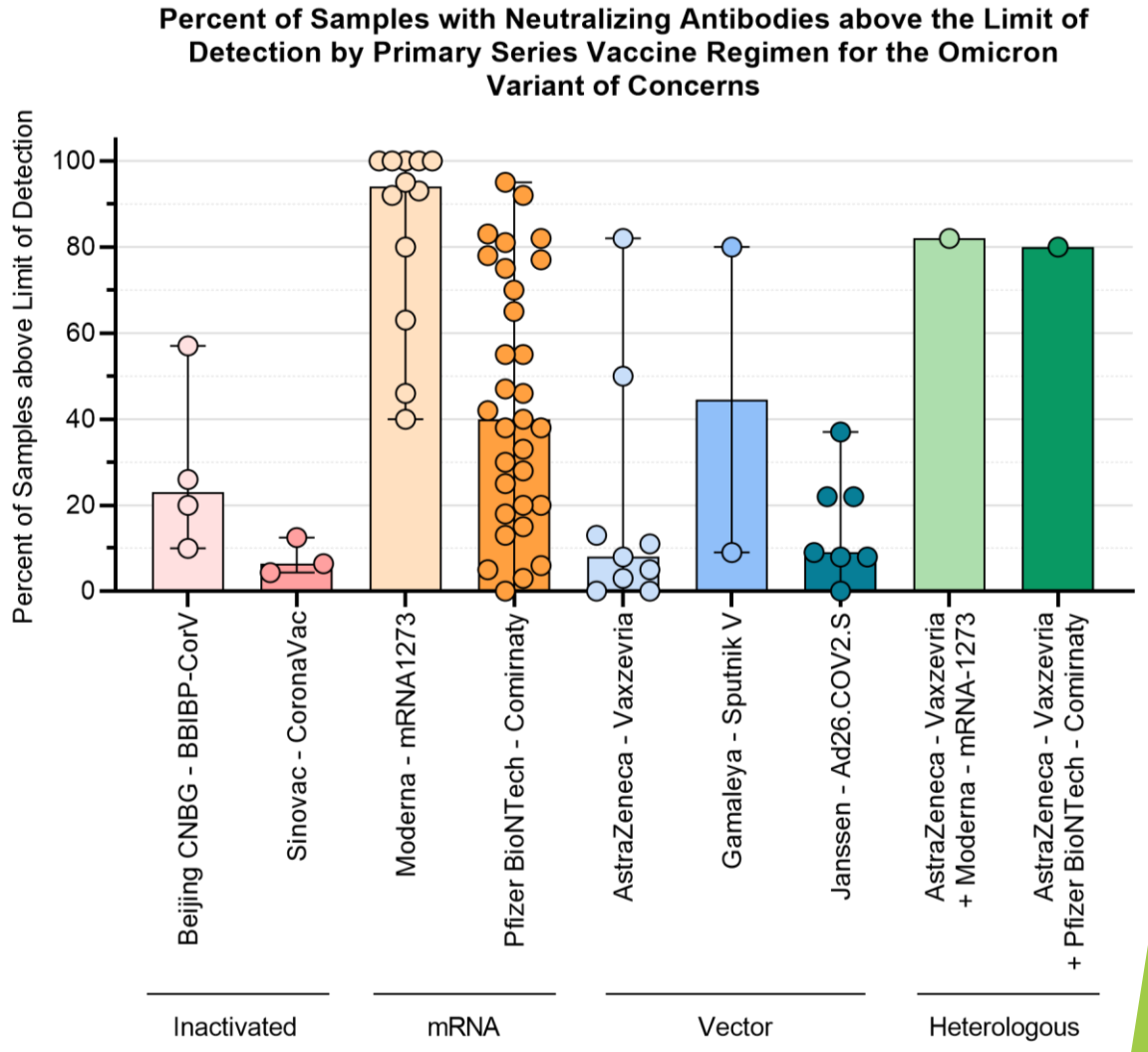
Neutralisation Data: Primary Vaccination Series



Sitaras, Jacobsen, Higdon, *et al.*, In preparation (2022)

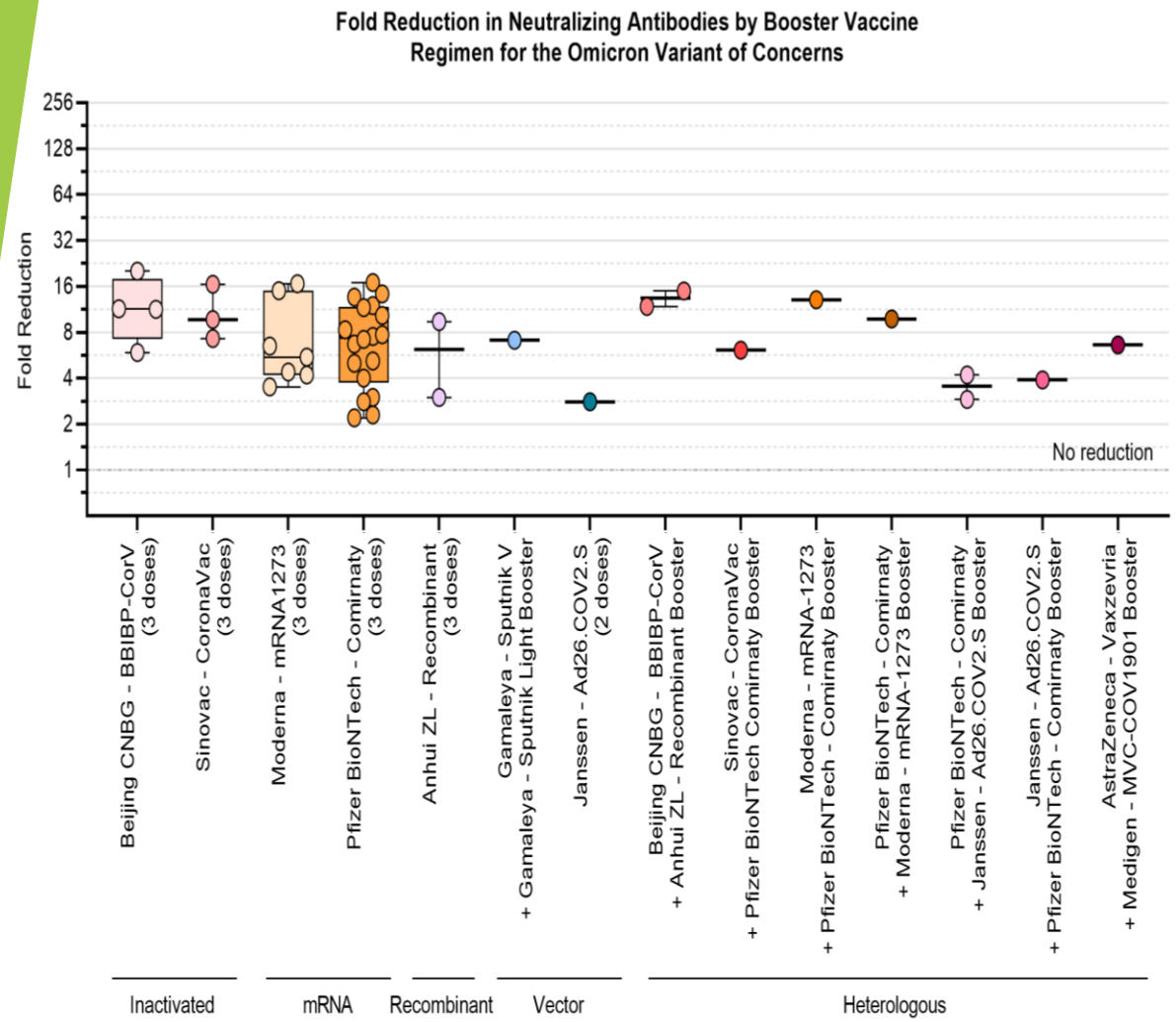
Neutralisation Data: Primary Vaccination Series





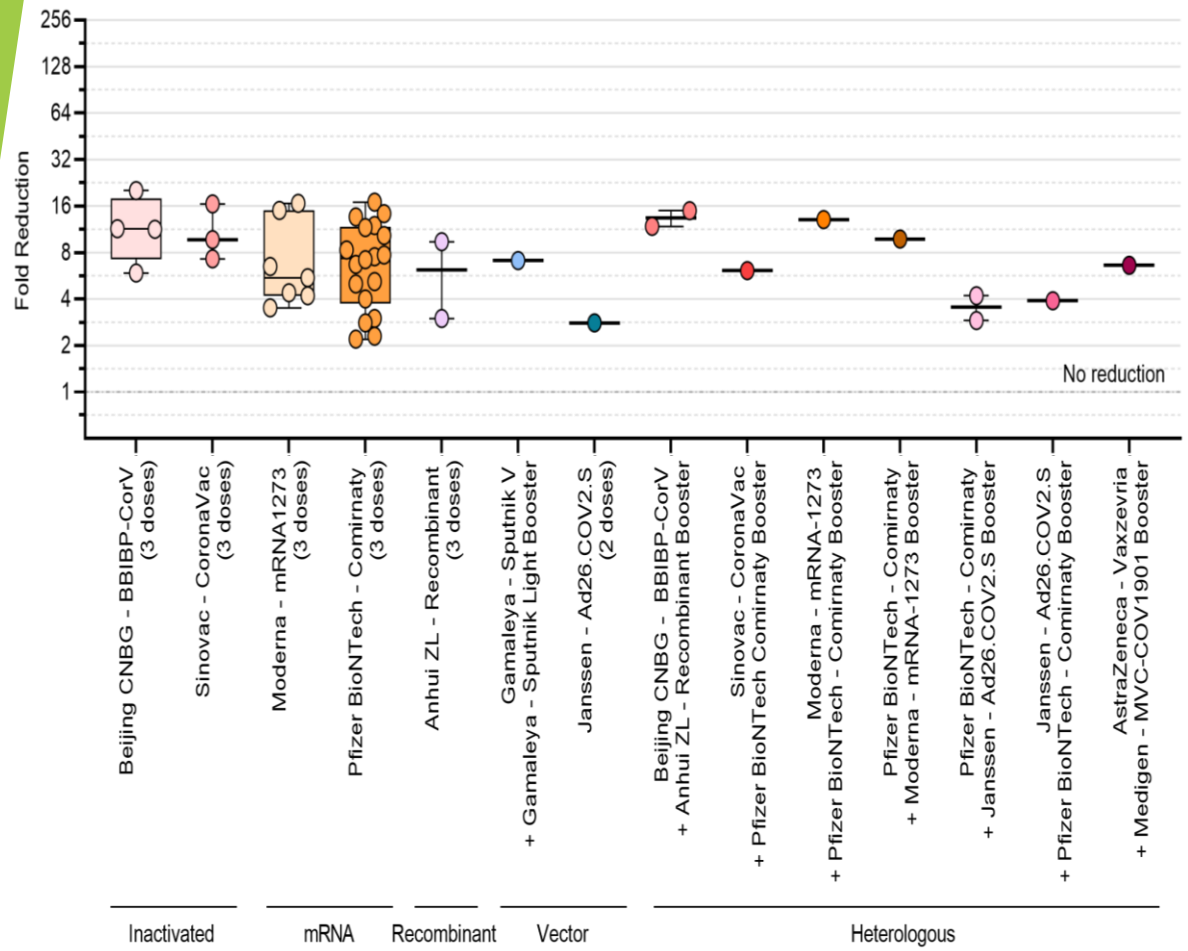
Sitaras, Jacobsen, Higdon, *et al.*, In preparation (2022)

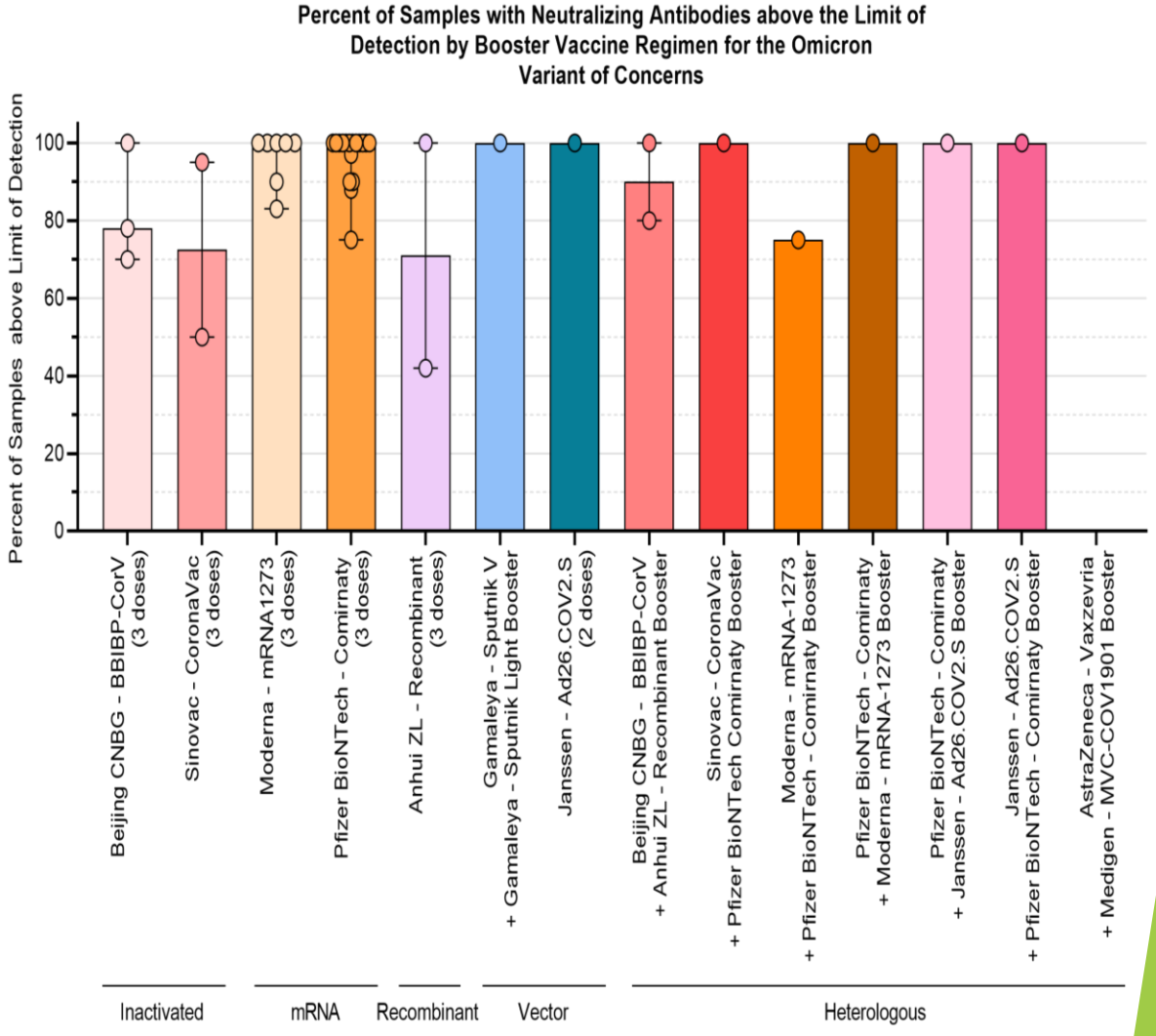
Neutralisation Data: Booster



Sitaras, Jacobsen, Higdon, *et al.*, In preparation (2022)

Neutralisation Data: Booster





INTERNATIONAL VACCINE ACCESS CENTER

World Health Organization

CEPI

Sitaras, Jacobsen, Higdon, *et al.*, In preparation (2022)

Summary of Main Findings

- Scarce data on many vaccines and vaccine combinations.
- Pseudoviruses carrying the full complement of Spike mutations are a viable alternative to live viruses.
  - Increase in contribution.
- Percentage of responders very important when evaluating fold decrease in NT activity against a variant, as well as measure of vaccine success in eliciting humoral immunity. Should be reported alongside NT data.
- Post-boost % of responders increases drastically compared to primary series vaccination.
- Calculating fold decrease in NT activity can be misleading. Sensible when:
  - NT titres against the vaccine-seed strain are high enough to allow large fold decreases against variants to be measurable. The higher the titres for the vaccine-seed strain, the higher the likelihood for more responders against Omicron.
  - Percentage of responders against Omicron is high enough to allow accurate calculation of fold decrease.
  - Immune waning further confounds fold decrease calculations.

Needs and Future Work

- Need for more data for some vaccines and vaccine combinations.
- Immune waning must be examined for further vaccine evaluation against Omicron (neutralisation activity over time).
- Contribution of pre-vaccination or breakthrough infections to immunity against Omicron.
- Examine if fold decreases should be calculated based on a threshold % of responders.

Acknowledgments

Melissa Higdon

Marley Jurgensmeyer

Naor Bar Zeev

Maria Deloria Knoll

Henning Jacobsen

William Dowling

Kate O'Brien

Mick Mulders

Daniel Feikin

Minal Patel