Appendix

Evaluation of COVID-19 vaccination strategies with a delayed second dose

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This appendix provides further details of model parameterization, and additional results for comparing a DSD strategy with the recommended schedule of vaccination for both Pfizer-BioNTech and Moderna vaccines, corresponding to the efficacy of vaccines against infection.

Table A1. Mixing patterns and the daily number of contacts derived from empirical observations. Daily numbers of contacts were sampled from negative binomial distributions for different scenarios.

Age group	Proportion of contacts between age groups					No. of daily contacts without self-isolation Mean (SD)	No. of daily contacts for self-isolated individuals Mean (SD)
	0-4	5-19	20-49	50-65	65+		
0-4	0.2287	0.1839	0.4219	0.1116	0.0539	10.21 (7.65)	2.86 (2.14)
5-19	0.0276	0.5964	0.2878	0.0591	0.0291	16.793 (11.7201)	4.70 (3.28)
20-49	0.0376	0.1454	0.6253	0.1423	0.0494	13.795	3.86 (2.95)

						(10.5045)	
50-65	0.0242	0.1094	0.4867	0.2723	0.1074	11.2669 (9.5935)	3.15 (2.66)
65+	0.0207	0.1083	0.4071	0.2193	0.2446	8.0027 (6.9638)	2.24 (1.95)

Table A2. Description of model parameters and their estimates.

Description	**0–4**	**5–19**	**20–49**	**50–64**	**65–79**	**80+**	**Source**
Transmission probability per contact during presymptomatic stage	Depending on the level of (herd immunity) 0.0395 (5%), 0.042 (10%), 0.0465 (20%), 0.053 (30%)						Calibrated to R=1.2 [47]
Incubation period (days)	LogNormal(shape: 1.434, scale: 0.661)						[19]
Asymptomatic period (days)	Gamma(shape: 5, scale: 1)						Derived from [21,22]
Presymptomatic period (days)	Gamma(shape: 1.058, scale: 2.174)						Derived from [17,20]
Infectious period from onset of symptoms (days)	Gamma(shape: 2.768, scale: 1.1563)						Derived from [21]
Proportion of infections that are asymptomatic	0.30	0.38	0.33	0.33	0.19	0.19	[48–50]
Proportion of symptomatic cases that exhibit mild symptoms	0.95	0.90	0.85	0.60	0.20	0.20	[13,23]
Proportion of cases hospitalized with one or more comorbidities	37.6%						[25,26]
Non-ICU	67%						
ICU	33%						
Proportion of cases hospitalized without any comorbidities	9%						[25,26]
Non-ICU	75%						

	ICU	25%	
Length of non-ICU stay (days)		Gamma(shape: 4.5, scale: 2.75)	Derived from [27,28]
Length of ICU stay (days)		Gamma(shape: 4.5, scale: 2.75) + 2	Derived from [27,28]

Table A3. Vaccination coverage of different age groups.

Age group	**0-17**	**18-49**	**50-64**	**65-79**	**80+**
Vaccination coverage	0%	45%	48%	70%	70%

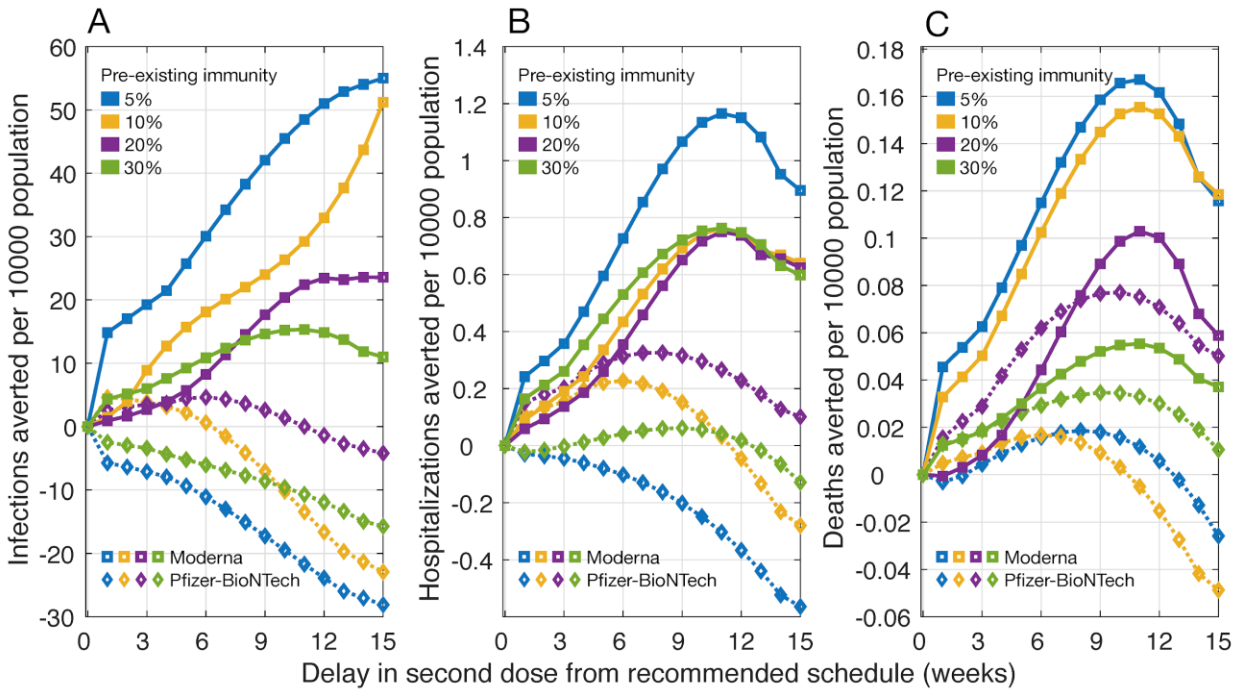

Figure A1. Projected number of infections, hospitalizations, and deaths averted per 10,000 population for a DSD vaccination program compared to the recommended schedule of two-doses of Pfizer-BioNTech (with a 21-day interval) and Moderna (with a 28-day interval) vaccines. The efficacy of vaccines in blocking infection transmission was assumed to be 50% lower than the efficacy against symptomatic and severe disease. Waning of vaccine efficacy was 5% per week, starting from week 7 after the first dose. Efficacy after the second dose was 94% for Moderna and 95% for Pfizer-BioNTech vaccines.

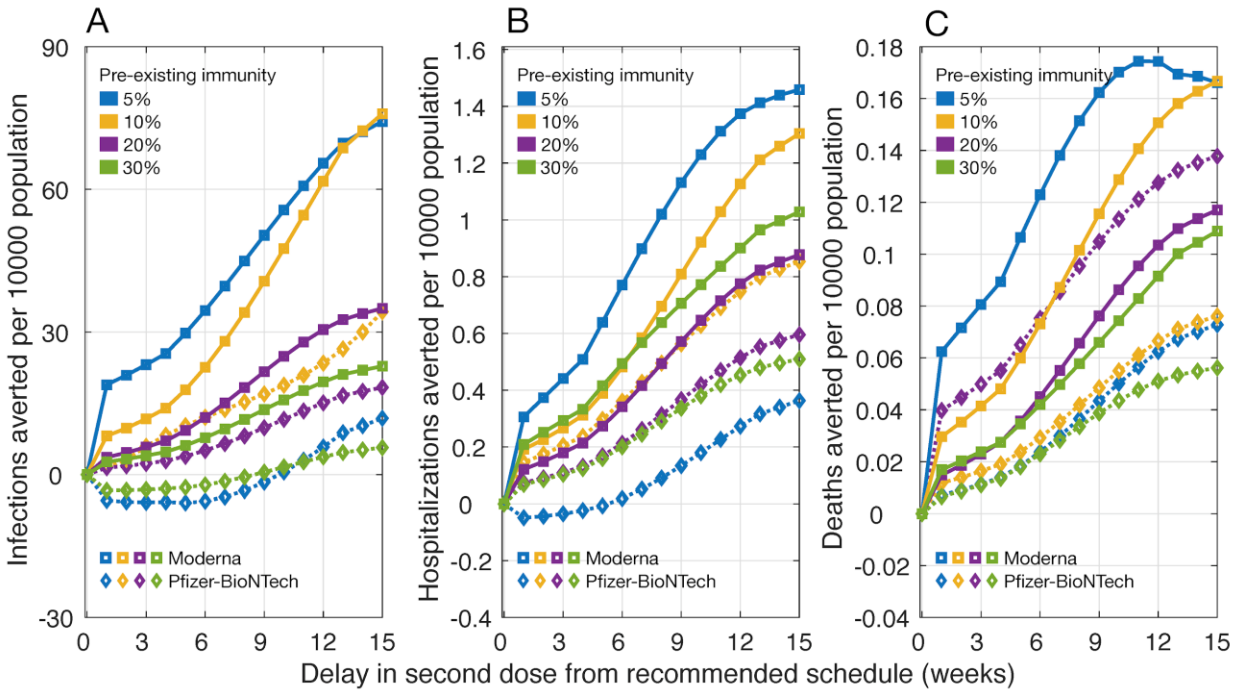

Figure A2. Projected number of infections, hospitalizations, and deaths averted per 10,000 population for a DSD vaccination program compared to the recommended schedule of two-doses of Pfizer-BioNTech (with a 21-day interval) and Moderna (with a 28-day interval) vaccines. The efficacy of vaccines in blocking infection transmission was assumed to be 50% lower than the efficacy against symptomatic and severe disease. There was no waning of vaccine efficacy within 15 weeks from the recommended schedule for the second dose. Efficacy after the second dose was 94% for Moderna and 95% for Pfizer-BioNTech vaccines.

Scenarios with reduced vaccine efficacy following two doses with a delayed second dose

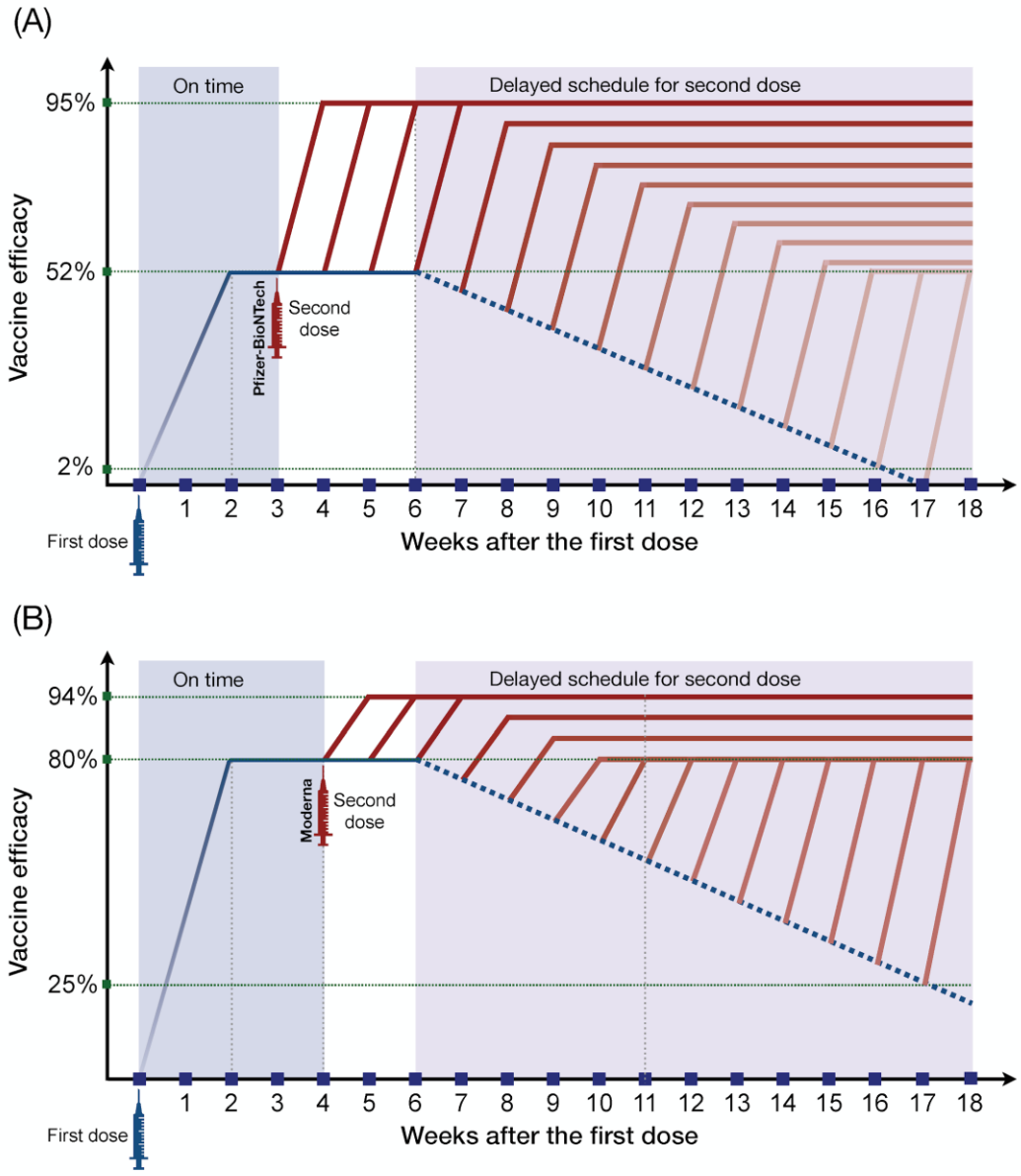

Figure A3. Schematic representation of temporal reduction of vaccine efficacy in a DSD vaccination strategy for Pfizer-BioNTech (A) and Moderna (B) vaccines.

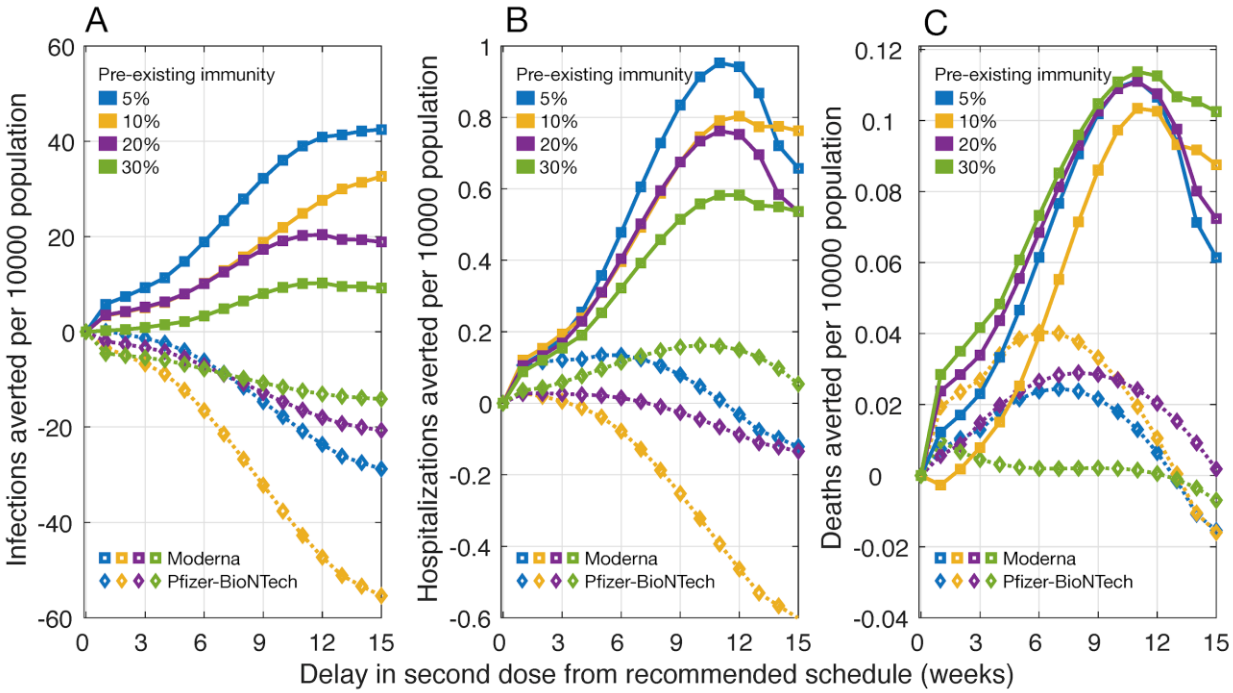

Figure A4. Projected number of infections, hospitalizations, and deaths averted per 10,000 population for a DSD vaccination program compared to the recommended schedule of two-doses of Pfizer-BioNTech (with a 21-day interval) and Moderna (with a 28-day interval) vaccines. The efficacy of vaccines in blocking infection transmission was assumed to be the same as the efficacy against symptomatic and severe disease. Waning of vaccine efficacy was 5% per week, starting from week 7 after the first dose. The same reduction factor of 5% per week was also applied to the efficacy of the second dose if received later than 6 weeks after the first dose.

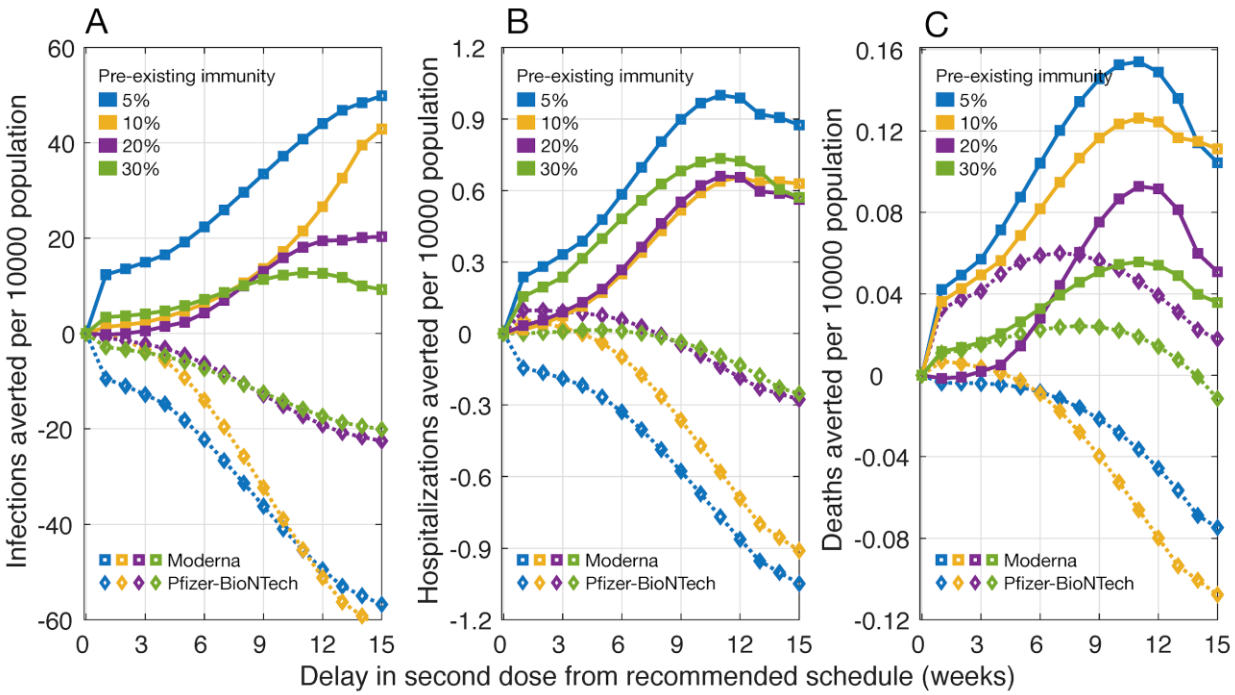

Figure A5. Projected number of infections, hospitalizations, and deaths averted per 10,000 population for a DSD vaccination program compared to the recommended schedule of two-doses of Pfizer-BioNTech (with a 21-day interval) and Moderna (with a 28-day interval) vaccines. The efficacy of vaccines in blocking infection transmission was assumed to be 50% lower than the efficacy against symptomatic and severe disease. Waning of vaccine efficacy was 5% per week, starting from week 7 after the first dose. The same reduction factor of 5% per week was also applied to the efficacy of the second dose if received later than 6 weeks after the first dose.