

Supplementary table 1:**Projected total and daily peaks of COVID-19 deaths by the end of 2024 in England under different scenarios of annual vaccination programmes****Assumptions and notes:**

- 75-90% vaccination coverage of individuals aged ≥ 16 years old.
- Initial overall vaccine efficacy: 62.5% after dose-1 and 85% after dose-2.
- The overall vaccine efficacy is equally attributable to the infection and disease protection.

Scenario	Vaccination waves (interval days)	Long-term vaccine efficacy	Reduction in reinfectivity	Immunity duration (day): Natural /vaccine	Total COVID-19 deaths (2020-2024)	Daily peaks of COVID-19 deaths		
						2022	2023	2024
A1a1	1	85.0%	60%	No waning	128,039	28	0	0
A1a2	2 (365)	85.0%	60%	No waning	127,464	28	0	0
A1a3	3 (365)	85.0%	60%	No waning	127,464	28	0	0
A1a4	4 (365)	85.0%	60%	No waning	127,464	28	0	0
A1b1	1	85.0%	60%	730/365	242,691	28	592	582
A1b2	2 (365)	85.0%	60%	730/365	154,956	28	0	592
A1b3	3 (365)	85.0%	60%	730/365	127,550	28	0	0
A1b4	4 (365)	85.0%	60%	730/365	127,550	28	0	0
A1c1	1	85.0%	60%	365/182	239,044	281	452	56
A1c2	2 (365)	85.0%	60%	365/182	196,149	89	78	392
A1c3	3 (365)	85.0%	60%	365/182	155,320	89	2	109
A1c4	4 (365)	85.0%	60%	365/182	148,093	89	2	7
B1a1	1	62.5%	60%	No waning	144,586	105	0	0
B1a2	2 (365)	62.5%	60%	No waning	142,720	104	0	0
B1a3	3 (365)	62.5%	60%	No waning	142,720	104	0	0
B1a4	4 (365)	62.5%	60%	No waning	142,720	104	0	0
B1b1	1	62.5%	60%	730/365	320,789	105	952	950
B1b2	2 (365)	62.5%	60%	730/365	230,198	104	0	1066
B1b3	3 (365)	62.5%	60%	730/365	143,670	104	0	16
B1b4	4 (365)	62.5%	60%	730/365	143,233	104	0	0
B1c1	1	62.5%	60%	365/182	353,663	528	536	407
B1c2	2 (365)	62.5%	60%	365/182	292,109	351	103	915
B1c3	3 (365)	62.5%	60%	365/182	225,230	351	2	412
B1c4	4 (365)	62.5%	60%	365/182	198,684	351	2	47
A2a1	1	85.0%	45%	No waning	132,749	42	0	0

A2a2	2 (365)	85.0%	45%	No waning	131,963	42	0	0
A2a3	3 (365)	85.0%	45%	No waning	131,963	42	0	0
A2a4	4 (365)	85.0%	45%	No waning	131,963	42	0	0
A2b1	1	85.0%	45%	730/365	265,799	42	627	243
A2b2	2 (365)	85.0%	45%	730/365	206,600	42	9	731
A2b3	3 (365)	85.0%	45%	730/365	159,912	42	0	582
A2b4	4 (365)	85.0%	45%	730/365	134,421	42	0	36
A2c1	1	85.0%	45%	365/182	373,907	479	588	435
A2c2	2 (365)	85.0%	45%	365/182	266,690	151	675	628
A2c3	3 (365)	85.0%	45%	365/182	222,944	151	55	363
A2c4	4 (365)	85.0%	45%	365/182	194,661	151	55	168
B2a1	1	62.5%	45%	No waning	163,679	209	0	0
B2a2	2 (365)	62.5%	45%	No waning	161,055	209	0	0
B2a3	3 (365)	62.5%	45%	No waning	161,055	209	0	0
B2a4	4 (365)	62.5%	45%	No waning	161,055	209	0	0
B2b1	1	62.5%	45%	730/365	383,433	209	916	801
B2b2	2 (365)	62.5%	45%	730/365	304,138	209	13	1301
B2b3	3 (365)	62.5%	45%	730/365	236,662	209	0	952
B2b4	4 (365)	62.5%	45%	730/365	179,002	209	0	224
B2c1	1	62.5%	45%	365/182	611,929	867	1542	2437
B2c2	2 (365)	62.5%	45%	365/182	443,176	615	1860	1096
B2c3	3 (365)	62.5%	45%	365/182	376,242	615	537	1092
B2c4	4 (365)	62.5%	45%	365/182	,016	615	537	886
A3a1	1	85.0%	30%	No waning	138,595	64	0	0
A3a2	2 (365)	85.0%	30%	No waning	137,672	64	0	0
A3a3	3 (365)	85.0%	30%	No waning	137,672	64	0	0
A3a4	4 (365)	85.0%	30%	No waning	137,672	64	0	0
A3b1	1	85.0%	30%	730/365	301,437	64	1235	218
A3b2	2 (365)	85.0%	30%	730/365	259,144	64	297	1645
A3b3	3 (365)	85.0%	30%	730/365	187,753	64	4	324
A3b4	4 (365)	85.0%	30%	730/365	152,926	64	4	131
A3c1	1	85.0%	30%	365/182	498,043	743	764	1933
A3c2	2 (365)	85.0%	30%	365/182	321,779	208	537	599
A3c3	3 (365)	85.0%	30%	365/182	317,223	208	145	618
A3c4	4 (365)	85.0%	30%	365/182	229,664	208	145	96
B3a1	1	62.5%	30%	No waning	188,227	366	0	0
B3a2	2 (365)	62.5%	30%	No waning	185,384	366	0	0
B3a3	3 (365)	62.5%	30%	No waning	185,384	366	0	0
B3a4	4 (365)	62.5%	30%	No waning	185,384	366	0	0
B3b1	1	62.5%	30%	730/365	448,904	366	1093	649

B3b2	2 (365)	62.5%	30%	730/365	392,651	366	98	2877
B3b3	3 (365)	62.5%	30%	730/365	291,181	366	3	720
B3b4	4 (365)	62.5%	30%	730/365	233,075	366	3	384
B3c1	1	62.5%	30%	365/182	822,318	1095	2571	3202
B3c2	2 (365)	62.5%	30%	365/182	682,299	888	1714	5055
B3c3	3 (365)	62.5%	30%	365/182	627,017	888	616	3165
B3c4	4 (365)	62.5%	30%	365/182	430,219	888	616	1362