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**Supplementary information**

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**SARS-CoV-2 evolution on a dynamic immune landscape**

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# **Supplementary Information for: SARS-CoV-2 Evolution on a Dynamic Immune Landscape**

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Supplementary Table 1: Number of antibodies per epitope class.

| Epitope Class | Number of antibodies |
|---------------|----------------------|
| A             | 109                  |
| B             | 51                   |
| C             | 88                   |
| D1            | 40                   |
| D2            | 32                   |
| E1            | 61                   |
| E2.1          | 25                   |
| E2.2          | 41                   |
| E3            | 63                   |
| F1            | 92                   |
| F2            | 167                  |
| F3            | 67                   |

Supplementary Table 2: List of antibodies per epitope class.

| Epitope Class | Antibody  |
|---------------|-----------|
| A             | B38       |
| A             | BD-236    |
| A             | BD-369    |
| A             | BD-494    |
| A             | BD-498    |
| A             | BD-500    |
| A             | BD-503    |
| A             | BD-504    |
| A             | BD-508    |
| A             | BD-598    |
| A             | BD-599    |
| A             | BD-605    |
| A             | BD-612    |
| A             | BD-614    |
| A             | BD-616    |
| A             | BD-618    |
| A             | BD-619    |
| A             | BD-693    |
| A             | BD-694    |
| A             | BD-715    |
| A             | BD-739    |
| A             | BD-822    |
| A             | BD-915    |
| A             | BD55-1061 |
| A             | BD55-1092 |
| A             | BD55-1208 |
| A             | BD55-1249 |
| A             | BD55-1315 |
| A             | BD55-1346 |
| A             | BD55-1374 |
| A             | BD55-1451 |
| A             | BD55-1456 |
| A             | BD55-1502 |
| A             | BD55-1503 |
| A             | BD55-1575 |
| A             | BD55-1763 |
| A             | BD55-1809 |
| A             | BD55-1970 |
| A             | BD55-300  |
| A             | BD55-5580 |
| A             | BD55-5731 |
| A             | BD55-5743 |
| A             | BD55-5856 |
| A             | BD55-5966 |
| A             | BD55-600  |
| A             | BD55-6413 |
| A             | BG4-25    |

|   |               |
|---|---------------|
| A | BG7-20        |
| A | BR11-196      |
| A | C093          |
| A | C102          |
| A | C105          |
| A | C135          |
| A | C1A-B12       |
| A | C1A-B3        |
| A | C1A-C2        |
| A | C1A-F10       |
| A | C578          |
| A | CC12.1        |
| A | CC12.3        |
| A | COV2-2037     |
| A | COV2-2068     |
| A | COV2-2098     |
| A | COV2-2113     |
| A | COV2-2308     |
| A | COV2-2589     |
| A | COV2-2807     |
| A | COV2-2919     |
| A | COVA2-04      |
| A | COVOX-150     |
| A | COVOX-222     |
| A | COVOX-269     |
| A | COVOX-40      |
| A | COVOX-88      |
| A | CV05-163      |
| A | CV07-250      |
| A | CV30          |
| A | DH1126        |
| A | DH1140        |
| A | DH1154        |
| A | DH1155        |
| A | DH1179        |
| A | DH1210        |
| A | DXP-604       |
| A | Ehling_mAb-64 |
| A | LY-CoV016     |
| A | LY-CoV481     |
| A | LY-CoV488     |
| A | P2B-1A10      |
| A | P4A1          |
| A | P5A-2G9       |
| A | P5A-3A1       |
| A | WIBP-2B11     |
| A | XG2v-039      |
| A | XG2v-098      |
| A | XGv-013       |
| A | XGv-017       |
| A | XGv-040       |

|   |                |
|---|----------------|
| A | XGv-177        |
| A | XGv-208        |
| A | XGv-225        |
| A | XGv-261        |
| A | XGv-298        |
| A | XGv-300        |
| A | XGv-301        |
| A | XGv-304        |
| A | XGv-387        |
| A | XGv-404        |
| A | XGv-405        |
| B | BD-319         |
| B | BD-417         |
| B | BD-566         |
| B | BD-623         |
| B | BD-805         |
| B | BD-833         |
| B | BD-836         |
| B | BD-922         |
| B | BD55-1180      |
| B | BD55-1263      |
| B | BD55-1334      |
| B | BD55-1421      |
| B | BD55-1508      |
| B | BD55-4662      |
| B | BD55-5183      |
| B | BD55-5324      |
| B | BD55-5399      |
| B | BD55-5463      |
| B | BD55-5530      |
| B | BD55-556       |
| B | BD55-5655      |
| B | BD55-5745      |
| B | BD55-5774      |
| B | BD55-5811      |
| B | BD55-6382      |
| B | BD55-6383      |
| B | BD56-887       |
| B | BG1-24         |
| B | C597           |
| B | COV2-2046      |
| B | COV2-2072      |
| B | COV2-2196      |
| B | COV2-2381      |
| B | COV2-2684      |
| B | COV2-2941      |
| B | COV2-3025      |
| B | COVA2-39       |
| B | COVOX-253H165L |
| B | COVOX-253H55L  |
| B | CV-X2-106      |

|   |           |
|---|-----------|
| B | CV07-209  |
| B | CV07-287  |
| B | S2E12     |
| B | XG2v-095  |
| B | XG2v-126  |
| B | XGv-050   |
| B | XGv-253   |
| B | XGv-279   |
| B | XGv-347   |
| B | XGv-402   |
| B | XGv-409   |
| C | 2-15      |
| C | BD-254    |
| C | BD-362    |
| C | BD-368    |
| C | BD-397    |
| C | BD-403    |
| C | BD-536    |
| C | BD-790    |
| C | BD-791    |
| C | BD-870    |
| C | BD-900    |
| C | BD55-1049 |
| C | BD55-1051 |
| C | BD55-1065 |
| C | BD55-1078 |
| C | BD55-1084 |
| C | BD55-1171 |
| C | BD55-1192 |
| C | BD55-1223 |
| C | BD55-1256 |
| C | BD55-1323 |
| C | BD55-1435 |
| C | BD55-1558 |
| C | BD55-1576 |
| C | BD55-1579 |
| C | BD55-1694 |
| C | BD55-4351 |
| C | BD55-4382 |
| C | BD55-4397 |
| C | BD55-5634 |
| C | BD55-5747 |
| C | BD55-5854 |
| C | BD55-5909 |
| C | C002      |
| C | C058      |
| C | C083      |
| C | C085      |
| C | C121      |
| C | C144      |
| C | C516      |

|    |           |
|----|-----------|
| C  | C591      |
| C  | CM32      |
| C  | COV2-2064 |
| C  | COV2-2353 |
| C  | COV2-2391 |
| C  | COV2-2479 |
| C  | COV2-2504 |
| C  | COV2-2539 |
| C  | COV2-2819 |
| C  | COV2-2955 |
| C  | COVOX-316 |
| C  | COVOX-384 |
| C  | CV07-200  |
| C  | CV07-222  |
| C  | CV07-255  |
| C  | CV07-262  |
| C  | CV07-283  |
| C  | CV07-315  |
| C  | DH1041    |
| C  | DH1042    |
| C  | DH1043    |
| C  | DH1082    |
| C  | DH1111    |
| C  | DH1143    |
| C  | DH1159-2  |
| C  | DH1173    |
| C  | DH1184    |
| C  | DH1186    |
| C  | DH1196    |
| C  | DH1214    |
| C  | DXP-593   |
| C  | H4        |
| C  | LY-CoV555 |
| C  | P2C-1A3   |
| C  | S2H13     |
| C  | S2M11     |
| C  | XG2v-045  |
| C  | XGv-051   |
| C  | XGv-052   |
| C  | XGv-055   |
| C  | XGv-097   |
| C  | XGv-152   |
| C  | XGv-155   |
| C  | XGv-172   |
| C  | XGv-232   |
| C  | XGv-324   |
| C  | XGv-337   |
| C  | XGv-343   |
| D1 | 1-57      |
| D1 | BD-643    |
| D1 | BD-804    |

|    |               |
|----|---------------|
| D1 | BD-824        |
| D1 | BD-864        |
| D1 | BD-918        |
| D1 | BD55-1009     |
| D1 | BD55-1039     |
| D1 | BD55-1268     |
| D1 | BD55-1354     |
| D1 | BD55-1706     |
| D1 | BD55-1779     |
| D1 | BD55-1962     |
| D1 | BD55-5462     |
| D1 | BD55-5566     |
| D1 | BD55-5721     |
| D1 | BD55-5836     |
| D1 | BD55-6385     |
| D1 | C110          |
| D1 | C119          |
| D1 | COV2-2130     |
| D1 | COV2-2693     |
| D1 | COV2-2780     |
| D1 | COVOX-75      |
| D1 | CV07-270      |
| D1 | DH1044        |
| D1 | DH1160        |
| D1 | DH1161-2      |
| D1 | Ehling_mAb-82 |
| D1 | P2B-2F6       |
| D1 | TAU-2230      |
| D1 | XG2v-052      |
| D1 | XG2v-083      |
| D1 | XGv-010       |
| D1 | XGv-047       |
| D1 | XGv-191       |
| D1 | XGv-250       |
| D1 | XGv-263       |
| D1 | XGv-345       |
| D1 | XGv-420       |
| D2 | BD-467        |
| D2 | BD-812        |
| D2 | BD-817        |
| D2 | BD55-1104     |
| D2 | BD55-1109     |
| D2 | BD55-1136     |
| D2 | BD55-387      |
| D2 | BG7-15        |
| D2 | COV2-2268     |
| D2 | COV2-2499     |
| D2 | Ehling_mAb-50 |
| D2 | LY-CoV1404    |
| D2 | XGv-016       |
| D2 | XGv-074       |

|    |           |
|----|-----------|
| D2 | XGv-107   |
| D2 | XGv-264   |
| D2 | XGv-265   |
| D2 | XGv-266   |
| D2 | XGv-282   |
| D2 | XGv-285   |
| D2 | XGv-286   |
| D2 | XGv-287   |
| D2 | XGv-288   |
| D2 | XGv-289   |
| D2 | XGv-290   |
| D2 | XGv-291   |
| D2 | XGv-292   |
| D2 | XGv-293   |
| D2 | XGv-294   |
| D2 | XGv-295   |
| D2 | XGv-296   |
| D2 | XGv-297   |
| E1 | BD-907    |
| E1 | BD55-1091 |
| E1 | BD55-1114 |
| E1 | BD55-1232 |
| E1 | BD55-1245 |
| E1 | BD55-1294 |
| E1 | BD55-1339 |
| E1 | BD55-1403 |
| E1 | BD55-2532 |
| E1 | BD55-3149 |
| E1 | BD55-3152 |
| E1 | BD55-3433 |
| E1 | BD55-3440 |
| E1 | BD55-3451 |
| E1 | BD55-3457 |
| E1 | BD55-3546 |
| E1 | BD55-3637 |
| E1 | BD55-4281 |
| E1 | BD55-4285 |
| E1 | BD55-4325 |
| E1 | BD55-4484 |
| E1 | BD55-4495 |
| E1 | BD55-4664 |
| E1 | BD55-4892 |
| E1 | BD55-5001 |
| E1 | BD55-5171 |
| E1 | BD55-5175 |
| E1 | BD55-5195 |
| E1 | BD55-5200 |
| E1 | BD55-5219 |
| E1 | BD55-5228 |
| E1 | BD55-5286 |
| E1 | BD55-5303 |

|      |           |
|------|-----------|
| E1   | BD55-5319 |
| E1   | BD55-5382 |
| E1   | BD55-5386 |
| E1   | BD55-5449 |
| E1   | BD55-5473 |
| E1   | BD55-5477 |
| E1   | BD55-5484 |
| E1   | BD55-5501 |
| E1   | BD55-5542 |
| E1   | BD55-5549 |
| E1   | BD55-5565 |
| E1   | BD55-5585 |
| E1   | BD55-5591 |
| E1   | BD55-5612 |
| E1   | BD55-5643 |
| E1   | BD55-5644 |
| E1   | BD55-5697 |
| E1   | BD55-5718 |
| E1   | BD55-5728 |
| E1   | BD55-5779 |
| E1   | BD55-5832 |
| E1   | BD55-5840 |
| E1   | BD55-6241 |
| E1   | BG10-19   |
| E1   | C576      |
| E1   | CV38-142  |
| E1   | S309      |
| E1   | XGv-421   |
| E2.1 | BD-713    |
| E2.1 | BD-744    |
| E2.1 | BD-914    |
| E2.1 | BD-923    |
| E2.1 | BD55-1029 |
| E2.1 | BD55-1073 |
| E2.1 | BD55-1274 |
| E2.1 | BD55-1312 |
| E2.1 | BD55-1432 |
| E2.1 | BD55-302  |
| E2.1 | BD55-311  |
| E2.1 | C556      |
| E2.1 | COV2-2389 |
| E2.1 | DH1151    |
| E2.1 | XG2v-070  |
| E2.1 | XGv-011   |
| E2.1 | XGv-094   |
| E2.1 | XGv-174   |
| E2.1 | XGv-175   |
| E2.1 | XGv-199   |
| E2.1 | XGv-214   |
| E2.1 | XGv-227   |
| E2.1 | XGv-233   |

|      |           |
|------|-----------|
| E2.1 | XGv-284   |
| E2.1 | XGv-346   |
| E2.2 | BD-692    |
| E2.2 | BD-748    |
| E2.2 | BD-796    |
| E2.2 | BD-913    |
| E2.2 | BD55-1251 |
| E2.2 | BD55-1266 |
| E2.2 | BD55-1275 |
| E2.2 | BD55-1307 |
| E2.2 | BD55-1442 |
| E2.2 | BD55-1472 |
| E2.2 | BD55-1831 |
| E2.2 | BD55-1957 |
| E2.2 | BD55-3300 |
| E2.2 | BD55-3370 |
| E2.2 | BD55-3484 |
| E2.2 | BD55-3525 |
| E2.2 | BD55-3698 |
| E2.2 | BD55-4467 |
| E2.2 | BD55-5320 |
| E2.2 | BD55-5413 |
| E2.2 | BD55-5524 |
| E2.2 | BD55-5598 |
| E2.2 | BD55-5617 |
| E2.2 | BD55-5789 |
| E2.2 | BD55-5844 |
| E2.2 | BD55-6078 |
| E2.2 | BD55-6511 |
| E2.2 | BD55-6637 |
| E2.2 | C091      |
| E2.2 | C581      |
| E2.2 | COV2-2485 |
| E2.2 | DH1193    |
| E2.2 | XG2v-006  |
| E2.2 | XGv-030   |
| E2.2 | XGv-038   |
| E2.2 | XGv-072   |
| E2.2 | XGv-198   |
| E2.2 | XGv-20    |
| E2.2 | XGv-212   |
| E2.2 | XGv-251   |
| E2.2 | XGv-380   |
| E3   | BD-815    |
| E3   | BD55-1027 |
| E3   | BD55-1041 |
| E3   | BD55-1140 |
| E3   | BD55-1146 |
| E3   | BD55-1199 |
| E3   | BD55-1241 |
| E3   | BD55-1405 |

|    |           |
|----|-----------|
| E3 | BD55-1453 |
| E3 | BD55-1458 |
| E3 | BD55-1486 |
| E3 | BD55-1570 |
| E3 | BD55-1811 |
| E3 | BD55-2314 |
| E3 | BD55-3150 |
| E3 | BD55-3327 |
| E3 | BD55-3337 |
| E3 | BD55-3417 |
| E3 | BD55-3561 |
| E3 | BD55-3597 |
| E3 | BD55-3611 |
| E3 | BD55-3773 |
| E3 | BD55-3807 |
| E3 | BD55-3832 |
| E3 | BD55-4804 |
| E3 | BD55-5212 |
| E3 | BD55-5251 |
| E3 | BD55-5263 |
| E3 | BD55-5268 |
| E3 | BD55-5293 |
| E3 | BD55-5379 |
| E3 | BD55-5415 |
| E3 | BD55-5418 |
| E3 | BD55-5470 |
| E3 | BD55-5485 |
| E3 | BD55-5545 |
| E3 | BD55-5551 |
| E3 | BD55-5569 |
| E3 | BD55-5583 |
| E3 | BD55-5625 |
| E3 | BD55-5630 |
| E3 | BD55-5687 |
| E3 | BD55-5752 |
| E3 | BD55-5830 |
| E3 | BD55-5858 |
| E3 | BD55-5992 |
| E3 | BD55-6041 |
| E3 | BD55-6234 |
| E3 | BD55-6346 |
| E3 | BD55-6585 |
| E3 | BD55-749  |
| E3 | BD55-751  |
| E3 | COVA1-16  |
| E3 | DH1072    |
| E3 | S2H97     |
| E3 | TAU-2310  |
| E3 | XGv-014   |
| E3 | XGv-179   |
| E3 | XGv-235   |

|    |           |
|----|-----------|
| E3 | XGv-355   |
| E3 | XGv-401   |
| E3 | XGv-418   |
| E3 | XGv-422   |
| F1 | BD-708    |
| F1 | BD55-1004 |
| F1 | BD55-1038 |
| F1 | BD55-1064 |
| F1 | BD55-1070 |
| F1 | BD55-1128 |
| F1 | BD55-1132 |
| F1 | BD55-1226 |
| F1 | BD55-1242 |
| F1 | BD55-1244 |
| F1 | BD55-1297 |
| F1 | BD55-1338 |
| F1 | BD55-1341 |
| F1 | BD55-1398 |
| F1 | BD55-1416 |
| F1 | BD55-1429 |
| F1 | BD55-2413 |
| F1 | BD55-3161 |
| F1 | BD55-3293 |
| F1 | BD55-3324 |
| F1 | BD55-3366 |
| F1 | BD55-3602 |
| F1 | BD55-3684 |
| F1 | BD55-3741 |
| F1 | BD55-4286 |
| F1 | BD55-4328 |
| F1 | BD55-4329 |
| F1 | BD55-4342 |
| F1 | BD55-4360 |
| F1 | BD55-4364 |
| F1 | BD55-4392 |
| F1 | BD55-4394 |
| F1 | BD55-4418 |
| F1 | BD55-4464 |
| F1 | BD55-5215 |
| F1 | BD55-5248 |
| F1 | BD55-5250 |
| F1 | BD55-5271 |
| F1 | BD55-5284 |
| F1 | BD55-5311 |
| F1 | BD55-5326 |
| F1 | BD55-5358 |
| F1 | BD55-5359 |
| F1 | BD55-5361 |
| F1 | BD55-5400 |
| F1 | BD55-5404 |
| F1 | BD55-5417 |

|    |           |
|----|-----------|
| F1 | BD55-5425 |
| F1 | BD55-5442 |
| F1 | BD55-5453 |
| F1 | BD55-5454 |
| F1 | BD55-5456 |
| F1 | BD55-5471 |
| F1 | BD55-5476 |
| F1 | BD55-5495 |
| F1 | BD55-5502 |
| F1 | BD55-5557 |
| F1 | BD55-5568 |
| F1 | BD55-5575 |
| F1 | BD55-5577 |
| F1 | BD55-5579 |
| F1 | BD55-5609 |
| F1 | BD55-5636 |
| F1 | BD55-5770 |
| F1 | BD55-5784 |
| F1 | BD55-5790 |
| F1 | BD55-5794 |
| F1 | BD55-5815 |
| F1 | BD55-5879 |
| F1 | BD55-5889 |
| F1 | BD55-5900 |
| F1 | BD55-5961 |
| F1 | BD55-6034 |
| F1 | BD55-6037 |
| F1 | BD55-6038 |
| F1 | BD55-6055 |
| F1 | BD55-6075 |
| F1 | BD55-6222 |
| F1 | BD55-746  |
| F1 | S304      |
| F1 | XGv-001   |
| F1 | XGv-018   |
| F1 | XGv-023   |
| F1 | XGv-024   |
| F1 | XGv-049   |
| F1 | XGv-073   |
| F1 | XGv-19    |
| F1 | XGv-252   |
| F1 | XGv-305   |
| F1 | XGv-306   |
| F1 | XGv-311   |
| F1 | XGv-318   |
| F2 | BD-702    |
| F2 | BD-801    |
| F2 | BD-899    |
| F2 | BD55-1075 |
| F2 | BD55-1096 |
| F2 | BD55-1117 |

|    |           |
|----|-----------|
| F2 | BD55-1129 |
| F2 | BD55-1225 |
| F2 | BD55-1233 |
| F2 | BD55-1237 |
| F2 | BD55-1239 |
| F2 | BD55-1273 |
| F2 | BD55-1343 |
| F2 | BD55-1411 |
| F2 | BD55-1412 |
| F2 | BD55-1868 |
| F2 | BD55-2696 |
| F2 | BD55-316  |
| F2 | BD55-3304 |
| F2 | BD55-347  |
| F2 | BD55-3500 |
| F2 | BD55-3670 |
| F2 | BD55-3716 |
| F2 | BD55-3721 |
| F2 | BD55-389  |
| F2 | BD55-4343 |
| F2 | BD55-4344 |
| F2 | BD55-4345 |
| F2 | BD55-4348 |
| F2 | BD55-4356 |
| F2 | BD55-4357 |
| F2 | BD55-4358 |
| F2 | BD55-4483 |
| F2 | BD55-4760 |
| F2 | BD55-5164 |
| F2 | BD55-5167 |
| F2 | BD55-5170 |
| F2 | BD55-5182 |
| F2 | BD55-5189 |
| F2 | BD55-5201 |
| F2 | BD55-5223 |
| F2 | BD55-5226 |
| F2 | BD55-5236 |
| F2 | BD55-5238 |
| F2 | BD55-5239 |
| F2 | BD55-5242 |
| F2 | BD55-5245 |
| F2 | BD55-5256 |
| F2 | BD55-5264 |
| F2 | BD55-5265 |
| F2 | BD55-5267 |
| F2 | BD55-5276 |
| F2 | BD55-5296 |
| F2 | BD55-5301 |
| F2 | BD55-5304 |
| F2 | BD55-5309 |
| F2 | BD55-5333 |

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| F2 | BD55-5339 |
| F2 | BD55-5343 |
| F2 | BD55-5380 |
| F2 | BD55-5384 |
| F2 | BD55-5387 |
| F2 | BD55-5397 |
| F2 | BD55-5411 |
| F2 | BD55-5416 |
| F2 | BD55-5419 |
| F2 | BD55-5427 |
| F2 | BD55-5431 |
| F2 | BD55-5432 |
| F2 | BD55-5438 |
| F2 | BD55-5450 |
| F2 | BD55-5467 |
| F2 | BD55-547  |
| F2 | BD55-5474 |
| F2 | BD55-5486 |
| F2 | BD55-5493 |
| F2 | BD55-5505 |
| F2 | BD55-5512 |
| F2 | BD55-5516 |
| F2 | BD55-5517 |
| F2 | BD55-5521 |
| F2 | BD55-5537 |
| F2 | BD55-5564 |
| F2 | BD55-5594 |
| F2 | BD55-5610 |
| F2 | BD55-5620 |
| F2 | BD55-5638 |
| F2 | BD55-5640 |
| F2 | BD55-5662 |
| F2 | BD55-5675 |
| F2 | BD55-5676 |
| F2 | BD55-5690 |
| F2 | BD55-5694 |
| F2 | BD55-5699 |
| F2 | BD55-5700 |
| F2 | BD55-5736 |
| F2 | BD55-5737 |
| F2 | BD55-5792 |
| F2 | BD55-5831 |
| F2 | BD55-5839 |
| F2 | BD55-5874 |
| F2 | BD55-5878 |
| F2 | BD55-5927 |
| F2 | BD55-6015 |
| F2 | BD55-6030 |
| F2 | BD55-6033 |
| F2 | BD55-6063 |
| F2 | BD55-6066 |

|    |           |
|----|-----------|
| F2 | BD55-6068 |
| F2 | BD55-6080 |
| F2 | BD55-6086 |
| F2 | BD55-6088 |
| F2 | BD55-6092 |
| F2 | BD55-6095 |
| F2 | BD55-6103 |
| F2 | BD55-6105 |
| F2 | BD55-6190 |
| F2 | BD55-6197 |
| F2 | BD55-6231 |
| F2 | BD55-6243 |
| F2 | BD55-6251 |
| F2 | BD55-6262 |
| F2 | BD55-6263 |
| F2 | BD55-6283 |
| F2 | BD55-6305 |
| F2 | BD55-6306 |
| F2 | BD55-6308 |
| F2 | BD55-6317 |
| F2 | BD55-632  |
| F2 | BD55-6379 |
| F2 | BD55-6392 |
| F2 | BD55-6486 |
| F2 | BD55-6507 |
| F2 | BD55-6510 |
| F2 | BD55-6564 |
| F2 | BD55-659  |
| F2 | BD55-6642 |
| F2 | BD55-6647 |
| F2 | BD55-676  |
| F2 | BD55-688  |
| F2 | BD55-711  |
| F2 | BD55-747  |
| F2 | BD55-822  |
| F2 | BD55-885  |
| F2 | BD55-948  |
| F2 | C048      |
| F2 | C594      |
| F2 | COV2-2015 |
| F2 | COV2-2103 |
| F2 | COV2-2258 |
| F2 | COV2-2514 |
| F2 | COV2-2531 |
| F2 | COV2-2677 |
| F2 | COV2-2678 |
| F2 | COV2-2828 |
| F2 | COV2-2841 |
| F2 | DH1045    |
| F2 | DH1046    |
| F2 | DH1047    |

|    |           |
|----|-----------|
| F2 | DH1073    |
| F2 | S2X259    |
| F2 | XGv-032   |
| F2 | XGv-157   |
| F2 | XGv-158   |
| F2 | XGv-159   |
| F2 | XGv-236   |
| F2 | XGv-416   |
| F3 | ADG-2     |
| F3 | BD-449    |
| F3 | BD55-1450 |
| F3 | BD55-1789 |
| F3 | BD55-3372 |
| F3 | BD55-3414 |
| F3 | BD55-4637 |
| F3 | BD55-5163 |
| F3 | BD55-5168 |
| F3 | BD55-5196 |
| F3 | BD55-5198 |
| F3 | BD55-5233 |
| F3 | BD55-5259 |
| F3 | BD55-5300 |
| F3 | BD55-5305 |
| F3 | BD55-5323 |
| F3 | BD55-5325 |
| F3 | BD55-5342 |
| F3 | BD55-5354 |
| F3 | BD55-5365 |
| F3 | BD55-5396 |
| F3 | BD55-5408 |
| F3 | BD55-5448 |
| F3 | BD55-5459 |
| F3 | BD55-5466 |
| F3 | BD55-5468 |
| F3 | BD55-5472 |
| F3 | BD55-5483 |
| F3 | BD55-5514 |
| F3 | BD55-5526 |
| F3 | BD55-5543 |
| F3 | BD55-5558 |
| F3 | BD55-5588 |
| F3 | BD55-5593 |
| F3 | BD55-5615 |
| F3 | BD55-5629 |
| F3 | BD55-5649 |
| F3 | BD55-5713 |
| F3 | BD55-5715 |
| F3 | BD55-5761 |
| F3 | BD55-5785 |
| F3 | BD55-5810 |
| F3 | BD55-5906 |

|    |           |
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| F3 | BD55-6025 |
| F3 | BD55-6069 |
| F3 | BD55-6112 |
| F3 | BD55-6195 |
| F3 | BD55-6203 |
| F3 | BD55-6206 |
| F3 | BD55-6208 |
| F3 | BD55-6261 |
| F3 | BD55-6329 |
| F3 | BD55-6340 |
| F3 | BD55-6411 |
| F3 | BD55-6447 |
| F3 | BD55-6477 |
| F3 | BD55-6478 |
| F3 | BD55-6520 |
| F3 | BD55-6527 |
| F3 | BD55-6552 |
| F3 | BD55-6626 |
| F3 | BD55-6638 |
| F3 | BD55-6651 |
| F3 | S2H14     |
| F3 | S2X35     |
| F3 | XGv-116   |
| F3 | XGv-360   |

**Supplementary Table 3: Omicron (BA.1) and Delta spike mutation profiles for vaccine efficacy simulations.**

Mutations in the spike protein of Omicron and Delta lineages as observed between November 20, 2021 until January 31, 2022 (for studies evaluating Wuhan-strain vaccine efficacy against Omicron) and July 4, 2021 until December 31, 2021 (for studies evaluating Wuhan-strain vaccine efficacy against Delta).

| <b>Omicron Spike mutations</b> | <b>Delta Spike mutations</b> |
|--------------------------------|------------------------------|
| A67V                           | D614G                        |
| D614G                          | D950N                        |
| D796Y                          | G142D                        |
| E484A                          | L452R                        |
| G339D                          | P681R                        |
| G496S                          | T19R                         |
| H655Y                          | T478K                        |
| L981F                          |                              |
| N501Y                          |                              |
| N679K                          |                              |
| N764K                          |                              |
| N856K                          |                              |
| N969K                          |                              |
| P681H                          |                              |
| Q493R                          |                              |
| Q498R                          |                              |
| Q954H                          |                              |
| S371L                          |                              |
| S373P                          |                              |
| S375F                          |                              |
| S477N                          |                              |
| T478K                          |                              |
| T547K                          |                              |
| T95I                           |                              |
| Y505H                          |                              |

Supplementary Table 4: Vaccine efficacy data against Delta as extracted from the literature.

| Source                                                                                                             | Days (ranges) | Vaccine Efficacy (%) | CI (%)        | Vaccine                   | Disease Status | Study Region | Study Design               | Used Statistic              |
|--------------------------------------------------------------------------------------------------------------------|---------------|----------------------|---------------|---------------------------|----------------|--------------|----------------------------|-----------------------------|
| <b>Hansen et al. 2022</b><br>(10.1101/2021.12.20.21267966)                                                         | 1 - 30        | 86.7                 | 84.6 – 88.6   | Pfizer                    | Any infection  | Denmark      | Test-negative case-control | Hazard Ratio                |
|                                                                                                                    | 31 – 60       | 80.9                 | 79 – 82.6     |                           |                |              |                            |                             |
|                                                                                                                    | 61 – 90       | 72.8                 | 71.7 – 73.8   |                           |                |              |                            |                             |
|                                                                                                                    | 91 – 150      | 53.8                 | 52.9 – 54.6   |                           |                |              |                            |                             |
|                                                                                                                    | 1 – 30        | 88.2                 | 83.1 – 91.8   | Moderna                   |                |              |                            |                             |
|                                                                                                                    | 31 – 60       | 81.5                 | 77.7 – 84.6   |                           |                |              |                            |                             |
|                                                                                                                    | 61 – 90       | 72.2                 | 70.4 – 74     |                           |                |              |                            |                             |
|                                                                                                                    | 91 – 150      | 65                   | 63.6 – 66.3   |                           |                |              |                            |                             |
|                                                                                                                    |               |                      |               |                           |                |              |                            |                             |
| <b>Gram et al. 2022</b><br>(10.1371/journal.pmed.1003992)                                                          | 14 – 30       | 92.2                 | 91.8 – 92.6   | Moderna/Pfizer (18-59 yo) | Any infection  | Denmark      | Test-negative case-control | Hazard Ratio                |
|                                                                                                                    | 31 – 60       | 88.1                 | 87.7 – 88.5   |                           |                |              |                            |                             |
|                                                                                                                    | 61 – 90       | 80.8                 | 80.2 – 81.2   |                           |                |              |                            |                             |
|                                                                                                                    | 91 – 120      | 72.2                 | 71.5 – 72.8   |                           |                |              |                            |                             |
|                                                                                                                    | 120 – 149     | 64.8                 | 63.9 – 65.8   | Moderna/Pfizer (<60 yo)   |                |              |                            |                             |
|                                                                                                                    | 14 – 30       | 82.3                 | 75.5 – 87.2   |                           |                |              |                            |                             |
|                                                                                                                    | 31 – 60       | 74.4                 | 70.1 – 78.2   |                           |                |              |                            |                             |
|                                                                                                                    | 61 – 90       | 77.3                 | 74.4 – 79.9   |                           |                |              |                            |                             |
|                                                                                                                    | 91 – 120      | 69.6                 | 66.5 – 72.4   |                           |                |              |                            |                             |
|                                                                                                                    | 120 – 149     | 50                   | 46.7 – 53     |                           |                |              |                            |                             |
|                                                                                                                    |               |                      |               |                           |                |              |                            |                             |
| <b>Tartof et al. 2021</b> (10.1016/S0140-6736(21)02183-8)                                                          | 28 – 35       | 92.423               | 85.27 – 98.13 | Pfizer                    | Any infection  | USA          | Retrospective cohort       | Hazard Ratio                |
|                                                                                                                    | 56 – 63       | 87.141               | 81.3 – 92.08  |                           |                |              |                            |                             |
|                                                                                                                    | 84 – 91       | 76.936               | 70.14 – 83.19 |                           |                |              |                            |                             |
|                                                                                                                    | 112 – 119     | 59.191               | 48.20 – 69.19 |                           |                |              |                            |                             |
|                                                                                                                    | 140 – 147     | 52.525               | 39.12 – 65.22 |                           |                |              |                            |                             |
|                                                                                                                    |               |                      |               |                           |                |              |                            |                             |
| <b>Rev. Feikin et al.2022 (Goldberg et al. 2021)</b> (10.1016/S0140-6736(22)00152-0 (10.1056/NEJMoa2114228))       | 41 – 91       | 82                   | 70 – 89       | Pfizer                    | Any infection  | Israel       | Retrospective cohort       | Rate of confirmed infection |
|                                                                                                                    | 72 – 121      | 81                   | 73 – 86       |                           |                |              |                            |                             |
|                                                                                                                    | 102 – 137     | 73                   | 67 – 79       |                           |                |              |                            |                             |
|                                                                                                                    | 118 – 152     | 74                   | 68 – 79       |                           |                |              |                            |                             |
|                                                                                                                    | 133 – 166     | 67                   | 59 – 73       |                           |                |              |                            |                             |
|                                                                                                                    | 147 – 180     | 63                   | 58 – 67       |                           |                |              |                            |                             |
|                                                                                                                    | 161 – 196     | 57                   | 52 – 62       |                           |                |              |                            |                             |
|                                                                                                                    |               |                      |               |                           |                |              |                            |                             |
| <b>Rev. Feikin et al.2022 (Poukka al. 2020)</b><br>(10.1016/S0140-6736(22)00152-0 (10.1016/j.vaccine.2021.12.032)) | 14 – 90       | 88                   | 71 – 95       | Astrazeneca               | Any infection  | Finland      | Retrospective cohort       | Hazard Ratio                |
|                                                                                                                    | 91 – 180      | 62                   | 17 – 95       |                           |                |              |                            |                             |

Supplementary Table 5: Vaccine efficacy data against Omicron as extracted from the literature.

| Source                                              | Days (ranges) | Vaccine Efficacy (%) | CI (%)         | Vaccine                  | Disease Status | Study Region | Study Design               | Used Statistic |
|-----------------------------------------------------|---------------|----------------------|----------------|--------------------------|----------------|--------------|----------------------------|----------------|
| Hansen et al. 2022<br>(10.1101/2021.12.20.21267966) | 1 – 30        | 55.2                 | 23.5 – 73.7    | Pfizer                   | Any infection  | Denmark      | Test-negative case-control | Hazard Ratio   |
|                                                     | 31 – 60       | 16.1                 | (-20.8) – 41.7 |                          |                |              |                            |                |
|                                                     | 61 – 90       | 9.8                  | (-10) – 26.1   |                          |                |              |                            |                |
|                                                     | 1 – 30        | 36.7                 | (-69.9) – 76.4 | Moderna                  |                |              |                            |                |
|                                                     | 31 – 60       | 30                   | (-41.3) – 65.4 |                          |                |              |                            |                |
|                                                     | 61 – 90       | 4                    | (-30.8) – 29.8 |                          |                |              |                            |                |
|                                                     |               |                      |                |                          |                |              |                            |                |
| Gram et al. 2022<br>(10.1371/journal.pmed.1003992)  | 14 – 30       | 40                   | 38.6 – 41.3    | Moderna/Pfizer(18-59 yo) | Any infection  | Denmark      | Test-negative case-control | Hazard Ratio   |
|                                                     | 31 – 60       | 31.9                 | 30.7 – 33      |                          |                |              |                            |                |
|                                                     | 61 – 90       | 32.3                 | 30.9 – 33.7    |                          |                |              |                            |                |
|                                                     | 91 – 120      | 31.3                 | 30.3 – 32.4    |                          |                |              |                            |                |
|                                                     | 120 – 149     | 12.6                 | 12 – 13.3      |                          |                |              |                            |                |
|                                                     | 14 – 30       | 39.9                 | 26.3 – 50.9    | Moderna/Pfizer (<60 yo)  |                |              |                            |                |
|                                                     | 31 – 60       | 39                   | 27.6 – 48.7    |                          |                |              |                            |                |
|                                                     | 61 – 90       | 25.2                 | 9 – 38.6       |                          |                |              |                            |                |
|                                                     | 91 – 120      | 24                   | 11.4 – 34.8    |                          |                |              |                            |                |
|                                                     | 120 – 149     | 4.4                  | (-0.1) – 8.7   |                          |                |              |                            |                |

Supplementary Table 6: Summary of genomic surveillance data sets across all 12 investigated countries.

| Country        | Data time-horizon       | Prediction time-horizon | Number of valid genomes | Minimum Sequences per time-steps | Number of lineages | Number of lineages in Spike-pseudo-groups | Number of Spike-pseudo-groups (> 1%) |
|----------------|-------------------------|-------------------------|-------------------------|----------------------------------|--------------------|-------------------------------------------|--------------------------------------|
| Germany        | 2021-07-01 – 2024-07-01 | 2022-03-01 – 2024-07-01 | 607798                  | 100                              | 1718               | 756                                       | 227                                  |
| USA            | 2022-02-01 – 2023-11-27 | 2022-10-01 – 2023-11-20 | 1958675                 | 100                              | 1736               | 1062                                      | 86                                   |
| United Kingdom | 2022-02-01 – 2023-11-23 | 2022-10-01 – 2023-11-15 | 975875                  | 100                              | 1468               | 1127                                      | 165                                  |
| Australia      | 2022-02-01 – 2023-11-23 | 2022-10-01 – 2023-11-16 | 151453                  | 100                              | 1242               | 947                                       | 201                                  |
| Brazil         | 2022-02-01 – 2023-11-24 | 2022-10-01 – 2023-10-30 | 87212                   | 100                              | 501                | 302                                       | 118                                  |
| Canada         | 2022-02-01 – 2023-11-24 | 2022-10-01 – 2023-11-16 | 284354                  | 100                              | 1312               | 1030                                      | 141                                  |
| Sweden         | 2022-02-01 – 2023-11-24 | 2022-10-01 – 2023-11-17 | 101188                  | 100                              | 1010               | 753                                       | 239                                  |
| France         | 2022-02-01 – 2023-11-25 | 2022-10-01 – 2023-11-20 | 311205                  | 100                              | 1347               | 1018                                      | 155                                  |
| Denmark        | 2022-02-01 – 2023-11-20 | 2022-10-01 – 2023-11-16 | 296003                  | 100                              | 1134               | 835                                       | 130                                  |
| Mexico         | 2022-02-01 – 2023-10-17 | 2022-10-01 – 2023-09-14 | 35141                   | 100                              | 556                | 409                                       | 127                                  |
| Japan          | 2022-02-01 – 2023-11-17 | 2022-10-01 – 2023-11-10 | 403515                  | 100                              | 1192               | 890                                       | 141                                  |
| South Africa   | 2022-02-01 – 2023-11-09 | 2022-10-01 – 2023-09-20 | 17152                   | 100                              | 411                | 296                                       | 120                                  |

## Supplementary Note 1: Acknowledgements for GISAID sequences.

### SUPPLEMENTAL TABLE

#### **Data Availability**

GISAID Identifier: EPI\_SET\_241022rp

doi: [10.55876/gis8.241022rp](https://doi.org/10.55876/gis8.241022rp)

All genome sequences and associated metadata in this dataset are published in GISAID's EpiCoV database. To view the contributors of each individual sequence with details such as accession number, Virus name, Collection date, Originating Lab and Submitting Lab and the list of Authors, visit [10.55876/gis8.241022rp](https://gisaid.org/EPI_SET_241022rp)

#### **Data Snapshot**

- EPI\_SET\_241022rp is composed of 5,617,986 individual genome sequences.
- The collection dates range from 2020-07-06 to 2023-11-27;
- Data were collected in 16 countries and territories;
- All sequences in this dataset are compared relative to hCoV-19/Wuhan/WIV04/2019 (WIV04), the official reference sequence employed by GISAID (EPI\_ISL\_402124). Learn more at <https://gisaid.org/WIV04>.