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*Updated February 2022*



**Supplementary Information for**

Characterizing Potential Interaction Between Respiratory [Syncytial Viruses](https://www.sciencedirect.com/topics/medicine-and-dentistry/human-respiratory-syncytial-virus) and Seasonal Influenza in the U.S.

Paste the full author list here

Paste corresponding author name here

Email: [xxxxx@xxxx.xxx](mailto:xxxxx@xxxx.xxx)

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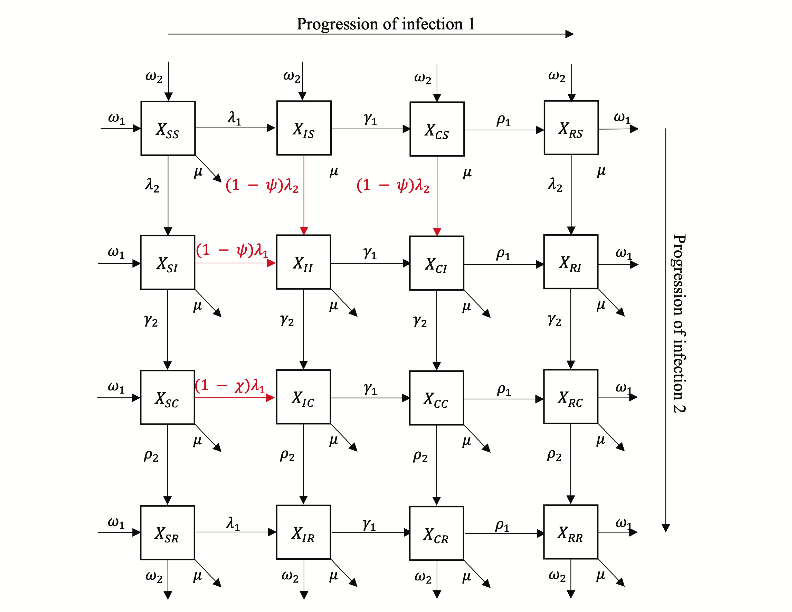
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Fig. S1. Type or paste legend here. Paste figure above the legend.



**Figure S1. Schematics of a two-pathogen model with competitive interaction.** Each box represents a possible host state, with individual indicates the states to the two pathogens, Susceptible (*S*), Infectious (*I*), Cross-protected (*C*) and Recovered (*R*). The horizontal arrows follow the progression of individuals’ infectious of the first pathogen, and the vertical arrows follow the progression of the second pathogen. indicates infectious rate of pathogen, indicates recovery rate of pathogen , rate to lose cross-protected immunity and rate to lost pathogen-specific immunity. The transitions denoted by read arrow are affected by pathogen completion. represents the proportion of inhibition of co-infection and represent the strength of cross-immunity. The diagonal arrow represents disease independent births and deaths. The mechanism of the models is detailed in methodology and parameters value are used are detailed in Table 1.



**FigS2**. **R0 estimation of RSV and seasonal influenza in the U.S. from 2010-2019.** A. Standard deviations are shown as vertical bars. R0 estimation from surveillance curve B. R0 estimation from GMRF Bayesian Skyride analysis.

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Fig. S2. Type or paste legend here. Paste figure above the legend.



**Fig. S2. Mean statistics of RSV and seasonal influenza phylogenies.**

Fig. S3



**Fig S3. Relative fits using the best fit hypothesis for seasons 2014-2018 in 10 HHS regions.** Plots from 2014-2017 show matched pathogen specific simulated trajectories (green) and plot from 2018 show the prediction of 2018 season (orange). The black solid line represented the HHS regional level weekly case report data. **(A)** The test of interaction between RSV and Flu A. **(B)** The test of interaction of RSV and Flu B.

Fig. S4



**FigS4. Relative fits between four epidemiological hypotheses for season 2014-2017 in 10 HHS regions.** Matched type specific simulated trajectories under four hypotheses are showed in different colors. The black solid line represented the HHS regional level weekly case report data. **(A)** The test of interaction between RSV and Flu A. **(B)** The test of interaction of RSV and Flu B.

Fig S5.



**Fig S5. Likelihood profile tests of competition interaction parameters for RSV and seasonal influenza, inferred in 10 HHS region from 2014 to 2017.** Plotted in each graph are likelihood profile for the strength of cross-immunity () in green and proportion of inhibition on co-inhibition () in orange, which are line connected by repeated likelihood estimates (shown in colored solid circles). The values within the two dashed lines are within the estimated 95% CI. **(A)** The test of interaction between RSV and Flu A. **(B)** The test of interaction of RSV and Flu B.

Table S1. Type or paste table title here. Paste table below the title.

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Table S2. Type or paste table title here. Paste table below the title.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| HHS  region | Parameter | RSV-Flu A | | | | RSV-Flu B | | | |
| No-interaction | Inhibition on co-infection | Cross protection | Co-infection and cross-protection | No-interaction | Inhibition on co-infection | Cross protection | Co-infection and cross-protection |
| 1 |  | 1.4871 | 1.458 | 1.8444 | 1.8917 | 1.4871 | 1.4887 | 1.3358 | 1.3649 |
|  | 1.3654 | 1.0523 | 1.3138 | 1.2713 | 1 | 1 | 1 | 1.0882 |
|  | 0.2559 | 0.3335 | 0.1326 | 0.1451 | 0.2559 | 0.2563 | 0.2856 | 0.2994 |
|  | 0.0959 | 0.2665 | 0.1727 | 0.2299 | 0.281 | 0.3183 | 0.3779 | 0.3192 |
|  | 0.9144 | 0.9269 | 0.9753 | 0.9887 | 0.9144 | 0.9158 | 0.8983 | 0.9028 |
|  | 0.1 | 0.0257 | 0.1173 | 0.1068 | 0.1428 | 0.1372 | 0.163 | 0.1647 |
|  | 0.0002 | 0.0002 | 0.0002 | 0.0002 | 0.0002 | 0.0002 | 0.0003 | 0.0003 |
|  | 0.0006 | 0.0011 | 0.0009 | 0.0009 | 0.0003 | 0.0003 | 0.0003 | 0.0002 |
|  | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0.9839 |
|  | 0 | 0 | 0.5342 | 0.4549 | 0 | 0 | 0.3625 | 0.3878 |
| loglik | -4946.3701 | -3966.7437 | -3673.1085 | -3463.3388 | -1504.85 | -1491.1587 | -1353.9941 | -1376.5631 |
| AIC | 9908.7402 | 7951.4873 | 7364.2171 | 6946.6775 | 3025.7 | 3000.3174 | 2725.9882 | 2773.1261 |
|  | 2962.0626 | 1004.8098 | 417.5396 | 0 | 299.7117 | 274.3292 | 0 | 47.1379 |
|  | 0.8258 | 0.8447 | 0.853 | 0.8636 | 0.8847 | 0.887 | 0.8919 | 0.8946 |
|  | 62.4665 | 52.5085 | 50.3574 | 49.3013 | 12.2573 | 12.2341 | 10.7383 | 11.4188 |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| HHS  region | Parameter | RSV-Flu A | | | | RSV-Flu B | | | |
| No-interaction | Inhibition on co-infection | Cross protection | Co-infection and cross-protection | No-interaction | Inhibition on co-infection | Cross protection | Co-infection and cross-protection |
| 2 |  | 1.5382 | 1.5612 | **1.1897** | 1.1897 | 1.5382 | 1.5411 | **1.1864** | 1.1864 |
|  | 1.5987 | 1.679 | **1.6384** | 1.6384 | 1.6793 | 1.683 | **1.7412** | 1.7412 |
|  | 0.2096 | 0.2051 | **0.2826** | 0.2825 | 0.2096 | 0.2071 | **0.3105** | 0.3105 |
|  | 0.0803 | 0.1041 | **0.0937** | 0.0937 | 0.1049 | 0.0968 | **0.1161** | 0.1161 |
|  | 0.8238 | 0.8326 | **0.8098** | 0.8098 | 0.8238 | 0.8241 | **0.7959** | 0.7959 |
|  | 0.2495 | 0.2314 | **0.2504** | 0.2504 | 0.437 | 0.4321 | **0.4291** | 0.4291 |
|  | 0.0003 | 0.0003 | **0.0007** | 0.0007 | 0.0003 | 0.0003 | **0.0007** | 0.0007 |
|  | 0.0003 | 0.0003 | **0.0003** | 0.0003 | 0.0001 | 0.0001 | **0.0001** | 0.0001 |
|  | 0 | 1 | **0** | 0 | 0 | 0.4908 | **0** | 0 |
|  | 0 | 0 | **0.314** | 0.3139 | 0 | 0 | **0.2834** | 0.2834 |
| loglik | -8231.887 | -8163.6851 | **-8161.4153** | -8161.4154 | -3371.6504 | -3370.8556 | **-3217.9092** | -3217.9092 |
| AIC | 16479.7739 | 16345.3703 | **16340.8306** | 16342.8307 | 6759.3007 | 6759.7112 | **6453.8184** | 6455.8184 |
|  | 138.9433 | 4.5397 | **0** | 2.0001 | 305.4823 | 305.8928 | **0** | 2 |
|  | 0.7597 | 0.7594 | 0.7592 | 0.7592 | 0.7854 | 0.7863 | 0.7844 | 0.7844 |
|  | 91.6182 | 91.3832 | 91.2831 | 91.283 | 31.7091 | 31.7211 | 28.9011 | 28.9012 |

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| HHS  region | Parameter | RSV-Flu A | | | | RSV-Flu B | | | |
| No-interaction | Inhibition on co-infection | Cross protection | Co-infection and cross-protection | No-interaction | Inhibition on co-infection | Cross protection | Co-infection and cross-protection |
| 3 |  | 1.5391 | 1.9768 | 1.2776 | **1.8734** | 1.5391 | 1.5438 | 1.1858 | **1.1747** |
|  | 1.2257 | 1.2671 | 1.1473 | **1.2552** | 1 | 1 | 1.0809 | **1.0804** |
|  | 0.2116 | 0.1114 | 0.2502 | **0.115** | 0.2116 | 0.21 | 0.3149 | **0.3171** |
|  | 0.1003 | 0.1302 | 0.1934 | **0.1892** | 0.2064 | 0.2348 | 0.1997 | **0.2075** |
|  | 0.8517 | 0.9499 | 0.8092 | **0.9171** | 0.8517 | 0.8526 | 0.8314 | **0.8323** |
|  | 0.9739 | 0.0104 | 0.0027 | **0.0438** | 0.0904 | 0.0841 | 0.1044 | **0.0989** |
|  | 0.0002 | 0.0002 | 0.0004 | **0.0002** | 0.0002 | 0.0002 | 0.0005 | **0.0005** |
|  | 0.0007 | 0.0007 | 0.001 | **0.0009** | 0.0003 | 0.0003 | 0.0002 | **0.0002** |
|  | 0 | 1 | 0 | **1** | 0 | 1 | 0 | **1** |
|  | 0 | 0 | 0.6299 | **0.4145** | 0 | 0 | 0.2541 | **0.2041** |
| loglik | -8531.4395 | -8302.7473 | -7106.1919 | **-6665.5266** | -2449.7294 | -2434.7553 | -2299.2385 | **-2292.0237** |
| AIC | 17078.8789 | 16623.4947 | 14230.3838 | **13351.0532** | 4915.4588 | 4887.5106 | 4616.477 | **4604.0473** |
|  | 3727.8258 | 3272.4415 | 879.3307 | **0** | 311.4115 | 283.4632 | 12.4296 | **0** |
|  | 0.782 | 0.7972 | 0.8181 | 0.8395 | 0.8625 | 0.8652 | 0.8732 | 0.8744 |
|  | 97.2049 | 96.1954 | 85.9031 | 85.3716 | 23.1146 | 23.1003 | 22.6787 | 22.6497 |

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| HHS  region | Parameter | RSV-Flu A | | | | RSV-Flu B | | | |
| No-interaction | Inhibition on co-infection | Cross protection | Co-infection and cross-protection | No-interaction | Inhibition on co-infection | Cross protection | Co-infection and cross-protection |
| 4 |  | 1.449 | 1.457 | 1.8335 | 1.823 | 1.449 | 1.6273 | 1.1276 | **1.1725** |
|  | 1.4244 | 1.4838 | 1.2619 | 1.2488 | 1.6037 | 1.6756 | 1.6037 | **1.7853** |
|  | 0.1632 | 0.1642 | 0.0748 | 0.0777 | 0.1632 | 0.1198 | 0.2372 | **0.227** |
|  | 0.0265 | 0.0434 | 0.0753 | 0.0825 | 0.0527 | 0.051 | 0.0527 | **0.0755** |
|  | 0.7588 | 0.7644 | 0.8347 | 0.8335 | 0.7588 | 0.7817 | 0.7434 | **0.74** |
|  | 0.1256 | 0.1203 | 0.0161 | 1 | 0.3796 | 0.3624 | 0.3796 | **0.3769** |
|  | 0.0002 | 0.0002 | 0.0001 | 0.0001 | 0.0002 | 0.0001 | 0.0004 | **0.0004** |
|  | 0.0003 | 0.0003 | 0.0011 | 0.0011 | 0.0001 | 0.0001 | 0.0001 | **0.0001** |
|  | 0 | 1 | 0 | 0.4334 | 0 | 1 | 0 | **1** |
|  | 0 | 0 | 0.6754 | 0.6279 | 0 | 0 | 0 | **0.1317** |
| loglik | -12684.878 | -12621.914 | -11589.976 | -11585.241 | -4621.0404 | -4599.658 | -4664.5914 | **-4587.5843** |
| AIC | 25385.7556 | 25261.8275 | 23197.9512 | 23190.4821 | 9258.0808 | 9217.3159 | 9347.1828 | **9195.1686** |
|  | 2195.2735 | 2071.3454 | 7.4691 | 0 | 62.9123 | 22.1473 | 152.0142 | **0** |
|  | 0.5616 | 0.563 | 0.5734 | 0.5748 | 0.6515 | 0.6525 | 0.6443 | 0.6371 |
|  | 134.7552 | 134.293 | 126.8941 | 126.7936 | 34.5302 | 34.6714 | 34.8429 | 34.0263 |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| HHS  region | Parameter | RSV-Flu A | | | | RSV-Flu B | | | |
| No-interaction | Inhibition on co-infection | Cross protection | Co-infection and cross-protection | No-interaction | Inhibition on co-infection | Cross protection | Co-infection and cross-protection |
| 5 |  | 1.5564 | 1.5847 | 1.7957 | **1.7936** | 1.5564 | 1.6905 | **1.5163** | 1.2188 |
|  | 1.3099 | 1.0919 | 1.191 | **1.1769** | 1 | 1.0026 | **1.0671** | 1.0448 |
|  | 0.2072 | 0.2092 | 0.1356 | **0.1421** | 0.2072 | 0.169 | **0.2216** | 0.3103 |
|  | 0.0481 | 0.155 | 0.0905 | **0.1141** | 0.3029 | 0.3313 | **0.2646** | 0.24 |
|  | 0.8648 | 0.8679 | 0.9066 | **0.9045** | 0.8648 | 0.8808 | **0.8572** | 0.8434 |
|  | 0.9366 | 0.916 | 0.9377 | **0.9558** | 0.1069 | 0.1028 | **0.1259** | 0.1056 |
|  | 0.0004 | 0.0004 | 0.0003 | **0.0003** | 0.0004 | 0.0003 | **0.0004** | 0.0007 |
|  | 0.0005 | 0.0008 | 0.0008 | **0.0008** | 0.0002 | 0.0002 | **0.0003** | 0.0003 |
|  | 0 | 1 | 0 | **1** | 0 | 1 | **0** | 1 |
|  | 0 | 0 | 0.2991 | **0.2219** | 0 | 0 | **0.3949** | 0.3108 |
| loglik | -17674.487 | -15063.16 | -14837.684 | **-14526.386** | -4449.5667 | -4417.6697 | **-3474.3851** | -3671.5423 |
| AIC | 35364.9748 | 30144.3203 | 29693.3681 | **29072.7723** | 8915.1334 | 8853.3394 | **6966.7702** | 7363.0847 |
|  | 6292.2025 | 1071.548 | 620.5957 | **0** | 1948.3632 | 1886.5691 | **0** | 396.3145 |
|  | 0.8055 | 0.8092 | 0.8094 | 0.8167 | 0.8585 | 0.8611 | 0.8933 | 0.901 |
|  | 203.481 | 191.8673 | 191.2018 | 189.7445 | 55.2457 | 56.127 | 51.0448 | 55.1337 |

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| HHS  region | Parameter | RSV-Flu A | | | | RSV-Flu B | | | |
| No-interaction | Inhibition on co-infection | Cross protection | Co-infection and cross-protection | No-interaction | Inhibition on co-infection | Cross protection | Co-infection and cross-protection |
| 6 |  | 1.0636 | 1.5275 | 1.0636 | **1.7488** | 1.5176 | 1.5181 | **1.2798** | 1.5057 |
|  | 1.435 | 1.4416 | 1.4351 | **1.1753** | 1.0125 | 1 | **1.1448** | 1.1062 |
|  | 0.3276 | 0.1982 | 0.3276 | **0.136** | 0.1929 | 0.1926 | **0.2581** | 0.1947 |
|  | 0.0551 | 0.0765 | 0.0551 | **0.1432** | 0.1165 | 0.1436 | **0.1104** | 0.1521 |
|  | 0.8086 | 0.8297 | 0.8086 | **0.8652** | 0.8244 | 0.8247 | **0.8055** | 0.8162 |
|  | 0.0458 | 0.0453 | 0.0458 | **0.9344** | 1 | 0.0082 | **0.06** | 0.0512 |
|  | 0.0017 | 0.0004 | 0.0017 | **0.0004** | 0.0004 | 0.0004 | **0.0007** | 0.0005 |
|  | 0.0004 | 0.0004 | 0.0004 | **0.0008** | 0.0005 | 0.0006 | **0.0003** | 0.0003 |
|  | 0 | 1 | 0 | **1** | 0 | 0.8456 | **0** | 0 |
|  | 0 | 0 | 0 | **0.2267** | 0 | 0 | **0.5457** | 0.25 |
| loglik | -14089.458 | -14041.531 | -14089.458 | **-13869.38** | -4965.6057 | -4962.0065 | **-4218.5807** | -4641.9232 |
|  | 28194.9165 | 28101.061 | 28196.9165 | **27758.759** | 9947.2113 | 9942.013 | **8455.1613** | 9303.8464 |
| AIC | 436.1575 | 342.3019 | 438.1575 | **0** | 1492.05 | 1486.8517 | **0** | 848.6851 |
|  | 0.6977 | 0.7092 | 0.6977 | 0.7115 | 0.8172 | 0.8157 | 0.8371 | 0.8299 |
|  | 143.4347 | 143.4092 | 143.4347 | 142.8496 | 51.6706 | 51.6857 | 49.9686 | 50.4909 |

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| HHS  region | Parameter | RSV-Flu A | | | | RSV-Flu B | | | |
| No-interaction | Inhibition on co-infection | Cross protection | Co-infection and cross-protection | No-interaction | Inhibition on co-infection | Cross protection | Co-infection and cross-protection |
| 7 |  | 1.4589 | 1.4654 | 1.2202 | **1.8787** | 1 | 1.4589 | 1 | **1.2386** |
|  | 1.4149 | 1.4041 | 1.467 | **1.2252** | 1 | 1 | 1 | **1.6295** |
|  | 0.2035 | 0.2115 | 0.2554 | **0.1099** | 0.3528 | 0.2035 | 0.3466 | **0.2424** |
|  | 0.088 | 0.1062 | 0.088 | **0.1675** | 0.2197 | 0.2197 | 0.2399 | **0.1157** |
|  | 0.8787 | 0.8817 | 0.8894 | **0.976** | 0.8828 | 0.8787 | 0.8931 | **0.8639** |
|  | 0.0687 | 0.0672 | 0.1028 | **0.0286** | 0.0797 | 0.0797 | 0.0907 | **0.3219** |
|  | 0.0004 | 0.0004 | 0.0007 | **0.0003** | 0.0015 | 0.0004 | 0.0022 | **0.0007** |
|  | 0.0004 | 0.0004 | 0.0004 | **0.0007** | 0.0002 | 0.0002 | 0.0002 | **0.0001** |
|  | 0 | 1 | 0 | **1** | 0 | 0 | 0 | **0.0497** |
|  | 0 | 0 | 0.262 | **0.483** | 0 | 0 | 0.831 | **0.3564** |
| loglik | -4497.1095 | -4456.5523 | -4343.8306 | **-4097.4722** | -2374.268 | -2424.0162 | -2372.0412 | **-2256.3799** |
| AIC | 9010.219 | 8931.1047 | 8705.6612 | **8214.9445** | 4764.5361 | 4866.0324 | 4762.0824 | **4532.7598** |
|  | 795.2746 | 716.1602 | 490.7167 | **0** | 231.7762 | 333.2726 | 229.3225 | **0** |
|  | 0.7237 | 0.729 | 0.7295 | 0.7473 | 0.7581 | 0.7533 | 0.7559 | 0.7581 |
|  | 42.2722 | 42.2154 | 41.7331 | 39.6037 | 17.3771 | 17.6675 | 17.3245 | 15.5958 |

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| HHS  region | Parameter | RSV-Flu A | | | | RSV-Flu B | | | |
| No-interaction | Inhibition on co-infection | Cross protection | Co-infection and cross-protection | No-interaction | Inhibition on co-infection | Cross protection | Co-infection and cross-protection |
| 8 |  | **1.3084** | 1.3081 | 1.3085 | 1.3085 | **1.3083** | 1.3084 | 1.3086 | 1.2619 |
|  | **1.4852** | 1.4847 | 1.4848 | 1.4845 | **1.21** | 1.2084 | 1.2099 | 1.6701 |
|  | **0.4187** | 0.4187 | 0.4187 | 0.4187 | **0.4188** | 0.4187 | 0.4188 | 0.3309 |
|  | **0.0995** | 0.0995 | 0.0996 | 0.0995 | **0.0986** | 0.099 | 0.0986 | 0.1286 |
|  | **0.9448** | 0.9447 | 0.9448 | 0.9448 | **0.9448** | 0.9448 | 0.9448 | 0.92 |
|  | **0.1062** | 0.1059 | 0.1059 | 0.1058 | **0.1366** | 0.136 | 0.1366 | 0.3412 |
|  | **0.0011** | 0.0011 | 0.0011 | 0.0011 | **0.0011** | 0.0011 | 0.0011 | 0.0018 |
|  | **0.0011** | 0.0011 | 0.0011 | 0.0011 | **0.0004** | 0.0004 | 0.0004 | 0.0003 |
|  | **0** | 0 | 0 | 0 | **0** | 0 | 0 | 0.0069 |
|  | **0** | 0 | 0 | 0 | **0** | 0 | 0 | 0.5366 |
| loglik | **-8367.0216** | -8367.0238 | -8367.0231 | -8367.0278 | **-2676.3421** | -2676.3437 | -2676.3433 | -3304.9287 |
| AIC | **16750.0433** | 16752.0476 | 16752.0463 | 16754.0555 | **5368.6843** | 5370.6875 | 5370.6867 | 6629.8573 |
|  | **0** | 2.0043 | 2.003 | 4.0122 | **0** | 2.0032 | 2.0024 | 1261.173 |
|  | 0.7817 | 0.7817 | 0.7817 | 0.7817 | 0.8453 | 0.8453 | 0.8453 | 0.8173 |
|  | 99.5577 | 99.5582 | 99.556 | 99.5621 | 26.6776 | 26.6765 | 26.6764 | 32.1063 |

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| HHS  region | Parameter | RSV-Flu A | | | | RSV-Flu B | | | |
| No-interaction | Inhibition on co-infection | Cross protection | Co-infection and cross-protection | No-interaction | Inhibition on co-infection | Cross protection | Co-infection and cross-protection |
| 9 |  | 1.1616 | 1.1606 | **1.1836** | 1.1834 | 1.1617 | 1.1619 | 1.1953 | **1.1879** |
|  | 1.7049 | 1.7312 | **1.7421** | 1.7444 | 1.1901 | 1.3133 | 1.424 | **1.4502** |
|  | 0.2424 | 0.2509 | **0.3175** | 0.3165 | 0.2423 | 0.2462 | 0.3609 | **0.3652** |
|  | 0.1085 | 0.1175 | **0.1205** | 0.1213 | 0.0368 | 0.024 | 0.0393 | **0.0385** |
|  | 0.8778 | 0.8771 | **0.8502** | 0.8491 | 0.8778 | 0.8765 | 0.8378 | **0.8382** |
|  | 0.2672 | 0.2641 | **0.2687** | 0.2689 | 0.0483 | 0.1311 | 0.2681 | **0.2747** |
|  | 0.0006 | 0.0006 | **0.0007** | 0.0007 | 0.0006 | 0.0006 | 0.0006 | **0.0007** |
|  | 0.0004 | 0.0004 | **0.0004** | 0.0004 | 0.0002 | 0.0002 | 0.0001 | **0.0001** |
|  | 0 | 0.6903 | **0** | 0.0003 | 0 | 1 | 0 | **0.8055** |
|  | 0 | 0 | **0.2136** | 0.2137 | 0 | 0 | 0.4438 | **0.4019** |
| loglik | -11570.429 | -11608.368 | **-10589.192** | -10596.154 | -8045.1447 | -7894.6028 | -6490.8206 | **-6486.6379** |
| AIC | 23156.8571 | 23234.7352 | **21196.3842** | 21212.308 | 16106.2894 | 15807.2056 | 12999.6411 | **12993.2759** |
|  | 1960.4729 | 2038.351 | **0** | 15.9239 | 3113.0135 | 2813.9297 | 6.3652 | **0** |
|  | 0.587 | 0.7712 | 0.815 | 0.8152 | 0.5134 | 0.7287 | 0.7663 | 0.7633 |
|  | 197.4036 | 150.026 | 146.6685 | 146.8132 | 159.8148 | 91.6672 | 84.3314 | 84.3334 |

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| HHS  region | Parameter | RSV-Flu A | | | | RSV-Flu B | | | |
| No-interaction | Inhibition on co-infection | Cross protection | Co-infection and cross-protection | No-interaction | Inhibition on co-infection | Cross protection | Co-infection and cross-protection |
| 10 |  | 1.4815 | 1.4804 | **1.2759** | 1.2721 | 1.4815 | 1.4845 | **1.2784** | 1.2664 |
|  | 1.6424 | 1.6093 | **1.6817** | 1.681 | 1.1437 | 1.2009 | **1.5882** | 1.6268 |
|  | 0.2926 | 0.3006 | **0.3361** | 0.3379 | 0.2925 | 0.2906 | **0.3523** | 0.3549 |
|  | 0.1 | 0.1055 | **0.1135** | 0.1135 | 0.0847 | 0.086 | **0.1126** | 0.1106 |
|  | 0.8907 | 0.8937 | **0.9109** | 0.9107 | 0.8907 | 0.8917 | **0.8729** | 0.876 |
|  | 0.2128 | 0.1891 | **0.2277** | 0.2276 | 0.1239 | 0.1246 | **0.3149** | 0.3272 |
|  | 0.0005 | 0.0005 | **0.001** | 0.001 | 0.0005 | 0.0005 | **0.001** | 0.0011 |
|  | 0.0005 | 0.0005 | **0.0006** | 0.0006 | 0.0002 | 0.0002 | **0.0001** | 0.0001 |
|  | 0 | 0.7806 | **0** | 0.0002 | 0 | 0.7105 | **0** | 0.2892 |
|  | 0 | 0 | **0.5034** | 0.5046 | 0 | 0 | **0.8048** | 0.7347 |
| loglik | -5369.6862 | -5352.0236 | **-5045.9053** | -5046.5653 | -2821.1922 | -2820.2194 | **-2311.6318** | -2313.7381 |
| AIC | 10755.3724 | 10722.0473 | **10109.8106** | 10113.1306 | 5658.3843 | 5658.4389 | **4641.2637** | 4647.4761 |
|  | 645.5617 | 612.2366 | **0** | 3.32 | 1017.1207 | 1017.1752 | **0** | 6.2124 |
|  | 0.7765 | 0.7744 | 0.7855 | 0.7857 | 0.8357 | 0.8355 | 0.8395 | 0.841 |
|  | 50.9467 | 50.8064 | 48.3842 | 48.4131 | 29.9055 | 29.9094 | 23.4284 | 23.5119 |

Movie S1 (separate file). Type or paste legend here.

Dataset S1 (separate file). Type or paste legend here.

**SI References**

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