PCV13-Serotype Breakthrough Pneumococcal Disease in Infants Receiving High-Valency Conjugate Vaccines: Population-Level Modeling in France

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SUPPLEMENTARY MATERIALS

Supplementary Figure S1. Model diagram

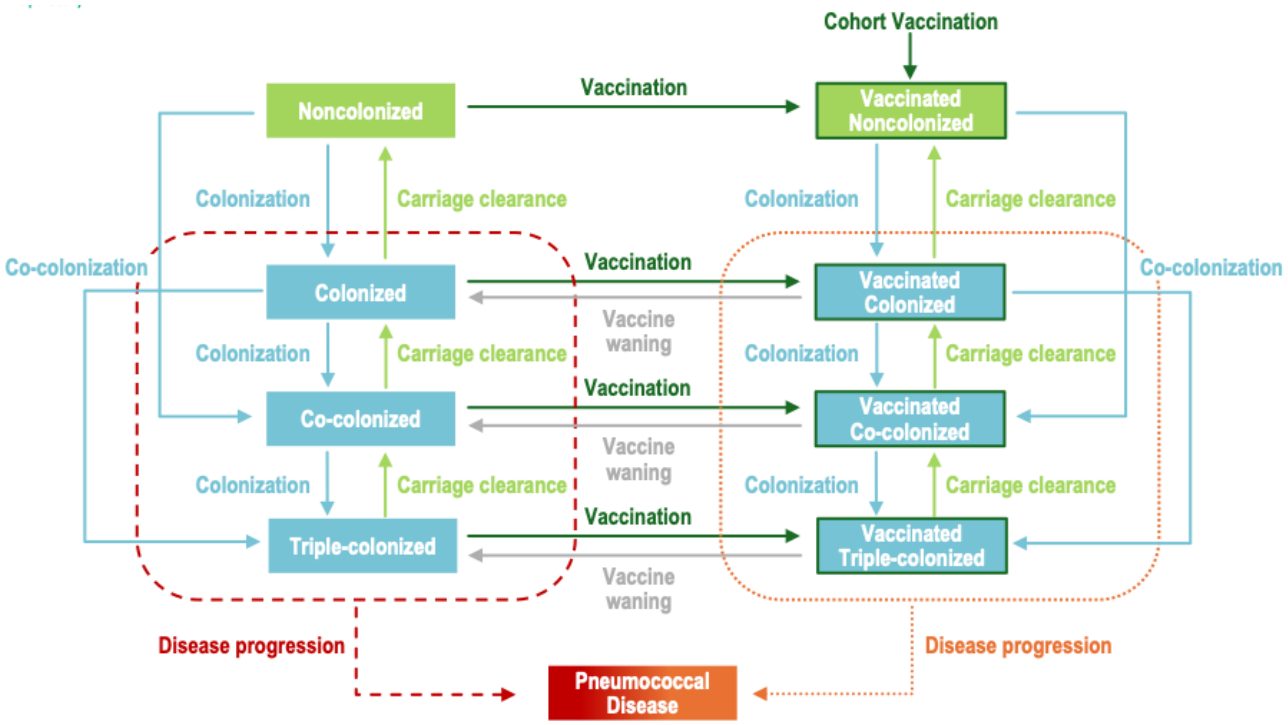
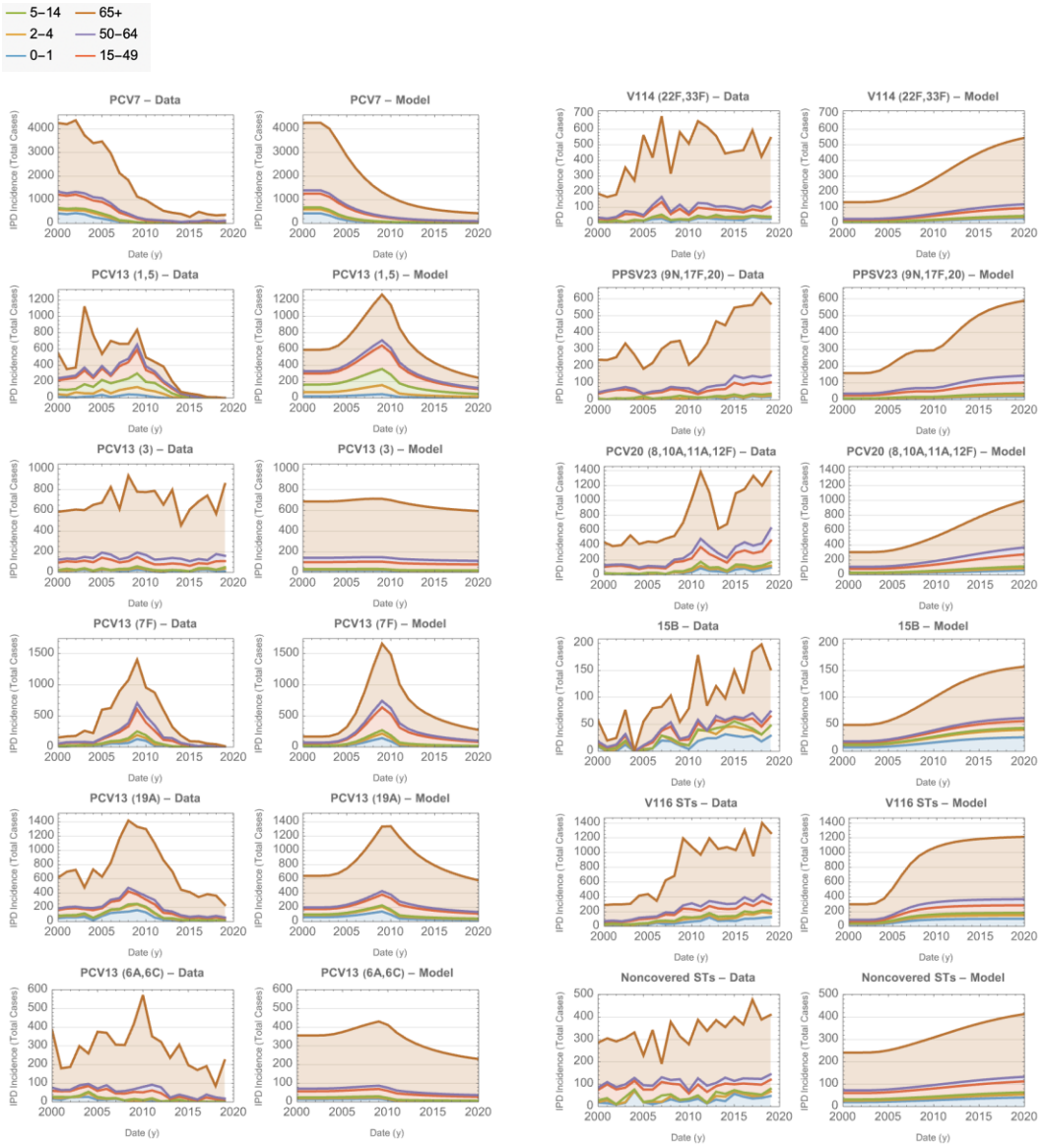


Figure adapted from Malik *et al.,* [1]

The left side of the diagram represents unvaccinated individuals while the right side presents vaccinated individuals. Noncolonized individuals (green) had no risk of developing IPD, while individuals with colonization (blue) had an age- and serotype-specific risk of developing IPD (red). Vaccination (moving from left to right, denoted by a green arrow and green border) and vaccine waning (moving from right to left, denoted by a gray arrow and loss of green border) were possible for any individual. Outcomes for this study (bIPD) are individuals in blue boxes on the right side who developed IPD and were aged 0-1 years.

Supplementary Figure S2. Incidence of IPD during the calibration period



The 12 serotype classes calibrated for the full model. First and third columns are raw data, while second and fourth columns are the model fit to those data. Panel titles indicate which serotypes were included in each class. The two left columns (PCV13 serotypes, with 6C protection from 6A) were re-grouped for this analysis. X-axis is time, data reported by year, and y-axis is total cases. Colors, from the bottom, represent different age groups; blue is 0-1 years, orange is 2-4 years, green is 5-14 years, red is 15-49 years, purple is 50-64 years, and brown is 65+ years.

Supplementary Table S1. Calibrated parameters

Calibrated parameters

$\beta_{a,i}$	1	2	3	4	5	6	7	8	9	10	11	12
1	0.009694	0.016262	0.019964	0.007887	0.006257	0.005761	0.002393	0.005595	0.005724	0.005266	0.008859	0.008293
2	0.00765	0.023058	0.004305	0.011174	0.006894	0.006302	0.003948	0.013507	0.007949	0.007482	0.010923	0.003901
3	0.002333	0.013027	0.004516	0.006361	0.004716	0.004334	0.002072	0.002467	0.004782	0.004483	0.002705	0.0052
4	0.002598	0.009045	0.001395	0.004076	0.002408	0.001982	0.001256	0.004215	0.00366	0.005051	0.00333	0.002293
5	0.003662	0.009558	0.002145	0.004505	0.002478	0.002328	0.002392	0.004054	0.003534	0.004849	0.004742	0.002543
6	0.011089	0.044961	0.008929	0.01605	0.009339	0.009262	0.009229	0.020104	0.013855	0.015891	0.021881	0.012916

$\rho_{a,i}$	1	2	3	4	5	6	7	8	9	10	11	12
1	0.000111	0.000068	0.000044	0.000113	0.000372	0.000047	0.00009	0.000026	0.000232	0.000058	0.000042	0.000163
2	0.000028	0.000076	0.000065	0.000025	0.000103	0.000011	0.00001	$2. \times 10^{-6}$	0.00005	0.000014	0.00001	0.000074
3	0.000036	0.000066	0.000016	$7. \times 10^{-6}$	0.00002	$8. \times 10^{-6}$	$3. \times 10^{-6}$	0.000019	0.00002	$1. \times 10^{-6}$	0.000024	$8. \times 10^{-6}$
4	0.000025	0.000037	0.000073	0.000025	0.000043	0.000032	0.000012	$6. \times 10^{-6}$	0.000019	$1. \times 10^{-6}$	0.00001	$8. \times 10^{-6}$
5	0.000014	0.000024	0.000085	0.000021	0.000045	0.000037	$9. \times 10^{-6}$	0.000012	0.000038	$2. \times 10^{-6}$	0.000017	0.00001
6	0.000111	0.000049	0.000227	0.000065	0.000265	0.000211	0.000037	0.000029	0.000073	0.000014	0.000036	0.000025

$\theta_{i,j}$	1	2	3	4	5	6	7	8	9	10	11	12
1	0.	0.899741	0.989888	0.1972	0.85507	0.95244	0.629872	0.80068	0.884758	0.795333	0.591251	0.906801
2	1.	0.	1.	1.	1.	1.	1.	0.696947	1.	1.	1.	1.
3	1.	1.	0.	1.	1.	1.	1.	1.	1.	1.	1.	1.
4	1.	1.	1.	0.	1.	1.	1.	0.695638	1.	1.	1.	1.
5	1.	1.	1.	1.	0.	1.	1.	0.698403	1.	1.	1.	1.
6	1.	1.	1.	1.	1.	0.	1.	0.697407	1.	1.	1.	1.
7	1.	1.	1.	1.	1.	1.	0.	1.	1.	1.	1.	1.
8	1.	1.	1.	1.	1.	1.	1.	0.	1.	1.	1.	1.
9	1.	1.	1.	1.	1.	1.	1.	1.	0.	1.	1.	1.
10	1.	1.	1.	1.	1.	1.	1.	1.	1.	0.	1.	1.
11	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	0.	1.
12	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	0.

$\epsilon_{v,ped,1}$	$\epsilon_{v,ped,2}$	$\epsilon_{v,ped,3}$	$\epsilon_{v,ped,4}$	$\epsilon_{v,ped,5}$	$\epsilon_{v,ped,6}$	$\epsilon_{v,adult,1}$	$\epsilon_{v,adult,2}$	$\epsilon_{v,adult,3}$	$\epsilon_{v,adult,4}$	$\epsilon_{v,adult,5}$	$\epsilon_{v,adult,6}$
0.44	0.037	0.005	0.18	0.06	0.03	0.35	0.019	0.002	0.1	0.03	0.02

Beta represents the carriage acquisition values, rho represents the case-carrier rates, theta is the competition parameters, and epsilon represents the vaccine efficacy against carriage. Columns for beta, rho, and theta are the serotype classes. Columns for epsilon are the serotype class (numbered 1-6) for the six serotype classes for PCV13. Rows for beta and rho are the six age groups listed in Supplementary Figure S2. Theta rows are the 12 serotype classes.

REFERENCES

1. Malik TM, Bakker KM, Oidtman RJ, Sharomi O, Meleleo G, Nachbar RB, et al. A dynamic transmission model for assessing the impact of pneumococcal vaccination in the United States. medRxiv 202510.1101/2024.06.11.24308671.