Dengue serotype immune-interactions and their consequences for vaccine impact predictions

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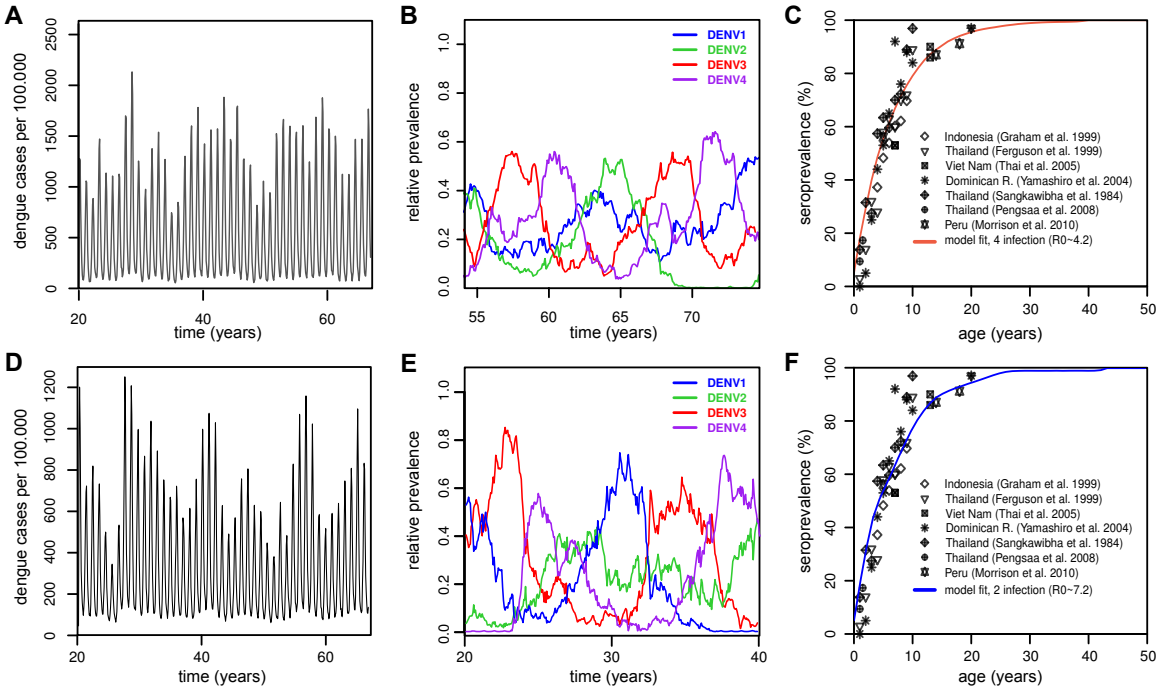
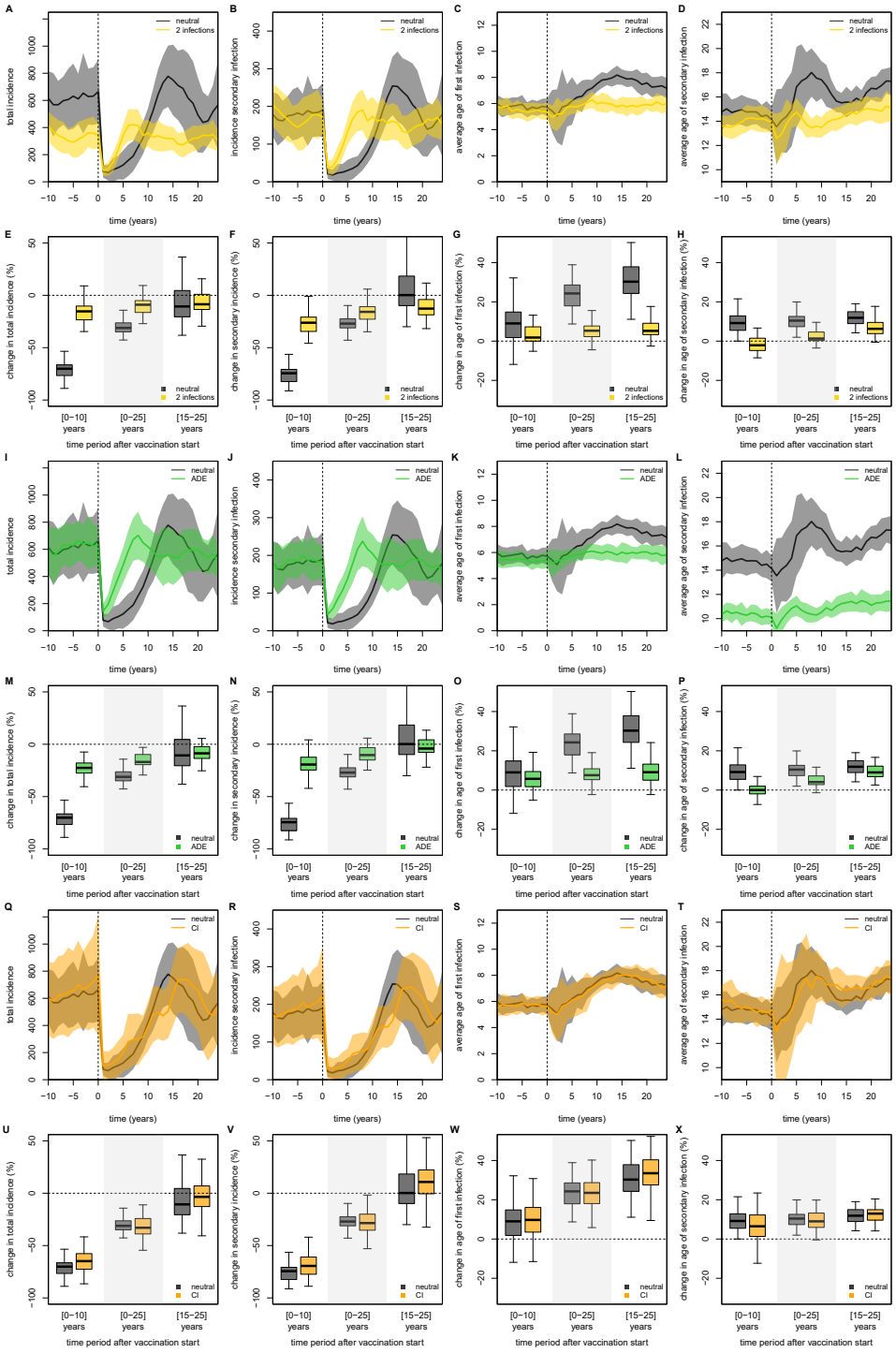
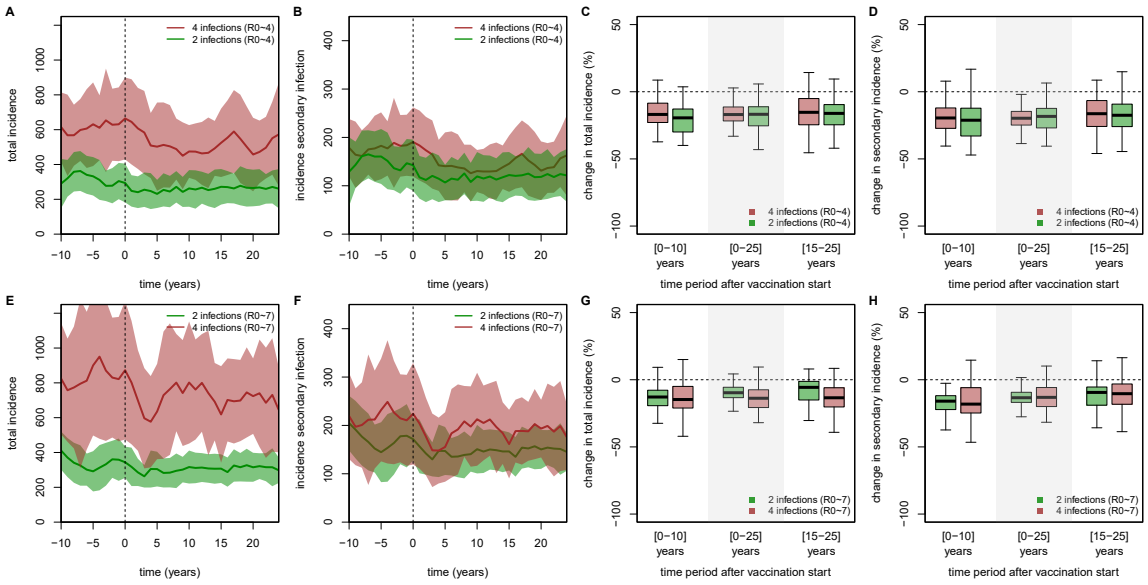
Supporting Information



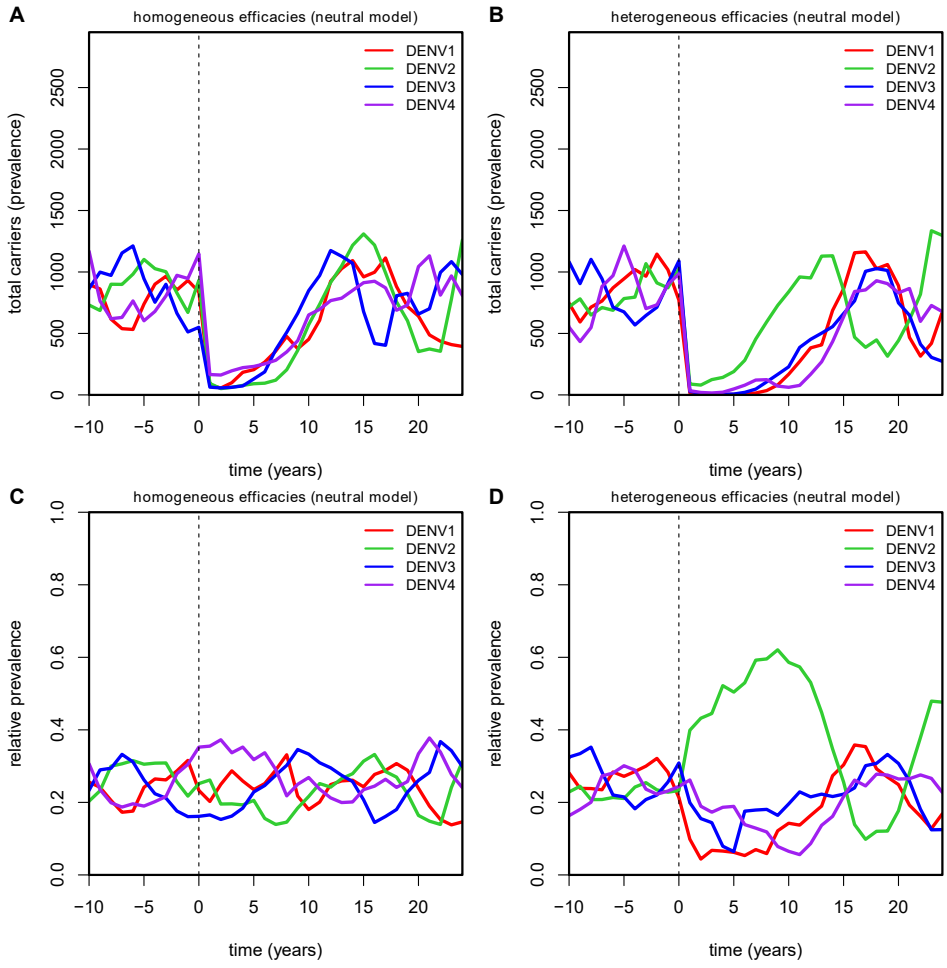
Supplementary Figure 1. Simulated epidemiologies and model fit. Examples of simulated timeseries of total dengue incidence (*A*,*D*) and relative serotype prevalence (*B*,*E*) for two models either allowing four consecutive infections (*top row*) or assuming full immunity after secondary infection (*bottom row*). In both cases the models were fit to seroprevalence data from highly endemic areas (*C*,*F*). The red and blue full lines in C,F are the average model behaviour for 200 simulations. Data taken from [1–7].



Supplementary Figure 2. Effect of immune-interactions on vaccination impact (full results). This figure completes the results presented on Figure 4 of the main text, by presenting the timeseries solution for secondary cases, as well as the ages of first and second infections. Results are based on 50 individual model runs. Please refer to the original figure legend for details.



Supplementary Figure 3. Effect of R0 on the 2-infection and 4-infection models. (*A-D*). Results for the 4-infection (light red) and 2-infection (green) models when using low R0. (*E-H*) Results for the 4-infection (light red) and 2-infection (green) models when using high R0. The suplots present (*A,E*) 1-year average of total incidence; (*B,F*) 1-year average of secondary incidence; (*C,G*) changes in total incidence in the post-vaccination era; and (*D,H*) changes in secondary incidence in the post-vaccination era. Results are derived from 50 independent simulations. As the qualitative behaviour of both models is invariant to the level of R0, we note that the observations described in the main text between these two models are not simply due to their intrinsic differences in R0, as presented in the results section.



Supplementary Figure 4. Effect of heterogeneous vaccine efficacies on long-term serotype dynamics. (*A,C*) Serotype dynamics, presented as prevalence (*A*) and relative prevalence (*C*) for the neutral model with homogeneous efficacies as described in the main text. (*B,D*) Serotype dynamics, presented as prevalence (*B*) and relative prevalence (*D*) for the neutral model with heterogeneous efficacies (DENV1: 50%; DENV2: 35%; DENV3: 78%, DENV4: 75%). DENV2 is seen to escape earlier from the introduction of the vaccine at year 0 in the scenario with heterogeneous vaccine efficacies. Results are based on 25 simulations.

References

1. Graham RR, Juffrie M, Tan R, Hayes CG, Laksono I, Ma'roef C, et al. A prospective seroepidemiologic study on dengue in children four to nine years of age in Yogyakarta, Indonesia I. studies in 1995-1996. American Journal of Tropical Medicine and Hygyiene. 1999;61(3):412–419.

2. Ferguson NM, Donnelly CA, Anderson RM. Transmission dynamics and epidemiology of dengue: insights from age-stratified sero-prevalence surveys. Philosophical Transactions of the Royal Society of London Series B, Biological Ssciences. 1999 Apr;354(1384):757–68.

3. Thai KT, Binh TQ, Giao PT, Phuong HL, Hung leQ, Van Nam N, et al. Seroprevalence of dengue antibodies, annual incidence and risk factors among children in southern Vietnam. Tropical Medicine and Internatinal Health. 2005 Apr;10(4):379–386.

4. Yamashiro T, Disla M, Petit A, Taveras D, Castro-Bello M, Lora-Orste M, et al. Seroprevalence of IgG specific for dengue virus among adults and children in Santo Domingo, Dominican Republic. American Journal of Tropical Medicine and Hygyiene. 2004 Aug;71(2):138–143.

5. Sangkawibha N, Rojanasuphot S, Ahandrik S, Viriyapongse S, Jatanasen S, Salitul V, et al. Risk factors in dengue shock syndrome: a prospective epidemiologic study in Rayong, Thailand. I. The 1980 outbreak. American Journal of Epidemiology. 1984 Nov;120(5):653–669.

6. Pengsaa K, Limkittikul K, Luxemburger C, Yoksan S, Chambonneau L, Ariyasriwatana C, et al. Age-specific prevalence of dengue antibodies in Bangkok infants and children. Pediatric Infectious Disease Journal. 2008 May;27(5):461–463.

7. Morrison AC, Minnick SL, Rocha C, Forshey BM, Stoddard ST, Getis A, et al. Epidemiology of dengue virus in Iquitos, Peru 1999 to 2005: interepidemic and epidemic patterns of transmission. PLoS Neglected Tropical Diseases. 2010;4(5):e670.