Appendix 2: Comparing models of waning VE_C

Three models of waning VE_C were considered.

For each study i,

$$\log\left(\frac{P_{Vi}{}^{R}}{1-P_{Vi}{}^{R}}\right)=\alpha_i \qquad \text{\# In all models}$$

$$\log\left(\frac{P_{Vi}{}^{T}}{1-P_{Vi}{}^{T}}\right)=\alpha_i+\theta_i+\beta_1*\log(t_i) \qquad \text{\# In model 1 (main model presented)}$$

$$\log\left(\frac{P_{Vi}{}^{T}}{1-P_{Vi}{}^{T}}\right)=\alpha_i+\theta_i+\beta_1*t_i \qquad \text{\# In model 2}$$

$$\log\left(\frac{P_{Vi}{}^{T}}{1-P_{Vi}{}^{T}}\right)=\alpha_i+\theta_i*\beta_1{}^{t_i} \qquad \text{\# In model 3}$$

, where $P_{Vi}{}^{R}$ and $P_{Vi}{}^{T}$ are the proportion of vaccinated individuals in the reference and target groups respectively, θ_i is the study-specific natural logarithm of the OR

We used a random effect model taking the between-study heterogeneity into account by assuming that θ_i were independent and sampled from a normal distribution centred around the mean log(OR) of carriage (μ) with a precision τ, such that $\theta_i \sim N(\mu,\tau)$ and $\tau=1/\sigma^2$, where σ^2 is the between-study variance. A fixed effect was assumed for β_1.

Therefore, the vaccine efficacy at time *t* (VE_{Ct}) is as follows;

$$VEc_t = 1 - (e^{\mu} * t^{\beta_1})$$ # In model 1

$$VEc_t = 1 - e^{(\mu + \beta_1 * t)}$$ # In model 2

$$VEc_t = 1 - e^{(\mu + \beta_1 t)}$$ # In model 3

We used the same priors in all three models.

The models outputs were compared visually (Figure 5) as well as through the Deviance Information Criterion (DIC), with the smallest DIC suggesting the best model fit.

In the models of vaccine efficacy against carriage acquisition of all VT serotypes, the DIC was the same at 307.7, 307.4 and 307.0 for models 1, 2 and 3 respectively. Differences in DIC smaller than 5 are not considered meaningful in random effects meta-regression models.

The DIC for the modelling of each individual serotype and each model considered are shown in Table 3.

The smallest DIC values were consistently seen for model 1 (the main model presented) – with the exception of serotype 9V -, but the difference in DIC values between models was not considered significant, except for 19F for which model 3 was outperformed by the two other models.

Hence, model 1 was presented as the main model in this paper based on a priori assumptions about the waning of vaccine efficacy, rather than on strong statistical grounds when comparing model 1 to the two other models.