Supplementary Material

S1. Model equations

As stated in the main text, the force of infection for age group *i* was calculated as:

$$\lambda_i = \beta_0(1 + \beta_1 \cos(\frac{2\pi t}{52} + \varphi))\frac{1}{N_i}\sum_{j=1}^{4} M_{i,j}\, I_j$$

This was chosen to represent the distinct seasonality of RSV. Similar seasonal forcing has been shown to accurately model RSV seasonality in temperate climates and accounts for the increase in observed RSV infections during winter periods. In the equation above, β_0 is the transmission coefficient, β_1 is the amplitude of seasonal forcing, and φ represents the phase shift. The mixing matrix $M_{i,j}$ is the number of contacts that an individual in age group *j* has with individuals in age group *i*.

In the equations below, λ_i represents the force of infection in each age group *i* while parameters σ, γ, and ν represent the latent, recovery, and immunity rates respectively. Live births are represented by μ. Reduced susceptibility to infection due to maternally derived antibodies is represented by α_1. Ageing is represented by η_i.

$$\frac{dS_1}{dt} = \mu - \alpha_1\lambda_1 S_1 - \eta_1 S_1 + \nu R_1$$

$$\frac{dE_1}{dt} = \alpha_1\lambda_1 S_1 - \eta_1 E_1 - \sigma E_1$$

$$\frac{dI_1}{dt} = \sigma E_1 - \eta_1 I_1 - \gamma I_1$$

$$\frac{dR_1}{dt} = \gamma I_1 - \eta_1 R_1 - \nu R_1$$

$$\frac{dS_i}{dt} = \eta_{i-1}S_{i-1} - \lambda_i S_i - \eta_i S_i + \nu R_i$$

$$\frac{dE_i}{dt} = \eta_{i-1}E_{i-1} + \lambda_i S_i - \eta_i E_i - \sigma E_i$$

$$\frac{dI_i}{dt} = \eta_{i-1}I_{i-1} + \sigma E_i - \eta_i I_i - \gamma I_i$$

$$\frac{dR_i}{dt} = \eta_{i-1}R_{i-1} + \gamma I_i - \eta_i R_i - \nu R_i$$

Note: Differential equations for S_i, E_i, I_i, R_i represent equations for age groups 2 to 4.

Model equations with maternal vaccination

The force of infection λ_i was calculated the same as for the baseline (no intervention) models. Immunized infants had susceptibility to infection reduced by factor $1 - ve$, where *ve* represents maternal vaccine effectiveness. The proportion vaccinated is represented by *pv*. Protection from vaccination is assumed to last for up to 180 days (six months), therefore vaccine effectiveness was set to 0 in age groups 3 and 4. The model equations are:

$$\frac{dS_1}{dt} = (1 - pv)\mu - \alpha_1\lambda_1 S_1 - \eta_1 S_1 + \nu R_1$$

$$\frac{dE_1}{dt} = \alpha_1\lambda_1 S_1 + (1 - ve)\alpha_1\lambda_1 P_1 - \eta_1 E_1 - \sigma E_1$$

$$\frac{dI_1}{dt} = \sigma E_1 - \eta_1 I_1 - \gamma I_1$$

$$\frac{dR_1}{dt} = \gamma I_1 - \eta_1 R_1 - \nu R_1$$

$$\frac{dP_1}{dt} = (pv)\mu - (1 - ve)\alpha_1\lambda_1 P_1 - \eta_1 P_1$$

$$\frac{dS_2}{dt} = \eta_1 S_1 - \lambda_2 S_2 - \eta_2 S_2 + \nu R_2$$

$$\frac{dE_2}{dt} = \eta_1 E_1 + \lambda_2 S_2 + (1 - ve)\lambda_2 P_2 - \eta_2 E_2 - \sigma E_2$$

$$\frac{dI_2}{dt} = \eta_1 I_1 + \sigma E_2 - \eta_2 I_2 - \gamma I_2$$

$$\frac{dR_2}{dt} = \eta_1 R_1 + \gamma I_2 - \eta_2 R_2 - \nu R_2$$

$$\frac{dP_2}{dt} = \eta_1 P_1 - (1 - ve)\lambda_2 P_2 - \eta_2 P_2$$

$$\frac{dS_3}{dt} = \eta_2 S_2 - \lambda_3 S_3 - \eta_3 S_3 + \nu R_3$$

$$\frac{dE_3}{dt} = \eta_2 E_2 + \lambda_3 S_3 + (1 - ve)\alpha_3 \lambda_3 P_3 - \eta_3 E_3 - \sigma E_3$$

$$\frac{dI_3}{dt} = \eta_2 I_2 + \sigma E_3 - \eta_3 I_3 - \gamma I_3$$

$$\frac{dR_3}{dt} = \eta_2 R_2 + \gamma I_3 - \eta_3 R_3 - \nu R_3$$

$$\frac{dP_3}{dt} = \eta_2 P_2 - (1 - ve)\lambda_3 P_3 - \eta_3 P_3$$

$$\frac{dS_4}{dt} = \eta_3 S_3 - \lambda_4 S_4 - \eta_4 S_4 + \nu R_4$$

$$\frac{dE_4}{dt} = \eta_3 E_3 + \lambda_4 S_4 + (1 - ve)\alpha_4 \lambda_4 P_4 - \eta_4 E_4 - \sigma E_4$$

$$\frac{dI_4}{dt} = \eta_3 I_3 + \sigma E_4 - \eta_4 I_4 - \gamma I_4$$

$$\frac{dR_4}{dt} = \eta_3 R_3 + \gamma I_4 - \eta_4 R_4 - \nu R_4$$

$$\frac{dP_4}{dt} = \eta_3 P_3 - (1 - ve)\lambda_4 P_4 - \eta_4 P_4$$

Model equations with seasonal mAb

Immunized infants had susceptibility to infection reduced by factor $1 - ve$, where ve is a proxy for mAb effectiveness. The proportion immunized is represented by pv. To investigate the impact of a seasonal mAb, equations were numerically solved with a condition that $pv = 0$ for weeks that were not two months prior to or within the winter season period (where the winter season was defined as weeks 18–39 of each year), and $pv = pv$ otherwise. The model equations are:

$$\frac{dS_1}{dt} = \mu - \alpha_1\lambda_1 S_1 - \eta_1 S_1 + \nu R_1 - pvS_1 + \omega P_1$$

$$\frac{dE_1}{dt} = \alpha_1\lambda_1 S_1 + (1 - ve)\alpha_1\lambda_1 P_1 - \eta_1 E_1 - \sigma E_1$$

$$\frac{dI_1}{dt} = \sigma E_1 - \eta_1 I_1 - \gamma I_1$$

$$\frac{dR_1}{dt} = \gamma I_1 - \eta_1 R_1 - \nu R_1$$

$$\frac{dP_1}{dt} = pvS_1 - (1 - ve)\alpha_1\lambda_1 P_1 - \eta_1 P_1 - \omega P_1$$

$$\frac{dS_2}{dt} = \eta_1 S_1 - \lambda_2 S_2 - \eta_2 S_2 + \nu R_2 - pvS_2 + \omega P_2$$

$$\frac{dE_2}{dt} = \eta_1 E_1 + \lambda_2 S_2 + (1 - ve)\lambda_2 P_2 - \eta_2 E_2 - \sigma E_2$$

$$\frac{dI_2}{dt} = \eta_1 I_1 + \sigma E_2 - \eta_2 I_2 - \gamma I_2$$

$$\frac{dR_2}{dt} = \eta_1 R_1 + \gamma I_2 - \eta_2 R_2 - \nu R_2$$

$$\frac{dP_2}{dt} = pvS_2 + \eta_1 P_1 - (1 - ve)\lambda_2 P_2 - \eta_2 P_2 - \omega P_2$$

$$\frac{dS_3}{dt} = \eta_2 S_2 - \lambda_3 S_3 - \eta_3 S_3 + \nu R_3 + \omega P_3$$

$$\frac{dE_3}{dt} = \eta_2 E_2 + \lambda_3 S_3 + (1 - ve)\alpha_3 \lambda_3 P_3 - \eta_3 E_3 - \sigma E_3$$

$$\frac{dI_3}{dt} = \eta_2 I_2 + \sigma E_3 - \eta_3 I_3 - \gamma I_3$$

$$\frac{dR_3}{dt} = \eta_2 R_2 + \gamma I_3 - \eta_3 R_3 - \nu R_3$$

$$\frac{dP_3}{dt} = \eta_2 P_2 - (1 - ve)\lambda_3 P_3 - \eta_3 P_3 - \omega P_3$$

$$\frac{dS_4}{dt} = \eta_3 S_3 - \lambda_4 S_4 - \eta_4 S_4 + \nu R_4 + \omega P_4$$

$$\frac{dE_4}{dt} = \eta_3 E_3 + \alpha_4 \lambda_4 S_4 + (1 - ve)\lambda_4 P_4 - \eta_4 E_4 - \sigma E_4$$

$$\frac{dI_4}{dt} = \eta_3 I_3 + \sigma E_4 - \eta_4 I_4 - \gamma I_4$$

$$\frac{dR_4}{dt} = \eta_3 R_3 + \gamma I_4 - \eta_4 R_4 - \nu R_4$$

$$\frac{dP_4}{dt} = \eta_3 P_3 - (1 - ve)\lambda_4 P_4 - \eta_4 P_4 - \omega P_4$$

S2. Contact matrices used in models

We used the following contact matrix in our model. It was adapted from New Zealand specific contact rates as reported by Prem et al.[1], and daily values were converted to weekly values.

	<3m	3-5m	6-23m	24m+
<3m	1.371	1.371	1.371	0.225
3-5m	1.371	1.371	1.371	0.225
6-23m	8.225	8.225	8.225	1.348
24m+	65.802	65.802	65.802	89.191

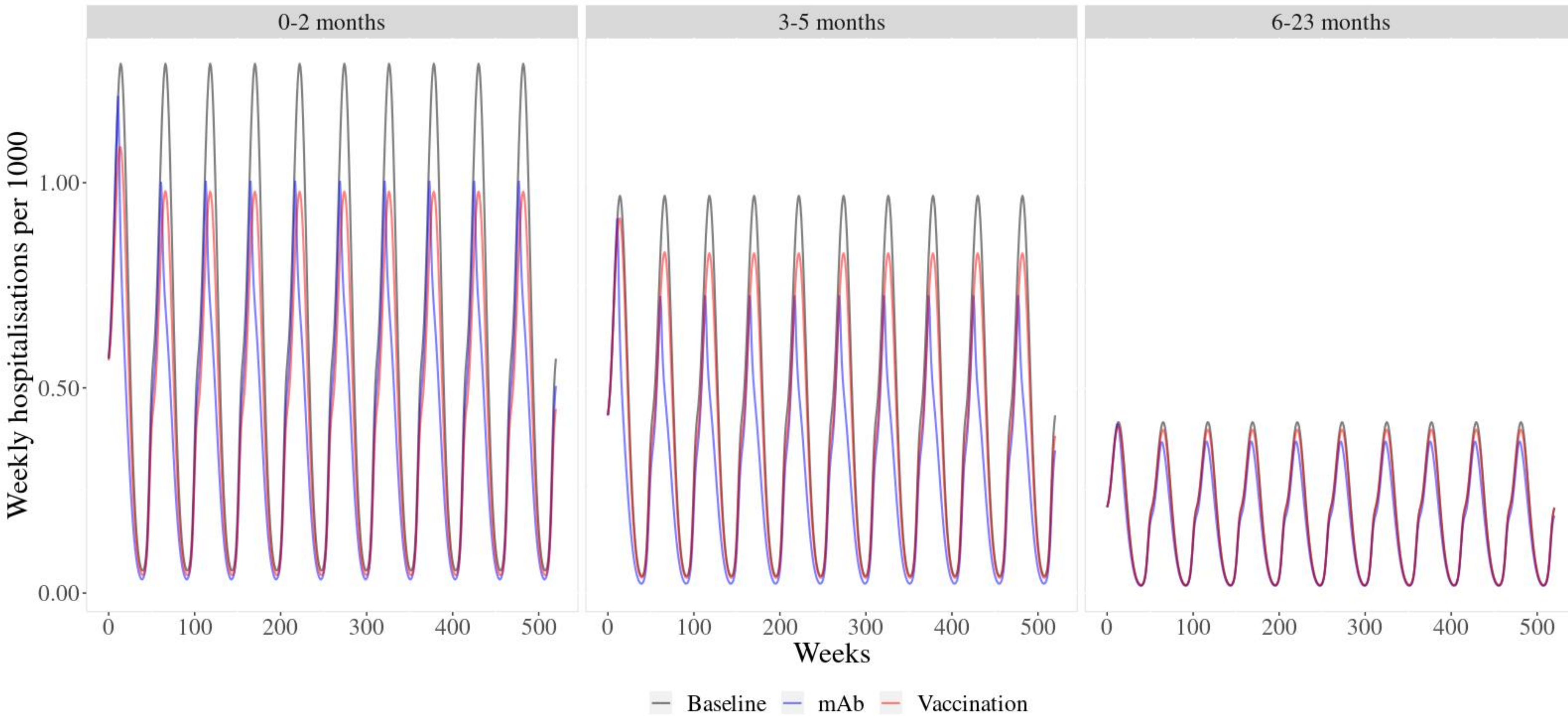
As contact rates provided by Prem et al. were in five year age groups, which were used to estimate contact rates in infants, we also undertook sensitivity analyses using contact data below from the United Kingdom as reported by Fumanelli et al.[2] which was in one-year age bands.

	<3m	3-5m	6-23m	24m+
<3m	0.484	0.484	0.474	0.193
3-5m	0.484	0.484	0.474	0.193
6-23m	2.777	2.777	2.728	1.112
24m+	68.020	68.020	66.429	89.191

1. Prem K, Cook AR, Jit M. Projecting social contact matrices in 152 countries using contact surveys and demographic data. PLoS Comput Biol. 2017;13:e1005697.

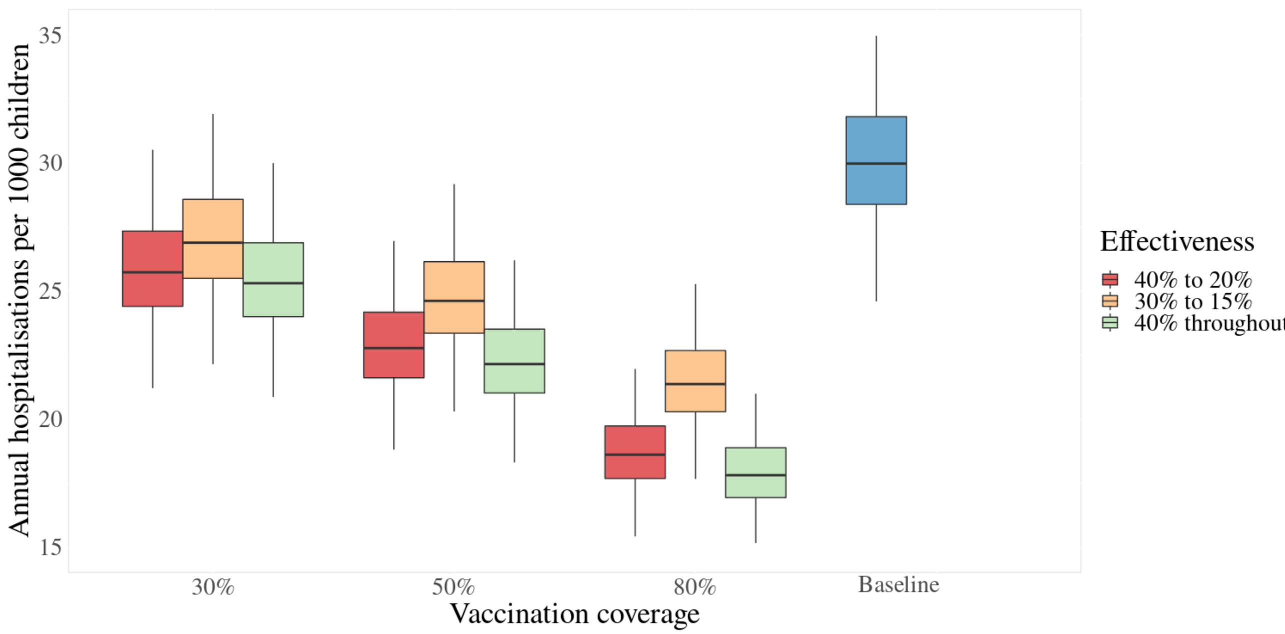
2. Fumanelli L, Ajelli M, Manfredi P, Vespignani A, Merler S. Inferring the Structure of Social Contacts from Demographic Data in the Analysis of Infectious Diseases Spread. PLoS Comput Biol. 2012;8:e1002673.

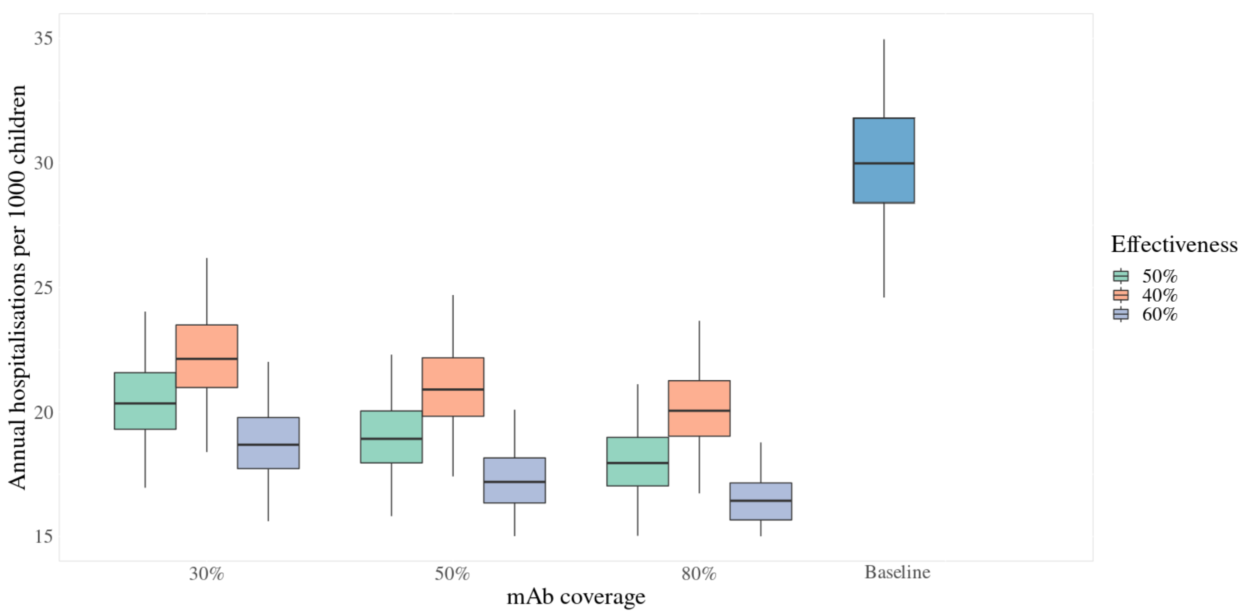
S3. Sensitivity analyses: Weekly RSV hospitalizations per 1000 children by age group for baseline, default maternal vaccine, and default seasonal infant monoclonal antibody (mAb) scenarios for five years following implementation using contact rates from Fumanelli et al.



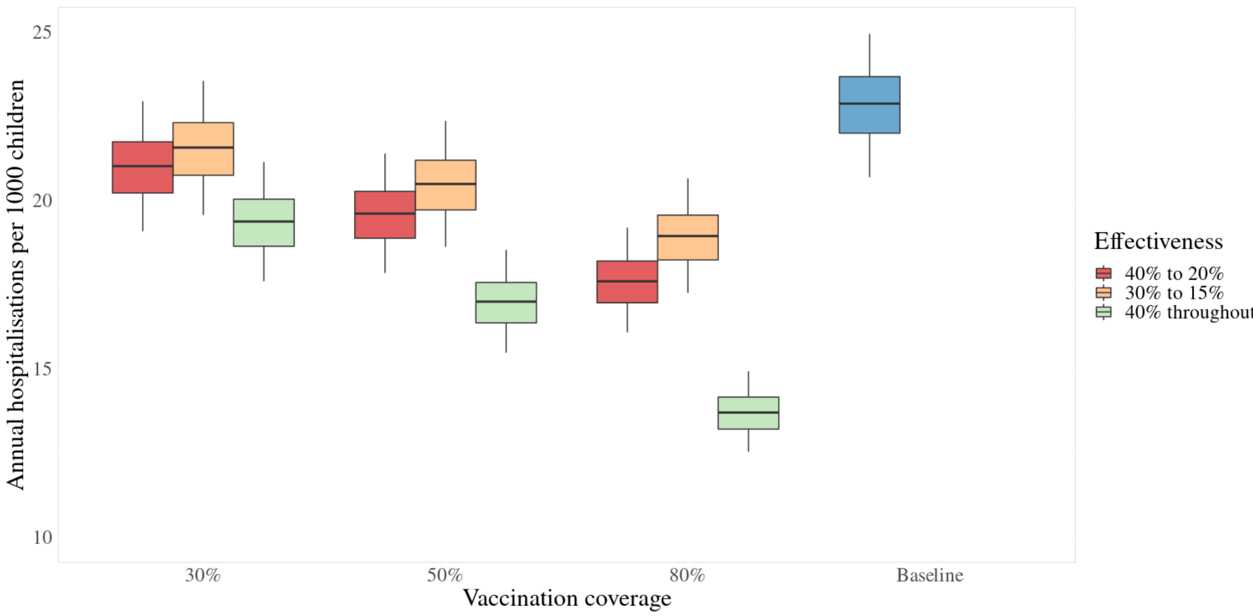
S4a-c: Estimated annual RSV hospitalizations per 1000 children aged less than two years (by age groups) for baseline and different vaccination and seasonal monoclonal antibody (mAb) effectiveness and coverage scenarios.

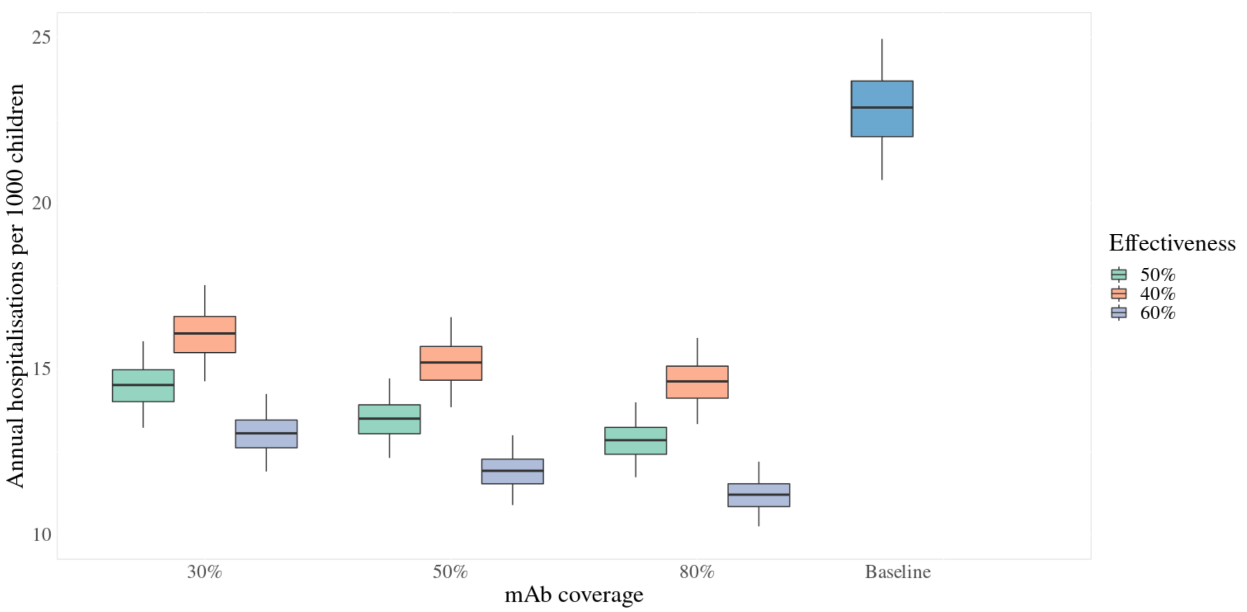
a. **Children aged 0-2 months**



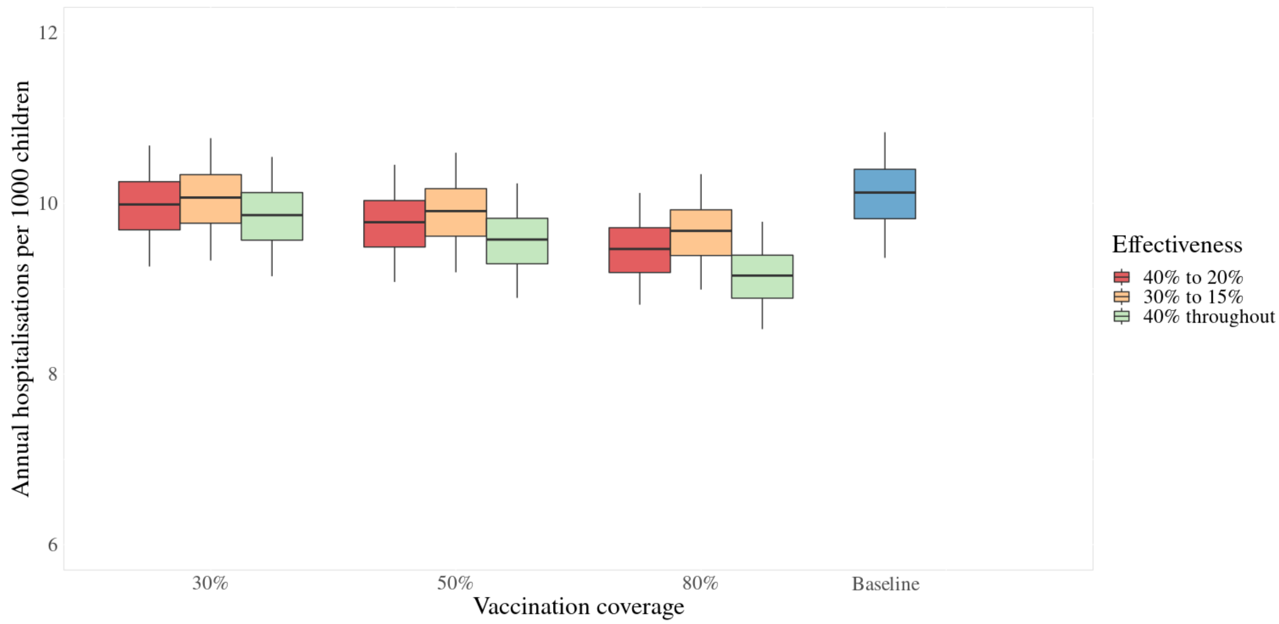


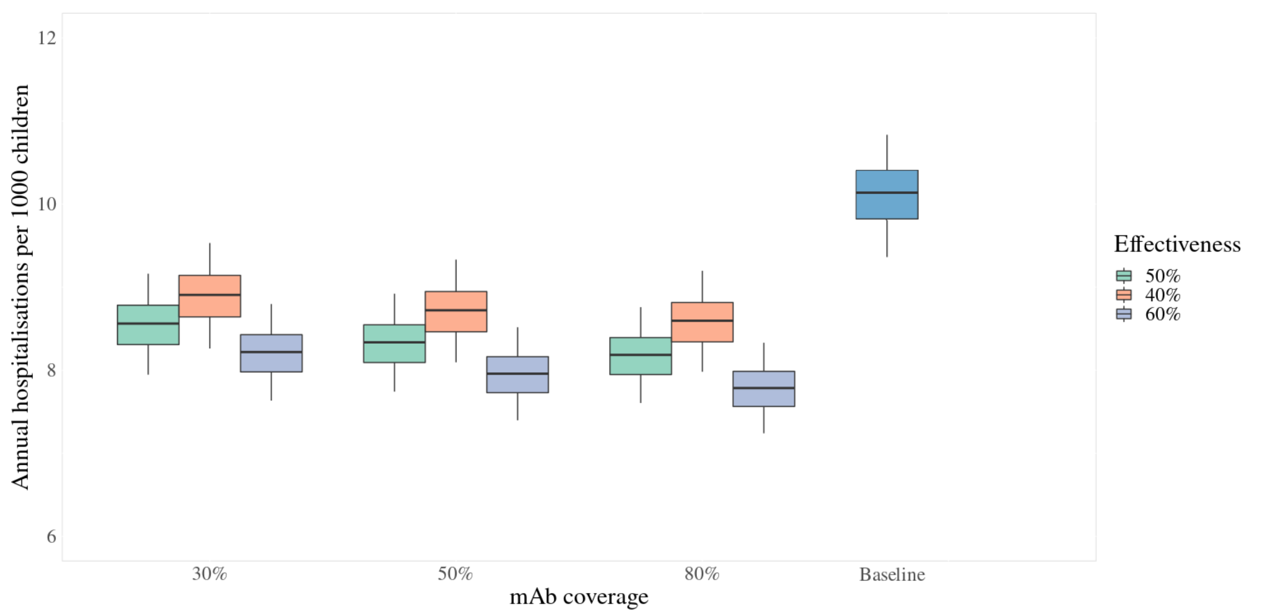
b. Children aged 3-5 months





c. Children aged 6-23 months





Distribution (2.5%, 25%, 75%, and 97.5% quantile and median) of each modelled scenario by age group, which were estimated from the distribution of 500 model simulations, each using a different combination of parameter values based on the fitted parameter uncertainty from maximum likelihood estimation, as shown in Table 1.