Supplementary Material

1. Model definition

We modeled changes over time in the number of pertussis hospitalizations using segmented Poisson regression. This model assumes that the relative changes in the hospitalization rate over time are constant within each of the three periods considered (2005–2009, 2010–2014, and 2015–2019). Specifically, it is assumed that the rate (ratio between the number of hospital admissions and the population at risk) is verified by the following equation:

$$\log(\text{ rate }) = \beta_0 + \beta_1 \text{time}_1 + \beta_2 \text{time}_2 + \beta_3 \text{time}_3$$

where the design matrix for time effects is defined as follows:

	time_1	time_2	time_3
Period 2005-2009			
2005	0	0	0
2006	1	0	0
2007	2	0	0
2008	3	0	0
2009	4	0	0
Period 2010-2014			
2010	5	0	0
2011	5	1	0
2012	5	2	0
2013	5	3	0
2014	5	4	0
Period 2015-2019			
2015	5	5	0
2016	5	5	1
2017	5	5	2
2018	5	5	3
2019	5	5	4

The coefficient of each of these three temporal variables corresponds to the linear trend (in log-scale) of the rate within each period. The coefficient β_k can be transformed into the Average Percentage Change (APC) for the period k using the formula

$$\text{APC} = \left(e^{\beta_k} - 1\right) \times 100$$

which translates the log-linear trend into a percentage change.

Then, to adjust these trends by gender, age group, and region, these variables are included in the model (coefficients have been omitted for clarity):

$$\log(\text{ rate }) = \text{time}_1 + \text{time}_2 + \text{time}_3 + \text{sex} + \text{age-group} + \text{region}$$

Note that this model without the interaction (between age group and time) provides the trends represented by the dashed curves in Figure 2.

Finally, in order to detect differences in the trend between the two age groups, a model with the interaction was considered:

$$\log(\text{rate}) = \text{age-group} \times \text{time}_1 + \text{age-group} \times \text{time}_2 + \text{age-group} \times \text{time}_3 + \text{sex} + \text{region}$$

The Poisson regression used to model variations in average hospital length stay μ is similar to the previous modeling, except that in this case the outcome is the number of days the infant remains in the hospital:

$$\log(\mu) = \text{age-group} \times \text{time}_1 + \text{age-group} \times \text{time}_2 + \text{age-group} \times \text{time}_3 + \text{sex} + \text{region}$$

2. Estimation results

Below, we present the results of the Poisson regression estimation for hospitalization rates and the hospital length stay. Note that in both model results the interaction between age group and time is significant (and negative) only in the last period (2015–2019), which corresponds to the period after the introduction of prenatal vaccination in Spain.

	Model for the hospitalization rate			Model for the hospital stay length		
Characteristic	**Beta**	**95% CI**[1]	**p-value**	**Beta**	**95% CI**[1]	**p-value**
Sex						
Male	—	—		—	—	
Female	0.05	-0.02, 0.13	0.13	0.03	0.00, 0.06	0.060
Age.group						
3–11 months	—	—		—	—	
0–2 months	1.7	1.5, 1.9	<0.001	0.32	0.22, 0.43	<0.001
$time_1$	0.07	0.02, 0.12	0.003	-0.03	-0.06, -0.01	0.008
$time_2$	0.16	0.12, 0.20	<0.001	-0.01	-0.03, 0.01	0.3
$time_3$	-0.30	-0.37, -0.24	<0.001	-0.06	-0.09, -0.03	<0.001
Age.group * $time_1$						
0–2 months * $time_1$	0.01	-0.05, 0.07	0.8	0.00	-0.02, 0.03	0.7
Age.group * $time_2$						
0–2 months * $time_2$	0.00	-0.05, 0.05	0.9	0.00	-0.03, 0.02	0.7
Age.group * $time_3$						
0–2 months * $time_3$	-0.12	-0.20, -0.03	0.006	-0.08	-0.12, -0.04	<0.001
region (sd)	0.27		<0.001	0.18		<0.001

[1]CI = Confidence Interval