

SUPPLEMENTARY MATERIALS

Supplementary Table 1. Infectious diseases included in the model.

Infectious disease	Included in the Spanish common vaccination and immunization calendar (1)	Included in the analysis	Analyzed in Cassini <i>et al.</i> (2)	Reason for exclusion From analysis
HAV infection	Yes	Yes	Yes	n/a
HBV infection	Yes	Yes	Yes	n/a
Influenza	Yes	Yes	Yes	n/a
Invasive <i>Haemophilus influenzae</i> infection	Yes	Yes	Yes	n/a
Invasive meningococcal disease	Yes	Yes	Yes	n/a
Invasive pneumococcal disease	Yes	Yes	Yes	n/a
Measles	Yes	Yes	Yes	n/a
Mumps	Yes	Yes	Yes	n/a
Parotiditis	Yes	No	No	Infection assumed similar to mumps
Rubella	Yes	No	Yes	No or low incidence*
Diphtheria	Yes	No	Yes	No or low incidence*
Tetanus	Yes	No	Yes	No or low incidence*
Pertussis	Yes	No	Yes	Due to exclusion of diphtheria and tetanus (Same recommendation)
Poliomyelitis	Yes	No	No	No or low incidence*
Human papilloma virus	Yes	No	No	Complex cancer outcomes to model
Varicella zoster	Yes	Yes	No	n/a
Herpes zoster	Yes	Yes	No	n/a
RSV	Yes**	Yes	No	n/a
Rotavirus	Potential**	Yes	No	n/a
COVID-19	No	No	No	Not included in 2023 vaccination calendar Uncertainty around future recommendations

HAV: hepatitis A virus; HBV: hepatitis B virus; n/a: not applicable; RSV: respiratory syncytial virus.

*There were no reported cases of rubella, tetanus, diphtheria, or polio in Spain in 2017 according to RENAVE (3), and fewer than 20 cases were reported for each of them combined in 2018.

**In the 2024 Vaccination and Immunization Calendar, rotavirus was included in the systematic immunization calendar and RSV was included for risk groups and children.

Supplementary Table 2. Annual incidence of influenza in Spain adjusted by sex and age.

Age (years)	Annual number of cases	
	Female	Male
0-4	119,823	119,823
5-9	59,912	59,912
10-14	59,912	59,912
15-19	143,349	143,349
20-24	143,349	143,349
25-29	143,349	143,349
30-34	143,349	143,349
35-39	143,349	143,349
40-44	143,349	143,349
45-49	177,394	177,394
50-54	177,394	177,394
55-59	177,394	177,394
60-64	177,394	177,394
65-69	6,022	6,022
70-74	6,022	6,022
75-79	6,022	6,022
80-84	6,022	6,022
85+	6,022	6,022
Total	1,839,426	1,839,426

Incidence data were collected from the Spanish National Epidemiological Surveillance Network (RENAVE) (3) and adjusted for underestimation for age groups between 15 and 64 years following the Flu Watch study (4). For the age group between 15 and 44 years, an underestimation of 17.85% (multiplication factor 5.6) was applied, whereas for individuals between 45 and 64 years, this factor was 14.43% (multiplication factor 6.9). Due to the severity of disease in the elderly and school attendance requirements, all children <15 years and adults over 65 years would seek medical care, therefore the data was not adjusted.

Supplementary Table 3. Annual incidence of RSV in Spain adjusted by sex and age.

Age (years)	Annual number of cases	
	Female	Male
0	11,794	12,582
1-4	50,709	53,907
5-9	232	343
10-14	72	183
15-19	39	45
20-24	24	30
25-29	39	41
30-34	75	45
35-39	96	119
40-44	136	149
45-49	160	265
50-54	253	340
55-59	410	519
60-64	533	739
65-69	642	933
70-74	976	1,257
75-79	1,193	1,530
80-84	1,853	1,668
85+	4,304	2,410
Total	73,543	77,105

Incidence data were collected from the Infection Surveillance System of Catalonia (SIVIC) (5).

Supplementary Table 4. Definition of the infectious diseases modelled de novo according to the ICD-10-CM codes used.

Infectious disease	ICD-10-CM code
Herpes zoster*	B02.0-Herpes zoster encephalitis
	B02.1-Herpes zoster meningitis
	B02.30-Herpes zoster ocular disease, unspecified
	B02.31-Herpes zoster conjunctivitis
	B02.32-Herpes zoster iridocyclitis
	B02.33-Herpes zoster keratitis
	B02.34-Herpes zoster scleritis
	B02.39-Other herpes zoster eye disease
	B02.3-Herpes zoster ocular disease
	B02.7-Disseminated herpes zoster
	B02.8-Herpes zoster with other complications
	B02.9-Herpes zoster without complications
Rotavirus	A08.0-Rotaviral enteritis
Varicella zoster	B01.0-Varicella meningitis
	B01.11-Varicella encephalitis and encephalomyelitis
	B01.12-Varicella myelitis
	B01.1-Varicella encephalitis, myelitis and encephalomyelitis
	B01.2-Varicella pneumonia
	B01.81-Varicella keratitis
	B01.89-Other varicella complications
	B01.8-Varicella with other complications
	B01.9-Varicella without complication
	B01-Varicella
RSV	B97.4-Respiratory syncytial virus as the cause of diseases classified elsewhere
	J12.1-Respiratory syncytial virus pneumonia
	J20.5-Acute bronchitis due to respiratory syncytial virus
	J21.0- Acute bronchiolitis due to respiratory syncytial virus

RSV: respiratory syncytial virus.

*Post-herpetic neuralgia diagnosis has not been considered for herpes zoster infection due to its inclusion as a health condition within the outcome tree with the corresponding probability of transition assigned.

Supplementary Table 5. Proportion, duration and disability weight of health conditions associated to the infectious diseases modelled in BCoDE.

Infectious disease	Clinical state	Proportion	Disability weight (UI)*	Duration/UI
HAV infection	Symptomatic infection	100%	0.125 P(0.104, 0.152)	<10 years U: 7/14 days ≥10 years: 30 days P(10;180)
	Symptomatic infection: fatal	U: 0.1/0.3%	n/a	n/a
HBV infection	Symptomatic infection	0 yrs: 10% 1-4 yrs: U: 5/15% ≥5yrs: U: 30/50%	0.051 P(0.039, 0.06)	42 days
	Symptomatic infection: chronic hepatitis	0 yrs: 90% 1-4 yrs: U: 20/30% ≥5yrs: 10%	0.07 P(0.057, 0.088)	U: 4.5/33.24 years
	Symptomatic infection: fulminant liver failure	U: 0.5/1%	0.515 P(0.459, 0.572)	U: 1-56 days
	Liver failure: fatal	U: 20/33.3%	n/a	n/a
	Chronic hepatitis: compensated cirrhosis	2.1%	0.07 P(0.057, 0.088)	A: 6-10.4 years
	Chronic hepatitis: decompensated cirrhosis	3-4%	0.163 P(0.136, 0.194)	U: 124/142 days
	Chronic hepatitis: hepatocellular carcinoma	0.3% P(0.1/0.41%)	0.265 (0.222, 0.303)	A: 0.72–4.48 years
	Compensated cirrhosis: hepatocellular carcinoma	2.2% P(1.71–2.71)	0.265 (0.222, 0.303)	A: 0.72–4.48 years
	Hepatocellular carcinoma: fatal	43.3% P(20-60%)	n/a	n/a
	Decompensated cirrhosis: fatal	U: 20/57%	n/a	n/a
Influenza	Symptomatic infection	100%	0.051 P(0.007,0.125)	5.11 days
	Symptomatic infection: fatal	U: 0.007–0.013%	n/a	n/a
	Symptomatic infection: permanent acute respiratory distress syndrome	0.10%	0.056 P(0.044,0.067)	Chronic
Invasive <i>Haemophilus Influenzae</i> infection	Symptomatic infection	100%	0.655 P(0.579,0.727)	7 days
	Symptomatic infection: meningitis	15-18%	see post meningitis	see post meningitis
	Post meningitis: multiple impairments	U: 0.39/0.47%	U: 0.004/0.421	Chronic
	Post meningitis: cognitive difficulties	U: 0.17/0.20%	U: 0.044/0.188	Chronic
	Post meningitis: seizures disorder	U: 0.23/0.27%	0.07 P(0.057, 0.188)	Chronic
	Post meningitis: hearing loss	U: 0.48/0.58%	U: 0.008/0.103	Chronic
	Post meningitis: motor deficit	U: 0.33/0.40%	U: 0.011/0.421	Chronic
	Post meningitis: visual disturbance	U: 0.08/0.09%	U: 0.004/0.171	Chronic
	Post meningitis: behavioural problems	U: 0.32/0.38%	0.088 P(0.07, 0.108)	Chronic
	Post meningitis: clinical impairments	U: 0.18/0.22%	U: 0.004/0.421	Chronic
	Symptomatic infection: fatal	A: 5.4-19.5%	n/a	n/a
Invasive meningococcal disease	Symptomatic infection	100%	0.655 P(0.579,0.727)	7 days
	Symptomatic infection: meningitis	60-63%	see post meningitis	see post meningitis
	Post meningitis: multiple impairments	U: 0.78/0.82%	U: 0.004/0.421	Chronic
	Post meningitis: cognitive difficulties	U: 0.96/1.01%	U: 0.044/0.188	Chronic
	Post meningitis: seizures disorder	U: 0.3/0.35%	0.07 P(0.057, 0.188)	Chronic
	Post meningitis: hearing loss	U: 1.56/1.64%	U: 0.008/0.103	Chronic
	Post meningitis: motor deficit	U: 0.9/0.95%	U: 0.011/0.421	Chronic
	Post meningitis: visual disturbance	U: 0.36/0.38%	U: 0.004/0.171	Chronic

	Post meningitis: behavioural problems	U: 0.12/0.13%	0.088 P(0.07, 0.108)	Chronic
	Post meningitis: clinical impairments	U: 0.12/0.13%	U: 0.004/0.421	Chronic
	Post meningitis: fatal	A: 6.9-17%	n/a	n/a
Invasive pneumococcal disease	Symptomatic infection	100%	0.655 P(0.579, 0.727)	U: 10/14 days
	Symptomatic infection: meningitis	60-63%	<i>see post meningitis</i>	<i>see post meningitis</i>
	Post meningitis: multiple impairments	0.57%	U: 0.004/0.421	Chronic
	Post meningitis: cognitive difficulties	0.42%	U: 0.044/0.188	Chronic
	Post meningitis: seizures disorder	0.25%	0.07 P(0.057, 0.188)	Chronic
	Post meningitis: hearing loss	0.58%	U: 0.008/0.103	Chronic
	Post meningitis: motor deficit	0.11%	U: 0.011/0.421	Chronic
	Post meningitis: visual disturbance	0.46%	U: 0.004/0.171	Chronic
	Post meningitis: behavioural problems	0.33%	0.088 P(0.07, 0.108)	Chronic
	Post meningitis: clinical impairments	0.75%	U: 0.004/0.421	Chronic
	Symptomatic infection: fatal	A: 3-14%	n/a	n/a
Measles	Symptomatic infection complicated	11.36-42.76%	0.125 P(0.104, 0.152)	10 days
	Symptomatic infection uncomplicated	57.24-88.64%	0.051 P(0.039, 0.06)	10 days
	Symptomatic infection: permanent disability, otitis	0.001%	U: 0.008/0.103	Chronic
	Symptomatic infection: permanent disability, encephalitis	U: 0.02/0.033%	U: 0.054/0.425	Chronic
	Symptomatic infection: permanent disability, post-infectious encephalitis	U: 0.033/0.1%	U: 0.054/0.425	Chronic
	Symptomatic infection: latency	n/a	0	U: 1 month/27 years
	Symptomatic infection: latency, subacute sclerosing panencephalitis	100%	0.276 P(0.088, 0.543)	U: ½ years
	Subacute sclerosing panencephalitis: fatal	0.005%-0.01%	n/a	n/a
	Symptomatic infection: fatal	0.05–0.1%	n/a	n/a
Mumps	Symptomatic infection complicated	80%/32–40%	0.125 P(0.104, 0.152)	U: 7/10 days
	Symptomatic infection uncomplicated	80%60–68%	0.051 P(0.039, 0.06)	U: 7/10 days
	Symptomatic infection: permanent hearing loss	0.005%	0.008 P(0.005, 0.012)	Chronic
	Symptomatic infection: fatal	0.0015%	n/a	n/a

A: age-dependent; HAV: hepatitis A virus; HBV: hepatitis B virus; n/a: not applicable; P: RAND PERT distribution; UI: uncertainty intervals; U: uniform distribution.

*Disability weights included in the BCoDE model are reported in Haagsma et al.(6)

Supplementary Table 6. Alternative disability weight of health conditions associated to the infectious diseases modelled *de novo*.

Infectious disease	Clinical state	Disability weight (UI)
Herpes zoster	Symptomatic infection complicated	0.125 ¹ (0.104, 0.152)
	Symptomatic infection uncomplicated	0.051 ¹ (0.039-0.06)
	Symptomatic infection: postherpetic neuralgia	0.068 ¹
RSV	Symptomatic infection complicated	0.125 ¹ (0.104, 0.152)
	Symptomatic infection uncomplicated	0.051 ¹ (0.039-0.06)
	Symptomatic infection: long-term complications controlled asthma	0.020 ¹
Rotavirus	Symptomatic infection complicated	0.239 ¹ (0.202-0.285)
	Symptomatic infection uncomplicated	0.073 ¹ (0.061-0.092)
Varicella zoster	Symptomatic infection complicated	0.125 ¹ (0.104, 0.152)
	Symptomatic infection uncomplicated	0.051 ¹ (0.039-0.06)

n/a: not available; RSV: respiratory syncytial virus; UI: uncertainty intervals.

¹Haagsma et al.(6)

Supplementary Table 7. Vaccination coverage rates for selected infectious diseases in Spain.

Infectious disease	Vaccination coverage rate (%)	
	2021	2022
HAV infection	n/a	n/a
HBV infection ^a	96.89	98.19
Herpes Zoster	n/a	n/a
Influenza	69.48	68.45
Invasive <i>Haemophilus influenzae</i> infection ^a	96.89	98.18
Invasive meningococcal disease	96.57	97.55
Invasive pneumococcal disease ^a	97.24	98.02
Measles ^{b,c}	95.57	97.24
Mumps ^{b,c}	95.57	97.24
RSV	n/a	n/a
Rotavirus	n/a	n/a
Varicella zoster ^c	93.11	95.26

HAV: hepatitis A virus; HBV: hepatitis B virus; n/a: not available RSV: respiratory syncytial virus

^aData for the two doses of the vaccine.

^bImmunization with a combined vaccine against measles, mumps and rubella.

^cData for the first dose of the vaccine.



Supplementary Figure 1. Annual burden of selected infectious diseases stratified by sex and age groups. The bars represent the total YLD and YLL per year for all the infections evaluated.

Supplementary References

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