Live attenuated influenza vaccine (LAIV) for children for the prevention of influenza illness in Sweden: a cost-effectiveness analysis

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Why did we perform this research?

There is significant morbidity and socioeconomic burden associated with seasonal influenza infections among children, with the highest rates of transmission also in children [1]

Intranasally delivered LAIV is indicated across Europe for children (2–17 years) but is currently limited to risk groups in Sweden [2]

Objectives

To assess the public health impact and cost-effectiveness of implementing a paediatric national vaccination programme using LAIV

To evaluate the benefits of vaccinating this group and its indirect effects on other groups within society

Summary

When considering a societal perspective, increased vaccination with LAIV is cost saving

Protecting children protects everyone, including vulnerable populations

Achieving high, consistent LAIV coverage ensures greater security against adverse influenza-related outcomes

Key takeaway

In Sweden, LAIV is cost-effective in 2–17-year-olds, and cost-saving from a societal perspective, by reducing disease burden and healthcare costs in both children and the broader population

What did we find?

LAIV is a cost-effective intervention and cost-saving from a societal perspective

- The intervention is cost-effective, with an incremental cost-effectiveness ratio (ICER) of 110,005 kr/QALY (€10,029/QALY, **Table 1**), well below commonly accepted thresholds
- With productivity losses (workdays lost) included, the intervention is cost-saving (less expensive and more effective; ICER -74,111 kr/QALY [-€6,760/QALY])

LAIV prevents influenza-related outcomes across populations

- Increasing target vaccine coverage rates to 25% in children requires an additional uptake of 439,028 vaccinations overall (SoC, 1,196,473; LAIV, 1,635,501; **Table 2**), for an "averaged" (2013-2020) influenza season
- Due to a higher attack rate and more intense contact rate for children, the LAIV scenario prevents 594,853 total influenza infections, including 197,406 within the target population (**Figure 1**)
- In a population of ~10.5 million, 31,837 cases of patients seeking medical care are prevented, including 2,003 hospitalisations

Outcomes are robust to key disease transmission model parameter variations

- LAIV remains cost-effective with variations in several key dynamics of seasonal influenza (**Figure 2**):
  - Calibration to seasons in which influenza B was most (65% of total infections) and least (6% of total infections) dominant (2016/2017 and 2015/2016, respectively)
  - Variations in natural background immunity (± 50% relative)
  - Variations in influenza attack rate (± 50% relative)

Limitations

- Infection with any of the three influenza strains in the model is assumed to lead to full cross-protection against all other strains
- The model captures vaccine effectiveness only through exposure and infection rates, excluding its impact on influenza-related complications, hospitalisations, and death

What are the implications for payers?

The cost of LAIV vaccination is shown to be offset by reduced productivity loss due to missed work for childcare

Vaccination of children via nasally administered LAIV (25% coverage) provides the additional indirect benefit of protecting vulnerable adult populations

Modelling results are robust, demonstrating LAIV remains cost-effective despite changes to key model inputs (**Figure 2**)

Table 1. Base case health economic outcomes

Population vaccinated, N	SoC†	LAIV†	Difference
N, total	1,196,473	1,635,501	439,028 (36.7%)
%, Swedish national population (N ~ 10.5 million)	11.36%	15.52%	4.17%
QALYs lost			
Total	2,829	1,692	1,137 (40.2%)
Total cost, kr			
Productivity loss excluded	617,492,435	742,551,299	125,058,864 (20.3%)
Productivity loss included	1,064,044,476	979,792,214	-84,252,262 (-7.9%)
ICER,‡ kr/QALY			
Productivity loss excluded	110,005 **(COST-EFFECTIVE)**		
Productivity loss included	-74,111 **(DOMINANT)**		

†In the SoC scenario all people who are vaccinated (including children aged 2-17 years) receive inactivated influenza vaccine. In the LAIV scenario, only children aged 2-17 are eligible receive LAIV, with IIV given to others as per the SoC scenario. ‡Willingness-to-pay threshold nominally set at 500,000 kr

Abbreviations: ICER, incremental cost-effectiveness ratio; LAIV, live attenuated influenza vaccine; QALY, quality-adjusted life year; SoC, standard of care

Table 2. Base case clinical outcomes by population

	SoC		LAIV	
Outcome, N	Direct†	Indirect	Direct†	Indirect
Population vaccinated	7,119	1,189,354‡	446,126	1,189,375‡
Influenza infections	405,244	862,250	208,199	464,444
Symptomatic cases	271,108	576,845	139,285	310,713
Require medical attention	21,689	46,148	11,143	24,857
Hospitalisations	1,019	3,239	492	1,763

†Direct population is children eligible to receive LAIV (aged 2–17 years); all others are indirect
‡While target vaccination uptake rate in indirect populations is equivalent, the dynamic nature of vaccination in the model may lead to non-zero differences

Figure 1. Incremental clinical outcomes by population

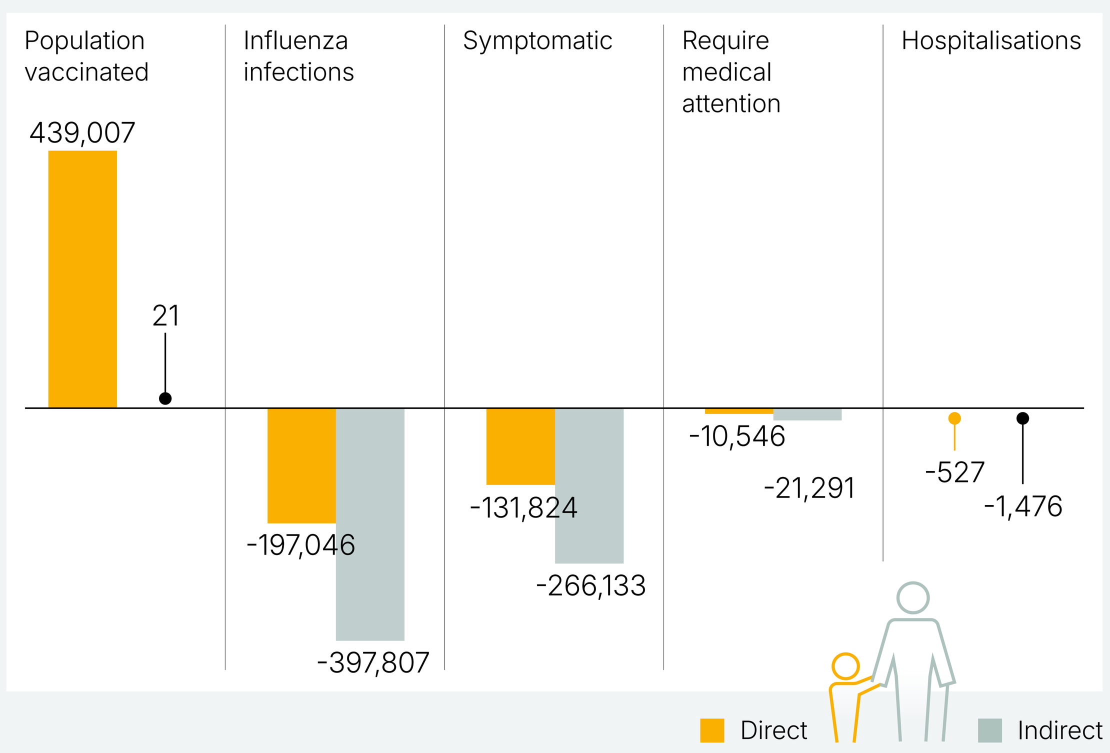
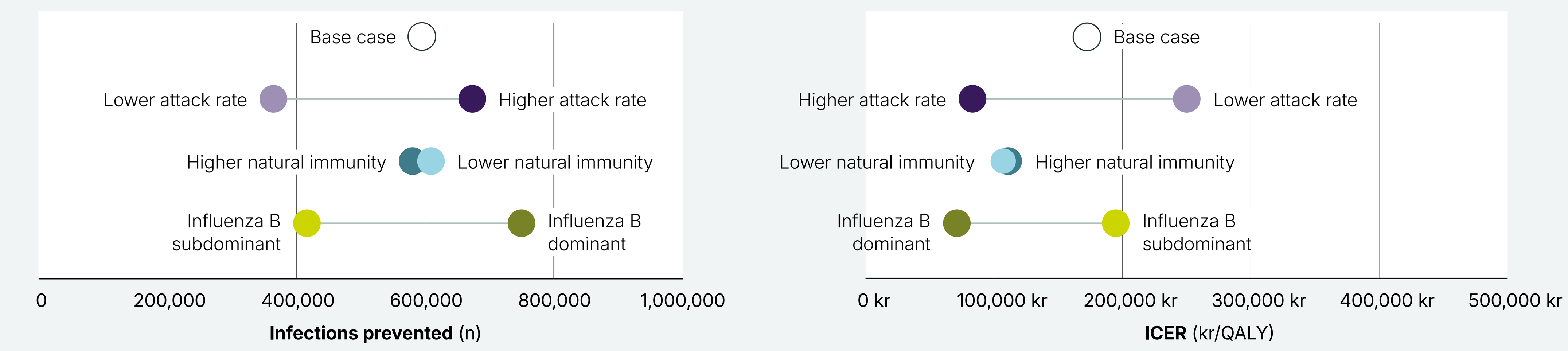


Figure 2. Scenario analyses by outcome: **a)** infections prevented, **b)** ICER (excluding productivity loss)



Abbreviations: ICER, incremental cost-effectiveness ratio; QALY, quality-adjusted life year

How did we perform this research?

- A de novo DTM employing a susceptible-exposed-infected-recovered (SEIR) structure was used to evaluate target coverage expansion up to 25% versus historical rates [3]
- The model estimates outcomes in the total Swedish national population (N = 10,536,632) [4]
- The prevalence of three influenza strains (A/H1N1, A/H2N3, B/Victoria) was modelled across an "average" (2014-2020) season for a 1-year time horizon [3]
- A decision tree model utilised modelled infection incidence to estimate case rate, resource usage, and mortality

Abbreviations: DTM, disease transmission model; GP, general practitioner; HCRU, healthcare resource usage; ICU, intensive care unit; LAIV, live attenuated influenza vaccine; SoC, standard of care

Figure 3. Study design

	Key Inputs	Key Outputs
Clinical	• Infection rates • Vaccine effectiveness • Target coverage rates • Contact rates	• Influenza infections, N • GP visits, N • Hospitalizations (general ward and ICU), N • Influenza-related deaths, N
Costs	• Vaccine costs • Admin costs • HCRU costs • Productivity costs	• Vaccination acquisition and administration costs • Adverse event management costs • Healthcare costs (GP visits, hospitalizations) • Productivity loss due to death • Productivity loss (workdays lost) due to healthcare visits and childcare

Swedish population stratified by age and influenza risk group

SoC scenario All vaccinations are IIV

Scenario with LAIV Background IIV coverage in the indirect population

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