Economic Evaluation of Decennial Pertussis Vaccination with Tetanus, Diphtheria and Acellular Pertussis (Tdap) Vaccine in Adult Populations with Asthma or Chronic Obstructive Pulmonary Disease (COPD) in Brazil

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Background

Pertussis, a respiratory disease caused by *Bordetella pertussis*, is **endemic in Brazil**[1].

Pertussis **vaccine is recommended for adults** in Brazil only for health professionals **in contact with newborns**, pregnant women from the 20th week of pregnancy, and **hematopoietic stem cell transplants recipients**[2].

Asthma and COPD populations are at increased risk of pertussis infection[3].

Pertussis incidence typically follows a **cyclical pattern** with a peak **every 3 to 5 years**[4].

Aim

To assess the **cost-utility of decennial pertussis vaccination** with Tdap vaccine versus no pertussis vaccination **in Brazil's adult asthma and COPD populations** in a high-incidence context.

Cost-utility model of decennial Tdap boosters

- **Model:** **static cross-sectional** population-based cost-utility model of **decennial Tdap boosters**
- **Population:** **asthma patients ≥50 years** and **COPD patients ≥40 years**
- **Perspective:** **payer**
- **Input:** peak-year pertussis incidence; vaccine efficacy and coverage; and costs and outcomes from the **literature** and **public databases**
- **Discount:** **5%** for costs and outcomes

Results for decennial Tdap vaccination versus no vaccination in Brazilian asthma and COPD patients

Number of decennial Tdap vaccinations and pertussis cases in asthma and COPD patients

	Asthma			COPD		
	No vaccination	Decennial vaccination	Incremental	No vaccination	Decennial vaccination	Incremental
N vaccinations with Tdap	0	188,964	188,964	0	1,039,309	1,039,309
Total N pertussis cases	32,854	20,791	12,063	151,940	96,080	55,860

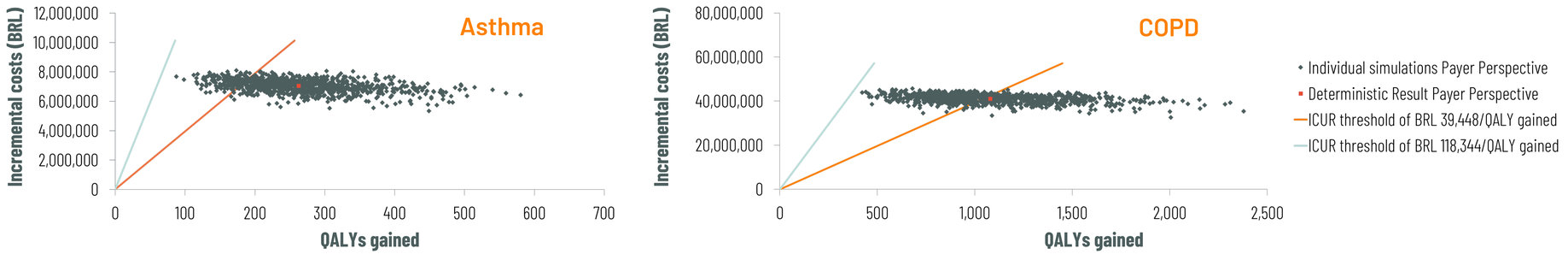
Outcomes of Tdap vaccination for asthma and COPD patients

Results	Asthma	COPD
Discounted direct incremental costs	7,065,788 BRL	41,102,844 BRL
Discounted QALYs gained due to avoided pertussis	262.13	1,078.26
ICUR (Cost per QALY gained)	**26,956 BRL/QALY**	**38,120 BRL/QALY**

PSA for asthma and COPD ~ 1,000 iterations

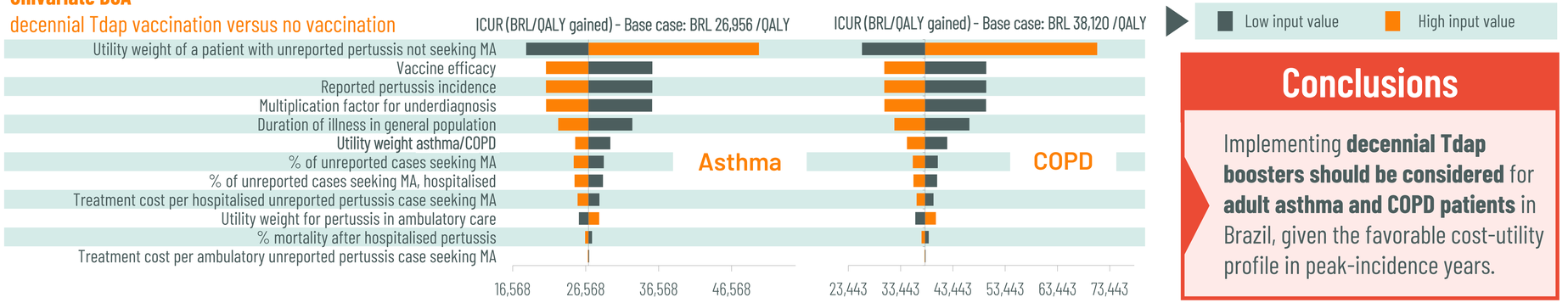
Incremental cost-effectiveness planes

At a cost-effectiveness threshold of 1 GDP/capita (39,448 BRL), **85.8%** and **49.7%** of **simulations** were **cost-effective in asthma and COPD** populations respectively, while **all simulations were cost-effective** at a threshold of **3 GDP/capita** (118,334 BRL).



Univariate DSA

decennial Tdap vaccination versus no vaccination



Conclusions

Implementing **decennial Tdap boosters should be considered** for **adult asthma and COPD patients** in Brazil, given the favorable cost-utility profile in peak-incidence years.

BRL Brazilian reais, **COPD** chronic obstructive pulmonary disease, **DSA** deterministic sensitivity analyses, **GDP** gross domestic product, **ICUR** incremental cost-utility ratio, **MA** medical advice, **N** number, **PSA** probabilistic sensitivity analysis, **QALY** quality-adjusted life year, **Tdap** tetanus, diphtheria and acellular pertussis

Funding: GlaxoSmithKline Biologicals SA (GSK study identifier: VEO-000346)

Acknowledgments: Business & Decision Life Sciences c/o GSK (writer: Esther Van de Vosse); Ilse Van Vlaenderen (CHESS in Health)

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Supplementary Material

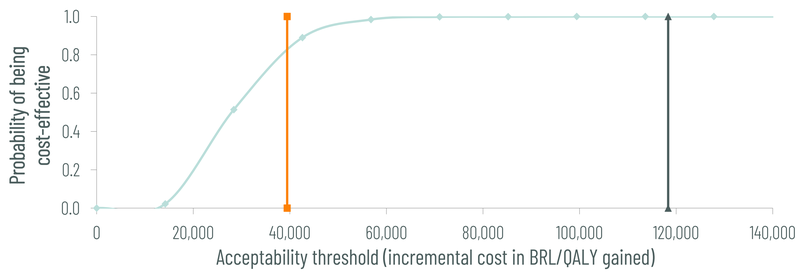
Supplementary methods

- We obtained pertussis incidence for 2014 from São Paulo's state surveillance system[5] and adjusted for underdiagnosis and relative risk in asthma and COPD populations.
- We ran deterministic and probabilistic sensitivity analyses, and scenario analyses.

Probabilistic sensitivity analyses

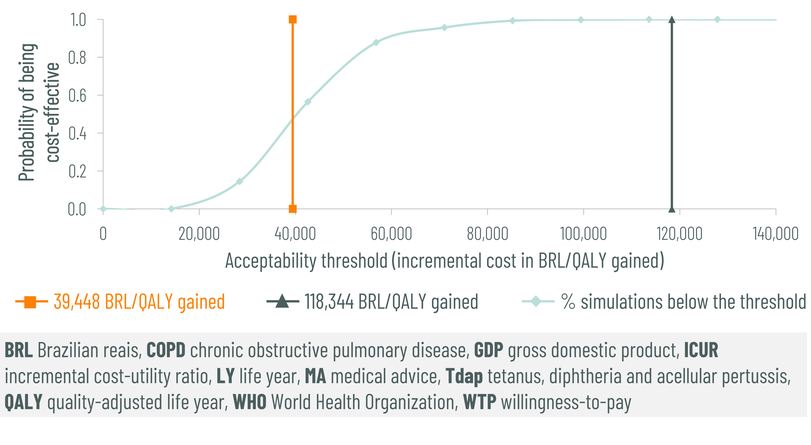
Cost-effectiveness acceptability curve for Asthma

Considering the WTP thresholds applied by the WHO, 100% of simulations are considered cost-effective (ICUR < 3 GDP per capita [BRL 118,344]) and 85.8% very cost-effective (ICUR < 1 GDP per capita [BRL 39,448]).



Cost-effectiveness acceptability curve for COPD

Considering the WTP thresholds applied by the WHO, 100% of simulations is considered cost-effective (ICUR < 3 GDP per capita) and 49.7% very cost-effective (ICUR < 1 GDP per capita).



BRL Brazilian reais, **COPD** chronic obstructive pulmonary disease, **GDP** gross domestic product, **ICUR** incremental cost-utility ratio, **LY** life year, **MA** medical advice, **Tdap** tetanus, diphtheria and acellular pertussis, **QALY** quality-adjusted life year, **WHO** World Health Organization, **WTP** willingness-to-pay

Undiscounted health outcomes

Asthma population	No vaccination	Decennial vaccination	Incremental
	(QA)LYs lost due to pertussis cases/ deaths		(QA)LYs loss avoided due to avoided pertussis cases/deaths
LYs due to:			
Pertussis deaths	192.26	121.41	70.85
QALYs due to:			
Pertussis cases and deaths	969.22	613.16	356.06
Hospitalised cases*	17.15	10.85	6.30
Ambulatory cases*	67.43	42.67	24.76
Unreported cases not seeking MA	749.47	474.28	275.19
Pertussis deaths	135.16	85.36	49.81

COPD population	No vaccination	Decennial vaccination	Incremental
	(QA)LYs lost due to pertussis cases/deaths		(QA)LYs loss avoided due to avoided pertussis cases/deaths
LYs due to:			
Pertussis deaths	963.62	608.46	355.16
QALYs due to:			
Pertussis cases and deaths	3,996.66	2,526.65	1,470.02
Hospitalised cases*	69.90	44.20	25.70
Ambulatory cases*	275.40	174.14	101.26
Unreported cases not seeking MA	3,060.82	1,935.42	1,125.40
Pertussis deaths	590.55	372.89	217.66

Undiscounted incremental direct healthcare costs from the payer perspective

Asthma population	No vaccination	Decennial vaccination	Incremental
Total direct medical costs	7,362,686 BRL	14,292,808 BRL	6,930,122 BRL
Vaccine purchase costs	0 BRL	9,633,382 BRL	9,633,382 BRL
Vaccine administration costs	0 BRL	0 BRL	0 BRL
Cost of treating hospitalised cases*	6,932,118 BRL	4,386,944 BRL	-2,545,174 BRL
Cost of treating ambulatory cases*	430,568 BRL	272,482 BRL	-158,086 BRL

COPD population	No vaccination	Decennial vaccination	Incremental
Total direct medical costs	32,493,555 BRL	73,531,466 BRL	41,037,910 BRL
Vaccine purchase costs	0 BRL	52,983,982 BRL	52,983,982 BRL
Vaccine administration costs	0 BRL	0 BRL	0 BRL
Cost of treating hospitalised cases*	30,593,339 BRL	19,345,872 BRL	-11,247,468 BRL
Cost of treating ambulatory cases*	1,900,216 BRL	1,201,612 BRL	-698,604 BRL

*Incurred by reported and unreported cases seeking MA

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- **Acknowledgments**: Ilse Van Vlaenderen (CHESS in Health) for her support in the model development. Business & Decision Life Sciences platform provided editorial assistance and publication coordination, on behalf of GSK. Esther Van de Vosse (Business & Decision Life Sciences on behalf of GSK) provided medical writing support.
- **Disclosures**: BDV, TP, JG and NJ are employed by GSK. JG also holds shares in GSK. KM and LAVB are employed by CHESS in Health who received consulting fees from GSK for the development of the economic model assessing the health and economic benefits of vaccination of adult asthma and COPD patients with Tdap in Brazil. The authors declare no other financial and non-financial relationships and activities.