EE394

Health Economic Impact of Introducing an Adult-Focused 21-Valent PCV in the Canadian Adult Population

Oluwaseun Sharomi[1]; Scott Weinrich[1]; Marie-Claude Meilleur[2]; Kevin Bakker[1]; Tufail Malik[1]; Rachel J. Oidtman[1]

[1] Merck & Co., Inc., Rahway, NJ, USA;
[2] Merck Canada Inc., Kirkland, QC, Canada

Objective

To assess the health economic impact of the 20-valent (PCV20) vs 21-valent (V116) pneumococcal conjugate vaccines (PCV) in older adults (≥65 years old) in Canada.

Background

- In Canada, the 7-valent PCV (PCV7) has been included in routine public immunization programs in pediatric populations since the mid-2000s, followed by PCV13 in 2010-2011 and PCV15 in 2022[1-3]
- The 23-valent pneumococcal polysaccharide vaccine (PPSV23) has been provided to adults 65 years and older through public provincial immunization programs since the late 1990s. The 15-valent PCV15 and 20-valent PCV20 were authorized for use in this population in 2021 and 2022, respectively, and 21-valent V116 was authorized for use in adults in July 2024[4,5]
- Pneumococcal vaccination programs in Canada are varied, with provinces funding different vaccines at different times[3,6]
- High pediatric vaccination rates in Canada have led to concomitant declines in vaccine-type (VT) invasive pneumococcal disease (IPD) in pediatric populations due to direct protection and in adults due to herd immunity[2,7,8]
- However, due to differences in serotype circulation between pediatric and adult populations, there remains a significant burden of pneumococcal disease (PD) in adults in serotypes not included in pediatric PCVs[9]

Methods

- A population-level, ordinary differential equation, compartmental dynamic transmission model (DTM) that incorporated carriage dynamics of *Streptococcus pneumoniae* was adapted to the Canadian setting (**Figure 1**)[10]
- The DTM considered 6 age strata: 3 in children (ages <2, 2-4, and 5-14 years) and 3 in adults (ages 15-49, 50-65, and ≥65 years); the DTM assumed transmission was possible from children to children and adults, and from adults to adults
- The DTM grouped serotypes into 11 serotype classes (STC) based on their inclusion in different pneumococcal vaccines and allowed co-colonization with up to 3 STCs (**Table 1**)
- The model was calibrated to real-world age- and STC-specific Canadian IPD data from 2001 to 2019 under a vaccination policy consistent with observed historical pediatric, adult, and at-risk pneumococcal vaccination in Canada[11-14]
- Calibrated parameters included the probability of carriage acquisition per contact, competition parameters between current and invading STCs, vaccine efficacy (VE) against carriage, and the case-to-carrier ratios for IPD and NBPP
- VEs for shared STCs between V116 and PCV20 were assumed to be equal (**Table 1**)[15]
- The model incorporated demographic data, historical vaccine coverage rates, vaccine efficacy values, and country-specific healthcare costs
- The calibrated DTM was used to simulate the incidence of IPD, inpatient and outpatient nonbacteremic pneumococcal pneumonia (NBPP), and the associated healthcare costs and QALYs under two vaccination scenarios (adult vaccination with PCV20 vs V116) (**Table 2**)
- The analysis focused on adults aged ≥15, with particular emphasis on those aged ≥65, and was conducted from both payer and societal perspectives (PP and SP) over a 100-year horizon (from 2020 to 2120)
- Costs were reported in 2023 Canadian dollars, and costs and QALYs were discounted annually at 1.5%

Figure 1. Flow diagram for dynamic transmission model

Upon carriage acquisition, individuals move to colonization, co-colonization, or triple-colonization (blue). A fraction of colonized individuals progress to pneumococcal disease (red and orange). Upon recovery, individuals return to noncolonization (light green), sequentially clearing one serotype at a time. Vaccination (dark green) reduces risk of carriage acquisition and disease development for vaccine serotypes.

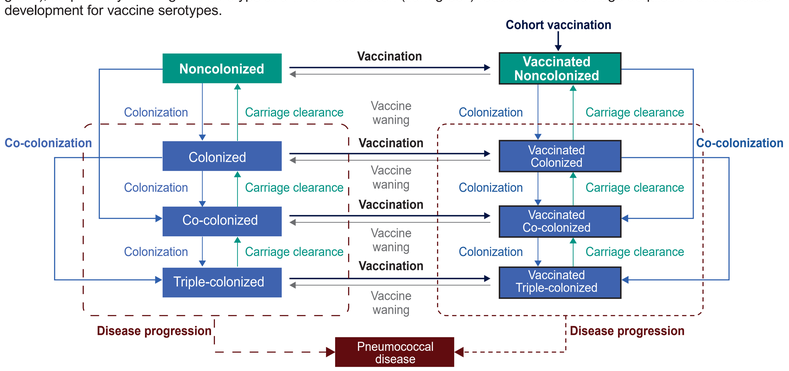

Table 1. Vaccine efficacy (VE) by serotype classes (STC)

Shading indicates inclusion in different vaccines. Empty cells indicate 0% VE.[15-17]

Serotype class	Serotypes included in class	Vaccine efficacy		
		PCV15	PCV20	V116
1	4, 6B, 9V, 14, 18C, 19F, 23F	0.95	0.75	
2	1, 5	0.87	0.75	
3	3	0.30	0.26	0.26
4	7F	0.92	0.75	0.75
5	19A	0.92	0.75	0.75
6	6A, 6C	0.86	0.75	0.75
7	22F, 33F	0.86	0.75	0.75
8	9N, 17F, 20A			0.75
9	8, 10A, 11A, 12F		0.75	0.75
10	15B		0.75	0.75
11	15A, 15C, 16F, 23A, 23B, 24F, 31, 35B			0.75
12	(NVTs)			

V116 contains deOAc15B pneumococcal polysaccharide which has a molecular structure similar to 15C (referred to as 15C hereafter). We include 6C as a vaccine type due to cross-protection from 6A.[16] While PPSV23 protects against ST2, it was merged with NVTs since it's a rare ST.

Table 2. Projected vaccination strategies for V116 and PCV20

Population	PCV20 scenario		V116 scenario	
	Vaccine	VCR	Vaccine	VCR
<2-year-olds	PCV15	84.4%	PCV15	84.4%
15- to 64-year-olds (at risk)	PCV20	26.2%	V116	26.2%
≥65-year-olds	PCV20	56.4%	V116	56.4%

Results

- Among ≥65-year-olds, relative to PCV20 vaccination, V116 vaccination resulted in
  - 11.2% lower IPD incidence and 17,294 fewer cumulative cases of IPD in the overall population in Canada over the 100-year time horizon (**Table 3**) and
  - 24.0% lower IPD incidence and 15,484 fewer cases in adults aged ≥65 (**Table 4** and **Figure 2**)
- Among all ages, V116 vaccination prevented more cumulative cases of IPD, post-meningitis sequelae, inpatient and outpatient NBPP, and deaths compared to PCV20 vaccination (**Table 3** and **Table 4**)
- The projected cost of care for adults 65 years and older infected with PD was approximately $25.3 billion (SP) and $21.8 billion (PP) for the V116 strategy, vs $25.5 billion (SP) and $22 billion (PP) for the PCV20 strategy (**Table 3**), over the 100-year time horizon
- The projected cost of care among all adults 15 years and older infected with PD was approximately $196.4 billion (SP) and $166.1 billion (PP) for the V116 strategy, vs $200.1 billion (SP) and $169.3 billion (PP) for the PCV20 strategy (**Table 4**), over the 100-year time horizon
- When factoring in the costs of the vaccination program, the overall costs over the entire time horizon of the PCV20 strategy were roughly $224 million (SP) and $194 million (PP) higher than those of the V116 strategy for adults age ≥65, while among adults age ≥15, the overall costs of the PCV20 strategy were roughly $3 billion (SP) and $2.5 billion (PP) higher than those of the V116 strategy
- The overall QALYs gained by implementing V116 exceeded those of PCV20 in both 15 years and 65 years and older (**Table 3** and **Table 4**), suggesting that V116 was more beneficial to the Canadian population than PCV20
- Combining the aforementioned information, the vaccination strategy with V116 is cost-saving compared with the PCV20 vaccination strategy in Canada in adults both 15 years and 65 years and older

Figure 2. Projected IPD incidence (cases per 100,000 population) for V116 (blue line) and PCV20 (green line) scenarios

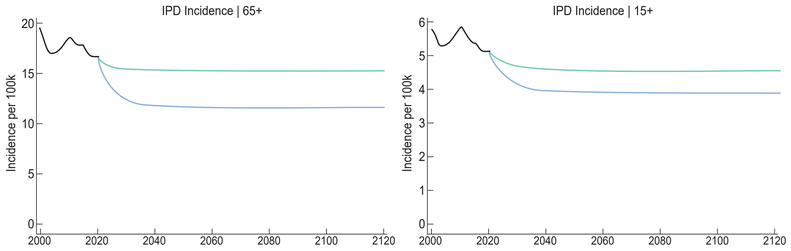

Table 3. Cumulative outcomes for V116 and PCV20 scenarios (2020-2120) for adults 65 years and older

Costs and QALYs were discounted at 1.5% annually. All costs are shown in 2023 Canadian dollars (CAN). Values in parentheses indicate negative incremental outcomes.

Outcome	PCV20 scenario	V116 scenario	Incremental
Epidemiological outcomes			
IPD	68,762	53,277	15,484
Bacteremia	39,997	30,990	9,007
Meningitis	2,101	1,628	473
Bacteremia without focus	26,664	20,660	6,005
PMS	420	326	95
NBPP	16,255,740	15,728,780	526,960
Inpatient	8,638,990	8,363,395	275,595
Outpatient	7,616,750	7,365,385	251,365
Deaths	156,185	148,900	7,285
IPD	11,914	9,231	2,683
NBPP	144,271	139,669	4,602
Treatment costs			
Payer perspective	22,481,615,527	22,362,535,435	(119,080,092)
Vaccine costs	455,715,838	530,792,583	75,076,745
Treatment costs	22,025,899,689	21,831,742,852	(194,156,837)
Societal perspective	26,003,805,542	25,854,719,140	(149,086,402)
Vaccine costs	455,715,838	530,792,583	75,076,745
Treatment costs	25,548,089,704	25,323,926,557	(224,163,147)
QALY			
QALYs gained	276,975,218	276,977,494	2,276

Both vaccination strategies include vaccinating the pediatric population with PCV15.
PMS, post-meningitis sequelae.

Table 4. Cumulative outcomes for V116 and PCV20 scenarios (2020-2120) for adults 15 years and older

Costs and QALYs were discounted at 1.5% annually. All costs are shown in 2023 Canadian dollars (CAN). Values in parentheses indicate negative incremental outcomes.

Outcome	PCV20 scenario	V116 scenario	Incremental
Epidemiological outcomes			
IPD	131,805	114,511	17,294
Bacteremia	74,962	64,948	10,014
Meningitis	6,868	6,264	604
Bacteremia without focus	49,975	43,299	6,676
PMS	1,375	1,254	121
NBPP	75,981,010	74,981,186	999,824
Inpatient	26,440,290	26,029,465	410,825
Outpatient	49,540,720	48,951,721	588,999
Deaths	933,146	919,775	13,371
IPD	16,463	13,649	2,814
NBPP	916,683	906,126	10,557
Treatment costs			
Payer perspective	173,540,070,202	171,060,362,660	(2,479,707,542)
Vaccine costs	4,211,859,472	4,905,740,759	693,881,287
Treatment costs	169,328,210,730	166,154,621,901	(3,173,588,829)
Societal perspective	204,349,618,057	201,375,525,972	(2,974,092,085)
Vaccine costs	4,211,859,472	4,905,740,759	693,881,287
Treatment costs	200,137,758,585	196,469,785,213	(3,667,973,372)
QALY			
QALYs gained	1,334,583,210	1,334,607,135	23,925

Both vaccination strategies include vaccinating the pediatric population with PCV15.
PMS, post-meningitis sequelae.

Conclusions

The analysis demonstrated the benefits of adult PCV vaccination in Canada, with projections indicating that V116 vaccination could substantially reduce the burden of PD and be cost-saving relative to PCV20 vaccination in adults ≥15 years old and ≥65 years old from both the societal and payer perspective. This provides a strong rationale for including V116 in provincial immunization policies.

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