Evaluating the potential lifetime health and economic impact of V116, an adult-specific 21-valent pneumococcal conjugate vaccine, on invasive pneumococcal disease in the United States

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Background

- *Streptococcus pneumoniae* is a Gram-positive bacterium that commonly colonizes the respiratory tract and can potentially cause invasive pneumococcal disease (IPD) in adults, with those considered immunocompromised/suppressed being at highest risk[1,2]
- IPD is associated with high morbidity and mortality, which causes substantial health and economic burden on the healthcare system[3,6]
- Although available vaccines have largely reduced the burden of IPD among adults, current data on IPD show substantial residual burden attributable to serotypes they do not currently cover[1]
- V116 is an investigational 21-valent pneumococcal conjugate vaccine (PCV) specifically designed for adults. It contains **21** serotypes: **3, 6A, 7F, 8, 9N, 10A, 11A, 12F, 15A, 15C[a], 16F, 17F, 19A, 20A, 22F, 23A, 23B, 24F, 31, 33F,** and **35B**. **Eight (15A, 15C[a], 16F, 23A, 23B, 24F, 31, 35B)** of the 21 serotypes are unique and are not included in any currently licensed vaccines
- The serotypes in V116 accounted for ~85% of IPD and the 8 unique serotypes accounted for ~30% of IPD in US adults ≥65 years in 2019[1]

[a]Serotype protection proposed with deOAc15B as the molecular structures for deOAc15B and 15C are similar.

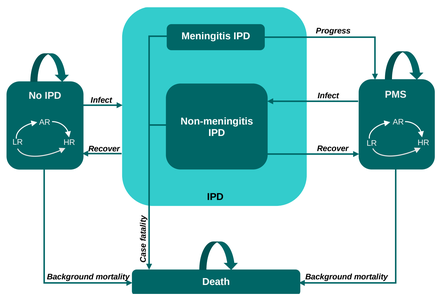
Objective

- To quantify and compare the potential lifetime health and economic impact of vaccination with V116 vs PCV20 on IPD in the US adults aged 50 and older

Methods

- A multi-cohort Markov model (structure depicted in **Figure 1**) was built to estimate the lifetime (until death or turned 100 years old) IPD cases, PMS cases, IPD related deaths, and the associated direct and indirect medical costs (in 2023 USD) among the current US adults aged 50-64 and 65+ (assuming 2021 population figures) of no vaccination or vaccinating with V116 or PCV20
- The study population was stratified into three mutually exclusive risk groups: low-risk (LR), at-risk (AR), and high-risk (HR) adults based on the age group-specific proportions and classifications from Pelton et al 2019[5]
- Risk group transitioning was implemented in the model as individuals aged, as depicted in **Figure 1**
- The same serotype-specific vaccine effectiveness was assumed for the two vaccines. The waning of the effectiveness was assumed to be flat for the first 5 years and then linearly declines to zero in the following 10 years[6]
- Vaccine coverage rates are the same for the two vaccines and for all risk groups: 38.83% for ages 50-64, and 46.15% for ages 65+[6]
- Discounting rate for costs is 3%. Other key model parameters are shown in **Table 1**
- Base-case results were summarized for V116 and PCV20, as well as no vaccination
- One-way sensitivity analysis (OWSA) was conducted to assess the robustness of the results and to identify the most influential parameters on the total direct medical costs saved by V116 when compared to PCV20

Figure 1. A schematic diagram depicting the structure of the state-transition Markov model



PD, pneumococcal disease; IPD, invasive pneumococcal disease; PMS, post-meningitis sequelae; LR, low risk; AR, at risk; HR, high risk.

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Table 1. Key model parameters

	Low risk	At risk	High risk	Source
IPD incidence (per 100,000 person-years)				
50-64	6.09	24.04	37.28	ABC data 2017-2018[2]; Stoecker 2021[7]
65-74	8.25	25.89	35.10	
75+	19.27	40.06	39.47	
% Meningitis of IPD cases		7.0%		ABC data 2019[1]
% PMS out of meningitis		20.0%		Rubin et al., 2010[6]
IPD direct medical cost				
50-64	$57,996	$51,678	$127,220	Stoecker et al., 2021[7]
65+	$28,650	$26,905	$37,168	
IPD indirect medical cost				McLaughlin et al., 2015[4]
50-64		$3,322		
65-74		$1,333		
75-84		$886		
85-100		$800		
PMS direct treatment cost per year				Rubin et al., 2010[6]
50-64		$10,309		
65+		$12,541		
PMS indirect treatment cost per year				Rubin et al., 2010[6]
50-64		$4,552		
65-74		$4,351		
75-84		$4,162		
85-100		$5,064		

ABC, Active Bacterial Core surveillance; IPD, invasive pneumococcal disease; PMS, post-meningitis sequelae.

Table 2. Estimated lifetime clinical and economic outcomes when vaccinating with V116 and PCV20 for ages 50-64

	V116	PCV20	No vaccine	Cases/costs averted, compared to no vaccine		Additional reduction by V116, compared to PCV20
				By V116	By PCV20	
Clinical outcomes (undiscounted)						
IPD cases	385,031	391,963	404,036	19,004	12,072	6,932 (57%)
IPD deaths	51,671	52,483	53,872	2,201	1,388	812 (59%)
PMS cases	4,695	4,781	4,932	237	150	86 (57%)
Economic outcomes (discounted; in million $)						
Direct cost, IPD	9,433	9,709	10,229	796	520	276 (53%)
Direct cost, PMS	382	395	418	37	24	13 (56%)
Indirect cost, IPD	363	377	404	41	27	14 (53%)
Indirect cost, PMS	139	144	152	13	9	5 (55%)

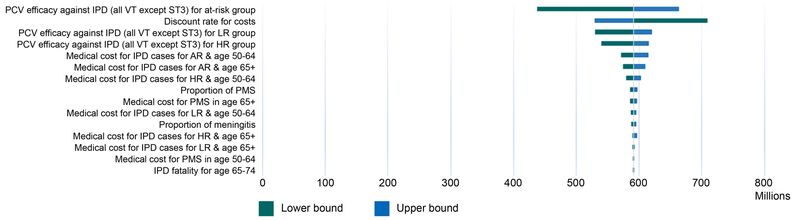
IPD, invasive pneumococcal disease; PCV20, 20-valent pneumococcal conjugate vaccine; PMS, post-meningitis sequelae; V116, an investigational 21-valent pneumococcal conjugate vaccine.

Table 3. Estimated lifetime clinical and economic outcomes when vaccinating with V116 and PCV20 for ages 65+

	V116	PCV20	No vaccine	Cases/costs averted, compared to no vaccine		Additional reduction by V116, compared to PCV20
				By V116	By PCV20	
Clinical outcomes (undiscounted)						
IPD cases	210,902	222,829	239,005	28,102	16,176	11,927 (74%)
IPD deaths	31,472	33,077	35,254	3,783	2,177	1,605 (74%)
PMS cases	2,527	2,672	2,870	343	197	145 (74%)
Economic outcomes (discounted; in million $)						
Direct cost, IPD	4,731	5,019	5,411	680	391	289 (74%)
Direct cost, PMS	177	190	209	32	18	13 (74%)
Indirect cost, IPD	144	154	168	24	14	10 (74%)
Indirect cost, PMS	66	71	77	12	7	5 (74%)

IPD, invasive pneumococcal disease; PCV20, 20-valent pneumococcal conjugate vaccine; PMS, post-meningitis sequelae; V116, an investigational 21-valent pneumococcal conjugate vaccine.

Figure 2. Scenario analysis – estimated lifetime direct medical cost in ages 50+ saved by V116, compared with PCV20 (2023 USD; discounted; in millions)



AR, at risk; HR, high risk; IPD, invasive pneumococcal disease; LR, low risk; PCV, pneumococcal conjugate vaccine; ST3, serotype 3; VT, vaccine type.

Results

- In adults aged 50-64, V116 prevented 19,004 lifetime IPD cases and 2,201 IPD deaths compared with no vaccination – 57% more than the 12,072 IPD cases and 1,388 IPD deaths prevented by PCV20. The averted IPD cases from V116 vaccination resulted in $838 million reduction in total lifetime medical costs (both direct and indirect) – 53% higher than the $547 million costs averted by PCV20 (**Table 2**)
- Similarly, in adults aged 50-64, V116 prevented 237 cases of PMS – 57% higher than the 150 PMS cases prevented by PCV20 (**Table 2**). The additional 86 PMS cases averted by V116 than PCV20 saved 18 million total medical costs
- In adults aged 65+, V116 prevented 28,102 IPD cases and 3,783 IPD deaths compared with no vaccination – 74% more than the 16,176 IPD cases and 2,177 IPD deaths prevented by PCV20. The averted IPD cases from V116 vaccination resulted in $704 million reduction in total medical costs (both direct and indirect) – 74% higher than the $405 million costs averted by PCV20 (**Table 3**)
- Similarly, in adults aged 65+, V116 prevented 343 cases of PMS – 73% higher than the 197 PMS cases prevented by PCV20 (**Table 3**). The additional 145 PMS cases averted by V116 than PCV20 saved 18 million total medical costs (**Table 3**)
- Among the parameters included in the OWSA, the top sensitive parameters are vaccine and IPD medical cost (**Figure 2**)
- OWSA confirmed the robustness of the results. All scenarios showed a large lifetime direct medical cost (438 million to 663 million) saved by V116 when compared to PCV20 (**Figure 2**)

Conclusions

- In both age groups, comparing with PCV20, V116 led to a greater reduction of both the lifetime health and economic burden associated with IPD
- The addition of V116 to the national vaccination recommendations has the potential to substantially reduce the health and economic burden associated with PD among adults in the US, compared to PCV20

Disclosure

All authors are employees of Merck Sharp & Dohme LLC, a subsidiary of Merck & Co., Inc., Rahway, NJ, USA, and may hold stock or stock options in Merck & Co., Inc., Rahway, NJ, USA.

References

1. US Centers for Disease Control and Prevention. ABCs Surveillance Report: *Streptococcus pneumoniae*, 2019. https://www.cdc.gov/abcs/downloads/SPN_Surveillance_Report_2019.pdf. Accessed March 14, 2024.
2. US Centers for Disease Control and Prevention. Active Bacterial Core surveillance. https://www.cdc.gov/abcs/. Accessed March 14, 2024.
3. US Centers for Disease Control and Prevention. Pneumococcal Disease. https://www.cdc.gov/vaccines/pubs/pinkbook/pneumo.html#streptococcus-pneumoniae. Accessed March 14, 2024.
4. McLaughlin JM, et al. *J Prim Prev.* 2015;36(4):259-273.
5. Pelton SI, et al. *Clin Infect Dis.* 2019;68(11):1831-1838.
6. Rubin JL, et al. *Vaccine.* 2010;28(48):7634-7643.
7. Stoecker C. Economic assessment PCV15 & PCV20. Presented at ACIP. June 15, 2021. https://www.cdc.gov/vaccines/acip/meetings/downloads/slides-2021-06/03-Pneumococcal-Stoecker-508.pdf. Accessed March 14, 2024.

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