Summary of three economic analyses of the use of 20-valent pneumococcal conjugate vaccine (PCV20) in children in the United States

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  - Pfizer team
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  - Merck team
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Conflicts of interest statement

- Diepreye Ayabina: None.
- Tulane-CDC team: None.
- Pfizer team:
  - Pfizer manufactures the PCV13 and PCV20 vaccines.
- Merck team:
  - Merck manufactures the PCV15 and PPSV23 vaccines

Terminology

Abbreviation	Full term/Meaning
AOM	Acute otitis media
CMC	Chronic medical conditions but not immunocompromised[1]
IC	Immunocompromising conditions[2]
ICER	Incremental cost-effectiveness ratio
IPD	Invasive pneumococcal disease
PCV13	13-valent pneumococcal conjugate vaccine
PCV15	15-valent pneumococcal conjugate vaccine
PCV20	20-valent pneumococcal conjugate vaccine
PPSV23	Pneumococcal polysaccharide vaccine (23 serotypes)
QALYs	Quality-adjusted life-years

[1]Includes chronic heart, lung, and liver diseases, diabetes.
[2]Includes chronic renal failure, nephrotic syndrome, congenital immunodeficiency, congenital or acquired asplenia, or splenic dysfunction, diseases associated with treatment of immunosuppressive drugs or radiation therapy such as Hodgkin disease, leukemia, lymphoma, malignant neoplasm and solid organ transplant, HIV and sickle cell disease.

Outline

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  - Model description
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  - Overview of cost-effectiveness results
  - Model assumptions driving differences + sensitivity analysis

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  - Estimated health outcomes and cost results
  - Overview of cost-effectiveness results
  - Model assumptions driving differences + sensitivity analysis

- Summary

Introduction

- This presentation describes three cost-effectiveness models that have been used to examine the costs and benefits of including PCV20 as an option in the childhood immunization schedule developed.
    - Tulane-CDC, Pfizer, and Merck
- Results of this presentation focus on routine use of PCV20 among <2-year-olds, and among 2-18-year-olds with underlying conditions.
    - Assessments of a supplemental PCV20 dose in children who completed the PCV series with PCV13 or PCV15 are not included
- All three reports went through the CDC economic review following the ACIP Guidance for Health Economics Studies
    - *Completion of the economic review does not confer any explicit or implied approval of the model*

Policy question 1

Routine use of PCV20 in children

Policy question #1

Should PCV20 be recommended as an option for pneumococcal conjugate vaccination according to currently recommended dosing and schedules, for children aged <2 years in the United States?

Intervention (dosing)	**Comparator (dosing)**
PCV20 (3+1)	PCV13 (3+1) /PCV15 (3+1)

$$\frac{Costs_{Intervention} - Costs_{Comparator}}{Outcomes_{Intervention} - Outcomes_{Comparator}} = \boldsymbol{Incremental\ cost\text{–}effectiveness\ ratio\ (ICER)}$$

Description of models
Policy question #1

Model characteristics	**Tulane-CDC**	**Merck**	**Pfizer**
Cohort type	Single birth cohort	Single birth cohort	Multi-cohort
Analytic model time frame	17 years	100 years	10 years
Include indirect effects	Yes	Yes (**only to IPD incidence)**	Yes
Base case perspective	Societal	Societal	Societal
Currency year	2022 $ US	2022 $ US	2022 $ US
[a]Vaccine price	PCV13: $184 PCV15: $183 PCV20: $213	PCV13: $192 PCV15: $189 PCV20: $213	PCV13: $182 PCV15: $184 PCV20: $204
Other vaccine costs per dose	Admin: $30; travel: $36	Admin: $19	Admin: $18

[a]All three models used blended vaccine prices (vaccine price was weighted average of private and public market prices, weights were private and public market shares, which varied across the models).

Health outcomes and cost results[a]

PCV20 vs PCV15, base case

		PCV20 vs PCV15		
	Outcomes and cost	**Tulane-CDC**	**Merck**	**[++]Pfizer**
Health outcomes	IPD cases	-360	-400	-30,000*
	Pneumonia cases	-13,000	-2,300	-1,400,000*
	AOM cases	-150,000	-201,000	-3,000,000*
	Deaths	-160	-28	-9,700*
	QALYs	1,900	1,400	280,000
Costs ($ millions)	Cost of disease + sequelae	-210	-180	-12,000
	Vaccine costs	440	330	2,100
	Total cost	230	150	-10,000

[a]These are discounted values (rounded up to 2 significant figures) for the complete horizon for the base case of each model

*Outcomes not reported as discounted values.

All other values were discounted at 3%.

Negative values indicate averted cases/deaths or reduced costs of PCV20, as compared to PCV15.

[++]Pfizer base case results involve vaccination of 10 cohorts of children, results from single cohort shown in supplemental slide.

Health outcomes and cost results[a]

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Model assumptions

*Indirect effects of pediatric PCV20 vaccination on adult pneumonia incidence

Model	Disease outcomes impacted by indirect effects	Details on the indirect effects methodology	Adjust for PCV20 use among 65+	Data years for indirect effect on pneumonia	Approximate % of PCV20 only type pneumonia	Approximate reduction in PCV20-only pneumonia per cohort
Merck	• IPD	• Assume 8% reduction per year, with a max of 33% achieved in year 4 and maintained until the end of the cohort	No	NA (IPD considered only)		

- Higher indirect effects as a result of PCV20 use would lead to PCV20 being more cost-effective when compared to other PCV vaccines.

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Merck	• IPD	• Assume 8% reduction per year, with a max of 33% achieved in year 4 and maintained until the end of the cohort	No	NA (IPD considered only)		
Tulane-CDC	• IPD • Pneumonia • AOM	• Based on regression model estimates • Estimated impact per vaccinated cohort • Indirect effect benefit attributed to birth cohort of children who receive PCV20	Yes	2013-2014[a]	0.6 to 2.4%	3.2%
Pfizer	• IPD • Pneumonia • AOM	• Based on observed reduction in all-cause pneumonia Percentage of PCV20 type disease Gradual increase in indirect effect over 10 years	Yes	2008/2009 to 2018[a]	Greater than 1 to 7%	0.5 to 3.4%[b]

* Higher indirect effects as a result of PCV20 use would lead to PCV20 being more cost effective when compared to other PCV vaccines. The Tulane-CDC and Pfizer models both accounted for the direct protection in all adults.

[a]The Tulane-CDC model estimated a monthly reduction in disease due to indirect effects, using data from 2013 and the first half of 2014 (Pilishvili 2018a; Pilishvili et al. 2018b). The Pfizer model used a total reduction in disease from 2008/2009 to 2018 (Tong et al. 2018, Table 3).

[b]These are approximations based on calculations by the presenting author, based on each cohort in the Pfizer model contributing to indirect effects for 5 years.

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[b]These are approximations based on calculations by the presenting author, based on each cohort in the Pfizer model contributing to indirect effects for 5 years.

Cost effectiveness results: base case

PCV20 vs PCV13

Intervention	Comparator	Model	Cost per QALY gained
PCV20	PCV13	Tulane-CDC	57,000
		Merck	[a]Cost-saving
		Pfizer	[a]Cost-saving
PCV20	PCV15	Tulane-CDC	125,000
		Merck	105,003
		Pfizer	[a]Cost-saving

[a]Cost-saving means lower costs and improved health outcomes in the intervention, as compared to the comparator.

Cost effectiveness results: base case

PCV20 vs PCV15

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PCV20	**PCV15**	**Tulane-CDC**	**125,000**
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Sensitivity analysis (Policy question #1)

Cost-effectiveness of routine vaccination with PCV20 for children

Intervention	Comparison	Model	Cost per QALY gained	
			Base case	Range[b]
PCV20	**PCV13**	Tulane-CDC	57,000	NA
		Merck	Cost-saving	NA
		Pfizer	Cost-saving	All cost-saving
PCV20	PCV15	Tulane-CDC	125,000	[31,000 210,000]
		Merck	105,000	[8,000 dominated[a]]
		Pfizer	Cost-saving	[Cost-saving 60,000]

[a] In one scenario in the Merck model, PCV15 was cost-saving relative to PCV20 (or PCV20 was dominated by PCV15), this scenario assumed re-emergence of IPD associated with certain serotypes that PCV20 missed the trial primary endpoint.

[b] The ranges presented are obtained from the scenario analyses and probabilistic sensitivity analysis.

Sensitivity analysis (Policy question #1)

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PCV20	PCV13	Tulane-CDC	57,000	NA
		Merck	Cost-saving	NA
		Pfizer	Cost-saving	All cost-saving
PCV20	**PCV15**	Tulane-CDC	125,000	**[**31,000 210,000**]**
		Merck	105,000	**[**8,000 dominated[a]**]**
		Pfizer	Cost-saving	**[**Cost-saving 60,000**]**

[a] In one scenario in the Merck model, PCV15 was cost-saving relative to PCV20 (or PCV20 was dominated by PCV15), this scenario assumed re-emergence of IPD associated with certain serotypes that PCV20 missed the trial primary endpoint.

[b] The ranges presented are obtained from the scenario analyses and probabilistic sensitivity analysis.

Policy question 2

Use of PCV20 in children with underlying medical conditions that increase the risk of pneumococcal disease

Policy question #2

Should PCV20 without PPSV23 be recommended as an option for pneumococcal vaccination according to currently recommended dosing and schedules, for U.S. children 2–18 years with underlying medical conditions that increase the risk of pneumococcal disease (CMC/IC)?

- 2.1. What is the cost effectiveness of PCV20 alone **vs** PCV13/15+PPSV23 series among CMC/IC?
- 2.2. What is the cost effectiveness of adding PPSV23 to a PCV20 series among CMC/IC?

Comparator (dosing)	Intervention (dosing)	Population
PCV13/15(3+1) + PPSV23 (1)	PCV20 (3+1)	CMC
PCV13/15(3+1) + PPSV23 (1+1)	PCV20 (3+1)	IC
PCV20(3+1) + PPSV23 (1)	PCV20 (3+1)	CMC
PCV20(3+1) + PPSV23 (1+1)	PCV20 (3+1)	IC

$$\frac{Costs_{Intervention} - Costs_{Comparator}}{Outcomes_{Intervention} - Outcomes_{Comparator}} = Incremental\ cost\ effectiveness\ ratio\ (ICER)$$

Policy question 2.1

PCV20 alone vs PCV13/15+PPSV23 series among CMC/IC

Health outcomes and costs

PCV20 alone vs PCV15+PPSV23 in CMC, base case

	Outcomes and cost	PCV20 vs PCV15 + PPSV23		
		Tulane-CDC	Merck	Pfizer[a]
Health outcomes	IPD cases	-26	-15	-5*
	Pneumonia cases	-780	-260	-1,100*
	AOM cases	-30,000	-28,000	-4,900*
	Deaths	-2	-1	-5*
	QALYs	200	140	120
Costs ($ millions)	Vaccine costs	-1	7	5
	Cost of disease + sequelae	-32	-23	-18
	Total cost	-33	-16	-12

[a]These are discounted values (rounded up to 2 significant figures) for the complete horizon for the base case of each model

*Outcomes not reported as discounted values.

Negative values indicate averted cases/deaths or reduced costs of PCV20, as compared to PCV15+PPSV23.

[a.] **The Pfizer model does not directly assess policy question 2 but compares the receipt of PCV20 with and without PPSV23 to the receipt of PPSV23 on six-year-old children with a history of PCV13 vaccination.**

Health outcomes and costs

PCV20 alone vs PCV15+PPSV23 in CMC, base case

	Outcomes and cost	PCV20 vs PCV15 + PPSV23		
		Tulane-CDC	Merck	Pfizer[a]
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Health outcomes and costs

PCV20 alone vs PCV15+PPSV23 in CMC, base case

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	QALYs	200	140	120
Costs ($ millions)	Vaccine costs	-1	7	5
	Cost of disease + sequelae	-32	-23	-18
	Total cost	-33	-16	-12

In these assessments, all three models estimate higher health and lower total costs

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Negative values indicate averted cases/deaths or reduced costs of PCV20, as compared to PCV15+PPSV23.

[a.] The Pfizer model does not directly assess policy question 2 but compares the receipt of PCV20 with and without PPSV23 to the receipt of PPSV23 on six-year-old children with a history of PCV13 vaccination.

Cost-effectiveness results, policy question
base case

Risk group	Intervention	Comparator	Model	Cost per QALY
CMC	PCV20	**PCV13** + PPSV23	Tulane-CDC & Merck	Cost-saving
		PCV15 +PPSV23		
	PCV13 + PCV20	**PCV13** + PPSV23	Pfizer[a]	
IC	PCV20	**PCV13** + PPSV23 +PPSV23	Tulane-CDC & Merck	Cost-saving
		PCV15 + PPSV23 + PPSV23		
	PCV13 + PCV20	**PCV13** + PPSV23 + PPSV23	Pfizer[a]	

[a]Pfizer model had a different set of comparisons: in CMC: PCV13 (3+1) + PCV20 vs. PCV13 (3+1)+ PPSV23; in IC: PCV13 (3+1) + PCV20 vs. PCV13 (3+1)+ PPSV23 + PPSV23 ,because it started at age 6.6.

Sensitivity analyses policy question #2.1

PCV20 alone vs PCV13/15+PPSV23

Risk group	Intervention	Comparator	Model	Ranges including sensitivity analyses ($/QALY)
CMC	PCV20	PCV13 + PPSV23	Tulane-CDC	*Cost-saving
			Merck	*Cost-saving
	PCV13 + PCV20	PCV13 + PPSV23	Pfizer	Cost-saving[b]
IC	PCV20	PCV13 + PPSV23 + PPSV23	Tulane-CDC	*Cost-saving
			Merck	Cost-saving
	PCV13 + PCV20	PCV13 + PPSV23 + PPSV23	Pfizer	Cost-saving[b]
CMC	PCV20	PCV15 + PPSV23	Tulane-CDC	Cost-saving to $19,000
			Merck	Cost-saving to dominated[a]
IC		PCV15 + PPSV23 + PPSV23	Tulane-CDC	Cost-saving
			Merck	Cost-saving to dominated[a]

Cost-saving means lower costs and improved health outcomes in the intervention, as compared to the comparator.

*Aside from the base case, no additional scenarios were conducted for this comparison.

[a]In the scenarios where the Merck model assumed a re-emergence of IPD associated with certain serotypes that PCV20 missed the trial primary endpoint, PCV15 was found to be cost-saving relative to PCV20 (or PCV20 was dominated by PCV15).

[b]Pfizer model had a different set of comparisons: in CMC: PCV13 + PCV20 vs. PCV13(3+1)+ PPSV23; in IC: PCV13 + PCV20 vs. PCV13(3+1)+ PPSV23 ,because it started at age 6.

Sensitivity analyses policy question #2.1

PCV20 alone vs PCV13/15+PPSV23

Risk group	Intervention	Comparator	Model	Ranges including sensitivity analyses ($/QALY)
CMC	PCV20	PCV13 + PPSV23	Tulane-CDC	*Cost-saving
			Merck	*Cost-saving
	PCV13 + PCV20	PCV13 + PPSV23	Pfizer	Cost-saving[b]
IC	PCV20	PCV13 + PPSV23 + PPSV23	Tulane-CDC	*Cost-saving
			Merck	Cost-saving
	PCV13 + PCV20	PCV13 + PPSV23 + PPSV23	Pfizer	Cost-saving[b]
CMC	PCV20	PCV15 + PPSV23	Tulane-CDC	Cost-saving to $19,000
			Merck	Cost-saving to dominated[a]
IC		PCV15 + PPSV23 + PPSV23	Tulane-CDC	Cost-saving
			Merck	Cost-saving to dominated[a]

Cost-saving means lower costs and improved health outcomes in the intervention, as compared to the comparator.

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[a]In the scenarios where the Merck model assumed a re-emergence of IPD associated with certain serotypes that PCV20 missed the trial primary endpoint, PCV15 was found to be cost-saving relative to PCV20 (or PCV20 was dominated by PCV15).

[b]Pfizer model had a different set of comparisons: in CMC: PCV13 + PCV20 vs. PCV13(3+1)+ PPSV23; in IC: PCV13 + PCV20 vs. PCV13(3+1)+ PPSV23 ,because it started at age 6.

Policy question 2.2

PCV20 +PPSV23 series vs PCV20 alone among CMC/IC

Cost-effectiveness results, policy question #2.2

PCV20+ PPSV23 vs PCV20 alone, base case

Risk group	Intervention	Comparator	Model	Cost per QALY
CMC	**PCV20 + PPSV23**	**PCV20**	**Tulane-CDC**	**$4 million**
			Merck	**$1.9 million[a]**
	PCV13 + PCV20 + PPSV23	**PCV13+ PCV20**	**Pfizer[b]**	**$6 million**
IC	PCV20 + PPSV23 +PPSV23	PCV20	Tulane-CDC	$690,000
			Merck	$204,000[a]
	PCV13 + PCV20 + PPSV23 + PPSV23	PCV13 + PCV20	Pfizer[b]	$535,000

[a]Values calculated by presenter using results in Merck technical report.

[b]Pfizer model had a different set of comparisons: in CMC: PCV13 + PCV20 vs. PCV13(3+1)+ PPSV23; in IC: PCV13 + PCV20 vs. PCV13(3+1)+ PPSV23 ,because it started at age 6.

Cost-effectiveness results, policy question #2.2

PCV20+ PPSV23 vs PCV20 alone, base case

Risk group	Intervention	Comparator	Model	Cost per QALY
CMC	**PCV20 + PPSV23**	**PCV20**	**Tulane-CDC**	**$4 million**
			Merck	**$1.9 million[a]**
	PCV13 + PCV20 + PPSV23	**PCV13+ PCV20**	**Pfizer[b]**	**$6 million**
IC	PCV20 + PPSV23 +PPSV23	PCV20	Tulane-CDC	$690,000
			Merck	$204,000[a]
	PCV13 + PCV20 + PPSV23 + PPSV23	PCV13 + PCV20	Pfizer[b]	$535,000

[a]Values calculated by presenter using results in Merck technical report.

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Summary

Summary

- **Policy question #1**
  - Vaccination with PCV20 is expected to improve health outcomes compared to PCV13 or PCV15.
  - **Compared to PCV13**, the Pfizer and Merck models estimated that PCV20 would be cost-saving, whereas the Tulane-CDC model estimated a cost per QALY of $57,000.
  - **Compared to PCV15**, the Pfizer model estimated that PCV20 would be cost-saving, whereas the Tulane-CDC model and the Merck model estimated a cost per QALY of just over $100,000.

Cost-saving means lower costs and improved health outcomes in the intervention, as compared to the comparator.

Summary

- **Policy question #2.1**
  - **Compared to PCV13/PCV15+PPSV23 series, PCV20 alone in CMC/IC** was estimated to be cost-saving in all **but two** scenarios investigated

- **Policy question #2.2**
  - **Compared to PCV20 alone**, PCV20 +PPSV23 series in CM/IC was estimated to cost between $204,000 to $7 million dollars for each QALY gained

Cost-saving means lower costs and improved health outcomes in the intervention, as compared to the comparator.

Summary

- Main differences across models appear to be related to **indirect effects**
  - [b]Other important factors: model structure, Vaccine effectiveness, QALY losses due to disease

Cost-saving means lower costs and improved health outcomes in the intervention, as compared to the comparator.
[b]Additional details on these model inputs provided in supplemental slides.

Contributors

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Thank you!

Supplemental slides

References

1. Stoecker C, Hampton LM, Link-Gelles R, Messonnier ML, Zhou F, Moore MR. Cost-effectiveness of using 2 vs 3 primary doses of 13-valent pneumococcal conjugate vaccine. Pediatrics. 2013;132(2):e324-e32.
2. Stoecker, Charles, Miwako Kobayashi, Almea Matanock, Bo-Hyun Cho, and Tamara Pilishvili. "Cost-effectiveness of continuing pneumococcal conjugate vaccination at age 65 in the context of indirect effects from the childhood immunization program." *Vaccine* 38, no. 7 (2020): 1770-1777.
3. Tong S, Amand C, Kieffer A, Kyaw MH. Trends in healthcare utilization and costs associated with pneumonia in the United States during 2008–2014. BMC Health Services Research. 2018 Dec;18(1):1-8.
4. Pfizer. CDC ABCs data (Data on File)
5. Stoecker, Charles, Lee M. Hampton, Ruth Link-Gelles, Mark L. Messonnier, Fangjun Zhou, and Matthew R. Moore. "Cost-effectiveness of using 2 vs 3 primary doses of 13-valent pneumococcal conjugate vaccine." Pediatrics 132, no. 2 (2013): e324-e332.
6. Pilishvili T. 2018a. “Estimating PCV13 direct and indirect effects on IPD among adults ≥65 years”. Presented at the meeting of the Advisory Committee on Immunization Practices, February 22, 2018. Atlanta, Georgia.
7. Pilishvili T, Girke R, Xing W, Farley M, Schaffner W, Thomas A, Reingold A, Harrison L, Lynfield R, Zansky S, Petit S, Barnes M, Bareta J, Beal B, Shang N, Whitney C. 2018b. “Changes in invasive pneumococcal disease (IPD) among adults following 6 years of 13-valent pneumococcal conjugate vaccine use in the U.S.” Presented at the International Symposium on Pneumococci and Pneumococcal Diseases, 2018. Melbourne, Australia.
8. Prasad, Namrata, Charles Stoecker, Wei Xing, Bo-Hyun Cho, Andrew J. Leidner, and Miwako Kobayashi. "Public health impact and cost-effectiveness of 15-valent pneumococcal conjugate vaccine use among the pediatric population of the United States." *Vaccine* 41, no. 18 (2023): 2914-2921.

Health outcomes and cost results[a]

PCV20 vs PCV15, base case

		PCV20 vs PCV15		PCV20 vs PCV13
	Outcomes and cost	**Tulane-CDC**	**Merck**	**++Pfizer**
Health outcomes	IPD cases	-360	-400	-430*
	Pneumonia cases	-13,000	-2,300	-25,000*
	AOM cases	-150,000	-201,000	-238,000*
	Total deaths	-160	-28	-93*
	QALYs	1,900	1,400	5,600
Costs ($ millions)	Cost of disease + sequelae	-210	-180	NA
	Vaccine costs	440	330	NA
	Total cost	230	150	NA

[a]These are discounted values (rounded up to 2 significant figures) for the complete horizon for the base case of each model

*Outcomes not reported as discounted values.

All other values were discounted at 3%.

Negative values indicate averted cases/deaths or reduced costs of PCV20, as compared to PCV15.

++Pfizer scenario analyses with single cohort and no indirect effects applied, and comparison is between PCV20 and PCV13

Model assumptions: Selected base case assumptions[a]
Policy question #1

Model input	Tulane-CDC	Merck	Pfizer
Vaccine effectiveness	• lower VE for ST3 and ST19F across all vaccines. • the serotype specific VEs in PCV20 were the same as the serotype specific VEs in PCV15 and PCV13 .	• serotype specific VE was lower in PCV20 for six serotypes (3,12F,1,4,23F,9V) than it was in PCV15.	• the serotype specific VEs in PCV20 were the same as the serotype specific VEs in PCV15 and PCV13 .
QALY loss due to hospitalized pneumonia in adults	**0.0105**	**0.071**	**0.13**
Model structure	Single cohort (17 years)	Single cohort (100 years)	Multiple cohorts (10 years)

[a]From the review, in addition to indirect effects, these assumptions appear to be the important in terms of determining differences between model results for policy question #1.
For added context, a QALY losses of 0.0016, 0.071 and 0.130 could be considered as representing a 32-day hospitalization 59-day hospitalization, respectively, where 20% health-related quality of life is experienced for the duration of hospitalization.

Description of models
Policy question #2

Model characteristics	Tulane-CDC	Merck	[a]Pfizer
Cohort type	Single birth cohort	Single birth cohort	Single-cohort (6-year-olds) • ~90 % have history of PCV13
Indirect effects	Yes (vaccinated CMC/IC contribute to indirect effect benefits)	In scenarios only (not in base case)	Yes (vaccinated CMC/IC experience reduced incidence)[b]
Vaccine coverage	PCV (3rd dose): 94 % PCV(4th dose): 82 % [c]PPSV23(1st dose): 78 % [d]PPSV23(2nd dose): 64 %	PCV (3+1): 93 % PPSV23(1st dose): 64 % PPSV23(2nd dose): 53 %	PCV20: 20% PPSV23: 20%
[e]Weighted vaccine price ($)	PPSV23: 85	PPSV23: 91	PPSV23: 85

[a]The Pfizer model does not directly assess policy question 2, but compares the receipt of PCV20 with and without PPSV23 to the receipt of PPSV23 on children with a history of PCV13 vaccination
[b]Incidence among 6+ year olds was reduced after year 2, assuming routine use of PCV20 would occur, so VPD burden declines from routine use.
[c]Vaccine coverage of first PPSV23 dose is a percentage of those who got 4 doses of PCVs.
[d]Coverage of second PPSV23 dose is a percentage of those who got the first PPSV23 dose.
[e]All three models used blended vaccine prices (combined using private and public market prices share weights which varied across the models).

Summary

	Policy Question	Base case estimates ($/QALY)			*Range across all models
		Tulane-CDC	Merck	Pfizer	
1.	PCV20 vs PCV13/PCV15	57,000 to 125,000	Cost-saving to 105,000	Cost-saving	Cost-saving to dominated[a]
2.1	**PCV20 alone (in CMC/IC)**	**Cost-saving**			**Cost-saving to dominated[a]**
2.2	**PCV20+PPSV23 vs PCV20 (in CMC/IC)**	**690,000 to 4 million**	**204,000 to 1.9 million**	**535,000 to 6 million**	**204,000 to 7 million**

- Main differences across models appear to be related to **indirect effects**
  - [b]Other important factors: model structure, Vaccine effectiveness, QALY losses due to disease

Cost-saving means lower costs and improved health outcomes in the intervention, as compared to the comparator.

*The ranges presented are obtained from the scenario analyses and probabilistic sensitivity analyses across all models

[a]The Merck model found PCV15 was cost-saving relative to PCV20 (or PCV20 was dominated by PCV15) in scenarios where they assumed a resurgence of specific PCV20-only serotype IPD disease.

[b]Additional details on these model inputs provided in supplemental slides.