

Economics of Pfizer maternal RSVpreF vaccine

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Conflicts of interest statements

- Authors have no known conflict of interests.

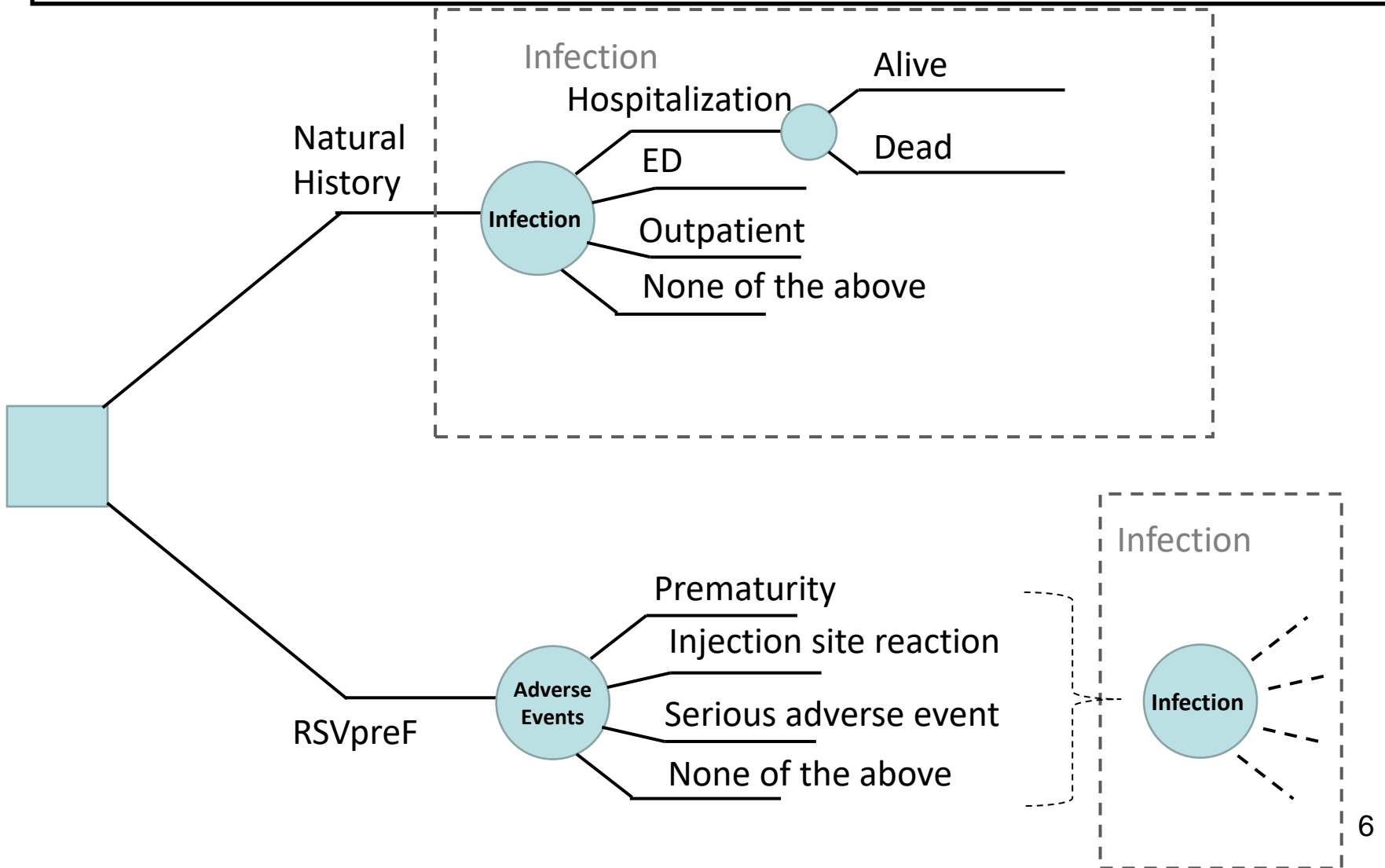
Methods: Study question

- Determine the cost-effectiveness of RSVpreF by:
 - Evaluating the population impact in terms of
 - annual resource utilization
 - total cases
 - total costs
 - deaths
 - quality-adjusted life-years (QALYs)
 - Comparing the incremental cost-effectiveness ratio (ICER) of RSVpreF to natural history/no vaccine.
 - Running scenario analyses outcomes that explore key areas of uncertainty.
- Perspective: Societal

Methods: Intervention(s)

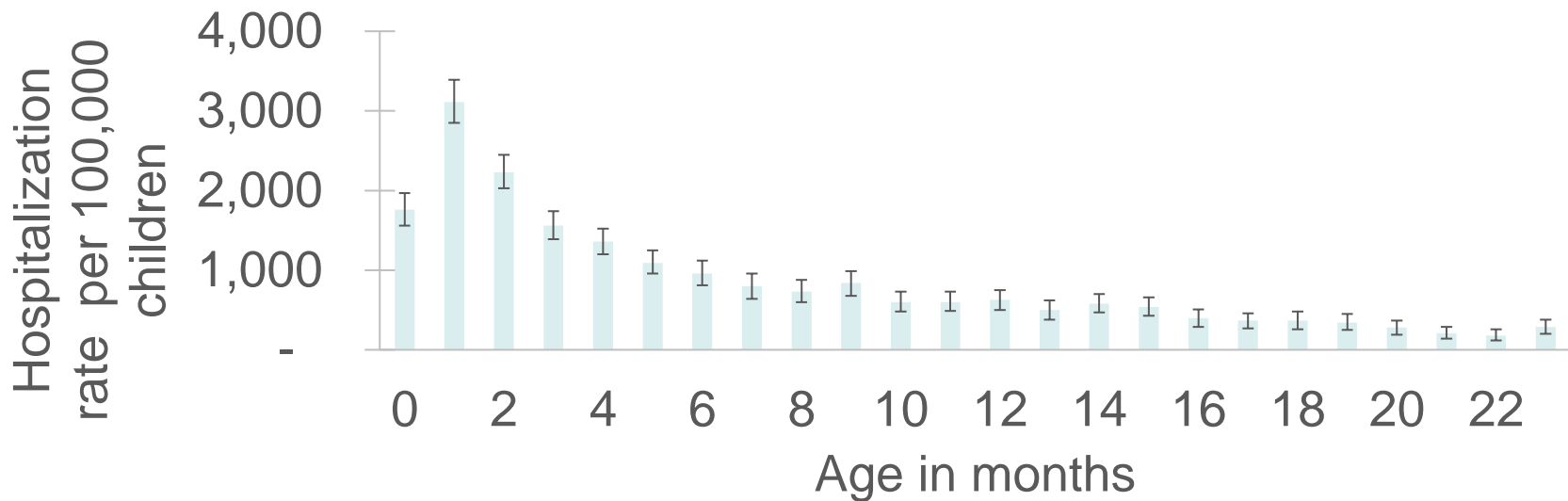
- Target population: US pregnant persons
- Interventions:
 1. No vaccination (Natural history)
 2. RSVpreF against RSV illness
- Timeframe: 1 year (1 RSV season)
- Analytic horizon: infant's lifetime
- Discount rate: 3%

Methods: Decision tree model



Methods: Epidemiology

Hospitalization



	Base Case	Range	Source
Respiratory syncytial virus (RSV) incidence, per 100,000	See Above	See Above	CDC NVSN, December 2016 to September 2020
Proportion with LRTI			
Age 0-5 months	1.0	0.5-1.0	Rainisch, 2020
Age 6-11 months	1.0	0.5-1.0	Rainisch, 2020

Methods: Epidemiology

ED and Outpatient

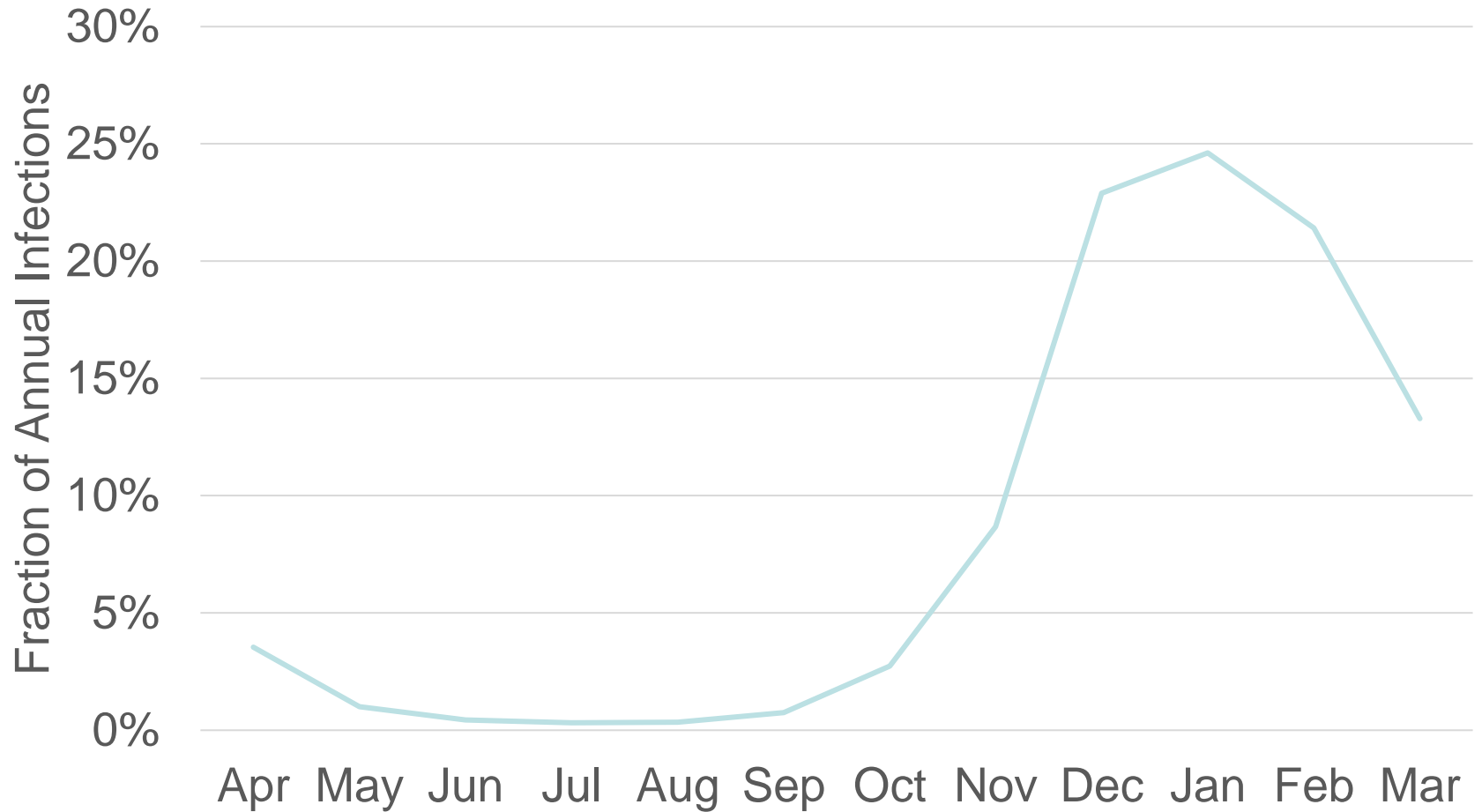
Respiratory syncytial virus (RSV) incidence, per 100,000	Base Case	Range	Source
Emergency Department			
Age 0-5 months	7,500	5,500 – 7,500	Lively 2019 (base case and range), Hall 2009 (range)
Age 6-11 months	5,800	5,700 – 5,800	Lively 2019 (base case and range), Hall 2009 (range)
Age 12-23 months	3,200	3,200 – 5,300	Hall 2009 (base case and range), Lively 2019 (range)
Proportion with LRTI			
Age 0-5 months	0.65	0.25-1.0	Rainisch, 2020
Age 6-11 months	0.5	0.25-1.0	Rainisch, 2020
Outpatient			
Age 0-5 months	21,600	13,200 – 21,600	Lively 2019 (base case and range), Hall 2009 (range)
Age 6-11 months	24,600	17,700 – 24,600	Lively 2019 (base case and range), Hall 2009 (range)
Age 12-23 months	18,440	6,600 – 29,620	Jackson 2021 (base case and range), Hall 2009 (range)
Proportion with LRTI			
Age 0-5 months	0.65	0.25-1.0	Rainisch, 2020
Age 6-11 months	0.3	0.1-1.0	Rainisch, 2020

Methods: Epidemiology

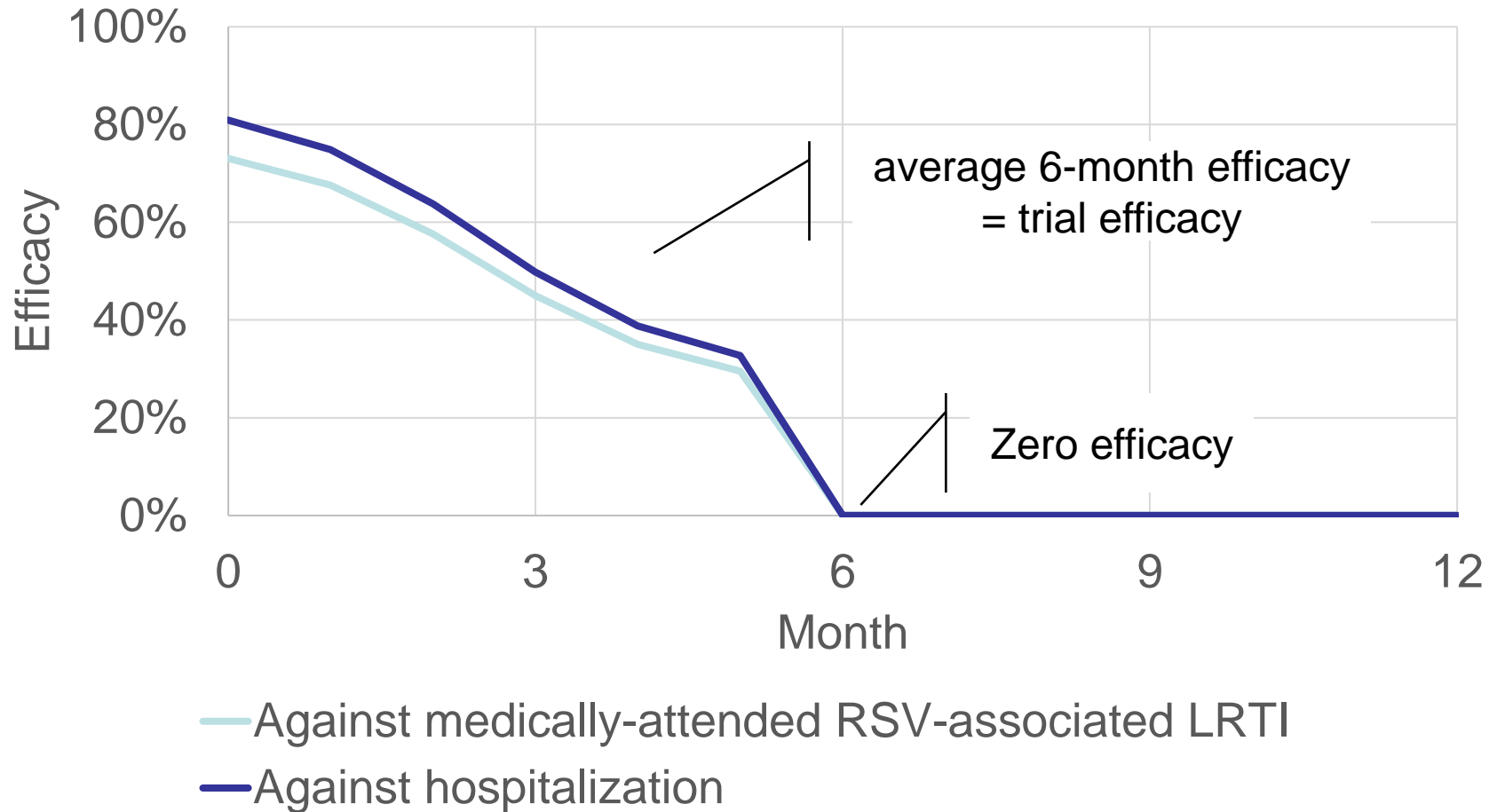
Mortality

	Base Case	Range	Source
RSV mortality per hospitalization			
Age 0-5 months	0.04%	0.03-0.05%	Doucette 2016
Age 6-11 months	0.04%	0.03-0.05%	Doucette 2016
Age 12-23 months	0.3%	0.28%- 0.34%	Gupta 2016

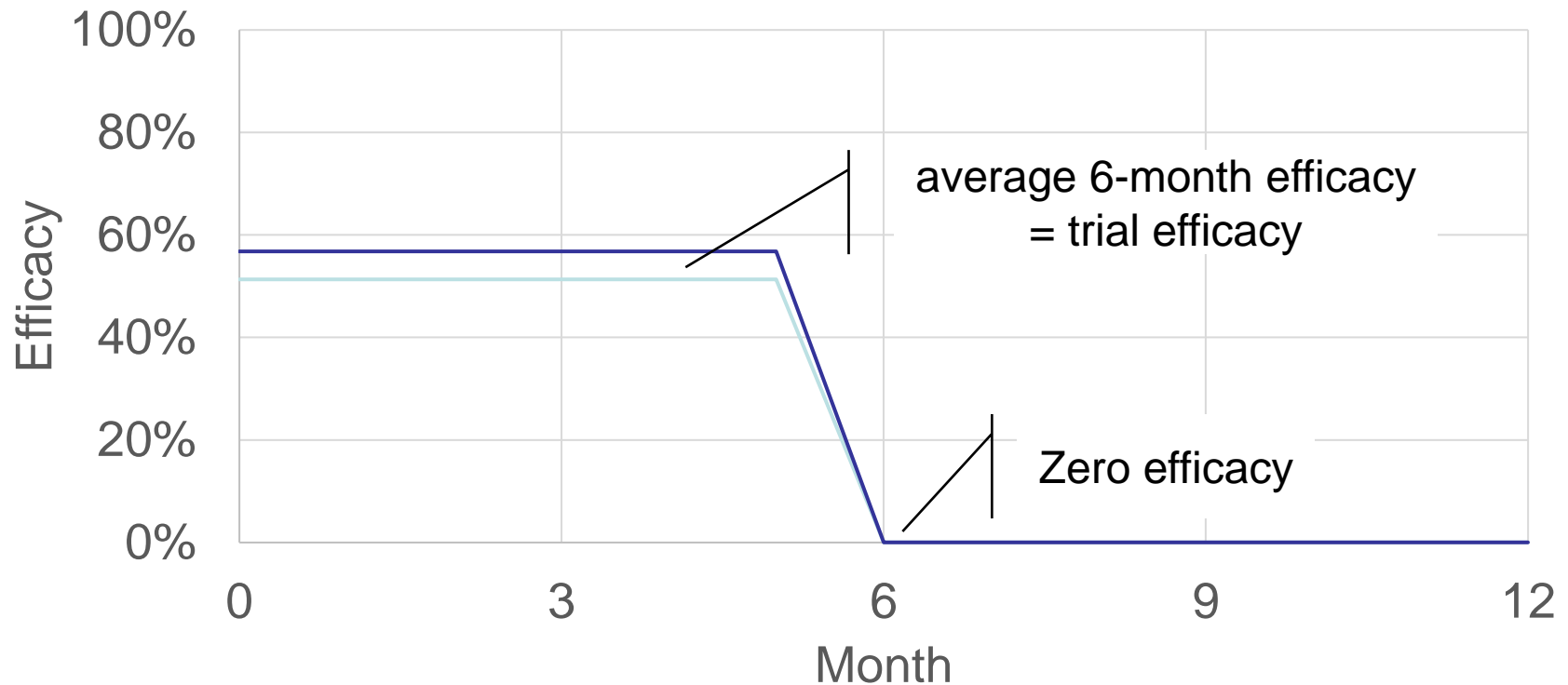
Seasonality



Methods: RSVpreF efficacy



Methods: RSVpreF efficacy alternate scenario



- Against medically-attended RSV-associated LRTI
- Against hospitalization

Methods: Efficacy

Variable	Base case value	Range for sensitivity analysis	Source
RSVpreF			
Initial efficacy (months 0-5) against medically-attended RSV-associated LRTI	51.3%	29.4% - 66.8%	Kampmann et al, 2023
Initial efficacy (months 0-5) against hospitalized RSV-associated LRTI	56.8%	10.1% - 80.7%	Kampmann et al, 2023
Efficacy months 6-12	0		

*Assumed 0% efficacy against upper respiratory tract infections
LRTI= Lower respiratory tract infection*

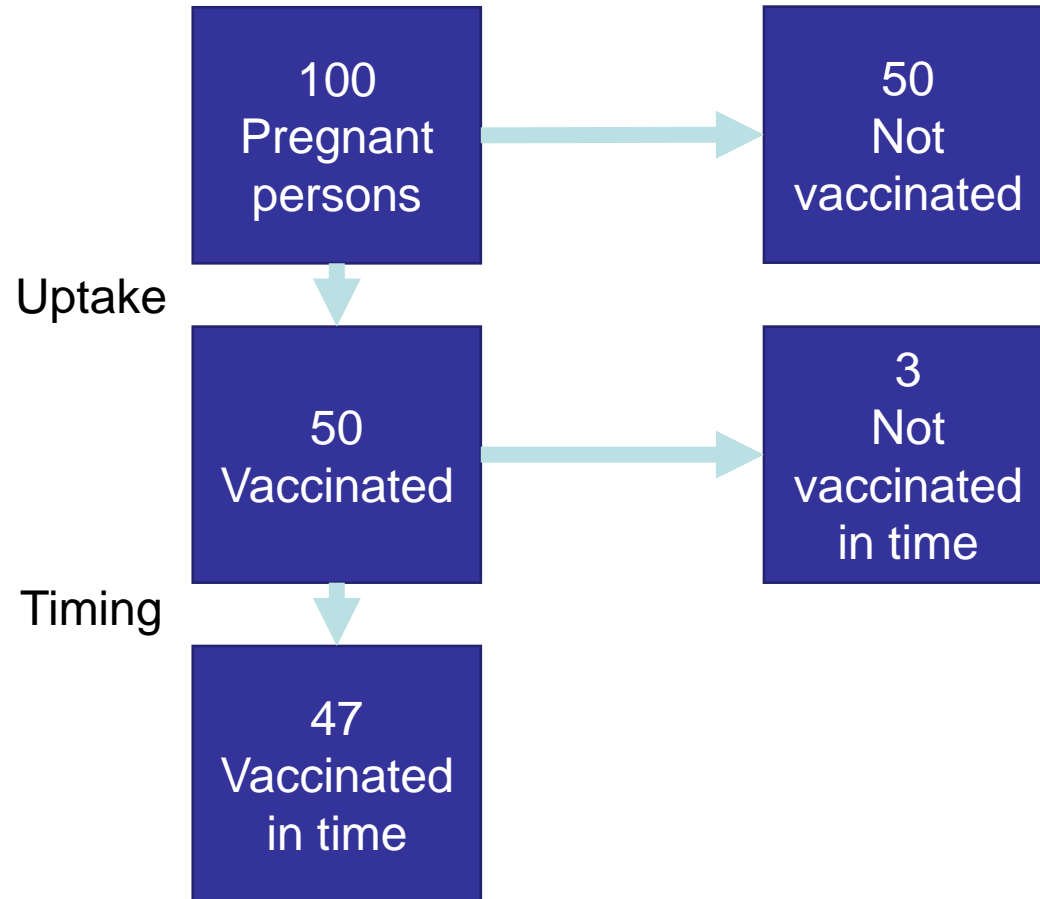
Methods: Provision of RSVpreF

- Base case:
 - Year round
- Scenarios
 - During June-February (no vaccine given in March-May)
 - During May-February (no vaccine given in March-April)
 - During April-February (no vaccine given in March)

Methods: Provision of RSVpreF

- Mother vaccinated
 - During 24-36 weeks gestation, based on distribution of Tdap vaccination by week in that time period
- Birth
 - Must be >2 weeks after vaccination for protective efficacy to pass to infant, based on historical gestational age

Methods: Provision of RSVpreF



Timing= ≥ 2 weeks prior to delivery

Methods: Medical Costs

Variable	Value	Range	Source
Disease-specific hospitalization costs (per hospitalization)			
Age 0-11 months	\$11,487	4,804 - 86,646	Bowser 2022
Age 12- 23 months	\$11,469	4,804 - 86,646	
Disease-specific ED costs (per ED visit)	\$563	544 - 581	Bowser 2022
Disease-specific outpatient costs (per outpatient visit)	\$82	46 - 118	Bowser 2022

- Bowser, 2022 is a systematic review using studies from 2014-2021
- Funded by Sanofi
- All numbers updated to 2022 dollars using GDP Deflator

Methods: Productivity costs

Variable	Value	Range	Source
Productivity burden of RSV disease (caregiver losses)			
Days of lost productivity			
Outpatient*	2.5	0-5	Fragaszy, 2018; Petrie, 2016; Van Wormer, 2017
ED*	2.5	0-5	Fragaszy, 2018; Petrie, 2016; Van Wormer, 2017
Hospitalization^	7.4	0-14	
Lifetime productivity for those <1 year old (lost from death)	1,795,936	1,346,951-2,244,919	Grosse, 2019

*Productivity for outpatient and ED based on adult influenza

^Hospitalization productivity loss = length of hospitalization + 2 days

Methods: Intervention cost

Variable	Value	Range	Source
Immunization-related costs			
RSVpreF, per dose	\$200	50 – 300	Assumption: Manufacturer costs for adult vaccine
RSVpreF administration	\$16.96	15 - 22	Medicare: HCPCS 90460

Both assume no additional visits, but do include costs of administration

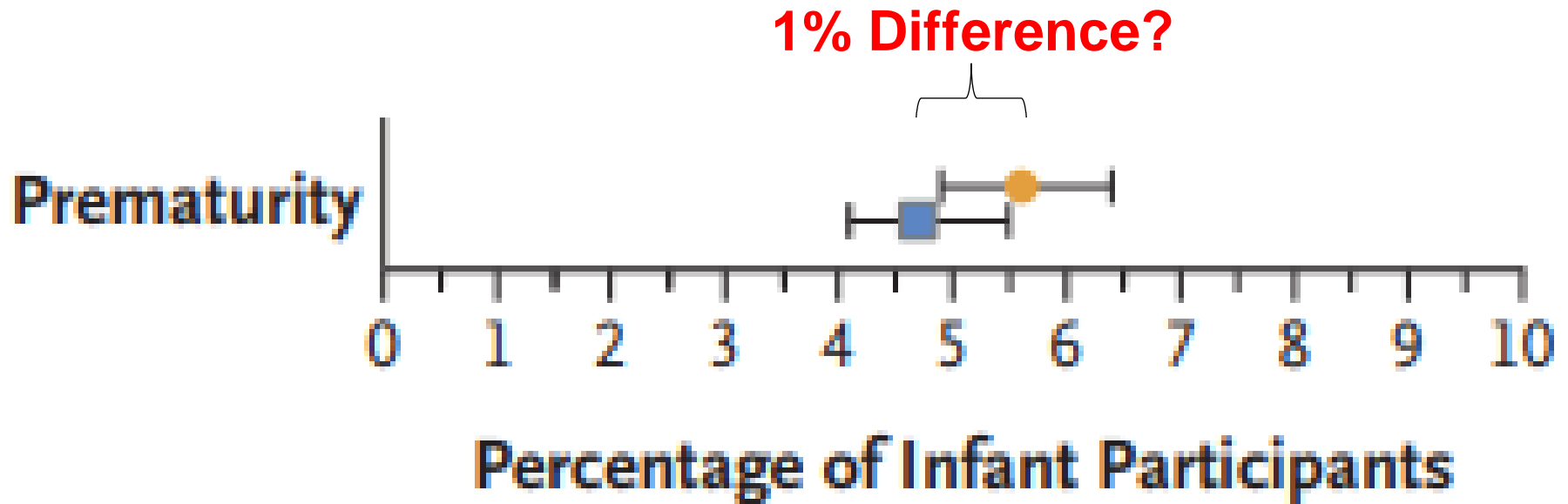
Methods: Adverse event costs

Variable	Value	Range	Source
RSVpreF Maternal Adverse Events			
Rate of injection site reaction	0.41	0.38 – 0.44	Pfizer Phase 3 Trial
Probability of healthcare visit, given injection site reaction	0.02	0.015 – 0.025	Curran, 2020
Cost of outpatient visit	\$367.76	23.15 – 1,758	(Deluca, 2023)
Recipient time, physician office for injection site reaction (hours)	2	1 - 3	Assumption
Hypothetical serious adverse event	0.000001	0 - 0.0002	Base: Prosser, 2006 High: 95% CI Phase 3 data for RSV adult vaccines

Methods: Prematurity?

B Adverse Events of Special Interest

● RSVpreF vaccine (maternal participants, N=3682; infant participants, N=3568) ■ Placebo (maternal participants, N=3675; infant participants, N=3558)



Methods: Prematurity scenario

Variable	Value	Range	Source
RSVpreF infant adverse events			
Higher Rate of Prematurity	0%	0-2%	Pfizer Phase 3 Trial

Outcomes, per prematurity			
Lifetime cost of late prematurity			
Medical	\$ 23,241	\$11,621 – \$46,482	Waitzman, Jalali, Grosse, 2021
Productivity	\$ 11,447	\$5,724 – \$22,894	Waitzman, Jalali, Grosse, 2021
QALYs lost from late prematurity	0.03	0 – 1.2	Werner, Hauspurg, Rouse, 2015 Petrini et al, 2008, Hirvonen et al, 2014, Crump et al, 2021, Darcy-Mahoney et al, 2016, Carroll et al, 2009, Payakachat et al, 2014

* All costs updated to 2022 using GDP Deflator

Methods: RSV

health-related quality of life

Measured in
Days Lost

LRTI quality-adjusted life DAYS lost	Base	Lower (Regnier)	Upper (JIVE)
Outpatient: Child	3.1	1.8	16.6
Outpatient: Caregiver	1.5	0	9.1
ED: Child	4.9	2.9	16.6
ED: Caregiver	2.5	0	9.1
Hospitalized: Child	6.2	3.7	26.5
Hospitalized: Caregiver	2.4	0	13.6



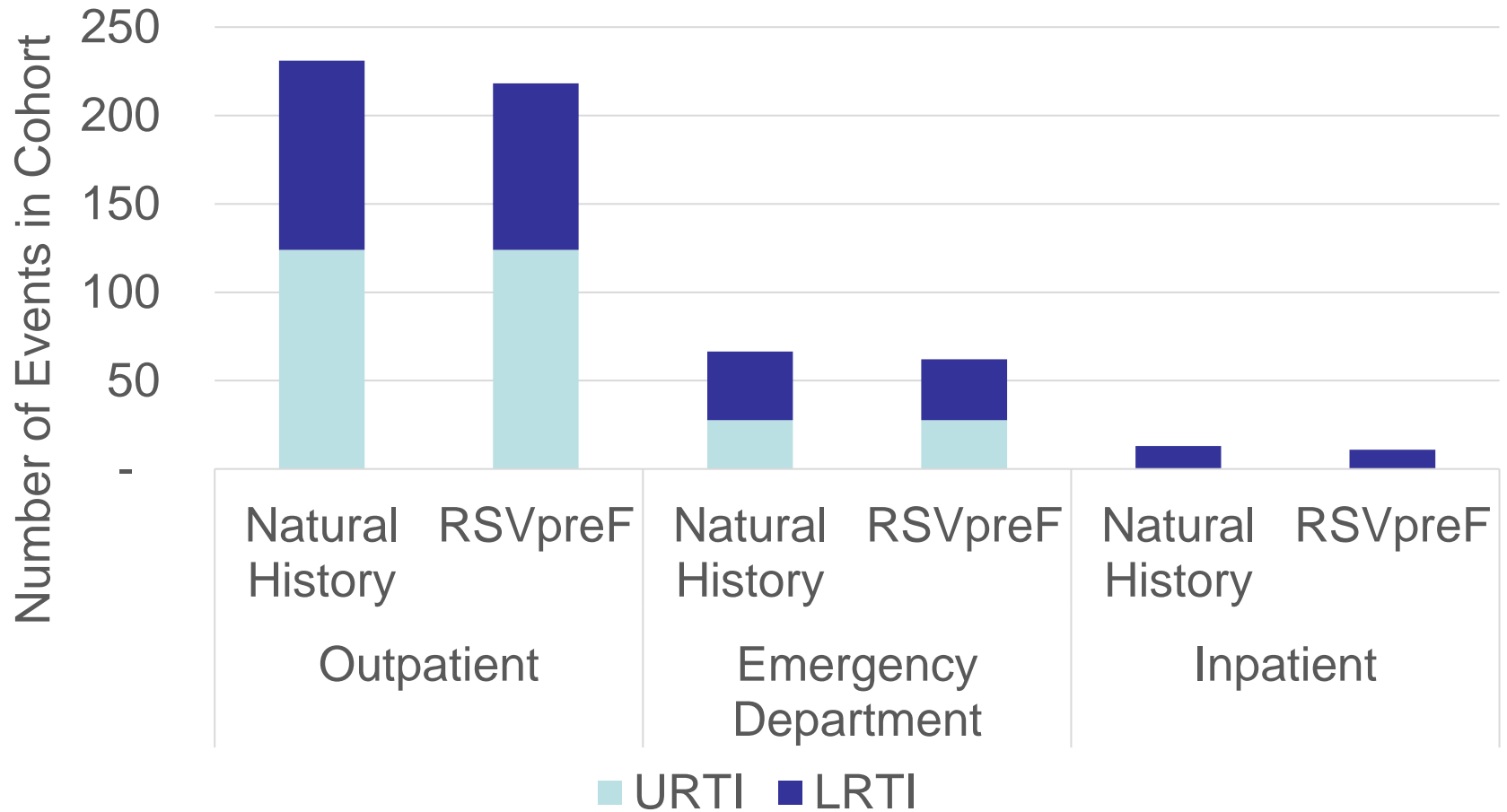
Methods: Uncertainty analyses

- One-way sensitivity
- Scenarios:
 - Prematurity
 - Cost
 - Month of administration
 - Upper respiratory tract infection effect
 - Efficacy waning

Results: Base case

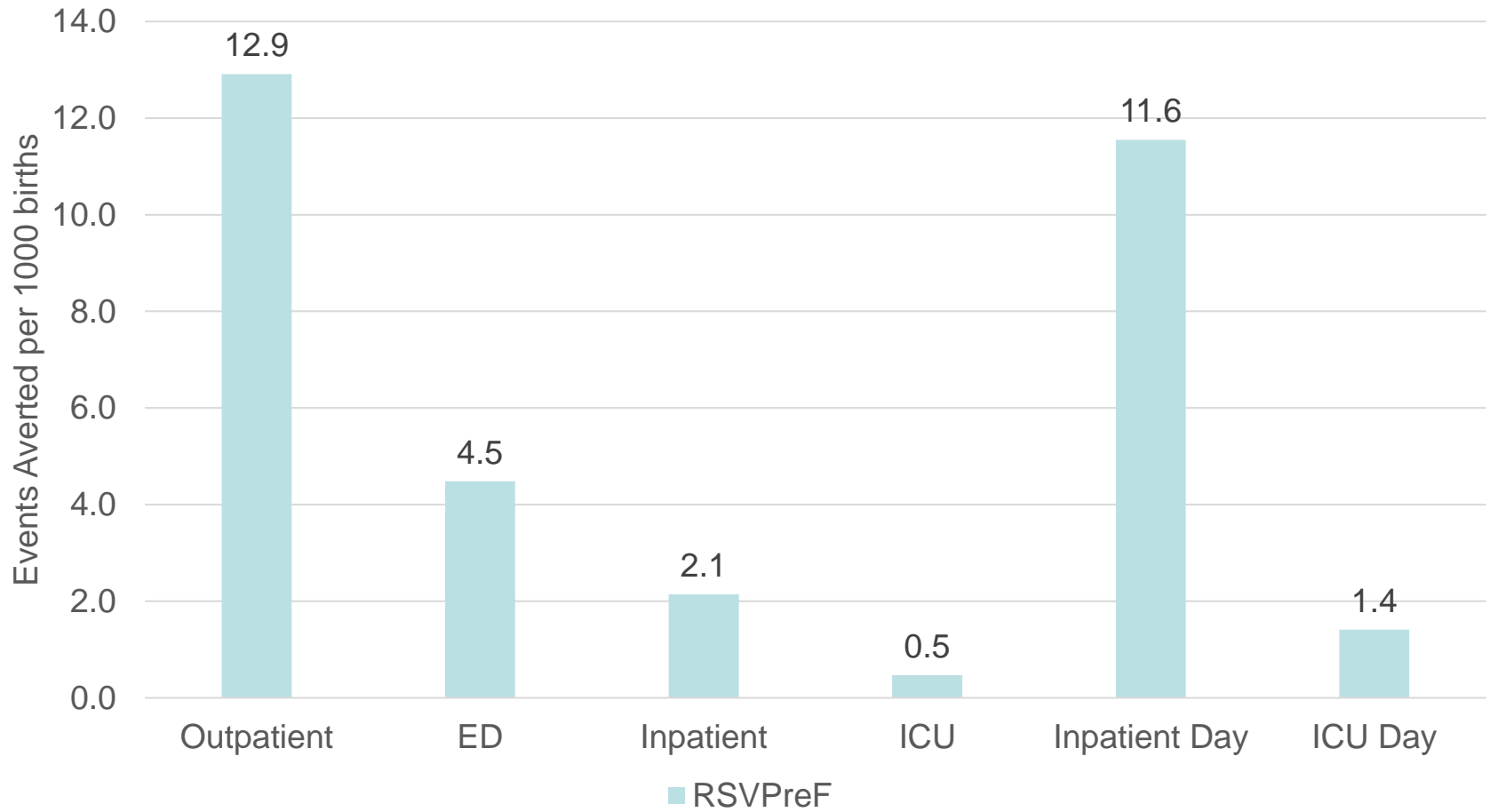
- Base case:
 - Population of 1,000 births
 - 50% uptake in the RSVpreF group
 - First RSV season
 - \$200/dose
 - RSVpreF only impacts LRTI

Results: Health outcomes



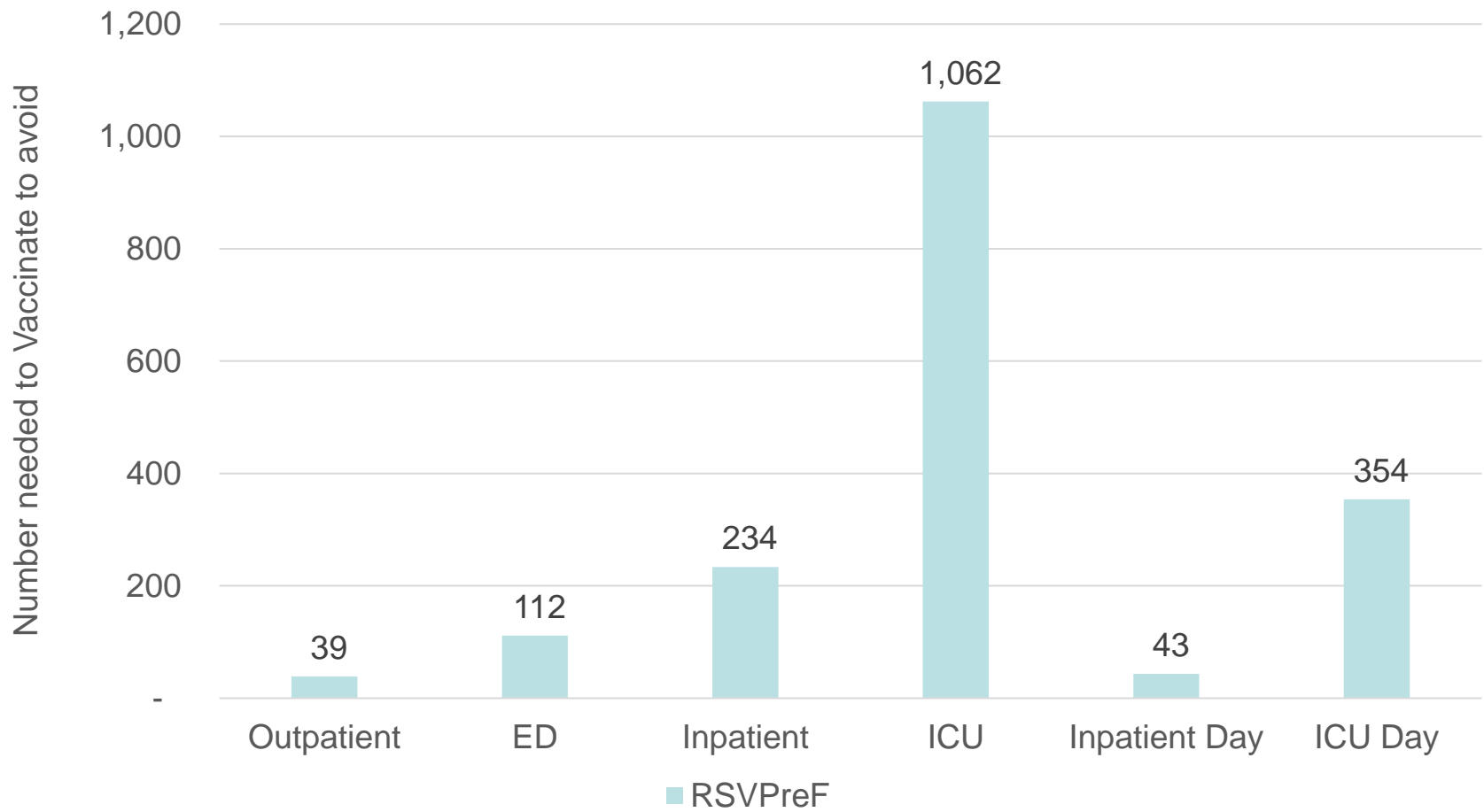
Cohort: 1,000 births, assuming 50% uptake in RSVpreF group
 URTI= upper respiratory tract infection; LRTI= lower respiratory tract infection

Results: Events Averted



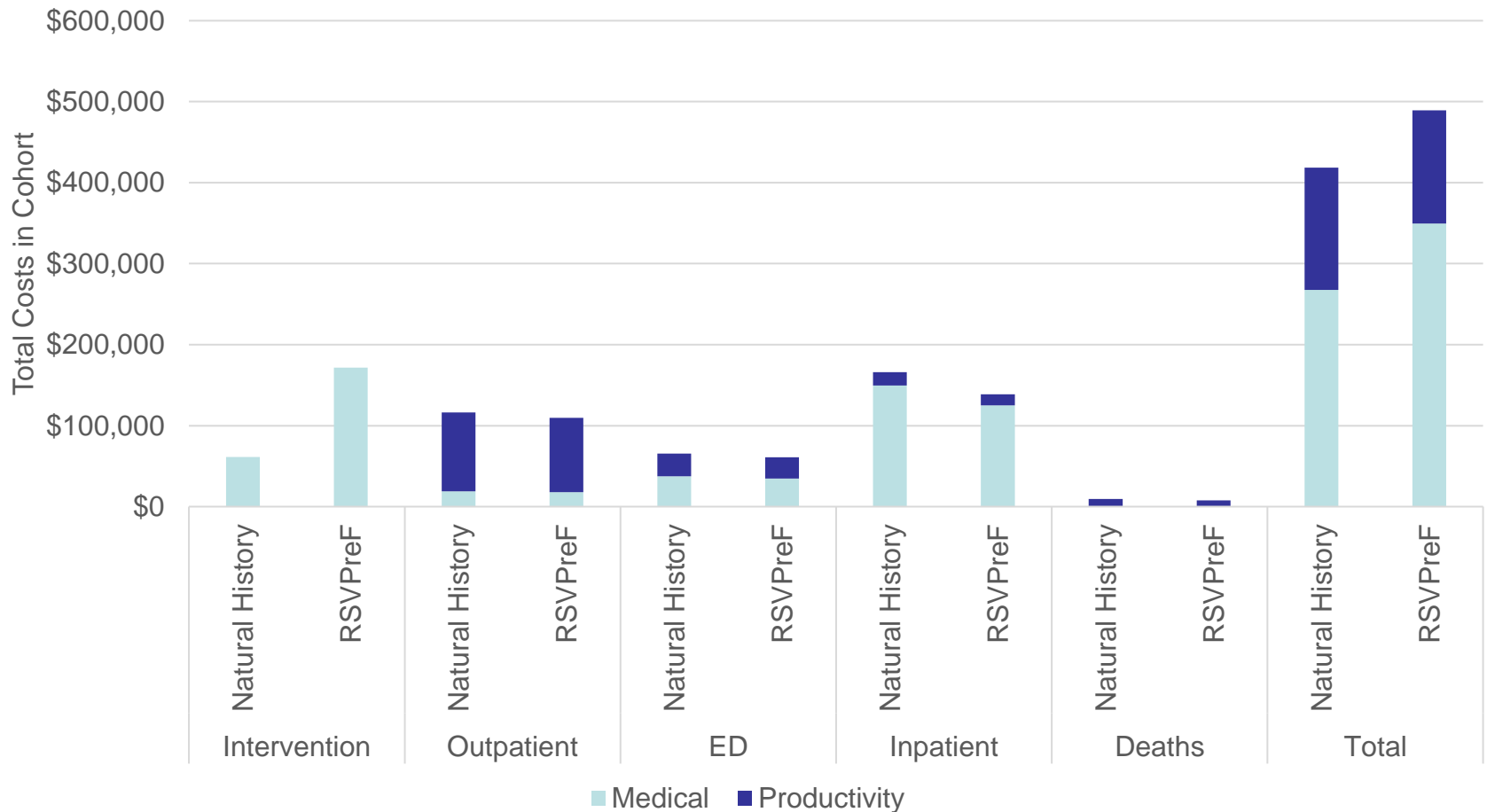
Cohort: 1,000 births, assuming 50% uptake in RSVpreF group

Results: Number Needed to Vaccinate



Cohort: 1,000 births, assuming 50% uptake in RSVpreF group

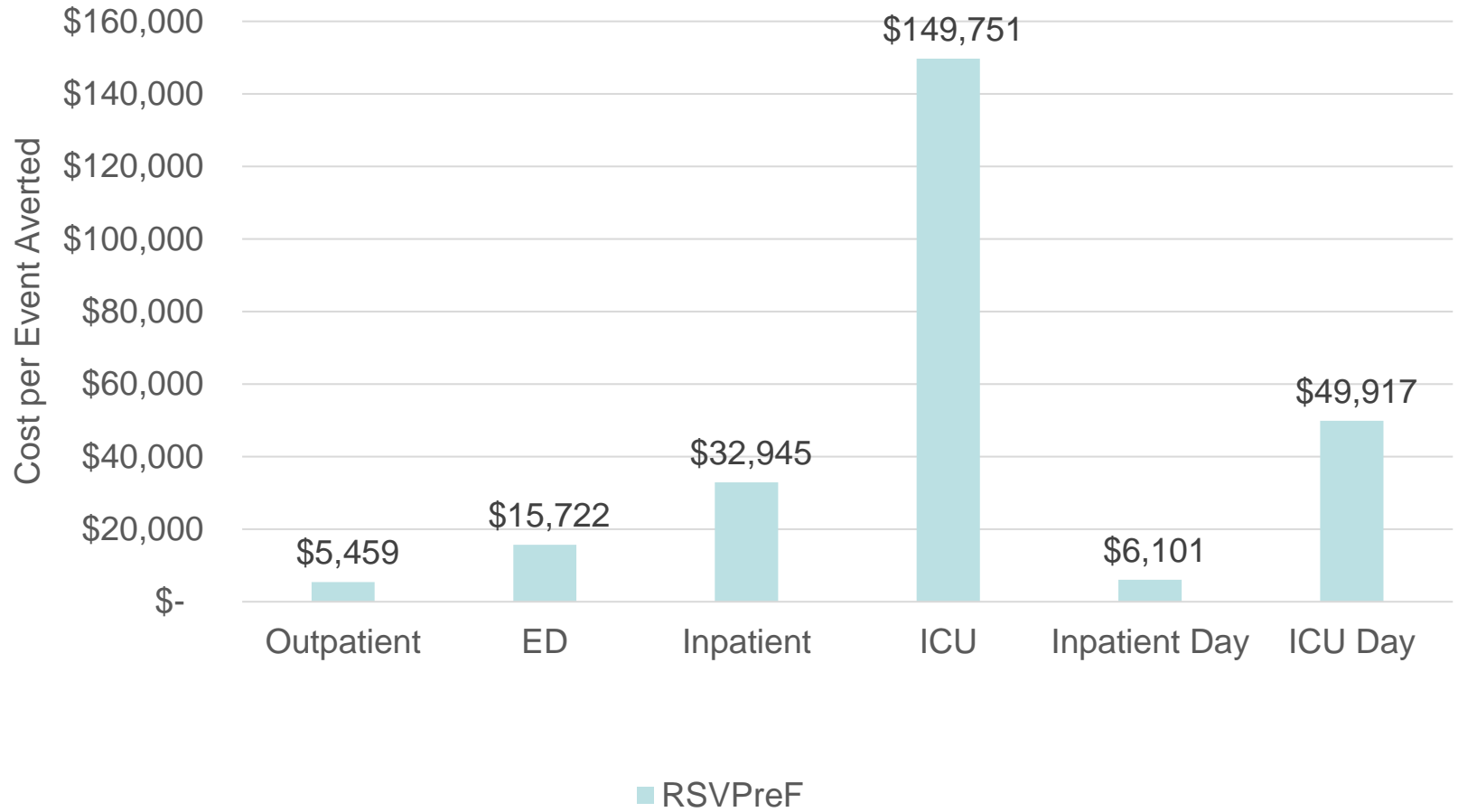
Results: Costs



Cohort: 1,000 births, assuming 50% uptake in RSVpreF group

Base costs of RSVpreF: \$200/dose, both natural history and RSVPreF involve palivizumab for high-risk children

Results: Cost per Event Averted



Results: QALYs Lost

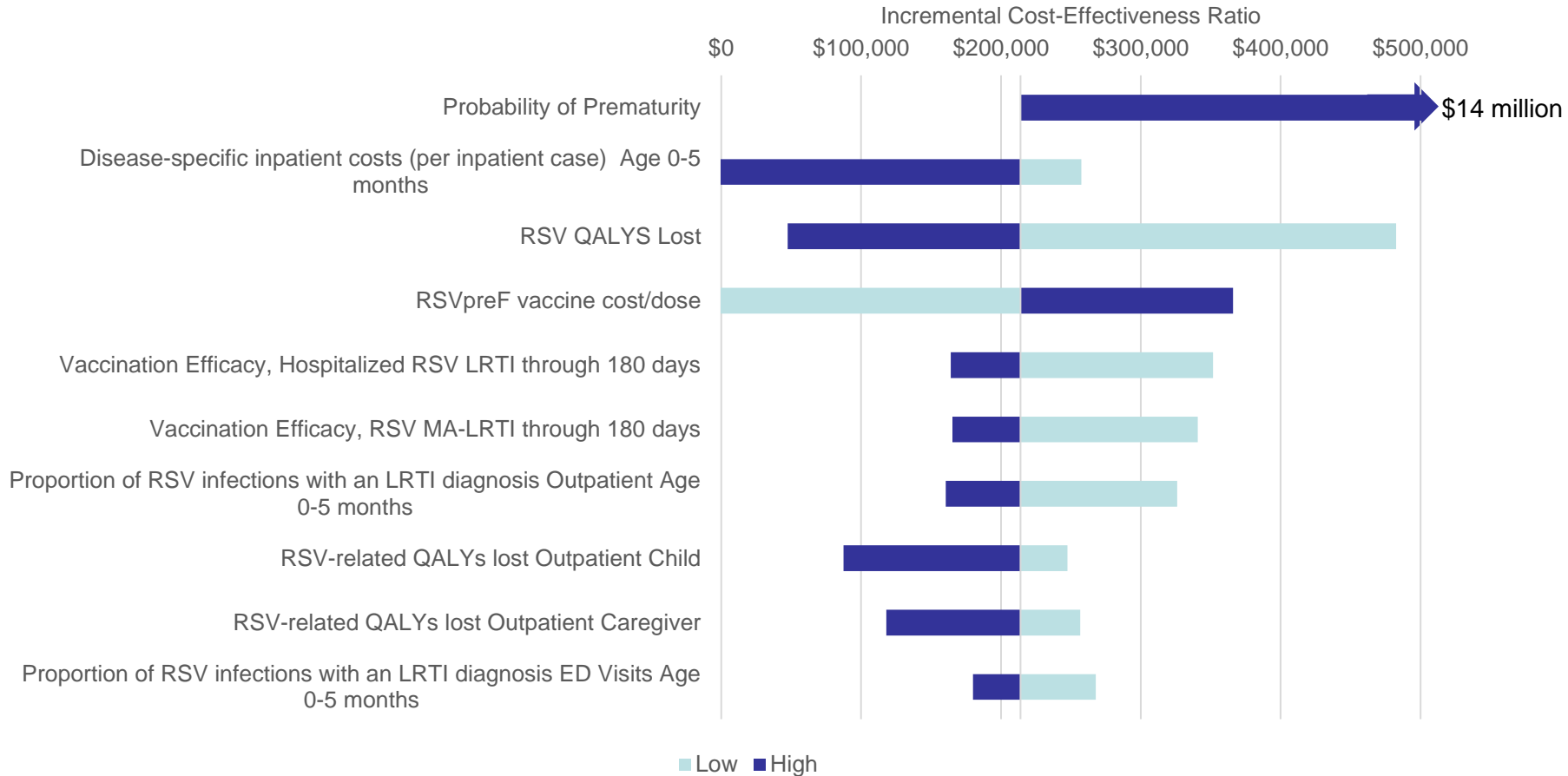
	Adverse Events	Outpatient		ED		Inpatient		Deaths	Total		Grand
		Child	Caregiver	Child	Caregiver	Child	Caregiver	Child	Child	Caregiver	Total
Natural History		1.95	0.98	0.90	0.45	0.22	0.09	0.15	3.22	1.51	4.73
RSVpreF	0.0001	1.85	0.93	0.84	0.42	0.19	0.07	0.12	3.00	1.42	4.42

Results: Cost-Effectiveness

Overall	Costs (\$)	QALYs lost	ICER (\$/QALY) Vs. NH
Natural History	418,556	4.73	
RSVpreF	489,038	4.40	214,087

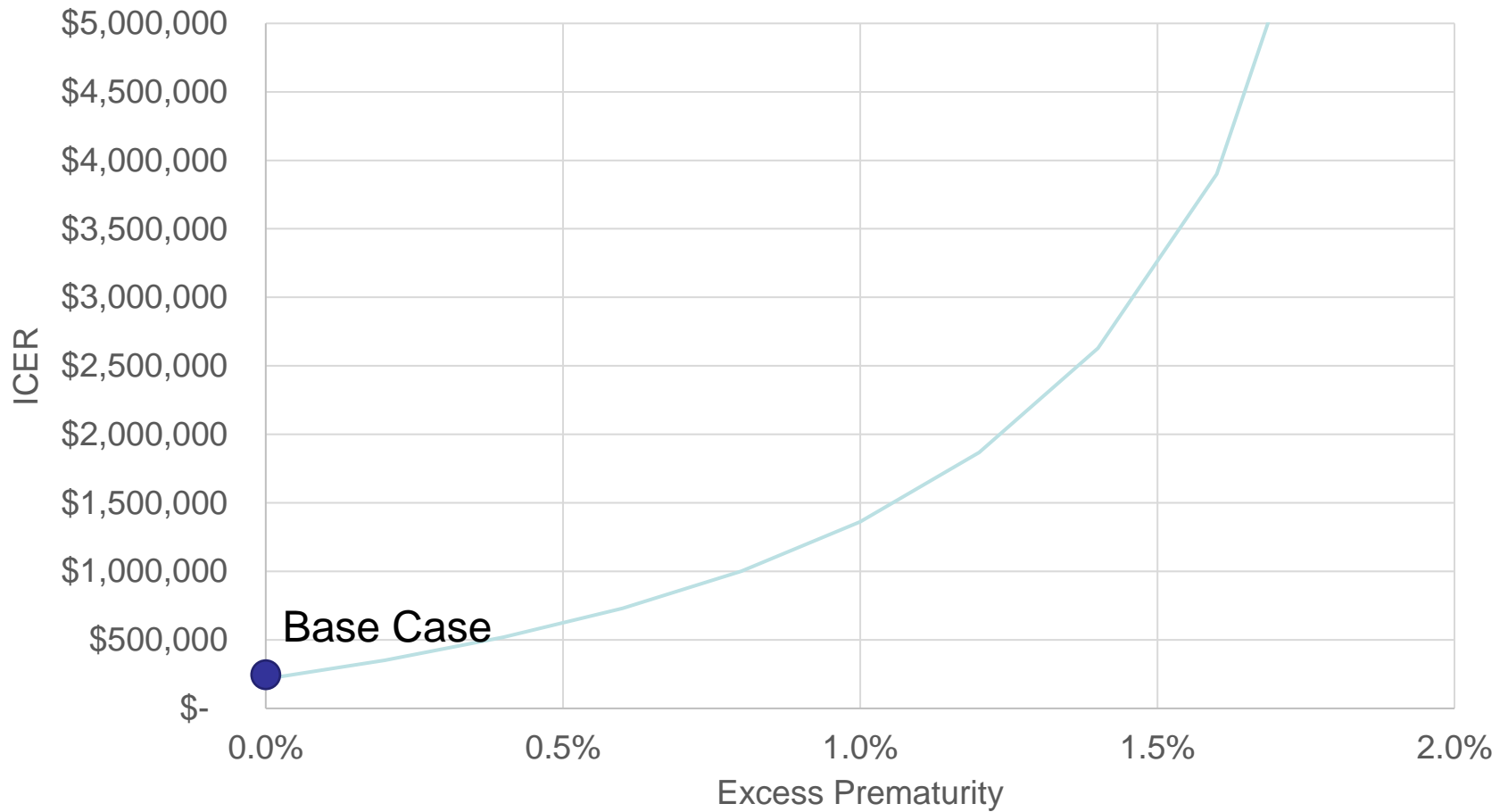
Cohort: 1,000 births, assuming 50% uptake in RSVpreF group, ICER is not affected by uptake
Base costs of RSVpreF: \$200/dose
QALY= quality-adjusted life-year; ICER= incremental cost-effectiveness ratio

Sensitivity: Tornado RSVpreF

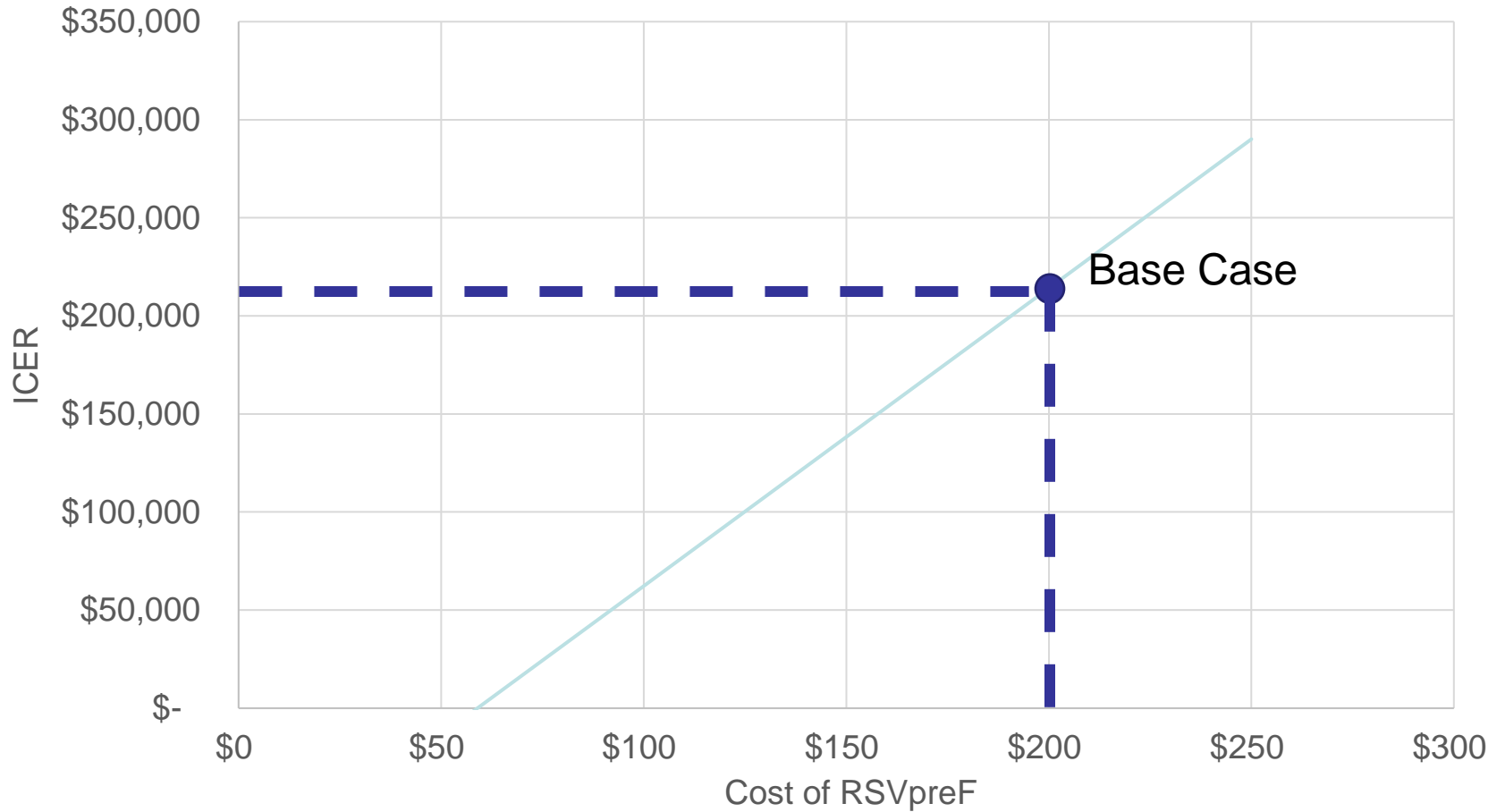


Base cost of RSVpreF: \$200/dose
 MA= Medically-attended
 LRTI= Lower respiratory tract infection
 QALY= Quality adjusted life year

Scenario: Prematurity



Sensitivity: Cost RSVpreF

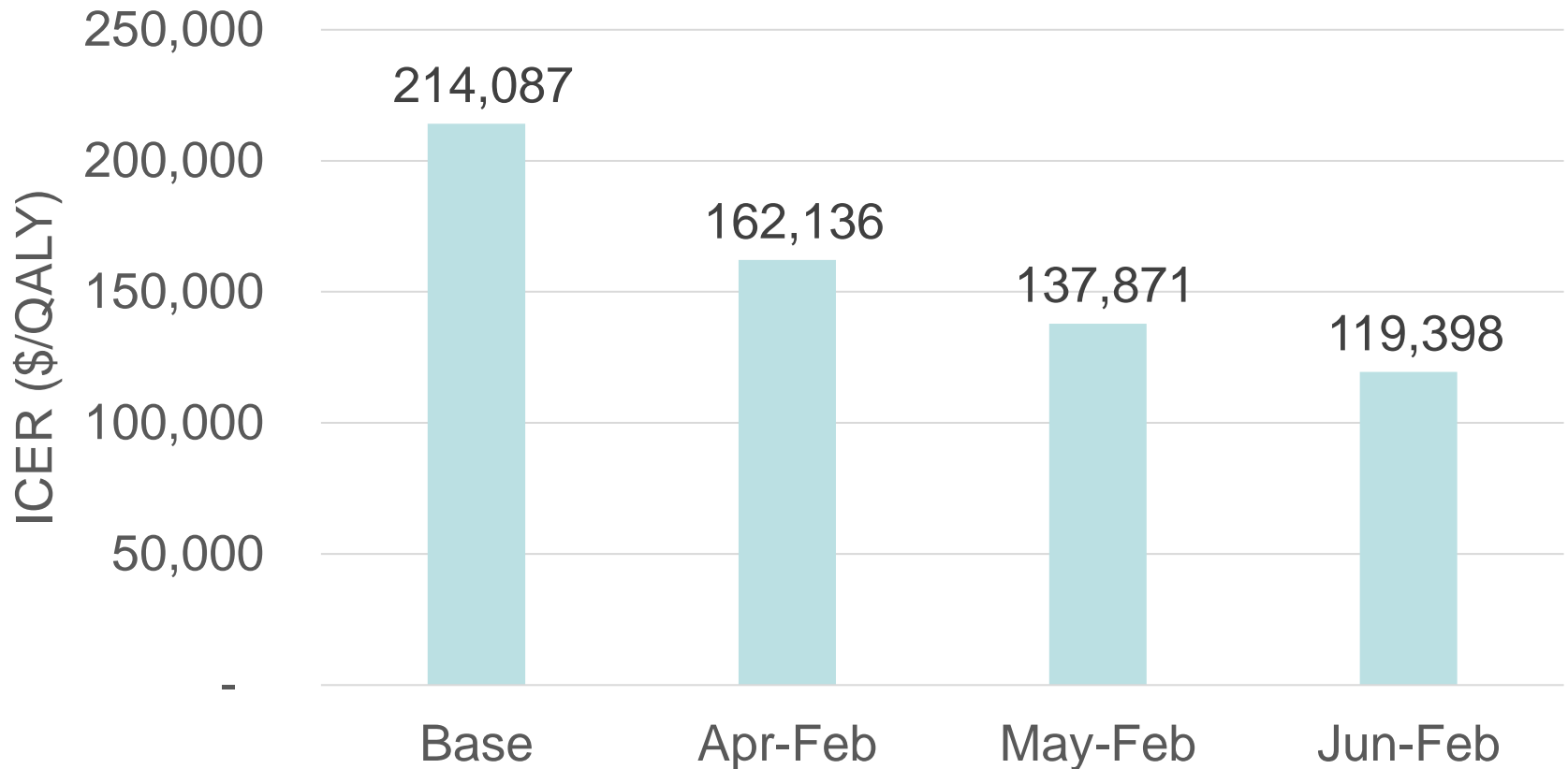


Results: RSVpreF timing scenarios

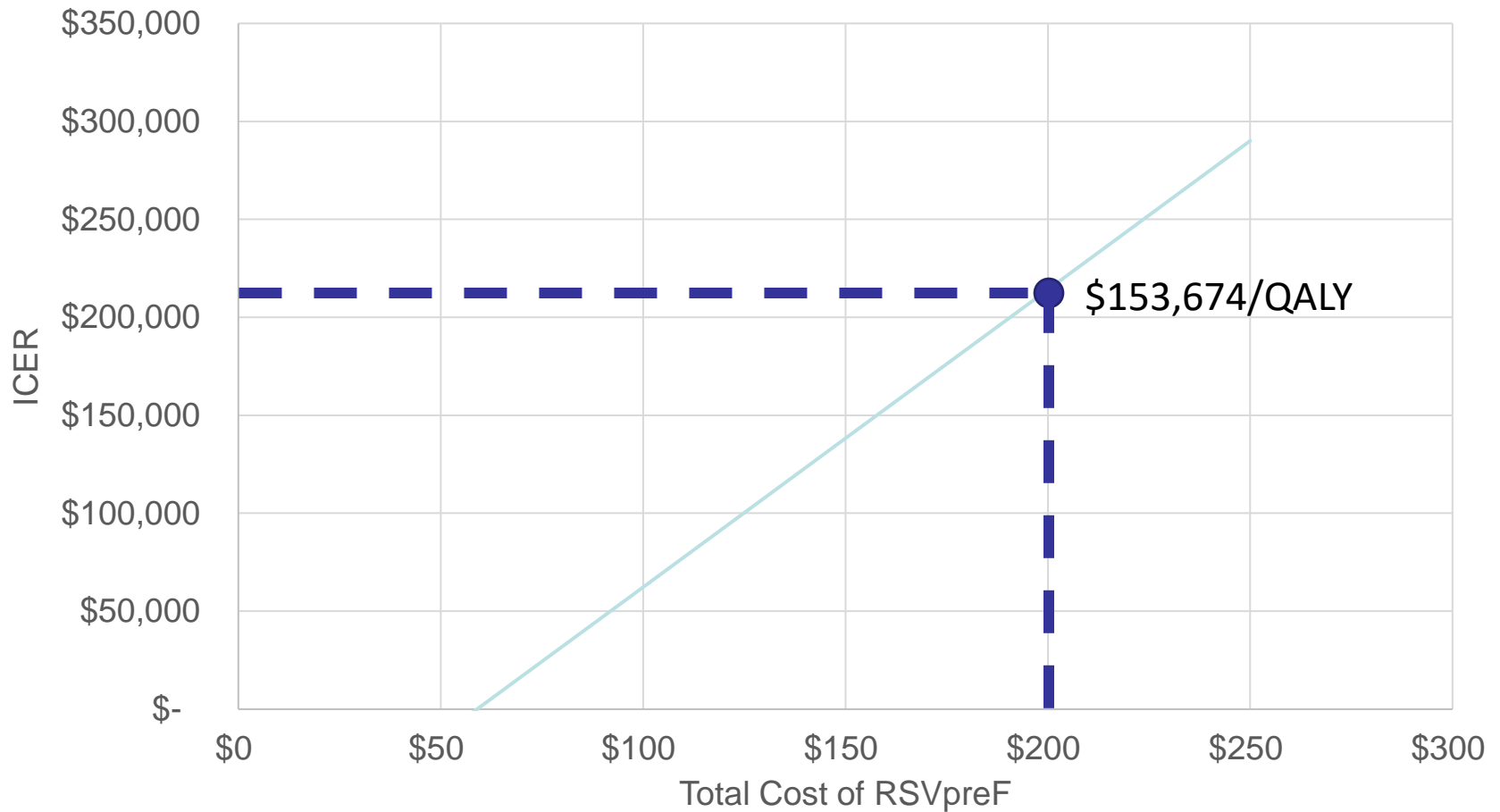
- Scenarios
 - Base: vaccine given year-round
 - During April-February (no vaccine given in March)
 - During May-February (no vaccine given in March-April)
 - During June-February (no vaccine given in March-May)

Results: RSVpreF timing scenarios

ICER: RSVpreF vs. Natural History



Scenario: Upper Respiratory Tract Infection Effect

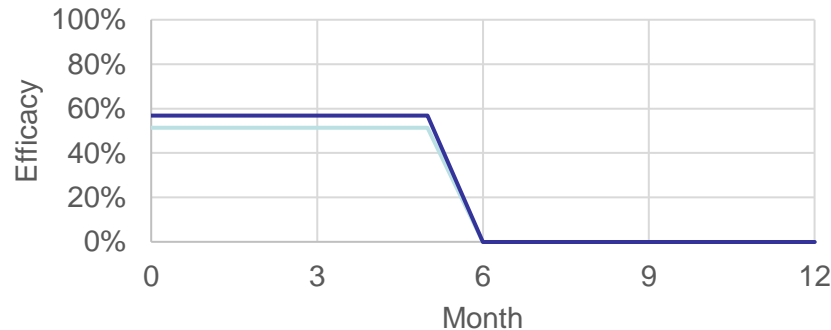


RSVpreF is assumed to have 37.9% efficacy for upper respiratory tract infections based on overall respiratory tract efficacy from phase 3 trial (Kampmann, 2023)

ICER= incremental cost effectiveness ratio; QALY= Quality adjusted life year

Methods: RSVpreF efficacy “flat efficacy” scenario

Overall	Costs (\$)	QALYs lost	ICER (\$/QALY)
Natural History	418,556	4.73	
RSVpreF	486,812	4.38	191,749



— Against medically-attended RSV-associated LRTI
— Against hospitalization

Slightly lower costs with RSVpreF, slightly fewer QALYs lost, slightly lower ICER

Limitations

- Model Structure
 - No risk groups
 - No dynamic transmission. No impact of the vaccine on transmission and indirect effects
- Uncertain inputs
 - RSVpreF cost
 - QALYs lost
 - Upper respiratory tract infections
 - Prematurity

Summary

- RSVpreF may improve RSV outcomes, but will also increase costs
- RSVpreF has the potential to be cost-effective
- Results sensitive to:
 - Rate of prematurity
 - Cost per dose (Cost-Saving – 350,000 \$/QALY)
 - Efficacy (~150,000 - 350,000 \$/QALY)
 - QALYs lost (~50,000 - 480,000 \$/QALY)
 - Hospitalization, Outpatient, ED
 - Child, Parent
 - Month of Administration (~120,000 – 215,000 \$/QALY)

Thank You

- Please send comments to:
- dwhutton@umich.edu

Appendix

Methods: Epidemiological model

Epidemiology

Seasonality

Incidence

- Outpatient
- ED
- Hospitalizations

Interventions

Nirsevimab

Timing

Waning
Protection

Health Economics

Health Burden/

- Outpatient
- ED
- Hospitalizations

Cost Burden/

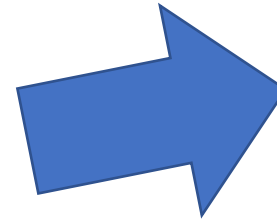
- Outpatient
- ED
- Hospitalizations

Health Effects

- Outpatient
- ED
- Hospitalizations
- Deaths

Economic Effects

- Intervention
- Disease
- Societal
- QALYs
- ICER



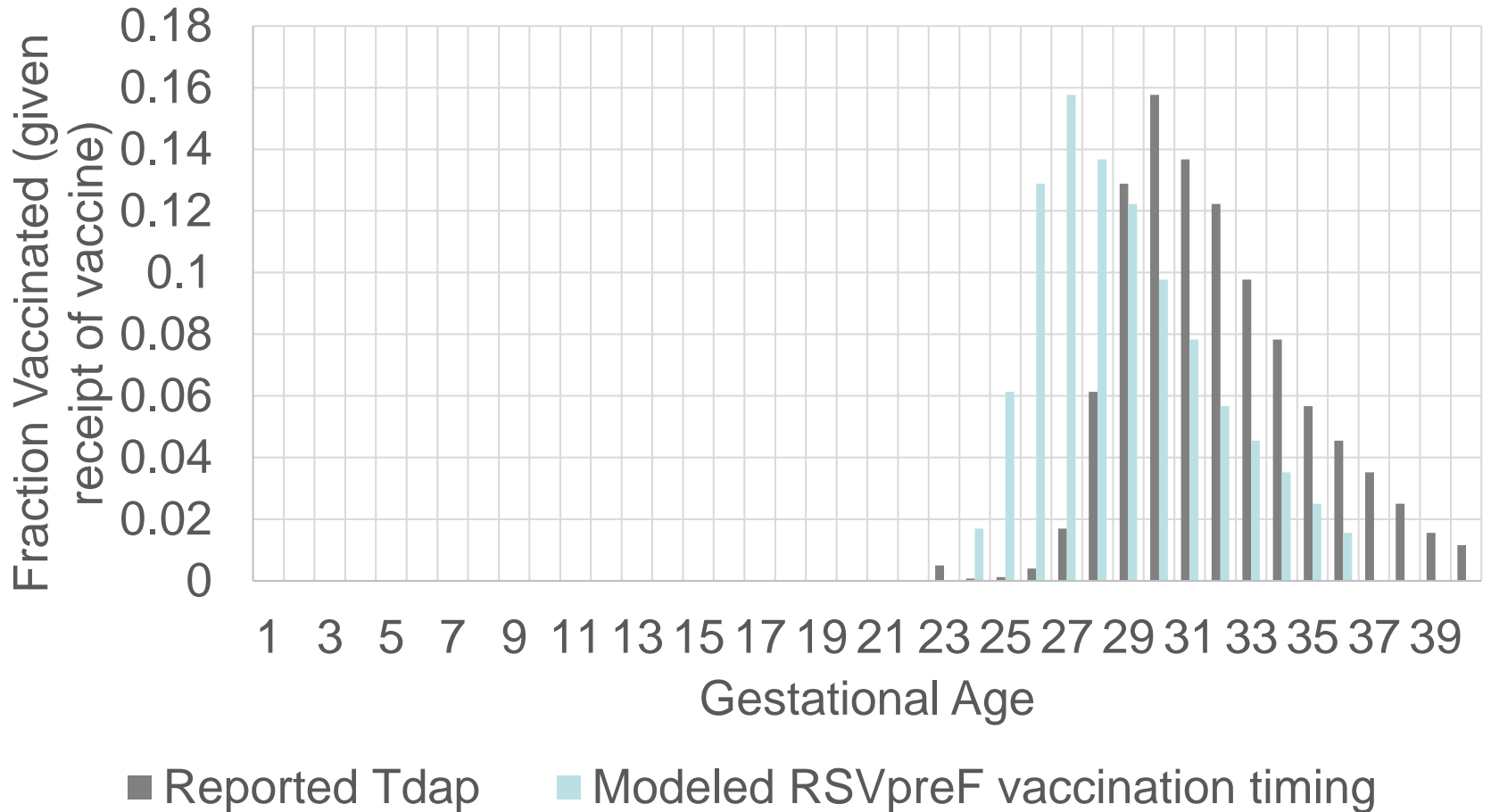
Methods: Inputs

- Incidence
 - Raw reported incidence may be underreported because of imperfect PCR sensitivity, so we consider an additional scenario in sensitivity analysis:
 - based on CDC Unpublished re-analysis of raw data from Zhang et al study which found decreased RSV PCR sensitivity in light of paired serology testing (adjustment factor: 87.6%).

Health-Related Quality-of-Life

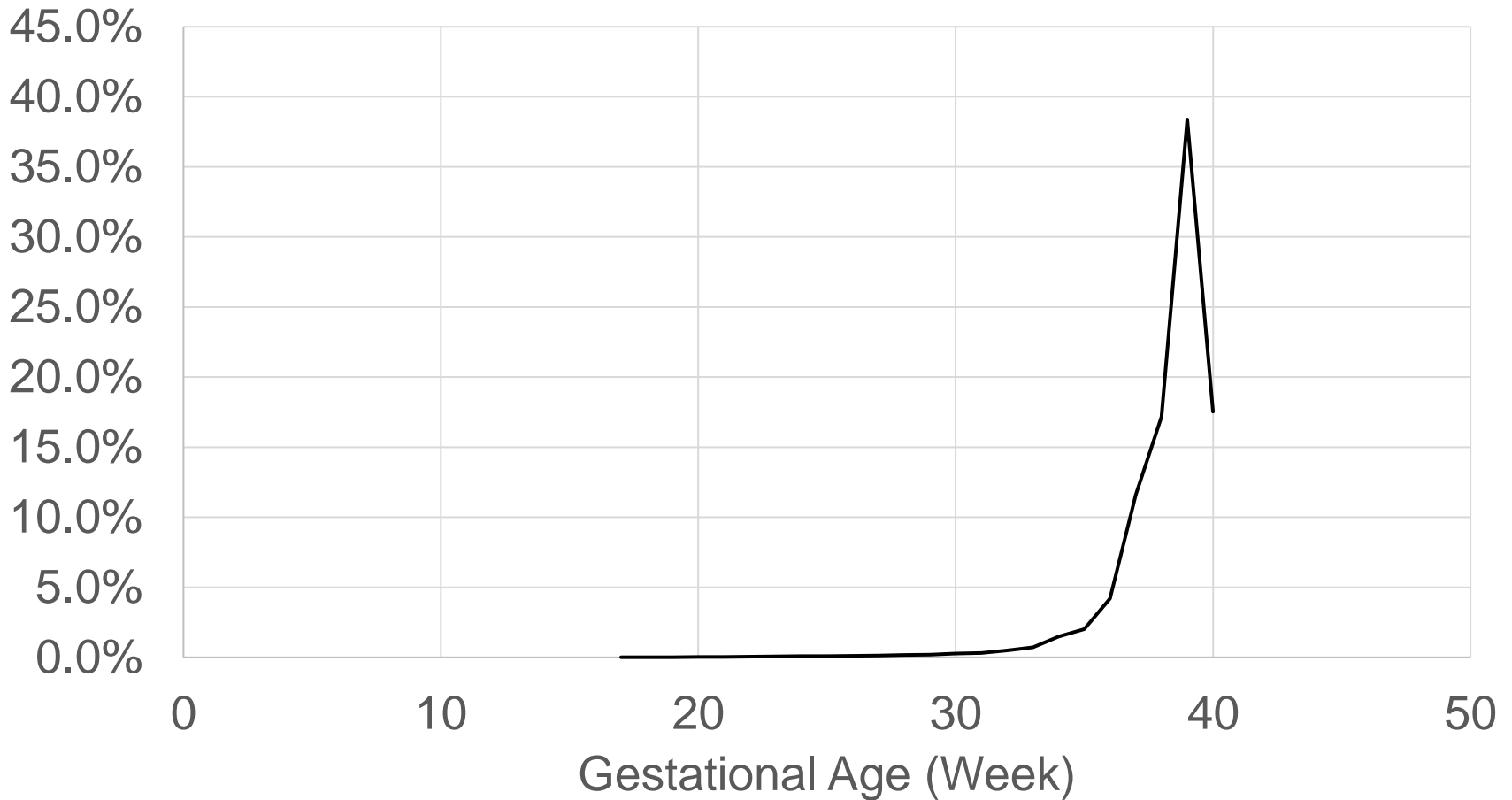
- Sources
 - Glaser (2022)
 - Estimate based on comparison of utility losses between premature children who had RSV vs. premature children without RSV and their caregivers
 - Used as base case for hospitalization for children and their caregivers
 - Regnier (2013)
 - Estimate QALY losses for hospitalization, ED visits, and outpatient visits for children with pertussis
 - Use relative QALYs between hospitalization, ED, and outpatient to estimate base losses for ED and outpatient in base case
 - JIVE RSV Utilities Survey (2021)
 - Estimates QALY losses for hospitalization and outpatient visits for child and caregiver
 - Estimates may be impacted by COVID-related concerns about respiratory viruses
 - Inform upper bound of range

Methods: Provision of RSVpreF



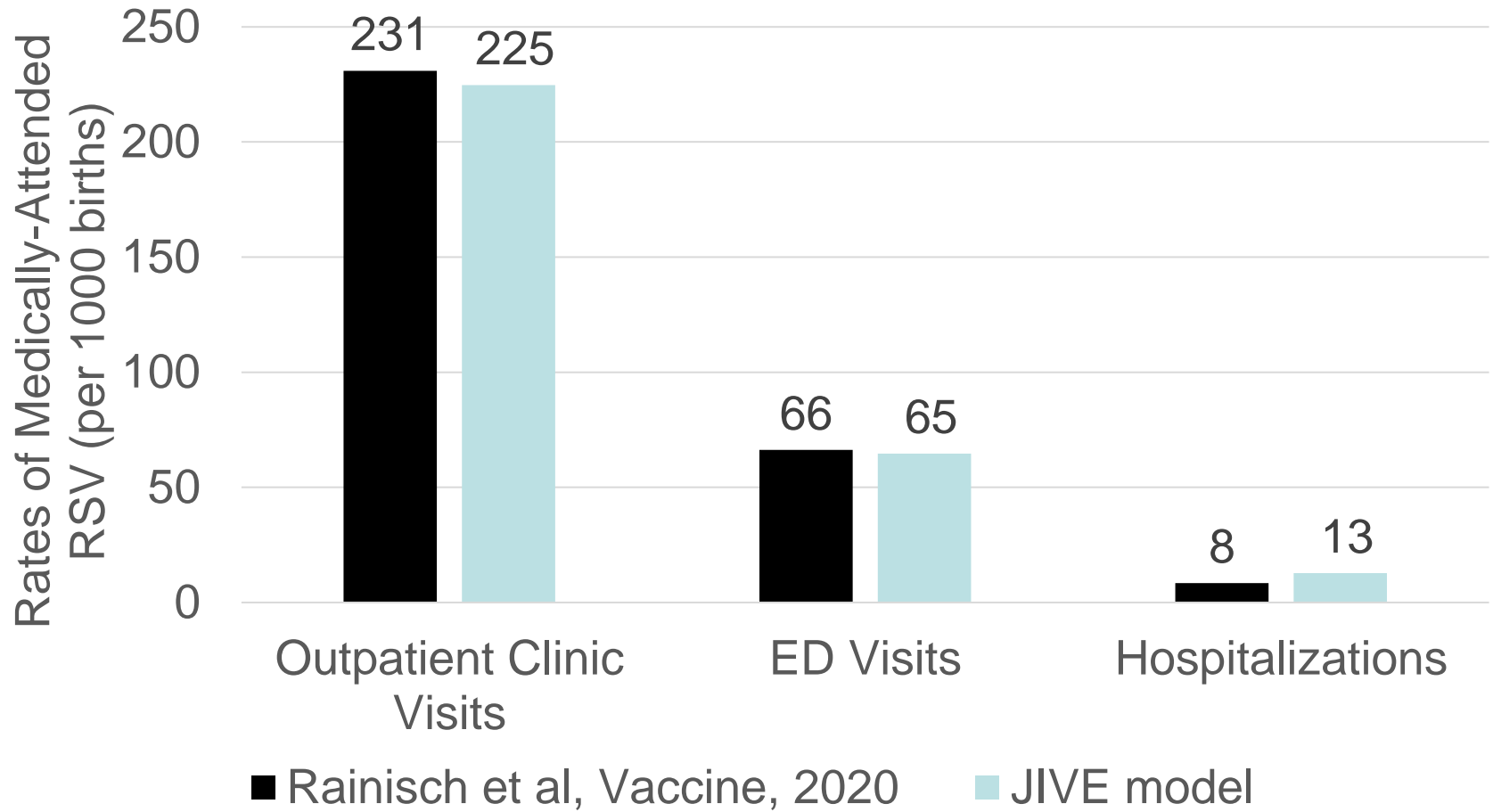
Timing of those who received vaccination during pregnancy
RSVpreF is assumed to start earlier at week 24 (vs. week 27)

Methods: Birth Timing



Source: NCHS from 2019 and 2021

Validation



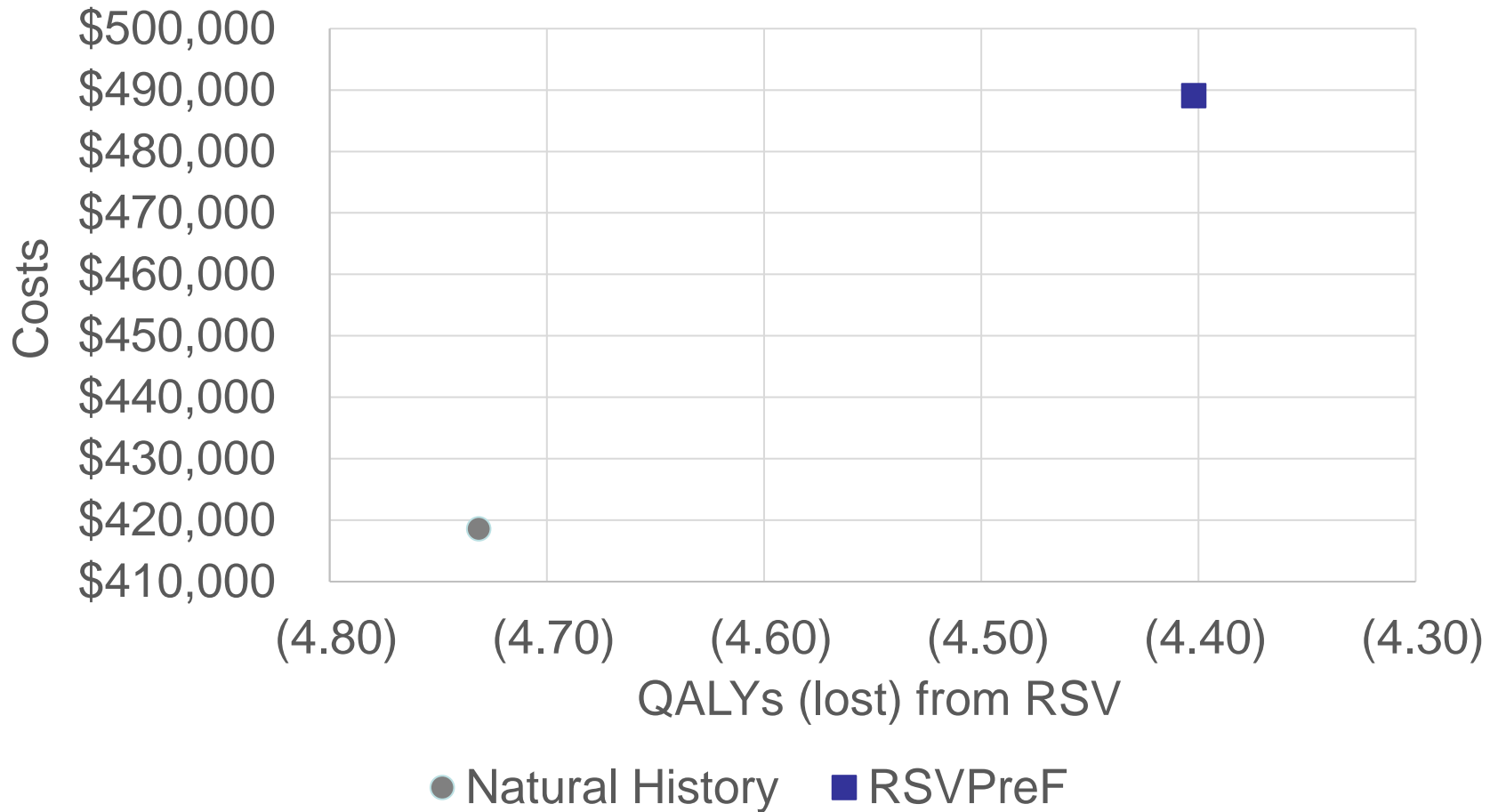
Methods: Maternal Adverse Event Health Effects

Variable	Value	Range	Source
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Adult Quality-Adjusted Life-Years lost due to adverse events

Injection Site Reaction	0		Assumed
Serious Adverse Event	0.141	0.092-0.199	Prosser, 2006

Results: Cost-Effectiveness



Cohort: 1,000 births, assuming 50% uptake in RSVpreF group

Base costs of RSVpreF: \$200/dose

Results: RSVpreF Administration June-February

	Costs (\$)	QALYs	ICER (\$/QALY) Vs. NH
Overall			
Natural History	418,556	4.73	
RSVpreF	454,928	4.43	119,398