Economic Analysis of Nirsevimab in Pediatric Populations

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Conflicts of interest statements

– Authors have no known conflict of interests.

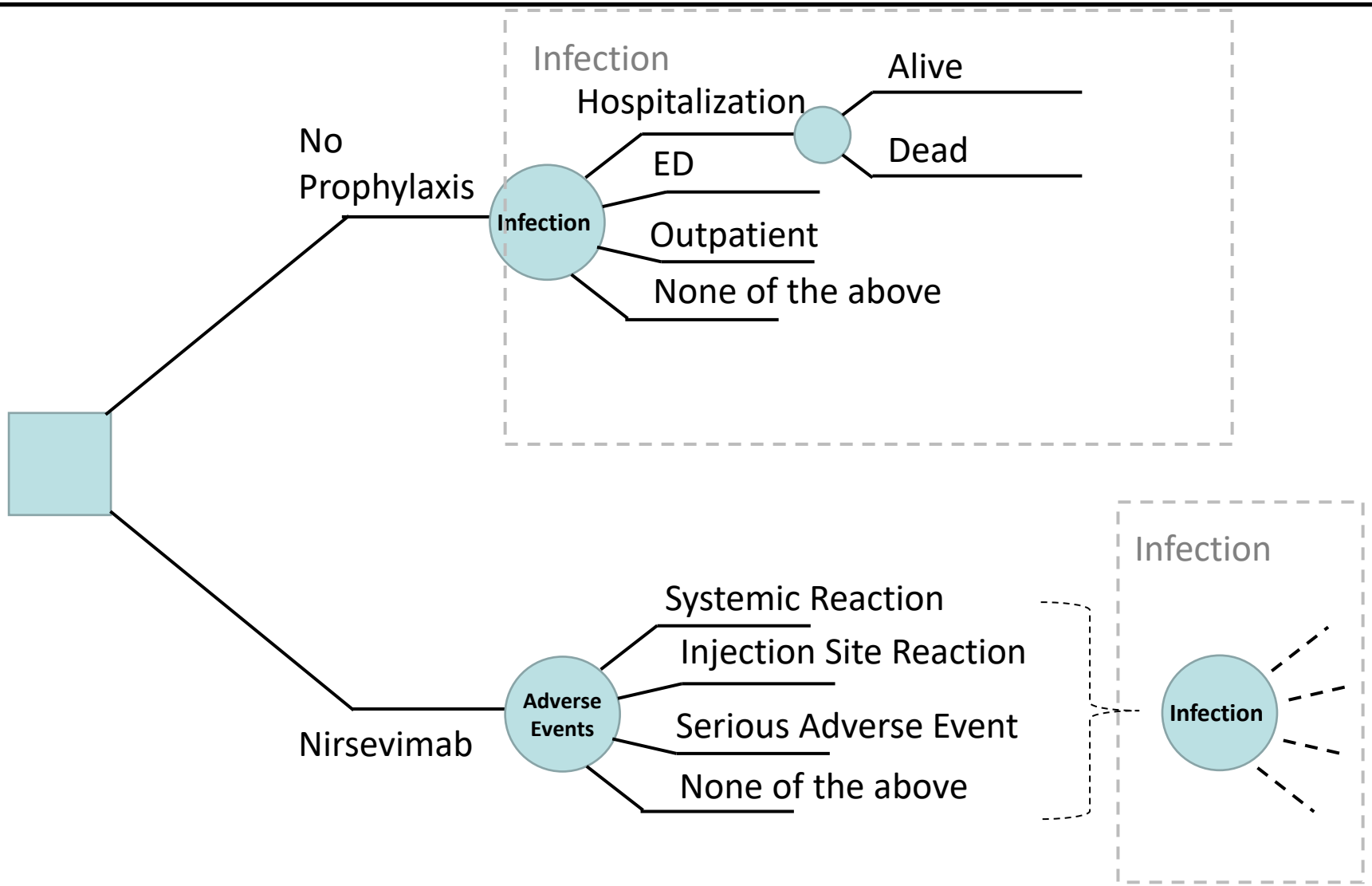
Methods: Study question

- Determine the cost-effectiveness of nirsevimab by:
  - Evaluating the population burden of disease in pediatric US population in terms of
    - annual resource utilization
    - total cases
    - total costs
    - deaths
    - quality-adjusted life years
  - Comparing the incremental cost-effectiveness ratio of nirsevimab to no prevention.
  - Running scenario analyses outcomes that explore key areas of uncertainty.
- Perspective: Societal

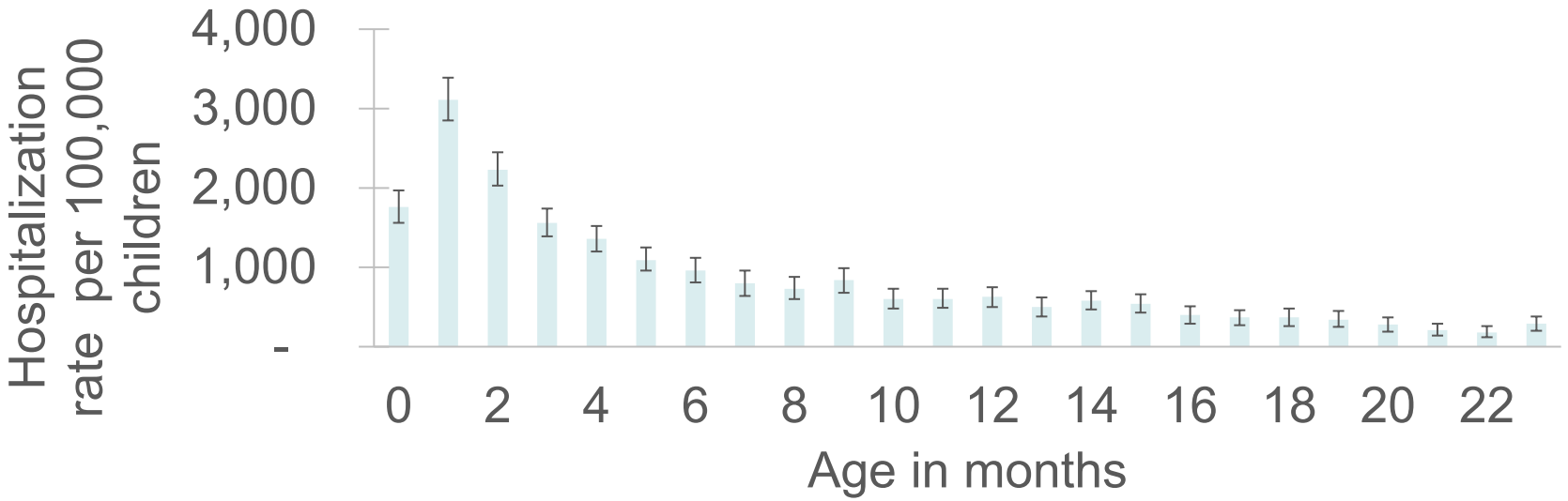
Methods: Intervention(s)

- Target population: US pediatric < 7 months of age entering their first RSV season
  - Secondary analysis high-risk infants in their second RSV season (7-18 months old)
- Interventions:
  1. No nirsevimab (Natural history)
  2. Nirsevimab against RSV illness
- Time horizon: 1 RSV season
- Analytic horizon: 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

CDC New Vaccine Surveillance Network (NVSN) hospitalization rates for children under 2 years of age from December 2016 to September 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)[5], Hall 2009 (range)[6]
Age 6-11 months	5,800	5,700 – 5,800	
Age 12 -23 months	3,200	3,200 – 5,300	Hall 2009 (base case and range)[6], Lively 2019 (range)[5]
Proportion with LRTI			
Age 0-5 months	0.65	0.25-1.0	Rainisch, 2020[4]
Age 6-11 months	0.5	0.25-1.0	Rainisch, 2020[4]
Medically attended outpatient			
Age 0-5 months	21,600	13,200 – 21,600	Lively 2019 (base case and range)[5], Hall 2009 (range)[6]
Age 6-11 months	24,600	17,700 – 24,600	
Age 12 -23 months	18,440	6,600 – 29,620	Jackson 2021 (base case and range)[7], Hall 2009 (range)[6]
Proportion with LRTI			
Age 0-5 months	0.65	0.25-1.0	Rainisch, 2020[4]
Age 6-11 months	0.3	0.1-1.0	Rainisch, 2020[4]

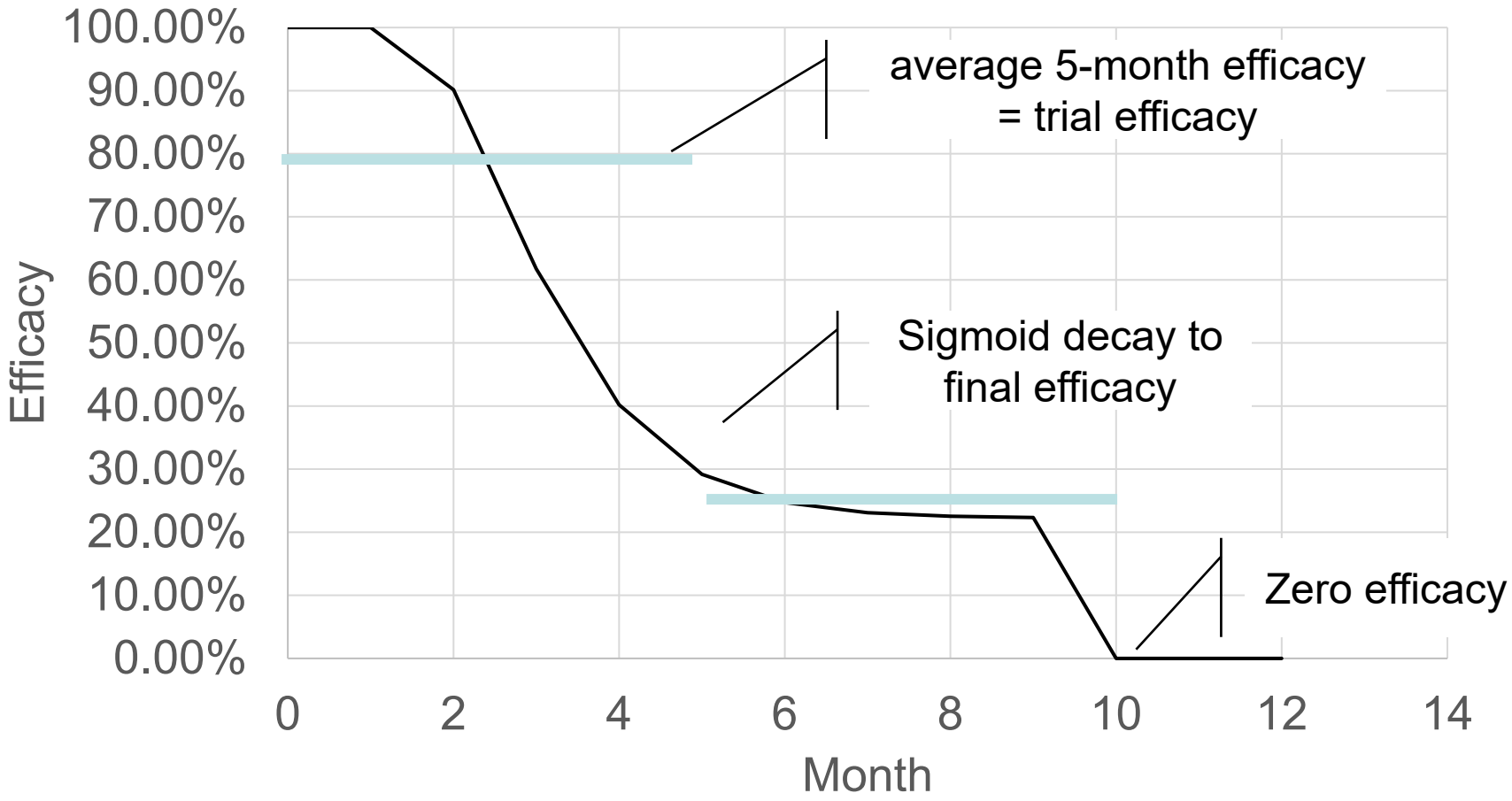
Methods: Epidemiology
Mortality

	Base Case	Range	Source
RSV mortality per hospitalization			
Age 0-5 months	0.04%	0.03-0.05%	Doucette 2016[8]
Age 6-11 months	0.04%	0.03-0.05%	
Age 12 -23 months	0.3%	0.24%-0.28%	Gupta 2016[10]

Seasonality

Source: National Respiratory and Enteric Virus Surveillance System (NREVSS) (2015-2019)

Methods: Inputs



Methods: Efficacy

Variable	Base case value	Range for sensitivity analysis	Source
Nirsevimab			
Initial efficacy (months 1-5) against RSV-associated LRTI	80.0%	68.5% - 86.1%	MELODY trial and Phase 2b recommended dose
Efficacy months 6-10	25.0%	0.0% - 50.0%	
Efficacy after 10 months	0.0%		

Methods: Provision of Nirsevimab

- Base case:
  - At birth for those born
    - October 1 – March 31
  - October for those born in
    - April (~6-month visit)
    - June (~4-month visit)
    - August (~2-month visit)
  - November for those born in
    - May (~6-month visit)
    - July (~4-month visit)
    - September (~2-month visit)

Methods: Medical Costs

Variable	Value	Range	Source
Disease-specific hospitalization costs (per hospitalization)			
Age 0-11 months	$11,487	11042 - 11933	Bowser 2022
Age 12- 23 months	$11,469	11029 - 11910	
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		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			
Nirsevimab, per dose	$300	$50-$600	Assumption

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: Additional Inputs

- Also included nirsevimab adverse events
  - Systemic reactions
  - Injection site reactions
  - Serious adverse events
  - Medical costs
  - Productivity costs
  - Quality-adjusted life-years lost

Methods: Uncertainty analyses

- One-way sensitivity

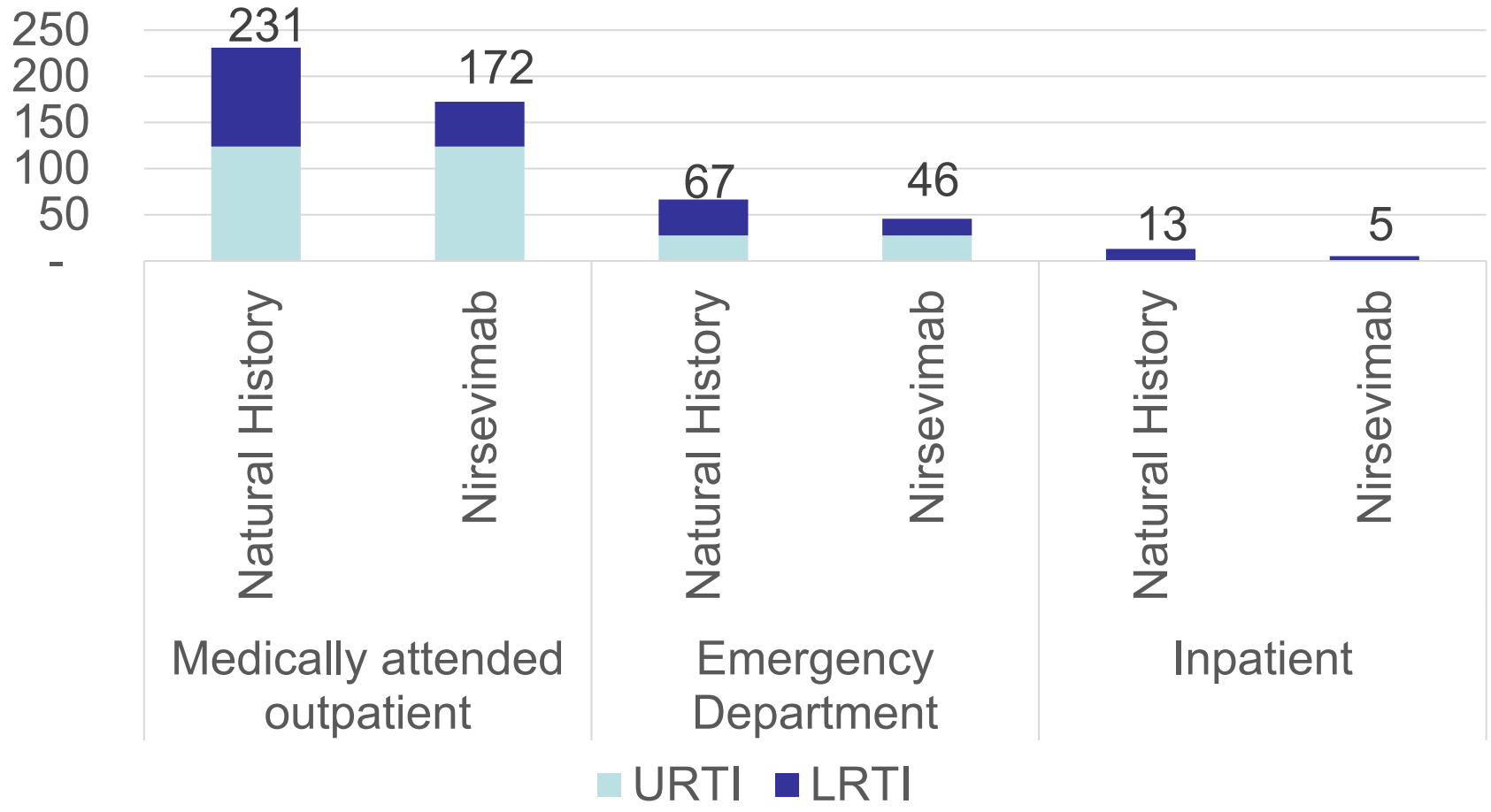
- Scenarios:
  - Upper respiratory infection effect
  - Timing of administration

- Additional Scenario:
  - High-risk children entering the second RSV season

Results: Base Case

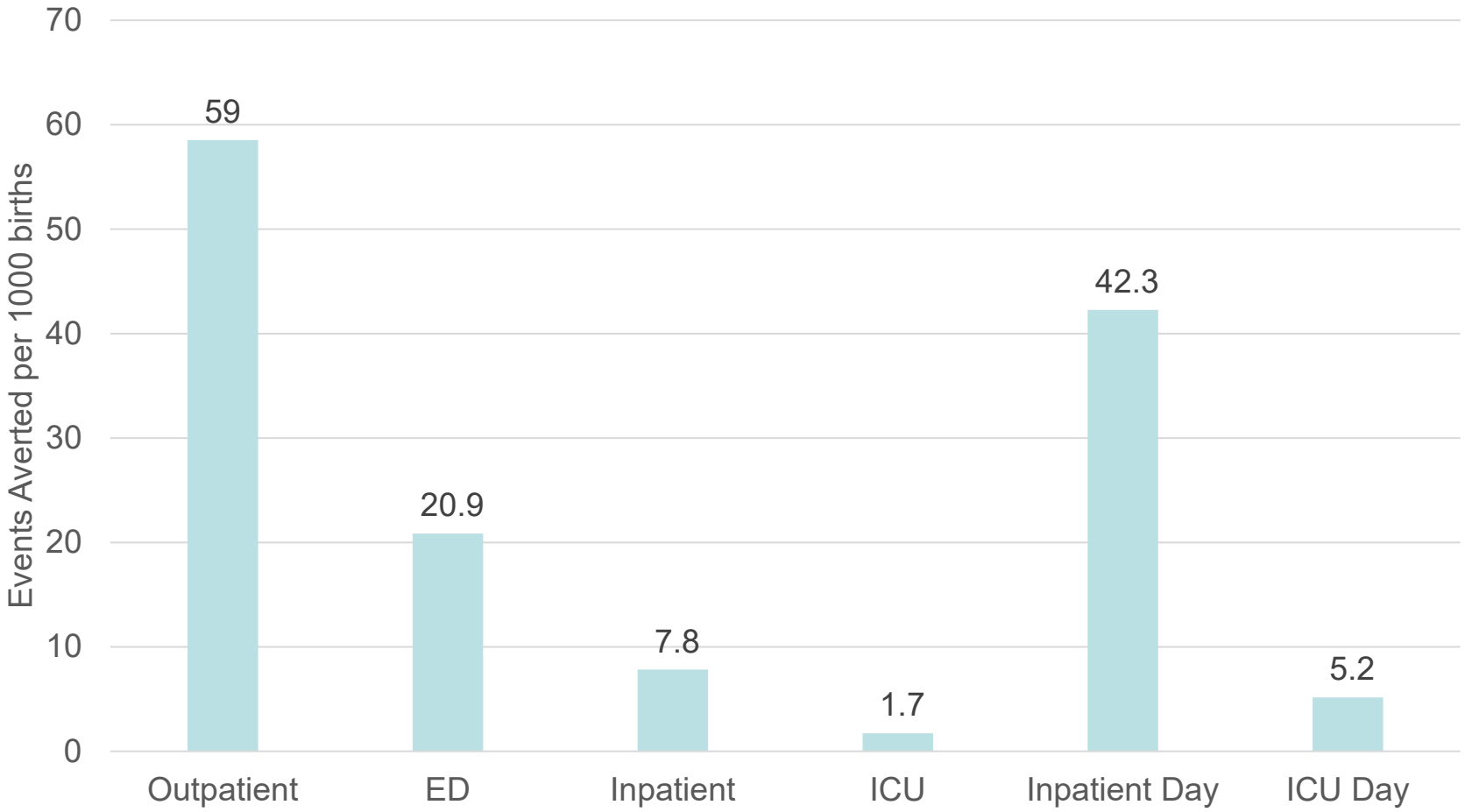
- Base Case:
  - Population of 1,000 births
  - 100% uptake in the nirsevimab group
  - First RSV season
  - $300/dose
  - Nirsevimab only impacts LRTI

Results: Health Outcomes



Cohort:1,000 nirsevimab and 1,000 natural history, assuming 100% uptake in nirsevimab group

Results: Health Outcomes



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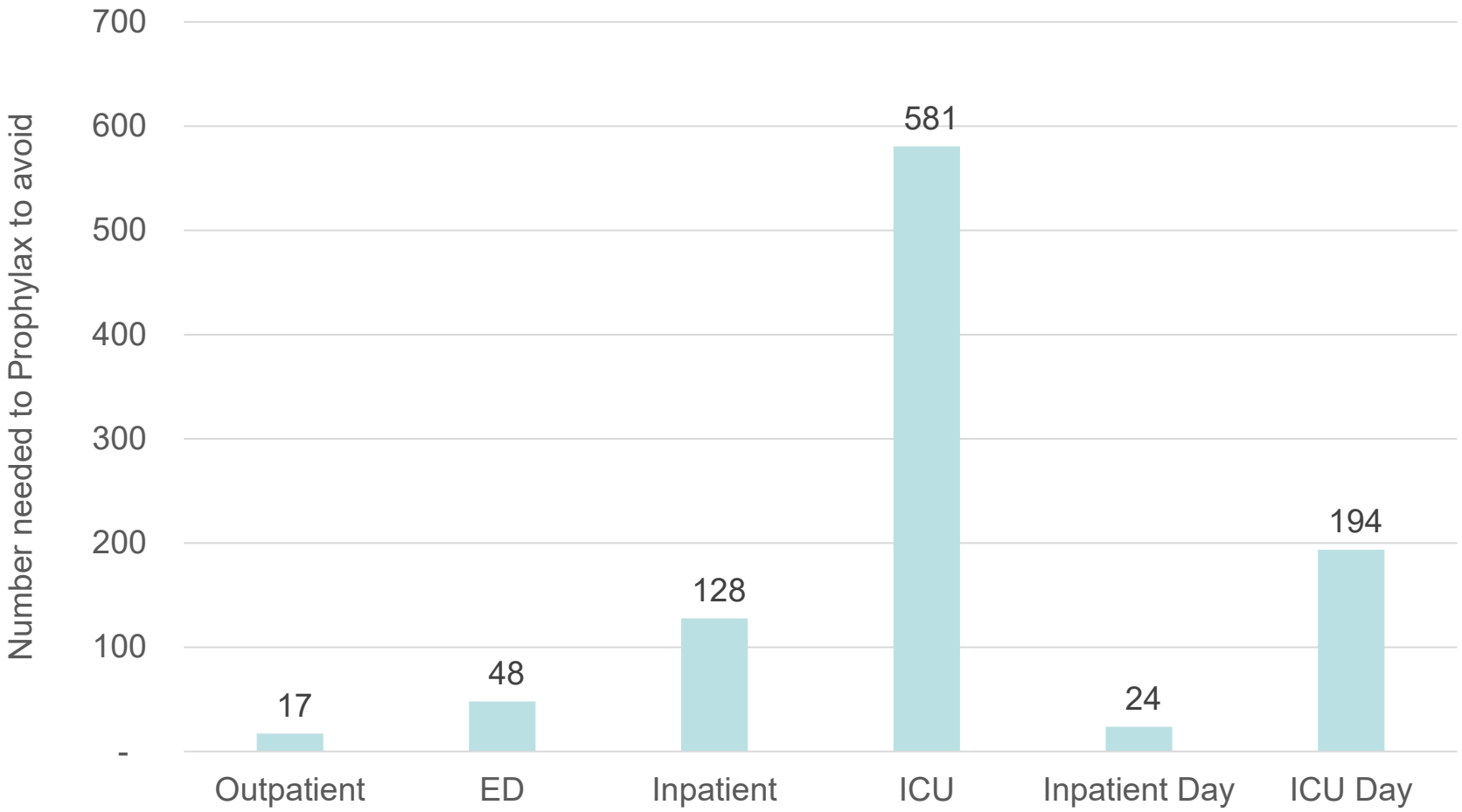
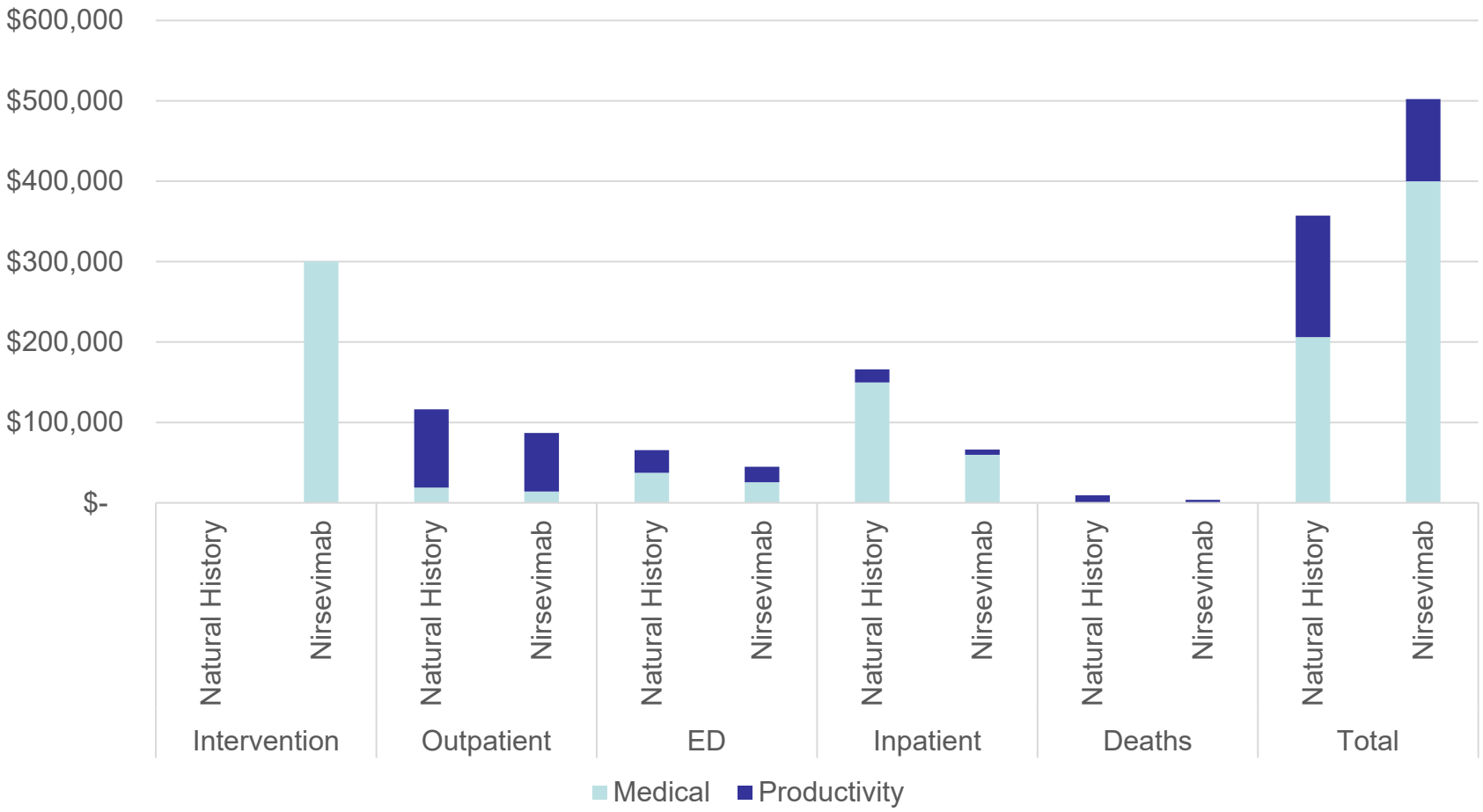


Cohort:1,000 nirsevimab and 1,000 natural history, assuming 100% uptake in nirsevimab group

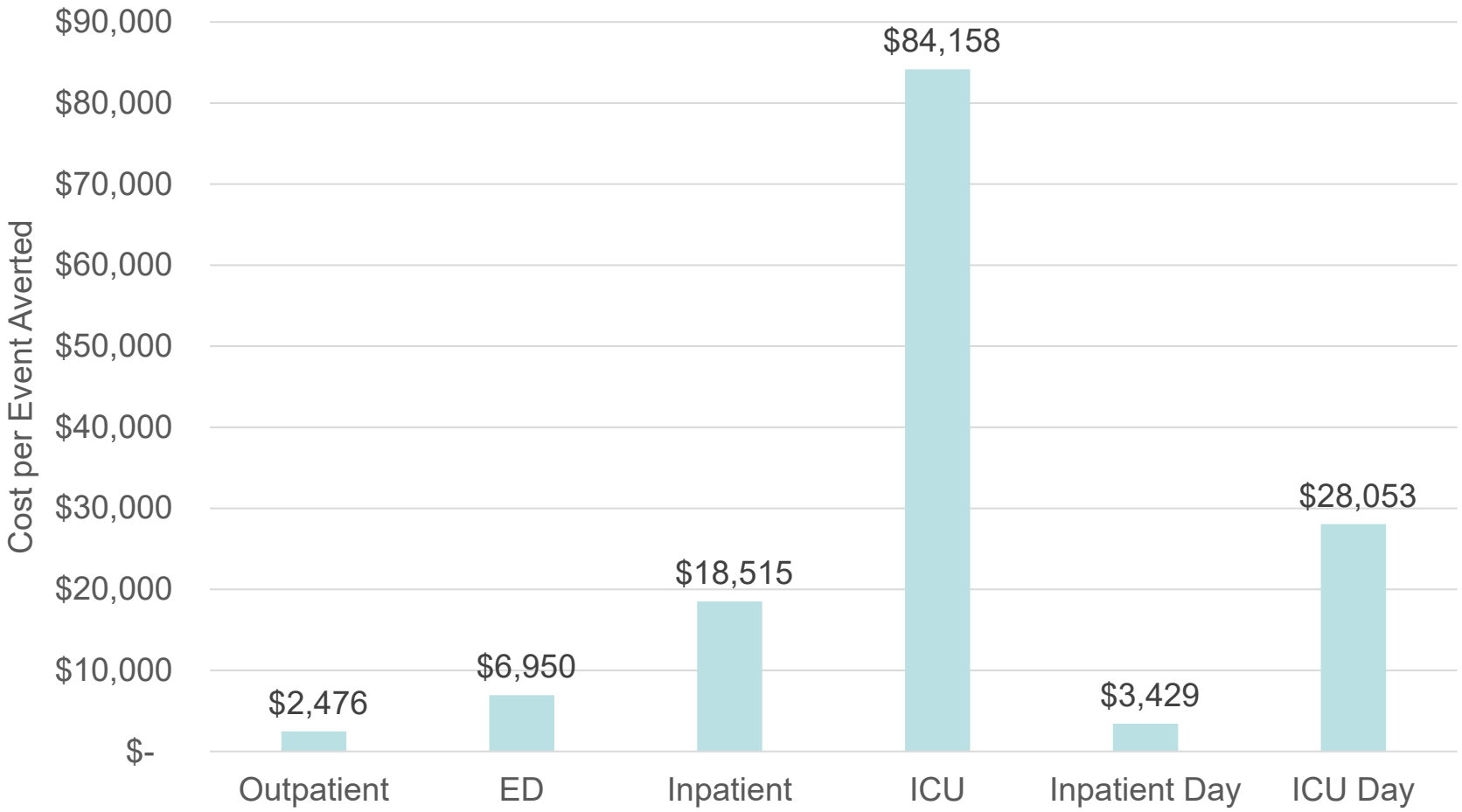
Results: Costs



Cohort:1,000 nirsevimab and 1,000 natural history, assuming 100% uptake in nirsevimab group

Base cost of $300/dose

Results: Health Outcomes



Cohort: 1,000 nirsevimab and 1,000 natural history, assuming 100% uptake in nirsevimab group

Base cost of $300/dose

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
Nirsevimab	0.03	1.46	0.73	0.62	0.31	0.09	0.03	0.06	2.25	1.07	3.32

Cohort:1,000 nirsevimab and 1,000 natural history, assuming 100% uptake in nirsevimab group

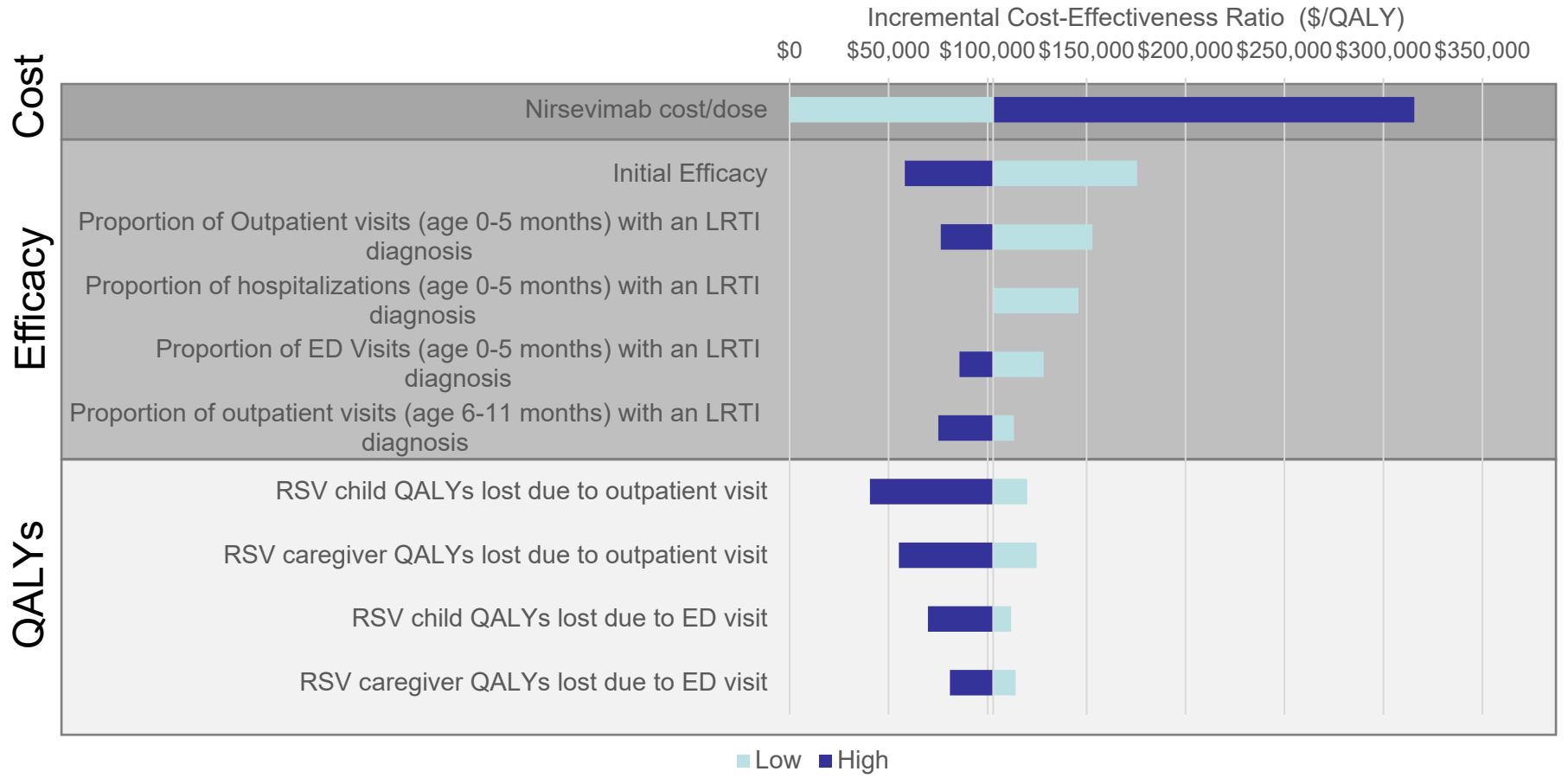
Results: Cost-Effectiveness

Overall	Costs	QALYs	ICER ($/QALY)
Natural History	$ 357,151	4.73	
Nirsevimab	$ 502,077	3.32	$ 102,805

Cohort: 1,000 nirsevimab and 1,000 natural history, assuming 100% uptake in nirsevimab group

Base cost of $300/dose

Sensitivity: Tornado



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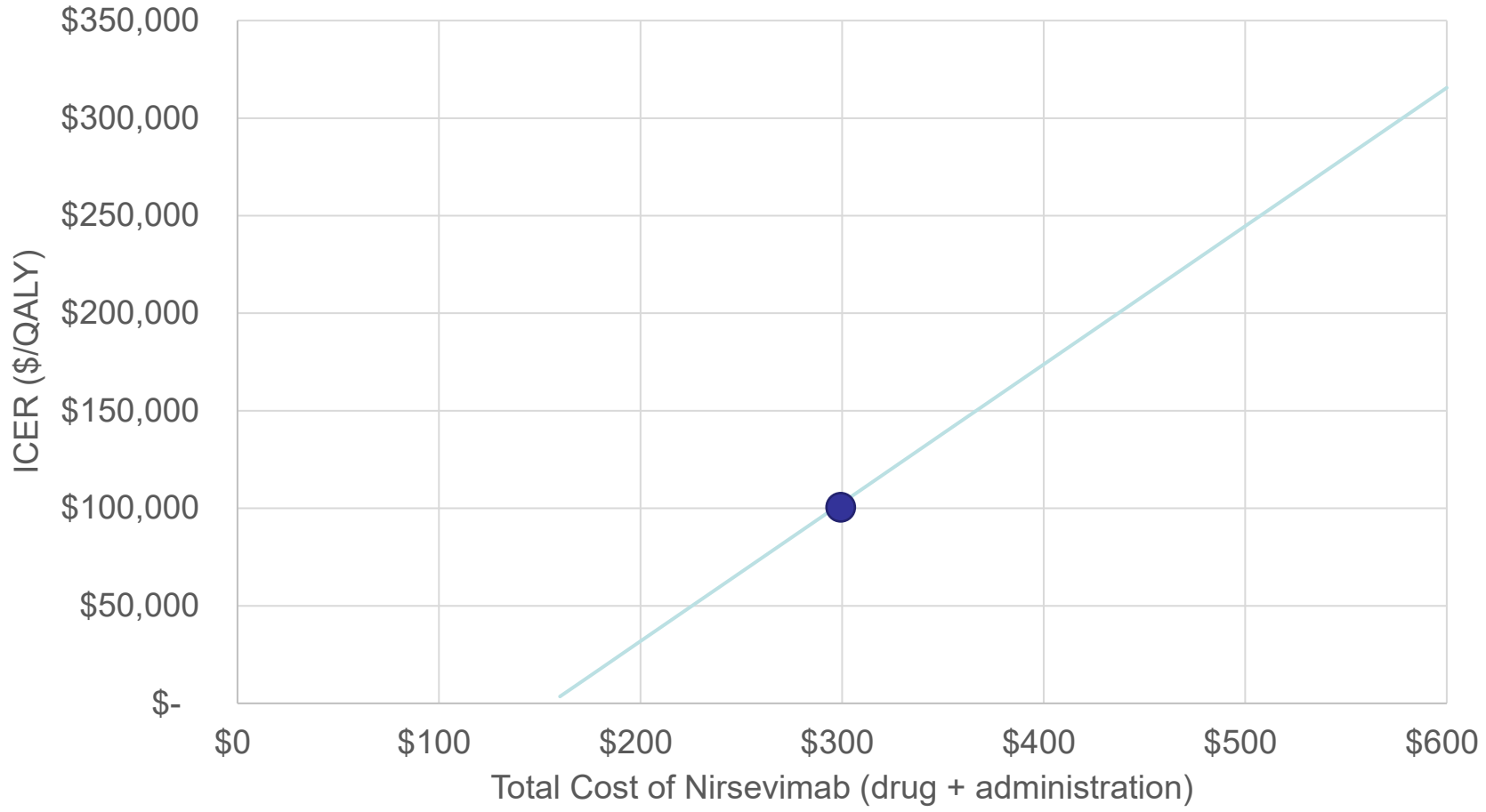
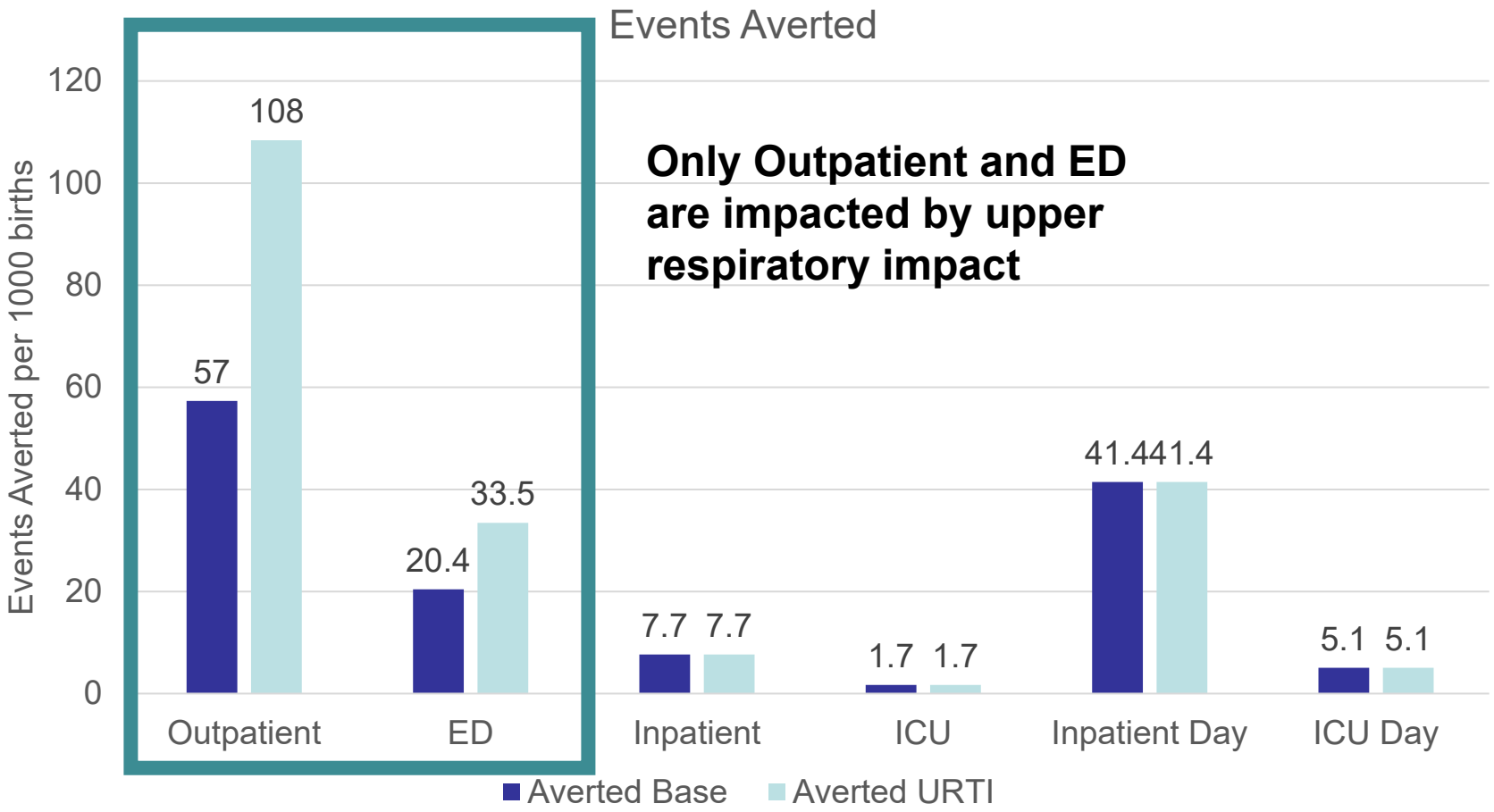
Base cost of $300/dose

Sensitivity: Cost



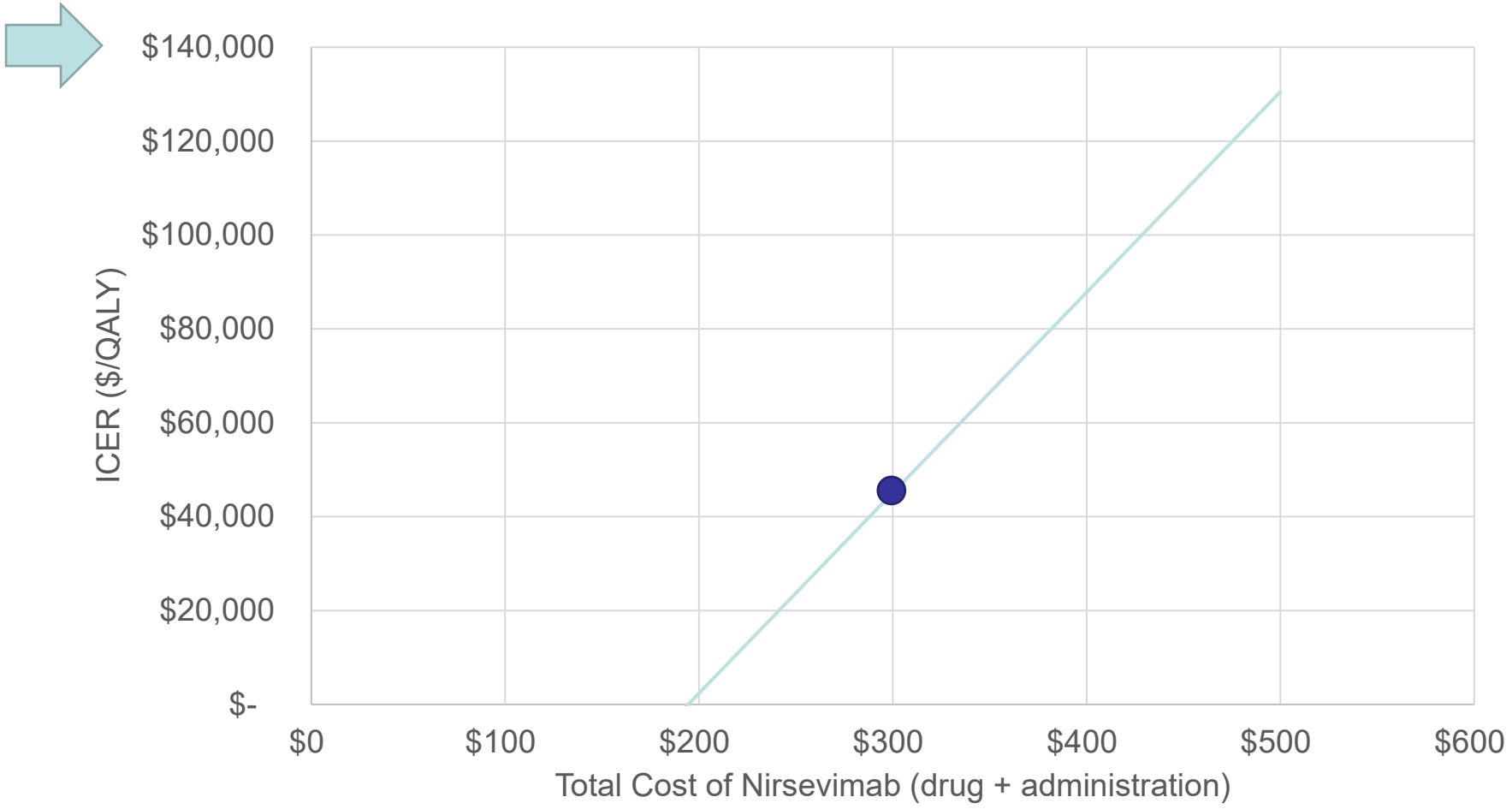
Cohort:1,000 nirsevimab and 1,000 natural history, assuming 100% uptake in nirsevimab group

Scenario: Upper Respiratory Infection Effect



Cohort:1,000 nirsevimab and 1,000 natural history, assuming 100% uptake in nirsevimab group

Scenario: Upper Respiratory Infection Effect



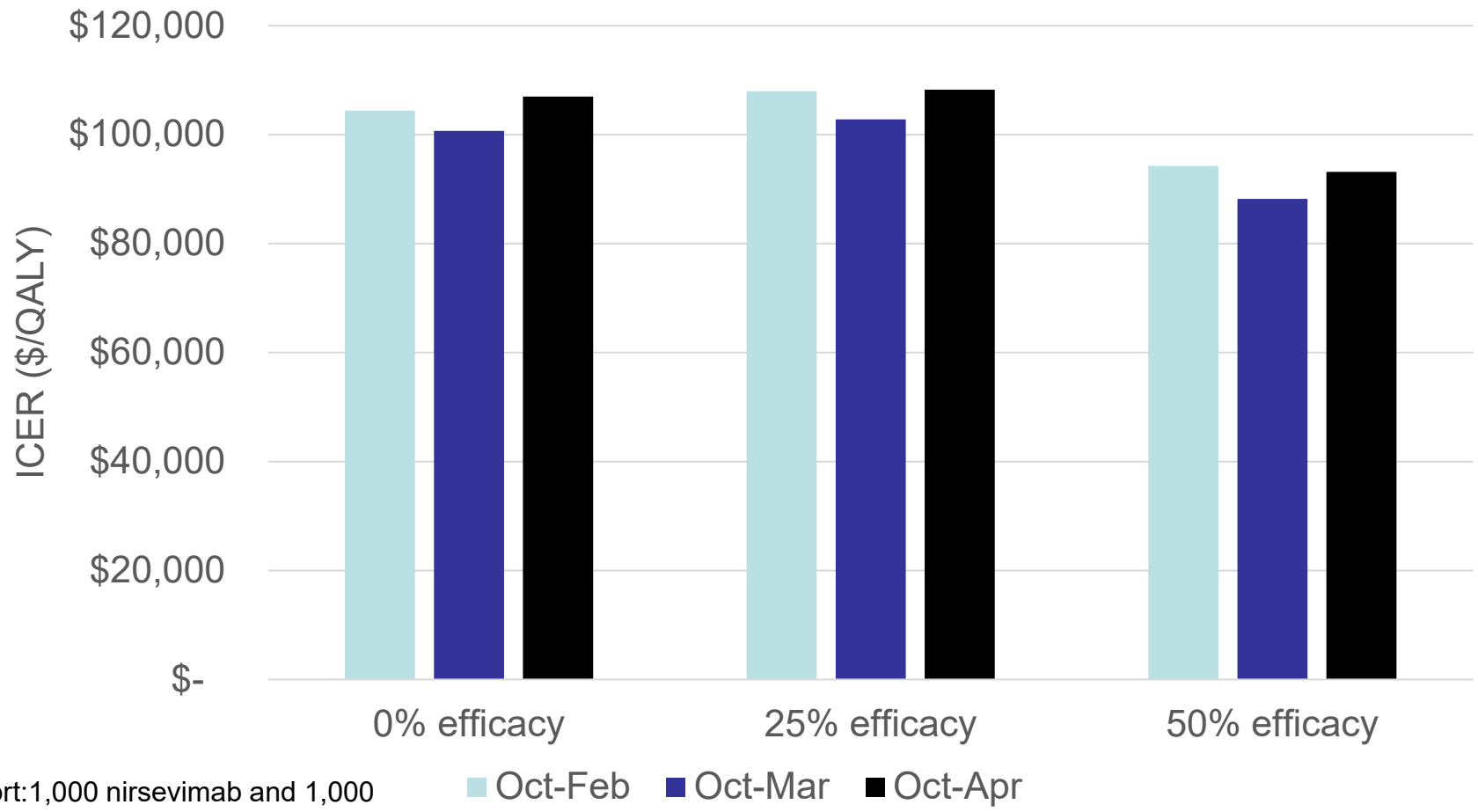
Cohort:1,000 nirsevimab and 1,000 natural history, assuming 100% uptake in nirsevimab group
Nirsevimab is assumed to be equally efficacious in preventing upper respiratory tract infections as lower respiratory tract infections.

Scenario: Timing Analysis

- Cost-effectiveness of an infant receiving nirsevimab as a newborn in
  - Oct-Feb
  - Oct-March
  - Oct-April
- With varying efficacy in months 6-10
  - 0%
  - 25%
  - 50%

Cohort:1,000 nirsevimab and 1,000 natural history, assuming 100% uptake in nirsevimab group

Scenario: Timing and Efficacy in months 6-10



Cohort:1,000 nirsevimab and 1,000 natural history, assuming 100% uptake in nirsevimab group

Base cost of $300/dose

Slightly Lower ICERs for Oct-Mar

Scenario: Reduction in Palivizumab

- Potential cost impact if clinicians choose to use nirsevimab in palivizumab-eligible infants
- Savings assumptions:
  - 1.6% are high-risk (palivizumab-eligible)
  - 75% uptake in high-risk
  - 4.1 palivizumab doses/person on average
  - $1,228/palivizumab dose

Overall	Costs	QALYs	ICER ($/QALY)
Natural History	$ 418,551	4.73	
Nirsevimab	$ 502,077	3.32	$ 59,250

Cohort: 1,000 nirsevimab and 1,000 natural history, assuming 100% uptake in nirsevimab group

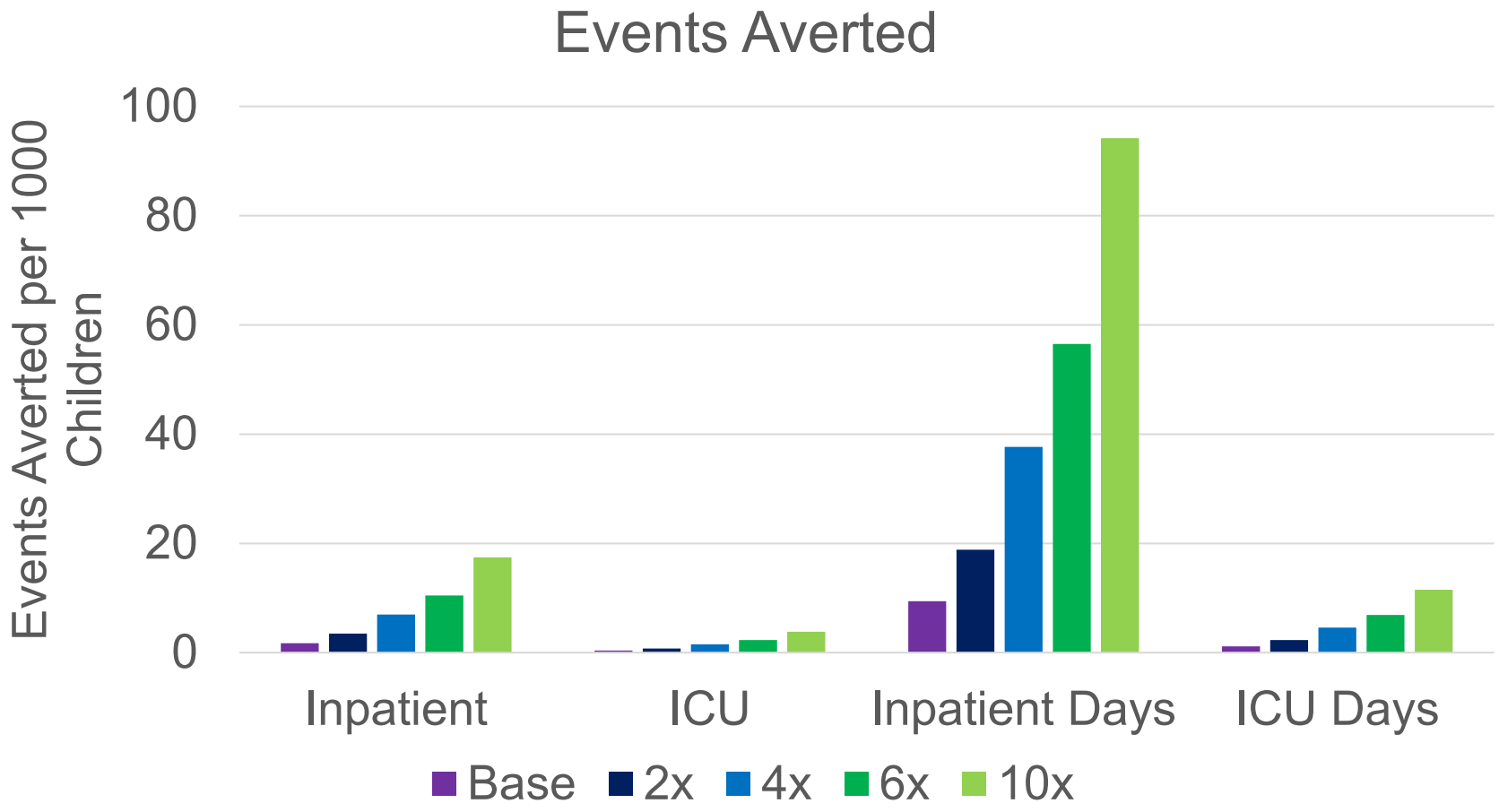
Base cost of $300/dose

Higher-risk children entering the second RSV season

- Immunization in October (under 19 months old in October)
- Incidence of RSV-associated hospitalization and mortality per hospitalization:
  - 1x, 2x, 4x 6x, 10x higher
- Cost
  - $600 nirsevimab costs (2x $300/dose)
  - $1000 nirsevimab costs (2x $500/dose)

Cohort:1,000 nirsevimab and 1,000 natural history, assuming 100% uptake in nirsevimab group

Second Season, High-Risk



Cohort:1,000 nirsevimab and 1,000 natural history, assuming 100% uptake in nirsevimab group

Second Season, High-Risk

	ICER by cost of nirsevimab (product plus administration) ($/QALY)	
Hospitalization and Mortality rate	$600	$1000
1x (base)	$ 815,051	$ 1,410,155
2x	$ 449,238	$ 800,666
4x	$ 145,014	$ 282,945
6x	$ 53,061	$ 122,409
10x	$ 404	$ 27,390

Cohort: 1,000 nirsevimab and 1,000 natural history, assuming 100% uptake in nirsevimab group

Cost is per overall course, for 2 doses

Limitations

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

Summary

- Nirsevimab may be cost-effective
- Results sensitive to:
  - Cost per dose (Cost-Saving – 316,000 $/QALY)
  - Efficacy (75,000 - 153,000 $/QALY)
    - URTI/LRTI
      - Proportion of infections with LRTI
      - Or efficacy of nirsevimab against URTI
  - QALYs lost (41,000 - 125,000 $/QALY)
    - Hospitalization, Outpatient, ED
    - Child, Parent

URTI: Upper Respiratory Tract Infection
LRTI: Lower Respiratory Tract Infection
QALY: Quality-Adjusted Life-Year

Thank You

- Please send comments to:
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