Economic Analysis of RSV Vaccination in Older Adults

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Conflicts of interest statements

– No known conflict of interests.

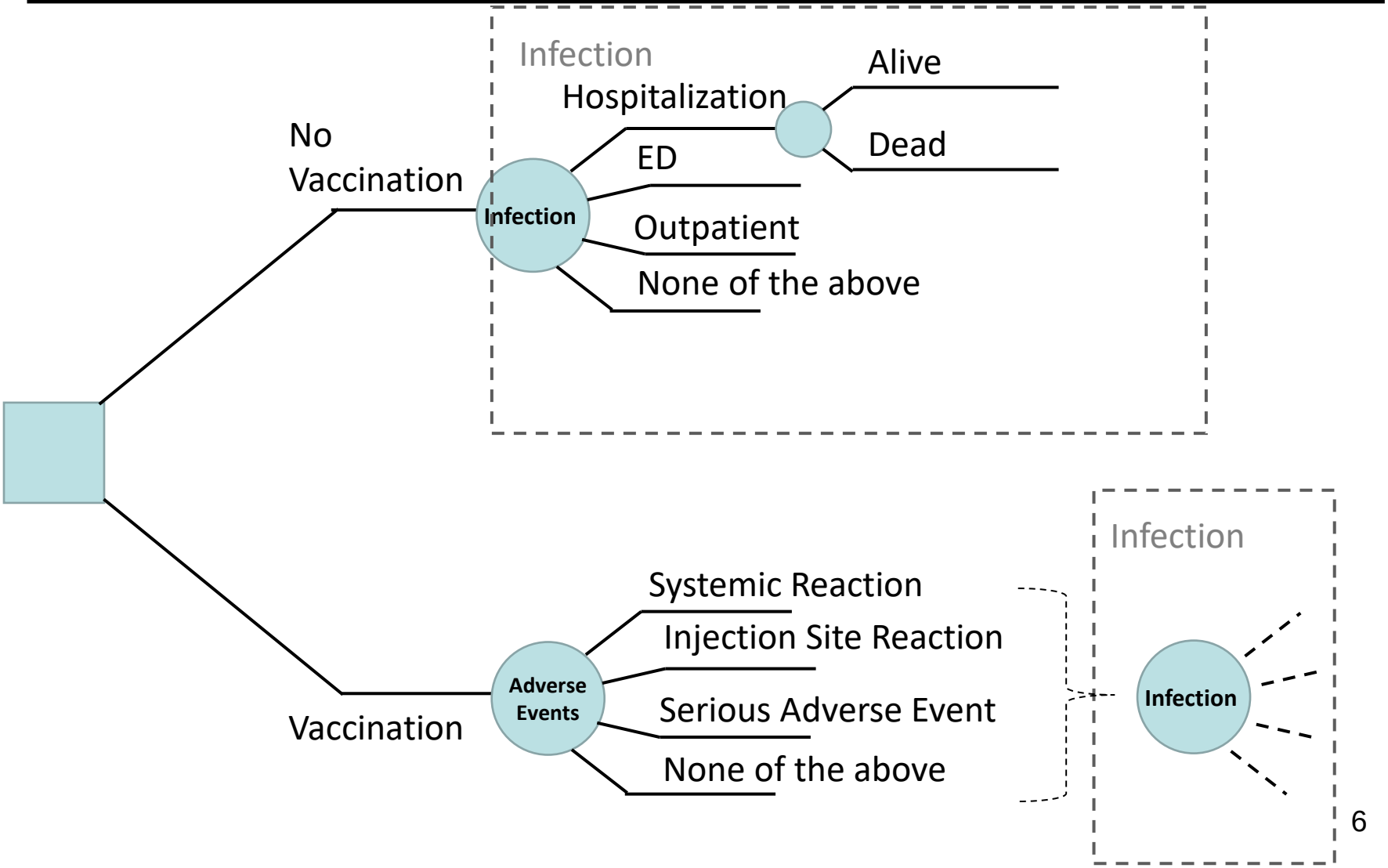
Methods: Study question

- Determine the cost-effectiveness of RSV vaccination by:
  - Evaluating the population burden of disease in the US population
  - Comparing vaccination to no vaccination using the incremental cost-effectiveness ratio
  - Scenario analyses exploring uncertainty.
- Perspective: Societal
- **Major updates:**
  - **Update to base case incidence of RSV**
  - **Incorporation of season 2 efficacy of a single vaccine dose**
  - **Alignment of vaccine price with that assumed by manufacturers**

Methods: Intervention(s)

- Target population: US adults, stratified by age
- Interventions: Pfizer and GSK vaccines
- Each compared to No Vaccination
- Base case assumes the age-based RSV vaccination recommendation is for ages ≥65
- Timeframe: 2 years
- Analytic horizon: lifetime
- Discounting rate: 3%

Methods: Decision Tree Model



Methods: Epidemiology

- Incidence of RSV
  - Raw reported incidence may be underreported because of imperfect PCR sensitivity
    - Base case assumption: 1.5x multiplier was applied to crude incidence estimates
    - Lower bound: lower multiplier assuming 95% PCR sensitivity (fewer missed cases)
    - Higher bound: upper bound from base case assumption

For incidence of inpatient (RSV-NET), outpatient, and ED visits (McLaughlin et al. 2022), this applies the McLaughlin et al. multiplier of 1.5x to the crude incidence estimates.

- McLaughlin JM, et al. Rates of Medically Attended RSV Among US Adults: A Systematic Review and Meta-analysis. Open Forum Infect Dis. 2022 Jun 17;9(7):ofac300. doi: 10.1093/ofid/ofac300. PMID: 35873302; PMCID: PMC9301578.

Other studies speak directly to under-detection of RSV infection through use of upper respiratory PCR alone:

- Onwuchekwa C, Moreo LM, Menon S, Machado B, Curcio D, Kalina W, Atwell JE, Gessner BD, Siapka M, Agarwal N, Rubbrecht M. Under-ascertainment of Respiratory Syncytial Virus infection in adults due to diagnostic testing limitations: A systematic literature review and meta-analysis. The Journal of Infectious Diseases. 2023 Jan 20.
- Ramirez J, Carrico R, Wilde A, Junkins A, Furmanek S, Chandler T, Schulz P, Hubler R, Peyrani P, Liu Q, Trivedi S. Diagnosis of Respiratory Syncytial Virus in Adults Substantially Increases When Adding Sputum, Saliva, and Serology Testing to Nasopharyngeal Swab RT–PCR. Infectious Diseases and Therapy. 2023 May 6:1-1.

Methods: Epidemiology Hospitalization

RSV incidence, per 100,000, *Hospitalization*

Variable	Value	Range	Source
age 60 to <65 years	65.5	47.2 – 101.3	CDC RSV-NET
age 65 to <70 years	93.8	65.9 – 149.1	
age 70 to <75 years	118.7	85.5 – 183.1	
age ≥75 years	302.9	212.6 – 489	

- CDC RSV-NET data from RSV seasons: 2016-17, 2017-18, 2018-19, and 2019-2020.
- Base value is based upon the average burden adjusted rate over those four seasons where "burden adjusted" means it is adjusted for 1.5x based on a reduced PCR test sensitivity *
- Range lower bound is based upon the average burden adjusted rate over those four seasons, but it uses a different "burden adjustment" multiplier of a "Standard" PCR test sensitivity of 95%**.
- Range upper bound is based on the upper 95% confidence limit for the base estimates

* Kujawski SA, Whitaker M, Ritchey MD, Reingold AL, Chai SJ, Anderson EJ, Openo KP, Monroe M, Ryan P, Bye E, Como-Sabetti K, Barney GR, Muse A, Bennett NM, Felsen CB, Thomas A, Crawford C, Talbot HK, Schaffner W, Gerber SI, Langley GE, Kim L. Rates of respiratory syncytial virus (RSV)-associated hospitalization among adults with congestive heart failure-United States, 2015-2017. PLoS One. 2022 Mar 9;17(3):e0264890. doi: 10.1371/journal.pone.0264890. PMID: 35263382; PMCID: PMC8906631.
** McLaughlin JM, et al. Rates of Medically Attended RSV Among US Adults: A Systematic Review and Meta-analysis. Open Forum Infect Dis. 2022 Jun 17;9(7):ofac300. doi: 10.1093/ofid/ofac300. PMID: 35873302; PMCID: PMC9301578.

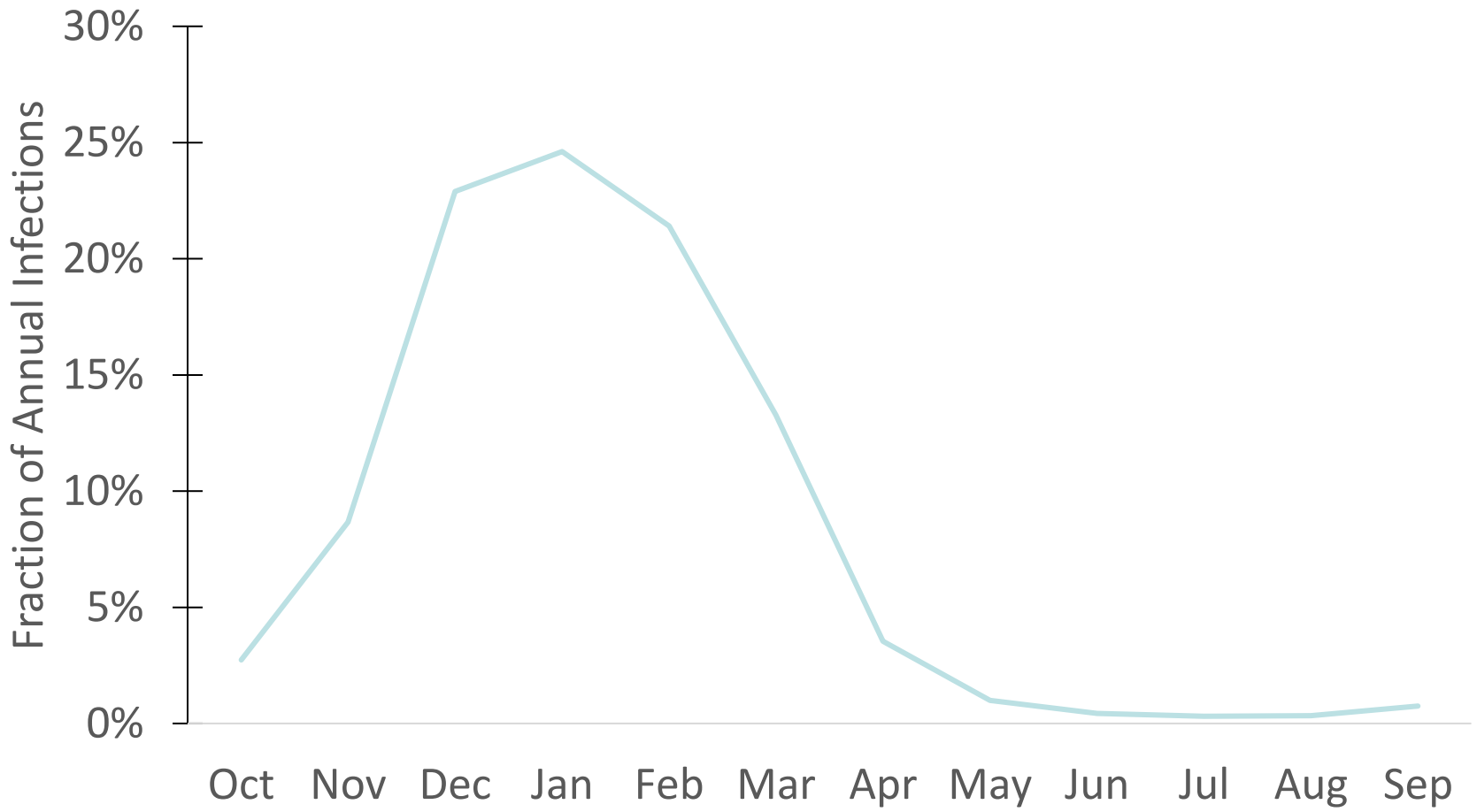
Methods: Epidemiology ED and Outpatient

Variable	Value	Range	Source
RSV incidence, per 100,000 ***Emergency Department***			
age 60 to <65 years	110.4	74 – 132	McLaughlin 2022
age 65 to <74 years	200	133 – 478	
age ≥75 years	200	133 – 478	
RSV Incidence, per 100,000 ***Outpatient***			
age 60 to <65 years	1722	1148 – 2041	McLaughlin 2022
age 65 to <74 years	2278	1519 – 2893	
age ≥75 years	2278	1519 – 2893	

- McLaughlin et. al. is a Pfizer-sponsored meta-analysis

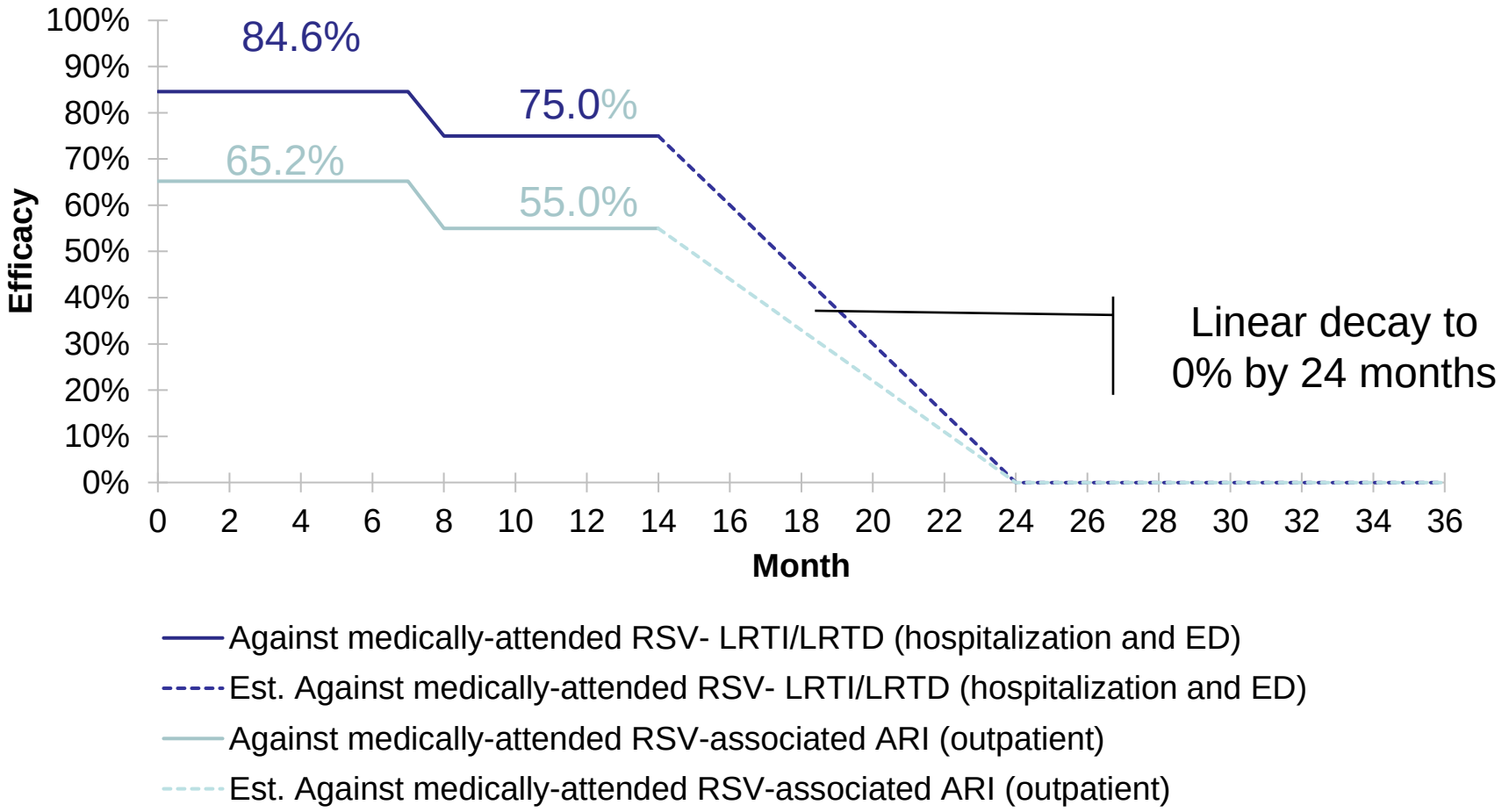
McLaughlin JM, Khan F, Begier E, Swerdlow DL, Jodar L, Falsey AR. Rates of Medically Attended RSV Among US Adults: A Systematic Review and Meta-analysis. Open forum infectious diseases 2022 Jul (Vol. 9, No. 7, p. ofac300).

Methods: Incidence Seasonality

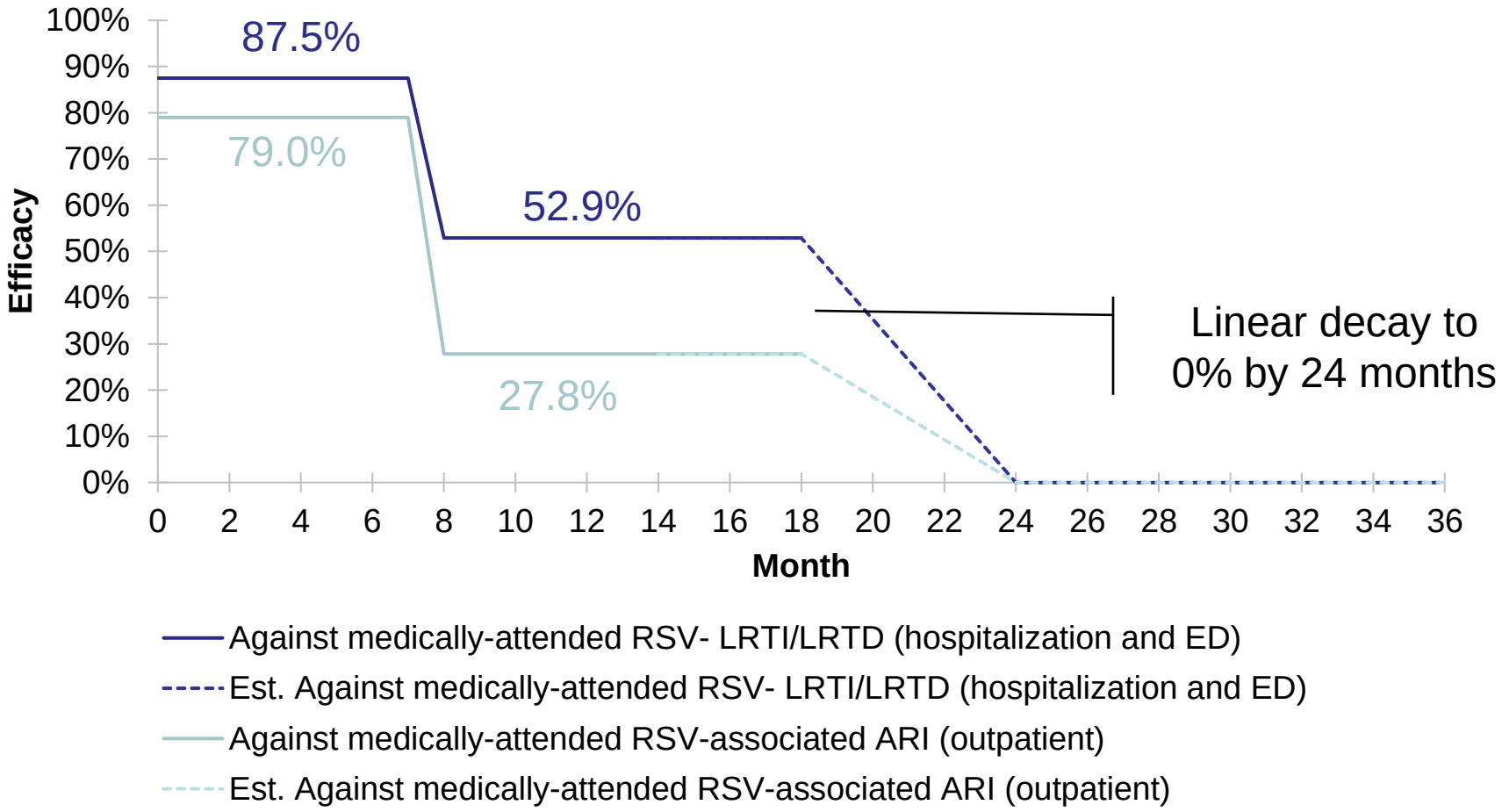


Source: NREVSS (2015-19)

Efficacy of a single vaccine dose over time: Pfizer

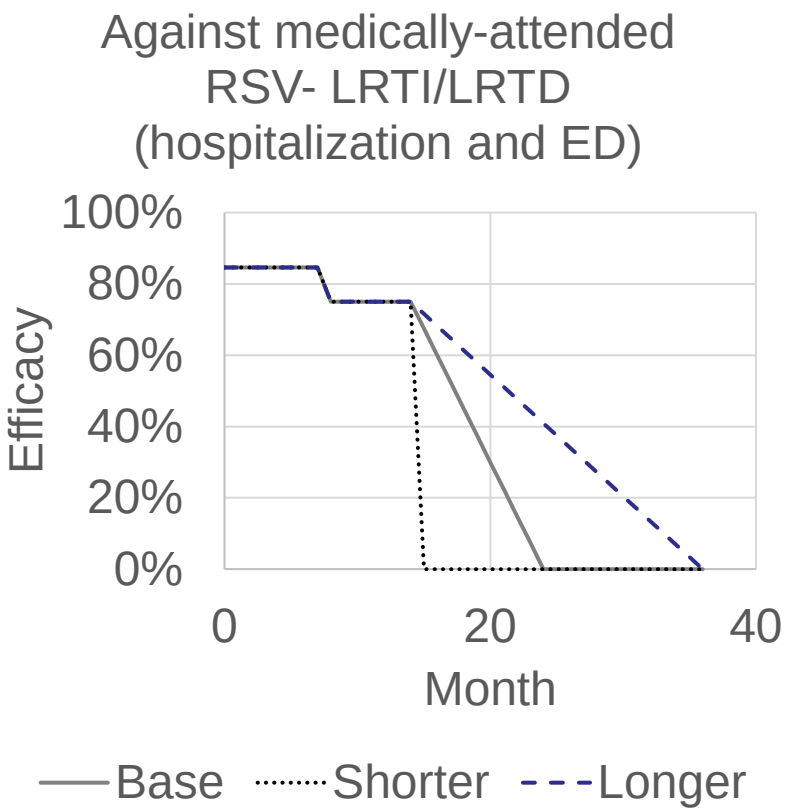


Efficacy of a single vaccine dose over time: GSK

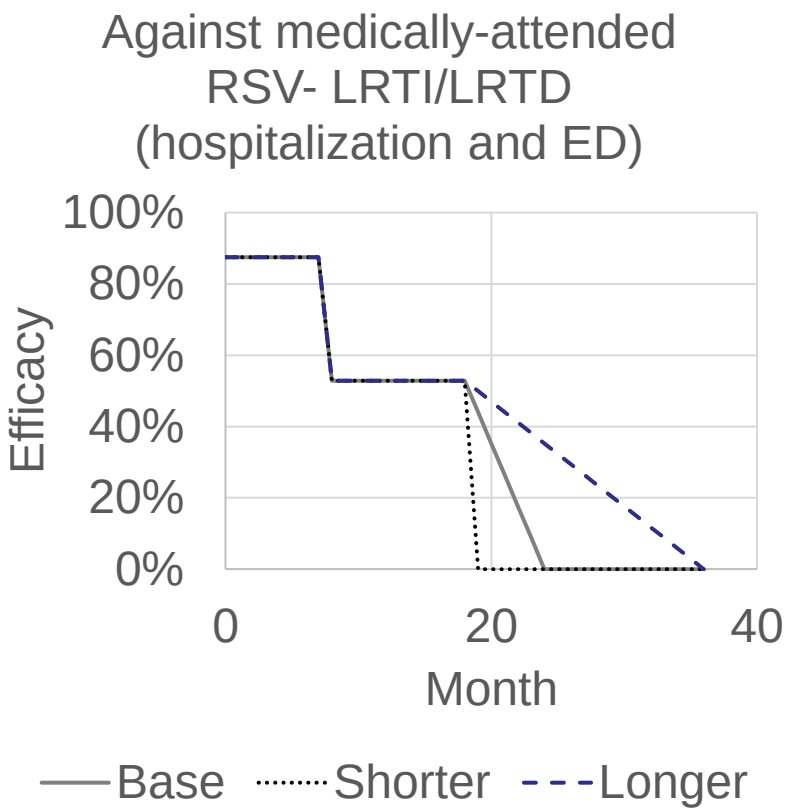


Upper and Lower Bound Efficacy Duration Scenarios

Pfizer



GSK



Methods: RSV Medical Costs

Variable	Value	Range	Source
Disease-specific hospitalization costs (per hospitalization)			
age 60 to <65 years	$21,417	9,288 – 45,454	Ackerson 2020*
age 65 to <75 years	$21,417	10,491 – 43,619	
age ≥75 years	$22,425	10,491 – 43,619	
Disease-specific ED costs (per ED visit)			
age 60 to <65 years	$1,210	-	2016 Marketscan*
age 65 to <75 years	$1,210	-	
age ≥75 years	$1,210	-	
Disease-specific outpatient costs (per outpatient visit)			
age 60 to <65 years	$117.58	65.88-145.38	MarketScan and Medicare FFS, 2020-2021
age 65 to <75 years	$100.86	50.48-120.08	
age ≥75 years	$100.86	50.48-120.08	

*Updated to Q3 2022$ using GDP Deflator

Methods: Additional Inputs

- Also included
  - RSV mortality
  - RSV QALYs lost
  - RSV illness productivity costs
  - Vaccination healthcare and productivity costs
  - Vaccination adverse events
    - Systemic reactions
    - Injection site reactions
    - Serious adverse events
    - Medical costs
    - Productivity costs
- *These assumption remain unchanged from February*

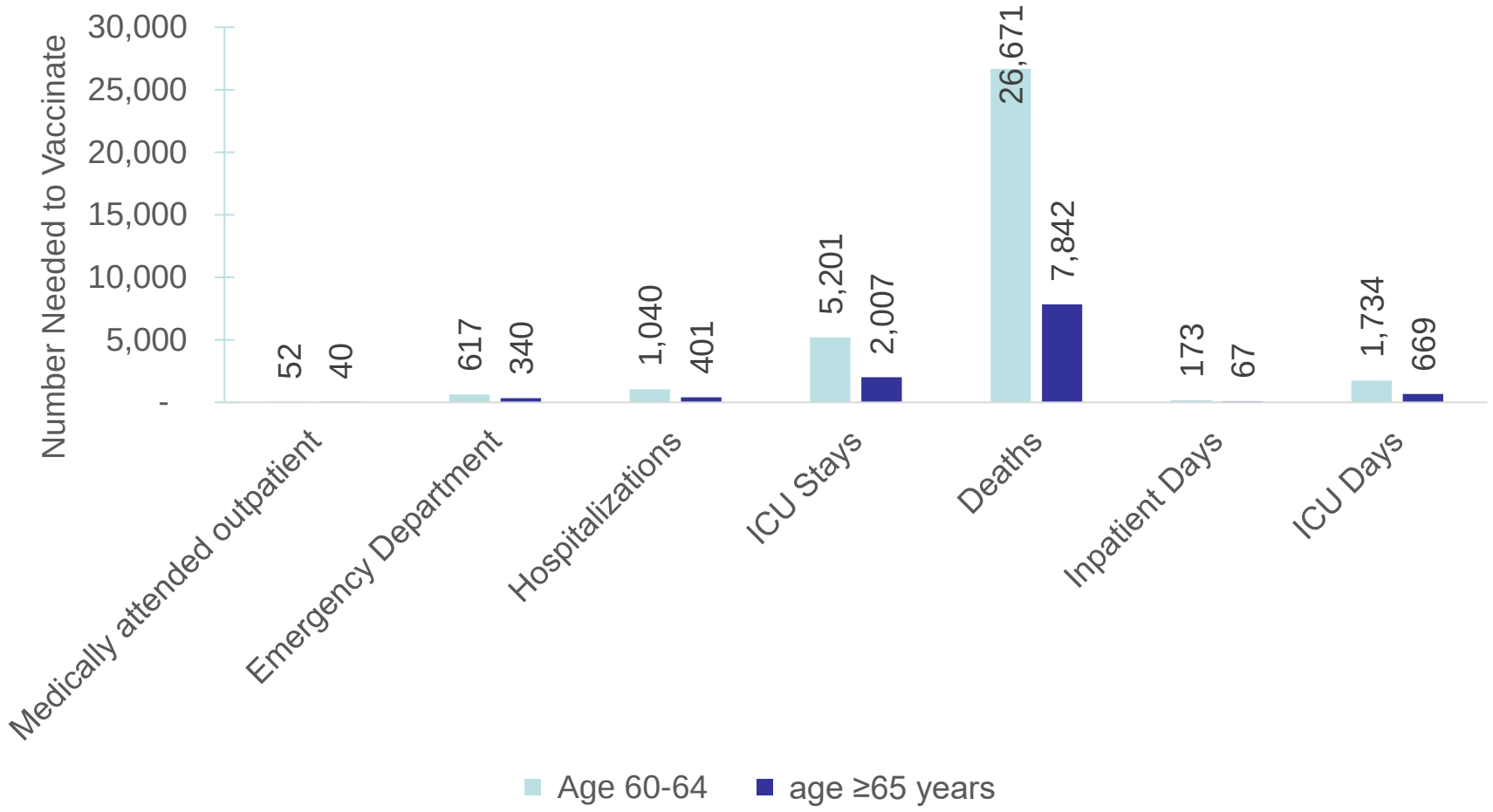
Methods: Sensitivity analyses

- Sensitivity analyses conducted
  - One-Way and Two-Way
  - Age-based recommendation for RSV vaccination
    - age ≥65 years
    - age 60 to <65 years
  - Vaccine cost
    - $180-$340
- Scenario analysis: shorter and longer duration of efficacy

Results: Base Case

- Cohort of US adult population age 65+ as of 2020 Census
- **Vaccine Cost:**
  - **Pfizer: $200**
  - **GSK: $270**
- **Two Year Timeframe**

Number Needed to Vaccinate, Pfizer



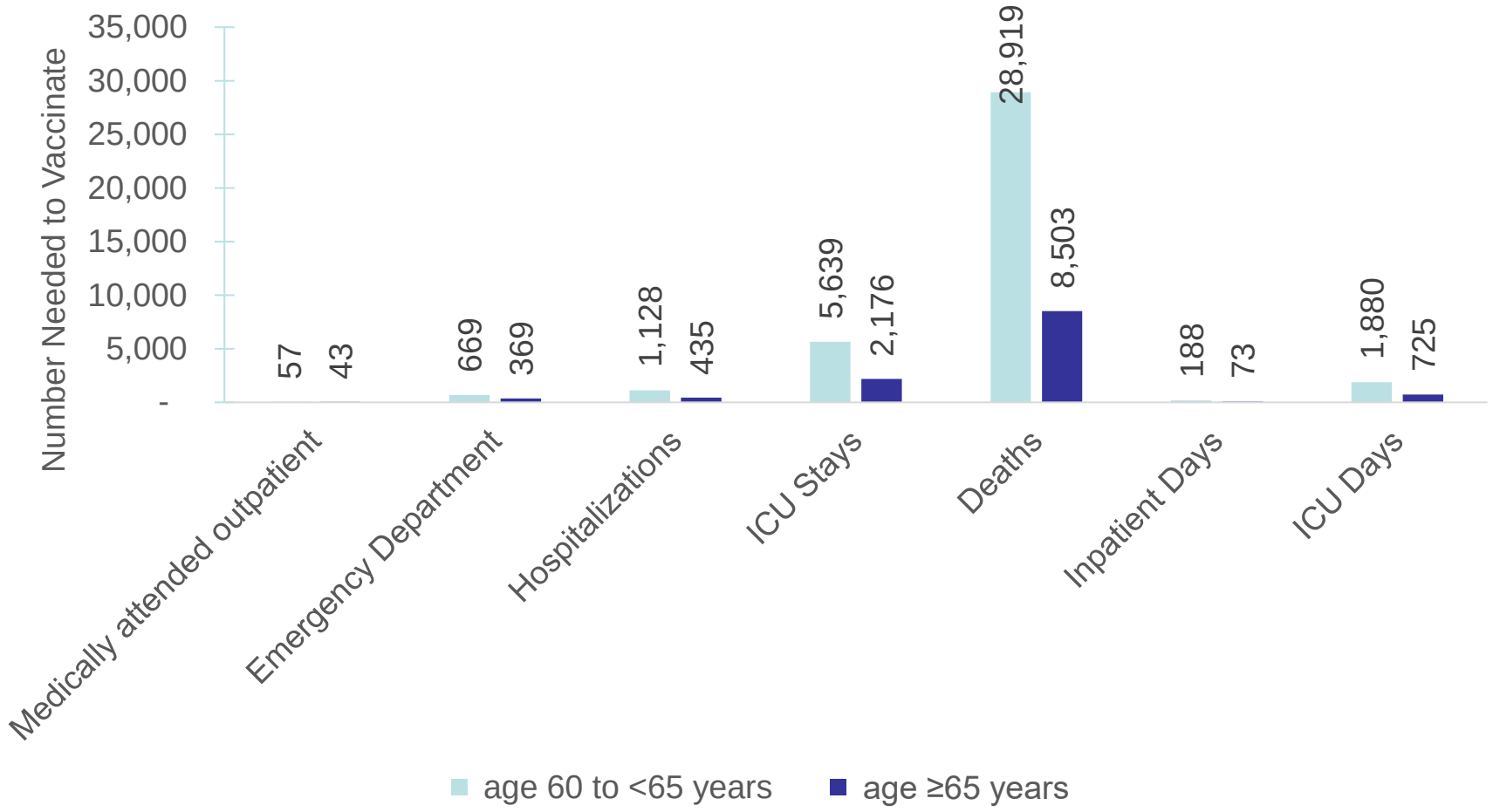
Two Year Timeframe

Net Cost per Outcome Averted, Pfizer

	Outpatient	ED	Hospitalizations	ICU Stays	Deaths
≥65 years	$5,600	$48,000	$57,000	$280,000	$1,100,000
60 to <65	$9,400	$110,000	$190,000	$930,000	$4,800,000

Two Year Timeframe
Age-based vaccination recommendation: ≥65 years
Pfizer vaccine cost: $200

Number Needed to Vaccinate, GSK



Two Year Timeframe

Net Cost per Outcome Averted, GSK

	Outpatient	ED	Hospitalizations	ICU Stays	Deaths
≥65 years	$9,300	$80,000	$94,000	$470,000	$1,800,000
60 to <65	$14,000	$170,000	$290,000	$1,400,000	$7,300,000

Two Year Timeframe
Age-based vaccination recommendation: ≥65 years
GSK vaccine cost: $270

Summary measure(s)
Pfizer

Age-based vaccination recommendation: ≥65 years	ICER ($/QALY)	ICER ($/LY)
	94,673	112,806

Age-based vaccination recommendation: 60 to <65 years	ICER ($/QALY)	ICER ($/LY)
	218,350	313,379

QALY = Quality-Adjusted Life-Year
ICER = Incremental Cost-Effectiveness Ratio
LY = Life-Year
ICER values do not depend on cohort size or uptake
$200 vaccine cost
Two Year Timeframe

Summary measure(s)
GSK

Age-based vaccination recommendation: ≥65 years	ICER ($/QALY)	ICER ($/LY)
	167,301	187,853

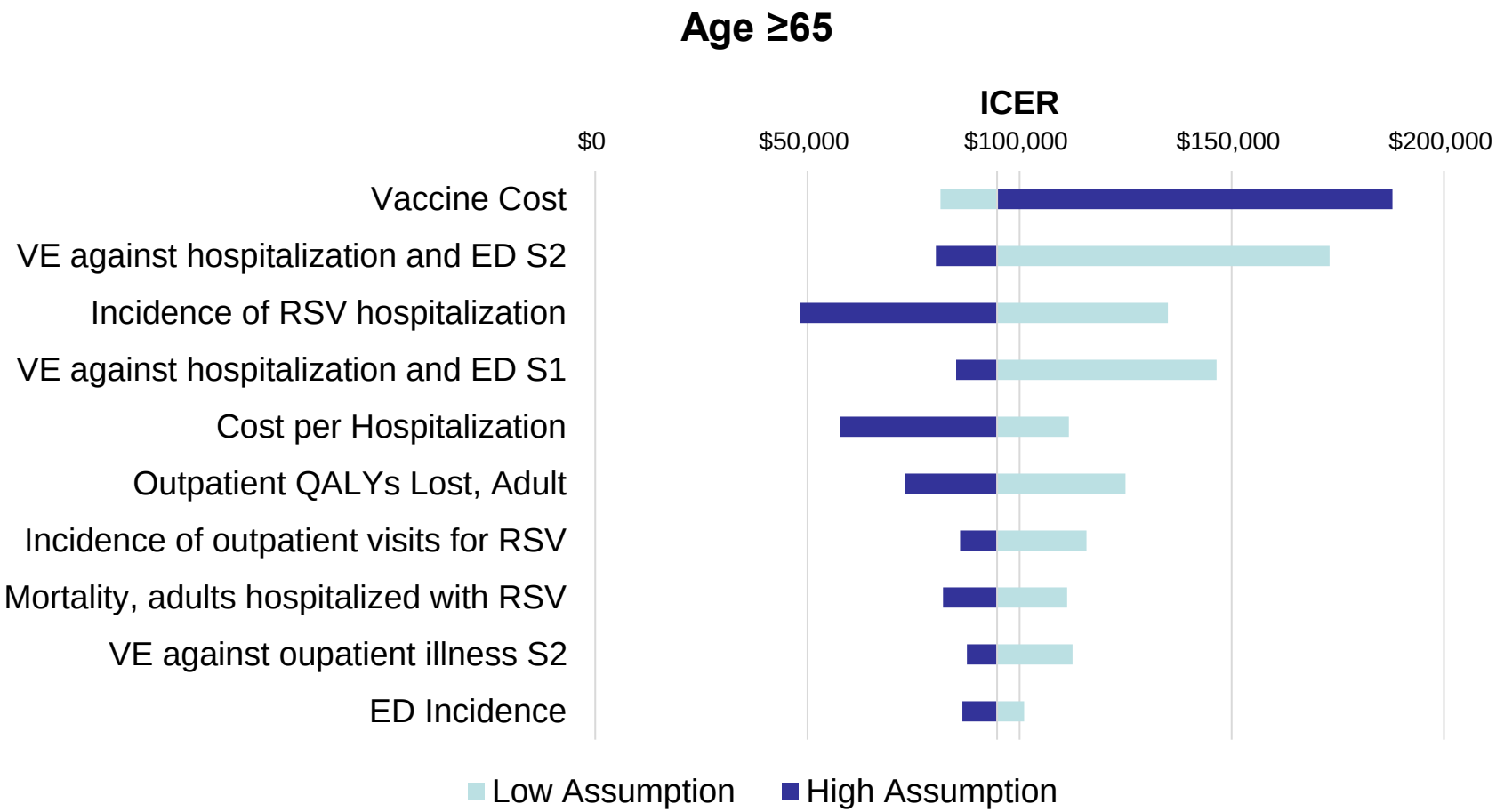
Age-based vaccination recommendation: 60 to <65 years	ICER ($/QALY)	ICER ($/LY)
	372,656	478,947

QALY = Quality-Adjusted Life-Year
ICER = Incremental Cost-Effectiveness Ratio
LY = Life-Year
ICER values do not depend on cohort size or uptake
$270 vaccine cost
Two Year Timeframe

Results: Sensitivity analyses,

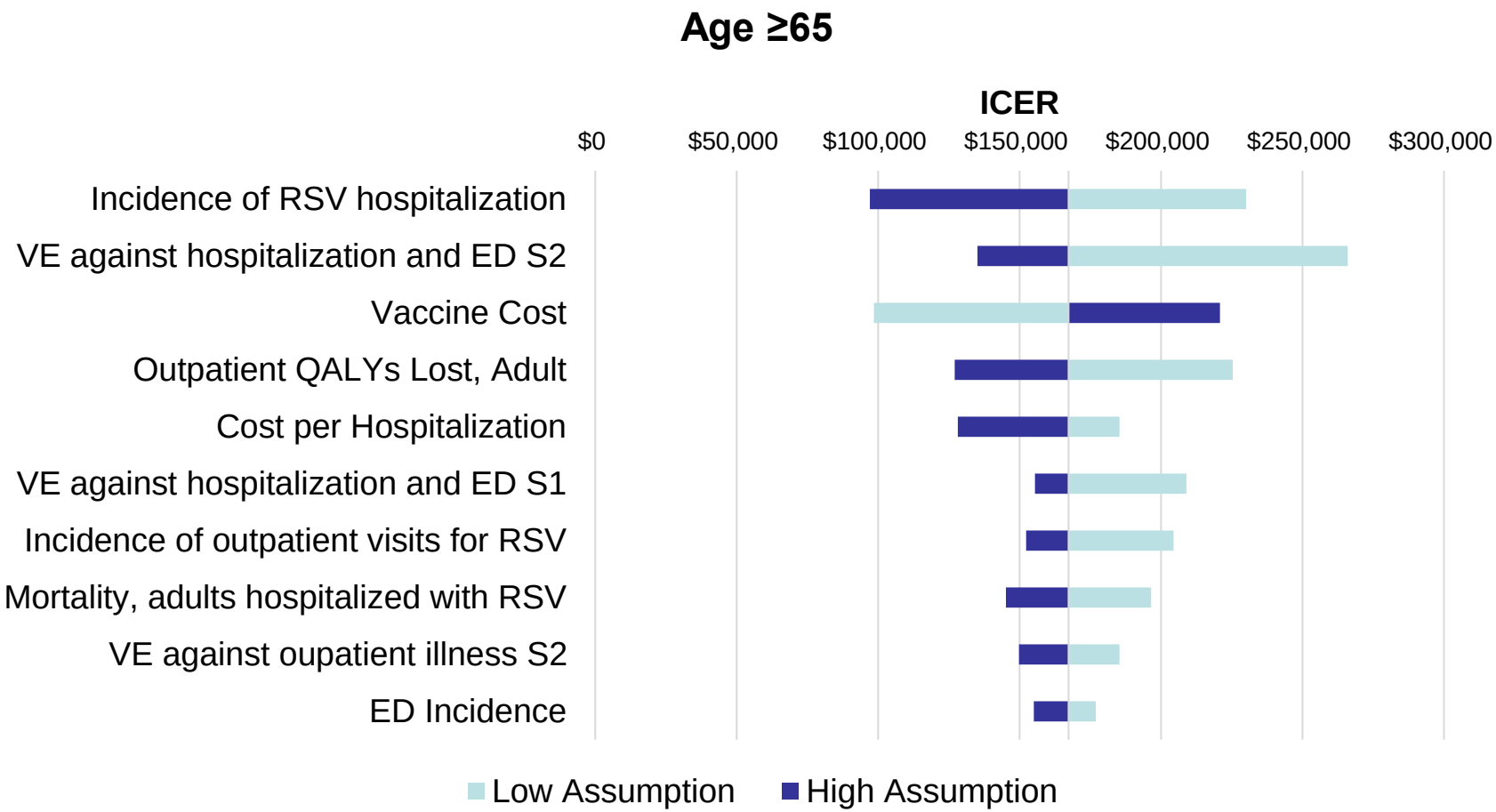
- Tornado Diagrams
  - one parameter varied at a time
- Age and Vaccine Cost
- Vaccine Duration

Sensitivity analyses, Pfizer Tornado Diagram



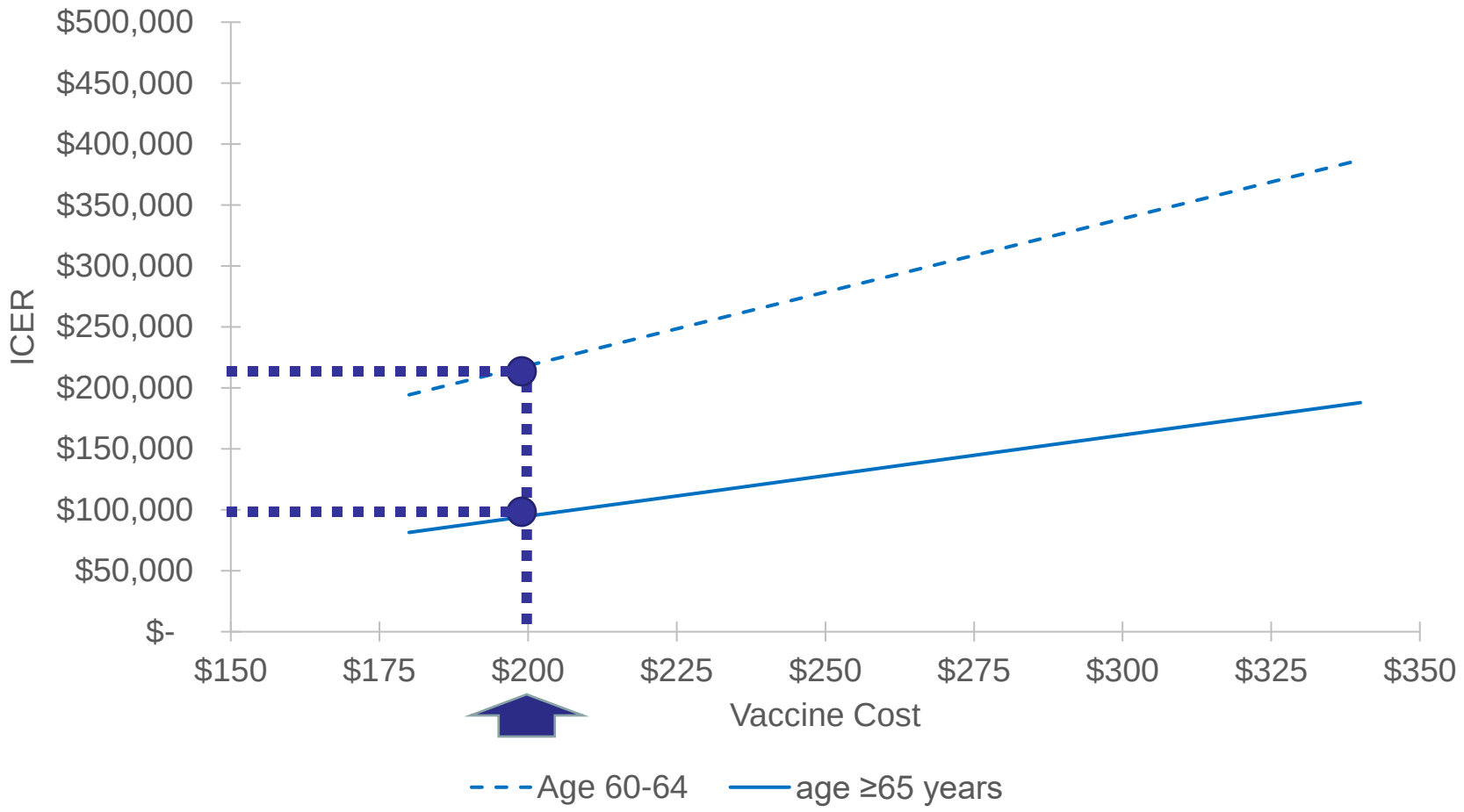
$200 vaccine cost
Two Year Timeframe
Age-based vaccination recommendation: ≥65 years, VE=Vaccine Efficacy LRTD= Lower Respiratory Tract Disease, S1=Season 1, S2=Season 2.

Sensitivity analyses, GSK Tornado Diagram



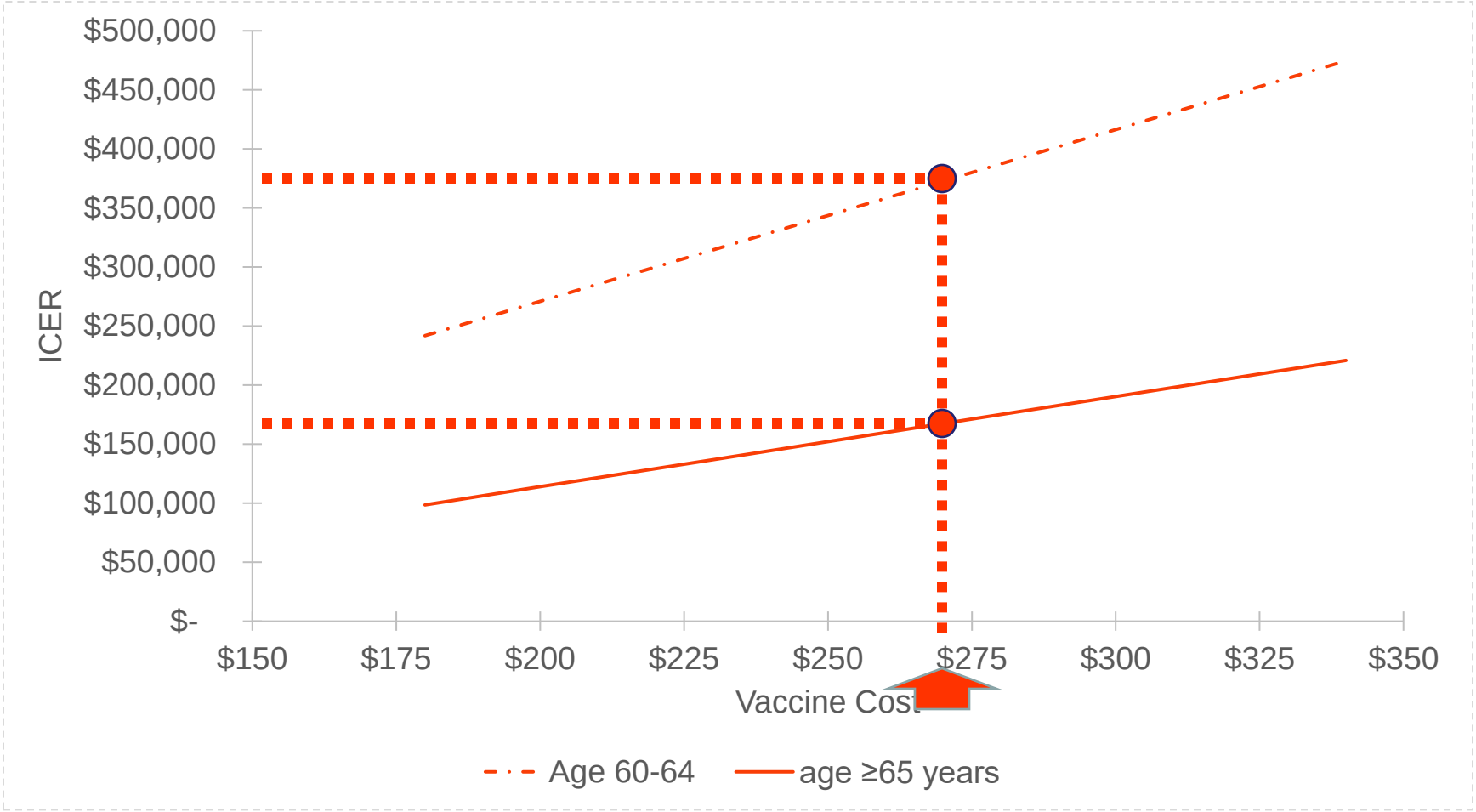
$270 vaccine cost
Two Year Timeframe
Age-based vaccination recommendation: ≥65 years, VE= Vaccine Efficacy, LRTD= Lower Respiratory Tract Disease, S1=Season 1, S2=Season 2.

Sensitivity analysis: Vaccine Cost, Pfizer



Two Year Timeframe

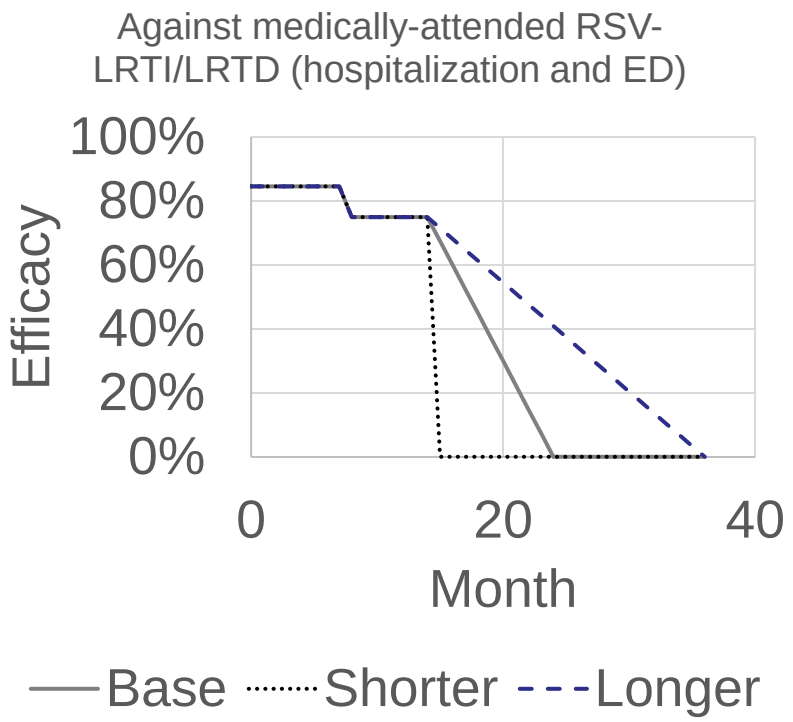
Sensitivity analysis: Vaccine Cost, GSK



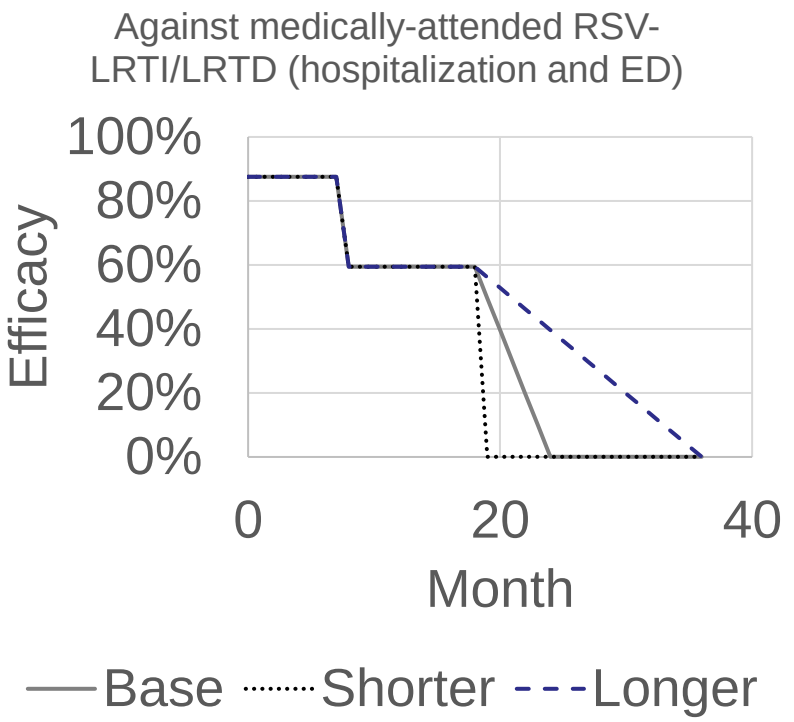
Two Year Timeframe

Vaccine Efficacy Duration Scenarios

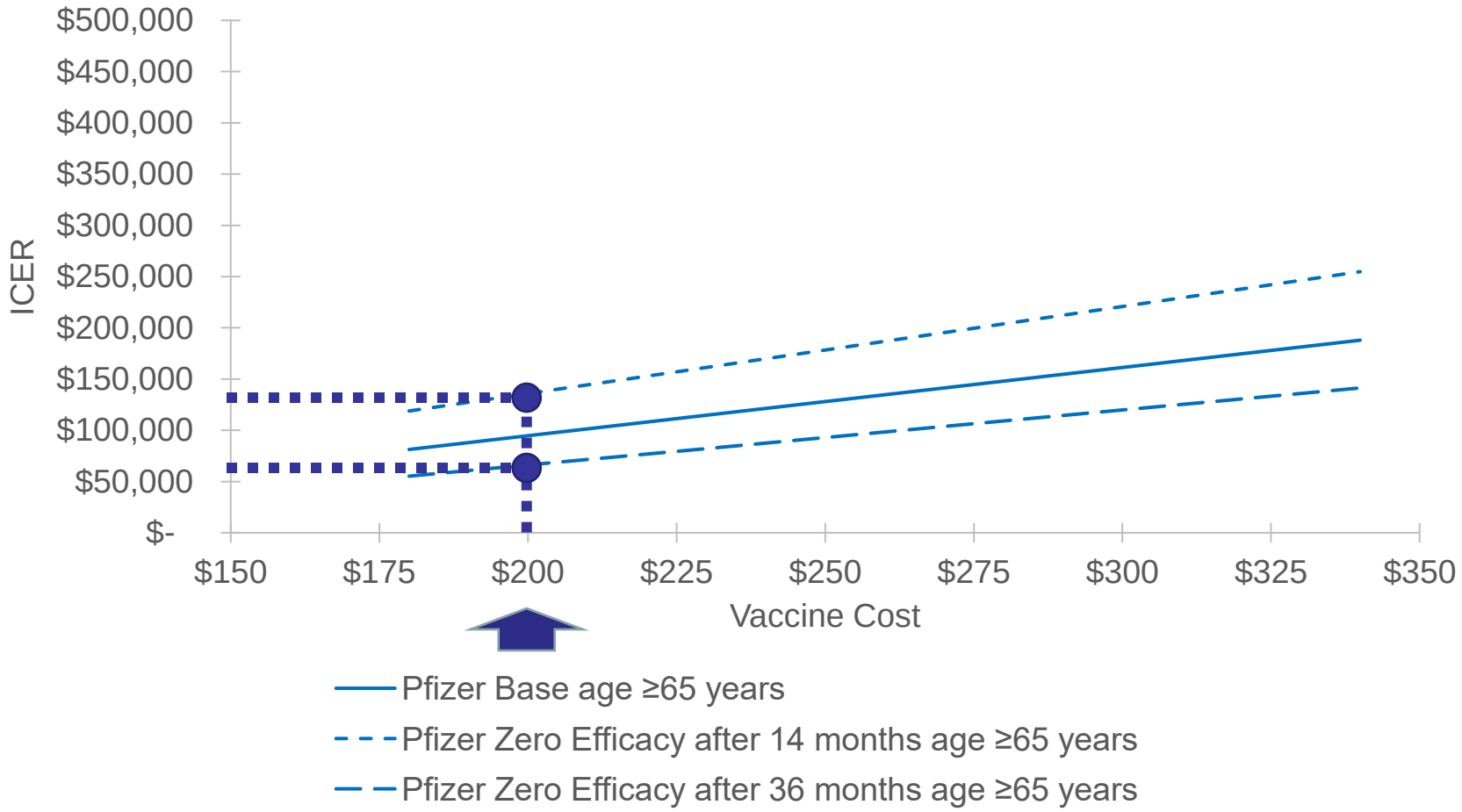
Pfizer



GSK

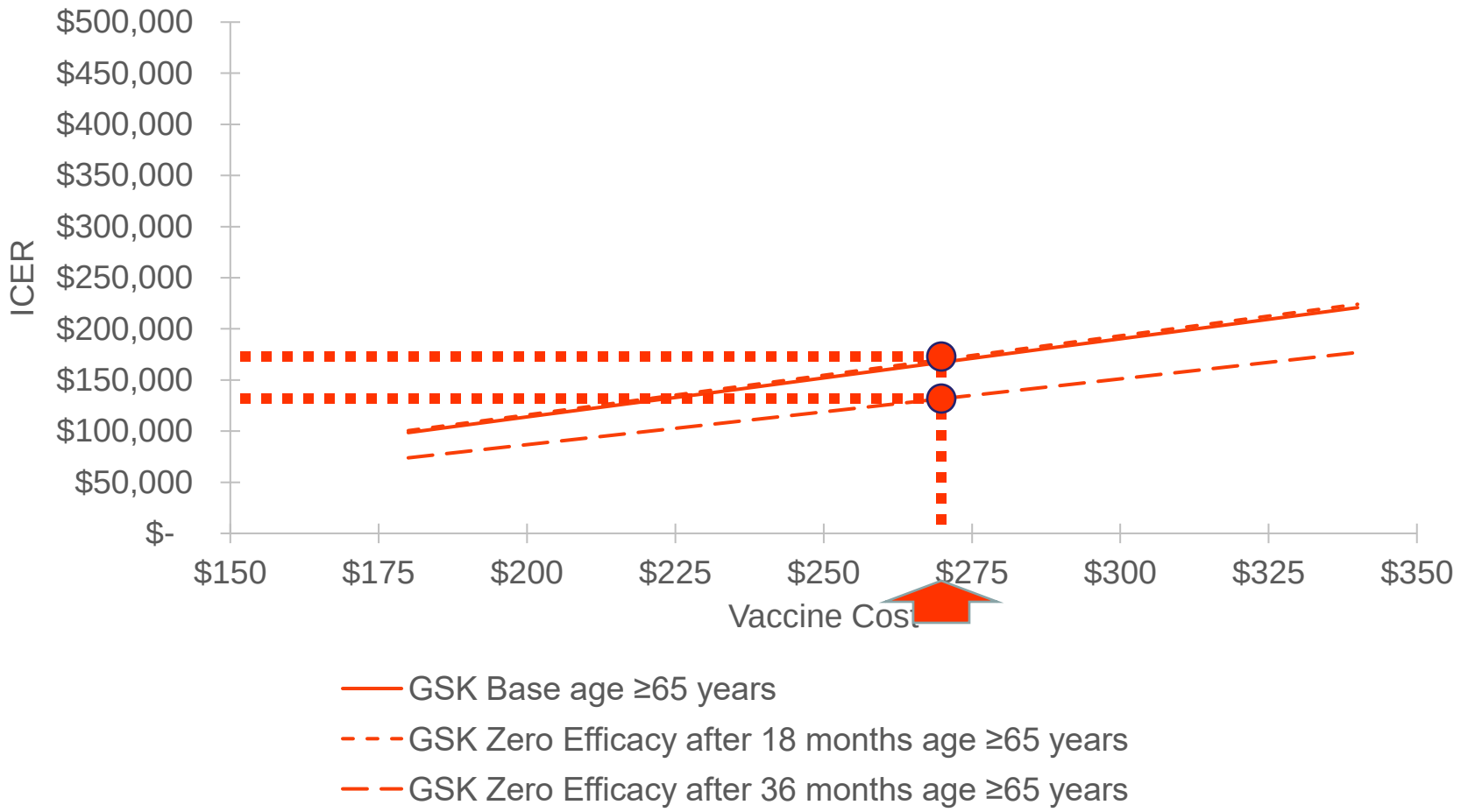


Sensitivity analyses, Pfizer: Varying Duration of Efficacy



Age-based vaccination recommendation: ≥65 years

Sensitivity analyses, GSK: Varying Duration of Efficacy



Age-based vaccination recommendation: ≥65 years

Limitations

- Model Structure
  - No risk groups
  - No dynamic transmission. No impact of the vaccine on transmission and indirect effects
- Uncertain inputs
  - Vaccine cost
  - RSV Incidence
  - Long-term efficacy

Summary

- Vaccination potentially Cost-Effective
- Results vary based on:
  - Vaccine Cost
    - ICER: 80,000– 220,000 $/QALY
  - Incidence of RSV Hospitalization
    - $50,000 - 230,000 $/QALY
  - Vaccine Efficacy
    - ICER: ~80,000 - 270,000 $/QALY
  - Ages Vaccinated
    - ICER: ~50,000 - 370,000 $/QALY
  - Duration of Efficacy
    - ICER: ~80,000 - 170,000 $/QALY

Thank You

- Please send comments to:
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