This slide deck was prepared by Dr. David Hutton of the University of Michigan and reflects his work. It is being presented by CDC staff on his behalf. Dr. Hutton will be available to answer questions at the end of this presentation.

This slide deck was prepared by Dr. David Hutton of the University of Michigan and reflects his work. It is being presented by Dr. Ismael Ortega-Sanchez (CDC) on his behalf.

Economic Analysis of Protein Subunit and mRNA RSV Vaccination in Adults aged 50-59 Years

Presentation for the Advisory Committee on Immunization Practices, April 16th, 2025

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Conflicts of interest statements

- No known conflict of interests.

Study Question

- Evaluate the Cost-Effectiveness of RSV vaccination
  - Compare vaccination to no vaccination using an incremental cost-effectiveness ratio
  - Scenario Analyses
  - Perspective: Societal
  - Focus: Age 50-59
    - We will show some results for other age groups as well

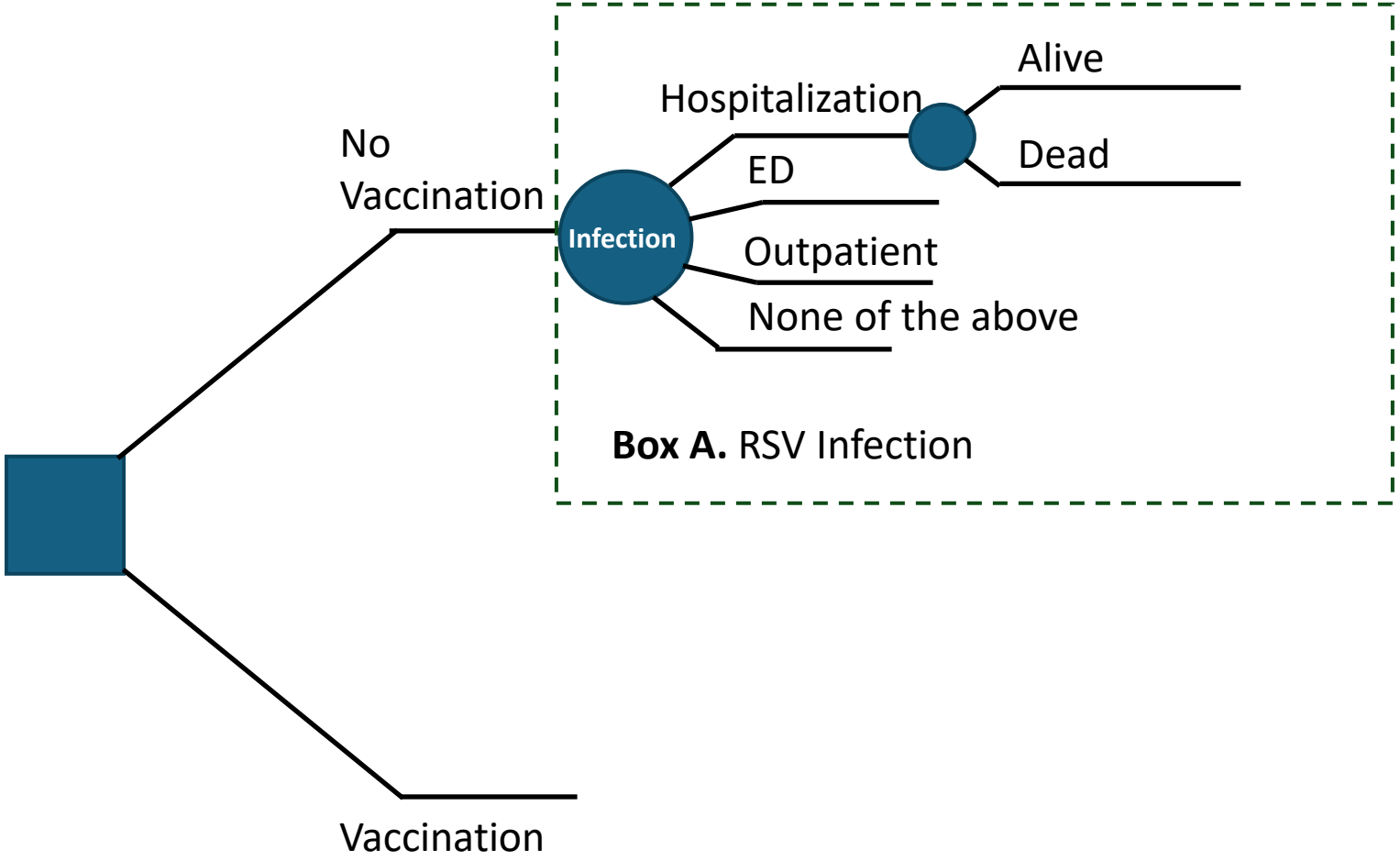
Methods

Methods: Intervention(s)

- Target population: US adults aged ≥50 years, stratified by age, chronic medical conditions
  - **Adults aged 50-59 years with at least one chronic medical condition***
  - **Adults aged 60-74 years with at least one chronic medical condition***
  - **Adults aged ≥75 years**
- Interventions: RSV vaccination
  - Protein subunit RSV vaccination (Pfizer's ABRYSVO, GSK's AREXVY)
  - Moderna RSV vaccination (Moderna's mRESVIA)
- Each compared to no vaccination

*For base case, at least one of: chronic obstructive pulmonary disease (COPD), asthma, coronary artery disease, chronic kidney disease, diabetes mellitus, severe obesity (BMI ≥40)

Methods: Decision Tree Model



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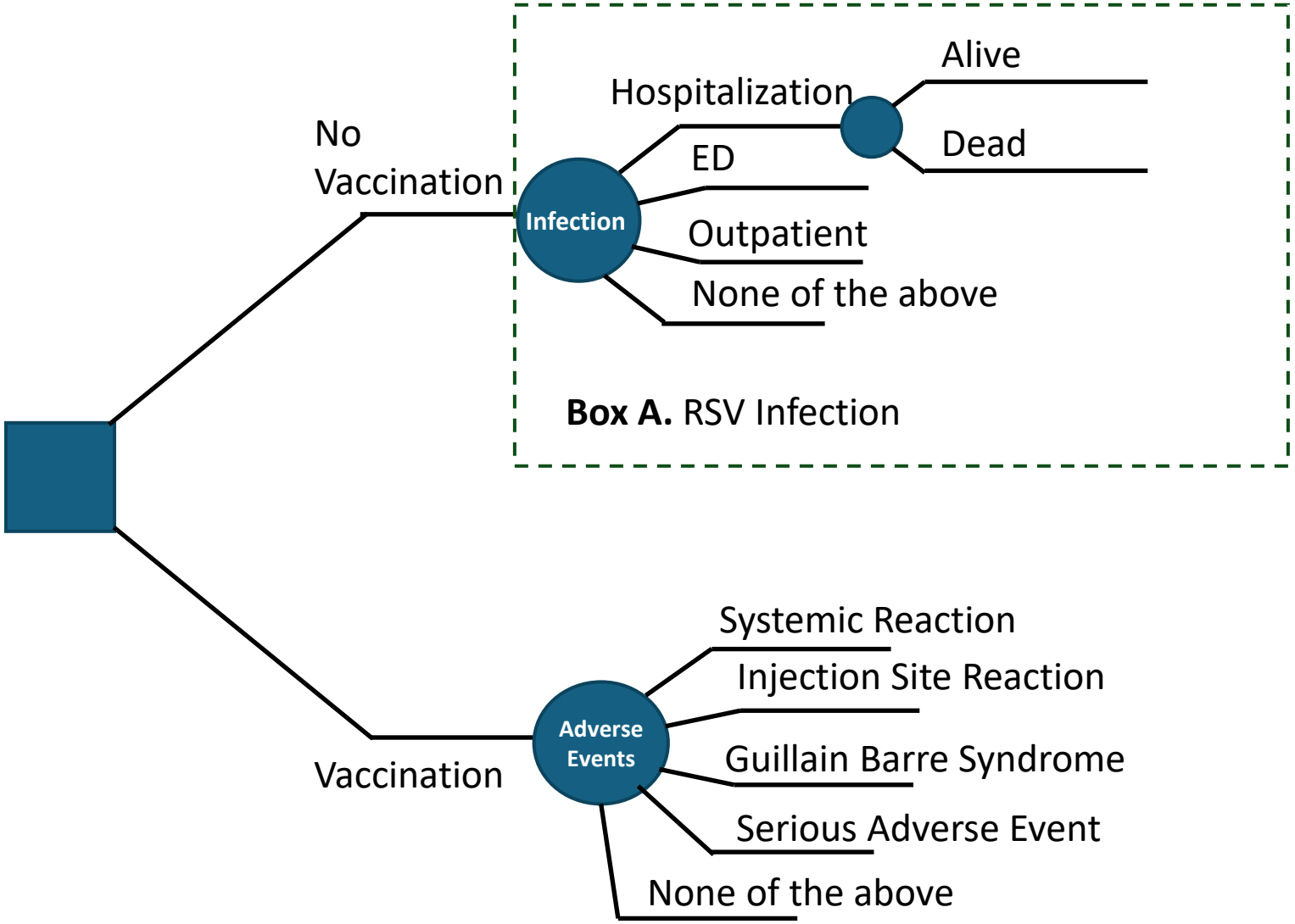

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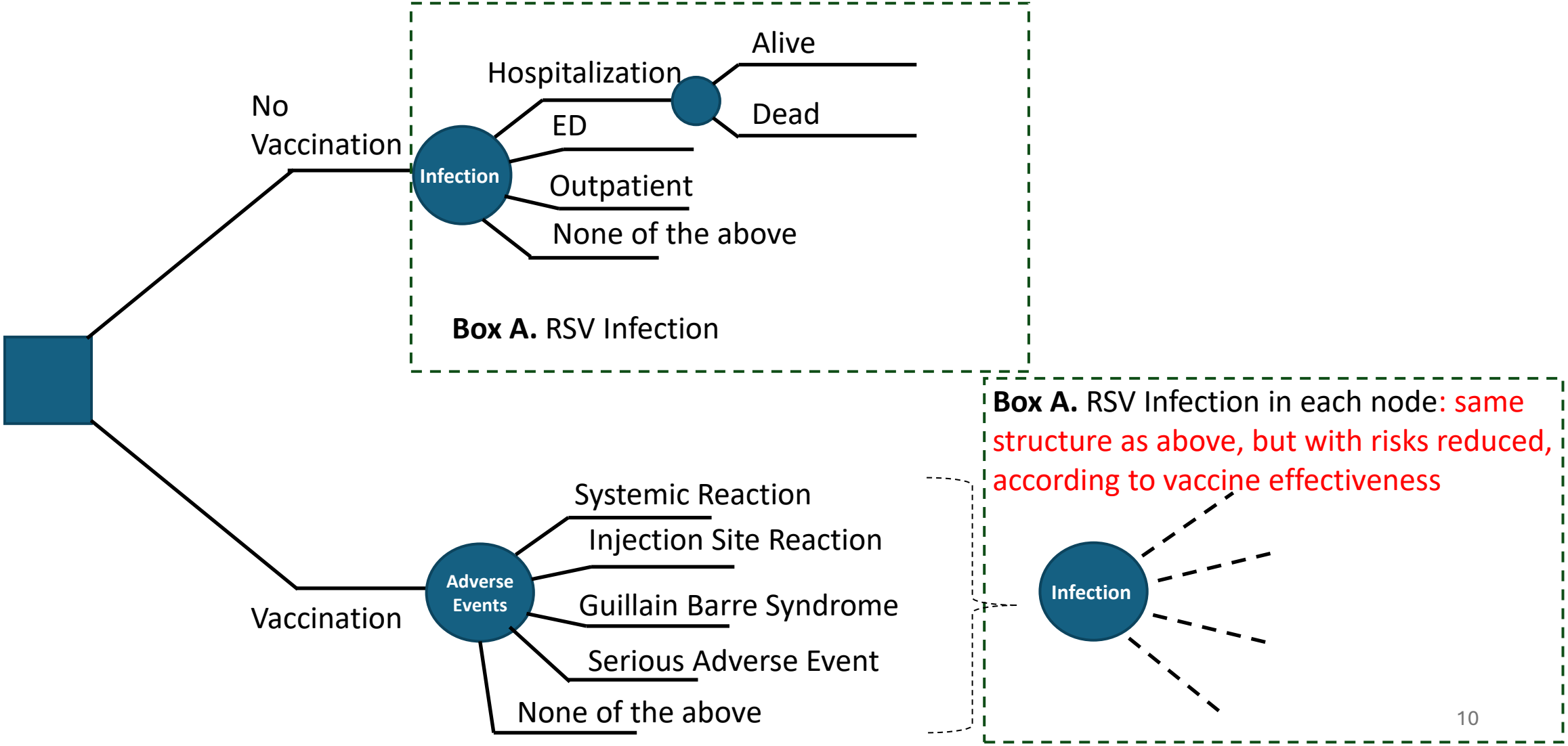

Annual RSV incidence

- **At least one** chronic medical condition (source RSV-NET and the Behavioral Risk Factor Surveillance System [BRFSS]):
  - Chronic obstructive pulmonary disease (COPD), OR
  - Asthma, OR
  - Coronary artery disease (CAD), OR
  - Diabetes mellitus, OR
  - Chronic kidney disease (CKD), OR
  - Severe obesity (body mass index [BMI] ≥40 kg/m^2)
- Additional chronic medical conditions evaluated in scenario analyses:
  - Heart failure[1]
  - Immune compromised
    - Lung transplant[2]
    - Hematopoietic cell transplant, allogeneic[3,4]
    - Hematopoietic cell transplant, autologous[3,4]

These conditions are considered separately because RSV epidemiologic parameters were derived from different published sources and cannot be combined with RSV-NET hospitalization rate estimates under “at least one” condition.

1. Kujawski SA, et al. 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
2. Testaert H, et al. Incidence, management and outcome of respiratory syncytial virus infection in adult lung transplant recipients: a 9-year retrospective multicentre study. Clin Microbiol Infect. 2021 Jun;27(6):897-903. doi: 10.1016/j.cmi.2020.07.050.
3. Martino R, et al. Prospective study of the incidence, clinical features, and outcome of symptomatic upper and lower respiratory tract infections by respiratory viruses in adult recipients of hematopoietic stem cell transplants for hematologic malignancies. Biol Blood Marrow Transplant. 2005 Oct;11(10):781-96. doi: 10.1016/j.bbmt.2005.07.007
4. Waghmare A, et al. Supplemental Oxygen-Free Days in Hematopoietic Cell Transplant Recipients With Respiratory Syncytial Virus. J Infect Dis. 2017 Dec 5;216(10):1235-1244. doi: 10.1093/infdis/jix390

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Assumed that vaccine effectiveness was reduced by half in immune compromised populations, compared with all others

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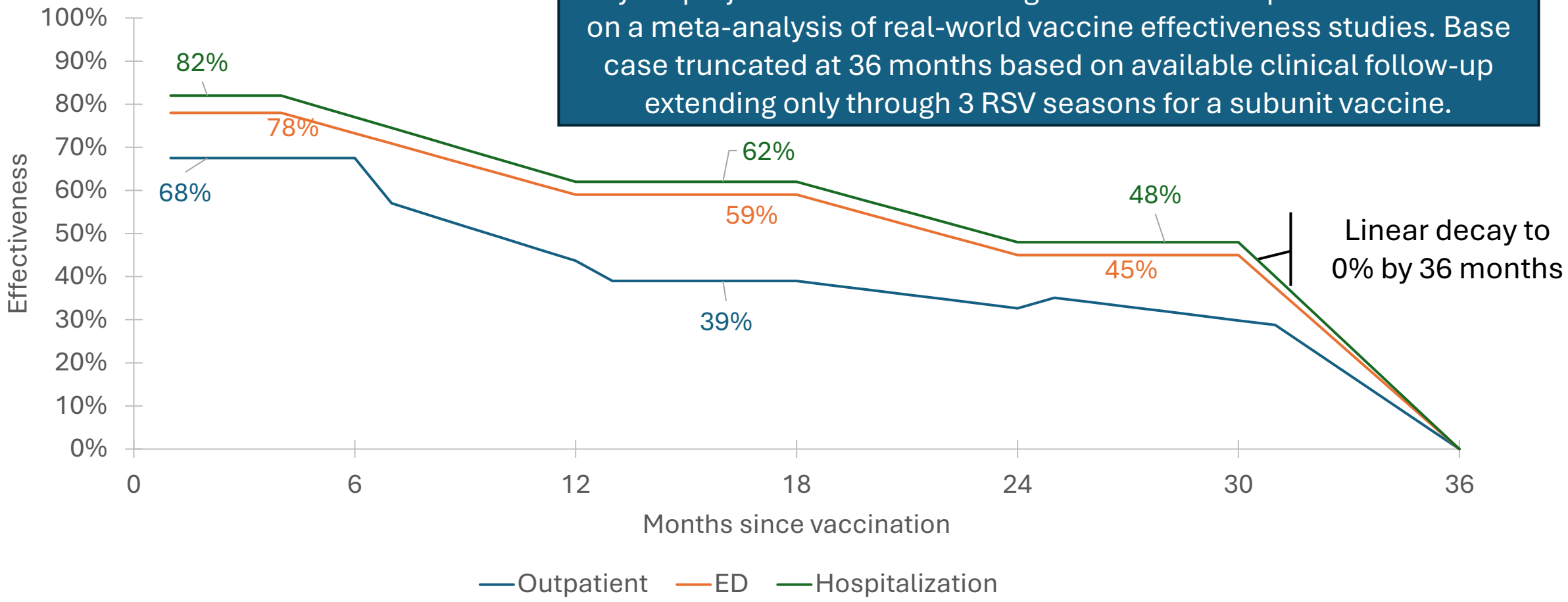
Vaccine effectiveness (VE) of a single dose over time: protein subunit RSV vaccine (combined Pfizer/GSK)

3-year projected effectiveness against ED and hospitalization based on a meta-analysis of real-world vaccine effectiveness studies. Base case truncated at 36 months based on available clinical follow-up extending only through 3 RSV seasons for a subunit vaccine.



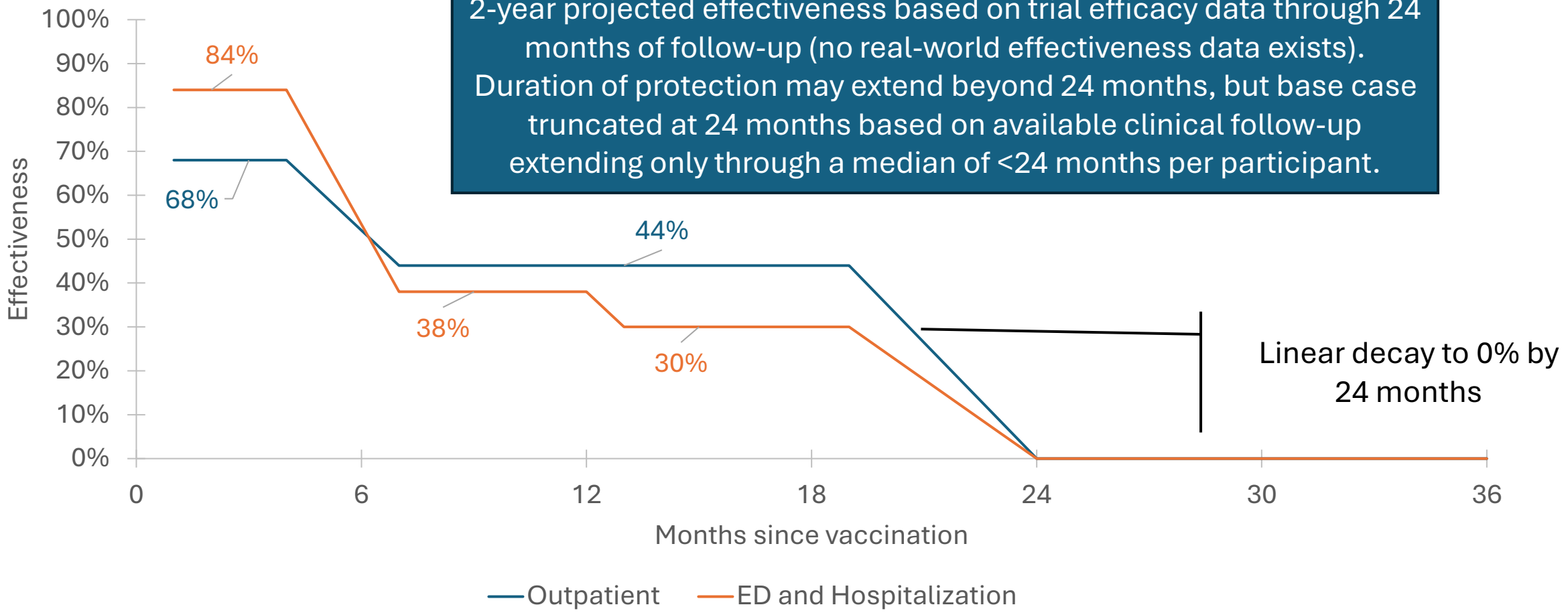
VE against hospitalization and emergency department visits was assumed to be equal to results of a meta-analysis of observational VE estimates from CDC, FDA/CMS, Veteran's Health Administration, and Pfizer analyses from the first RSV season of vaccine availability. VE against outpatient illness was assumed to be the mean across the two products of trial efficacy against RSV acute respiratory illness.

Unlike for protein subunit RSV vaccines, there are still no published vaccine effectiveness results for Moderna's mRNA RSV vaccine.

All effectiveness assumptions in this model are derived from clinical trial efficacy against symptomatic disease. Median clinical trial follow up does not extend beyond 2 years per participant.

Vaccine effectiveness (VE) of a single dose over time base case: mRNA Moderna RSV vaccine (mRESVIA)

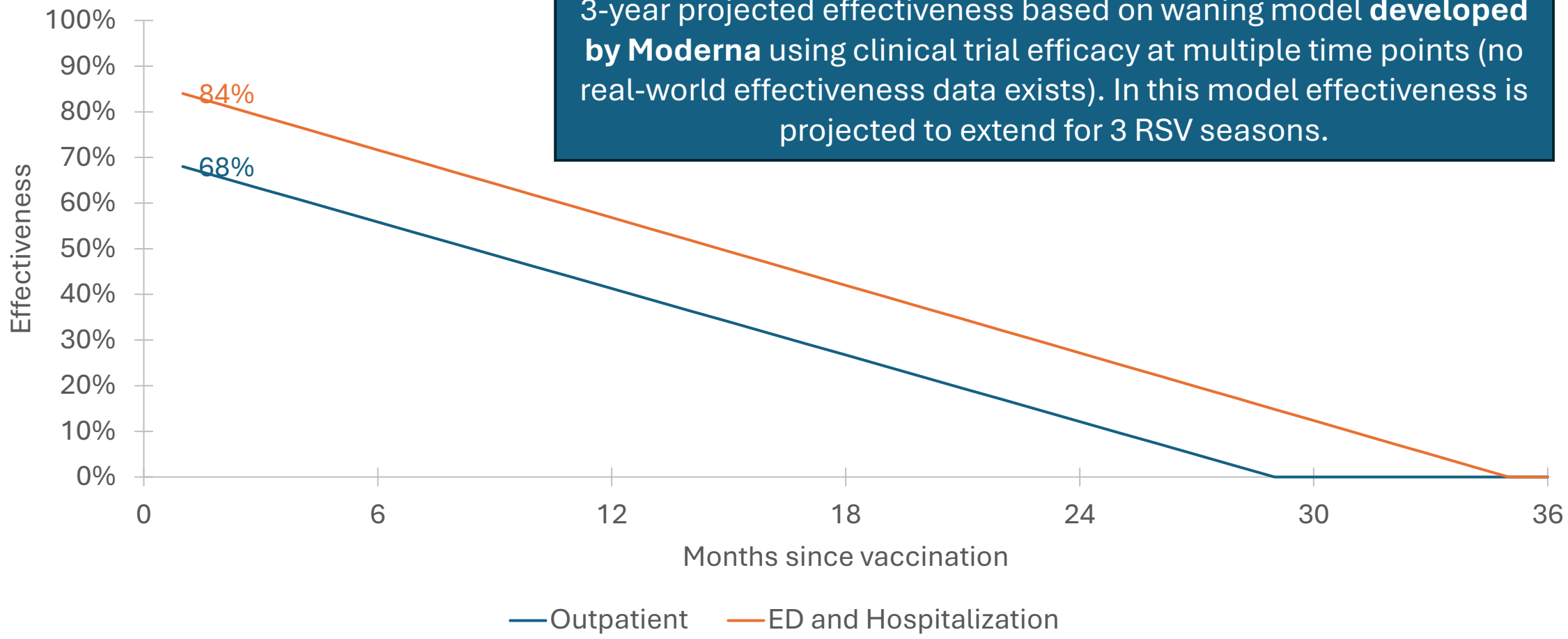
2-year projected effectiveness based on trial efficacy data through 24 months of follow-up (no real-world effectiveness data exists). Duration of protection may extend beyond 24 months, but base case truncated at 24 months based on available clinical follow-up extending only through a median of <24 months per participant.



VE against emergency department visits and hospitalization was assumed to be equal to clinical trial vaccine efficacy against RSV lower respiratory tract disease with ≥2 signs/symptoms. VE against outpatient illness was assumed to be equal to clinical vaccine efficacy against medically attended RSV acute respiratory illness. VE was assumed to decline to zero by month 24 post-vaccination.

Vaccine effectiveness (VE) of a single dose over time scenario analysis: mRNA Moderna RSV vaccine (mRESVIA)

3-year projected effectiveness based on waning model **developed by Moderna** using clinical trial efficacy at multiple time points (no real-world effectiveness data exists). In this model effectiveness is projected to extend for 3 RSV seasons.



Orange line: VE: RSV-LRTD
Blue line: VE: RSV-ARD
Moderna performed a weighted least square regression on VE data estimated every 2 months, through 18 months

Methods Updates

Same model presented in June 2024 and October 2024, with the following changes:

- Costs
  - Costs for those under 65 based on an analysis using MarketScan by Averin et al.
    - Marketscan (all of US)
    - Matched adults 18+, also reports by chronic condition
    - Averin et al analysis was conducted using final support from Pfizer Inc
  - Costs for those 65 and older based on a CDC analysis of Medicare data
- Corrected productivity calculation for ages 50-64
- Vaccine Effectiveness
  - Subunit 36 months of efficacy
  - Moderna long-term efficacy assumption
- Mortality
- Guillain Barre Syndrome (GBS)

Averin A, Atwood M, Sato R, Yacisin K, Begier E, Shea K, Curcio D, Houde L, Weycker D. Attributable Cost of Adult Respiratory Syncytial Virus Illness Beyond the Acute Phase. In Open Forum Infectious Diseases 2024 Mar (Vol. 11, No. 3, p. ofae097). US: Oxford University Press.

Guillain-Barre Syndrome (protein subunit vaccines only)

- Base: FDA analysis of adults 65+ with rates ranging between 0 – 18 excess cases per million doses administered
- Scenario:
  - Baseline GBS rates in U.S. adults 50-64 (assumed same for adults 50-59 in the model)
    - 25.2 per million person-years (combined male, female)
    - 2021 study of 50 million person-years of observation[1]
    - Inpatient and emergency department results, adjusted downward by the positive predictive value (55%) of ICD codes in identifying "true" GBS in inpatient/ED.
  - Relative measures of GBS risk from protein subunit RSV vaccination applied relative to the assumed 50-59 baseline to see what happens if risk is lower in younger adults[2]
    - GSK: Incidence rate ratio (IRR) = 2.46 (95% CI 1.19 – 5.08)
    - Pfizer: IRR = 2.02 (95% CI 0.93 – 4.40)
    - 42-day risk window used in FDA's analysis.
  - Net Excess 42-day risk of 3.6 per million doses (average of Pfizer and GSK)

1. Shui IM, Rett MD, and Weintraub E et al. Guillain-Barré syndrome incidence in a large United States cohort (2000-2009). Neuroepidemiology. 2012;39(2):109-15. doi: 10.1159/000339248. Epub 2012 Jul 28. PMID: 22846726.
2. Package inserts: GSK, Pfizer.

Methods: Additional Inputs

- Also included
  - RSV illness QALYs lost
  - RSV illness productivity costs
  - Vaccination healthcare and productivity costs
  - Vaccination adverse events
    - Medical costs
    - Productivity costs
- *These assumptions remain unchanged from October 2024*

Hutton, 2023. “Economic Analysis of RSV Vaccination in Older Adults”. June 2023 ACIP Meeting
Hutton et al., 2024. “Cost-effectiveness of vaccinating adults aged 60 years and older against respiratory syncytial virus”. *Vaccine* 42(24): 126294

Methods: Scenarios

- Manufacturer-specific (Pfizer and GSK-specific models; Moderna is considered separately in the base case, so no scenario needed)
- For Moderna, assuming longer duration of protection (manufacturer 3-year efficacy assumption)
- Vaccination of persons *without* chronic medical conditions
- Condition-specific (e.g., vaccination of persons with heart failure)
- Public sector prices for each vaccine (Federal Supply Schedule prices from the Veterans Health Administration*), rather than the manufacturer list price

*https://www.vendorportal.ecms.va.gov/NAC/Pharma/List

Results

Previous (June 2024) Cost-Effectiveness Results: Societal costs per quality-adjusted life year (QALY) gained

	2-year PreF subunit vaccines	2-year PreF mRNA vaccines	
Adults aged 50-59 years with at least 1 condition	$154,501*		
Adults aged 60-74 years with at least 1 condition	$60,933	$80,953	
All adults aged ≥75 years	$51,447	$66,287	

At least one condition refers to: chronic obstructive pulmonary disease, asthma, coronary artery disease, diabetes mellitus, chronic kidney disease, severe obesity (body mass index [BMI] ≥40)

*The $154,501 incremental cost-effectiveness ratio (ICER) is GSK-specific, but the other two are for subunit in general.

Today's Cost-Effectiveness Results: Societal costs per quality-adjusted life year (QALY) gained

	3-year	2-year	3-year
	PreF subunit vaccines	**PreF mRNA vaccines**	**PreF mRNA vaccines**
Adults aged 50-59 years with at least 1 condition	$43,070 (<0-$266,769)	$152,293 ($1,154-$811,138)	$95,182 (<0-$682,508)
Adults aged 60-74 years with at least 1 condition	$21,721 (<0-$120,989)	$85,781 ($3,368-$409,467)	$50,864 ($3,668-$249,938)
All adults aged ≥75 years	$45,769 ($25,505-$84,871)	$100,571 ($58,277-$225,885)	$70,731 ($42,069-$159,451)

At least one condition refers to: chronic obstructive pulmonary disease, asthma, coronary artery disease, diabetes mellitus, chronic kidney disease, severe obesity (body mass index [BMI] ≥40)
Ranges reflect 2.5th and 97.5th percentile from Monte Carlo simulation.
"<0" represents cost-saving (lower costs, improved health/QALYs)

Number Needed to Vaccinate to Prevent One Outpatient Visit, Hospitalization, or Death

Age 50-59 years with at least one condition

Outcome	Subunit (3-year)	mRNA (2-year)	mRNA (3-year)
Outpatient	43	56	62
Hospitalization	510	933	681
Death	7,985	14,620	10,675

At least one condition refers to: chronic obstructive pulmonary disease, asthma, coronary artery disease, diabetes mellitus, chronic kidney disease, severe obesity (body mass index [BMI] ≥40)

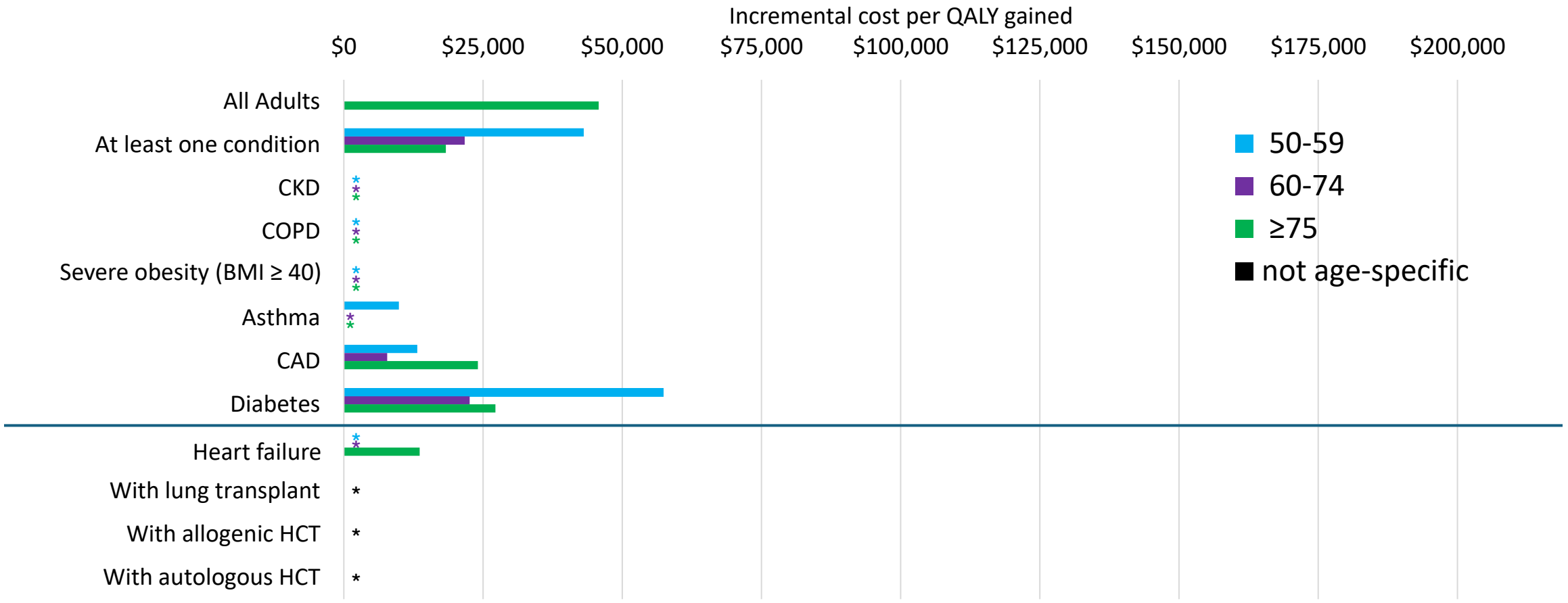
Scenario Analyses

Scenario: Cost-Effectiveness Results Using Veterans Affairs (VA) Federal Supply Schedule (FSS) Vaccine Prices: Societal costs per quality-adjusted life year (QALY) gained

	3-year	2-year	3-year
	Subunit RSV vaccine	PreF mRNA vaccines	PreF mRNA vaccines
Adults aged 50-59 years with at least 1 condition	$25,967	$79,443	$37,082
Adults aged 60-74 years with at least 1 condition	$12,122	$43,670	$18,380
All adults aged ≥75 years	$37,536	$64,251	$42,882

VA Federal Supply Schedule prices used in lieu of list prices (VA National Acquisition Center Contract Catalog Search Tool): Arexvy (GSK) $263, Abrysvo (Pfizer) $258, mResvia (Moderna) $204.
At least one condition refers to: chronic obstructive pulmonary disease, asthma, coronary artery disease, diabetes mellitus, chronic kidney disease, severe obesity (body mass index [BMI] ≥40)

Specific Chronic Conditions: Subunit

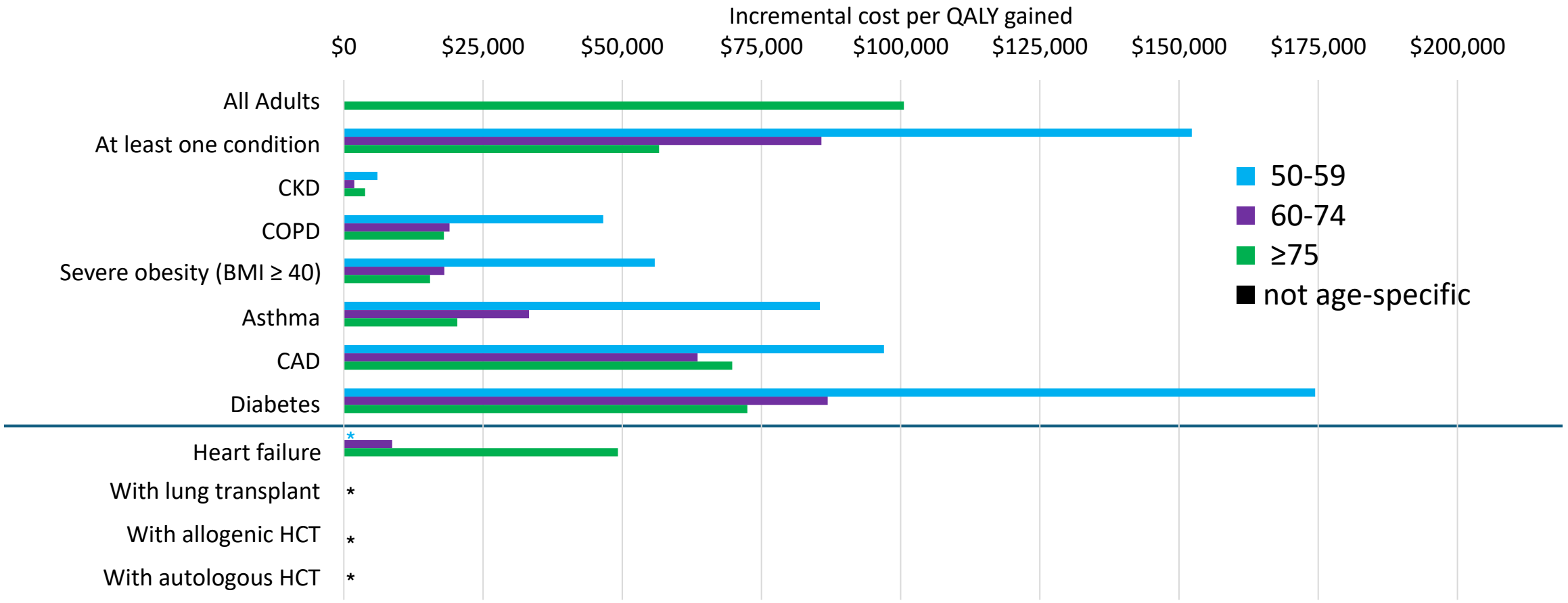


CKD: chronic kidney disease; COPD: chronic obstructive pulmonary disease; BMI: body mass index; CAD: coronary artery disease; HCT: hematopoietic cell transplant

***Indicates cost saving which means net costs are reduced and health outcomes are improved when compared to "no vaccination"**

At least one condition refers to: COPD, asthma, CAD, diabetes mellitus, CKD, severe obesity (BMI ≥40)

Specific Chronic Conditions: mRNA (2-year)



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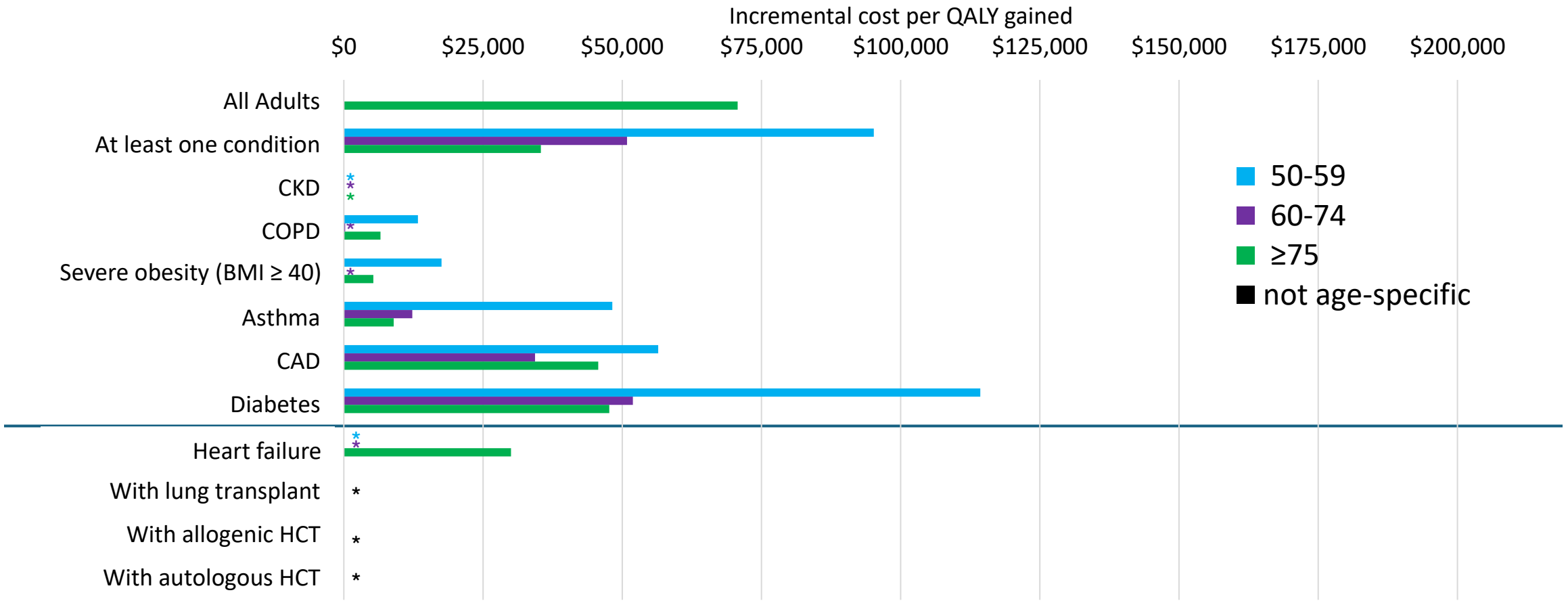

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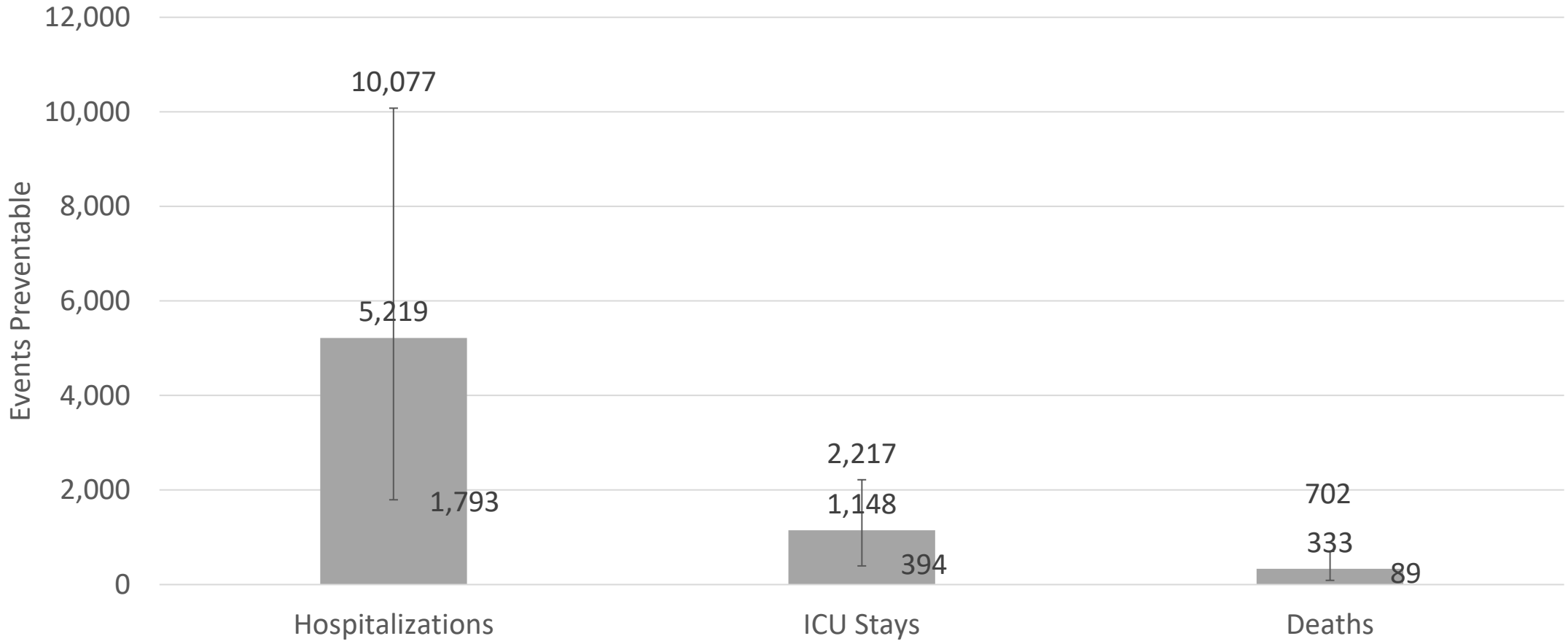
***Indicates cost saving which means costs are reduced and health outcomes are improved**

At least one condition refers to: COPD, asthma, CAD, diabetes mellitus, CKD, severe obesity (BMI ≥40)

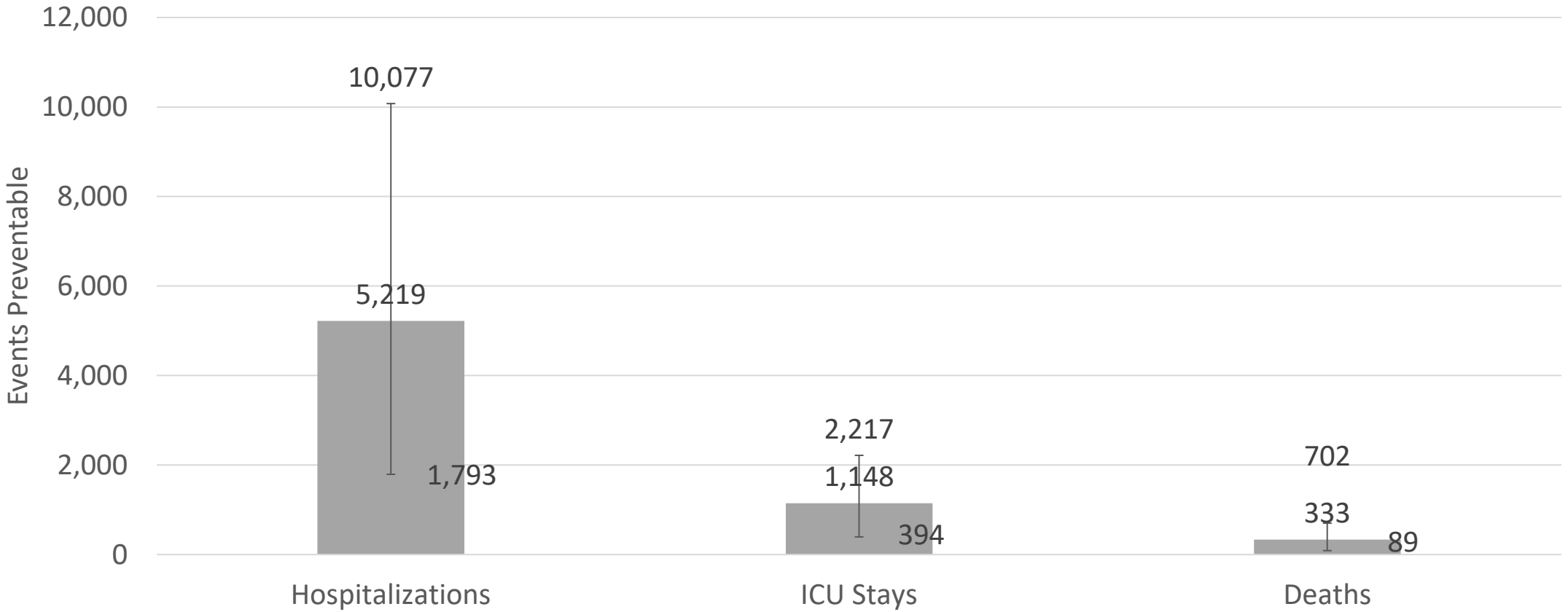
Hospitalizations, ICU stays, and deaths preventable **if 20% of all U.S. adults aged 50-59 years** with at least one chronic condition* were vaccinated



The model assumed 0–48 cases of Guillain-Barre Syndrome total

*At least one condition refers to: chronic obstructive pulmonary disease, asthma, coronary artery disease, diabetes mellitus, chronic kidney disease, severe obesity (body mass index [BMI] ≥40)

Scenario (lower GBS risk in adults aged <65)*: Hospitalizations, ICU stays, and deaths preventable **if 20% of all U.S. adults aged 50-59 years** with at least one chronic condition** were vaccinated



The model assumed 1–29 cases of Guillain-Barre Syndrome total

*Assuming lower baseline risk of GBS in adults aged 50-59 years than in adults aged ≥65 years. In this scenario, the relative risk of GBS was applied to published background rates of GBS for this age group.

**At least one condition refers to: chronic obstructive pulmonary disease, asthma, coronary artery disease, diabetes mellitus, chronic kidney disease, severe obesity (body mass index [BMI] ≥40)

Limitations

- Model Structure
  - No dynamic transmission. No impact of the vaccine on transmission and indirect effects
- We did not include or analyze all potential RSV risk factors.
  - Some medical conditions (e.g., interstitial lung disease) are likely associated with high risk of severe RSV disease, but literature on population-based hospitalization rates and other outcomes are lacking.
- Uncertain inputs
  - RSV burden of disease, especially hospitalization and mortality
  - RSV costs
    - Caregivers of persons ill with RSV may incur additional productivity losses not included in this model
  - Duration and waning pattern of vaccine protection (especially mRNA)

Conclusions

- Cost-Effectiveness of vaccinating adults **50-59 with at least one chronic medical condition:**
  - Subunit: $43,070/QALY
  - mRNA: $152,293/QALY (2-year), $95,182/QALY (3-year)
  - Vaccinating people with the following conditions may be cost-saving:
    - Immune compromise, defined as hematopoietic cell transplant or lung transplant
    - Heart failure
    - Chronic obstructive pulmonary disease (COPD)
    - Chronic kidney disease
    - Severe obesity (body mass index [BMI] ≥40)
- Scenarios with lower prices were more cost-effective

Thank You

- Please send questions/comments to:
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