Cost-Effectiveness of Meningococcal Vaccination Strategies for Adolescents in the United States*

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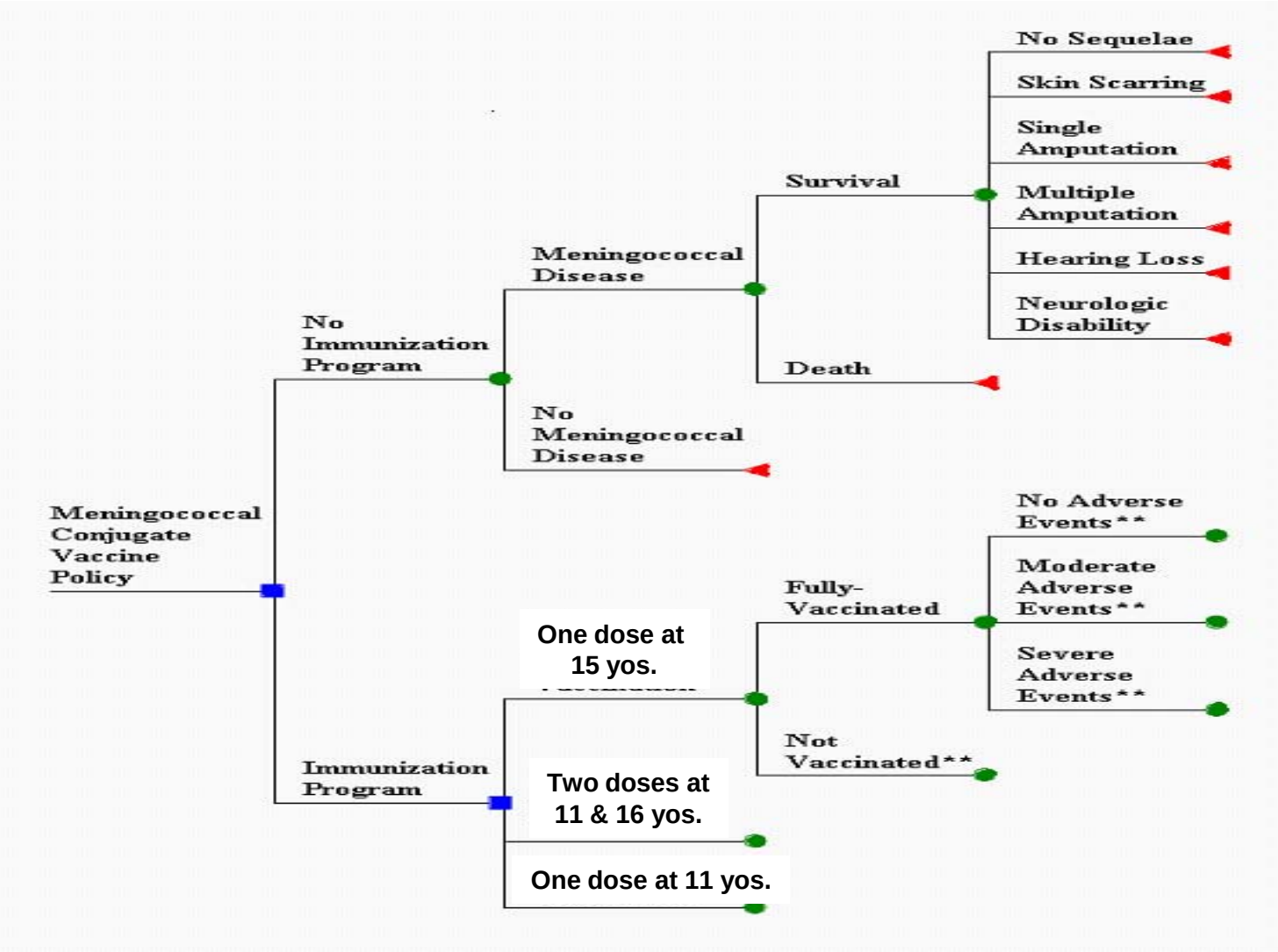
* **The findings and conclusions expressed are those of the author and do not necessarily represent the views of CDC or DHHS**

Objective

- Analyze the effectiveness and cost-effectiveness of ***three*** meningococcal vaccination programs in **Adolescents** in the US under reduced
  - disease incidence
  - duration of vaccine effectiveness: ***5 years***
- **Three strategies**
  - One dose at 11 years old (*currently recommended*)
  - One dose at 15 years old
  - Two doses: first at 11 years old & second at 16 years old
- Societal perspective

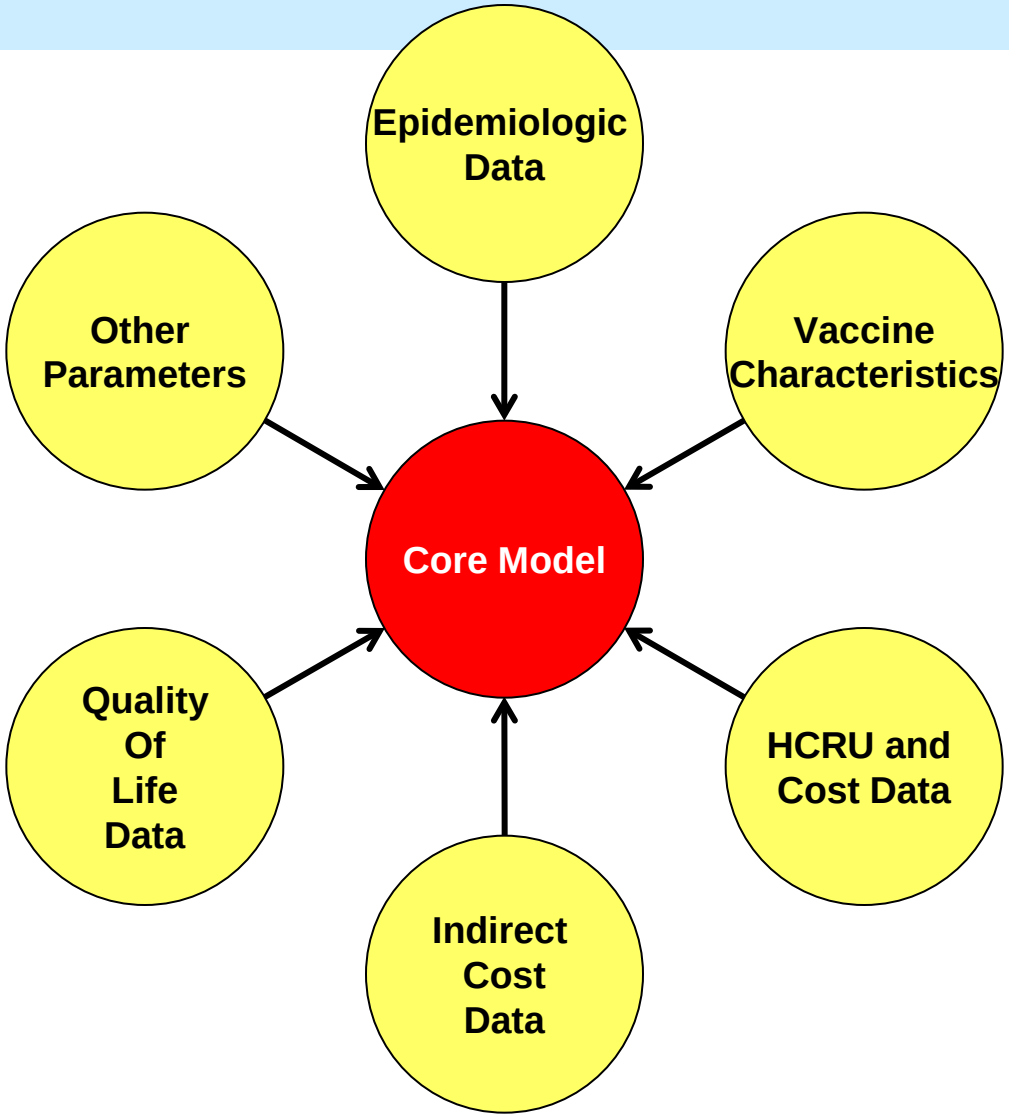
The Model


Meningococcal Conjugate Vaccine Policy
No Immunization Program
Immunization Program
Meningococcal Disease
No Meningococcal Disease
Survival
Death
No Sequelae
Skin Scarring
Single Amputation
Multiple Amputation
Hearing Loss
Neurologic Disability
One dose at 15 yos.
Two doses at 11 & 16 yos.
One dose at 11 yos.
Fully-Vaccinated
Not Vaccinated**
No Adverse Events**
Moderate Adverse Events**
Severe Adverse Events**

Design

- Monte Carlo simulation analysis
- Hypothetical population
  - 4 million adolescent cohort (11 yos.)
- Time Frame: 10 years
- Analytic Horizon: Age-specific Life Expectancy
- Discount rate: 3% (0%-5%)
- Pre-vaccine epi data (1996-2005)

Core Model with Inputs



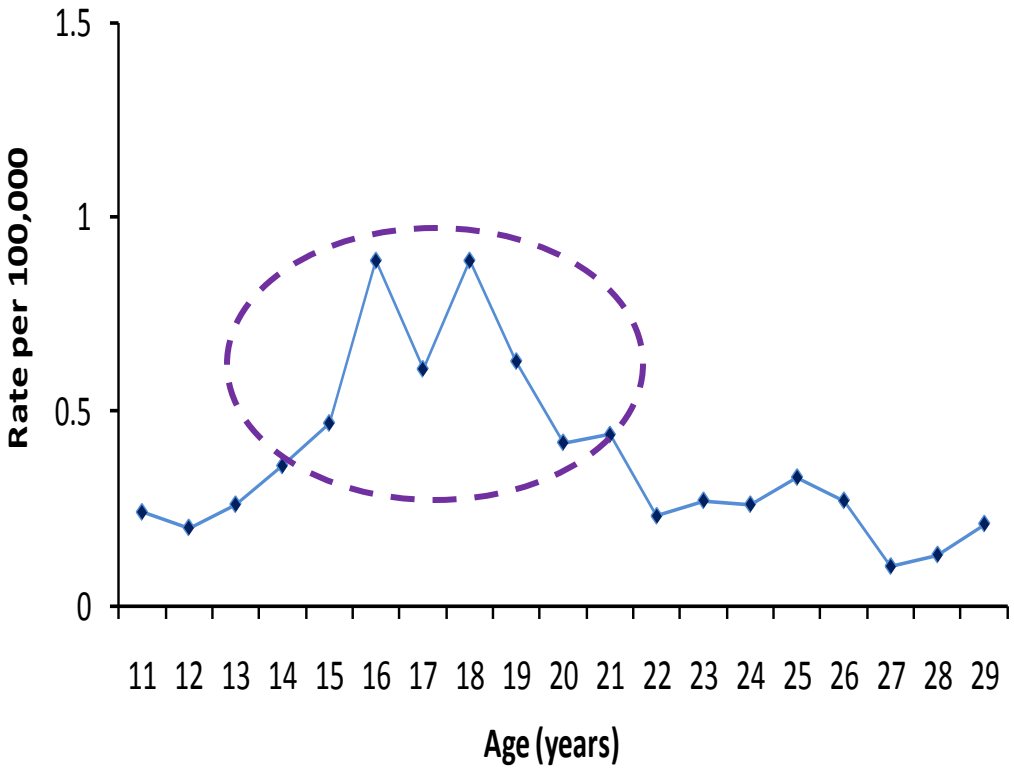
Epidemiologic Data

- Age- year- and C+Y+W135 serogroup-specific incidence rates (1996-2005)
- Age- and serogroup-specific case fatality ratios
- Proportion of survivors with sequelae by condition

Changes in the Annual Incidence in Vaccine Serogroups CYW135 by Age Group per 100,000 (95% CI)

Year	Aged 11–19 years
1998–1999	1.10 (0.87–1.37))
2000–2001	0.67 (0.50–0.87)
2002–2003	0.47 (0.34–0.64)
2004–2005	0.23 (0.15–0.35)
2006–2007	0.27 (0.18–0.40)

One fourth



Source: Active Bacterial Core Surveillance in Cohn *et al* CID 2010

Vaccination
Strategies, Effectiveness and Coverage

- **Three vaccination strategies**

Strategy	Effectiveness % (range)	Coverage % (range)	Doses
One dose at 11y	93 (73-98)	72 (40-89)	1
Two doses at 11y &16y	93 (73-98)	72 (40-89)	2
One dose at 15y	93 (73-98)	72 (40-89)	1

- **New scenario for efficacy duration: 5 years**

Sources: Pichichero et al., *Pediatr Infect Dis J* 2005
Shepard et al., Pediatrics 2005; Snape et al., JAMA. 2008
For vaccine coverage among adolescents
Smith et al., Pediatrics 2009

Cost of Vaccination

- Vaccine cost based on 2009 public and private sector prices
- **For adolescents using ONE dose of *MCV4***
  - **$90 a dose** +$AEs* +$Adm** (= $101)
  - Vaccine cost are varied from $30 to $120
- **For adolescents using TWO doses of *MCV4***
  - **$189 per vaccinee** (includes $AEs*, $Adm** discounted cost for second dose)

* Adverse event rates were taken from the UK experience with MCC
Trotter et al., *BMJ* 2002; Ortega-Sanchez et al., *CID* 2008

**Cost of vaccine administration among pediatric practices
Glazner et al., Pediatrics 2009

Other Benchmark Elements

- Meningococcal disease incidence under vaccination
- Direct and Indirect costs of meningococcal disease
  - Acute phase costs and long-term costs
  - Productivity loss to deaths and sequelae
- Health related quality-of-life scores for estimating QALYs lost to sequelae
- Cost-effectiveness ratios

Sources: Shepard et al., Pediatrics 2005;
Ortega-Sanchez, et al., CID 2008

Results

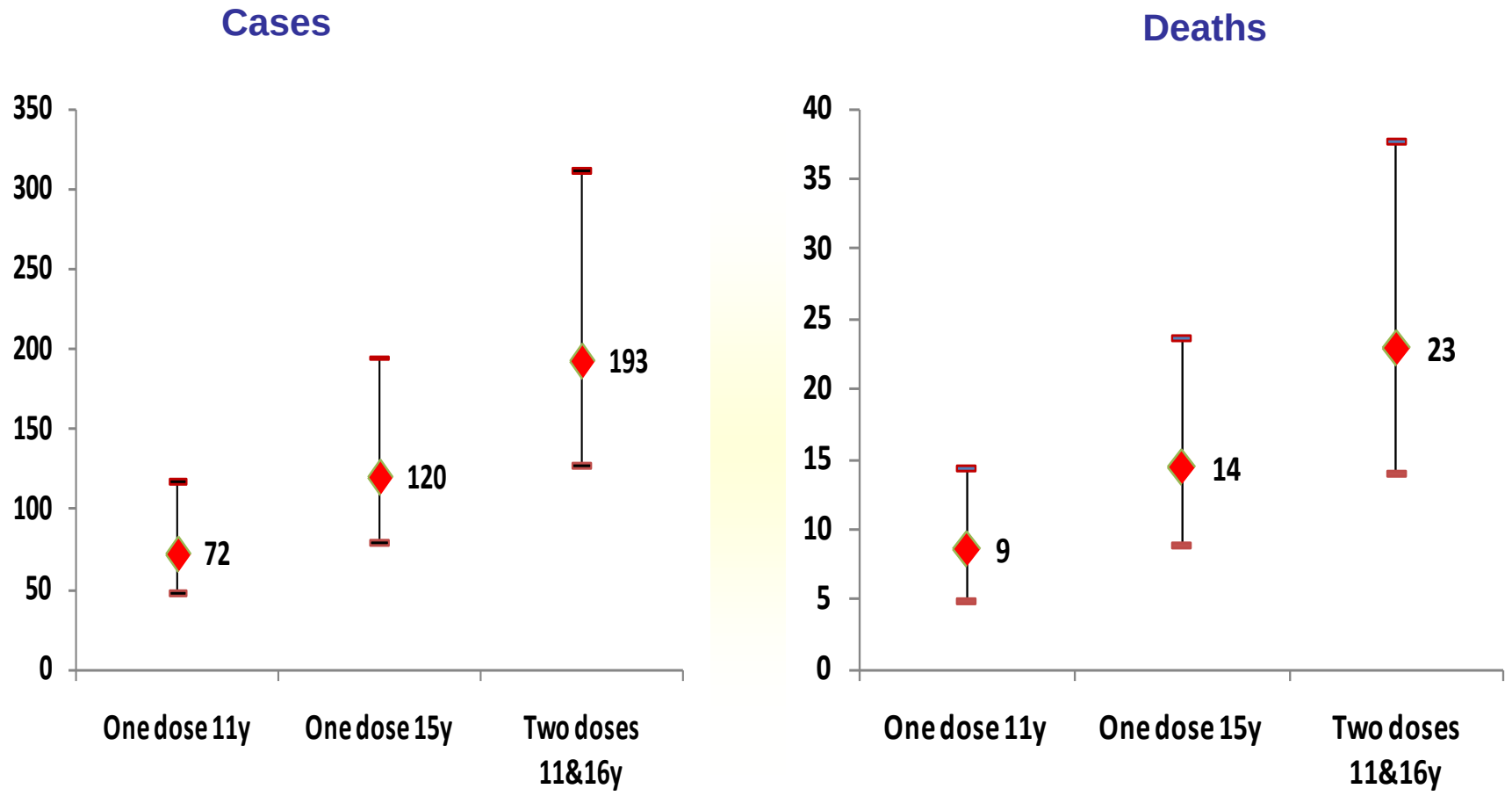
Baseline per 4M Cohort
No vaccination: Mean (5^{th},95^{th} Percentile)*

	Adolescent Cohort
Cases	**305** (267-369)
Deaths	**36** (28-47)
Life years lost **	**880** (709-1,087)
QALY's lost**	**4,015** (3,404-5,519)
Total cost of illness (in Millions $) **	**$143** ($118-$175)

* **Estimates from Monte Carlo Simulation**

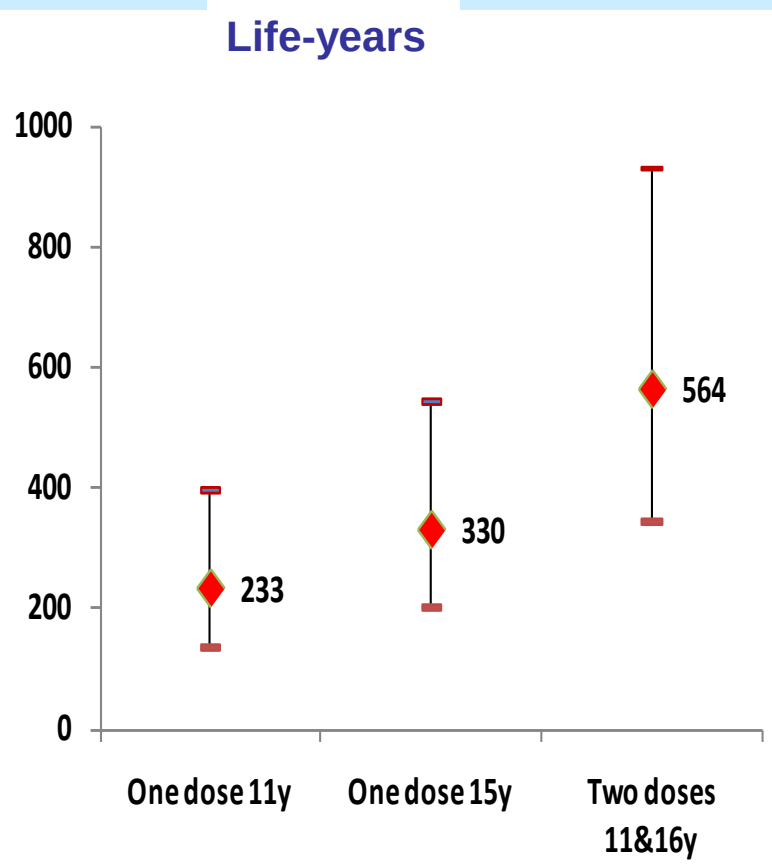
** **Discounted at 3%**

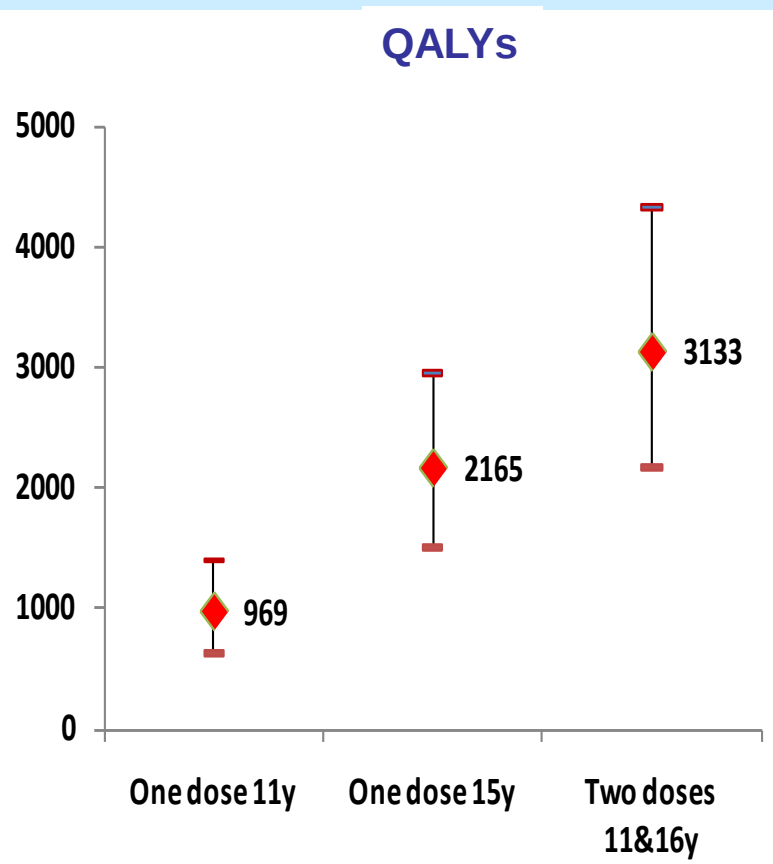
Cases and Deaths Prevented per 4M Cohort Mean, 5th and 95th Percentiles*



* Estimates from Monte Carlo Simulation

Life-years and QALY saved* per 4M Cohort
Mean, 5th and 95th Percentiles**



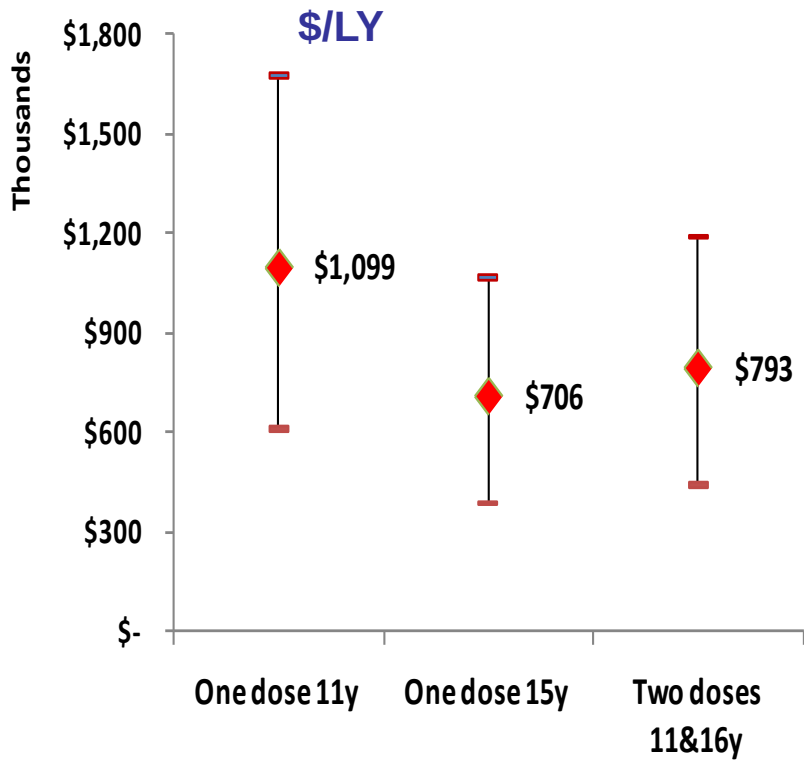


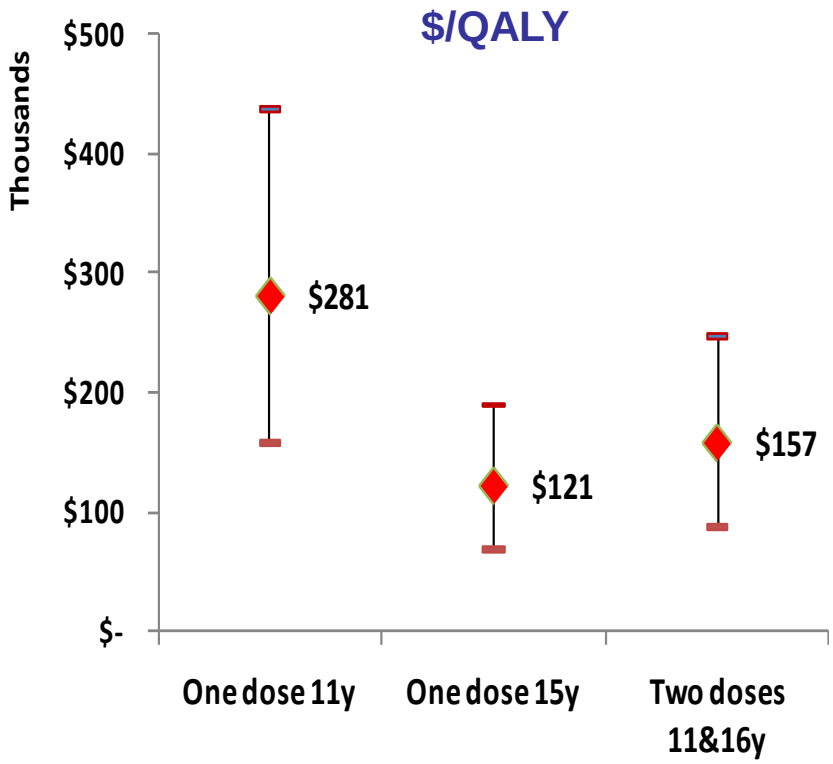
* Adjusted

** **Estimates from Monte Carlo Simulation**

$/LY and $/QALY* saved per 4M Cohort

Mean, 5th and 95th Percentiles

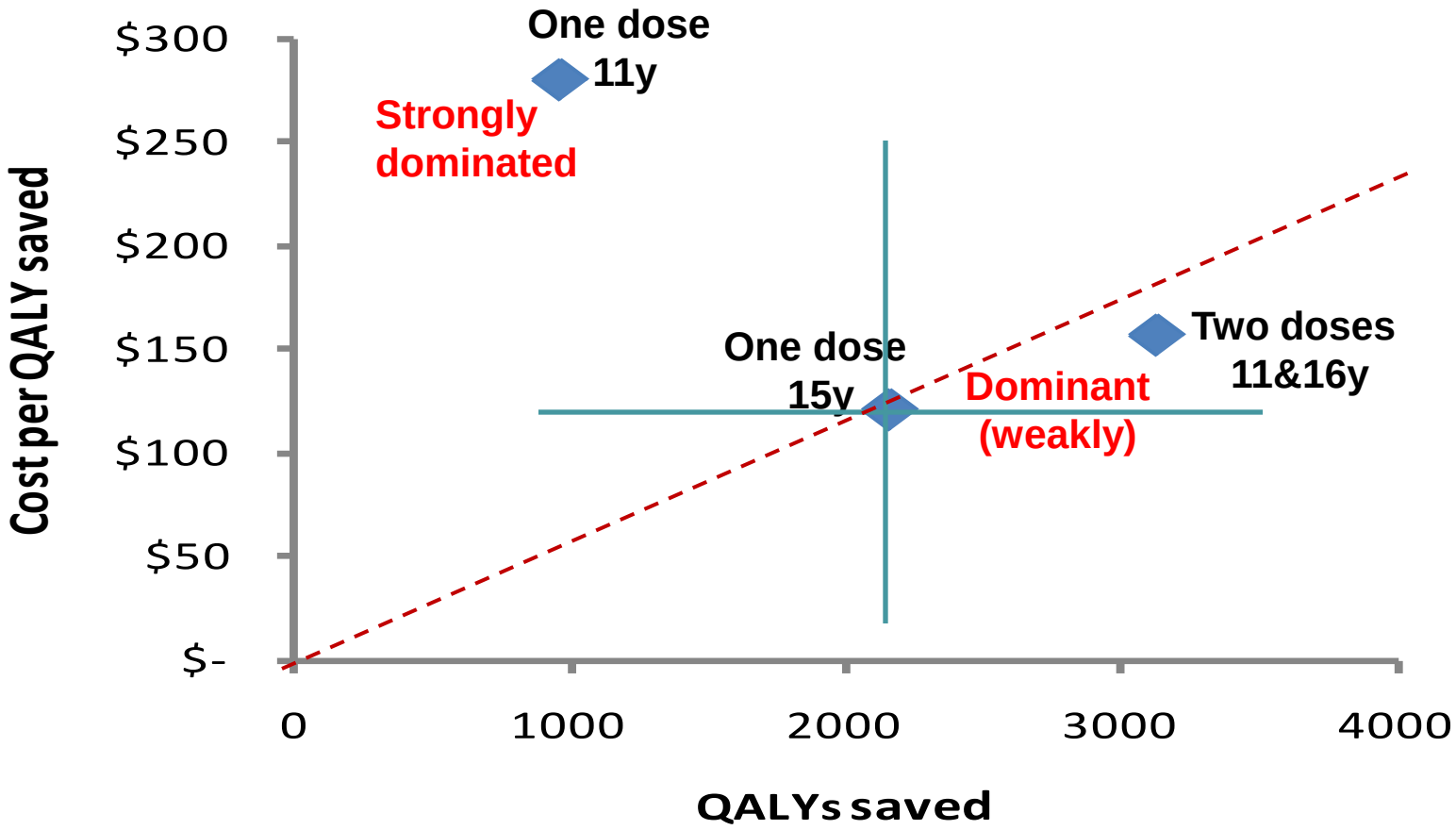




*** $/QALY excludes indirect cost from deaths**
Estimates from Monte Carlo Simulation

Incremental Analysis

Cost per QALY* in Thousands and QALYs saved



* Excluding indirect cost from deaths
Estimates from Monte Carlo Simulation

Base case Comparisons
$/QALY in adolescent vaccines in the US

Vaccine	Target group	Cost per QALY gained (compared to no vaccination)
Hepatitis B	College freshmen	<$0 (cost-saving) to ≈ $10,000
Hepatitis A	College freshmen	<$0 (cost-saving) to ≈ $15,000
HPV	12-year-old females	≈ $3,000 to $45,000
Influenza (LAIV)	12- to 17-year olds, high risk	≈ $11,000
TDaP	All 11-year-olds	≈ $21,000
Meningococcal (MCV4)	**1-dose, all 15-year-olds**	**$121,000**
Influenza	12- to 17-year olds, healthy	≈ $128,000
Meningococcal (MCV4)	**2-dose, all 11 & 16-year-olds**	**$157,000**
Meningococcal (MCV4)	**1-dose for all 11-year-olds**	**$281,000**

Source: Ortega-Sanchez et al. *Pediatrics* (2008), except new Meningococcal strategies

All figures were adjusted to Dec 2009 US$

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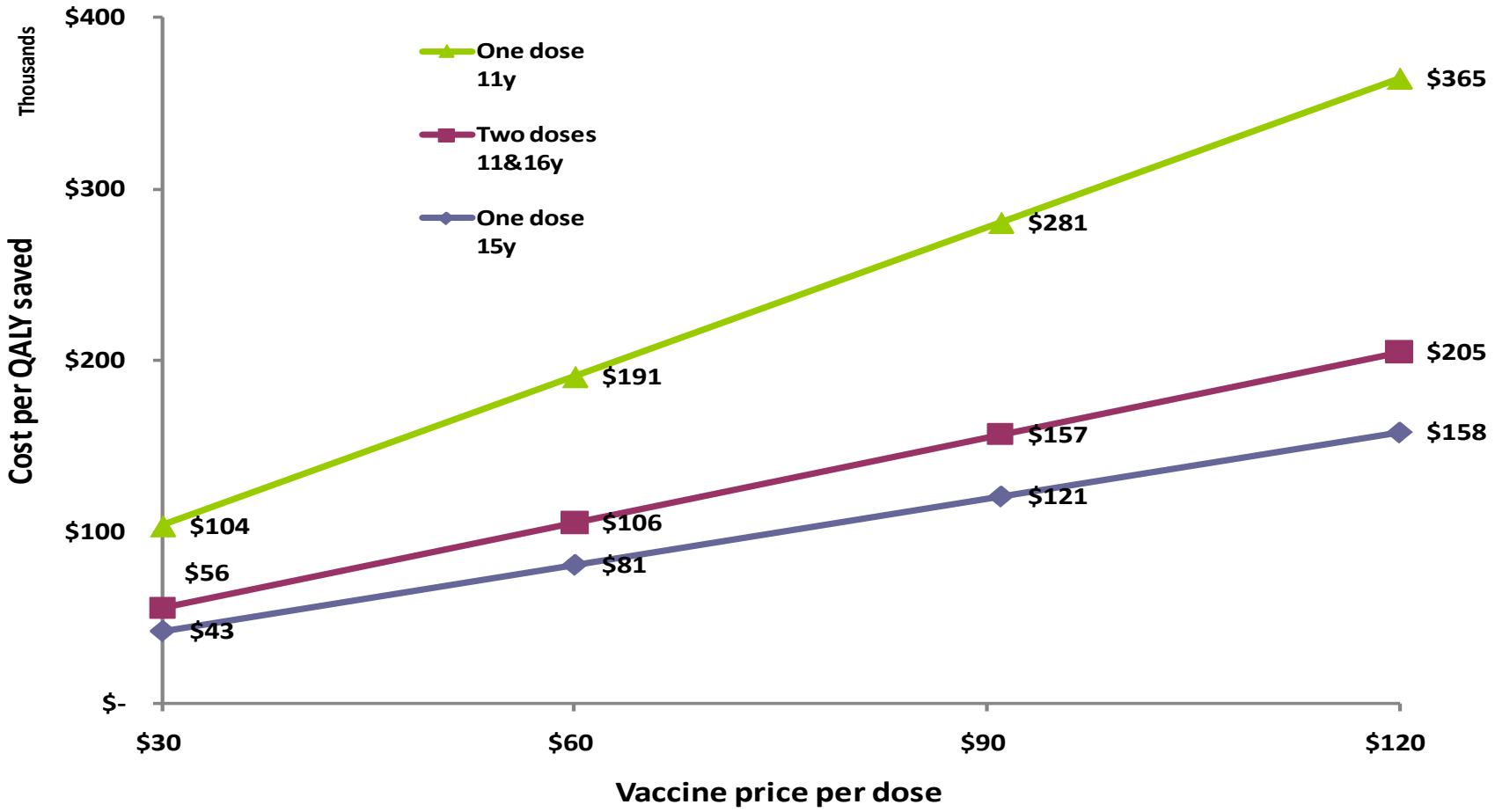
Sensitivity Analyses

Cost per QALY saved* by Vaccine Price

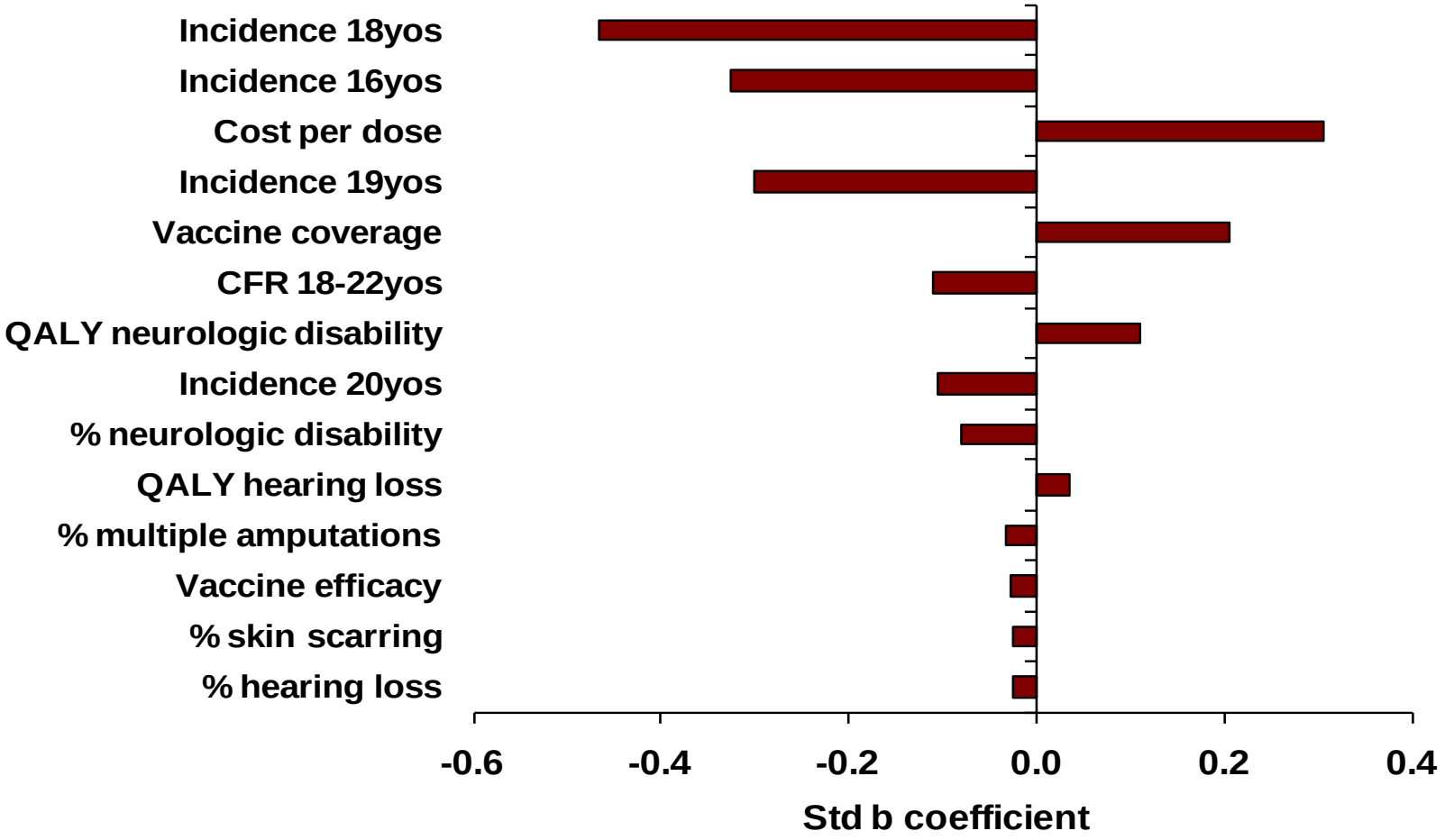
Three Vaccination Strategies



* Excluding indirect cost from deaths

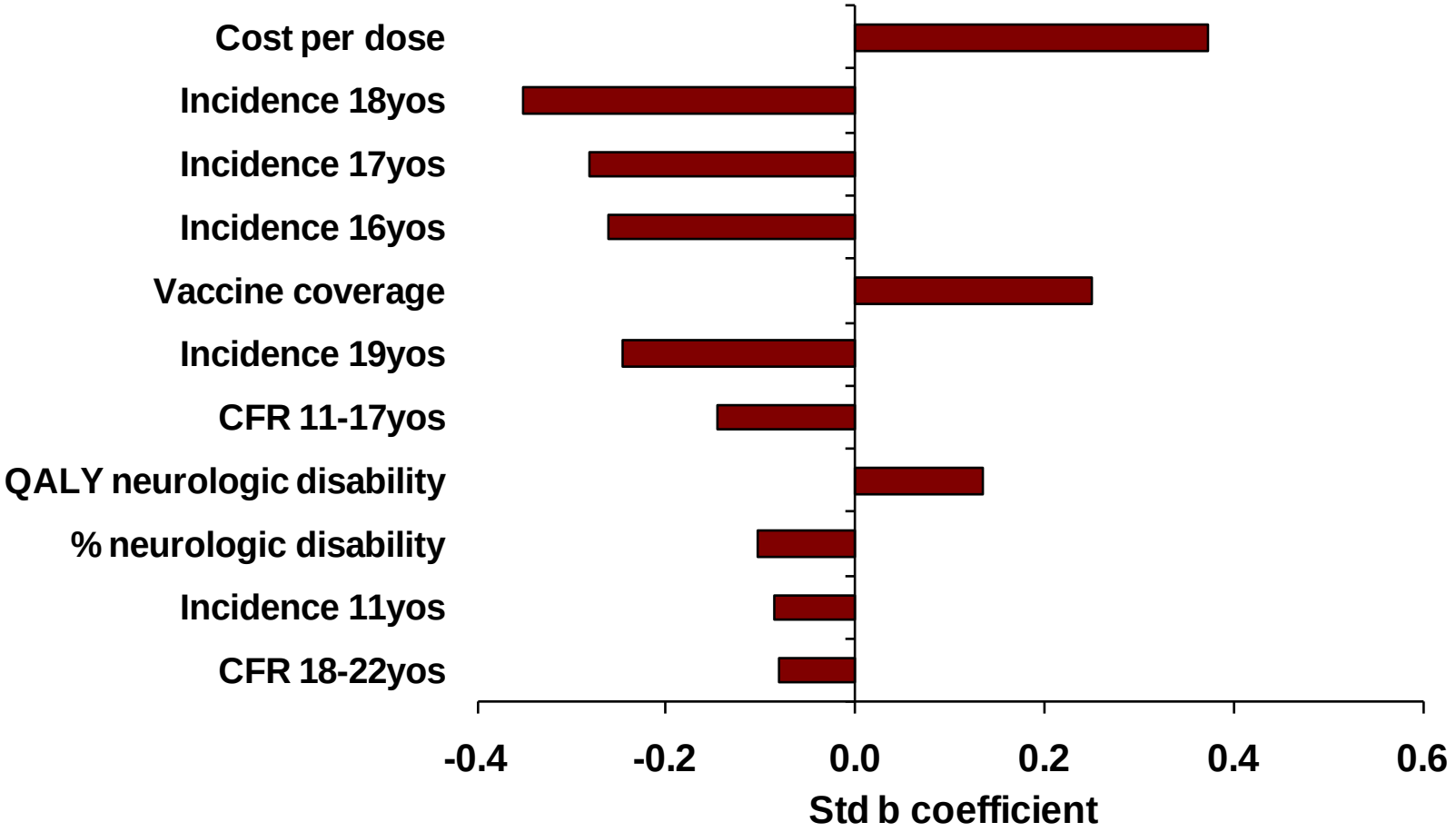
Estimates from Monte Carlo Simulation

Sensitivity Analysis
$/QALY saved with One dose at 15yos*



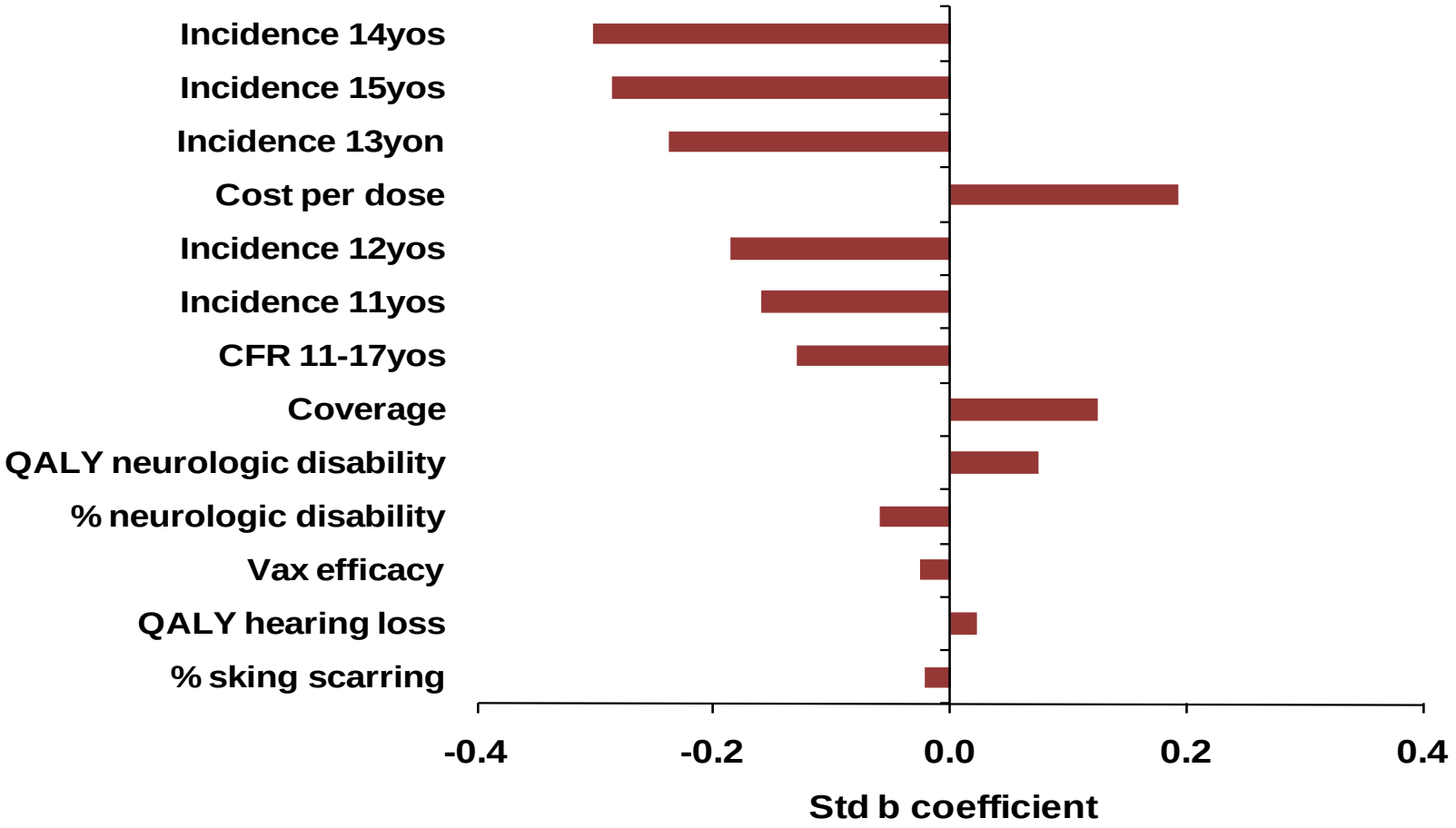
* Estimates from Monte Carlo Simulation

Sensitivity Analysis
$/QALY saved with TWO doses at 11 & 16y*



* Estimates from Monte Carlo Simulation

Sensitivity Analysis
$/QALY saved with ONE dose at 11 yos*



* Estimates from Monte Carlo Simulation

Conclusions

- A 5-year VE duration makes vaccinating at 11 years the ***less*** cost-effective strategy
- The other two strategies cost between $121,000 to $157,000 per QALY saved
  - Vaccinating at 15 years would prevent the greatest number of cases per dose given
  - Vaccinating at 11 years and revaccinating at 16 years would prevent the most number of cases
- Disease rates and vaccine cost drive the analyses

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