

Cost-effectiveness of 9-valent HPV vaccination for persons who have completed an HPV vaccination series

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Outline

- Brief review of health economics presentation from February ACIP meeting
 - Summary of three models of 9vHPV in US
 - Cost-effectiveness of routine 9vHPV vaccination vs. routine 4vHPV vaccination
- Impact and cost-effectiveness of additional 9vHPV vaccination among prior 3-dose 4vHPV vaccinees

Three US models of 9vHPV

- **US HPV-ADVISE model** (Brisson et al.)
 - October 2014 ACIP
 - Based on published 9vHPV Canadian model
- **Merck model** (Weiss, Pillsbury, Dasbach)
 - Based on published 4vHPV model
- **Simplified model** (Chesson et al.)
 - Based on published 4vHPV model

US HPV-ADVISE based on Canadian HPV-ADVISE model, recalibrated to fit US data (see Drolet et al., Int J Cancer 2014; Brisson et al., Vaccine 2013; Van de Velde et al., JNCI 2012)

Merck model based on Elbasha & Dasbach, Vaccine 2010

Simplified model based on Chesson et al., Vaccine 2011

Cost-effectiveness of routine 9vHPV

What is the cost-effectiveness of a routine 9vHPV vaccination program for both sexes compared to a routine 4vHPV vaccination program for both sexes?

Cost-effectiveness of routine 9vHPV vs routine 4vHPV (both sexes)

Summary of results of 3 models

Model	Incremental cost per QALY gained	
	No 4vHPV cross-protection	With 4vHPV cross-protection
HPV-ADVISE	< \$0 (cost-saving)	< \$0 (cost-saving)
Merck	< \$0 (cost-saving)	Not reported
Simplified	< \$0 (cost-saving)	\$8,600

In the scenario of 4vHPV cross-protection, 4vHPV provided partial protection against the additional 5 types in 9vHPV

Efficacy assumptions ranged from 46.2% against HPV 31 to 5.5% against HPV 58

QALY: quality-adjusted life year

HPV-ADVISE results are in 2010 US dollars; Merck model and simplified model are in 2013 US dollars

Estimate of \$8,600 differs from estimate of \$8,100 presented in February 2015 due to update of simplified model assumptions

Summary: Routine 9vHPV vaccination

- 9vHPV for both sexes (vs 4vHPV for both sexes) is likely cost-saving
 - Cost per QALY gained by 9vHPV
 - < \$0 in most scenarios
 - Did not exceed \$25,000 when exploring reasonable changes in key assumptions
- Most of the benefits of 9vHPV are due to vaccination of females

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Cost-effectiveness of additional 9vHPV

- What is the cost-effectiveness of providing 3 doses of 9vHPV to females who were previously vaccinated with 3 doses of 4vHPV?
- The 3 models used to examine routine 9vHPV vaccination were also used to examine additional 9vHPV vaccination

Age and sex of vaccine recipients

Scenario	HPV-ADVISE	Simplified	Merck
Additional 9vHPV vaccination (4vHPV recipients eligible for 9vHPV)	Females 13-18		
Routine 9vHPV vaccination	Males and females, 13-18	Males and females, 12-18	Males 13-21 and females 12-26

Impact and cost per QALY gained by additional 9vHPV vaccination

Item estimated	HPV-ADVISE		Simplified	Merck
	No 4vHPV cross protection	With 4vHPV cross protection	No 4vHPV cross protection	No 4vHPV cross protection
Number of female 4vHPV recipients given additional 9vHPV	1,065,000	1,065,000	950,300	1,109,000
Incremental cost	\$432 million	\$420 million	\$392 million	\$390 million
Incremental gain in QALYs	3,700	2,500	2,700	2,500
Incremental cost per QALY gained by additional 9vHPV	\$117,400	\$170,600	\$146,200	\$156,100

QALY: quality-adjusted life year

Additional 9vHPV: providing 3 doses of 9vHPV to prior 3-dose recipients of 4vHPV

Why is routine 9vHPV more cost-effective than additional 9vHPV?

Incremental costs and benefits	Routine 9vHPV (vs routine 4vHPV)	Additional 9vHPV for prior 4vHPV recipients (vs. no additional 9vHPV)
Incremental benefits to person vaccinated	Protection against HPV 31,33,45,52,58	
Incremental cost per dose per person vaccinated	~ \$13 (the difference in the cost per dose of 9vHPV and 4vHPV)	~ \$134 to \$163 (the cost per dose of 9vHPV)

The 9vHPV cost per dose is \$134.26 (public) and \$163.09 (private)

The 4vHPV cost per dose is \$121.03 (public) and \$147.01 (private)

Source: CDC vaccine price list: <http://www.cdc.gov/vaccines/programs/vfc/awardees/vaccine-management/price-list/index.html>

Sensitivity analyses (HPV-ADVISE model)

- Model accounts for uncertainty in natural history by applying 50 different parameter sets
 - Each parameter set is run 40+ times
 - Results differ from one model run to another due to chance
 - 80% uncertainty intervals calculated from 10th and 90th percentiles of simulations
- Because chance effects are relatively large compared to additional 9vHPV program effects, uncertainty intervals should be interpreted with caution

Cost-effectiveness of additional 9vHPV vaccination

Base case results and sensitivity analyses (HPV-ADVISE model)

HPV ADVISE Model	Cost per QALY gained by additional 9vHPV vaccination	
	Base case estimate	80% uncertainty interval
No 4vHPV cross protection	\$117,400	\$7,600 to infinity
With 4vHPV cross protection	\$170,600	\$6,800 to infinity

QALY: quality-adjusted life year.

Additional 9vHPV: providing 3 doses of 9vHPV to prior 3-dose recipients of 4vHPV.

All results are in 2013 US dollars.

Summary of cost-effectiveness of additional 9vHPV vaccination

- Cost per QALY gained by three doses of 9vHPV for prior 3-dose 4vHPV recipients
 - HPV-ADVISE: \$117,400
 - Simplified: \$146,200
 - Merck: \$156,100
- These estimates are for additional 9vHPV of females aged 13-18 years
 - Cost per QALY gained by additional 9vHPV would be higher for females > 18 years and males of any age

Conclusions

- Routine 9vHPV for both sexes is likely cost-saving
 - vs. routine 4vHPV for both sexes
- Additional 9vHPV vaccination cost > \$100,000 per QALY gained
 - Cost-effectiveness could be even less favorable than estimated

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- US HPV-ADVISE model

 - Marc Brisson, Jean-François Laprise, Mélanie Drolet

- Merck model

 - Matthew Pillsbury, Thomas Weiss, Erik Dasbach

- Simplified model

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 - Unpublished cancer-related data provided by Meg Watson, Jessica King, and Trevor Thompson

- CDC

 - Elizabeth Unger, Robin Curtis, Gui Liu

- ACIP health economics review:

 - Conflict of interest statement:

 - Chesson: No known conflicts of interest

 - For this presentation, no new models were developed

 - New results (updates and sensitivity analyses) obtained from models reviewed for previous ACIP presentations

 - Existing model structures not changed except to add additional HPV types in 9vHPV