



Cost-Effectiveness of HPV Catch-up Vaccination Program in Women Aged 13-24 Years in Low-and Middle- Income Country.

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Introduction

- Cervical cancer is an important global health problem.
- Nearly all cases are caused by exposure to the human papillomavirus or HPV.
- The US Center for Disease Control and Prevention (CDC)'s Advisory Committee on Immunization Practices (ACIP) recommends routine vaccination at the age of 11- or 12-years. Catch-up vaccination is also recommended for everyone through age 26 years.⁽¹⁾
- In Thailand, the current routine HPV vaccination program has implemented two doses of quadrivalent HPV vaccine (4vHPV) for girls at 11-12 years of age.
- The catch-up vaccination program has been successfully implemented in several countries.
- A previous study in Thailand estimated the cost-effectiveness of routine 4vHPV vaccination of 11- to 12-year-old girls and catch-up of 13- to 24-year-old females, compared with no vaccination.⁽²⁾
- The estimated cost per QALY gained (ICER) when compared to no vaccination was 8,370 THB (248.58 USD) per QALY for the routine vaccination and 9,650 THB (286.60 USD) per QALY for the routine with the catch-up vaccination strategy.

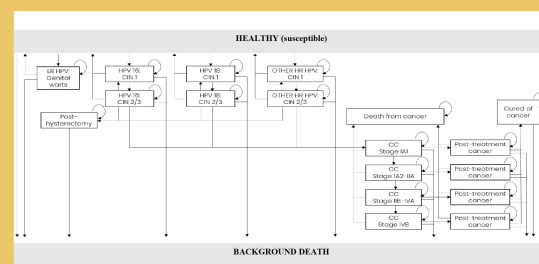
Objective

- This study aims to evaluate the public health impact and the cost-effectiveness of expanding the current routine HPV vaccination program of all available HPV vaccines to women aged 13-24 years compared with the status quo (current vaccination program).

Material and methods

- A Markov model of HPV infection and cervical cancer was adapted to Thailand's healthcare setting. (Fig1)
- The models comprise women aged 13- to 24 years old (based on previous study)⁽³⁾, who moved through eight different health states; healthy, HPV infection, genital wart, CIN2/3, cancer, post-treatment cancer, cured of cancer, and death.
- We compared catch-up cohorts with four types of available HPV vaccines in Thailand: (1) bivalent (Cervarix®, GlaxoSmithKline), (2) bivalent (Cecolin®, Inovax, China), (3) quadrivalent (Gardasil®, Merck & Co, USA), and (4) nonavalent (Gardasil9®, Merck & Co, USA).), and (5) no vaccination.
- The incidence rate, mortality rate, and probabilities of annual transition in each stage were derived from previous published literature and expert opinions.
- Direct medical costs included the cost of vaccination, screening, treatment, and follow-up of HPV-related diseases, which were obtained from our previous articles⁽²⁾ and then inflated to reflect value in 2023.
- All costs and outcomes were discounted at a rate of 3%
- The outcomes included the number of new cancer cases, cancer-related deaths, quality-adjusted life years (QALYs), and incremental cost-effectiveness ratios (ICERs) of each strategy from a healthcare perspective.
- The interpretation of ICER was based on the Thai willingness-to-pay (WTP) threshold of 160,000 THB (4,552.50 USD) per QALY gained for reimbursing new life-saving treatment.⁽⁴⁾

Figure1. A Markov model of natural history of HPV infection and progression to cervical cancer



Results

- Compared to no vaccination (status quo), the model showed that catch-up vaccination programs decreased the incidence of cervical cancer cases and cancer-related deaths by 44.9-63.4% over a lifetime. (Fig2)
- Vaccinating with 2vHPV (Cervarix®), 2vHPV (Cecolin®), 4vHPV (Gardasil®), and 9vHPV (Gardasil9®) resulted in decremental costs of 3,094, 3,378, 3,118, and 2,847 THB (88.03, 96.11, 88.72, 81.01 USD) per capita and incremental benefits of 0.29, 0.30, 0.32 and 0.45 QALYs, compared to no vaccination, respectively.
- Based on the incremental analysis, 9vHPV was the most cost-effective intervention with the ICER of 3,661.38 THB (104.19 USD) per QALY after excluding extended-dominated comparators, compared to 2vHPV (Cecolin®). (table1)
- Figure 3 shows the results of probabilistic sensitivity analysis in the cost-effectiveness plane. Most iterations of the 9vHPV vaccine showed additional costs and cost-saving compared to a no-vaccination program and 2vHPV (Cecolin®) vaccine.
- If willingness to pay is equal to 160,000 THB (4,552.50 USD) per QALY, a catch-up program with the 9vHPV vaccine is the most likely strategy to be considered cost-effective with a probability of 100% and 99.3% compared to no vaccination program and 2vHPV (Cecolin®) vaccine, respectively.

Figure 2. Incidence of new cases of HPV-related disease and deaths per 100,000 women

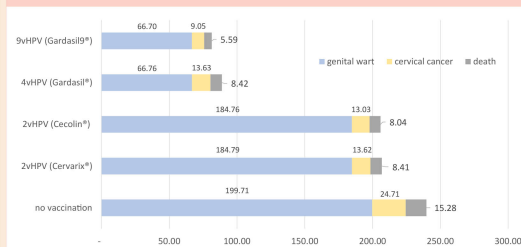
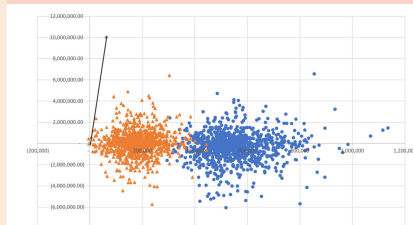


Table1. Base case results of health impact (Incremental analysis)

Vaccine	Total costs (THB)	Total Effectiveness (QALYs)	ICER (THB/QALY)
No vaccination	2,928,863,710.00	27,924,426.1	Dominated
2vHPV (Cervarix®)	9,200,654,579.89	28,268,046.56	Extended dominated
2vHPV (Cecolin®)	8,859,363,274.08	28,287,526.9	(115,494)
4vHPV (Gardasil®)	9,075,533,672.40	28,306,792.96	Extended dominated
9vHPV (Gardasil9®)	9,496,982,394.71	28,461,673.40	3,661.38

Figure 3. Incremental costs (thousand THB) and incremental effectiveness (QALYs) of 9v HPV (Gardasil9®) compared to no vaccination (blue circle) and compared to 2vHPV (Cecolin®), (orange triangle). The dashed line indicates a willingness-to-pay (WTP) threshold set at 160,000THB



Conclusions

- All catch-up vaccination programs in women aged 13 to 24 years produce additional health benefits with reduced overall healthcare costs.
- Vaccination with 9vHPV was considered the most cost-effective option with the current willingness-to-pay threshold of 160,000 THB (4,552.50 USD) per QALY. (1 USD=33.67 THB).
- Our analysis informs policymakers of the potential benefits of this program in the Thai population.

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