



AN INVESTMENT CASE STUDY ON HPV VACCINATION IN VIET NAM

Currently, cervical cancer remains a public health concern that continues to threaten the welfare and well-being of women and the population as a whole. According to a recent report by UNFPA and the Cancer Council NSW (2020), cervical cancer is the sixth most common cancer in women in Viet Nam, with 4,177 new cases (7.1 per 100,000 women) and 2,420 deaths (4.0 per 100,000 women) in 2018. The burden of cervical cancer varies among regions in Viet Nam with higher rates in southern regions.

Infection with the human papilloma virus (HPV) is the major cause of cervical cancer and its associated deaths, and a significant cause of vaginal and vulvar cancers in women, penile cancer in men, and anal, head and neck cancers, genital warts and recurrent respiratory papillomatosis (RRP) in both men and women. Evidence from international studies also confirms that a strategic combination of a sufficient coverage of HPV vaccination for adolescent girls and a sufficient coverage of cervical screening and an appropriate treatment for all women can eliminate cervical cancer as a public health problem within our lifetime. Unfortunately, in Vietnam, the HPV vaccination rate and the cervical cancer screening rate are low. Our study in 2021 shows that only 12% of women and girls aged 15-29 are vaccinated, and only 28% of women aged 30-49 have been screened so far.

Objectives of the study

1. To estimate costs and benefits of different investment scenarios on HPV vaccination, cervical cancer screening and treatment.
2. To analyse investment returns of alternative strategies on HPV vaccination, cervical cancer screening and treatment.
3. To estimate the timeline for eliminating cervical cancer in the country by different investment options.

Methods

This study applies both epidemiological and economic models to estimate health and cost outcomes. Policy1-Cervix is a dynamic model of HPV transmission, HPV vaccination, cervical precancer, cancer survival, screening, diagnosis, and treatment (Figure 1). The economic model estimates the return on investment from each scenario (Figure 2).

Figure 1: Policy1-Cervix model platform

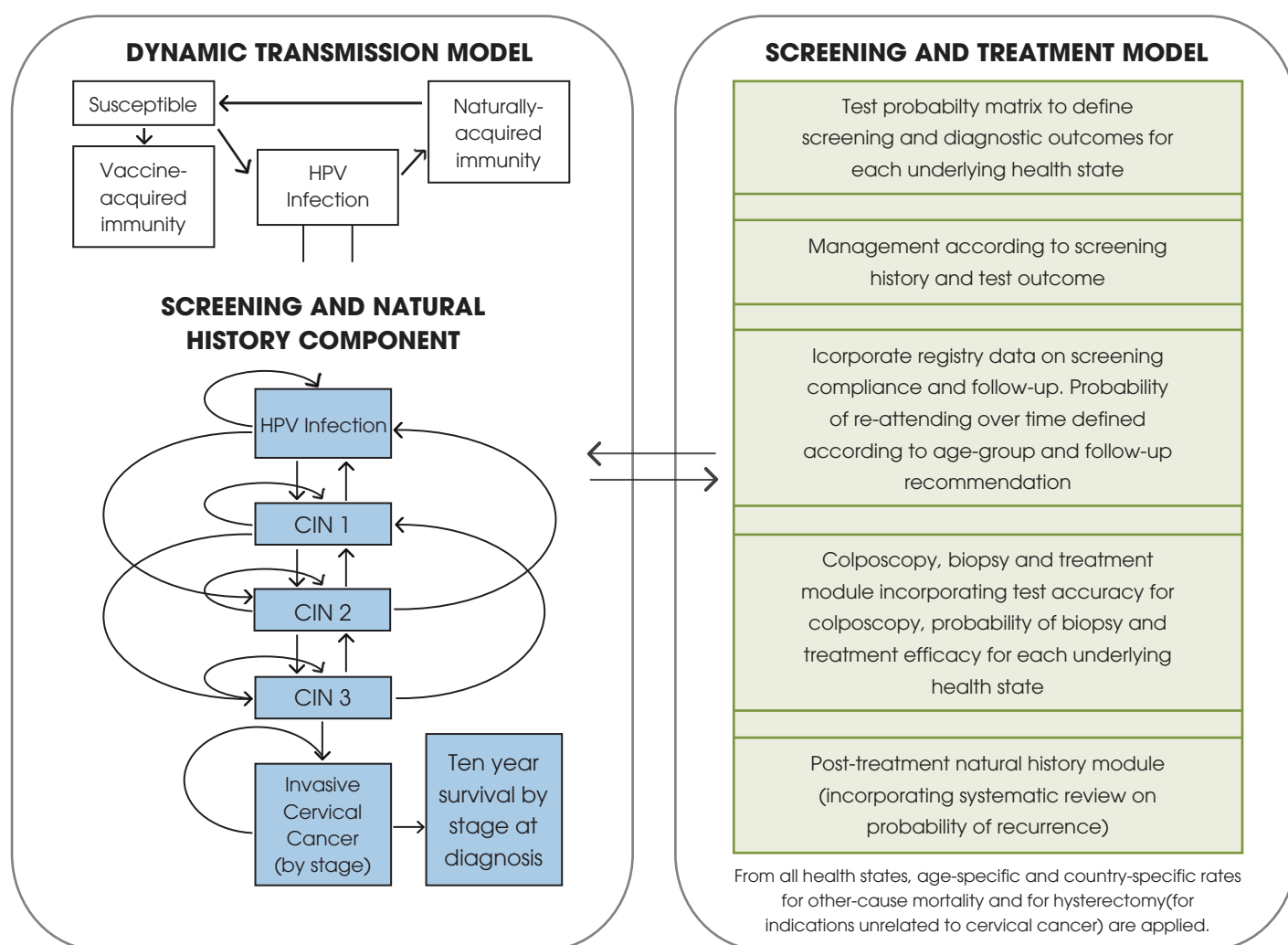
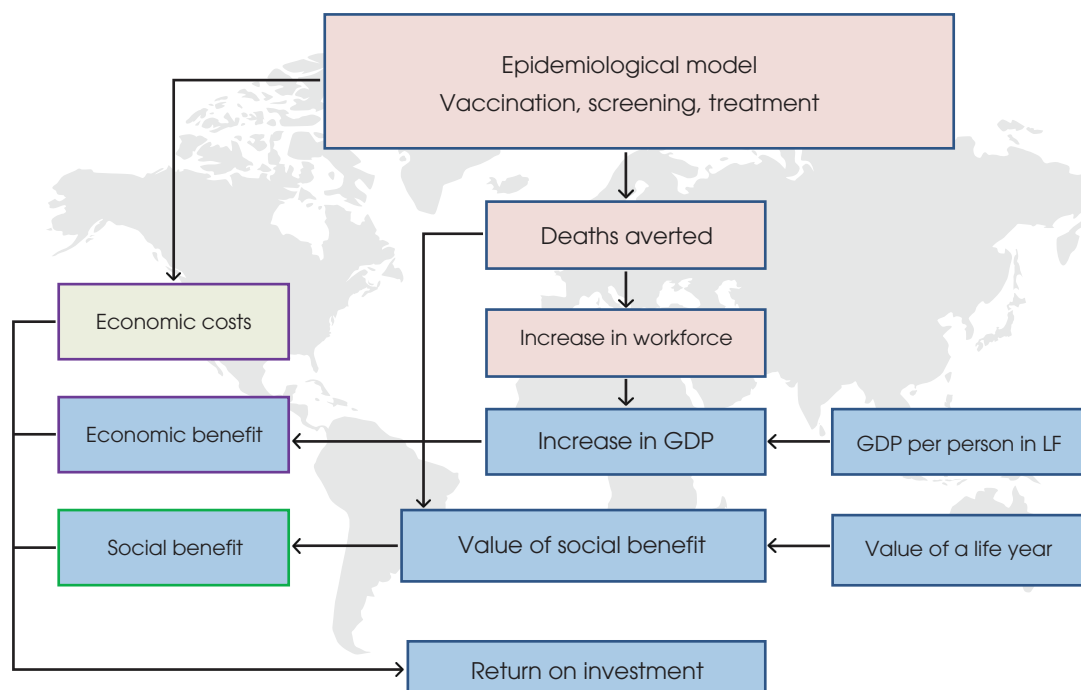
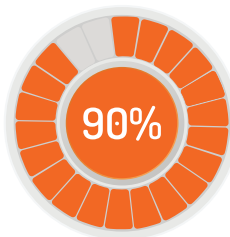


Figure 2: Return on investment model



KEY FINDINGS

IF



Vaccination coverage in girls

(Scenario 1)



Status-quo screening and cancer treatment

Cost: 540 million US\$

Economic benefit: 4,344 million US\$

Social benefit: 3,182 million US\$

THEN

2-doses of the female HPV vaccine are **cost-effective** at US\$6.50 per dose (ICER=US\$136/Life-years saved (LYS) or US\$15.00 per dose (ICER=US\$281/LYS)

Predicted to prevent **149,342** cancer cases and **108,926** cancer deaths by 2100 compared to status-quo (Scenario 0)

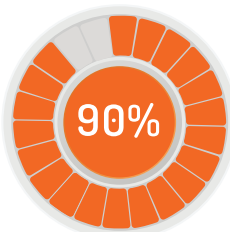
✗ Elimination can be reached by **2084**

Economic benefit-cost ratio: 8

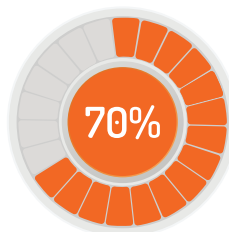
Economic and social benefit-cost ratio: 13.9

This scenario will return 8 times its cost in economic benefits, and 13.9 times its cost in combined economic and social benefits.

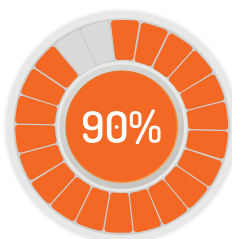
IF



vaccination coverage in girls



coverage of 10-yearly HPV-based screening



cancer treatment scale-up
(Scenario 6)

Cost: 1,657 million US\$

Economic benefit: 10,747 million US\$

Social benefit: 9,722 million US\$

THEN

Female HPV vaccination is **cost-effective** at either US\$6.50 per-dose (ICER=US\$738/LYS) or US\$15.00 per-dose (ICER=US\$1,547/LYS)

Predicted to prevent **286,006** cancer cases and **301,846** cancer deaths by 2100 compared to status-quo.

✗ Elimination can be reached by **2055**

(29 years earlier compared to female HPV vaccination only)

Adding males at 60% coverage is not **cost-effective**, and is predicted to prevent additional 702 deaths (+0.2%) by 2100. It has no noticeable impact on the timing of elimination, and reduces return on investment benefits, compared to female-only vaccination.

Economic benefit-cost ratio: 6.5







Economic and social benefit-cost ratio: 12.4

This scenario will return 6.5 times its cost in economic benefits, and 12.4 times its cost in combined economic and social benefits.

HPV vaccination alone will not show its impact in the first 3-4 decades. Scaling up screening and treatment services will be crucial for women who have missed the chance to receive the vaccine, so that they can be screened and treated as needed. Therefore, triple pillar interventions are necessary.

KEY FINDINGS

IF considering only:

 10-yearly HPV screening and treatment scale up (Scenario 5) <i>*Three times in a lifetime</i>	OR	 3-yearly VIA screening and treatment scale up (Scenario 12) <i>*Seven times in a lifetime</i>	OR	 5-yearly cytology screening and treatment scale up (Scenario 13) <i>*Five times in a lifetime</i>
 Cost-effective		 Not cost-effective		 Not cost-effective
Number needed to treat: 15 <i>*fewer screening visits</i> <i>*fewer number of pre-cancer treatment required</i>		Number needed to treat: 197		Number needed to treat: 11

These 3 scenarios are predicted to achieve a similar impact on reduction of cervical cancer incidence and mortality rates

However, all strategies which consider only screening and treatment scale up **do not achieve elimination of cervical cancer.**

Table 1: Cost, benefits and return on investment of different scenarios

Scenario name	Economic benefit	Social benefit	Cost	Economic benefit-cost ratio	Economic and social benefit-cost ratio
	US\$ million	US\$ million	US\$ million		
1. HPV4 vaccination for girls (90%) at current screening and treatment	4,344	3,182	540	8.0	13.9
2. HPV4 vaccination for girls (50%) at current screening and treatment	2,812	2,087	295	9.5	16.6
3. HPV4 vaccination for girls (90%) and boys (60%) at current screening and treatment	4,466	3,283	984	4.5	7.9
4. HPV4 vaccination for girls (50%) and boys (20%) at current screening and treatment	3,044	2,255	433	7.0	12.2
5. 10-yearly HPV screening and treatment scale up	9,936	9,186	1,005	9.9	19.0
6. HPV4 vaccination for girls (90%), at 10 - yearly HPV screening and treatment scale up	10,747	9,722	1,657	6.5	12.4
7. HPV4 vaccination for girls (50%), at 10 - yearly HPV screening and treatment scale up	10,441	9,521	1,362	7.7	14.7
8. HPV4 vaccination for girls (90%) & boys (60%), at 10-yearly HPV screening and treatment scale up	10,766	9,736	2,181	4.9	9.4
9. HPV4 vaccination for girls (50%) and boys (20%), at 10-yearly HPV screening and treatment scale up	10,498	9,559	1,537	6.8	13.0
10. HPV4 vaccination for girls (90%), at 3 - yearly VIA screening & treatment scale up	10,976	9,787	1,536	7.1	13.5
11. HPV4 vaccination for girls (90%), at 5 - yearly cytology screening & treatment scale up	11,078	9,949	1,686	6.6	12.5
12. 3-yearly VIA screening and treatment scale up	10,133	9,226	912	11.1	21.2
13. 5-yearly cytology screening and treatment scale up	10,332	9,460	1,062	9.7	18.6

Depending on the extent and composition of the program, it will reduce the number of deaths among women from cervical cancer by up to 300,000.

The program will return between around 5 and 11 times its cost in economic benefits and between 8 and 20 times its cost in combined economic and social benefits.

Table 2: Effectiveness, cost-effectiveness, return of investment and timelines for cervical cancer elimination

Scenario name	Incidence ASR* (% reduction)	Mortality ASR* (% reduction)	Cumulative cervical cancer cases averted 2023-2100	Cumulative cervical cancer deaths averted 2023-2100	2-dose ICER US\$/LYS (life-years saved)		Benefit-cost ratio (Economic benefit)	Benefit-cost ratio (Economic and social benefit)	Time for elimination of cervical cancer
					\$6.5	\$6.5, then \$15/dose			
0. Current screening and treatment (status quo)	7.9	5.7	-	-	-	-	-	-	2100 – Cannot reach elimination
1. HPV4 vaccination for girls (90%) at current screening and treatment	2.7 (65.7%)	1.9 (66.5%)	149,342	108,926	\$136	\$281	8.0	13.9	2084
2. HPV4 vaccination for girls (50%) at current screening and treatment	4.8 (39.5%)	3.4 (39.5%)	91,997	67,017	\$125	\$262	9.5	16.6	2100 – Cannot reach elimination
3. HPV4 vaccination for girls (90%) and boys (60%) at current screening and treatment	2.6 (67.5%)	1.8 (67.9%)	154,335	112,439	\$4,640	\$8,463	4.5	7.9	2083
4. HPV4 vaccination for girls (50%) and boys (20%) at current screening and treatment	4.5 (43.4%)	3.3 (42.8%)	101,274	73,598	\$717	\$1,347	7.0	12.2	2100 – Cannot reach elimination
5. 10-yearly HPV screening and treatment scale up only	3.3	1.1	226,724	282,403	\$164 *in unvaccinated cohorts *no vaccination costs		9.9	19.0	2100 – Cannot reach elimination
6. HPV4 vaccination for girls (90%), at 10-yearly HPV screening and treatment scale up	1.3 (83.2%)	0.4 (92.5%)	286,006	301,846	\$738	\$1,547	6.5	12.4	2055
7. HPV4 vaccination for girls (50%), at 10-yearly HPV screening and treatment scale up	2.1 (73.5%)	0.7 (87.9%)	263,511	294,551	\$666	\$1,426	7.7	14.7	2060
8. HPV4 vaccination for girls (90%) & boys (60%), at 10-yearly HPV screening and treatment scale up	1.3 (83.2%)	0.4 (92.5%)	288,946	302,548	not cost-effective	not cost-effective	4.9	9.4	2055
9. HPV4 vaccination for girls (50%) and boys (20%), at 10-yearly HPV screening and treatment scale up	2.0 (74.8%)	0.7 (88.6%)	267,761	296,076	\$3,207	\$5,978	6.8	13.0	2059
10. HPV4 vaccination for girls (90%), at 3-yearly VIA screening & treatment scale up	1.4 (82.2%)	0.4 (92.8%)	276,094	300,382	not cost-effective	not cost-effective	7.1	13.5	2057
11. HPV4 vaccination for girls (90%), at 5-yearly cytology screening & treatment scale up	1.3 (83.1%)	0.4 (92.8%)	288,201	305,285	not cost-effective	not cost-effective	6.6	12.5	2055
12. 3-yearly VIA screening and treatment scale up	3.4 (56.7%)	1.0 (81.9%)	209,945	279,849	not cost-effective *in unvaccinated cohorts		11.1	21.2	2100 – Cannot reach elimination
13. 5-yearly cytology screening and treatment scale up	3.2 (58.7%)	1.0 (82.2%)	226,699	287,074	not cost-effective *in unvaccinated cohorts		9.7	18.6	2100 – Cannot reach elimination

Table 3: Estimated annual and 5-yearly financial costs (undiscounted) of different strategies in Viet Nam, US\$

Scenario name	Annual undiscounted financial costs	5-yearly undiscounted financial costs
0. Current screening and treatment (status quo)	\$152,301,839	\$795,317,189
1. HPV4 vaccination for girls (90%) at current screening and treatment	\$217,875,943	\$1,089,379,716
2. HPV4 vaccination for girls (50%) at current screening and treatment	\$192,158,524	\$960,792,618
3. HPV4 vaccination for girls (90%) and boys (60%) at current screening and treatment	\$258,710,761	\$1,293,553,807
4. HPV4 vaccination for girls (50%) and boys (20%) at current screening and treatment	\$205,096,469	\$1,025,482,345
5. 10-yearly HPV screening and treatment scale up only	\$252,070,208	\$1,260,351,038
6. HPV4 vaccination for girls (90%), at 10 - yearly HPV screening and treatment scale up	\$311,222,548	\$1,556,112,741
7. HPV4 vaccination for girls (50%), at 10 - yearly HPV screening and treatment scale up	\$285,373,172	\$1,426,865,860
8. HPV4 vaccination for girls (90%) & boys (60%), at 10-yearly HPV screening and treatment scale up	\$351,953,892	\$1,759,769,460
9. HPV4 vaccination for girls (50%) and boys (20%), at 10-yearly HPV screening and treatment scale up	\$298,506,938	\$1,492,534,692
10. HPV4 vaccination for girls (90%), at 3 - yearly VIA screening & treatment scale up	\$307,893,528	\$1,539,467,642
11. HPV4 vaccination for girls (90%), at 5 - yearly cytology screening & treatment scale up	\$341,841,456	\$2,013,620,097
12. 3-yearly VIA screening and treatment scale up only	\$246,552,348	\$1,232,761,740
13. 5-yearly cytology screening and treatment scale up only	\$341,841,456	\$1,714,207,283



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