

Supplementary File

Table of Contents

Figure S1. Overview of simulation models	4
Figure S2. Delivery cost assumptions.....	11
Figure S3. Annual number of cervical cancer cases averted: varying campaign frequency (Panel A) and varying target age group (Panel B), assuming 15-year boost to duration of protection.....	13
Table S1. Discounted ^a incremental costs, disability-adjusted life years (DALYs) averted and cost-effectiveness of campaign one-dose ^b HPV vaccination strategies versus routine one-dose ^b and two-dose HPV vaccination with full treatment costs	14
S1a. Assuming lifelong duration of protection and campaign coverage of 20% (base case: 40% coverage)	14
S1b. Assuming lifelong duration of protection and campaign coverage of 40% (base case).....	14
S1c. Assuming lifelong duration of protection and campaign coverage of 60% (base case: 40% coverage)	15
Table S2. Discounted ^a incremental costs, disability-adjusted life years (DALYs) averted and cost-effectiveness of campaign one-dose ^b HPV vaccination strategies versus routine one-dose ^b and two-dose HPV vaccination with full treatment costs	16
S2a. Assuming 15-year boost to duration of protection and campaign coverage of 20% (base case: lifelong protection and 40% coverage).....	16
S2b. Assuming 15-year boost to duration of protection and campaign coverage of 40% (base case: lifelong protection)	16
S2c. Assuming 15-year boost to duration of protection and campaign coverage of 60% (base case: lifelong protection and 40% coverage).....	17
Table S3. Discounted ^a incremental costs, disability-adjusted life years (DALYs) averted and cost-effectiveness of campaign one-dose ^b HPV vaccination strategies versus routine one-dose ^b and two-dose HPV vaccination with full treatment costs and campaign delivery costs of \$0.70 per girl	18
S3a. Assuming lifelong duration of protection and campaign coverage of 20% (base case: campaign delivery costs of \$1.00 per girl and 40% coverage)	18
S3b. Assuming lifelong duration of protection and campaign coverage of 40% (base case: campaign delivery costs of \$1.00 per girl).....	18
S3c. Assuming lifelong duration of protection and campaign coverage of 60% (base case: campaign delivery costs of \$1.00 per girl and 40% coverage)	19
Table S4. Discounted ^a incremental costs, disability-adjusted life years (DALYs) averted and cost-effectiveness of campaign one-dose ^b HPV vaccination strategies versus routine one-dose ^b and two-dose HPV vaccination with full treatment costs and campaign delivery costs of \$1.20 per girl	20
S4a. Assuming lifelong duration of protection and campaign coverage of 20% (base case: campaign delivery costs of \$1.00 per girl and 40% coverage)	20
S4b. Assuming lifelong duration of protection and campaign coverage of 40% (base case: campaign delivery costs of \$1.00 per girl).....	20
S4c. Assuming lifelong duration of protection and campaign coverage of 60% (base case: campaign delivery costs of \$1.00 per girl and 40% coverage)	21
Table S5. Discounted ^a incremental costs, disability-adjusted life years (DALYs) averted and cost-effectiveness of campaign one-dose ^b HPV vaccination strategies versus routine one-dose ^b and two-dose HPV vaccination with full treatment costs and campaign delivery costs of \$1.00 per girl for ages 9-14 years and \$1.70 per girl for ages 15 years and higher	22

S5a. Assuming lifelong duration of protection and campaign coverage of 20% (base case: campaign delivery costs of \$1.00 per girl and 40% coverage)	22
S5b. Assuming lifelong duration of protection and campaign coverage of 40% (base case: campaign delivery costs of \$1.00 per girl).....	22
S5c. Assuming lifelong duration of protection and campaign coverage of 60% (base case: campaign delivery costs of \$1.00 per girl and 40% coverage)	23
Table S6. Discounted ^a incremental costs, disability-adjusted life years (DALYs) averted and cost-effectiveness of campaign one-dose ^b HPV vaccination strategies versus routine one-dose ^b and two-dose HPV vaccination with cancer treatment costs incurred by 8.5% of women with cancer based on level of treatment access	24
S6a. Assuming lifelong duration of protection and campaign coverage of 20% (base case: cancer treatment costs incurred by 100% of women with cancer and 40% coverage)	24
S6b. Assuming lifelong duration of protection and campaign coverage of 40% (base case: cancer treatment costs incurred by 100% of women with cancer)	24
S6c. Assuming lifelong duration of protection and campaign coverage of 60% (base case: cancer treatment costs incurred by 100% of women with cancer and 40% coverage)	25
Table S7. Discounted ^a incremental costs, disability-adjusted life years (DALYs) averted and cost-effectiveness of campaign one-dose ^b HPV vaccination strategies versus routine one-dose ^b and two-dose HPV vaccination with 60% one-dose and 80% two-dose efficacy for girls ages 19 and older.....	26
S7a. Assuming lifelong duration of protection and campaign coverage of 20% (base case: one-dose efficacy of 80%, two-dose efficacy of 100%, and 40% coverage).....	26
S7b. Assuming lifelong duration of protection and campaign coverage of 40% (base case: one-dose efficacy of 80% and two-dose efficacy of 100%)	26
S7c. Assuming lifelong duration of protection and campaign coverage of 60% (base case: one-dose efficacy of 80%, two-dose efficacy of 100%, and 40% coverage).....	27
Table S8. Discounted ^a incremental costs, disability-adjusted life years (DALYs) averted and cost-effectiveness of campaign one-dose ^b HPV vaccination strategies versus routine one-dose ^b and two-dose HPV vaccination with 40% one-dose and 60% two-dose efficacy for girls ages 19 and older.....	28
S8a. Assuming lifelong duration of protection and campaign coverage of 20% (base case: one-dose efficacy of 80%, two-dose efficacy of 100%, and 40% coverage).....	28
S8b. Assuming lifelong duration of protection and campaign coverage of 40% (base case: one-dose efficacy of 80% and two-dose efficacy of 100%)	28
S8c. Assuming lifelong duration of protection and campaign coverage of 60% (base case: one-dose efficacy of 80%, two-dose efficacy of 100%, and 40% coverage).....	29
Table S9. Discounted ^a incremental costs, disability-adjusted life years (DALYs) averted and cost-effectiveness of campaign one-dose ^b HPV vaccination strategies versus routine one-dose ^b and two-dose HPV vaccination with 20% one-dose and 40% two-dose efficacy for girls ages 19 and older.....	30
S9a. Assuming lifelong duration of protection and campaign coverage of 20% (base case: one-dose efficacy of 80%, two-dose efficacy of 100%, and 40% coverage).....	30
S9b. Assuming lifelong duration of protection and campaign coverage of 40% (base case: one-dose efficacy of 80% and two-dose efficacy of 100%)	30
S9c. Assuming lifelong duration of protection and campaign coverage of 60% (base case: one-dose efficacy of 80%, two-dose efficacy of 100%, and 40% coverage).....	31

Table S10. Discounted^a incremental costs, disability-adjusted life years (DALYs) averted and cost-effectiveness of campaign one-dose^b HPV vaccination strategies versus routine one-dose^b and two-dose HPV vaccination with 0% one-dose and 20% two-dose efficacy for girls ages 19 and older.....32

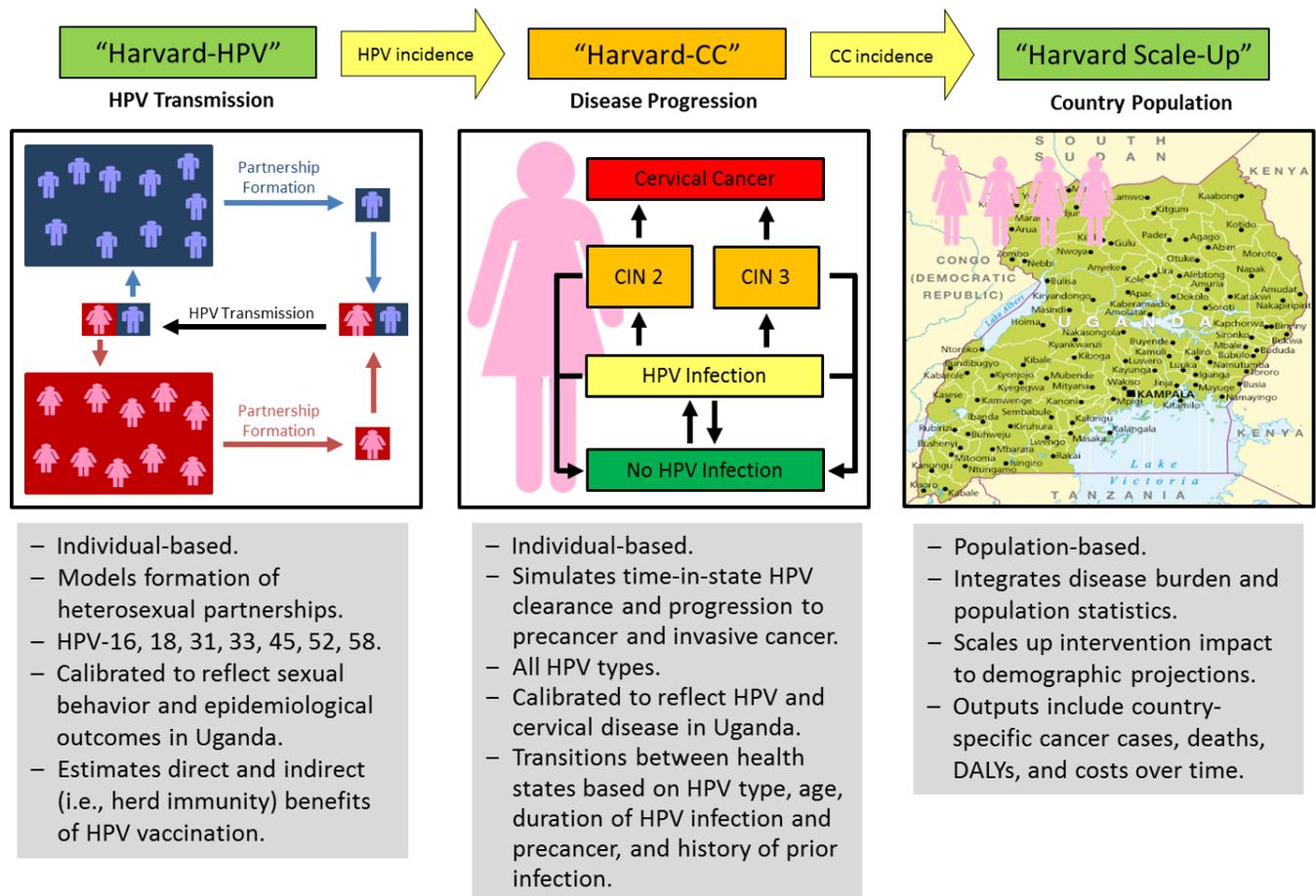
S10a. Assuming lifelong duration of protection and campaign coverage of 20% (base case: one-dose efficacy of 80%, two-dose efficacy of 100%, and 40% coverage).....32

S10b. Assuming lifelong duration of protection and campaign coverage of 40% (base case: one-dose efficacy of 80% and two-dose efficacy of 100%)32

S10c. Assuming lifelong duration of protection and campaign coverage of 60% (base case: one-dose efficacy of 80%, two-dose efficacy of 100%, and 40% coverage).....33

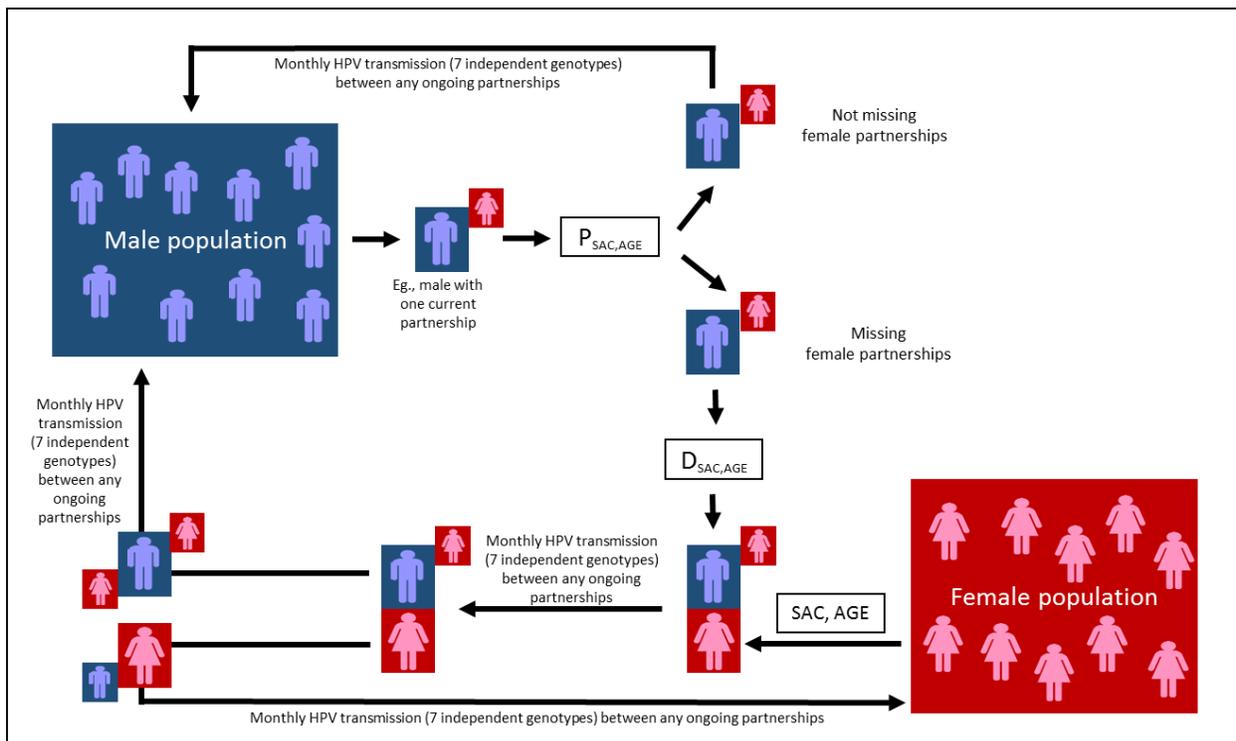
Figure S1. Overview of simulation models

As previously described [1], we used a multi-modeling approach involving the linkage of a dynamic transmission model of HPV transmission (“Harvard-HPV”), an individual-based model of cervical carcinogenesis (“Harvard-CC”) and a companion multi-country population model (“Harvard-Scale Up”) to project the population health and economic consequences for alternative HPV vaccination scenarios for women over time. Harvard-HPV, Harvard-CC, and Harvard-Scale Up can be used independently, or they can be linked to include direct and indirect benefits from HPV vaccination, and synergies between vaccination and long-term vaccination benefits. Harvard-HPV is an agent-based model that simulates heterosexual HPV transmission and projects the impact of HPV vaccination policy on HPV incidence and prevalence among men and women. Model outputs from Harvard-HPV can inform the complex natural history model of cervical squamous cell carcinoma (Harvard-CC), which simulates individual women from an early age over their lifetime through health states including no HPV infection, HPV infection status, cervical precancer (i.e., cervical intraepithelial neoplasia grade 2 or 3) and cancer. Harvard-Scale Up is a multi-cohort, Excel-based companion model used to capture current and future health and economic benefits at the population level taking into account changing demographics (e.g., population size, mortality rates) over time.



Abbreviations. CC: cervical cancer, CIN: Cervical intraepithelial neoplasia, HPV: Human papillomavirus

Schematic of the agent-based model of HPV transmission (“Harvard-HPV”). The agent-based dynamic model simulates heterosexual partnership acquisition and dissolution, and independent transmission of seven HPV genotypes (HPV-16, -18, -31, -33, -45, -52, -58). Individuals are stratified by sex, age, and sexual activity category (SAC; four categories: none (0); low (1); medium (2); high (3)), which govern initial sexual mixing in the population. Each month, individuals in the model cycle through four steps: (1) sexual mixing; (2) HPV infection; (3) HPV clearance and natural immunity; (4) aging, births, and deaths. For each male in the population, the annual number of partnerships (P) is assigned as a function of SAC and age. Partnership assessment occurs at the start of each year of each male’s life, and any new partnerships are formed randomly during the course of the upcoming year. For males who are missing one or more female partner(s), a new partnership is formed, with the duration (D) of each partnership randomly drawn from age- and SAC-specific normal distributions. HPV transmission may occur between discordant partners. Sex-specific clearance of an HPV infection allows HPV natural immunity to increase exponentially with each acquisition and clearance of the same HPV genotype. Individuals are eligible to form another partnership, irrespective of ongoing partnerships. Model version 3.06.



For the current analysis, we adapted the our dynamic model of HPV transmission [1] to reflect sexual mixing behavior in Uganda. Baseline inputs on sexual behavior were derived from the Ugandan Demographic Health Survey (2016) and fit to Ugandan-specific HPV prevalence among females [2,3] and males [4]. For females calibration targets included an IARC study among women aged 15-24 years and adjusted START-UP prevalence by age and HPV genotype (Odida proportion, RLU cutoff 0.5) [2,3]. For males, calibration targets include a study among uncircumcised men aged 15-49 years in Rakai (HIV+: 30%) [4].

Baseline sexual mixing inputs for each setting varied by the number of heterosexual partnerships in the last 12 months by age and four sexual activity categories (SACs), the duration of heterosexual partnerships by age and SAC, and assortativeness by age (probability of finding partnerships within age bucket, one age-bucket older or one age-bucket younger) and SAC (probability of mixing with partner in the same SAC). Baselines inputs, including HPV genotype-specific natural immunity and monthly transmission probabilities were fit (i.e., calibrated) to lifetime number of partnerships, and age- and genotype-specific HPV prevalence. Our multi-parameter calibration approach, which has been explained previously, involves a likelihood-based approach to fit to HPV prevalence by uniformly varying the sex- and genotype-specific natural immunity, and uniformly varying the sex- and genotype-specific monthly partnership transmission probability [5]. Following 100,000 model draws, we identified the 50 best-fitting parameters sets that fit to the calibration targets (see figures below). Analyses were performed using the best-fitting parameter set.

Mean annual number of male partnerships^a as a function of age and sexual activity category (Uganda DHS 2016). Number of partnerships were adjust to balance those reported by females.

Age, Years	SAC1-mean	SAC2-mean	SAC3-mean	SAC4-mean
12-14	0	0	1	3
15-24	0	1	3	10
25-49	0	1	3	12
50-59	0	1	3	13

Abbreviations: HPV, human papillomavirus; SAC, Sexual activity category.

^aValues are rounded to nearest discrete value.

Monthly duration of male sexual partnership, by age and sexual activity category (SAC) (Uganda DHS 2016).

Age, Years	SAC1-mean	SAC2-mean	SAC3-mean	SAC4-mean
10-14 ^a	0	0	6	6
15-19	0	24	12	6
20-24	0	24	12	6
25-29	0	36	18	6
30-34	0	42	24	12
35-39	0	60	60	24
40-59	0	127.5	106.5	77

Assortativeness sexual mixing parameter by age (Uganda DHS 2016).

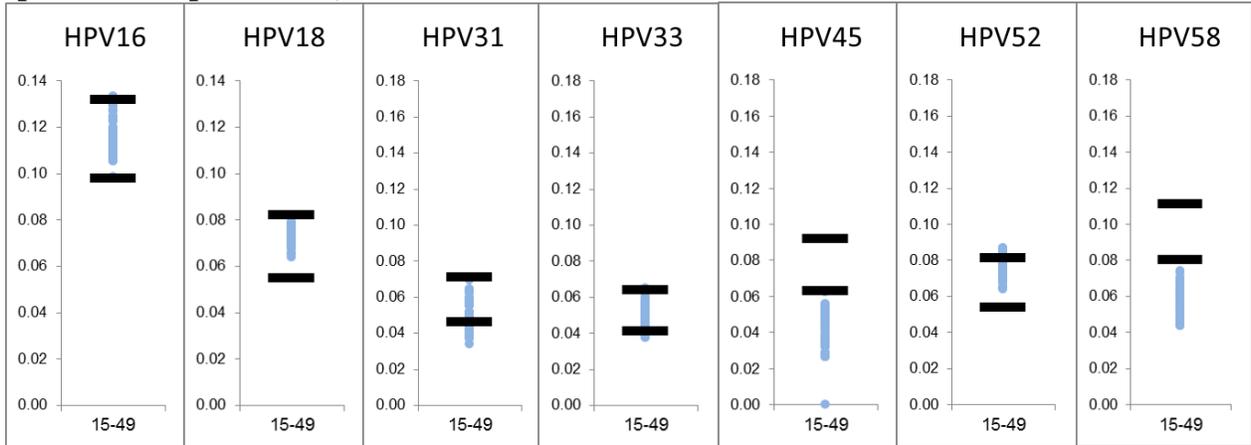
Parameter, males	Value
Probability partner within age bucket	0.2282
Probability partner one age bucket younger	0.0362
Probability partner one age bucket older	0.4630

Calibrated parameter set used in analysis.

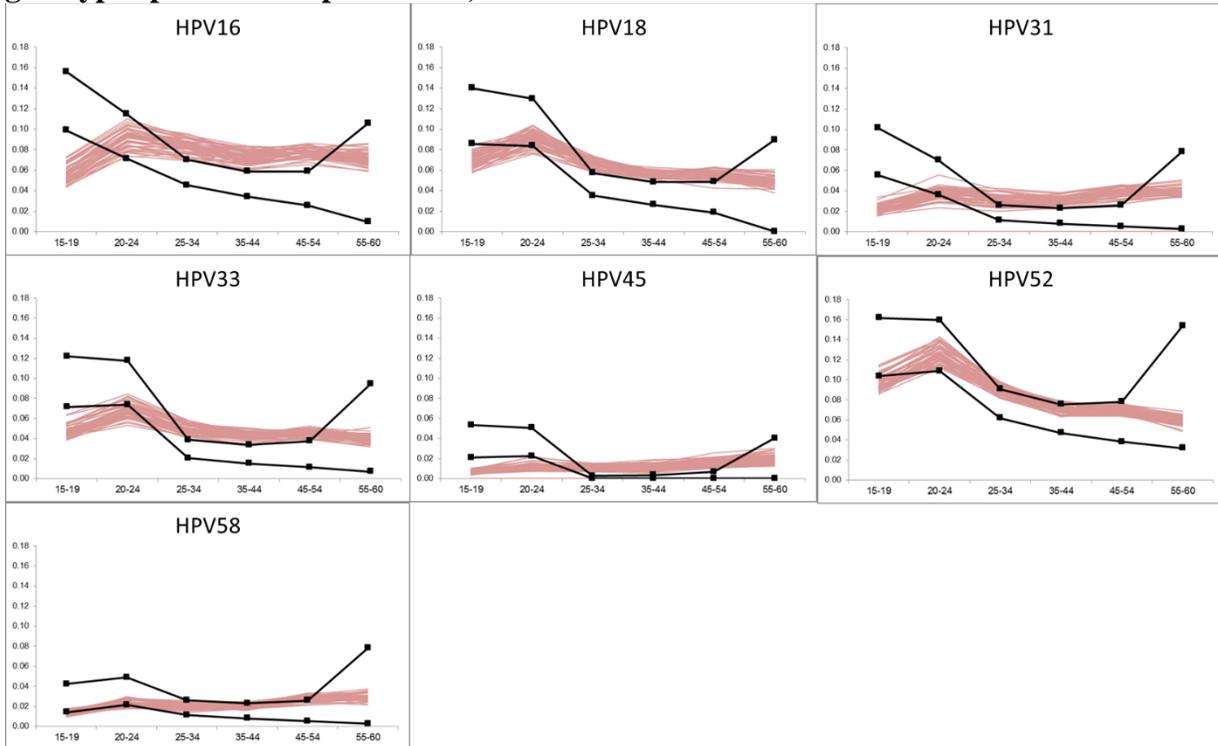
Calibration parameter	Search range	Best-fitting parameter set
Male to female HPV transmission, monthly per partner		
HPV 16	0.01-female	0.010412

HPV 18	0.01-female	0.03716
HPV 31	0.01-female	0.010496
HPV 33	0.01-female	0.028631
HPV 45	0.01-female	0.010896
HPV 52	0.01-female	0.052502
HPV 58	0.01-female	0.010965
Female to male HPV transmission, monthly per partner		
HPV 16	0.01-0.10	0.061951
HPV 18	0.01-0.10	0.082025
HPV 31	0.01-0.10	0.054081
HPV 33	0.01-0.10	0.071582
HPV 45	0.01-0.10	0.086559
HPV 52	0.01-0.10	0.06263
HPV 58	0.01-0.10	0.084088
Natural immunity, males		
HPV 16	0.00-0.10	0.016181
HPV 18	0.00-0.10	0.076011
HPV 31	0.10-0.50	0.045512
HPV 33	0.10-0.50	0.043114
HPV 45	0.10-0.50	0.067366
HPV 52	0.10-0.50	0.094761
HPV 58	0.10-0.50	0.060315
Natural immunity, females		
HPV 16	0.10-0.50	0.467665
HPV 18	0.10-0.50	0.480271
HPV 31	0.10-0.50	0.47295
HPV 33	0.10-0.50	0.498096
HPV 45	0.10-0.50	0.475061
HPV 52	0.10-0.50	0.491974
HPV 58	0.10-0.50	0.492951
Abbreviations: HPV, human papillomavirus		

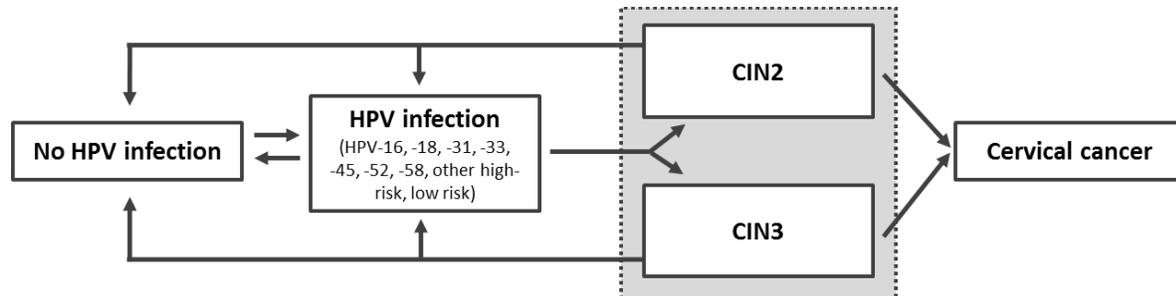
Harvard-HPV calibration targets (black bars) [4] and model fit (blue dots) to genotype-specific HPV prevalence, Males.



Harvard-HPV calibration targets (black lines) [2, 3] and model fit (red lines) to age- and genotype-specific HPV prevalence, Females.



Schematic of the microsimulation model of HPV and cervical cancer carcinogenesis (“Harvard-CC”). HPV infections and precancer are stratified by genotype (16, 18, 31, 33, 45, 52, 58, other high-risk genotypes, and non-high-risk genotypes). Baseline model input parameters (prior to calibration to epidemiological settings) were derived from large, empirical studies [6-9]. For example, HPV clearance and progression rates were based on primary data from the Costa Rica Vaccine Trial. High-grade precancerous health states (i.e., CIN2 and CIN3) were considered as heterogeneous entities with differential probabilities of regression and progression to cancer. Progression to cancer required infection with a high-risk genotype. Cancer detection occurs at either the local, regional, or distant stage [10].

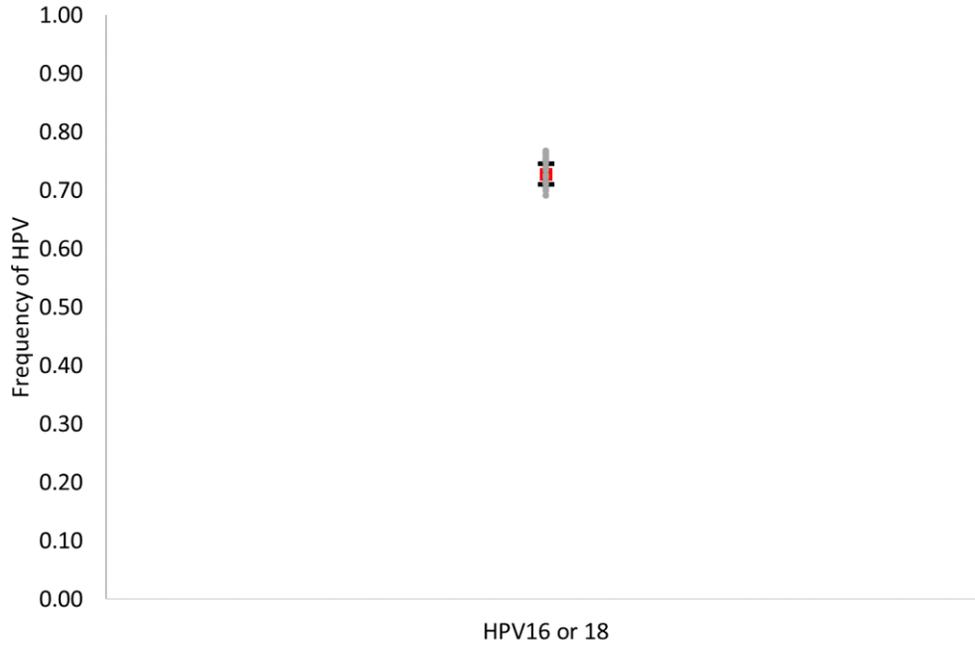


CIN: cervical intraepithelial neoplasia (grade 2 or 3); HPV: human papillomavirus

For the current analysis, we adapted our static model of HPV-induced cervical carcinogenesis to be calibrated to (i.e., calibration targets) HPV genotype frequency in cancer and age-specific cancer incidence in Uganda. Details of the model parameterization process, including examples of our calibration and adaptation to country-specific settings have been published previously [1,10-12]. Following 2 million model draws, we identified the 50 best-fitting parameters sets that fit to the calibration targets. For each profile, analyses were performed using the top-fitting parameter set. See Burger, et al. 2018, Campos, et al. 2014, and Campos, et al. 2015 for additional details on model structure and assumptions [1,10,12].

Harvard-CC was calibrated to reflect HPV and cervical cancer burden in Uganda.

Harvard-CC calibration targets (black lines) [13], model fit (grey dots) and top-fitting set used in analysis (red) to frequency of human papillomavirus (HPV)-16/18 in cervical cancer.



Harvard-CC calibration targets (black lines) from Kyadondo registry [14], Globocan 2012 cancer incidence (red square) [15], and model fit (grey dots) to age-specific cancer incidence in Uganda.

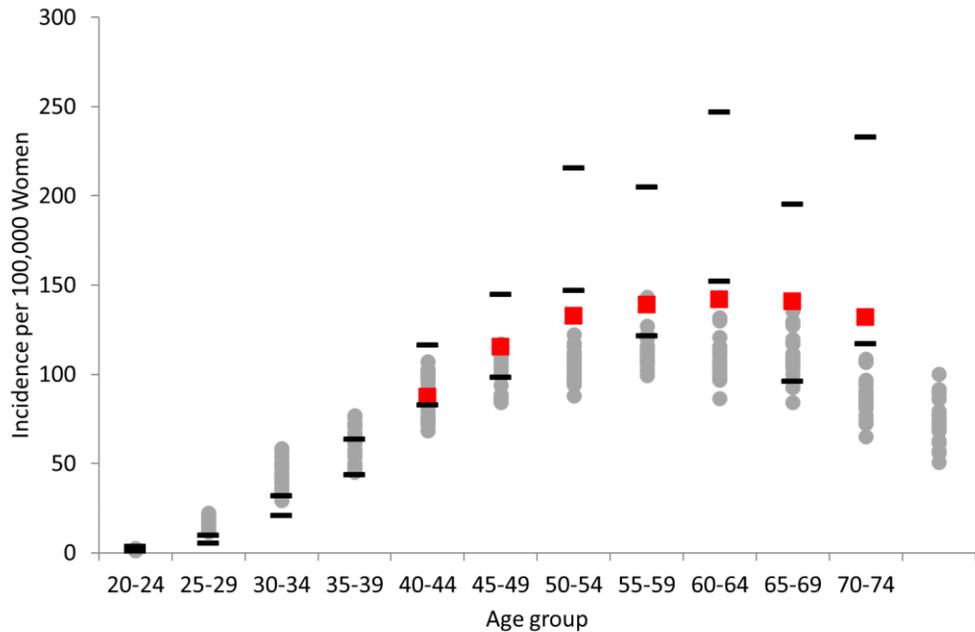
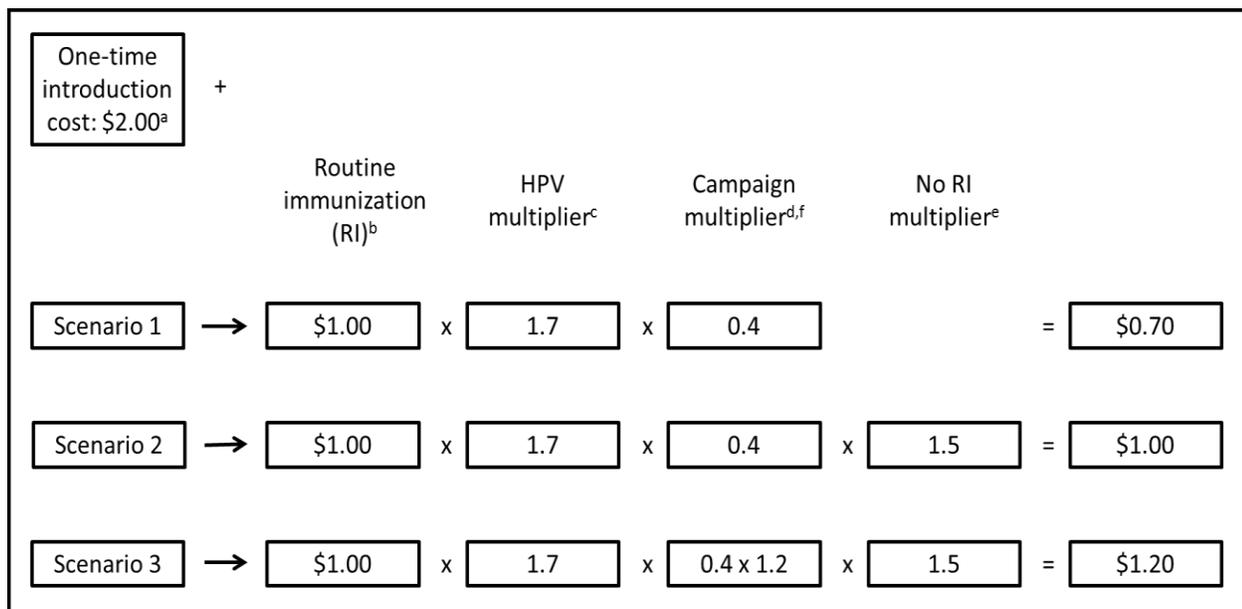


Figure S2. Delivery cost assumptions

The ongoing analyses of HPV vaccination campaigns proposes to include three scenarios for recurrent vaccine delivery costs as outlined in the Figure below. In the first year of a campaign or a routine vaccination program, there is a one-time introduction cost of \$2.00 per targeted girl. Routine vaccination recurrent costs are assumed to be \$1.00. Scenario 1 assumes that recurrent routine vaccination costs must be adjusted for HPV vaccine and the economies of scale from a multi-age cohort campaign, resulting in \$0.70. Scenario 2 adjusts Scenario 1 for the fact that there is no established routine vaccination program in the case of introducing HPV vaccine via a standalone campaign delivery platform, resulting in \$1.00. Scenario 3 adjusts Scenario 2 for the higher expected recurrent costs for the larger healthcare workforce and additional costs of the greater depth and scope of campaigns for HPV (i.e., suggesting that an HPV campaign differs from an HPV routine program), resulting in \$1.20. All costs are rounded to the nearest tenth.



^a One-time introduction cost of \$2.00 per targeted girl: This fixed unit costs represents non-recurrent introduction activities: planning, training, social mobilization, and information, education, communication (IEC). Given that the amount of \$2.40 per targeted girl for the Gavi vaccine introduction grant for HPV vaccines is based on 80% of estimated average per girl introduction costs according to country expenditure data, we can assume approximately \$3.00 per girl is required in the year of introduction [16]. Relying on an assumption of \$1.00 per targeted girl for recurrent costs (below), we can also assume approximately \$2.00 for fixed costs.

^b Routine immunization (RI) unit cost of \$1.00 per girl: The assumption of \$1.00 represents the recurrent costs for ongoing vaccination activities, as evidenced by the operational cost of \$0.80 per targeted individual according to Gavi, which can be assumed to go towards ongoing recurrent costs of vaccination for each campaign [16], \$1.20 for routine service delivery according to Portnoy, et al. [17], and average operational costs per dose of approximately \$1.00 according to Gandhi and Lydon [18]. Therefore, our assumption for recurrent childhood vaccination delivery costs would be approximately \$1.00.

^c HPV multiplier of 1.7: Whereas the routine vaccination unit costs are based on childhood vaccination data, we can assume that routine vaccination of HPV would be higher given the different target age group

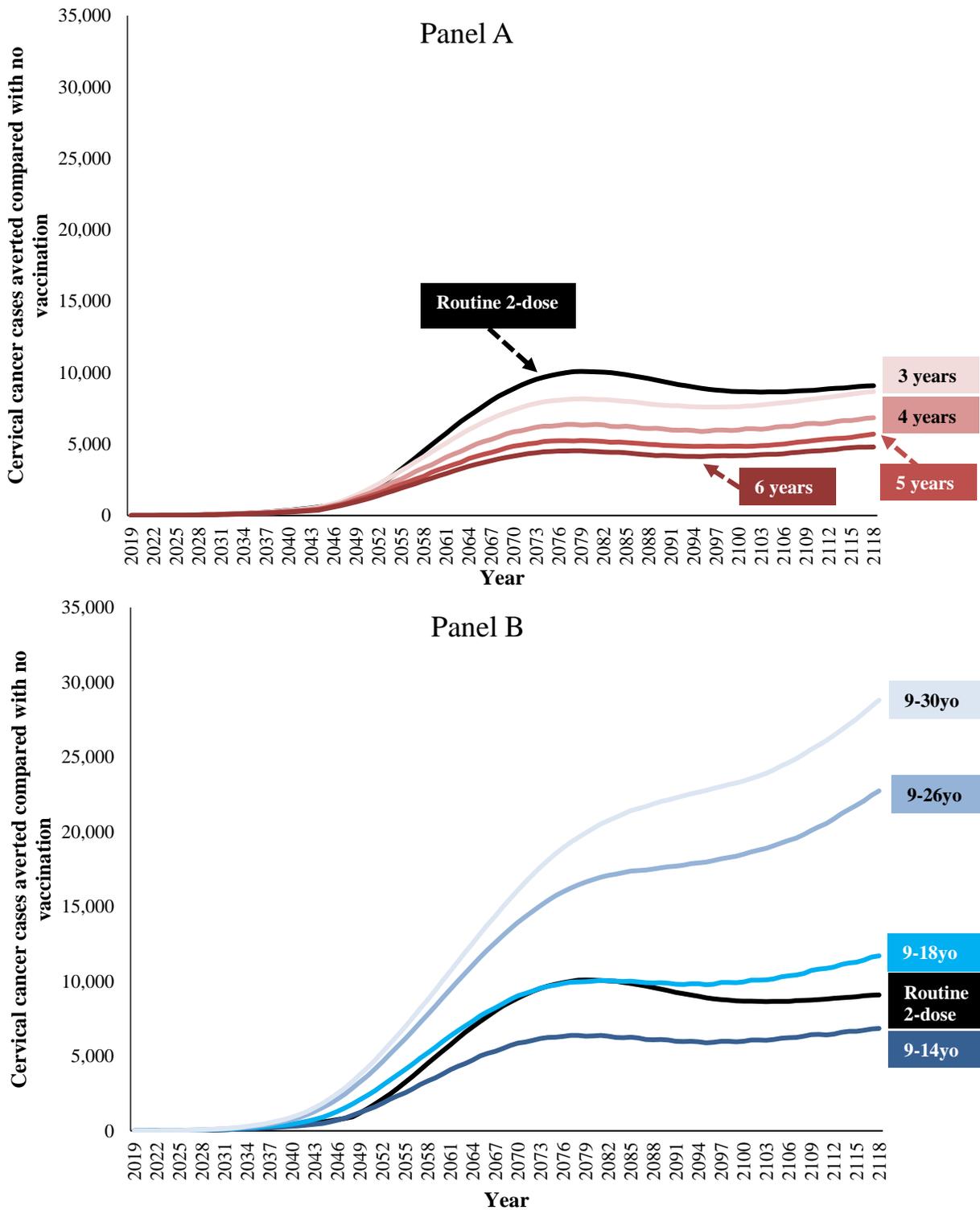
and delivery infrastructure required. While the Gavi vaccine introduction grant subsidy is \$1.60 higher per targeted person for HPV compared to childhood vaccinations [16], Botwright, et al. estimated \$1.80 as the cost for school-based delivery of HPV vaccine [19]. Therefore, we assume 1.7 as the base case multiplier for the increased delivery cost of HPV (representing \$1.70 as the routine delivery cost per targeted girl).

^d Campaign multiplier of 0.4: From the Portnoy, et al. analysis of baseline comprehensive multi-year plan (cMYP) data, when comparing the routine delivery costs per dose to campaign delivery costs per dose, the campaign delivery cost per dose is 60% less [17]. This difference represents the economies of scale gains from multi-age cohort campaigns of infant and childhood vaccinations. Therefore, we assume 0.4 as the base case multiplier for the campaign multiplier.

^e “No routine immunization (RI) program” multiplier of 1.5: Whereas current vaccination campaigns such as measles or adult influenza experience the specified economies of scale gains from a multi-age cohort campaign, HPV vaccine campaigns conducted without an established routine program would require additional support for the same introduction activities that a routine program would require, such as training of personnel and social mobilization. Using data from Botwright, et al. [19], the introduction cost components represent approximately 50% of the financial cost per dose for HPV vaccine introduction across Gavi-supported demonstration projects of HPV vaccine. We might expect that in the case of vaccination campaigns without an established routine that subsequent campaigns beyond the first would have lower overall delivery costs, but may be higher compared to campaigns supplementing an established routine program given some loss of knowledge and skills in the health care workforce every few years. Therefore, we will assume 1.5 as the base case multiplier for the “no routine immunization (RI) program” multiplier.

^f HPV campaign multiplier of 1.2: Given the larger health care workforce required for a campaign as compared to the introduction of a new vaccine into a routine program, the recurrent costs of campaigns might be expected to exceed that of a routine program. Additionally, we might expect that the social mobilization and IEC activities would differ in depth and scope given the adolescent and young adult target population, as well as the sexual transmission component of HPV. While not as evidence-based as the other multipliers, we will assume a small multiplier of 1.2 in the base case.

Figure S3. Annual number of cervical cancer cases averted: varying campaign frequency (Panel A) and varying target age group (Panel B), assuming 15-year boost to duration of protection



Note: Campaign strategies represent 40% vaccination coverage. Campaign strategies that vary frequency assume vaccination of 9- to 14-year-old (i.e., 9-14yo) girls; campaign strategies that vary target age group assume 4-year frequency. Routine strategies assume 70% vaccination coverage, including a one-year multi-age program of 10-14 year old girls.

Table S1. Discounted^a incremental costs, disability-adjusted life years (DALYs) averted and cost-effectiveness of campaign one-dose^b HPV vaccination strategies versus routine one-dose^b and two-dose HPV vaccination with full treatment costs

S1a. Assuming lifelong duration of protection and campaign coverage of 20% (base case: 40% coverage)

Scenario	Total costs ^c	Total DALYs averted ^d	Incremental cost	Incremental DALYs averted	Cost (USD) per DALY averted
No vaccination	\$617,051,343	--	\$617,051,343	--	--
6 years, 9- to 14-year-olds	\$637,905,527	366,100	--	--	Weakly dominated ^e
5 years, 9- to 14-year-olds	\$640,160,331	448,571	--	--	Weakly dominated ^e
4 years, 9- to 14-year-olds	\$643,924,934	572,389	--	--	Weakly dominated ^e
6 years, 9- to 18-year-olds	\$644,812,698	648,975	--	--	Weakly dominated ^e
5 years, 9- to 18-year-olds	\$648,311,225	782,049	--	--	Weakly dominated ^e
3 years, 9- to 14-year-olds	\$650,278,012	778,847	--	--	Strongly dominated ^f
4 years, 9- to 18-year-olds	\$652,898,253	994,528	--	--	Weakly dominated ^e
6 years, 9- to 26-year-olds	\$654,482,774	1,141,588	--	--	Weakly dominated ^e
6 years, 9- to 30-year-olds	\$655,933,840	1,378,363	--	--	Weakly dominated ^e
5 years, 9- to 26-year-olds	\$658,568,294	1,371,567	--	--	Strongly dominated ^f
5 years, 9- to 30-year-olds	\$660,855,556	1,643,546	--	--	Weakly dominated ^e
3 years, 9- to 18-year-olds	\$661,806,689	1,329,153	--	--	Strongly dominated ^f
4 years, 9- to 26-year-olds	\$666,156,840	1,705,025	--	--	Weakly dominated ^e
4 years, 9- to 30-year-olds	\$670,144,215	2,026,372	\$53,092,871	2,026,372	\$26 ^g
3 years, 9- to 26-year-olds	\$682,762,600	2,215,207	--	--	Weakly dominated ^e
3 years, 9- to 30-year-olds	\$691,321,526	2,600,624	\$21,177,311	574,252	\$37 ^g
Routine 1-dose	\$728,040,360	1,160,599	--	--	Strongly dominated ^f
Routine 2-dose	\$833,104,416	1,549,362	--	--	Strongly dominated ^f

S1b. Assuming lifelong duration of protection and campaign coverage of 40% (base case)

Scenario	Total costs ^c	Total DALYs averted ^d	Incremental cost	Incremental DALYs averted	Cost (USD) per DALY averted
No vaccination	\$617,051,343	--	\$617,051,343	--	--
6 years, 9- to 14-year-olds	\$656,437,779	765,683	--	--	Weakly dominated ^e
5 years, 9- to 14-year-olds	\$659,830,257	938,428	--	--	Weakly dominated ^e
4 years, 9- to 14-year-olds	\$665,043,876	1,202,381	--	--	Weakly dominated ^e
6 years, 9- to 18-year-olds	\$665,498,237	1,372,025	--	--	Weakly dominated ^e
5 years, 9- to 18-year-olds	\$670,209,585	1,652,910	--	--	Weakly dominated ^e
3 years, 9- to 14-year-olds	\$675,645,607	1,620,475	--	--	Strongly dominated ^f
4 years, 9- to 18-year-olds	\$678,910,364	2,049,504	--	--	Weakly dominated ^e
6 years, 9- to 26-year-olds	\$679,680,405	2,377,978	--	--	Weakly dominated ^e
6 years, 9- to 30-year-olds	\$685,909,860	2,804,103	\$68,858,517	2,804,103	\$25 ^g

5 years, 9- to 26-year-olds	\$690,670,885	2,780,468	--	--	Strongly dominated ^f
3 years, 9- to 18-year-olds	\$698,496,286	2,646,970	--	--	Strongly dominated ^f
5 years, 9- to 30-year-olds	\$703,346,743	3,214,803	\$17,436,882	410,701	\$42 ^g
4 years, 9- to 26-year-olds	\$716,419,654	3,276,830	--	--	Weakly dominated ^e
Routine 1-dose	\$728,040,360	1,160,599	--	--	Strongly dominated ^f
4 years, 9- to 30-year-olds	\$746,136,160	3,641,857	\$42,789,417	427,053	\$100 ^g
3 years, 9- to 26-year-olds	\$789,363,769	3,741,105	--	--	Weakly dominated ^e
Routine 2-dose	\$833,104,416	1,549,362	--	--	Strongly dominated ^f
3 years, 9- to 30-year-olds	\$852,131,262	3,941,650	\$105,995,102	299,794	\$354 ^g

S1c. Assuming lifelong duration of protection and campaign coverage of 60% (base case: 40% coverage)

Scenario	Total costs ^c	Total DALYs averted ^d	Incremental cost	Incremental DALYs averted	Cost (USD) per DALY averted
No vaccination	\$617,051,343	--	\$617,051,343	--	--
6 years, 9- to 14-year-old girls	\$675,816,813	1,151,813	--	--	Weakly dominated ^e
5 years, 9- to 14-year-old girls	\$678,251,561	1,432,060	--	--	Weakly dominated ^e
6 years, 9- to 18-year-old girls	\$680,353,599	2,135,705	--	--	Weakly dominated ^e
4 years, 9- to 14-year-old girls	\$681,965,686	1,860,268	--	--	Strongly dominated ^f
5 years, 9- to 18-year-old girls	\$683,700,752	2,580,867	\$66,649,409	2,580,867	\$26 ^g
3 years, 9- to 14-year-old girls	\$691,822,121	2,525,703	--	--	Strongly dominated ^f
4 years, 9- to 18-year-old girls	\$702,057,499	3,078,743	--	--	Weakly dominated ^e
6 years, 9- to 26-year-old girls	\$709,392,092	3,501,014	\$25,691,340	920,147	\$28 ^g
Routine 1-dose	\$728,040,360	1,160,599	--	--	Strongly dominated ^f
6 years, 9- to 30-year-old girls	\$743,454,390	3,830,226	\$34,062,298	329,213	\$103 ^g
5 years, 9- to 26-year-old girls	\$750,675,178	3,771,217	--	--	Strongly dominated ^f
3 years, 9- to 18-year-old girls	\$755,576,438	3,618,549	--	--	Strongly dominated ^f
5 years, 9- to 30-year-old girls	\$804,467,345	3,994,013	\$61,012,955	163,787	\$373 ^g
4 years, 9- to 26-year-old girls	\$831,359,392	3,971,640	--	--	Strongly dominated ^f
Routine 2-dose	\$833,104,416	1,549,362	--	--	Strongly dominated ^f
4 years, 9- to 30-year-old girls	\$908,888,369	4,115,389	\$104,421,024	121,375	\$860
3 years, 9- to 26-year-old girls	\$984,249,294	4,115,578	--	--	Weakly dominated ^e
3 years, 9- to 30-year-old girls	\$1,094,205,052	4,221,430	\$185,316,683	106,042	\$1,748

^aCosts and DALYs discounted at 3% per year; ^bOne-dose HPV vaccine efficacy of 80% and 15 year duration of protection; two-dose vaccine efficacy of 100% and lifelong duration of protection; ^cTotal costs reflect vaccine program costs associated with 100 incoming birth cohorts from years 2019-2118, and disease cost offsets over the lifetimes of women aged <100 years alive in year 2019; ^dTotal DALYs averted are aggregated over multiple birth cohorts and capture the benefit over the lifetimes of women aged <100 years alive in year 2019; ^eWeakly dominated strategies are either less costly and less effective or more costly and more effective than another strategy; ^fStrongly dominated strategies are more costly and less effective than another strategy; ^gThe incremental cost-effectiveness ratio is less than the gross domestic product per capita in Uganda (i.e., \$674). Abbreviations. HPV: Human papillomavirus; DALY: disability-adjusted life year.

Table S2. Discounted^a incremental costs, disability-adjusted life years (DALYs) averted and cost-effectiveness of campaign one-dose^b HPV vaccination strategies versus routine one-dose^b and two-dose HPV vaccination with full treatment costs

S2a. Assuming 15-year boost to duration of protection and campaign coverage of 20% (base case: lifelong protection and 40% coverage)

Scenario	Total costs ^c	Total DALYs averted ^d	Incremental cost	Incremental DALYs averted	Cost (USD) per DALY averted
No vaccination	\$617,051,343	--	\$617,051,343	--	--
6 years, 9- to 14-year-olds	\$637,905,527	366,100	--	--	Weakly dominated ^e
5 years, 9- to 14-year-olds	\$641,392,280	433,508	--	--	Weakly dominated ^e
4 years, 9- to 14-year-olds	\$646,790,520	538,686	--	--	Weakly dominated ^e
6 years, 9- to 18-year-olds	\$648,759,924	602,503	--	--	Weakly dominated ^e
5 years, 9- to 18-year-olds	\$654,151,086	715,084	--	--	Weakly dominated ^e
3 years, 9- to 14-year-olds	\$656,949,109	700,328	--	--	Strongly dominated ^f
4 years, 9- to 18-year-olds	\$662,703,827	881,893	--	--	Weakly dominated ^e
6 years, 9- to 26-year-olds	\$665,694,344	1,016,707	--	--	Weakly dominated ^e
6 years, 9- to 30-year-olds	\$670,270,541	1,220,564	\$53,219,197	1,220,564	\$44 ^g
5 years, 9- to 26-year-olds	\$674,872,877	1,191,255	--	--	Strongly dominated ^f
3 years, 9- to 18-year-olds	\$680,155,246	1,119,902	--	--	Strongly dominated ^f
5 years, 9- to 30-year-olds	\$680,596,613	1,427,056	\$10,326,073	206,491	\$50 ^g
4 years, 9- to 26-year-olds	\$690,289,025	1,439,663	--	--	Weakly dominated ^e
4 years, 9- to 30-year-olds	\$698,565,607	1,713,584	\$17,968,994	286,529	\$63 ^g
3 years, 9- to 26-year-olds	\$721,364,925	1,788,452	--	--	Weakly dominated ^e
Routine 1-dose	\$728,040,360	1,160,599	--	--	Strongly dominated ^f
3 years, 9- to 30-year-olds	\$734,760,328	2,121,771	\$36,194,721	408,186	\$89 ^g
Routine 2-dose	\$833,104,416	1,549,362	--	--	Strongly dominated ^f

S2b. Assuming 15-year boost to duration of protection and campaign coverage of 40% (base case: lifelong protection)

Scenario	Total costs ^c	Total DALYs averted ^d	Incremental cost	Incremental DALYs averted	Cost (USD) per DALY averted
No vaccination	\$617,051,343	--	\$617,051,343	--	--
6 years, 9- to 14-year-olds	\$656,437,779	765,683	--	--	Weakly dominated ^e
5 years, 9- to 14-year-olds	\$664,741,477	881,250	--	--	Weakly dominated ^e
4 years, 9- to 14-year-olds	\$677,322,525	1,059,702	--	--	Weakly dominated ^e
6 years, 9- to 18-year-olds	\$680,132,409	1,205,750	--	--	Weakly dominated ^e
5 years, 9- to 18-year-olds	\$692,868,291	1,397,053	--	--	Weakly dominated ^e
3 years, 9- to 14-year-olds	\$700,747,755	1,329,790	--	--	Strongly dominated ^f
4 years, 9- to 18-year-olds	\$715,091,411	1,646,752	--	--	Weakly dominated ^e
6 years, 9- to 26-year-olds	\$719,205,656	1,942,497	--	--	Weakly dominated ^e
Routine 1-dose	\$728,040,360	1,160,599	--	--	Strongly dominated ^f

6 years, 9- to 30-year-olds	\$731,083,555	2,310,807	\$114,032,211	2,310,807	\$49 ^g
5 years, 9- to 26-year-olds	\$742,838,645	2,207,777	--	--	Strongly dominated ^f
3 years, 9- to 18-year-olds	\$758,181,545	1,983,794	--	--	Strongly dominated ^f
5 years, 9- to 30-year-olds	\$760,052,266	2,595,304	\$28,968,711	284,497	\$102 ^g
4 years, 9- to 26-year-olds	\$784,009,319	2,543,340	--	--	Strongly dominated ^f
4 years, 9- to 30-year-olds	\$810,301,696	2,954,637	\$50,249,430	359,333	\$140 ^g
Routine 2-dose	\$833,104,416	1,549,362	--	--	Strongly dominated ^f
3 years, 9- to 26-year-olds	\$865,494,585	2,943,344	--	--	Strongly dominated ^f
3 years, 9- to 30-year-olds	\$910,519,968	3,351,564	\$100,218,272	396,927	\$252 ^g

S2c. Assuming 15-year boost to duration of protection and campaign coverage of 60% (base case: lifelong protection and 40% coverage)

Scenario	Total costs ^c	Total DALYs averted ^d	Incremental cost	Incremental DALYs averted	Cost (USD) per DALY averted
No vaccination	\$617,051,343	--	\$617,051,343	--	--
6 years, 9- to 14-year-olds	\$675,816,813	1,151,813	\$58,765,469	1,151,813	\$51 ^g
5 years, 9- to 14-year-olds	\$689,052,872	1,309,141	--	--	Weakly dominated ^e
4 years, 9- to 14-year-olds	\$710,016,547	1,540,453	--	--	Weakly dominated ^e
6 years, 9- to 18-year-olds	\$714,252,281	1,758,422	\$38,435,468	606,608	\$63 ^g
Routine 1-dose	\$728,040,360	1,160,599	--	--	Strongly dominated ^f
5 years, 9- to 18-year-olds	\$735,711,357	2,003,450	--	--	Weakly dominated ^e
3 years, 9- to 14-year-olds	\$748,636,176	1,884,089	--	--	Strongly dominated ^f
4 years, 9- to 18-year-olds	\$774,766,003	2,283,472	--	--	Weakly dominated ^e
6 years, 9- to 26-year-olds	\$781,405,778	2,727,628	--	--	Weakly dominated ^e
6 years, 9- to 30-year-olds	\$807,493,603	3,156,207	\$93,241,322	1,397,786	\$67 ^g
5 years, 9- to 26-year-olds	\$826,265,499	2,979,970	--	--	Strongly dominated ^f
Routine 2-dose	\$833,104,416	1,549,362	--	--	Strongly dominated ^f
3 years, 9- to 18-year-olds	\$849,998,673	2,618,971	--	--	Strongly dominated ^f
5 years, 9- to 30-year-olds	\$863,206,293	3,401,150	\$55,712,691	244,943	\$227 ^g
4 years, 9- to 26-year-olds	\$902,876,035	3,258,848	--	--	Strongly dominated ^f
4 years, 9- to 30-year-olds	\$957,966,244	3,653,541	\$94,759,951	252,391	\$375 ^g
3 years, 9- to 26-year-olds	\$1,047,185,986	3,530,163	--	--	Strongly dominated ^f
3 years, 9- to 30-year-olds	\$1,133,355,348	3,884,862	\$175,389,104	231,321	\$758

^aCosts and DALYs discounted at 3% per year; ^bOne-dose HPV vaccine efficacy of 80% and 15 year duration of protection; two-dose vaccine efficacy of 100% and lifelong duration of protection; ^cTotal costs reflect vaccine program costs associated with 100 incoming birth cohorts from years 2019-2118, and disease cost offsets over the lifetimes of women aged <100 years alive in year 2019; ^dTotal DALYs averted are aggregated over multiple birth cohorts and capture the benefit over the lifetimes of women aged <100 years alive in year 2019; ^eWeakly dominated strategies are either less costly and less effective or more costly and more effective than another strategy; ^fStrongly dominated strategies are more costly and less effective than another strategy; ^gThe incremental cost-effectiveness ratio is less than the gross domestic product per capita in Uganda (i.e., \$674). Abbreviations. HPV: Human papillomavirus; DALY: disability-adjusted life year.

Table S3. Discounted^a incremental costs, disability-adjusted life years (DALYs) averted and cost-effectiveness of campaign one-dose^b HPV vaccination strategies versus routine one-dose^b and two-dose HPV vaccination with full treatment costs and campaign delivery costs of \$0.70 per girl

S3a. Assuming lifelong duration of protection and campaign coverage of 20% (base case: campaign delivery costs of \$1.00 per girl and 40% coverage)

Scenario	Total costs ^c	Total DALYs averted ^d	Incremental cost	Incremental DALYs averted	Cost (USD) per DALY averted
No vaccination	\$617,051,343	--	\$617,051,343	--	--
6 years, 9- to 14-year-olds	\$635,748,061	366,100	--	--	Weakly dominated ^e
5 years, 9- to 14-year-olds	\$637,602,593	448,571	--	--	Weakly dominated ^e
4 years, 9- to 14-year-olds	\$640,752,248	572,389	--	--	Weakly dominated ^e
6 years, 9- to 18-year-olds	\$641,330,912	648,975	--	--	Weakly dominated ^e
5 years, 9- to 18-year-olds	\$644,182,972	782,049	--	--	Weakly dominated ^e
3 years, 9- to 14-year-olds	\$646,060,891	778,847	--	--	Strongly dominated ^f
4 years, 9- to 18-year-olds	\$647,775,659	994,528	--	--	Weakly dominated ^e
6 years, 9- to 26-year-olds	\$648,637,958	1,141,588	--	--	Weakly dominated ^e
6 years, 9- to 30-year-olds	\$649,050,750	1,378,363	--	--	Weakly dominated ^e
5 years, 9- to 26-year-olds	\$651,636,774	1,371,567	--	--	Strongly dominated ^f
5 years, 9- to 30-year-olds	\$652,692,116	1,643,546	--	--	Weakly dominated ^e
3 years, 9- to 18-year-olds	\$654,994,138	1,329,153	--	--	Strongly dominated ^f
4 years, 9- to 26-year-olds	\$657,549,935	1,705,025	--	--	Weakly dominated ^e
4 years, 9- to 30-year-olds	\$660,004,491	2,026,372	\$7,312,375	2,026,372	\$4 ^g
3 years, 9- to 26-year-olds	\$671,304,041	2,215,207	--	--	Weakly dominated ^e
3 years, 9- to 30-year-olds	\$677,815,243	2,600,624	\$17,810,752	574,252	\$31 ^g
Routine 1-dose	\$728,040,360	1,160,599	--	--	Strongly dominated ^f
Routine 2-dose	\$833,104,416	1,549,362	--	--	Strongly dominated ^f

S3b. Assuming lifelong duration of protection and campaign coverage of 40% (base case: campaign delivery costs of \$1.00 per girl)

Scenario	Total costs ^c	Total DALYs averted ^d	Incremental cost	Incremental DALYs averted	Cost (USD) per DALY averted
No vaccination	\$617,051,343	--	\$617,051,343	--	--
6 years, 9- to 14-year-olds	\$652,122,847	765,683	--	--	Weakly dominated ^e
5 years, 9- to 14-year-olds	\$654,714,781	938,428	--	--	Weakly dominated ^e
6 years, 9- to 18-year-olds	\$658,534,665	1,372,025	--	--	Weakly dominated ^e
4 years, 9- to 14-year-olds	\$658,698,506	1,202,381	--	--	Strongly dominated ^f
5 years, 9- to 18-year-olds	\$661,953,079	1,652,910	--	--	Weakly dominated ^e
3 years, 9- to 14-year-olds	\$667,211,365	1,620,475	--	--	Strongly dominated ^f
6 years, 9- to 26-year-olds	\$667,990,773	2,377,978	--	--	Weakly dominated ^e
4 years, 9- to 18-year-olds	\$668,665,176	2,049,504	--	--	Strongly dominated ^f
6 years, 9- to 30-year-olds	\$672,143,680	2,804,103	\$55,092,337	2,804,103	\$20 ^g

5 years, 9- to 26-year-olds	\$676,807,844	2,780,468	--	--	Strongly dominated ^f
3 years, 9- to 18-year-olds	\$684,871,184	2,646,970	--	--	Strongly dominated ^f
5 years, 9- to 30-year-olds	\$687,019,863	3,214,803	\$14,876,182	410,701	\$36 ^g
4 years, 9- to 26-year-olds	\$699,205,845	3,276,830	--	--	Weakly dominated ^e
4 years, 9- to 30-year-olds	\$725,856,712	3,641,857	\$38,836,849	427,053	\$91 ^g
Routine 1-dose	\$728,040,360	1,160,599	--	--	Strongly dominated ^f
3 years, 9- to 26-year-olds	\$766,446,652	3,741,105	--	--	Weakly dominated ^e
3 years, 9- to 30-year-olds	\$825,118,696	3,941,650	\$99,261,984	299,794	\$331 ^g
Routine 2-dose	\$833,104,416	1,549,362	--	--	Strongly dominated ^f

S3c. Assuming lifelong duration of protection and campaign coverage of 60% (base case: campaign delivery costs of \$1.00 per girl and 40% coverage)

Scenario	Total costs ^c	Total DALYs averted ^d	Incremental cost	Incremental DALYs averted	Cost (USD) per DALY averted
No vaccination	\$617,051,343	--	\$617,051,343	--	--
6 years, 9- to 14-year-olds	\$669,344,414	1,151,813	--	--	Weakly dominated ^e
6 years, 9- to 18-year-olds	\$669,908,242	2,135,705	--	--	Weakly dominated ^e
5 years, 9- to 14-year-olds	\$670,578,347	1,432,060	--	--	Strongly dominated ^f
5 years, 9- to 18-year-olds	\$671,315,992	2,580,867	\$54,264,649	2,580,867	\$21 ^g
4 years, 9- to 14-year-olds	\$672,447,630	1,860,268	--	--	Strongly dominated ^f
3 years, 9- to 14-year-olds	\$679,170,760	2,525,703	--	--	Strongly dominated ^f
4 years, 9- to 18-year-olds	\$686,689,717	3,078,743	--	--	Weakly dominated ^e
6 years, 9- to 26-year-olds	\$691,857,642	3,501,014	\$20,541,650	920,147	\$22 ^g
6 years, 9- to 30-year-olds	\$722,805,120	3,830,226	\$30,947,478	329,213	\$94 ^g
Routine 1-dose	\$728,040,360	1,160,599	--	--	Strongly dominated ^f
5 years, 9- to 26-year-olds	\$729,880,618	3,771,217	--	--	Strongly dominated ^f
3 years, 9- to 18-year-olds	\$735,138,785	3,618,549	--	--	Strongly dominated ^f
5 years, 9- to 30-year-olds	\$779,977,025	3,994,013	\$57,171,905	163,787	\$349 ^g
4 years, 9- to 26-year-olds	\$805,538,678	3,971,640	--	--	Strongly dominated ^f
Routine 2-dose	\$833,104,416	1,549,362	--	--	Strongly dominated ^f
4 years, 9- to 30-year-olds	\$878,469,197	4,115,389	\$98,492,173	121,375	\$811
3 years, 9- to 26-year-olds	\$949,873,619	4,115,578	--	--	Weakly dominated ^e
3 years, 9- to 30-year-olds	\$1,053,686,203	4,221,430	\$175,217,006	106,042	\$1,652

^aCosts and DALYs discounted at 3% per year; ^bOne-dose HPV vaccine efficacy of 80% and 15 year duration of protection; two-dose vaccine efficacy of 100% and lifelong duration of protection; ^cTotal costs reflect vaccine program costs associated with 100 incoming birth cohorts from years 2019-2118, and disease cost offsets over the lifetimes of women aged <100 years alive in year 2019; ^dTotal DALYs averted are aggregated over multiple birth cohorts and capture the benefit over the lifetimes of women aged <100 years alive in year 2019; ^eWeakly dominated strategies are either less costly and less effective or more costly and more effective than another strategy; ^fStrongly dominated strategies are more costly and less effective than another strategy; ^gThe incremental cost-effectiveness ratio is less than the gross domestic product per capita in Uganda (i.e., \$674). Abbreviations. HPV: Human papillomavirus; DALY: disability-adjusted life year.

Table S4. Discounted^a incremental costs, disability-adjusted life years (DALYs) averted and cost-effectiveness of campaign one-dose^b HPV vaccination strategies versus routine one-dose^b and two-dose HPV vaccination with full treatment costs and campaign delivery costs of \$1.20 per girl

S4a. Assuming lifelong duration of protection and campaign coverage of 20% (base case: campaign delivery costs of \$1.00 per girl and 40% coverage)

Scenario	Total costs ^c	Total DALYs averted ^d	Incremental cost	Incremental DALYs averted	Cost (USD) per DALY averted
No vaccination	\$617,051,343	--	\$617,051,343	--	--
6 years, 9- to 14-year-olds	\$639,343,838	366,100	--	--	Weakly dominated ^e
5 years, 9- to 14-year-olds	\$641,865,490	448,571	--	--	Weakly dominated ^e
4 years, 9- to 14-year-olds	\$646,040,057	572,389	--	--	Weakly dominated ^e
6 years, 9- to 18-year-olds	\$647,133,888	648,975	--	--	Weakly dominated ^e
5 years, 9- to 18-year-olds	\$651,063,394	782,049	--	--	Weakly dominated ^e
3 years, 9- to 14-year-olds	\$653,089,426	778,847	--	--	Strongly dominated ^f
4 years, 9- to 18-year-olds	\$656,313,316	994,528	--	--	Weakly dominated ^e
6 years, 9- to 26-year-olds	\$658,379,318	1,141,588	--	--	Weakly dominated ^e
6 years, 9- to 30-year-olds	\$660,522,567	1,378,363	--	--	Weakly dominated ^e
5 years, 9- to 26-year-olds	\$663,189,307	1,371,567	--	--	Strongly dominated ^f
5 years, 9- to 30-year-olds	\$666,297,849	1,643,546	--	--	Weakly dominated ^e
3 years, 9- to 18-year-olds	\$666,348,390	1,329,153	--	--	Strongly dominated ^f
4 years, 9- to 26-year-olds	\$671,894,776	1,705,025	--	--	Weakly dominated ^e
4 years, 9- to 30-year-olds	\$676,904,031	2,026,372	\$59,852,687	2,026,372	\$30 ^g
3 years, 9- to 26-year-olds	\$690,401,639	2,215,207	--	--	Weakly dominated
3 years, 9- to 30-year-olds	\$700,325,714	2,600,624	\$23,421,684	574,252	\$41 ^g
Routine 1-dose	\$728,040,360	1,160,599	--	--	Strongly dominated ^f
Routine 2-dose	\$833,104,416	1,549,362	--	--	Strongly dominated ^f

S4b. Assuming lifelong duration of protection and campaign coverage of 40% (base case: campaign delivery costs of \$1.00 per girl)

Scenario	Total costs ^c	Total DALYs averted ^d	Incremental cost	Incremental DALYs averted	Cost (USD) per DALY averted
No vaccination	\$617,051,343	--	\$617,051,343	--	--
6 years, 9- to 14-year-olds	\$659,314,401	765,683	--	--	Weakly dominated ^e
5 years, 9- to 14-year-olds	\$663,240,575	938,428	--	--	Weakly dominated ^e
4 years, 9- to 14-year-olds	\$669,274,123	1,202,381	--	--	Weakly dominated ^e
6 years, 9- to 18-year-olds	\$670,140,618	1,372,025	--	--	Weakly dominated ^e
5 years, 9- to 18-year-olds	\$675,713,923	1,652,910	--	--	Weakly dominated ^e
3 years, 9- to 14-year-olds	\$681,268,434	1,620,475	--	--	Strongly dominated ^f
4 years, 9- to 18-year-olds	\$685,740,489	2,049,504	--	--	Weakly dominated ^e
6 years, 9- to 26-year-olds	\$687,473,494	2,377,978	--	--	Weakly dominated ^e
6 years, 9- to 30-year-olds	\$695,087,314	2,804,103	\$78,035,970	2,804,103	\$28 ^g

5 years, 9- to 26-year-olds	\$699,912,912	2,780,468	--	--	Strongly dominated ^f
3 years, 9- to 18-year-olds	\$707,579,687	2,646,970	--	--	Strongly dominated ^f
5 years, 9- to 30-year-olds	\$714,231,329	3,214,803	\$19,144,016	410,701	\$47 ^g
4 years, 9- to 26-year-olds	\$727,895,527	3,276,830	--	--	Weakly dominated ^e
Routine 1-dose	\$728,040,360	1,160,599	--	--	Strongly dominated ^f
4 years, 9- to 30-year-olds	\$759,655,791	3,641,857	\$45,424,462	427,053	\$106 ^g
3 years, 9- to 26-year-olds	\$804,641,848	3,741,105	--	--	Weakly dominated ^e
Routine 2-dose	\$833,104,416	1,549,362	--	--	Strongly dominated ^f
3 years, 9- to 30-year-olds	\$870,139,639	3,941,650	\$110,483,848	299,794	\$369 ^g

S4c. Assuming lifelong duration of protection and campaign coverage of 60% (base case: campaign delivery costs of \$1.00 per girl and 40% coverage)

Scenario	Total costs ^c	Total DALYs averted ^d	Incremental cost	Incremental DALYs averted	Cost (USD) per DALY averted
No vaccination	\$617,051,343	--	\$617,051,343	--	--
6 years, 9- to 14-year-olds	\$680,131,746	1,151,813	--	--	Weakly dominated ^e
5 years, 9- to 14-year-olds	\$683,367,037	1,432,060	--	--	Weakly dominated ^e
6 years, 9- to 18-year-olds	\$687,317,171	2,135,705	--	--	Weakly dominated ^e
4 years, 9- to 14-year-olds	\$688,311,056	1,860,268	--	--	Strongly dominated ^f
5 years, 9- to 18-year-olds	\$691,957,259	2,580,867	\$74,905,915	2,580,867	\$29 ^g
3 years, 9- to 14-year-olds	\$700,256,363	2,525,703	--	--	Strongly dominated ^f
4 years, 9- to 18-year-olds	\$712,302,687	3,078,743	--	--	Weakly dominated ^e
6 years, 9- to 26-year-olds	\$721,081,724	3,501,014	\$29,124,466	920,147	\$32 ^g
Routine 1-dose	\$728,040,360	1,160,599	--	--	Strongly dominated ^f
6 years, 9- to 30-year-olds	\$757,220,570	3,830,226	\$36,138,846	329,213	\$110 ^g
5 years, 9- to 26-year-olds	\$764,538,219	3,771,217	--	--	Strongly dominated ^f
3 years, 9- to 18-year-olds	\$769,201,540	3,618,549	--	--	Strongly dominated ^f
5 years, 9- to 30-year-olds	\$820,794,225	3,994,013	\$63,573,655	163,787	\$388 ^g
4 years, 9- to 26-year-olds	\$848,573,202	3,971,640	--	--	Strongly dominated ^f
Routine 2-dose	\$833,104,416	1,549,362	--	--	Strongly dominated ^f
4 years, 9- to 30-year-olds	\$929,167,816	4,115,389	\$108,373,592	121,375	\$893
3 years, 9- to 26-year-olds	\$1,007,166,412	4,115,578	--	--	Weakly dominated ^e
3 years, 9- to 30-year-olds	\$1,121,217,618	4,221,430	\$192,049,801	106,042	\$1,811

^aCosts and DALYs discounted at 3% per year; ^bOne-dose HPV vaccine efficacy of 80% and 15 year duration of protection; two-dose vaccine efficacy of 100% and lifelong duration of protection; ^cTotal costs reflect vaccine program costs associated with 100 incoming birth cohorts from years 2019-2118, and disease cost offsets over the lifetimes of women aged <100 years alive in year 2019; ^dTotal DALYs averted are aggregated over multiple birth cohorts and capture the benefit over the lifetimes of women aged <100 years alive in year 2019; ^eWeakly dominated strategies are either less costly and less effective or more costly and more effective than another strategy; ^fStrongly dominated strategies are more costly and less effective than another strategy; ^gThe incremental cost-effectiveness ratio is less than the gross domestic product per capita in Uganda (i.e., \$674). Abbreviations. HPV: Human papillomavirus; DALY: disability-adjusted life year.

Table S5. Discounted^a incremental costs, disability-adjusted life years (DALYs) averted and cost-effectiveness of campaign one-dose^b HPV vaccination strategies versus routine one-dose^b and two-dose HPV vaccination with full treatment costs and campaign delivery costs of \$1.00 per girl for ages 9-14 years and \$1.70 per girl for ages 15 years and higher

S5a. Assuming lifelong duration of protection and campaign coverage of 20% (base case: campaign delivery costs of \$1.00 per girl and 40% coverage)

Scenario	Total costs ^c	Total DALYs averted ^d	Incremental cost	Incremental DALYs averted	Cost (USD) per DALY averted
No vaccination	\$617,051,343	--	\$617,051,343	--	--
6 years, 9- to 14-year-olds	\$637,905,527	366,100	--	--	Weakly dominated ^e
5 years, 9- to 14-year-olds	\$640,160,331	448,571	--	--	Weakly dominated ^e
4 years, 9- to 14-year-olds	\$643,924,934	572,389	--	--	Weakly dominated ^e
6 years, 9- to 18-year-olds	\$647,902,776	648,975	--	--	Weakly dominated ^e
3 years, 9- to 14-year-olds	\$650,278,012	778,847	--	--	Weakly dominated ^e
5 years, 9- to 18-year-olds	\$651,975,761	782,049	--	--	Weakly dominated ^e
4 years, 9- to 18-year-olds	\$657,448,040	994,528	--	--	Weakly dominated ^e
6 years, 9- to 26-year-olds	\$663,086,591	1,141,588	--	--	Weakly dominated ^e
6 years, 9- to 30-year-olds	\$666,960,295	1,378,363	--	--	Weakly dominated ^e
3 years, 9- to 18-year-olds	\$667,862,693	1,329,153	--	--	Strongly dominated ^f
5 years, 9- to 26-year-olds	\$668,773,785	1,371,567	--	--	Strongly dominated ^f
5 years, 9- to 30-year-olds	\$673,935,527	1,643,546	--	--	Weakly dominated ^e
4 years, 9- to 26-year-olds	\$678,836,685	1,705,025	--	--	Weakly dominated ^e
4 years, 9- to 30-year-olds	\$686,400,638	2,026,372	\$69,349,295	2,026,372	\$34 ^g
3 years, 9- to 26-year-olds	\$699,659,289	2,215,207	--	--	Weakly dominated ^e
3 years, 9- to 30-year-olds	\$712,996,238	2,600,624	\$26,595,600	574,252	\$46 ^g
Routine 1-dose	\$728,040,360	1,160,599	--	--	Strongly dominated ^f
Routine 2-dose	\$833,104,416	1,549,362	--	--	Strongly dominated ^f

S5b. Assuming lifelong duration of protection and campaign coverage of 40% (base case: campaign delivery costs of \$1.00 per girl)

Scenario	Total costs ^c	Total DALYs averted ^d	Incremental cost	Incremental DALYs averted	Cost (USD) per DALY averted
No vaccination	\$617,051,343	--	\$617,051,343	--	--
6 years, 9- to 14-year-olds	\$656,437,779	765,683	--	--	Weakly dominated ^e
5 years, 9- to 14-year-olds	\$659,830,257	938,428	--	--	Weakly dominated ^e
4 years, 9- to 14-year-olds	\$665,043,876	1,202,381	--	--	Weakly dominated ^e
6 years, 9- to 18-year-olds	\$671,678,394	1,372,025	--	--	Weakly dominated ^e
3 years, 9- to 14-year-olds	\$675,645,607	1,620,475	--	--	Weakly dominated ^e
5 years, 9- to 18-year-olds	\$677,538,656	1,652,910	--	--	Weakly dominated ^e
4 years, 9- to 18-year-olds	\$688,009,938	2,049,504	--	--	Weakly dominated ^e
6 years, 9- to 26-year-olds	\$696,888,039	2,377,978	--	--	Weakly dominated ^e

6 years, 9- to 30-year-olds	\$707,962,770	2,804,103	\$90,911,427	2,804,103	\$32 ^g
3 years, 9- to 18-year-olds	\$710,608,294	2,646,970	--	--	Strongly dominated ^f
5 years, 9- to 26-year-olds	\$711,081,868	2,780,468	--	--	Strongly dominated ^f
Routine 1-dose	\$728,040,360	1,160,599	--	--	Strongly dominated ^f
5 years, 9- to 30-year-olds	\$729,506,685	3,214,803	\$21,543,914	410,701	\$52 ^g
4 years, 9- to 26-year-olds	\$741,779,345	3,276,830	--	--	Weakly dominated ^e
4 years, 9- to 30-year-olds	\$778,649,006	3,641,857	\$49,142,322	427,053	\$115 ^g
3 years, 9- to 26-year-olds	\$823,157,147	3,741,105	--	--	Weakly dominated ^e
Routine 2-dose	\$833,104,416	1,549,362	--	--	Strongly dominated ^f
3 years, 9- to 30-year-olds	\$895,480,686	3,941,650	\$116,831,679	299,794	\$390 ^g

S5c. Assuming lifelong duration of protection and campaign coverage of 60% (base case: campaign delivery costs of \$1.00 per girl and 40% coverage)

Scenario	Total costs ^c	Total DALYs averted ^d	Incremental cost	Incremental DALYs averted	Cost (USD) per DALY averted
No vaccination	\$617,051,343	--	\$617,051,343	--	--
6 years, 9- to 14-year-olds	\$675,816,813	1,151,813	--	--	Weakly dominated ^e
5 years, 9- to 14-year-olds	\$678,251,561	1,432,060	--	--	Weakly dominated ^e
4 years, 9- to 14-year-olds	\$681,965,686	1,860,268	--	--	Weakly dominated ^e
6 years, 9- to 18-year-olds	\$689,623,835	2,135,705	--	--	Weakly dominated ^e
3 years, 9- to 14-year-olds	\$691,822,121	2,525,703	\$74,770,778	2,525,703	\$30 ^g
5 years, 9- to 18-year-olds	\$694,694,358	2,580,867	--	--	Weakly dominated ^e
4 years, 9- to 18-year-olds	\$715,706,860	3,078,743	--	--	Weakly dominated ^e
Routine 1-dose	\$728,040,360	1,160,599	--	--	Strongly dominated ^f
6 years, 9- to 26-year-olds	\$735,203,541	3,501,014	\$43,381,420	975,310	\$44 ^g
3 years, 9- to 18-year-olds	\$773,744,450	3,618,549	--	--	Weakly dominated ^e
6 years, 9- to 30-year-olds	\$776,533,755	3,830,226	\$41,330,213	329,213	\$126 ^g
5 years, 9- to 26-year-olds	\$781,291,653	3,771,217	--	--	Strongly dominated ^f
Routine 2-dose	\$833,104,416	1,549,362	--	--	Strongly dominated ^f
5 years, 9- to 30-year-olds	\$843,707,258	3,994,013	\$67,173,503	163,787	\$410 ^g
4 years, 9- to 26-year-olds	\$869,398,928	3,971,640	--	--	Strongly dominated ^f
4 years, 9- to 30-year-olds	\$957,657,639	4,115,389	\$113,950,381	121,375	\$939
3 years, 9- to 26-year-olds	\$1,034,939,360	4,115,578	--	--	Weakly dominated ^e
3 years, 9- to 30-year-olds	\$1,159,229,188	4,221,430	\$201,571,549	106,042	\$1,901

^aCosts and DALYs discounted at 3% per year; ^bOne-dose HPV vaccine efficacy of 80% and 15 year duration of protection; two-dose vaccine efficacy of 100% and lifelong duration of protection; ^cTotal costs reflect vaccine program costs associated with 100 incoming birth cohorts from years 2019-2118, and disease cost offsets over the lifetimes of women aged <100 years alive in year 2019; ^dTotal DALYs averted are aggregated over multiple birth cohorts and capture the benefit over the lifetimes of women aged <100 years alive in year 2019; ^eWeakly dominated strategies are either less costly and less effective or more costly and more effective than another strategy; ^fStrongly dominated strategies are more costly and less effective than another strategy; ^gThe incremental cost-effectiveness ratio is less than the gross domestic product per capita in Uganda (i.e., \$674). Abbreviations. HPV: Human papillomavirus; DALY: disability-adjusted life year.

Table S6. Discounted^a incremental costs, disability-adjusted life years (DALYs) averted and cost-effectiveness of campaign one-dose^b HPV vaccination strategies versus routine one-dose^b and two-dose HPV vaccination with cancer treatment costs incurred by 8.5% of women with cancer based on level of treatment access

S6a. Assuming lifelong duration of protection and campaign coverage of 20% (base case: cancer treatment costs incurred by 100% of women with cancer and 40% coverage)

Scenario	Total costs ^c	Total DALYs averted ^d	Incremental cost	Incremental DALYs averted	Cost (USD) per DALY averted
No vaccination	\$52,449,364	--	\$52,449,364	--	--
6 years, 9- to 14-year-olds	\$93,255,351	366,100	--	--	Weakly dominated ^e
5 years, 9- to 14-year-olds	\$100,436,254	448,571	--	--	Weakly dominated ^e
4 years, 9- to 14-year-olds	\$111,493,991	572,389	--	--	Weakly dominated ^e
6 years, 9- to 18-year-olds	\$117,735,373	648,975	--	--	Weakly dominated ^e
5 years, 9- to 18-year-olds	\$129,320,878	782,049	--	--	Weakly dominated ^e
3 years, 9- to 14-year-olds	\$130,271,149	778,847	--	--	Strongly dominated ^f
4 years, 9- to 18-year-olds	\$147,073,206	994,528	--	--	Weakly dominated ^e
6 years, 9- to 26-year-olds	\$161,041,594	1,141,588	--	--	Weakly dominated ^e
3 years, 9- to 18-year-olds	\$177,339,185	1,329,153	--	--	Weakly dominated ^e
6 years, 9- to 30-year-olds	\$179,772,213	1,378,363	--	--	Weakly dominated ^e
5 years, 9- to 26-year-olds	\$180,364,070	1,371,567	--	--	Strongly dominated ^f
5 years, 9- to 30-year-olds	\$202,547,070	1,643,546	\$150,097,706	1,643,546	\$91 ^g
4 years, 9- to 26-year-olds	\$210,263,403	1,705,025	--	--	Weakly dominated ^e
Routine 1-dose	\$226,168,156	1,160,599	--	--	Strongly dominated ^f
4 years, 9- to 30-year-olds	\$237,844,993	2,026,372	\$35,297,922	382,826	\$92 ^g
3 years, 9- to 26-year-olds	\$261,468,335	2,215,207	--	--	Weakly dominated ^e
3 years, 9- to 30-year-olds	\$298,429,394	2,600,624	\$60,584,401	574,252	\$106 ^g
Routine 2-dose	\$352,411,048	1,549,362	--	--	Strongly dominated ^f

S6b. Assuming lifelong duration of protection and campaign coverage of 40% (base case: cancer treatment costs incurred by 100% of women with cancer)

Scenario	Total costs ^c	Total DALYs averted ^d	Incremental cost	Incremental DALYs averted	Cost (USD) per DALY averted
No vaccination	\$52,449,364	--	\$52,449,364	--	--
6 years, 9- to 14-year-olds	\$133,863,973	765,683	--	--	Weakly dominated ^e
5 years, 9- to 14-year-olds	\$148,130,823	938,428	--	--	Weakly dominated ^e
4 years, 9- to 14-year-olds	\$170,049,472	1,202,381	--	--	Weakly dominated ^e
6 years, 9- to 18-year-olds	\$182,419,937	1,372,025	--	--	Weakly dominated ^e
5 years, 9- to 18-year-olds	\$205,396,663	1,652,910	--	--	Weakly dominated ^e
3 years, 9- to 14-year-olds	\$207,424,913	1,620,475	--	--	Strongly dominated ^f
Routine 1-dose	\$226,168,156	1,160,599	--	--	Strongly dominated ^f
4 years, 9- to 18-year-olds	\$240,861,090	2,049,504	--	--	Weakly dominated ^e

6 years, 9- to 26-year-olds	\$268,593,950	2,377,978	--	--	Weakly dominated ^e
3 years, 9- to 18-year-olds	\$301,543,417	2,646,970	--	--	Weakly dominated ^e
6 years, 9- to 30-year-olds	\$306,338,012	2,804,103	\$253,888,648	2,804,103	\$91 ^g
5 years, 9- to 26-year-olds	\$307,478,555	2,780,468	--	--	Strongly dominated ^f
Routine 2-dose	\$352,411,048	1,549,362	--	--	Strongly dominated ^f
5 years, 9- to 30-year-olds	\$352,533,170	3,214,803	\$46,195,158	410,701	\$112 ^g
4 years, 9- to 26-year-olds	\$368,175,815	3,276,830	--	--	Weakly dominated ^e
4 years, 9- to 30-year-olds	\$425,187,043	3,641,857	\$72,653,873	427,053	\$170 ^g
3 years, 9- to 26-year-olds	\$473,962,949	3,741,105	--	--	Weakly dominated ^e
3 years, 9- to 30-year-olds	\$551,765,286	3,941,650	\$126,578,244	299,794	\$422 ^g

S6c. Assuming lifelong duration of protection and campaign coverage of 60% (base case: cancer treatment costs incurred by 100% of women with cancer and 40% coverage)

Scenario	Total costs ^c	Total DALYs averted ^d	Incremental cost	Incremental DALYs averted	Cost (USD) per DALY averted
No vaccination	\$52,449,364	--	\$52,449,364	--	--
6 years, 9- to 14-year-olds	\$174,544,572	1,151,813	--	--	Weakly dominated ^e
5 years, 9- to 14-year-olds	\$195,719,260	1,432,060	--	--	Weakly dominated ^e
Routine 1-dose	\$226,168,156	1,160,599	--	--	Strongly dominated ^f
4 years, 9- to 14-year-olds	\$228,248,197	1,860,268	--	--	Weakly dominated ^e
6 years, 9- to 18-year-olds	\$246,608,936	2,135,705	--	--	Weakly dominated ^e
5 years, 9- to 18-year-olds	\$280,757,837	2,580,867	\$228,308,472	2,580,867	\$88 ^g
3 years, 9- to 14-year-olds	\$283,797,435	2,525,703	--	--	Strongly dominated ^f
4 years, 9- to 18-year-olds	\$334,405,452	3,078,743	--	--	Weakly dominated ^e
Routine 2-dose	\$352,411,048	1,549,362	--	--	Strongly dominated ^f
6 years, 9- to 26-year-olds	\$376,530,002	3,501,014	\$95,772,165	920,147	\$104 ^g
3 years, 9- to 18-year-olds	\$427,480,846	3,618,549	--	--	Weakly dominated ^e
6 years, 9- to 30-year-olds	\$435,247,134	3,830,226	\$58,717,132	329,213	\$178 ^g
5 years, 9- to 26-year-olds	\$436,964,685	3,771,217	--	--	Strongly dominated ^f
5 years, 9- to 30-year-olds	\$507,502,769	3,994,013	\$72,255,635	163,787	\$441 ^g
4 years, 9- to 26-year-olds	\$531,585,765	3,971,640	--	--	Strongly dominated ^f
4 years, 9- to 30-year-olds	\$619,903,715	4,115,389	\$112,400,946	121,375	\$926
3 years, 9- to 26-year-olds	\$693,961,733	4,115,578	--	--	Weakly dominated ^e
3 years, 9- to 30-year-olds	\$812,008,623	4,221,430	\$192,104,908	106,042	\$1,812

^aCosts and DALYs discounted at 3% per year; ^bOne-dose HPV vaccine efficacy of 80% and 15 year duration of protection; two-dose vaccine efficacy of 100% and lifelong duration of protection; ^cTotal costs reflect vaccine program costs associated with 100 incoming birth cohorts from years 2019-2118, and disease cost offsets over the lifetimes of women aged <100 years alive in year 2019; ^dTotal DALYs averted are aggregated over multiple birth cohorts and capture the benefit over the lifetimes of women aged <100 years alive in year 2019; ^eWeakly dominated strategies are either less costly and less effective or more costly and more effective than another strategy; ^fStrongly dominated strategies are more costly and less effective than another strategy; ^gThe incremental cost-effectiveness ratio is less than the gross domestic product per capita in Uganda (i.e., \$674). Abbreviations. HPV: Human papillomavirus; DALY: disability-adjusted life year.

Table S7. Discounted^a incremental costs, disability-adjusted life years (DALYs) averted and cost-effectiveness of campaign one-dose^b HPV vaccination strategies versus routine one-dose^b and two-dose HPV vaccination with 60% one-dose and 80% two-dose efficacy for girls ages 19 and older

S7a. Assuming lifelong duration of protection and campaign coverage of 20% (base case: one-dose efficacy of 80%, two-dose efficacy of 100%, and 40% coverage)

Scenario	Total costs ^c	Total DALYs averted ^d	Incremental cost	Incremental DALYs averted	Cost (USD) per DALY averted
No vaccination	\$617,051,343	--	\$617,051,343	--	--
6 years, 9- to 14-year-olds	\$637,905,527	366,100	--	--	Weakly dominated ^e
5 years, 9- to 14-year-olds	\$640,160,331	448,571	--	--	Weakly dominated ^e
4 years, 9- to 14-year-olds	\$643,924,934	572,389	--	--	Weakly dominated ^e
6 years, 9- to 18-year-olds	\$644,812,698	648,975	--	--	Weakly dominated ^e
5 years, 9- to 18-year-olds	\$648,311,225	782,049	--	--	Weakly dominated ^e
3 years, 9- to 14-year-olds	\$650,278,012	778,847	--	--	Strongly dominated ^f
4 years, 9- to 18-year-olds	\$652,898,253	994,528	--	--	Weakly dominated ^e
3 years, 9- to 18-year-olds	\$661,806,689	1,329,153	\$44,755,346	1,329,153	\$34 ^g
6 years, 9- to 26-year-olds	\$668,448,380	954,752	--	--	Strongly dominated ^f
5 years, 9- to 26-year-olds	\$675,893,796	1,143,674	--	--	Strongly dominated ^f
6 years, 9- to 30-year-olds	\$676,955,210	1,103,926	--	--	Strongly dominated ^f
5 years, 9- to 30-year-olds	\$686,082,209	1,316,294	--	--	Strongly dominated ^f
4 years, 9- to 26-year-olds	\$688,827,626	1,410,720	--	--	Weakly dominated ^e
4 years, 9- to 30-year-olds	\$702,421,835	1,610,842	--	--	Weakly dominated ^e
3 years, 9- to 26-year-olds	\$713,788,737	1,815,024	--	--	Weakly dominated ^e
Routine 1-dose	\$728,040,360	1,160,599	--	--	Strongly dominated ^f
3 years, 9- to 30-year-olds	\$735,525,595	2,035,827	\$73,718,905	706,675	\$104 ^g
Routine 2-dose	\$833,104,416	1,549,362	--	--	Strongly dominated ^f

S7b. Assuming lifelong duration of protection and campaign coverage of 40% (base case: one-dose efficacy of 80% and two-dose efficacy of 100%)

Scenario	Total costs ^c	Total DALYs averted ^d	Incremental cost	Incremental DALYs averted	Cost (USD) per DALY averted
No vaccination	\$617,051,343	--	\$617,051,343	--	--
6 years, 9- to 14-year-olds	\$656,437,779	765,683	--	--	Weakly dominated ^e
5 years, 9- to 14-year-olds	\$659,830,257	938,428	--	--	Weakly dominated ^e
4 years, 9- to 14-year-olds	\$665,043,876	1,202,381	--	--	Weakly dominated ^e
6 years, 9- to 18-year-olds	\$665,498,237	1,372,025	--	--	Weakly dominated ^e
5 years, 9- to 18-year-olds	\$670,209,585	1,652,910	--	--	Weakly dominated ^e
3 years, 9- to 14-year-olds	\$675,645,607	1,620,475	--	--	Strongly dominated ^f
4 years, 9- to 18-year-olds	\$678,910,364	2,049,504	\$61,859,020	2,049,504	\$30 ^g
3 years, 9- to 18-year-olds	\$698,496,286	2,646,970	\$19,585,922	597,466	\$33 ^g

6 years, 9- to 26-year-olds	\$713,525,749	1,942,129	--	--	Strongly dominated ^f
Routine 1-dose	\$728,040,360	1,160,599	--	--	Strongly dominated ^f
5 years, 9- to 26-year-olds	\$733,438,657	2,235,129	--	--	Strongly dominated ^f
6 years, 9- to 30-year-olds	\$734,477,225	2,184,648	--	--	Strongly dominated ^f
5 years, 9- to 30-year-olds	\$758,666,510	2,515,677	--	--	Strongly dominated ^f
4 years, 9- to 26-year-olds	\$766,449,251	2,649,348	--	--	Weakly dominated ^e
4 years, 9- to 30-year-olds	\$802,930,718	2,931,259	--	--	Weakly dominated ^e
Routine 2-dose	\$833,104,416	1,549,362	--	--	Strongly dominated ^f
3 years, 9- to 26-year-olds	\$836,762,418	3,155,286	--	--	Weakly dominated ^e
3 years, 9- to 30-year-olds	\$897,369,829	3,382,577	\$198,873,543	735,606	\$270 ^g

S7c. Assuming lifelong duration of protection and campaign coverage of 60% (base case: one-dose efficacy of 80%, two-dose efficacy of 100%, and 40% coverage)

Scenario	Total costs ^c	Total DALYs averted ^d	Incremental cost	Incremental DALYs averted	Cost (USD) per DALY averted
No vaccination	\$617,051,343	--	\$617,051,343	--	--
6 years, 9- to 14-year-olds	\$675,816,813	1,151,813	--	--	Weakly dominated ^e
5 years, 9- to 14-year-olds	\$678,251,561	1,432,060	--	--	Weakly dominated ^e
6 years, 9- to 18-year-olds	\$680,353,599	2,135,705	--	--	Weakly dominated ^e
4 years, 9- to 14-year-olds	\$681,965,686	1,860,268	--	--	Strongly dominated ^f
5 years, 9- to 18-year-olds	\$683,700,752	2,580,867	\$66,649,409	2,580,867	\$26 ^g
3 years, 9- to 14-year-olds	\$691,822,121	2,525,703	--	--	Strongly dominated ^f
4 years, 9- to 18-year-olds	\$702,057,499	3,078,743	\$18,356,747	497,876	\$37 ^g
Routine 1-dose	\$728,040,360	1,160,599	--	--	Strongly dominated ^f
3 years, 9- to 18-year-olds	\$755,576,438	3,618,549	\$53,518,939	539,806	\$99 ^g
6 years, 9- to 26-year-olds	\$761,171,072	2,855,640	--	--	Strongly dominated ^f
5 years, 9- to 26-year-olds	\$800,602,861	3,155,213	--	--	Strongly dominated ^f
6 years, 9- to 30-year-olds	\$800,877,079	3,113,824	--	--	Strongly dominated ^f
Routine 2-dose	\$833,104,416	1,549,362	--	--	Strongly dominated ^f
5 years, 9- to 30-year-olds	\$850,878,279	3,420,117	--	--	Strongly dominated ^f
4 years, 9- to 26-year-olds	\$872,034,942	3,476,140	--	--	Strongly dominated ^f
4 years, 9- to 30-year-olds	\$943,999,689	3,684,870	--	--	Weakly dominated ^e
3 years, 9- to 26-year-olds	\$1,014,345,420	3,751,677	--	--	Weakly dominated ^e
3 years, 9- to 30-year-olds	\$1,121,287,510	3,893,587	\$365,711,072	275,037	\$1,330

^aCosts and DALYs discounted at 3% per year; ^bOne-dose: 15 year duration of protection; two-dose: lifelong duration of protection; ^cTotal costs reflect vaccine program costs associated with 100 incoming birth cohorts from years 2019-2118, and disease cost offsets over the lifetimes of women aged <100 years alive in year 2019; ^dTotal DALYs averted are aggregated over multiple birth cohorts and capture the benefit over the lifetimes of women aged <100 years alive in year 2019; ^eWeakly dominated strategies are either less costly and less effective or more costly and more effective than another strategy; ^fStrongly dominated strategies are more costly and less effective than another strategy; ^gThe incremental cost-effectiveness ratio is less than the gross domestic product per capita in Uganda (i.e., \$674). Abbreviations. HPV: Human papillomavirus; DALY: disability-adjusted life year.

Table S8. Discounted^a incremental costs, disability-adjusted life years (DALYs) averted and cost-effectiveness of campaign one-dose^b HPV vaccination strategies versus routine one-dose^b and two-dose HPV vaccination with 40% one-dose and 60% two-dose efficacy for girls ages 19 and older

S8a. Assuming lifelong duration of protection and campaign coverage of 20% (base case: one-dose efficacy of 80%, two-dose efficacy of 100%, and 40% coverage)

Scenario	Total costs ^c	Total DALYs averted ^d	Incremental cost	Incremental DALYs averted	Cost (USD) per DALY averted
No vaccination	\$617,051,343	--	\$617,051,343	--	--
6 years, 9- to 14-year-olds	\$637,905,527	366,100	--	--	Weakly dominated ^e
5 years, 9- to 14-year-olds	\$640,160,331	448,571	--	--	Weakly dominated ^e
4 years, 9- to 14-year-olds	\$643,924,934	572,389	--	--	Weakly dominated ^e
6 years, 9- to 18-year-olds	\$644,812,698	648,975	--	--	Weakly dominated ^e
5 years, 9- to 18-year-olds	\$648,311,225	782,049	--	--	Weakly dominated ^e
3 years, 9- to 14-year-olds	\$650,278,012	778,847	--	--	Strongly dominated ^f
4 years, 9- to 18-year-olds	\$652,898,253	994,528	--	--	Weakly dominated ^e
3 years, 9- to 18-year-olds	\$661,806,689	1,329,153	\$44,755,346	1,329,153	\$34 ^g
6 years, 9- to 26-year-olds	\$678,874,757	812,553	--	--	Strongly dominated ^f
5 years, 9- to 26-year-olds	\$689,069,572	966,366	--	--	Strongly dominated ^f
6 years, 9- to 30-year-olds	\$698,870,569	825,723	--	--	Strongly dominated ^f
4 years, 9- to 26-year-olds	\$705,671,344	1,186,275	--	--	Strongly dominated ^f
5 years, 9- to 30-year-olds	\$714,360,994	962,343	--	--	Strongly dominated ^f
Routine 1-dose	\$728,040,360	1,160,599	--	--	Strongly dominated ^f
3 years, 9- to 26-year-olds	\$736,573,442	1,517,728	\$74,766,753	188,576	\$396 ^g
4 years, 9- to 30-year-olds	\$739,234,236	1,157,770	--	--	Strongly dominated ^f
3 years, 9- to 30-year-olds	\$786,734,416	1,413,754	--	--	Strongly dominated ^f
Routine 2-dose	\$833,104,416	1,549,362	\$96,530,974	31,634	\$3,052

S8b. Assuming lifelong duration of protection and campaign coverage of 40% (base case: one-dose efficacy of 80% and two-dose efficacy of 100%)

Scenario	Total costs ^c	Total DALYs averted ^d	Incremental cost	Incremental DALYs averted	Cost (USD) per DALY averted
No vaccination	\$617,051,343	--	\$617,051,343	--	--
6 years, 9- to 14-year-olds	\$656,437,779	765,683	--	--	Weakly dominated ^e
5 years, 9- to 14-year-olds	\$659,830,257	938,428	--	--	Weakly dominated ^e
4 years, 9- to 14-year-olds	\$665,043,876	1,202,381	--	--	Weakly dominated ^e
6 years, 9- to 18-year-olds	\$665,498,237	1,372,025	--	--	Weakly dominated ^e
5 years, 9- to 18-year-olds	\$670,209,585	1,652,910	--	--	Weakly dominated ^e
3 years, 9- to 14-year-olds	\$675,645,607	1,620,475	--	--	Strongly dominated ^f
4 years, 9- to 18-year-olds	\$678,910,364	2,049,504	\$61,859,020	2,049,504	\$30 ^g
3 years, 9- to 18-year-olds	\$698,496,286	2,646,970	\$19,585,922	597,466	\$33 ^g

Routine 1-dose	\$728,040,360	1,160,599	--	--	Strongly dominated ^f
6 years, 9- to 26-year-olds	\$738,984,228	1,609,823	--	--	Strongly dominated ^f
5 years, 9- to 26-year-olds	\$764,199,096	1,836,737	--	--	Strongly dominated ^f
6 years, 9- to 30-year-olds	\$788,806,362	1,522,195	--	--	Strongly dominated ^f
4 years, 9- to 26-year-olds	\$806,490,701	2,134,746	--	--	Strongly dominated ^f
5 years, 9- to 30-year-olds	\$824,961,429	1,712,575	--	--	Strongly dominated ^f
Routine 2-dose	\$833,104,416	1,549,362	--	--	Strongly dominated ^f
4 years, 9- to 30-year-olds	\$885,567,374	1,937,261	--	--	Strongly dominated ^f
3 years, 9- to 26-year-olds	\$888,058,886	2,509,720	--	--	Strongly dominated ^f
3 years, 9- to 30-year-olds	\$996,268,385	2,205,929	--	--	Strongly dominated ^f

S8c. Assuming lifelong duration of protection and campaign coverage of 60% (base case: one-dose efficacy of 80%, two-dose efficacy of 100%, and 40% coverage)

Scenario	Total costs ^c	Total DALYs averted ^d	Incremental cost	Incremental DALYs averted	Cost (USD) per DALY averted
No vaccination	\$617,051,343	--	\$617,051,343	--	--
6 years, 9- to 14-year-olds	\$675,816,813	1,151,813	--	--	Weakly dominated ^e
5 years, 9- to 14-year-olds	\$678,251,561	1,432,060	--	--	Weakly dominated ^e
6 years, 9- to 18-year-olds	\$680,353,599	2,135,705	--	--	Weakly dominated ^e
4 years, 9- to 14-year-olds	\$681,965,686	1,860,268	--	--	Strongly dominated ^f
5 years, 9- to 18-year-olds	\$683,700,752	2,580,867	\$66,649,409	2,580,867	\$26 ^g
3 years, 9- to 14-year-olds	\$691,822,121	2,525,703	--	--	Strongly dominated ^f
4 years, 9- to 18-year-olds	\$702,057,499	3,078,743	\$18,356,747	497,876	\$37 ^g
Routine 1-dose	\$728,040,360	1,160,599	--	--	Strongly dominated ^f
3 years, 9- to 18-year-olds	\$755,576,438	3,618,549	\$53,518,939	539,806	\$99 ^g
6 years, 9- to 26-year-olds	\$805,648,575	2,287,177	--	--	Strongly dominated ^f
Routine 2-dose	\$833,104,416	1,549,362	--	--	Strongly dominated ^f
5 years, 9- to 26-year-olds	\$852,678,636	2,499,775	--	--	Strongly dominated ^f
6 years, 9- to 30-year-olds	\$889,283,880	2,052,098	--	--	Strongly dominated ^f
4 years, 9- to 26-year-olds	\$932,571,205	2,726,850	--	--	Strongly dominated ^f
5 years, 9- to 30-year-olds	\$950,357,496	2,235,209	--	--	Strongly dominated ^f
4 years, 9- to 30-year-olds	\$1,050,535,073	2,433,699	--	--	Strongly dominated ^f
3 years, 9- to 26-year-olds	\$1,080,357,285	2,948,485	--	--	Strongly dominated ^f
3 years, 9- to 30-year-olds	\$1,230,216,340	2,633,701	--	--	Strongly dominated ^f

^aCosts and DALYs discounted at 3% per year; ^bOne-dose: 15 year duration of protection; two-dose: lifelong duration of protection; ^cTotal costs reflect vaccine program costs associated with 100 incoming birth cohorts from years 2019-2118, and disease cost offsets over the lifetimes of women aged <100 years alive in year 2019; ^dTotal DALYs averted are aggregated over multiple birth cohorts and capture the benefit over the lifetimes of women aged <100 years alive in year 2019; ^eWeakly dominated strategies are either less costly and less effective or more costly and more effective than another strategy; ^fStrongly dominated strategies are more costly and less effective than another strategy; ^gThe incremental cost-effectiveness ratio is less than the gross domestic product per capita in Uganda (i.e., \$674). Abbreviations. HPV: Human papillomavirus; DALY: disability-adjusted life year.

Table S9. Discounted^a incremental costs, disability-adjusted life years (DALYs) averted and cost-effectiveness of campaign one-dose^b HPV vaccination strategies versus routine one-dose^b and two-dose HPV vaccination with 20% one-dose and 40% two-dose efficacy for girls ages 19 and older

S9a. Assuming lifelong duration of protection and campaign coverage of 20% (base case: one-dose efficacy of 80%, two-dose efficacy of 100%, and 40% coverage)

Scenario	Total costs ^c	Total DALYs averted ^d	Incremental cost	Incremental DALYs averted	Cost (USD) per DALY averted
No vaccination	\$617,051,343	--	\$617,051,343	--	--
6 years, 9- to 14-year-olds	\$637,905,527	366,100	--	--	Weakly dominated ^e
5 years, 9- to 14-year-olds	\$640,160,331	448,571	--	--	Weakly dominated ^e
4 years, 9- to 14-year-olds	\$643,924,934	572,389	--	--	Weakly dominated ^e
6 years, 9- to 18-year-olds	\$644,812,698	648,975	--	--	Weakly dominated ^e
5 years, 9- to 18-year-olds	\$648,311,225	782,049	--	--	Weakly dominated ^e
3 years, 9- to 14-year-olds	\$650,278,012	778,847	--	--	Strongly dominated ^f
4 years, 9- to 18-year-olds	\$652,898,253	994,528	--	--	Weakly dominated ^e
3 years, 9- to 18-year-olds	\$661,806,689	1,329,153	\$44,755,346	1,329,153	\$34 ^g
6 years, 9- to 26-year-olds	\$687,373,090	696,045	--	--	Strongly dominated ^f
5 years, 9- to 26-year-olds	\$699,745,132	819,443	--	--	Weakly dominated ^e
6 years, 9- to 30-year-olds	\$705,173,127	727,473	--	--	Strongly dominated ^f
4 years, 9- to 26-year-olds	\$719,252,698	1,003,232	--	--	Strongly dominated ^f
5 years, 9- to 30-year-olds	\$720,514,180	859,607	--	--	Strongly dominated ^f
Routine 1-dose	\$728,040,360	1,160,599	--	--	Strongly dominated ^f
4 years, 9- to 30-year-olds	\$745,446,323	1,046,803	--	--	Strongly dominated ^f
3 years, 9- to 26-year-olds	\$754,464,959	1,279,072	--	--	Strongly dominated ^f
3 years, 9- to 30-year-olds	\$792,645,329	1,294,815	--	--	Strongly dominated ^f
Routine 2-dose	\$833,104,416	1,549,362	\$171,297,727	220,210	\$778

S9b. Assuming lifelong duration of protection and campaign coverage of 40% (base case: one-dose efficacy of 80% and two-dose efficacy of 100%)

Scenario	Total costs ^c	Total DALYs averted ^d	Incremental cost	Incremental DALYs averted	Cost (USD) per DALY averted
No vaccination	\$617,051,343	--	\$617,051,343	--	--
6 years, 9- to 14-year-olds	\$656,437,779	765,683	--	--	Weakly dominated ^e
5 years, 9- to 14-year-olds	\$659,830,257	938,428	--	--	Weakly dominated ^e
4 years, 9- to 14-year-olds	\$665,043,876	1,202,381	--	--	Weakly dominated ^e
6 years, 9- to 18-year-olds	\$665,498,237	1,372,025	--	--	Weakly dominated ^e
5 years, 9- to 18-year-olds	\$670,209,585	1,652,910	--	--	Weakly dominated ^e
3 years, 9- to 14-year-olds	\$675,645,607	1,620,475	--	--	Strongly dominated ^f
4 years, 9- to 18-year-olds	\$678,910,364	2,049,504	\$61,859,020	2,049,504	\$30 ^g
3 years, 9- to 18-year-olds	\$698,496,286	2,646,970	\$19,585,922	597,466	\$33 ^g

Routine 1-dose	\$728,040,360	1,160,599	--	--	Strongly dominated ^f
6 years, 9- to 26-year-olds	\$758,615,178	1,348,149	\$30,574,818	187,550	\$163 ^g
5 years, 9- to 26-year-olds	\$788,207,292	1,520,689	\$29,592,114	172,540	\$172 ^g
6 years, 9- to 30-year-olds	\$798,503,424	1,353,083	--	--	Strongly dominated ^f
Routine 2-dose	\$833,104,416	1,549,362	--	--	Weakly dominated ^e
5 years, 9- to 30-year-olds	\$834,360,720	1,540,555	--	--	Strongly dominated ^f
4 years, 9- to 26-year-olds	\$836,349,118	1,748,205	\$48,141,826	227,516	\$212 ^g
4 years, 9- to 30-year-olds	\$895,567,256	1,749,427	--	--	Weakly dominated ^e
3 years, 9- to 26-year-olds	\$925,681,570	2,025,912	\$89,332,453	277,707	\$322 ^g
3 years, 9- to 30-year-olds	\$1,009,186,802	1,972,304	--	--	Strongly dominated ^f

S9c. Assuming lifelong duration of protection and campaign coverage of 60% (base case: one-dose efficacy of 80%, two-dose efficacy of 100%, and 40% coverage)

Scenario	Total costs ^c	Total DALYs averted ^d	Incremental cost	Incremental DALYs averted	Cost (USD) per DALY averted
No vaccination	\$617,051,343	--	\$617,051,343	--	--
6 years, 9- to 14-year-olds	\$675,816,813	1,151,813	--	--	Weakly dominated ^e
5 years, 9- to 14-year-olds	\$678,251,561	1,432,060	--	--	Weakly dominated ^e
6 years, 9- to 18-year-olds	\$680,353,599	2,135,705	--	--	Weakly dominated ^e
4 years, 9- to 14-year-olds	\$681,965,686	1,860,268	--	--	Strongly dominated ^f
5 years, 9- to 18-year-olds	\$683,700,752	2,580,867	--	--	Weakly dominated ^e
3 years, 9- to 14-year-olds	\$691,822,121	2,525,703	--	--	Strongly dominated ^f
4 years, 9- to 18-year-olds	\$702,057,499	3,078,743	--	--	Weakly dominated ^e
Routine 1-dose	\$728,040,360	1,160,599	--	--	Strongly dominated ^f
3 years, 9- to 18-year-olds	\$755,576,438	3,618,549	--	--	Weakly dominated ^e
Routine 2-dose	\$833,104,416	1,549,362	--	--	Strongly dominated ^f
6 years, 9- to 26-year-olds	\$838,337,842	1,863,056	\$221,286,498	1,863,056	\$119 ^g
5 years, 9- to 26-year-olds	\$890,552,797	2,012,112	\$52,214,956	149,056	\$350 ^g
6 years, 9- to 30-year-olds	\$903,361,945	1,808,702	--	--	Strongly dominated ^f
5 years, 9- to 30-year-olds	\$964,854,770	1,981,710	--	--	Weakly dominated ^e
4 years, 9- to 26-year-olds	\$977,570,309	2,152,407	--	--	Weakly dominated ^e
4 years, 9- to 30-year-olds	\$1,069,465,216	2,120,161	--	--	Strongly dominated ^f
3 years, 9- to 26-year-olds	\$1,130,217,774	2,319,622	\$239,664,977	307,510	\$779
3 years, 9- to 30-year-olds	\$1,253,953,800	2,258,915	--	--	Strongly dominated ^f

^aCosts and DALYs discounted at 3% per year; ^bOne-dose: 15 year duration of protection; two-dose: lifelong duration of protection; ^cTotal costs reflect vaccine program costs associated with 100 incoming birth cohorts from years 2019-2118, and disease cost offsets over the lifetimes of women aged <100 years alive in year 2019; ^dTotal DALYs averted are aggregated over multiple birth cohorts and capture the benefit over the lifetimes of women aged <100 years alive in year 2019; ^eWeakly dominated strategies are either less costly and less effective or more costly and more effective than another strategy; ^fStrongly dominated strategies are more costly and less effective than another strategy; ^gThe incremental cost-effectiveness ratio is less than the gross domestic product per capita in Uganda (i.e., \$674). Abbreviations. HPV: Human papillomavirus; DALY: disability-adjusted life year.

Table S10. Discounted^a incremental costs, disability-adjusted life years (DALYs) averted and cost-effectiveness of campaign one-dose^b HPV vaccination strategies versus routine one-dose^b and two-dose HPV vaccination with 0% one-dose and 20% two-dose efficacy for girls ages 19 and older

S10a. Assuming lifelong duration of protection and campaign coverage of 20% (base case: one-dose efficacy of 80%, two-dose efficacy of 100%, and 40% coverage)

Scenario	Total costs ^c	Total DALYs averted ^d	Incremental cost	Incremental DALYs averted	Cost (USD) per DALY averted
No vaccination	\$617,051,343	--	\$617,051,343	--	--
6 years, 9- to 14-year-olds	\$637,905,527	366,100	--	--	Weakly dominated ^e
5 years, 9- to 14-year-olds	\$640,160,331	448,571	--	--	Weakly dominated ^e
4 years, 9- to 14-year-olds	\$643,924,934	572,389	--	--	Weakly dominated ^e
6 years, 9- to 18-year-olds	\$644,812,698	648,975	--	--	Weakly dominated ^e
5 years, 9- to 18-year-olds	\$648,311,225	782,049	--	--	Weakly dominated ^e
3 years, 9- to 14-year-olds	\$650,278,012	778,847	--	--	Strongly dominated ^f
4 years, 9- to 18-year-olds	\$652,898,253	994,528	--	--	Weakly dominated ^e
3 years, 9- to 18-year-olds	\$661,806,689	1,329,153	\$44,755,346	1,329,153	\$34 ^g
6 years, 9- to 26-year-olds	\$694,942,194	592,370	--	--	Strongly dominated ^f
5 years, 9- to 26-year-olds	\$708,375,585	702,385	--	--	Strongly dominated ^f
6 years, 9- to 30-year-olds	\$716,626,985	571,796	--	--	Strongly dominated ^f
Routine 1-dose	\$728,040,360	1,160,599	--	--	Strongly dominated ^f
4 years, 9- to 26-year-olds	\$730,460,967	850,687	--	--	Strongly dominated ^f
5 years, 9- to 30-year-olds	\$733,772,748	681,016	--	--	Strongly dominated ^f
4 years, 9- to 30-year-olds	\$761,878,568	827,329	--	--	Strongly dominated ^f
3 years, 9- to 26-year-olds	\$769,404,303	1,078,952	--	--	Strongly dominated ^f
3 years, 9- to 30-year-olds	\$813,088,217	1,023,548	--	--	Strongly dominated ^f
Routine 2-dose	\$833,104,416	1,549,362	\$171,297,727	220,210	\$778

S10b. Assuming lifelong duration of protection and campaign coverage of 40% (base case: one-dose efficacy of 80% and two-dose efficacy of 100%)

Scenario	Total costs ^c	Total DALYs averted ^d	Incremental cost	Incremental DALYs averted	Cost (USD) per DALY averted
No vaccination	\$617,051,343	--	\$617,051,343	--	--
6 years, 9- to 14-year-olds	\$656,437,779	765,683	--	--	Weakly dominated ^e
5 years, 9- to 14-year-olds	\$659,830,257	938,428	--	--	Weakly dominated ^e
4 years, 9- to 14-year-olds	\$665,043,876	1,202,381	--	--	Weakly dominated ^e
6 years, 9- to 18-year-olds	\$665,498,237	1,372,025	--	--	Weakly dominated ^e
5 years, 9- to 18-year-olds	\$670,209,585	1,652,910	--	--	Weakly dominated ^e
3 years, 9- to 14-year-olds	\$675,645,607	1,620,475	--	--	Strongly dominated ^f
4 years, 9- to 18-year-olds	\$678,910,364	2,049,504	\$61,859,020	2,049,504	\$30 ^g
3 years, 9- to 18-year-olds	\$698,496,286	2,646,970	\$19,585,922	597,466	\$33 ^g

Routine 1-dose	\$728,040,360	1,160,599	--	--	Strongly dominated ^f
6 years, 9- to 26-year-olds	\$775,005,420	1,127,380	--	--	Strongly dominated ^f
5 years, 9- to 26-year-olds	\$807,732,208	1,259,352	--	--	Strongly dominated ^f
6 years, 9- to 30-year-olds	\$821,644,558	1,046,192	--	--	Strongly dominated ^f
Routine 2-dose	\$833,104,416	1,549,362	--	--	Strongly dominated ^f
4 years, 9- to 26-year-olds	\$860,532,306	1,428,152	--	--	Strongly dominated ^f
5 years, 9- to 30-year-olds	\$860,720,281	1,191,412	--	--	Strongly dominated ^f
4 years, 9- to 30-year-olds	\$926,736,420	1,340,275	--	--	Strongly dominated ^f
3 years, 9- to 26-year-olds	\$954,926,252	1,643,752	--	--	Strongly dominated ^f
3 years, 9- to 30-year-olds	\$1,045,635,785	1,496,714	--	--	Strongly dominated ^f

S10c. Assuming lifelong duration of protection and campaign coverage of 60% (base case: one-dose efficacy of 80%, two-dose efficacy of 100%, and 40% coverage)

Scenario	Total costs ^c	Total DALYs averted ^d	Incremental cost	Incremental DALYs averted	Cost (USD) per DALY averted
No vaccination	\$617,051,343	--	\$617,051,343	--	--
6 years, 9- to 14-year-olds	\$675,816,813	1,151,813	--	--	Weakly dominated ^e
5 years, 9- to 14-year-olds	\$678,251,561	1,432,060	--	--	Weakly dominated ^e
6 years, 9- to 18-year-olds	\$680,353,599	2,135,705	--	--	Weakly dominated ^e
4 years, 9- to 14-year-olds	\$681,965,686	1,860,268	--	--	Strongly dominated ^f
5 years, 9- to 18-year-olds	\$683,700,752	2,580,867	\$66,649,409	2,580,867	\$26 ^g
3 years, 9- to 14-year-olds	\$691,822,121	2,525,703	--	--	Strongly dominated ^f
4 years, 9- to 18-year-olds	\$702,057,499	3,078,743	\$18,356,747	497,876	\$37 ^g
Routine 1-dose	\$728,040,360	1,160,599	--	--	Strongly dominated ^f
3 years, 9- to 18-year-olds	\$755,576,438	3,618,549	\$53,518,939	539,806	\$99 ^g
Routine 2-dose	\$833,104,416	1,549,362	--	--	Strongly dominated ^f
6 years, 9- to 26-year-olds	\$864,801,140	1,512,933	--	--	Strongly dominated ^f
5 years, 9- to 26-year-olds	\$920,446,000	1,619,287	--	--	Strongly dominated ^f
6 years, 9- to 30-year-olds	\$937,028,494	1,369,035	--	--	Strongly dominated ^f
5 years, 9- to 30-year-olds	\$1,002,211,491	1,493,637	--	--	Strongly dominated ^f
4 years, 9- to 26-year-olds	\$1,012,464,154	1,697,305	--	--	Strongly dominated ^f
4 years, 9- to 30-year-olds	\$1,110,312,501	1,589,071	--	--	Strongly dominated ^f
3 years, 9- to 26-year-olds	\$1,168,795,013	1,818,197	--	--	Strongly dominated ^f
3 years, 9- to 30-year-olds	\$1,297,437,366	1,696,076	--	--	Strongly dominated ^f

^aCosts and DALYs discounted at 3% per year; ^bOne-dose: 15 year duration of protection; two-dose: lifelong duration of protection; ^cTotal costs reflect vaccine program costs associated with 100 incoming birth cohorts from years 2019-2118, and disease cost offsets over the lifetimes of women aged <100 years alive in year 2019; ^dTotal DALYs averted are aggregated over multiple birth cohorts and capture the benefit over the lifetimes of women aged <100 years alive in year 2019; ^eWeakly dominated strategies are either less costly and less effective or more costly and more effective than another strategy; ^fStrongly dominated strategies are more costly and less effective than another strategy; ^gThe incremental cost-effectiveness ratio is less than the gross domestic product per capita in Uganda (i.e., \$674). Abbreviations. HPV: Human papillomavirus; DALY: disability-adjusted life year.

References

1. Burger EA, Campos NG, Sy S, Regan C, Kim JJ (2018) Health and economic benefits of single-dose HPV vaccination in a Gavi-eligible country. *Vaccine* **2018**;36: 4823-4829.
2. Jeronimo J, Bansil P, Lim J, Peck R, Paul P, et al. (2014) A multicountry evaluation of careHPV testing, visual inspection with acetic acid, and papanicolaou testing for the detection of cervical cancer. *Int J Gynecol Cancer* **2014**;24: 576-585.
3. Odida M, Sandin S, Mirembe F, Kleter B, Quint W, et al. (2011) HPV types, HIV and invasive cervical carcinoma risk in Kampala, Uganda: a case-control study. *Infect Agent Cancer* **2011**;6: 8.
4. Tobian AA, Grabowski MK, Kigozi G, Gravitt PE, Eaton KP, et al. (2013) High-risk human papillomavirus prevalence is associated with HIV infection among heterosexual men in Rakai, Uganda. *Sex Transm Infect* **2013**;89: 122-127.
5. Kim JJ, Goldie SJ (2008) Health and economic implications of HPV vaccination in the United States. *N Engl J Med* **2008**;359: 821-832.
6. Herrero R, Hildesheim A, Rodriguez AC, Wacholder S, Bratti C, et al. (2008) Rationale and design of a community-based double-blind randomized clinical trial of an HPV 16 and 18 vaccine in Guanacaste, Costa Rica. *Vaccine* **2008**;26: 4795-4808.
7. McCredie MR, Sharples KJ, Paul C, Baranyai J, Medley G, et al. (2008) Natural history of cervical neoplasia and risk of invasive cancer in women with cervical intraepithelial neoplasia 3: a retrospective cohort study. *Lancet Oncol* **2008**;9: 425-434.
8. Munoz N, Mendez F, Posso H, Molano M, van den Brule AJ, et al. (2004) Incidence, duration, and determinants of cervical human papillomavirus infection in a cohort of Colombian women with normal cytological results. *J Infect Dis* **2004**;190: 2077-2087.
9. Sankaranarayanan R, Swaminathan R, Brenner H, Chen K, Chia KS, et al. (2010) Cancer survival in Africa, Asia, and Central America: a population-based study. *Lancet Oncol* **2010**;11: 165-173.
10. Campos NG, Burger EA, Sy S, Sharma M, Schiffman M, et al. (2014) An updated natural history model of cervical cancer: derivation of model parameters. *Am J Epidemiol* **2014**;180: 545-555.
11. Campos NG, Maza M, Alfaro K, Gage JC, Castle PE, et al. (2015) The comparative and cost-effectiveness of HPV-based cervical cancer screening algorithms in El Salvador. *Int J Cancer* **2015**;137: 893-902.
12. Campos NG, Tsu V, Jeronimo J, Mvundura M, Lee K, et al. (2015) When and how often to screen for cervical cancer in three low- and middle-income countries. A cost-effectiveness analysis. *Papillomavirus Research* **2015**;1: 38-58.
13. Guan P, Howell-Jones R, Li N, Bruni L, de Sanjose S, et al. (2012) Human papillomavirus types in 115,789 HPV-positive women: a meta-analysis from cervical infection to cancer. *Int J Cancer* **2012**;131: 2349-2359.
14. Bray F, Colombet M, Mery L, Piñeros M, Znaor A, et al. (2017) Cancer Incidence in Uganda (2008-2012). In: *Cancer Incidence in Five Continents, Vol XI*. Lyon, France: International Agency for Research on Cancer. **2017**.
15. Ferlay J, Soerjomataram I, Ervik M, et al. (2013) GLOBOCAN 2012 cancer incidence and mortality worldwide: IARC cancerbase No. 11. Lyon, France: International Agency for Research on Cancer. **2013**.
16. Gavi The Vaccine Alliance (2013) GAVI Alliance Vaccine Introduction Grant and Operational Support for Campaigns Policy. Version No. 1.0. Geneva: Gavi, The Vaccine Alliance. Last updated: 2 April 2013. [Online] Accessed 12 July 2018. Available at: www.gavi.org **2013**.
17. Portnoy A, Ozawa S, Grewal S, Norman BA, Rajgopal J, et al. (2015) Costs of vaccine programs across 94 low- and middle-income countries. *Vaccine* **2015**;33: A99-108.

18. Gandhi G, Lydon P (2014) Updating the evidence base on the operational costs of supplementary immunization activities for current and future accelerated disease control, elimination and eradication efforts. *BMC Public Health* **2014**;14: 67.
19. Botwright S, Holroyd T, Nanda S, Bloem P, Griffiths UK, et al. (2017) Experiences of operational costs of HPV vaccine delivery strategies in Gavi-supported demonstration projects. *PLoS One* **2017**;12: e0182663.