

Analysis of cervical HPV infections among unvaccinated young adult women to inform vaccine strategies in this age group: The Costa Rica HPV Vaccine Trial

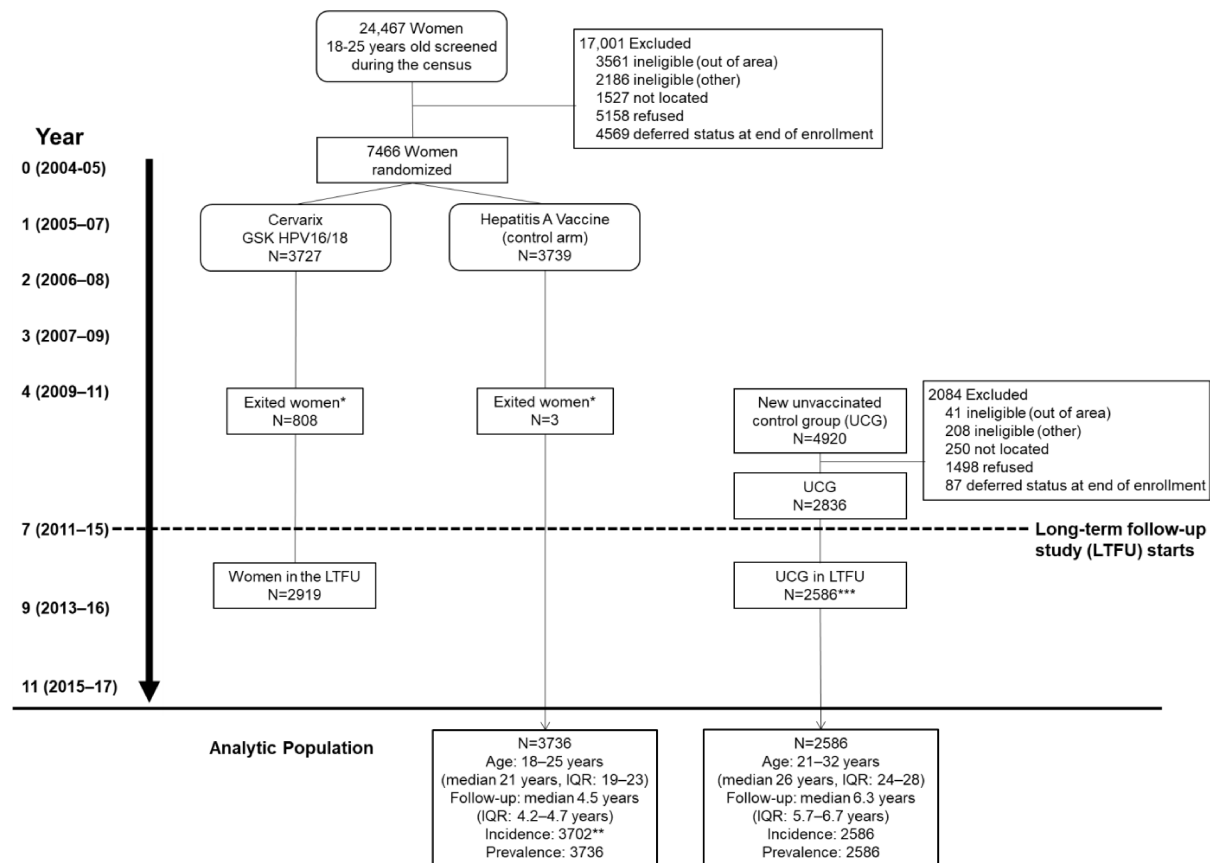
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Supplemental Table 1. Number of unvaccinated young adult women in the Costa Rica HPV Vaccine Trial

Age (years)	Study Visits								TOTAL
	Year 0 (2004–05)	Year 1 (2005–07)	Year 2 (2006–08)	Year 3 (2007–09)	Year 4 (2009–11)	Year 7 (2011–15)	Year 9 (2013–16)	Year 11 (2015–17)	
18	652	45							697
19	591	550	28						1169
20	490	538	532	16					1576
21	416	475	513	489	2				1895
22	447	405	456	521	275				2104
23	397	434	371	424	476	7			2109
24	384	383	415	348	476	79			2085
25	358	362	358	410	392	214	18		2112
26		318	342	349	385	311	98	1	1804
27		42	305	334	404	364	189	6	1644
28			30	291	347	292	319	64	1343
29				48	317	287	330	189	1171
30					156	282	280	321	1039
31					29	286	266	320	901
32					6	225	266	288	785
33						137	255	244	636
34						22	211	257	490
35						1	115	259	375
36							18	227	245
37							1	116	117
38*								21	21
TOTAL	3735	3552	3350	3230	3265	2507	2366	2313	24318

* Observations from women at age 38 excluded from current analysis due to small sample size

Supplemental Figure 1. CONSORT diagram of participants in the Costa Rica HPV Vaccine Trial (CVT)



* Exited per study protocol

** No follow-up information (n=34)

*** UCG women excluded because they did not have any follow-up visits at years 7, 9, and 11 (n=250)

Supplemental Table 2. Prevalent HPV infections

Age (years)	Any HPV			Oncogenic HPV			Non-oncogenic HPV			Vaccine-preventable HPV types											
										HPV16/18			HPV31/33/45			HPV31/33/45/52/58			HPV6/11		
	n	HPV+	%	n	HPV+	%	n	HPV+	%	n	HPV+	%	n	HPV+	%	n	HPV+	%	n	HPV+	%
18	695	184	26.5	695	145	20.9	695	91	13.1	695	52	7.5	695	22	3.2	695	68	9.8	695	14	2.0
19	1168	369	31.6	1168	286	24.5	1168	178	15.2	1168	110	9.4	1168	60	5.1	1168	129	11.0	1168	30	2.6
20	1571	543	34.6	1571	412	26.2	1571	274	17.4	1571	154	9.8	1571	119	7.6	1571	228	14.5	1571	46	2.9
21	1892	691	36.5	1892	547	28.9	1892	347	18.3	1892	206	10.9	1892	140	7.4	1892	268	14.2	1892	52	2.7
22	2100	810	38.6	2100	603	28.7	2100	399	19.0	2100	196	9.3	2100	136	6.5	2100	301	14.3	2100	50	2.4
23	2108	812	38.5	2108	604	28.7	2108	401	19.0	2108	196	9.3	2108	156	7.4	2108	301	14.3	2108	41	1.9
24	2084	806	38.7	2084	593	28.5	2084	389	18.7	2084	195	9.4	2084	124	6.0	2084	292	14.0	2084	46	2.2
25	2110	784	37.2	2110	599	28.4	2110	364	17.3	2110	204	9.7	2110	146	6.9	2110	295	14.0	2110	37	1.8
26	1802	660	36.6	1802	498	27.6	1802	315	17.5	1802	149	8.3	1802	145	8.0	1802	259	14.4	1802	25	1.4
27	1643	615	37.4	1643	445	27.1	1643	301	18.3	1643	130	7.9	1643	130	7.9	1643	238	14.5	1643	24	1.5
28	1343	512	38.1	1343	374	27.8	1343	254	18.9	1343	100	7.4	1343	112	8.3	1343	199	14.8	1343	22	1.6
29	1169	434	37.1	1169	307	26.3	1169	226	19.3	1169	88	7.5	1169	84	7.2	1169	145	12.4	1169	23	2.0
30	1038	332	32.0	1038	224	21.6	1038	185	17.8	1038	69	6.6	1038	48	4.6	1038	107	10.3	1038	14	1.3
31	901	293	32.5	901	185	20.5	901	168	18.6	901	49	5.4	901	41	4.6	901	81	9.0	901	8	0.9
32	785	235	29.9	785	159	20.3	785	128	16.3	785	45	5.7	785	44	5.6	785	77	9.8	785	9	1.1
33	635	198	31.2	635	133	20.9	635	107	16.9	635	42	6.6	635	38	6.0	635	71	11.2	635	5	0.8
34	490	166	33.9	490	93	19.0	490	111	22.7	490	29	5.9	490	32	6.5	490	53	10.8	490	14	2.9
35	375	125	33.3	375	83	22.1	375	67	17.9	375	26	6.9	375	23	6.1	375	39	10.4	375	5	1.3
36	245	73	29.8	245	51	20.8	245	43	17.6	245	8	3.3	245	23	9.4	245	37	15.1	245	4	1.6
37	117	34	29.1	117	20	17.1	117	20	17.1	117	4	3.4	117	8	6.8	117	11	9.4	117	7	6.0

n, number of visits tested at each single year of age; HPV+, The number testing HPV positive %, percentage

Supplemental Table 3. Incident HPV infections

Age (years)	Any HPV			Oncogenic HPV			Non-oncogenic HPV			Vaccine-preventable HPV types											
										HPV16/18			HPV31/33/45			HPV31/33/45/52/58			HPV6/11		
	n	HPV+	%	n	HPV+	%	n	HPV+	%	n	HPV+	%	n	HPV+	%	n	HPV+	%	n	HPV+	%
19	576	147	25.5	576	110	19.1	576	73	12.7	573	32	5.6	576	23	4.0	576	47	8.2	576	9	1.6
20	1084	304	28.0	1084	222	20.5	1084	165	15.2	1078	69	6.4	1084	59	5.4	1084	121	11.2	1084	24	2.2
21	1473	414	28.1	1473	299	20.3	1473	227	15.4	1463	87	5.9	1473	77	5.2	1473	142	9.6	1473	28	1.9
22	1653	460	27.8	1653	315	19.1	1653	237	14.3	1644	74	4.5	1653	71	4.3	1653	158	9.6	1652	23	1.4
23	1711	495	28.9	1711	345	20.2	1711	262	15.3	1702	85	5.0	1711	79	4.6	1711	162	9.5	1710	29	1.7
24	1699	457	26.9	1699	312	18.4	1699	237	13.9	1691	86	5.1	1699	54	3.2	1699	148	8.7	1699	23	1.4
25	1753	497	28.4	1753	337	19.2	1753	253	14.4	1748	92	5.3	1753	80	4.6	1753	165	9.4	1752	28	1.6
26	1801	474	26.3	1801	317	17.6	1801	257	14.3	1790	70	3.9	1801	88	4.9	1801	167	9.3	1800	22	1.2
27	1642	448	27.3	1642	300	18.3	1642	242	14.7	1642	77	4.7	1642	82	5.0	1642	154	9.4	1642	22	1.3
28	1342	386	28.8	1342	261	19.4	1342	198	14.8	1339	54	4.0	1342	70	5.2	1342	136	10.1	1342	20	1.5
29	1168	323	27.7	1168	200	17.1	1168	184	15.8	1166	51	4.4	1167	46	3.9	1168	85	7.3	1168	17	1.5
30	1038	260	25.0	1038	163	15.7	1038	152	14.6	1032	33	3.2	1038	33	3.2	1038	78	7.5	1038	13	1.3
31	901	229	25.4	901	135	15.0	901	135	15.0	899	34	3.8	901	29	3.2	901	57	6.3	901	7	0.8
32	784	186	23.7	784	123	15.7	784	102	13.0	783	32	4.1	784	29	3.7	784	55	7.0	784	8	1.0
33	635	156	24.6	635	102	16.1	635	83	13.1	635	30	4.7	635	28	4.4	635	55	8.7	635	4	0.6
34	490	134	27.3	490	73	14.9	490	88	18.0	490	17	3.5	490	28	5.7	490	42	8.6	490	11	2.2
35	375	96	25.6	375	62	16.5	375	54	14.4	374	15	4.0	375	14	3.7	375	24	6.4	375	2	0.5
36	245	55	22.4	245	38	15.5	245	30	12.2	244	6	2.5	245	14	5.7	245	24	9.8	245	3	1.2
37	117	26	22.2	117	16	13.7	117	15	12.8	117	3	2.6	117	6	5.1	117	9	7.7	117	5	4.3

n, number of visits tested at each single year of age; HPV+, Number testing HPV positive; %, percentage

Supplemental Table 3. Model estimated age-specific prevalence of HPV among unvaccinated women 18–37 years in the Costa Rica Vaccine Trial, using generalized estimating equations (GEE).

Age (years)	Any HPV Prevalence % (95% CI)	Oncogenic HPV Prevalence % (95% CI)	Non-oncogenic HPV Prevalence % (95% CI)	Vaccine-preventable HPV types			
				HPV16/18 Prevalence % (95% CI)	HPV31/33/45 Prevalence % (95% CI)	HPV31/33/45/52/58 Prevalence % (95% CI)	HPV6/11 Prevalence % (95% CI)
18	26.5 (23.2–30.0)	20.9 (17.9–24.1)	13.1 (10.7–16.0)	7.5 (5.7–9.8)	3.2 (2.1–4.8)	9.8 (7.7–12.3)	2.0 (1.2–3.4)
19	31.6 (28.9–34.4)	24.5 (22.0–27.1)	15.2 (13.3–17.5)	9.4 (7.8–11.3)	5.1 (4.0–6.6)	11.0 (9.3–13.1)	2.6 (1.8–3.7)
20	34.6 (32.1–37.1)	26.2 (24.0–28.6)	17.4 (15.6–19.5)	9.8 (8.4–11.5)	7.6 (6.3–9.1)	14.5 (12.8–16.5)	2.9 (2.2–4.0)
21	36.5 (34.3–38.8)	28.9 (26.8–31.1)	18.3 (16.6–20.2)	10.9 (9.5–12.5)	7.4 (6.3–8.7)	14.2 (12.6–15.9)	2.7 (2.1–3.6)
22	38.6 (36.4–40.8)	28.7 (26.7–30.8)	19.0 (17.3–20.8)	9.3 (8.1–10.7)	6.5 (5.5–7.7)	14.3 (12.8–16.0)	2.4 (1.8–3.1)
23	38.5 (36.4–40.7)	28.7 (26.7–30.7)	19.0 (17.4–20.8)	9.3 (8.1–10.7)	7.4 (6.3–8.7)	14.3 (12.8–15.9)	1.9 (1.4–2.6)
24	38.7 (36.6–40.9)	28.5 (26.5–30.6)	18.7 (17.1–20.5)	9.3 (8.1–10.7)	6.0 (5.0–7.1)	14.0 (12.5–15.7)	2.2 (1.6–2.9)
25	37.2 (35.1–39.5)	28.4 (26.4–30.6)	17.3 (15.7–19.1)	9.6 (8.3–11.1)	6.9 (5.9–8.2)	14.0 (12.5–15.7)	1.7 (1.2–2.4)
26	36.4 (34.0–38.9)	27.5 (25.3–29.8)	17.2 (15.4–19.2)	8.1 (6.7–9.6)	7.9 (6.7–9.5)	14.2 (12.5–16.1)	1.3 (0.82–1.9)
27	36.7 (34.0–39.4)	26.6 (24.2–29.1)	17.5 (15.6–19.7)	7.5 (6.2–9.1)	7.6 (6.2–9.4)	14.0 (12.2–16.1)	1.2 (0.81–1.9)
28	35.7 (32.7–38.8)	26.3 (23.5–29.2)	16.6 (14.4–19.0)	6.7 (5.3–8.4)	7.6 (6.0–9.5)	13.6 (11.6–15.9)	1.3 (0.77–2.1)
29	33.3 (30.1–36.6)	23.8 (21.0–26.9)	15.7 (13.4–18.2)	6.4 (4.9–8.3)	6.2 (4.7–8.0)	10.8 (8.9–13.0)	1.4 (0.81–2.3)
30	27.2 (24.0–30.7)	18.8 (16.1–21.8)	13.4 (11.2–16.0)	5.4 (4.0–7.2)	3.8 (2.7–5.3)	8.5 (6.7–10.8)	0.87 (0.47–1.6)
31	27.3 (23.7–31.1)	17.6 (14.7–20.8)	13.7 (11.2–16.6)	4.3 (3.0–6.1)	3.6 (2.5–5.3)	7.3 (5.6–9.5)	0.54 (0.25–1.2)
32	24.5 (21.0–28.5)	17.1 (14.2–20.6)	11.6 (9.3–14.4)	4.4 (3.1–6.4)	4.4 (3.0–6.4)	7.9 (6.0–10.3)	0.69 (0.32–1.5)
33	25.1 (21.2–29.5)	17.4 (14.1–21.3)	11.6 (9.1–14.6)	5.0 (3.4–7.4)	4.6 (3.0–6.9)	8.8 (6.5–11.7)	0.47 (0.18–1.2)
34	26.1 (21.7–30.9)	15.0 (11.8–18.9)	14.7 (11.6–18.5)	4.3 (2.8–6.7)	4.7 (3.1–7.2)	8.1 (5.8–11.1)	1.6 (0.81–3.3)
35	24.9 (20.2–30.3)	17.3 (13.4–21.9)	10.9 (8.2–14.4)	5.0 (3.1–7.9)	4.3 (2.6–7.1)	7.6 (5.2–10.9)	0.74 (0.28–2.0)
36	21.7 (16.8–27.7)	16.0 (11.7–21.5)	10.5 (7.4–14.7)	2.3 (1.0–5.2)	6.6 (4.0–10.8)	11.0 (7.5–15.9)	0.90 (0.25–3.2)
37	21.2 (14.8–29.3)	13.0 (8.1–20.3)	10.2 (6.3–16.3)	2.4 (0.86–6.5)	4.8 (2.3–9.8)	6.7 (3.6–12.2)	3.4 (1.4–8.0)

Supplemental Table 4. Model estimated age-specific incidence of HPV among unvaccinated women 19–37 years in the Costa Rica Vaccine Trial, using generalized estimating equations (GEE)

Age (years)	Any HPV Incidence % (95% CI)	Oncogenic HPV Incidence % (95% CI)	Non–oncogenic HPV Incidence % (95% CI)	Vaccine-preventable HPV types			
				HPV16/18 Incidence % (95% CI)	HPV31/33/45 Incidence % (95% CI)	HPV31/33/45/52/58 Incidence % (95% CI)	HPV6/11 Incidence % (95% CI)
19	25.6 (22.1–29.4)	19.1 (16.0–22.5)	12.8 (10.3–15.9)	5.7 (4.0–7.9)	3.9 (2.6–5.8)	8.1 (6.1–10.7)	1.6 (0.83–3.0)
20	28.0 (25.3–30.9)	20.3 (17.9–22.9)	15.4 (13.3–17.7)	6.4 (5.1–8.1)	5.3 (4.1–6.8)	11.0 (9.3–13.1)	2.2 (1.5–3.4)
21	27.9 (25.6–30.3)	20.0 (18.0–22.2)	15.5 (13.7–17.5)	5.9 (4.8–7.3)	5.0 (4.0–6.3)	9.4 (8.0–11.1)	1.9 (1.3–2.8)
22	27.3 (25.1–29.5)	18.4 (16.6–20.4)	14.2 (12.6–16.1)	4.4 (3.5–5.5)	4.0 (3.2–5.1)	9.2 (7.8–10.7)	1.4 (0.92–2.1)
23	27.8 (25.6–30.1)	19.1 (17.2–21.1)	14.9 (13.2–16.7)	4.6 (3.7–5.7)	4.2 (3.4–5.3)	8.9 (7.6–10.3)	1.7 (1.1–2.4)
24	25.4 (23.3–27.6)	17.0 (15.2–18.9)	13.4 (11.8–15.2)	4.5 (3.6–5.6)	2.8 (2.1–3.7)	8.0 (6.8–9.4)	1.3 (0.84–2.0)
25	26.4 (24.2–28.7)	17.4 (15.6–19.4)	13.8 (12.1–15.6)	4.4 (3.5–5.6)	3.9 (3.1–5.0)	8.4 (7.2–9.9)	1.4 (0.95–2.1)
26	24.0 (21.9–26.2)	15.6 (13.9–17.5)	13.2 (11.6–15.0)	3.2 (2.4–4.1)	4.1 (3.3–5.2)	8.1 (6.9–9.6)	1.0 (0.65–1.6)
27	23.5 (21.3–26.0)	15.3 (13.5–17.3)	12.8 (11.1–14.6)	3.4 (2.6–4.5)	4.0 (3.1–5.1)	7.7 (6.5–9.2)	1.0 (0.65–1.6)
28	22.9 (20.4–25.6)	15.3 (13.2–17.5)	11.2 (9.4–13.2)	2.7 (1.9–3.6)	3.8 (2.9–5.1)	7.8 (6.4–9.5)	1.0 (0.59–1.7)
29	20.1 (17.6–22.9)	12.3 (10.4–14.5)	10.6 (8.8–12.7)	2.6 (1.8–3.6)	2.6 (1.9–3.7)	5.1 (4.0–6.6)	0.83 (0.44–1.6)
30	16.8 (14.4–19.6)	10.6 (8.7–12.8)	8.9 (7.2–11.0)	1.7 (1.1–2.6)	2.0 (1.3–3.0)	5.0 (3.8–6.6)	0.62 (0.31–1.2)
31	16.5 (13.8–19.5)	9.7 (7.8–12.0)	8.7 (6.9–11.0)	1.9 (1.3–3.0)	1.9 (1.2–2.9)	4.1 (3.0–5.6)	0.36 (0.15–0.83)
32	15.1 (12.6–18.1)	10.2 (8.2–12.7)	7.3 (5.7–9.4)	2.1 (1.4–3.2)	2.2 (1.4–3.4)	4.5 (3.3–6.2)	0.47 (0.21–1.0)
33	15.5 (12.7–18.7)	10.4 (8.1–13.2)	7.1 (5.4–9.3)	2.4 (1.6–3.8)	2.6 (1.6–4.1)	5.6 (4.0–7.7)	0.28 (0.09–0.85)
34	16.6 (13.4–20.4)	9.3 (7.1–12.2)	9.2 (7.0–12.0)	1.7 (1.0–3.0)	3.3 (2.1–5.2)	5.4 (3.7–7.7)	0.95 (0.45–2.0)
35	14.7 (11.4–18.7)	10.0 (7.4–13.4)	6.8 (4.9–9.4)	1.9 (1.1–3.5)	2.0 (1.1–3.7)	3.9 (2.5–6.0)	0.21 (0.05–0.91)
36	12.5 (9.1–16.9)	9.2 (6.3–13.2)	5.6 (3.7–8.4)	1.2 (0.48–2.7)	3.1 (1.7–5.5)	6.0 (3.8–9.3)	0.46 (0.13–1.6)
37	11.8 (7.6–17.8)	7.7 (4.4–13.1)	5.7 (3.2–10.0)	1.1 (0.33–3.6)	2.6 (1.1–6.2)	4.5 (2.2–8.9)	1.6 (0.54–4.6)

Supplemental Table 5. Model estimated proportion of total incident HPV infections by age*, using generalized estimating equations (GEE)

Age (years)	Any	Oncogenic	Vaccine-Preventable Oncogenic†
	% Incident Infections (%95 CI)	% Incident Infections (%95 CI)	% Incident Infections (%95 CI)
19	100.0 (100.0-100.0)	100.0 (100.0-100.0)	100.0 (100.0-100.0)
20	92.9 (91.7-94.2)	92.7 (91.2-94.0)	92.9 (91.1-94.5)
21	84.9 (83.2-86.5)	84.4 (82.5-86.4)	83.6 (81.3-85.9)
22	76.9 (74.8-78.9)	76.2 (73.7-78.5)	75.4 (72.6-78.1)
23	70.1 (67.6-72.2)	69.2 (66.5-71.9)	68.5 (65.4-71.5)
24	62.9 (60.4-65.2)	62.0 (59.2-65.0)	61.4 (58.1-64.7)
25	56.5 (53.7-58.9)	55.7 (52.5-58.8)	54.9 (51.3-58.5)
26	50.1 (47.1-52.7)	49.2 (45.8-52.5)	48.2 (44.4-52.1)
27	44.0 (40.9-46.7)	43.2 (39.6-46.5)	42.3 (38.3-46.2)
28	38.1 (35.0-41.0)	37.3 (33.7-40.8)	36.3 (32.3-40.5)
29	32.8 (29.7-35.7)	31.8 (28.3-35.3)	30.9 (26.9-35.1)
30	28.1 (25.2-30.9)	27.4 (24.1-30.9)	27.0 (23.2-31.1)
31	24.0 (21.3-26.7)	23.3 (20.5-26.4)	23.4 (20.0-27.2)
32	20.2 (17.8-22.8)	19.9 (17.1-22.9)	20.2 (17.0-23.8)
33	16.7 (14.6-19.2)	16.3 (13.6-19.1)	16.8 (13.8-20.3)
34	13.1 (11.2-15.3)	12.4 (10.2-14.9)	12.7 (10.0-15.8)
35	9.1 (7.4-11.1)	9.0 (7.1-11.2)	9.1 (6.7-11.7)
36	5.9 (4.4-7.5)	5.9 (4.2-7.8)	6.2 (4.1-8.4)
37	2.7 (1.5-3.9)	2.4 (1.3-3.6)	2.8 (1.4-4.7)

† All vaccine-preventable oncogenic types (i.e., HPV16/18/31/33/45/52/58).

* We estimated the total number of observed incident infections in a woman who is annually screened for HPV between the ages of 19 to 37. We report the proportion of those infections that are likely to occur at or after each of the specified ages.

Supplemental Table 6. Number of sexually active unvaccinated women in the Costa Rica Vaccine Trial, by time since first sexual intercourse and study visit

Time since first sexual intercourse (years)	Visit								TOTAL
	Year 0 (2004–05)	Year 1 (2005–07)	Year 2 (2006–08)	Year 3 (2007–09)	Year 4 (2009–11)	Year 7 (2011–15)	Year 9 (2013–16)	Year 11 (2015–17)	
<1	215	158	104	76	34	4	2	1	594
1	283	221	178	131	81	7	7	2	910
2	372	271	213	170	99	15	8	5	1153
3	403	357	229	200	158	16	7	4	1374
4	408	369	349	242	191	34	17	5	1615
5	319	395	342	303	213	54	16	6	1648
6	270	311	360	365	295	96	35	10	1742
7	202	254	311	337	343	154	59	22	1682
8	165	204	235	288	335	201	95	32	1555
9	142	155	200	244	336	251	133	51	1512
10	86	140	144	182	272	267	198	84	1373
11	38	92	139	142	220	247	260	149	1287
12	7	30	70	140	168	243	223	188	1069
13	3	13	43	77	117	227	262	227	969
14		3	7	32	127	185	224	243	821
15	1	1	3	15	46	158	200	231	655
16					28	116	171	218	533
17	1			1	4	72	146	211	435
18					2	48	100	158	308
19		1				20	83	152	256
20			1			14	38	108	161
21+	1			2	2	22	47	172	246
TOTAL	2916	2975	2928	2947	3071	2451	2331	2279	21898

Supplemental Table 7. Overall model estimated prevalence and incidence of HPV among sexually active unvaccinated young adult women in the Costa Rica Vaccine Trial followed for a median of 4.8 years, using generalized estimating equations (GEE)

	PREVALENCE			INCIDENCE		
	N= 21,872	%	95% CI	N= 18,952	%	95% CI
HPV category						
Any HPV	8650	39.5	(38.6-40.5)	5542	29.2	(28.5-30.0)
Any oncogenic HPV	6343	29.0	(28.2-29.9)	3729	19.7	(19.1-20.3)
Any non-oncogenic HPV	4352	19.9	(19.2-20.6)	2990	15.8	(15.2-16.4)
Vaccine-preventable HPV types						
HPV16/18	2048	9.4	(8.8-9.9)	951	5.0	(4.7-5.4)
HPV31/33/45	1620	7.4	(6.9-7.9)	908	4.8	(4.5-5.1)
HPV31/33/45/52/58	3185	14.6	(13.9-15.2)	1825	9.6	(9.2-10.1)
HPV6/11	474	2.2	(2.0-2.4)	297	1.6	(1.4-1.8)