Global Control of HPV Related Diseases and Cancer

HPV Vaccination: Evidence from British Columbia and Globally

BC Immunization Forum 2020

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Speaker Disclosure slide

- I do not have an affiliation (financial or otherwise) with a pharmaceutical, medical device or communications organization.
- I do not intend to make therapeutic recommendations for medications that have not received regulatory approval (i.e. “off-label” use of medication)

World Health Organization Call to Action

May 18, 2018:

- Director-General of WHO issued call for action towards elimination of cervical cancer as a public health problem.
- Called for coordinated action globally.

"High income countries have shown the way. In many of these countries, cervical cancer is becoming a thing of the past. Now is the time for global elimination"

Adhanom Ghebreyesus, T. (2018).

Dr Tedros Adhanom Ghebreyesus, WHO Director-General.

Global Burden of Cervical cancer

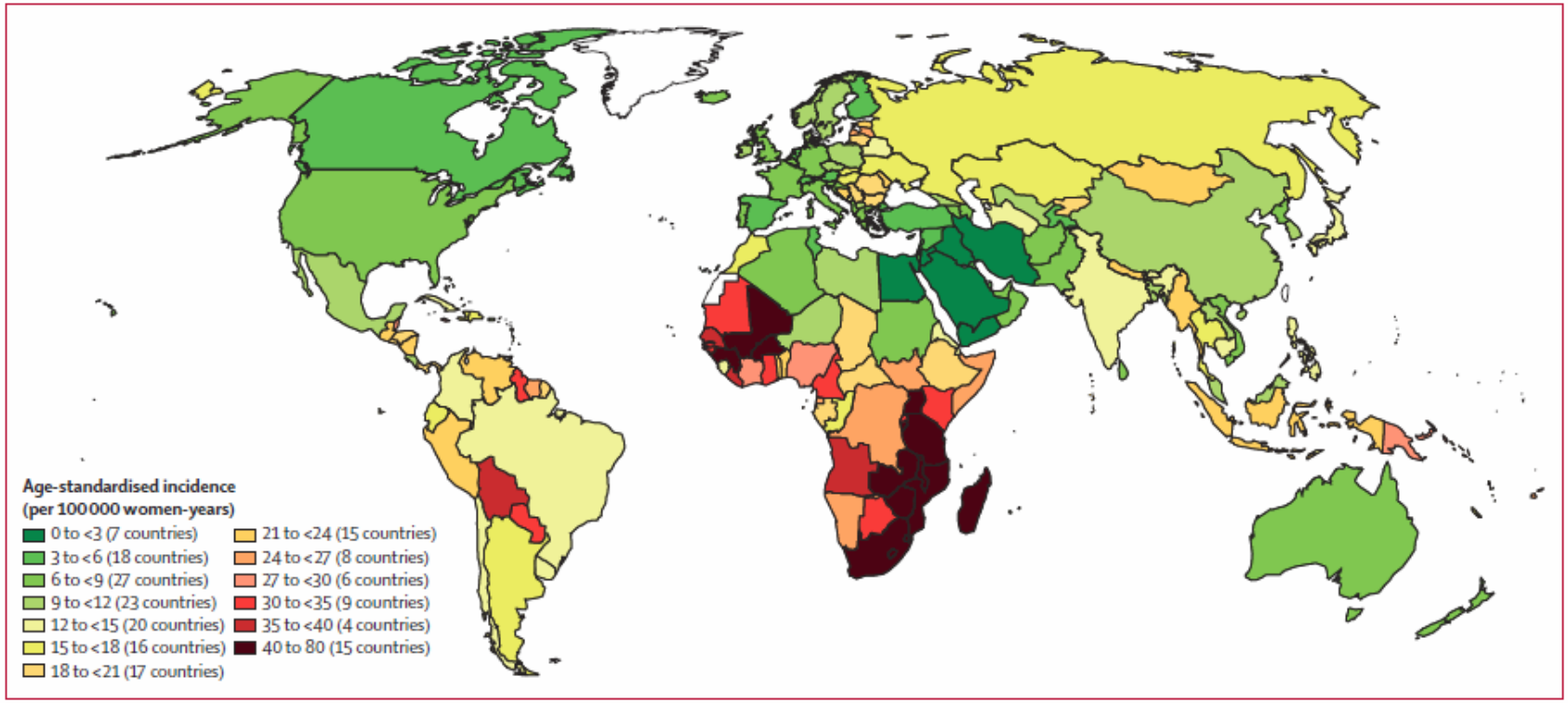


Figure 1: Geographical distribution of world age-standardised incidence of cervical cancer by country, estimated for 2018

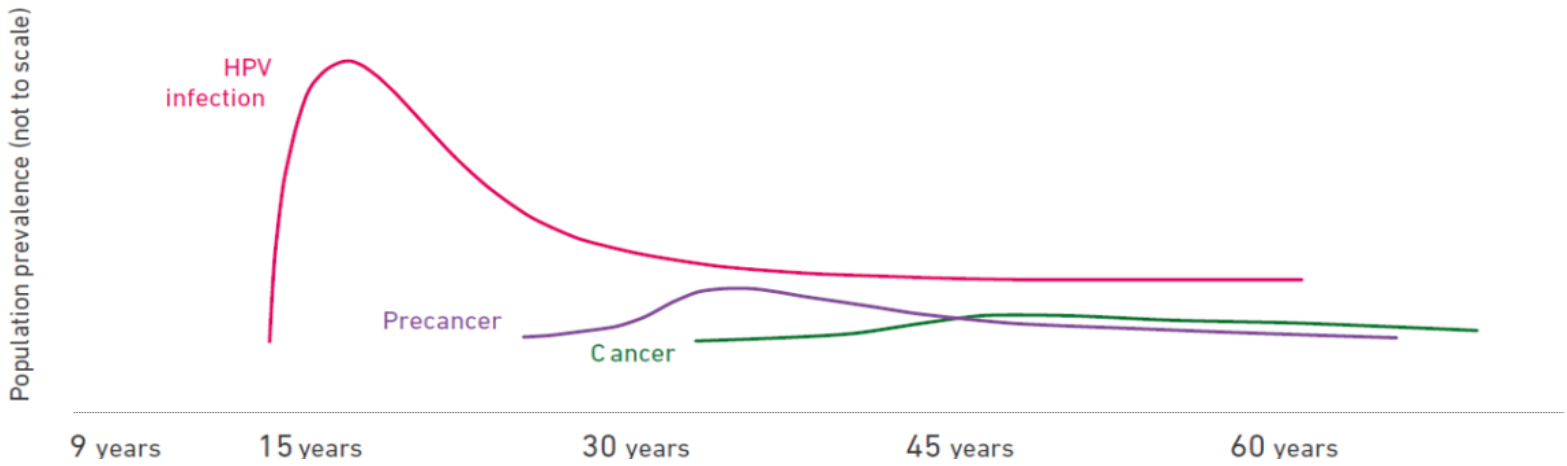
SOGC Canadian Statement

October 1, 2018

- Society of Obstetricians and Gynaecologists of Canada (SOGC) sets goal to become first country in the world to eliminate cervical cancer

- Goal for elimination to be achieved for the next generation

WHO life-course approach to cervical cancer control



Primary Prevention

Girls 9-14 years
- HPV vaccination

Girls and boys, as appropriate
- Health information and warnings about tobacco use
- Sexuality education tailored to age & culture
- Condom promotion/provision for those engaged in sexual activity
- Male circumcision

Secondary Prevention

Women > 30 years of age

"Screen and treat" – single visit approach

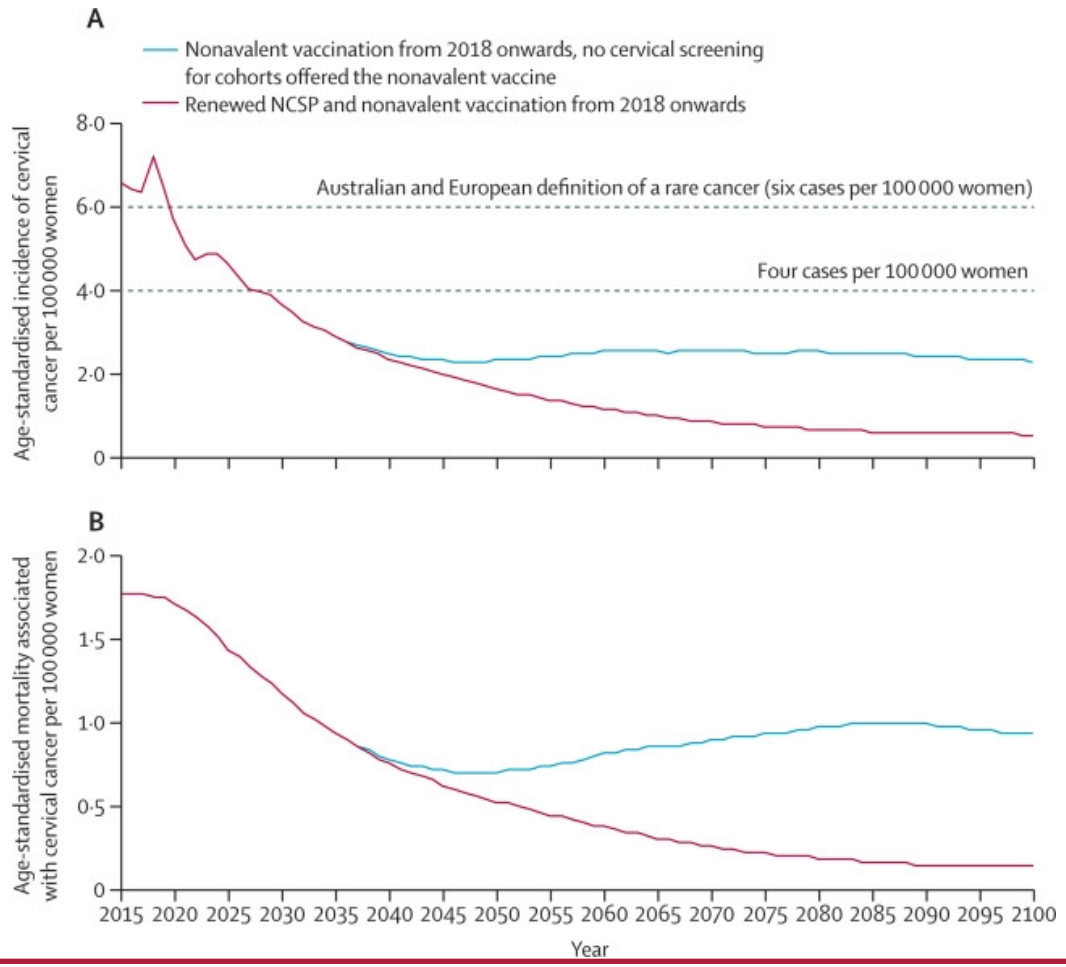
- Point-of-care rapid HPV testing for high risk HPV types
- Followed by immediate treatment
- On site treatment

Tertiary Prevention

All women as needed

Treatment of invasive cancer at any age and palliative care
- Ablative surgery
- Radiotherapy
- Chemotherapy
- *Palliative Care*

Age-standardized annual incidence (A) of invasive cervical cancer and associated mortality (B)

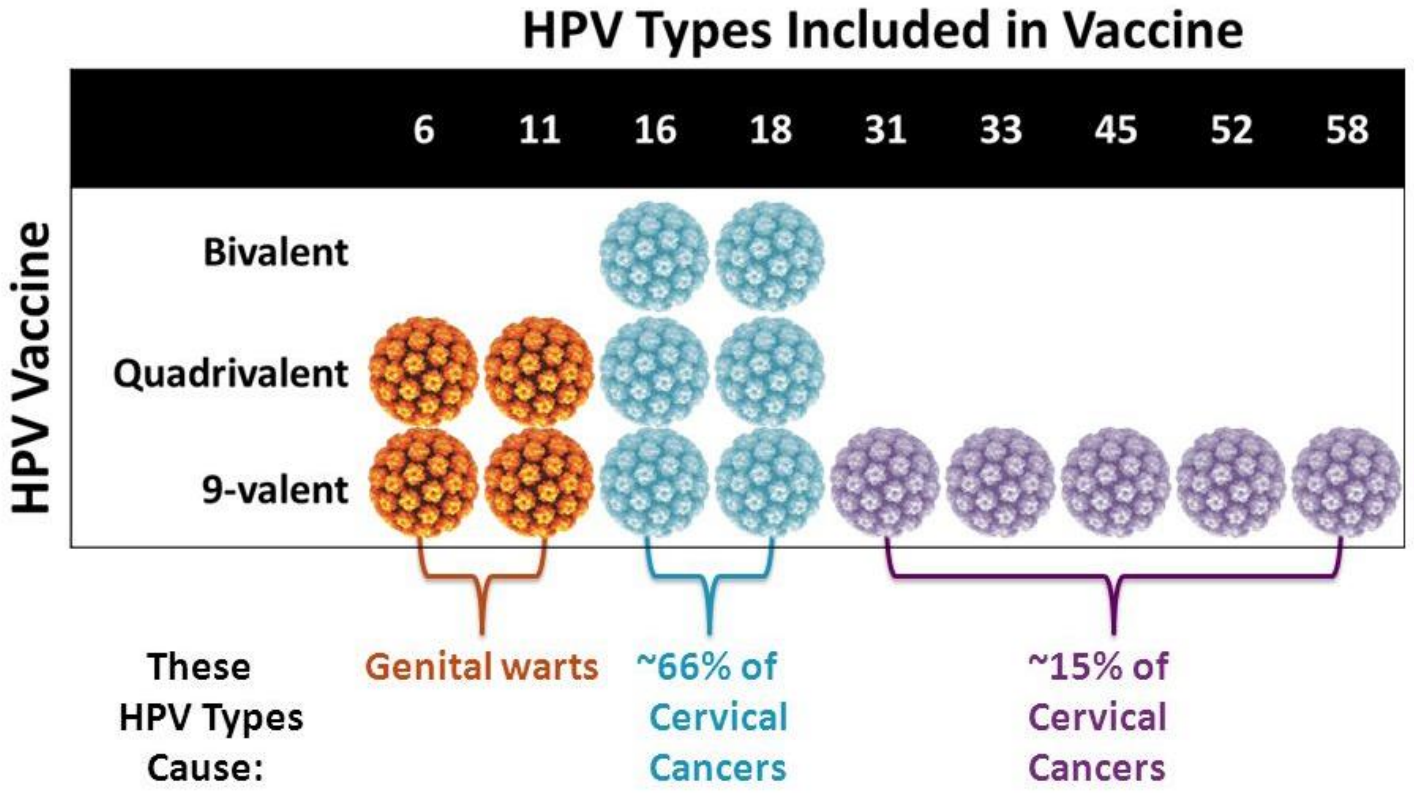


Cervical cancer in Canada

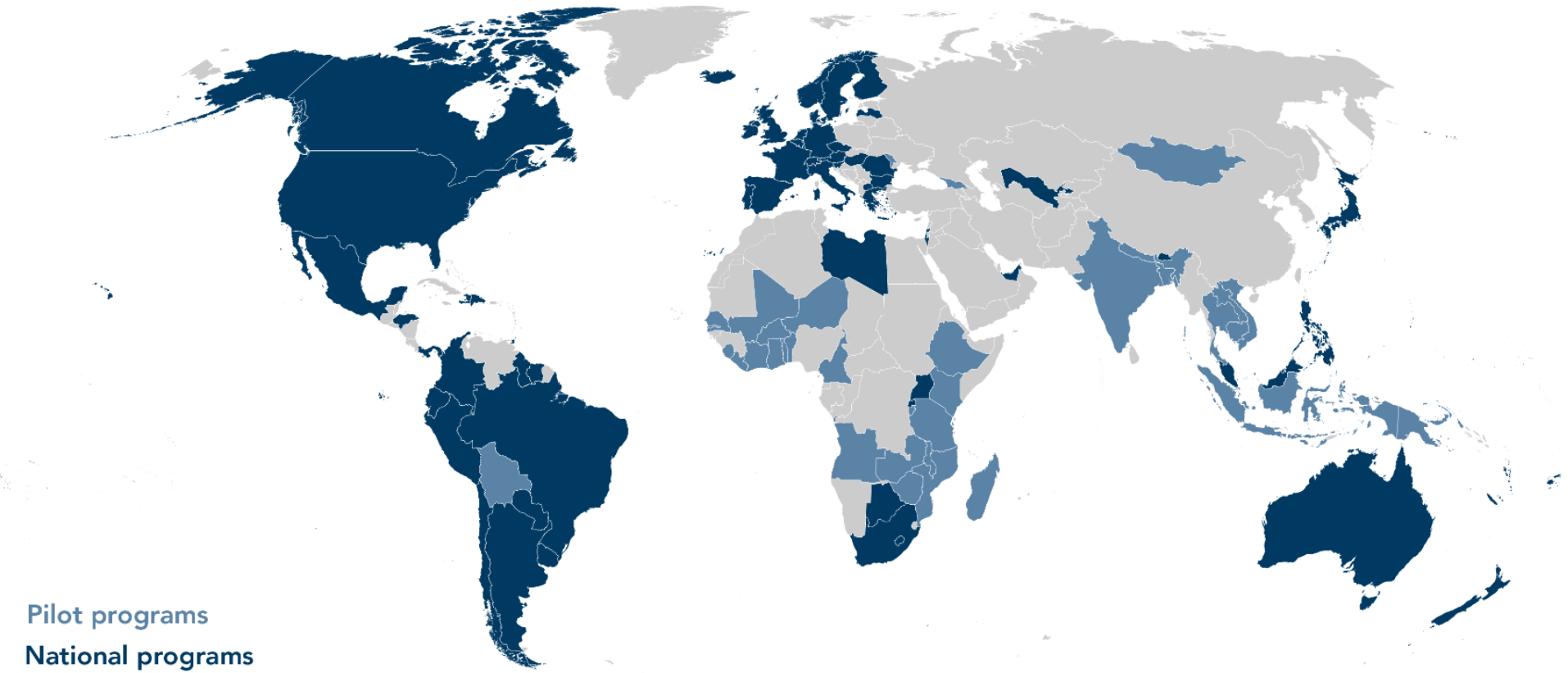
- Median age of diagnosis is 47 years
- 73% of cervical cancer in women 25-59 years
- Immigrant women; women who do not speak English or French at home more likely to develop cervical cancer
- Incidence rate of cervical cancer rate in First Nations is significantly higher than in non First Nations women in BC: 33.1(95%CI: 27.0-39) vs 17.2 (95%CI:16.6–17.9) [Standardized rate ratio: 1.92 (1.49–2.48)]

A lot can change in 12 years…

Primary prevention: HPV vaccines

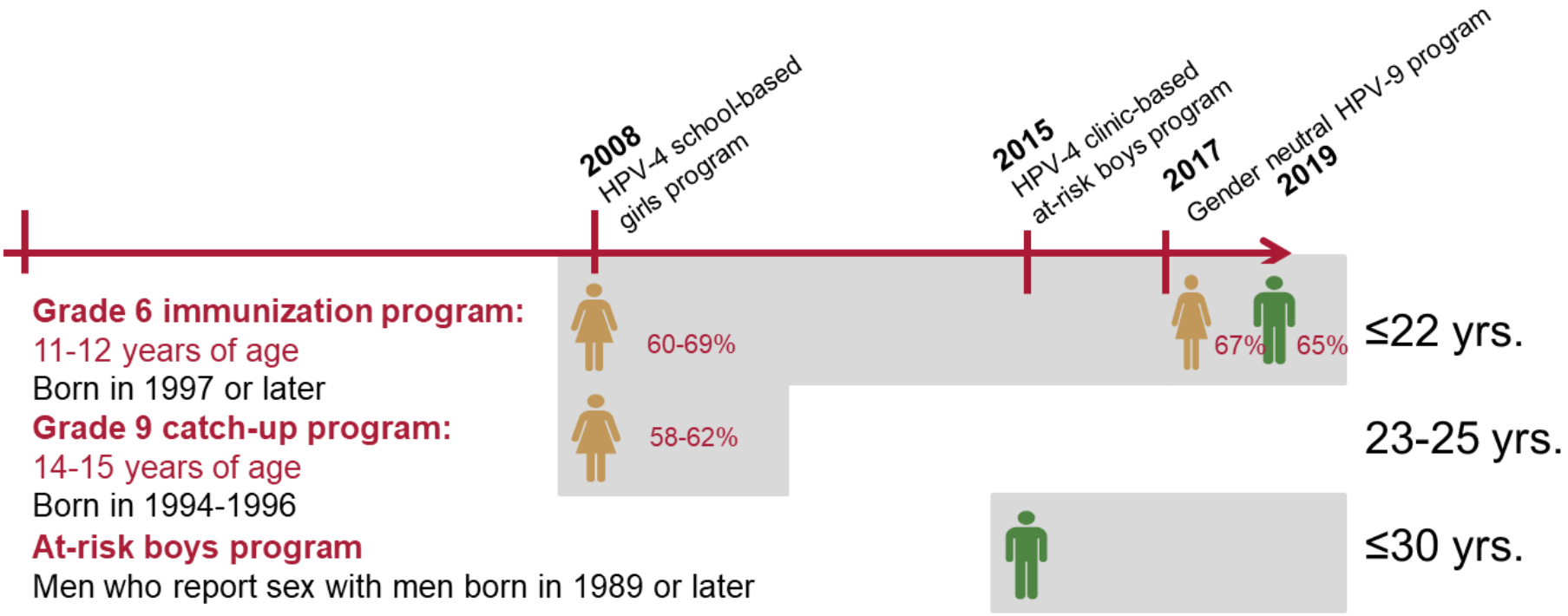


HPV vaccine programs: Global



Source: Cervical Cancer Action, June 2017

Current BC Program



Grade 6 immunization program:
11-12 years of age
Born in 1997 or later

Grade 9 catch-up program:
14-15 years of age
Born in 1994-1996

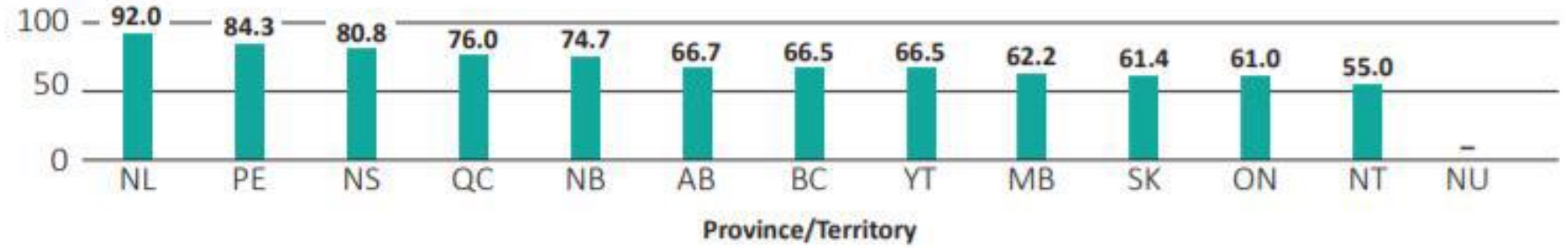
At-risk boys program
Men who report sex with men born in 1989 or later

Slide Courtesy: C. Lukac

HPV vaccination uptake: Canada; 2015/16

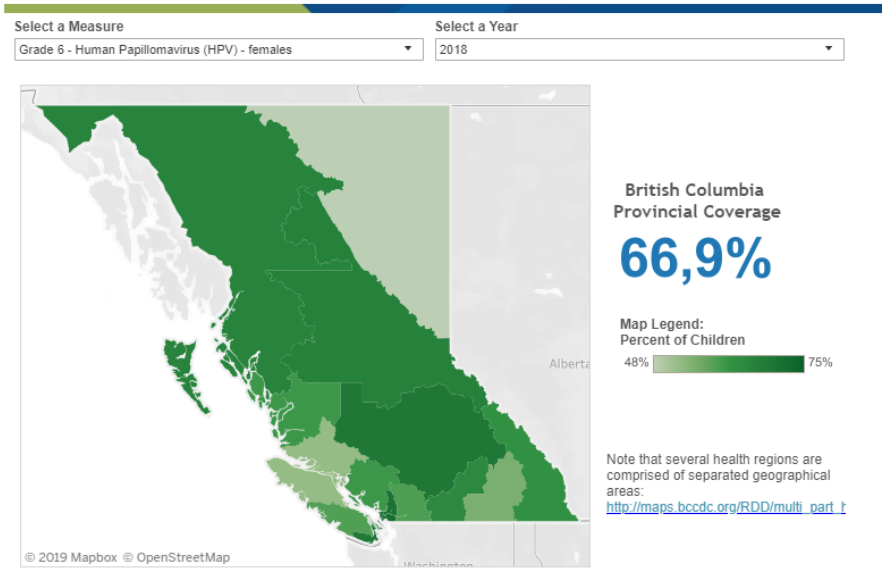
FIGURE 5.3

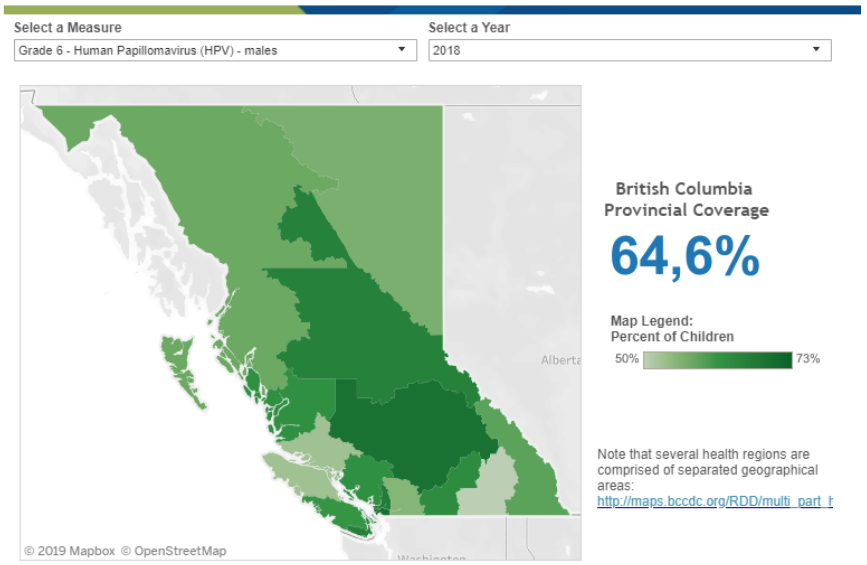
Percentage of girls who received a full course† of human papillomavirus (HPV) vaccination from school-based HPV immunization programs, by jurisdiction — most recent reported year‡



† As of the 2015/16 school year, the full course of vaccination for school-based HPV vaccination programs is three doses in AB, SK, NT and NU, and two doses in all other provinces and territories. ‡ 2015/16: MB, ON, NS, PE, NL, NT; 2016: SK; 2016/17: BC, AB, QC, NB, YT. "—" Data not available. Data source: Provincial and territorial immunization programs.

HPV vaccine coverage: BC





http://www.bccdc.ca/health-professionals/data-reports/childhood-immunization-coverage-dashboard

How can we increase vaccine coverage?

- Reduce doses required
- Support and endorsement of practitioners

- Improve parent's confidence in vaccine:
  - Impact on sexual health decisions
  - Effectiveness
  - Safety

Immunogenicity of HPV Vaccine – 2 or 3 Doses?

INTRODUCTION

The quadrivalent

HPV VACCINE

was originally approved in a **3-DOSE (3D)** schedule

A **2-DOSE (2D)** schedule has been recommended based on recent immunobridging studies

OBJECTIVE:

Compare the **LONG TERM ANTIBODY LEVELS** of **2D** and **3D schedules** of the **4vHPV vaccine**

METHODS

GIRLS
Age: 9-13

→ 2 DOSES n = 35

→ 3 DOSES n = 38

WOMEN
Age: 16-26

→ 3 DOSES n = 30

Evaluated at
7, 24, and 120 months after first dose

ASSAYS:
Competitive Luminex immunoassay (cLIA)
Total Immunoglobulin G (TIgG)

OUTCOMES:
Geometric Mean Titers (GMT's)
Seropositivity Rates

Donken R et al. Immunogenicity of 2 and 3 Doses of the Quadrivalent Human Papillomavirus Vaccine up to 120 Months Postvaccination: Follow-up of a Randomized Clinical Trial. Clinical infectious diseases: an official publication of the Infectious Diseases Society of America. 2019.

WOMEN'S HEALTH RESEARCH INSTITUTE AT BC WOMEN'S

Provincial Health Services Authority
Province-wide solutions. Better health.

CIHR IRSC
BC Centre for Disease Control
An agency of the Provincial Health Services Authority

BC CANCER
Provincial Health Services Authority

Global Control of HPV Related Diseases and Cancer

Immunogenicity of HPV Vaccine – 2 or 3 Doses?

RESULTS

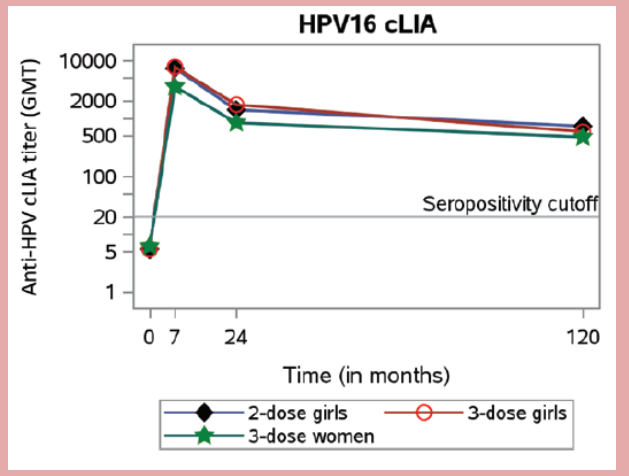
2D & 3D GIRLS showed **NONINFERIOR GMTs** for all HPV Vaccine types compared to 3D women

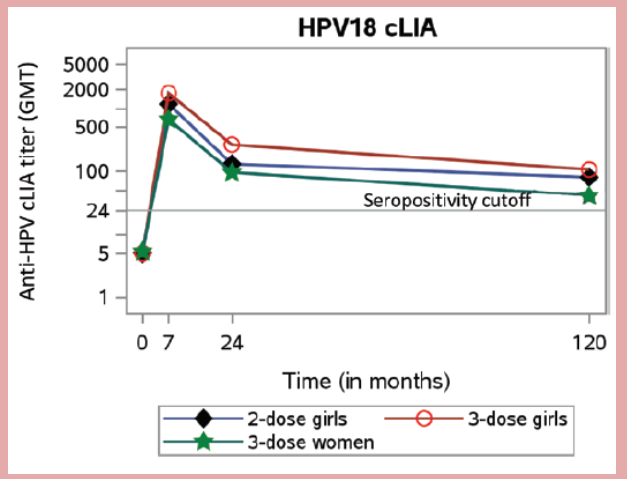
2D GIRLS showed **NONINFERIOR GMTs** for HPV 6, 11, and 16 compared to 3D women

No difference in decline of **ANTIBODY TITERS** between schedules

cLIA SEROPOSITIVITY RATES >95% for all HPV types (except for HPV18)

HPV18 **SEROPOSITVITY RATES DECREASED** over time with the most prominent effects for **3D WOMEN**





Donken R et al. Immunogenicity of 2 and 3 Doses of the Quadrivalent Human Papillomavirus Vaccine up to 120 Months Postvaccination: Follow-up of a Randomized Clinical Trial. Clinical infectious diseases: an official publication of the Infectious Diseases Society of America. 2019.

Immunogenicity of HPV Vaccine – 2 or 3 Doses?

CONCLUSION

2-DOSE

HPV VACCINATION SCHEDULE

GMT's were statistically **noninferior** to 3D up to 120 months after 4vHPV vaccine

2D schedule of 4vHPV vaccine **highly immunogenic**

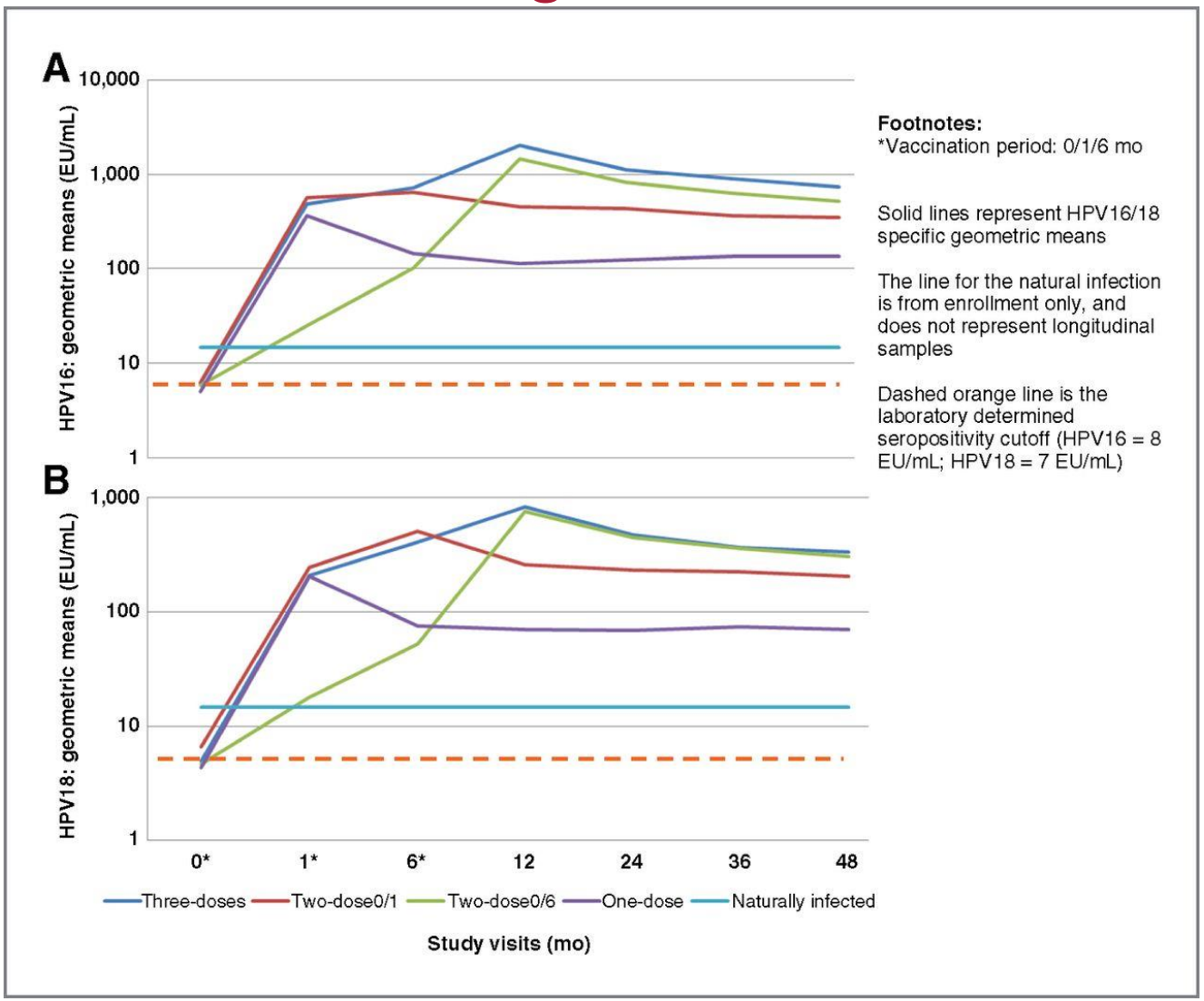
Antibody responses persisted up to 10 years post vaccination

IMPLICATIONS

- Findings confirm **DURABILITY** of immune response after 2D of HPV Vaccine for at least **10 YEARS**
- **2-DOSE SCHEDULE** supported in recommendation for World Health Organization
- Girls vaccinated with 4vHPV vaccine will be **well protected** for more than a **decade**

Donken R et al. Immunogenicity of 2 and 3 Doses of the Quadrivalent Human Papillomavirus Vaccine up to 120 Months Postvaccination: Follow-up of a Randomized Clinical Trial. Clinical infectious diseases: an official publication of the Infectious Diseases Society of America. 2019.

HPV Vaccination: Might one dose be enough?



Safaeian et al. 2013 Canc Prev Research

Is one dose of human papillomavirus vaccine as effective as three?: A national cohort analysis

Julia ML. Brotherton[a,b,*], Alison Budd[c], Christopher Rompotis[c], Natasha Bartlett[c], Michael J. Malloy[a,b], Rachael L. Andersen[d], Kim AR. Coulter[e], Peter W. Couvee[f], Nerida Steel[g,h], Gail H. Ward[i], Marion Saville[j,k]

Table 2

Rate of histologically confirmed CIN2/AIS + (due to any HPV type) and hazard ratios by number of quadrivalent human papillomavirus vaccine doses received*, national cohort of screening women born in 1992 or later, 2007–2014, Australia.

Abnormalities		No. women	Person –time (years)	No. abnormalities	Rate per 1000 women	Rate per 1000 women- years	Hazard ratio**
CIN2 + /AIS	Unvaccinated	48,845	85,417	645	13·2	7.6	1·0
	1 dose	8,618	18,104	89	10·3	4.9	0·65 (0·52–0·81)
	2 doses	18,190	37,819	174	9·6	4.6	0·61 (0·52–0·72)
	3 doses	174,995	334,410	1,496	8·5	4.5	0·59 (0·54–0·65)

* Vaccine dose status assigned to outcome using 'Final status last' method.

** From Cox proportional hazard regression, with age as the time–scale, adjusted for area of residence and socioeconomic status.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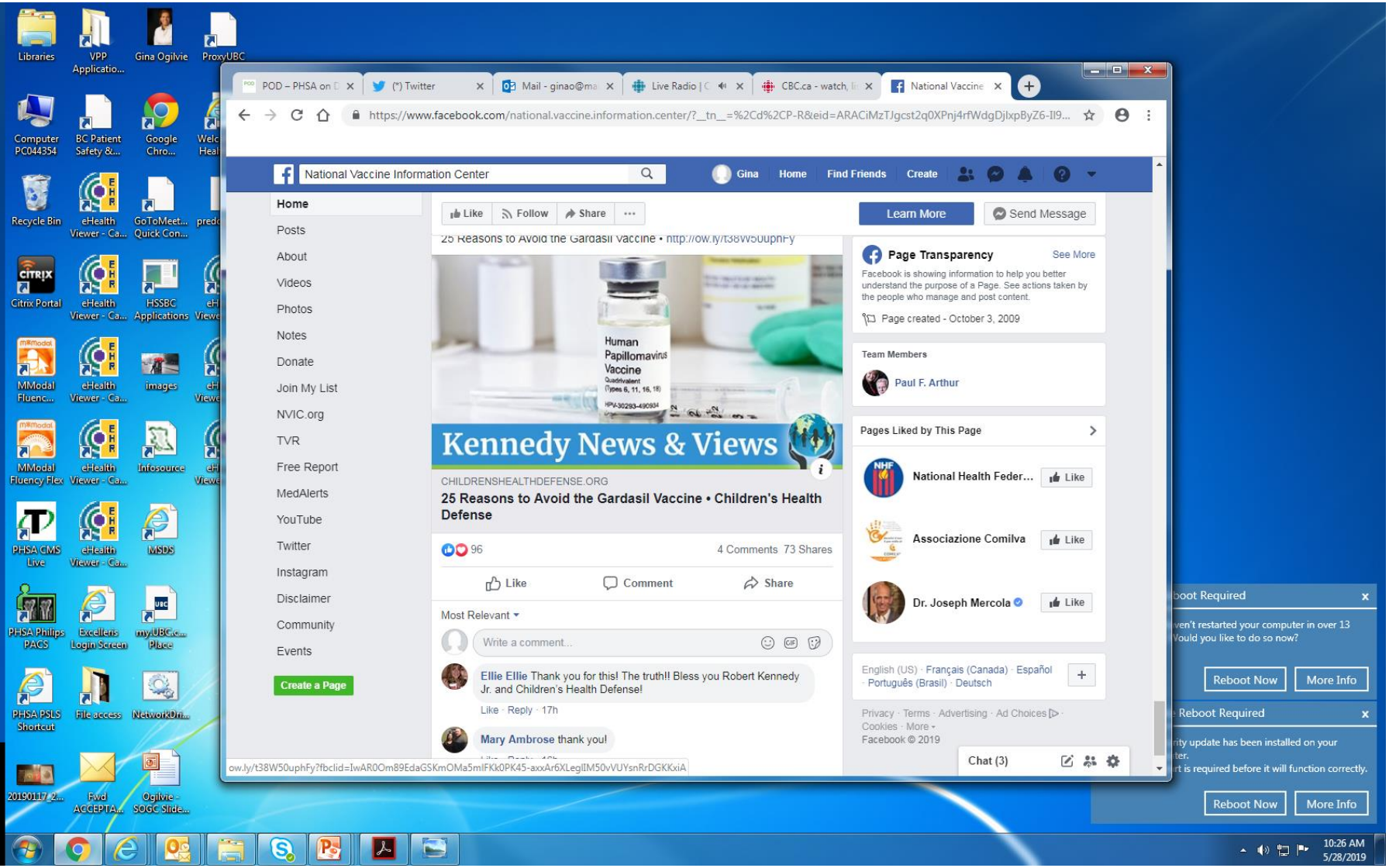
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25 Reasons to Avoid the Gardasil Vaccine • http://ow.ly/t38W50uphFy
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Impact of Vaccine Hesitancy: Japan

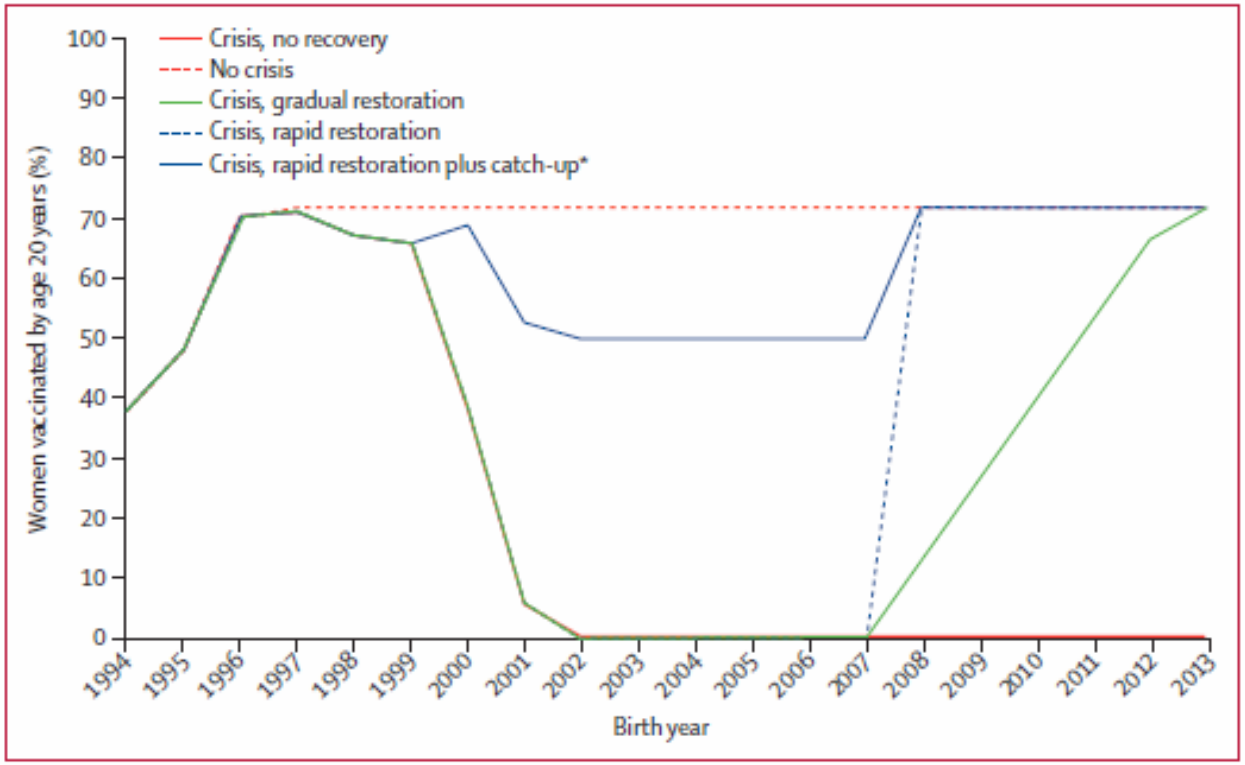


Figure 2: **Vaccine coverage at age 20 years by birth cohort in five scenarios**
*50% uptake achieved for females aged 13–20 years in 2020, some of whom might already be infected; for these cohorts, vaccination is given to them in the year 2020 only.

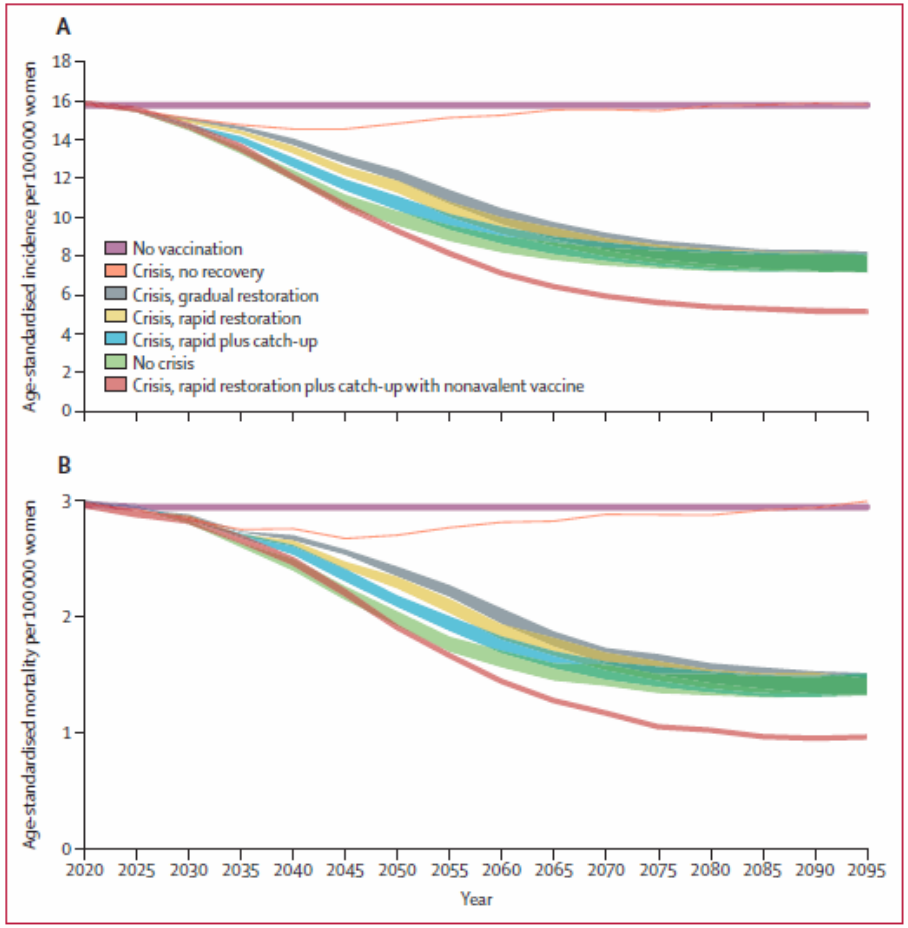
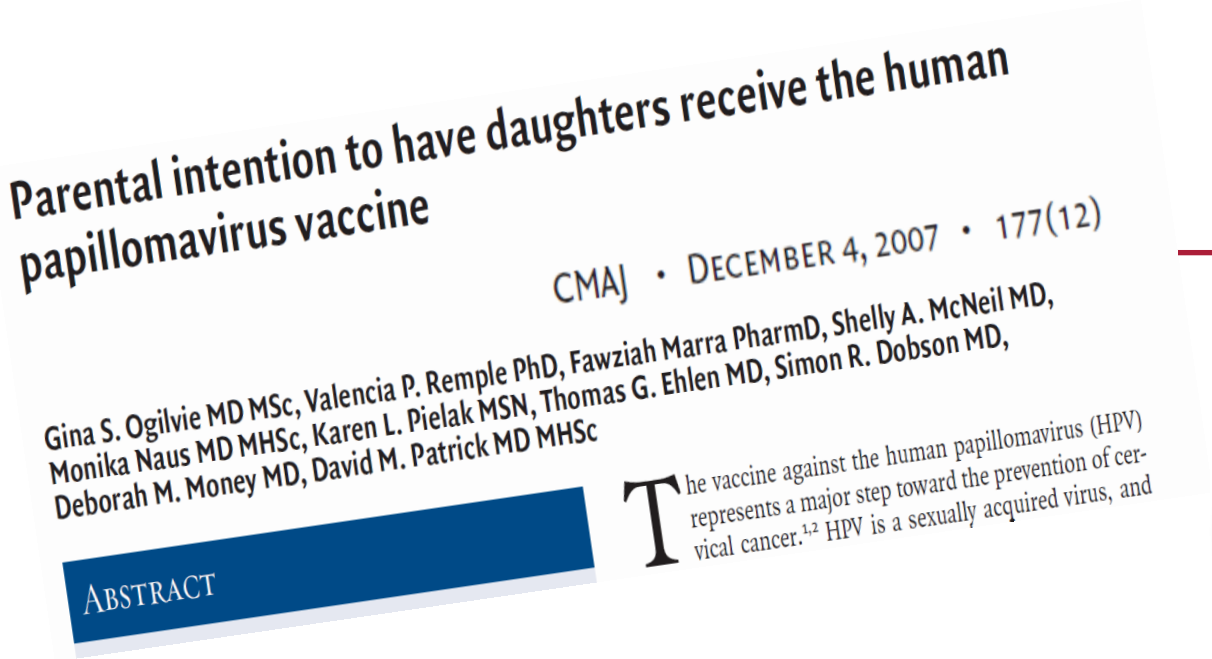


***Figure 3*: Impact of the vaccine crisis and potential recovery scenarios from 2020 to 2095 on age-standardised cervical cancer incidence (A) and cervical cancer mortality (B)**
Unless otherwise stated, we assume the bivalent or quadrivalent vaccines are used in recovery scenarios. Age-standardisation was calculated using the World Standard Population for ages 10–84 years. Shaded areas represent variation depending on assumptions of cross-protective efficacy against non-vaccine-included HPV types, with the lower range showing cross-protection (on the basis of data from the bivalent vaccine) and the higher range showing zero cross-protection.

Vaccine Hesitancy: Japan

- Women, YOB 1994-2007
- Vaccine crisis from 2013-2019
- Modeling: Assume 70% coverage
- Predict additional ~ 25,000 cases; ~ 5500 deaths
- Each year ~ 3600 cases; ~ 750 cases



Parental intention to have daughters receive the human papillomavirus vaccine

CMAJ • DECEMBER 4, 2007 • 177(12)

Gina S. Ogilvie MD MSc, Valencia P. Remple PhD, Fawziah Marra PharmD, Shelly A. McNeil MD, Monika Naus MD MHSc, Karen L. Pielak MSN, Thomas G. Ehlen MD, Simon R. Dobson MD, Deborah M. Money MD, David M. Patrick MD MHSc

ABSTRACT

The vaccine against the human papillomavirus (HPV) represents a major step toward the prevention of cervical cancer.[1,2] HPV is a sexually acquired virus, and

"Just over 20% of parents expressed concerns about the influence of the HPV vaccine on sexual behaviour"

"Those who felt that the vaccine had limited influence on sexual behaviour were significantly more likely (AOR = 3.2 (2.2–4.6)) to intend that their daughters undergo HPV vaccination"

Methods: Study sample

- BC AHS data from 2003, 2008, 2013, stratified by grade & health service delivery area (for provincial representation), weighted and age adjusted
- Final weighted sample included adolescent girls who self-reported heterosexual, unsure, questioning or without attractions
- Lesbian & bisexual girls (less than 5% of sample) warrant a stand-alone, future analysis as there may be differences in sexual decision-making with unclear comparability

Methods: Analysis

Have you ever had sexual intercourse?

How old were you when you had sexual intercourse for the first time?

During your life, with how many different partners have you had sexual intercourse?

Did you drink alcohol or use drugs before you had sexual intercourse the last time?

The last time you had sexual intercourse, did you or your partner use a condom or other latex barrier?

The last time you had sexual intercourse, what method(s) did you or your partner use to prevent pregnancy? *(Mark all that apply)*

How many times have you been pregnant or gotten someone pregnant?

- Prevalence of self-reported sexual behaviors
- Test linear trends of sexual behaviors, contraception use, & pregnancy involvement across years using adjusted odd ratio

RISKY SEX BEFORE AND AFTER THE HPV VACCINE

A VISUAL RESEARCH ABSTRACT

STUDY POPULATION
Adolescent girls identifying as heterosexual in the British Columbia Adolescent Health Surveys of 2003, 2008 and 2013.

OBJECTIVE
Determine whether receiving the HPV vaccination is associated with increased sexual risk-taking at the population level.

AGE-ADJUSTED ODDS OF SEXUAL BEHAVIOURS AND OUTCOMES BETWEEN 2003 AND 2013

Less likely after vaccine:

- 0.79 Sexual intercourse
- 0.82 Intercourse before age 14 years
- 0.69 Substance use before intercourse
- 0.56 Pregnancy

More likely after vaccine:

- 1.19 Condom use
- 1.43 Use of birth control pills

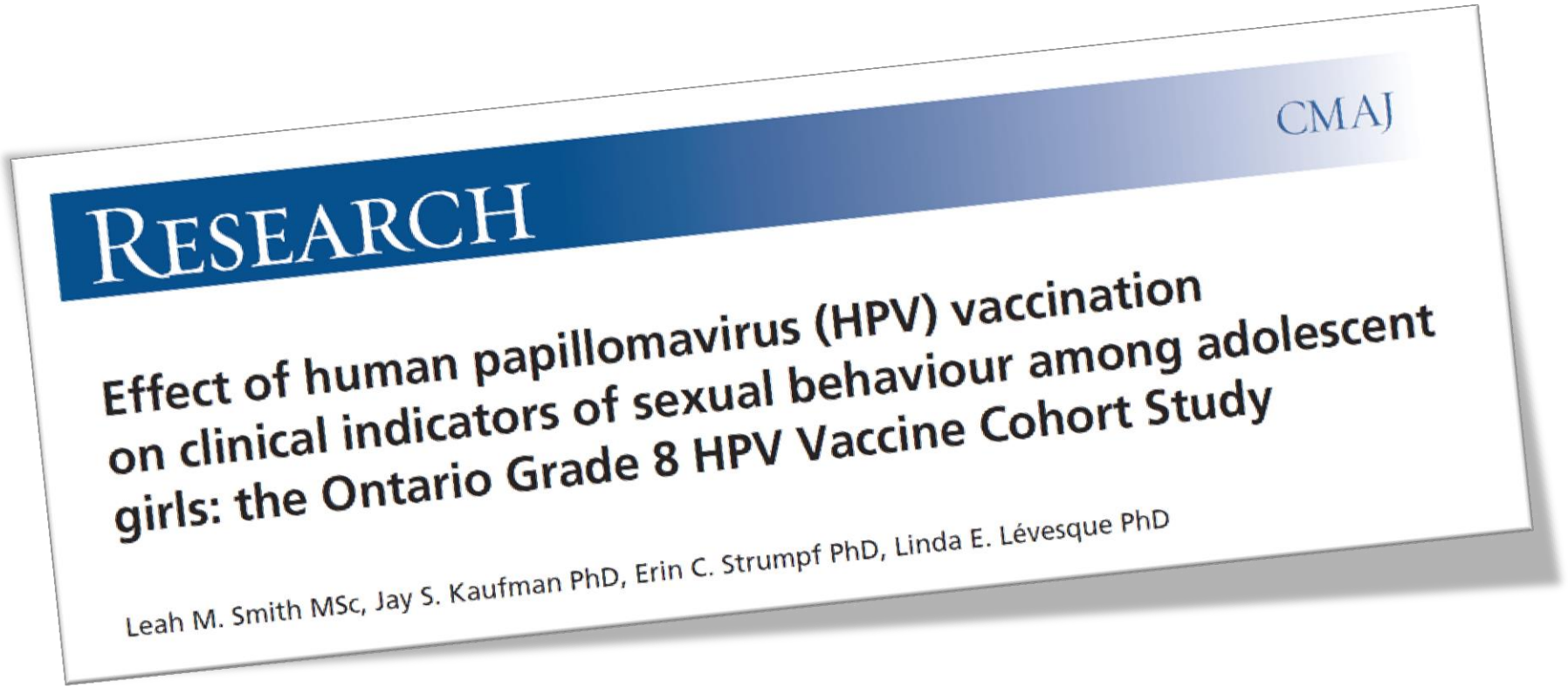
No change after vaccine:

- 1.02 Three or more partners in past year

These findings suggest no association between HPV vaccination and more risky sexual behaviours.

Source: Ogilvie GS, Phan F, Pedersen HN, et al. Population-level sexual behaviours in adolescent girls before and after introduction of the human papillomavirus vaccine (2003–2013). *CMAJ* 2018;190:E1221–1226.

cmaj



RESEARCH

CMAJ

Effect of human papillomavirus (HPV) vaccination on clinical indicators of sexual behaviour among adolescent girls: the Ontario Grade 8 HPV Vaccine Cohort Study

Leah M. Smith MSc, Jay S. Kaufman PhD, Erin C. Strumpf PhD, Linda E. Lévesque PhD

Effect of human papillomavirus (HPV) vaccination on clinical indicators of sexual behaviour among adolescent girls: the Ontario Grade 8 HPV Vaccine Cohort Study

- Administrative data analysis of grade 8 girls 2 years before (2005/06, 2006/07) and after (2007/08, 2008/09) HPV vaccine program implementation
- Indicators on sexual behaviour in grades 10-12 included pregnancy & STIs
- Regression discontinuity to estimate RD and RR attributable to vaccination and to program eligilbility

Smith et al, 2015

Effect of human papillomavirus (HPV) vaccination on clinical indicators of sexual behaviour among adolescent girls: the Ontario Grade 8 HPV Vaccine Cohort Study

- N=260,493, 15 441 (5.9%) cases of pregnancy or STI (outcome variable), no increased risk with vaccination or program eligibility
- Vaccination: RD=0.61 per 1000 girls (95% CI: 10.71 - 9.49), RR=0.96 (95% CI: 0.81 - 1.14)
- Program eligibility: RD=0.25 per 1000 girls (95% CI: 4.35 - 3.85), RR=0.99 (95% CI 0.93 - 1.06)

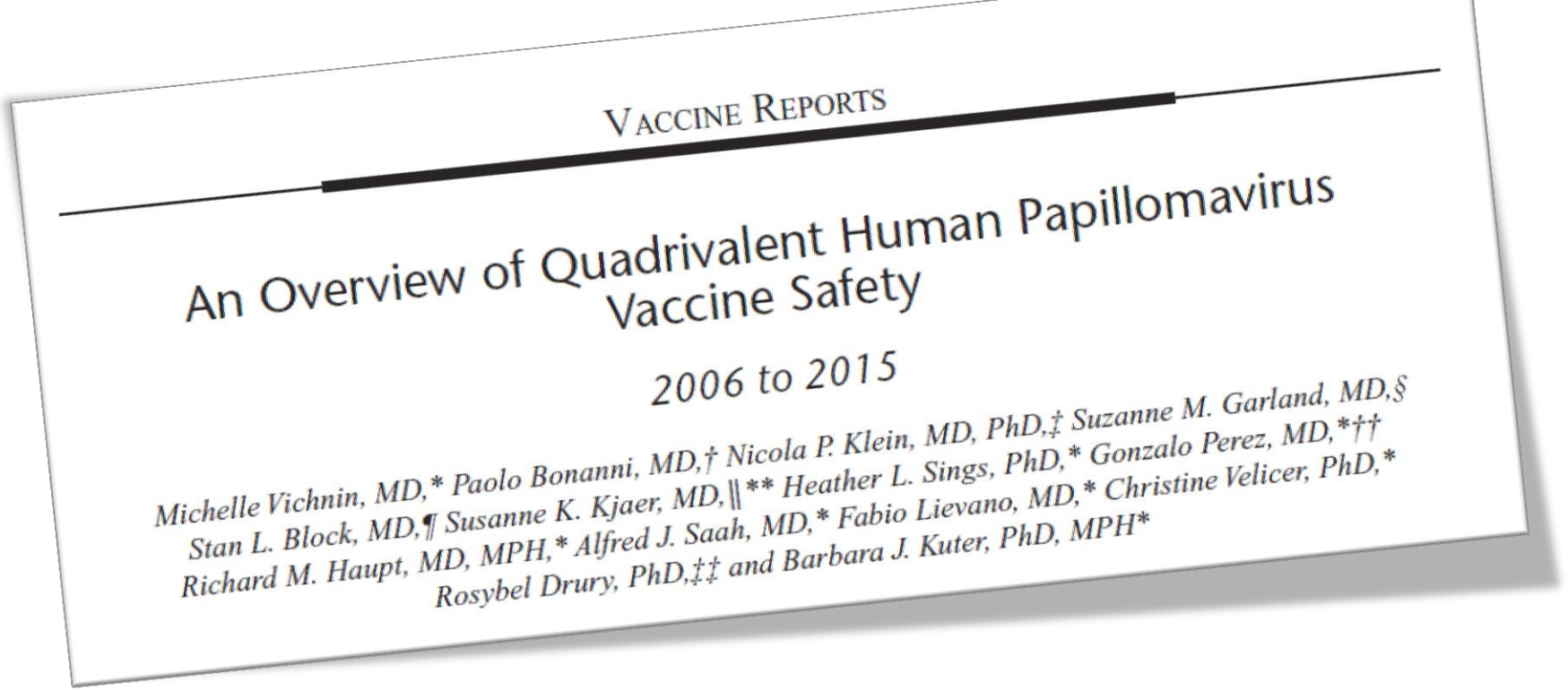
Smith et al, 2015

Safety Profile of the 9-Valent HPV Vaccine: A Combined Analysis of 7 Phase III Clinical Trials

PEDIATRICS Volume 138, r

Edson D. Moreira Jr, MD, PhD,[a] Stan L. Block, MD,[b] Daron Ferris, MD,[c] Anna R. Giuliano, PhD,[d] Ole-Erik Iversen, MD,[e] Elmar A. Joura, MD,[f] Pope Kosalaraksa, MD,[g] Andrea Schilling, MD,[h] Pierre Van Damme, MD, PhD,[i] Jacob Bornstein, MD, MPA,[j] F. Xavier Bosch, MD,[k] Sophie Pils, MD,[f] Jack Cuzick, PhD,[l] Suzanne M. Garland, MD,[m] Warner Huh, MD,[n] Susanne K. Kjaer, MD,[o] Hong Qi, MD, MPH,[p] Donna Hyatt, BA,[p] Jason Martin, MS,[p] Erin Moeller, MPH,[p] Michael Ritter, BA,[p] Martine Baudin, MD,[q] Alain Luxembourg, MD, PhD[p]

- Discontinuation and serious adverse effects were rare (0.1% and <0.1%). 7 deaths during the studies were found to be unrelated to vaccination.
- Most common adverse effects were headache, pyrexia, and injection-site related (pain, swelling, erythema) (≥5%)
- HPV9 was found to be similar to HPV4 in safety.



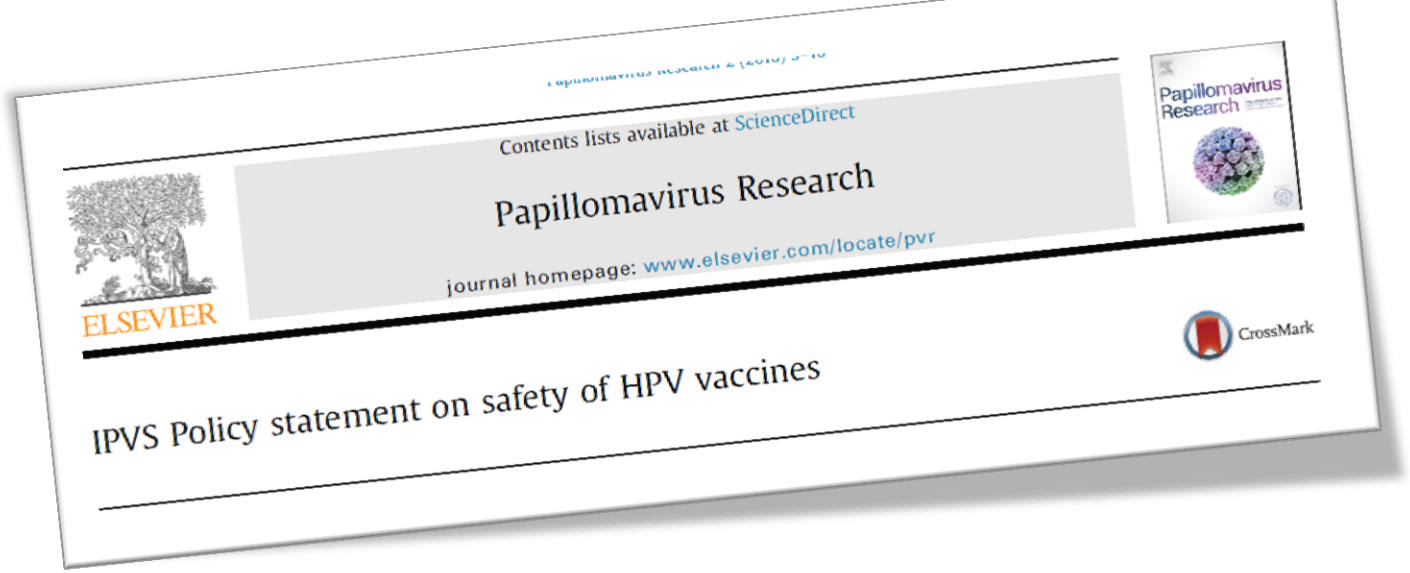
VACCINE REPORTS

An Overview of Quadrivalent Human Papillomavirus Vaccine Safety

2006 to 2015

Michelle Vichnin, MD,* Paolo Bonanni, MD,† Nicola P. Klein, MD, PhD,‡ Suzanne M. Garland, MD,§ Stan L. Block, MD,¶ Susanne K. Kjaer, MD,‖** Heather L. Sings, PhD,* Gonzalo Perez, MD,*†† Richard M. Haupt, MD, MPH,* Alfred J. Saah, MD,* Fabio Lievano, MD,* Christine Velicer, PhD,* Rosybel Drury, PhD,‡‡ and Barbara J. Kuter, PhD, MPH*

- Register-based Safety Studies in Denmark N=1.6M
- & Sweden N=997,585
- No evidence between HPV4 and autoimmune disorders, neurological conditions, MS or CNS demyelinating diseases
- 13 years of data
- Initial reporting (2 years) disproportionate VTE reporting, no association in subsequent evaluation

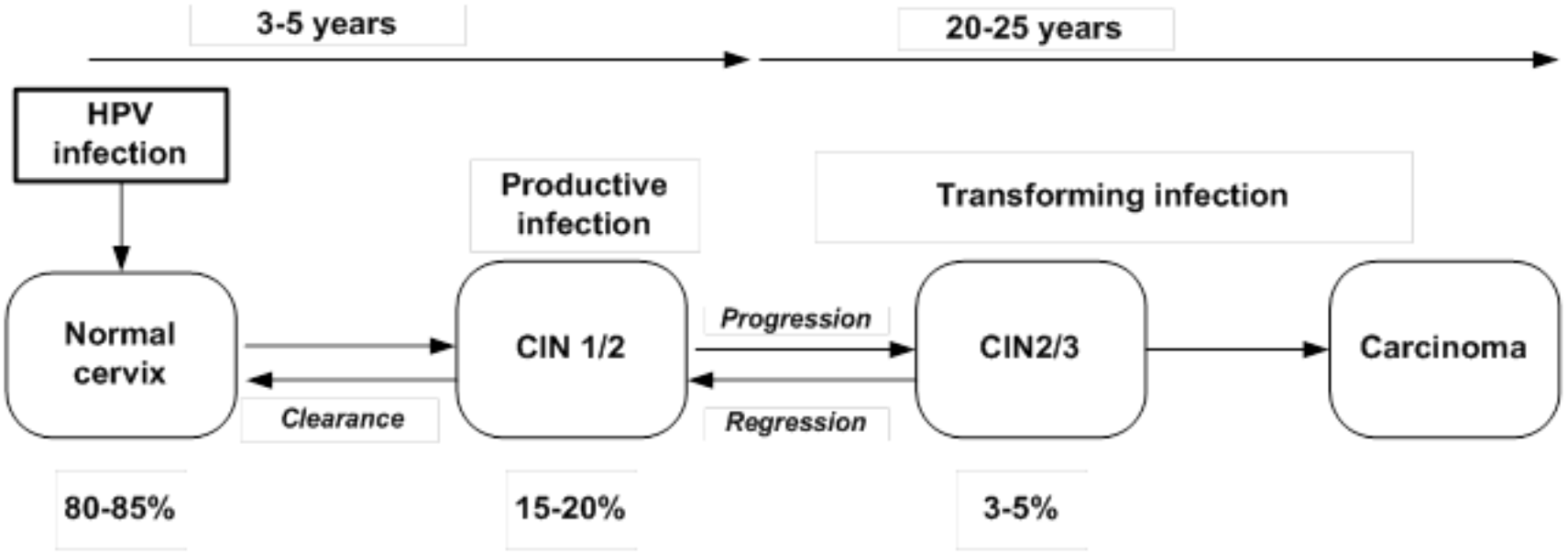


"The safety of these vaccines has been reviewed by multiple medical authorities and regulatory agencies globally… All have endorsed them as safe and effective. Importantly, there is no evidence for neurological or autoimmune diseases caused by the HPV vaccines. To date, there have been no deaths directly attributed to HPV vaccination. "

IPVS International Papillomavirus Society

"IPVS strongly endorses HPV vaccination of all girls and women per the indications specified by the relevant national regulatory authorities and vaccination of boys and men wherever already approved."

Disease surveillance HPV-related diseases



Endpoints we have information on a decade after introduction:

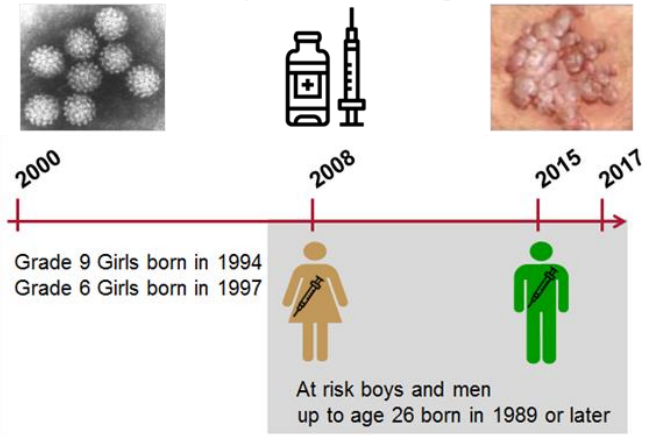
- Genital warts ☑
- Juvenile-onset recurrent papillomatosis ☑
- HPV Prevalence ☑
- Incident and persistent HPV infections ☑
- CIN ☑
- Cancer ☑

Impact of the Human Papillomavirus Immunization Program on Rates of Anogenital Warts in British Columbia, Canada 2000 - 2017

Christine Lukac, Robine Donken, Michael Otterstatter, Olga Mazo, Stanley Wong, Fawziah Marra, Laurie Smith, Monika Naus, Deborah Money, Mel Krajden, Troy Grennan, Mark Gilbert, Jason Wong , Gina Ogilvie

Background

- HPV-4 vaccine prevents anogenital warts

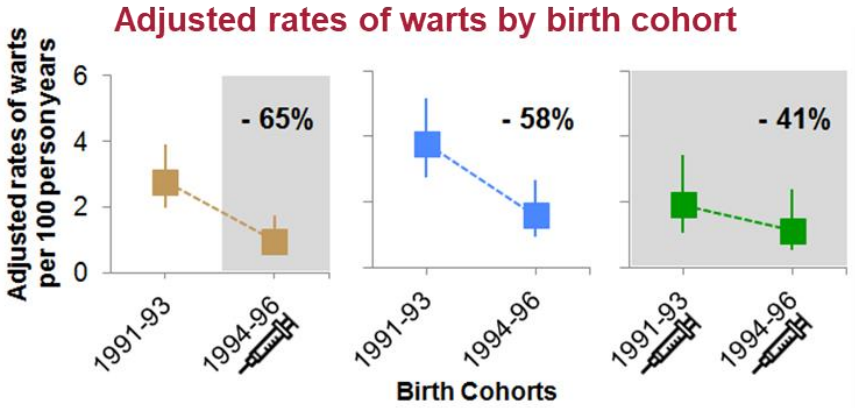


Objectives & Hypotheses

- To measure of impact of HPV-4 vaccine program on warts

Results

- 85,158 individuals accessed STI services 2000-2017



Conclusion

- HPV-4 vaccine program achieved its intended impact.

a place of mind UBC
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Ecological impact: Pre-/post vaccination rates

- Eligible for vaccination

* Per year
** Per 1000 PY

		CIN2 Rate** (95%CI)		Rate Ratio * (95%CI)		CIN 3 Rate** (95%CI)		Rate Ratio * (95%CI)	
16 -23 years	Pre	6.04	(5.76-6.44)	Ref		4.43	(4.15-4.71)	Ref	
	Post	2.71	(2.15-3.42)	**0.89**	**(0.86-0.93)**	1.69	(1.33-2.14)	**0.87**	**(0.84-0.91)**

- Ineligible for vaccination

		CIN2 Rate (95%CI)		Rate Ratio * (95%CI)		CIN 3 Rate (95%CI)		Rate Ratio * (95%CI)	
24-28 years	Pre	5.67	(5.05-6.36)	Ref		8.54	(8.00-9.12)	Ref	
	Post	6.70	(6.26-7.18)	1.04	(0.99-1.09)	9.29	(8.93-9.66)	1.00	(0.97-1.02)

BACKGROUND

Understanding the real-world HPV Vaccine Impact

Randomized controlled trials have demonstrated that **HPV vaccines are highly efficacious** for the prevention of HPV infections and pre-cancerous lesions

The vaccine administered provides **protection against HPV 6, 11, 16 and 18**

In 2008 British Columbia implemented a **school-based HPV immunization** program

Since 1960 cervical cancer screening has been coordinated by the BC Cancer Cervix Screening Program.

HPV **vaccination status for all girls in BC is** recorded in two provincial electronic immunization registries.

Females born in 1994 through 2005

VS

Cytological (high-grade squamous intraepithelial lesion **(HSIL)**) and histological **(CIN of any degree)** **outcomes in a screening cohort were compared** between those who were vaccinated against HPV and those

Cervical Cancer Awareness

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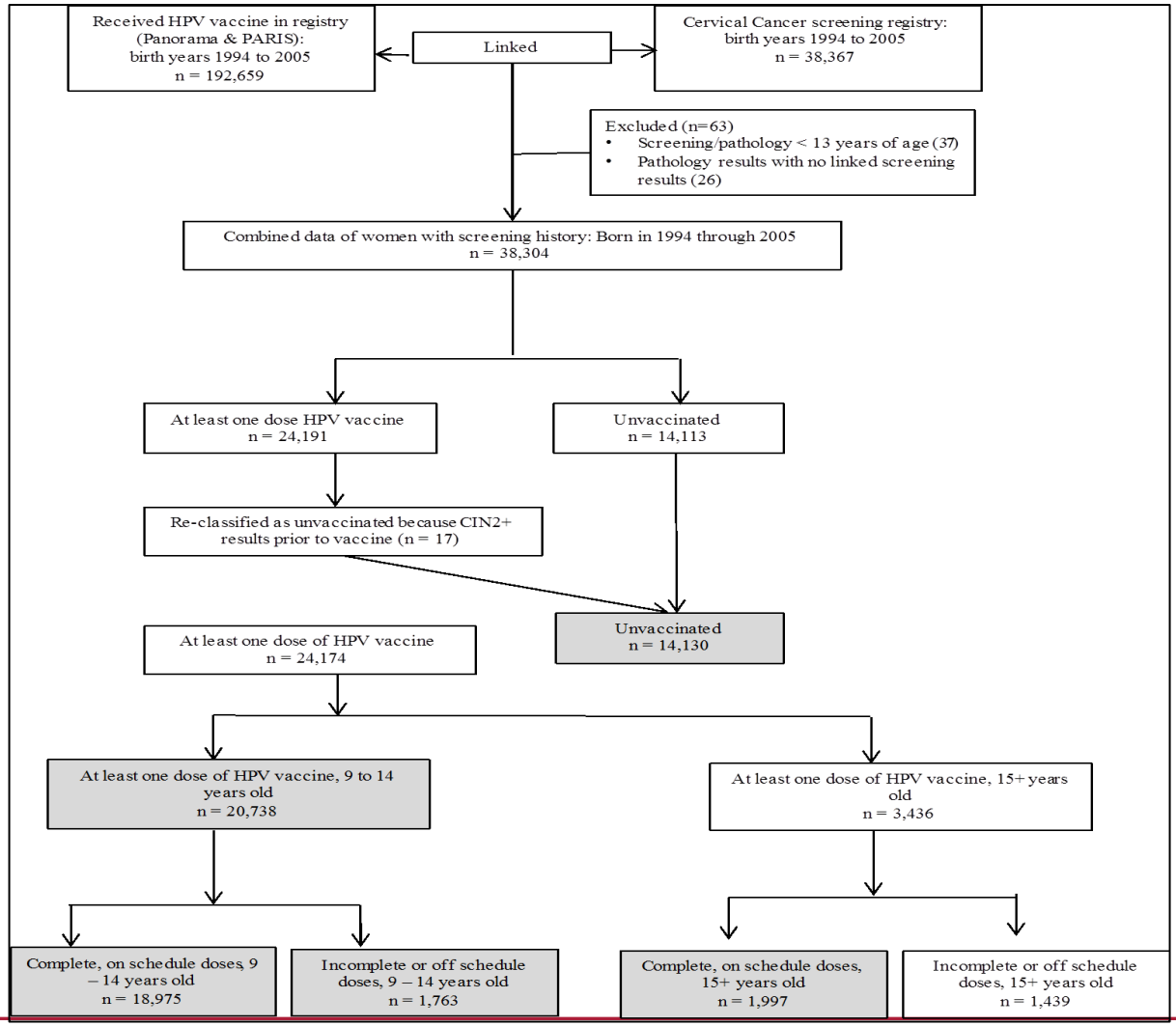
Data linkage: Methods

- **Unvaccinated:** No doses of HPV vaccine in immunization record, or vaccine recorded after or 6 months prior to CIN/HSIL diagnosis, for all women born in 1994 – 2005.
- **At least one dose, 9-14 years old:** Women who received at least one dose of HPVV between 9 – 14 years of age (includes women who received incomplete or complete doses based on vaccine schedule).
  - **Complete on-schedule doses, 9 – 14 years old:** Full course of doses (either 2 or 3 doses based on birth cohort), on-schedule, with first dose between 9 -14 years of age.
  - **Incomplete doses 9 - 14 years of age:** At least one dose received, but less than full course, or was off-schedule, based on birth cohort.
- **Complete on-schedule doses, 15 years or older:** 3 doses, on-schedule, with first dose at 15 years of age or older.

METHODS

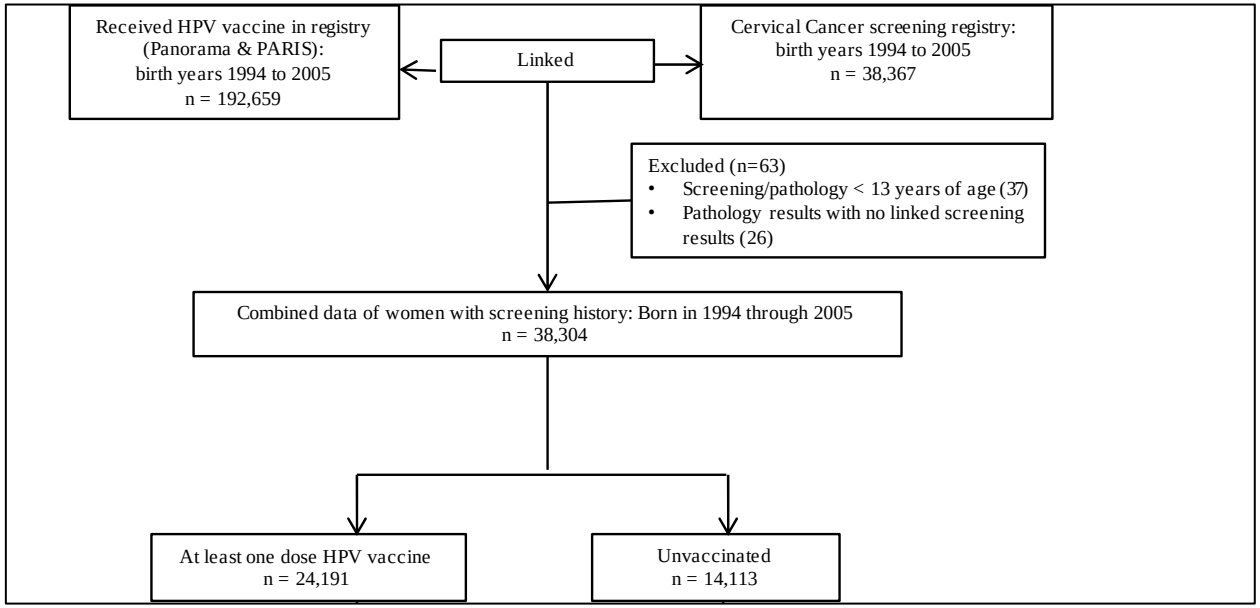
Understanding the real-world HPV Vaccine Impact



Code and citation here once available

METHODS

Understanding the real-world HPV Vaccine Impact



Results: Incidence Rates

Table 2. Incidence Rates Adjusted for Person Time at Risk and Stratified by Dosage and Age at First Vaccine

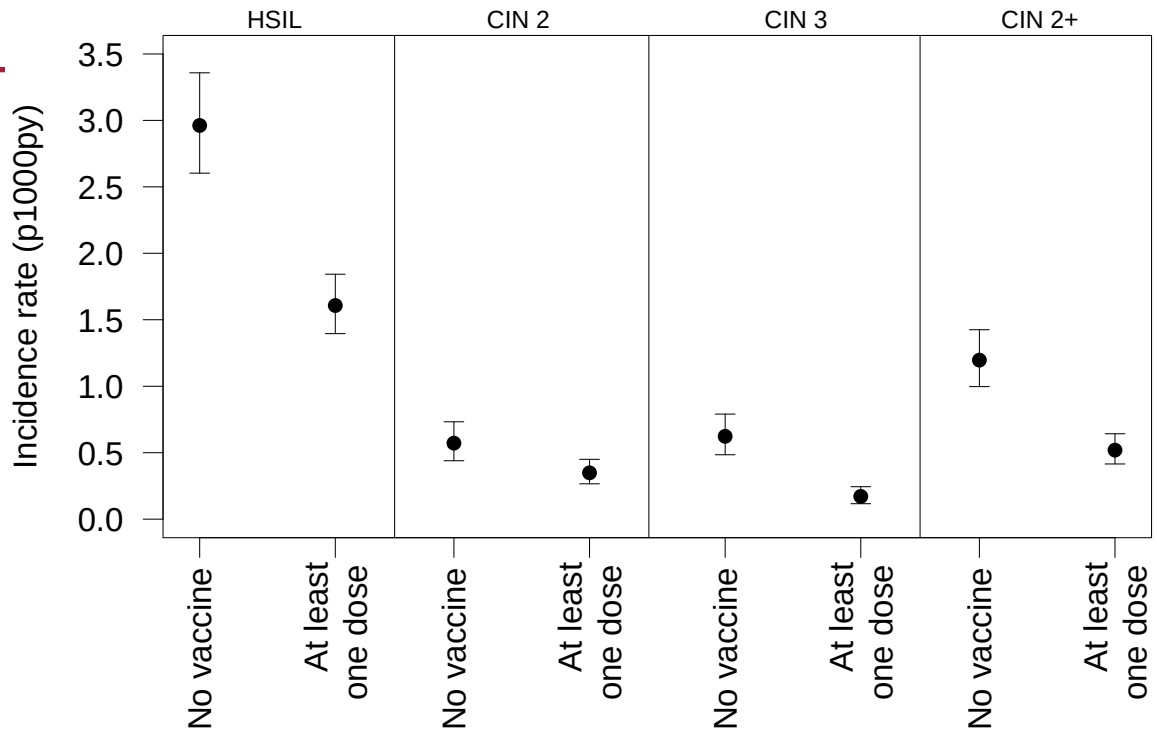
Vaccine Status (n)	HSIL, IR (95% CI)	No. of HSIL	CIN 2, IR (95% CI)	No. of CIN2	CIN 3, IR (95% CI)	No. of CIN3	CIN 2+, IR (95% CI)	No. of CIN 2+
Unvaccinated (14 130)	2.96 (2.60–3.36)	229	0.57 (.44–.73)	55	0.62 (.48–.79)	60	1.20 (1.00–1.42)	115
At least 1 dose of vaccine 9–14 y (20 738)	1.61 (1.40–1.84)	191	0.35 (.27–.45)	51	0.17 (.12–.24)	25	0.52 (.42–.64)	76
Incomplete series or off schedule 9–14 y (1763)	1.88 (1.22–2.79)	20	0.46 (.22–.90)	6	0.23 (.08–.56)	<5[a]	0.69 (.37–1.22)	9
Complete series on schedule 9–14 y (18 975)	1.58 (1.36–1.83)	171	0.34 (.26–.44)	45	0.16 (.11–.24)	22	0.50 (.40–.63)	67
At least 1 dose of vaccine 15 y and older (3436)	2.62 (2.04–3.33)	68	0.54 (.29–.91)	14	0.46 (.24–.81)	12	1.00 (.66–1.47)	26
Incomplete series or off schedule 15 y and older (1439)	3.32 (2.32–4.59)	36	0.55 (.20–1.20)	6	0.64 (.26–1.33)	7	1.20 (.64–2.05)	13
Complete series, on schedule 15 y and older (1997)	2.59 (1.84–3.57)	32	0.53 (.27–.96)	8	0.33 (.15–.68)	5	0.87 (.51–1.40)	13

Abbreviations: CI, confidence interval; CIN, cervical intraepithelial neoplasia; HSIL, high-grade squamous intraepithelial lesion; IR, incidence rate per 1000 person-years.

[a]Suppressed due to small numbers.

Results: IRs

Figure 1: Incidence rates per 1000 women per year (p1000py) and 95% CI for unvaccinated vs. at least 1 dose administered between 9 – 14 yrs. HSIL, CIN 2, CIN 3, and CIN 2+ shown separately.



Results: RR Estimates

	HSIL		CIN2+	
	RR* (95%CI)	P-value	RR* (95%CI)	P-value
Unvaccinated	ref		ref	
Incomplete doses, 9 – 14 yrs	0.61 (0.37 – 0.94)	0.03	0.57 (0.27 – 1.06)	0.1
Complete doses, 9 – 14 yrs	0.53 (0.43 – 0.64)	<0.0001	0.42 (0.31 – 0.57)	<0.0001

*Adjusted for birth year and age at first screening test less 3 years

- There was **no significant difference in the RR of CIN2, CIN3, or CIN2+, in young women with incomplete HPV vaccine series administered 9 – 14 yrs of age** compared to unvaccinated women.

FINDINGS

Understanding the real-world HPV Vaccine Impact

Vaccine effectiveness

9-14 years old

On schedule complete series:

57.9%

At least one dose: **56.6%**

Females who received complete series and on-schedule vaccination between the ages of 9-14 had a **RR=0.42 for CIN2+** compared to unvaccinated females.

Increased CIN2+, RR 1.56 (95%CI 0.82-2.74) was found in females who received complete on schedule HPV series beginning at 15 years or older, **compared to females starting at 9 -14 years of age.**

However, HPV vaccination at 15 years or older is **still more effective than not vaccinating**

Females vaccinated against HPV have a **lower incidence of cervical dysplasia** compared to unvaccinated females.

Immunization between **9 - 14 years of age** should be

Continued program evaluation is important for measuring long-term population impact.

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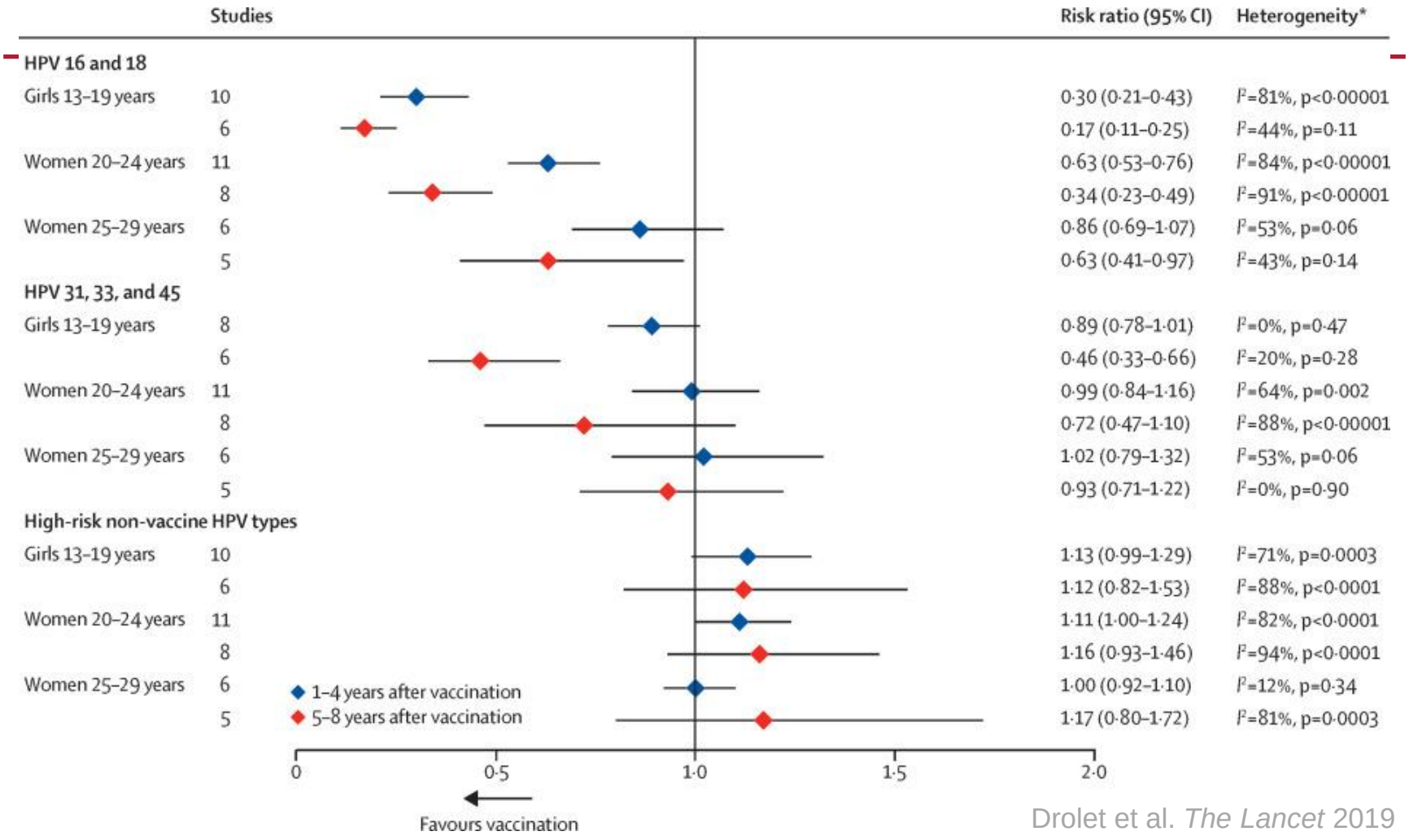
HPV Prevalence



Drolet et al. *The Lancet* 2019

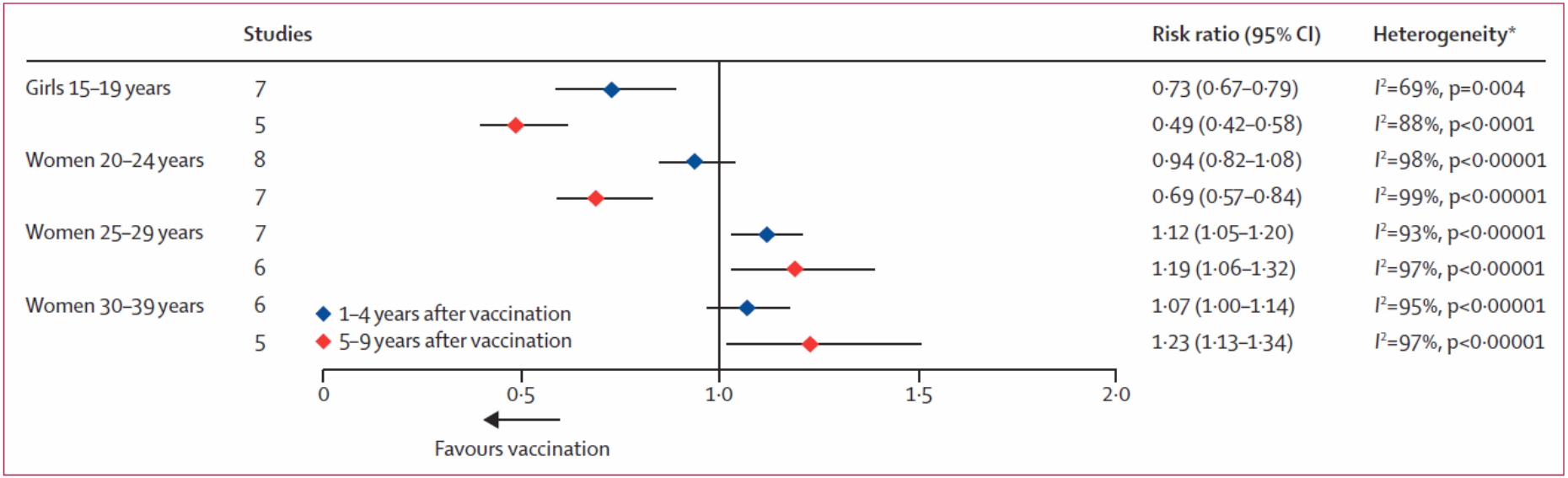


Figure 5: **Changes in CIN2+ among screened girls and women between the pre-vaccination and post-vaccination periods**
CIN2+=cervical intraepithelial neoplasia grade 2+. *p values are associated with the χ^2 statistic.

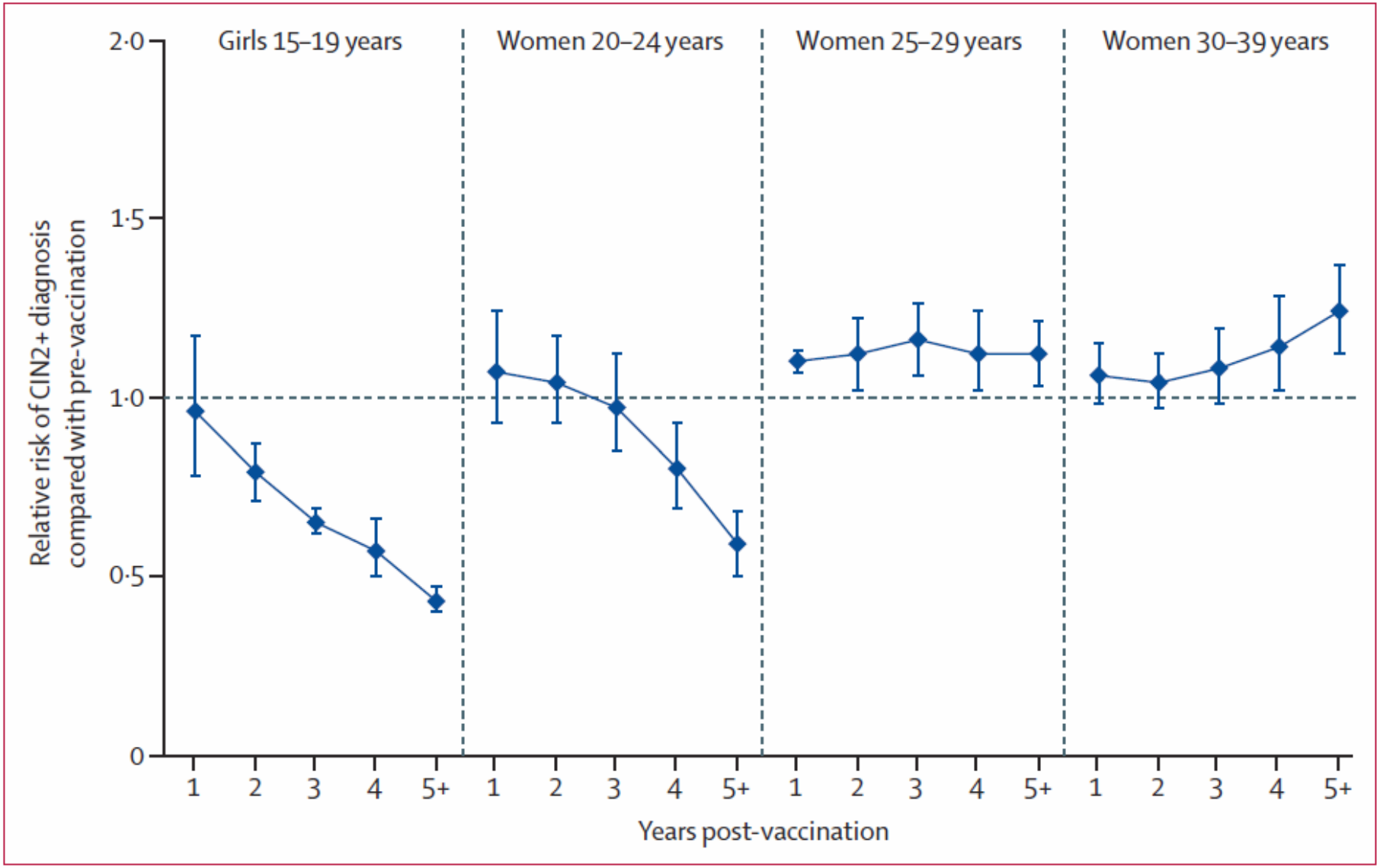


Figure 6: Changes in CIN2+ among screened girls and women during the first 7 years after the introduction of girls-only human papillomavirus vaccination, in countries with multi-cohort vaccination and high vaccination coverage

Cancer

- Population-based cancer registry follow-up Finland
- Vaccinated at 14-19 years (RCT)

Table 1. Numbers (*n*) and incidence rates (/100,000 woman-years) of human papillomavirus (HPV) associated invasive cancers in cluster-randomized cohorts of altogether 9,529 14- to 17-year-old female HPV16/18 or HPV6/11/16/18 vaccine recipients and 17,838 non-HPV vaccinated, originally 14- to 19-year-old women[2–4]

	HPV vaccinated women			Non-HPV vaccinated women		
Malignancy	Person years	*n*	Rate (95% CI)	Person years	*n*	Rate (95% CI)
Cervix cancer	65,656	0	–	124,245	8	6.4 (3.2, 13)
Vulva cancer	65,656	0	–	124,245	1	0.8 (0.1, 5.7)
Oropharyngeal cancer	65,656	0	–	124,245	1	0.8 (0.1, 5.7)
Other HPV cancers[1]	65,656	0	–	124,245	0	–
All HPV associated invasive cancers	65,656	0	–	124,245	10	8.0 (4.3, 15)
Breast cancer	65,656	2	3.0 (0.8, 12)	124,245	10	8.0 (4.3, 15)
Thyroid cancer	65,656	1	1.5 (0.2, 11)	124,245	9	7.2 (3.8, 14)
Melanoma	65,656	3	4.6 (1.5, 14)	124,245	13	10.5 (6.1, 18)
Non-melanoma skin cancer	65,656	2	3.0 (0.8, 12)	124,245	3	2.4 (0.8, 7.5)

[1]Vaginal carcinoma, anal carcinoma.
For corresponding sub-cohorts age-aligned, 7-year periods of passive follow-up were by the population-based Finnish Cancer Registry.

Luostarinen et al. *IJC* 2018

Juvenile-Onset Recurrent Papillomatosis (4HPV)

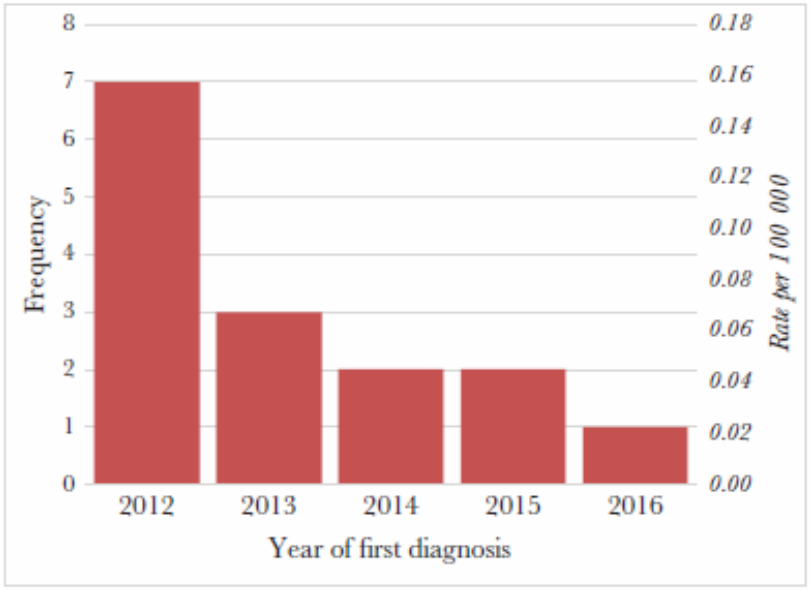


Figure 1. Incident cases of juvenile onset recurrent respiratory papillomatosis notified in Australia per year 2012–2016. *Frequency and rates per 100,000 children aged 0–14 years. Notes: Difference between rate in 2012 and 2016 $P = 0.036$. *Surveillance commenced in October 2011 but no cases were reported in 2011.

Novakovic et al. *JID* 2017

Opportunities to increase HPV vaccine uptake

- BC led the way in program delivery
- Social media engagement with messaging
- Innovations in vaccine offering during school based programs
- Parental engagement by public health nurses
- Better understanding of ongoing concerns for parents

Article | Published: 24 June 2019

Effective strategies for rebutting science denialism in public discussions

Philipp Schmid & Cornelia Betsch

Nature Human Behaviour **3**, 931–939(2019) | Cite this article

✗ Not responding

✓ Providing the facts about the topic or uncovering the rhetorical techniques typical for denialism

Elimination of cervical cancer

- Excellent HPV vaccine uptake is essential
- Opportunity in BC to increase coverage
- Support by public health professionals is key to high uptake and parental confidence
- Important role for providers

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