# Adolescent vaccination

Australian Vaccinology Course

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# Presentation overview

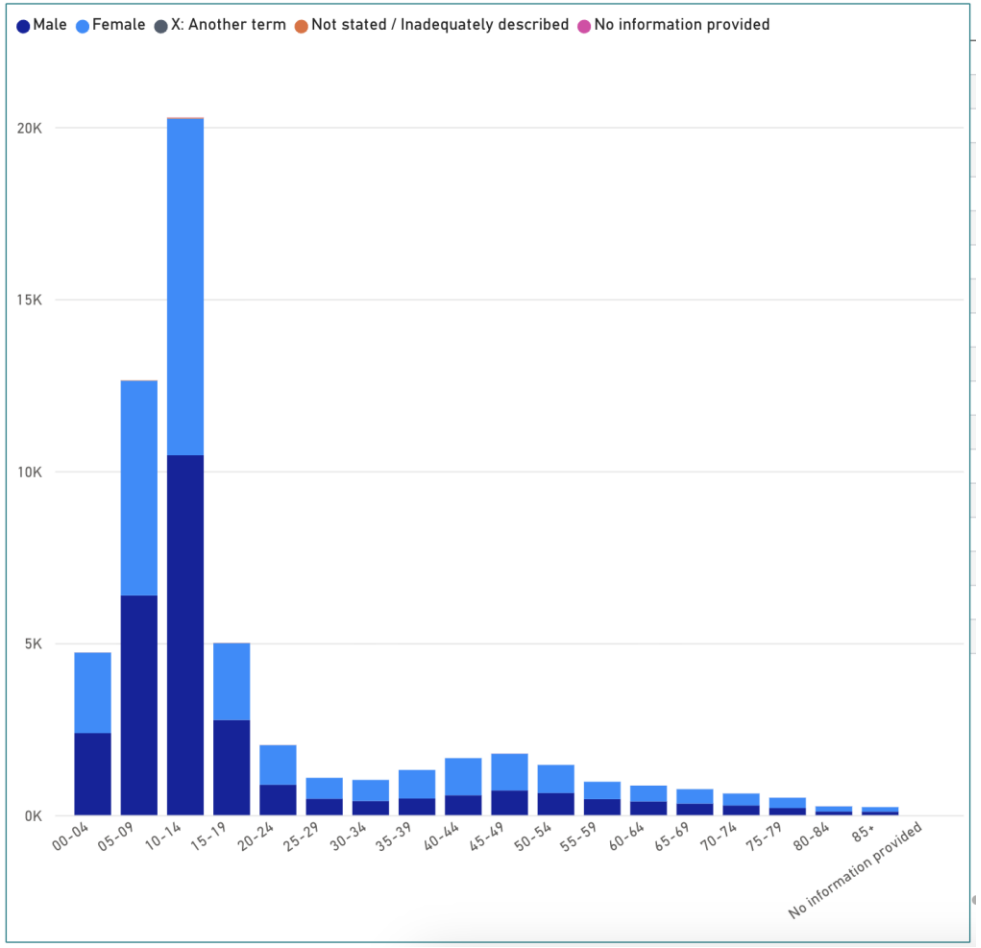
- Beyond the childhood schedule – why adolescents?
  - Risk, immunology, Australia's schedule
  - What do adolescents think about vaccines?
- HPV vaccines primer
- Meningococcal vaccines primer
- Safety of adolescent vaccinations
- Where are adolescents vaccinated in Australia?
- Coverage – where to now?
- Resources to support adolescent vaccination conversations
- Emerging research in adolescent vaccination


*Image from* *https://www.health.wa.gov.au/Articles/A_E/campaign-adolescent-immunisation*

# Beyond the childhood schedule – why adolescents?

- Waning of protection from some childhood immunisations for diseases that occur throughout life (eg pertussis, tetanus)
  - Important for individual protection but also for herd protection eg of infants, elderly
- New exposures create new risk of other vaccine preventable diseases (eg HPV, meningococcal disease)

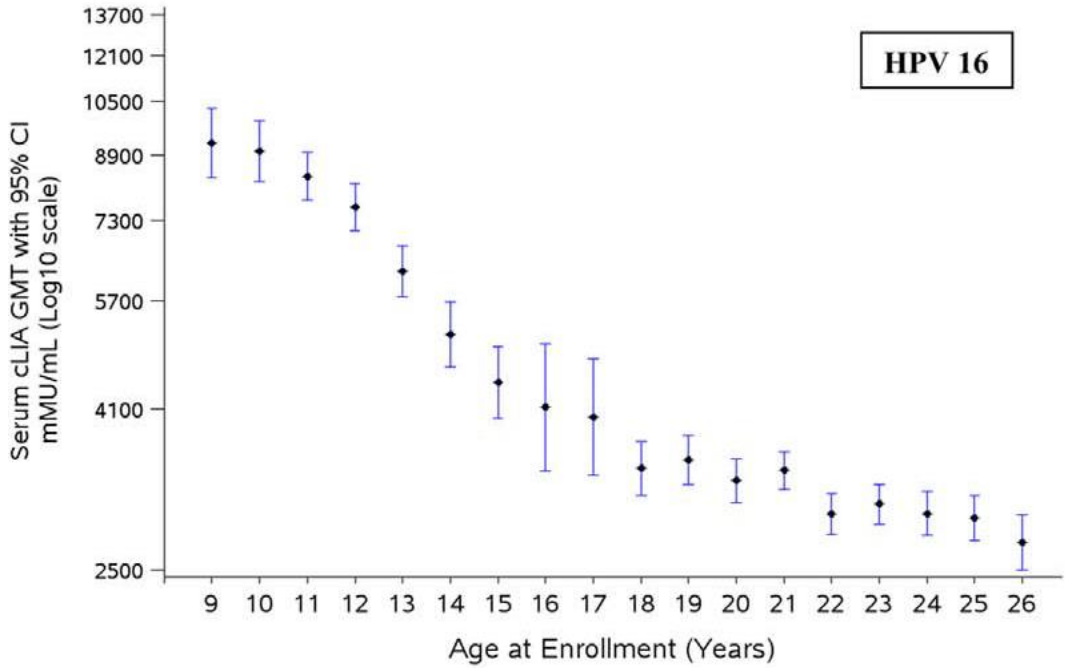
## Pertussis notifications, 2024, Australia




*Source: NNDS, downloaded 24/8/2025*
*https://nindss.health.gov.au/pbi-dashboard/*

# Robust responses to immunisation in adolescence

## 9vHPV vaccine (primary) – GMT lower with age




*Petersen LK, et al. Impact of baseline covariates on the immunogenicity of the 9-valent HPV vaccine - A combined analysis of five phase III clinical trials. Papillomavirus Res. 2017 Jun;3:105-115. doi: 10.1016/j.pvr.2017.03.002.*

## Pertussis responses (boosting)

- In a study (UK, Finland, Netherlands) of responses to an acellular pertussis booster in children (7-10 yrs) , adolescents (11-15 yrs), young adults (20-34 yrs) and older adults (60-70yrs):
  - Geometric mean (GMTs) were highest at day 28 in adolescents for:
    - Memory B cell frequencies for pertussis antigens
    - IgG antibody concentrations to pertussis toxin and filamentous haemagglutinin
  - Whereas, pertactin and IgA responses increased with age

*Versteegen P et al. Memory B Cell Activation Induced by Pertussis Booster Vaccination in Four Age Groups of Three Countries. Front Immunol. 2022 May 23;13:864674; Versteegen P, et al. Responses to an acellular pertussis booster vaccination in children, adolescents, and young and older adults: A collaborative study in Finland, the Netherlands, and the United Kingdom. EBioMedicine. 2021 Mar;65:103247.*

# What do adolescents think about vaccines?

## Systematic review of qualitative studies n= 59 (54 from HIC, 75% about HPV vaccine)

| Adolescents' understanding of vaccines | Vaccine information sources described by adolescents | Vaccine decision-making |
|---|---|---|
| **Purpose of vaccines:**<br>• Understand general purpose, but often unclear about specific vaccines<br>• May be unsure whether vaccines preventative or therapeutic<br>• Tend to think about vaccines in terms of personal rather than public protection | **Parents or caretakers:**<br>• Usually main source of information<br>• Generally perceived by adolescents as being responsible for obtaining and evaluating vaccine information<br>• Vaccines usually discussed at home at the time of vaccine consent | **Lead by parents or caretakers:**<br>• Parents generally required to provide vaccine consent<br>• Adolescents may have pre-formulated opinions about vaccines, but final decision is generally parental, even when adolescent self-consent is an option |
| **Vaccine preventable diseases:**<br>• Difficulties understanding and differentiating present and future risk<br>• May be unfamiliar with diseases and disease transmission | **Schools:**<br>• Many adolescents wish for more vaccine information through schools<br>• Vaccine information sheets not sufficient, adolescents wish for interactive sessions | **Lead by adolescents:**<br>• Self-consent often not offered in practice<br>• Sub-groups of adolescents from marginalized and minority groups may exercise higher degree of autonomy when it comes to vaccine decisions |
| **Concerns about vaccines:**<br>• Pain with vaccination<br>• Lack of privacy during vaccination<br>• Short and long-term side effects<br>• Questionable effectiveness | **Healthcare providers:**<br>• Trusted information resource, but not all providers initiate vaccine conversations<br>• Adolescents perceive providers address parents rather than adolescents when discussing vaccines | |
| | **Peers:**<br>• Not commonly described as key information source<br>• Can be source of support during school vaccine clinics | |
| | **Media**<br>• Increasing use of internet and social media<br>• Unclear how adolescents assess and triangulate media information<br>• In-person communication remains important | |

Mitchell H, et al (2022) What do adolescents think about vaccines? Systematic review of qualitative studies. PLOS Glob Public Health 2(9):e0001109.

# National Immunisation Schedule

## Adolescent vaccination

(also see vaccination for people with medical risk conditions)

| Age | Diseases | Vaccine Brand |
|---|---|---|
| All ages | Influenza (adolescents with specified medical risk conditions) | Age appropriate |
| | Influenza (Aboriginal and Torres Strait Islander adolescents) | Age appropriate |
| | Pneumococcal (adolescents with specified medical risk conditions) | Prevenar 13® and Pneumovax 23® |
| 12–13 years (Year 7 or age equivalent) | Human papillomavirus (HPV) | Gardasil®9 |
| | Diphtheria, tetanus, pertussis (whooping cough) | Boostrix® or Adacel® |
| 14–16 years (Year 10 or age equivalent) | Meningococcal ACWY | MenQuadfi® |

# State and Territory additional scheduled adolescent vaccines

## National Immunisation Program

**February 2025** South Australia Schedule

| Age | Antigen | Vaccine Brand | Route | Important Information |
|---|---|---|---|---|
| **9-14 years Aboriginal**** | 23vPPV | Pneumovax 23® | IM | 5-10 years after the previous dose of 23vPPV |
| **Year 7** students | dTpa<br>HPV | Boostrix® **OR** Adacel®<br>Gardasil® 9 | IM<br>IM | 1 dose of Gardasil 9 is recommended unless person is immunocompromised |
| **Year 10** students | 4vMenCV (ACWY)<br>Meningococcal B | MenQuadfi™<br>Bexsero® | IM<br>IM | 2 doses Bexsero with a minimum 8 week interval |

NORTHERN TERRITORY GOVERNMENT

NT Immunisation Schedule

**Children and Adolescents**

Up to 19 years

July 2025

89228315

Immunisation program | NT Health

All people | Aboriginal and Torres Strait Islander people | Specified medical risk conditions

| | | | | | |
|---|---|---|---|---|---|
| 12 years year 7 students | INFLUENZA | Human papillomavirus (HPV) | Gardasil 9® (IM) | 1 | People who are immunocompromised \| Human papillomavirus (HPV) \| AIH |
| | | Diphtheria, tetanus, pertussis | Boostrix® (IM) or Adacel® (IM) | 1 | |
| 14 - 19 years | | Meningococcal ACWY | MenQuadfi® (IM) | 2 | Recommended to receive one dose of Men ACWY vaccine 14 years and over regardless of previous doses |
| | | Meningococcal B | Bexsero® (IM) | 1 & 2 | Catch-up schedule for adolescents 15-19 years till 31 Dec 2026. 8 weeks between doses * |
| | | Pneumococcal | Pneumovax 23® (IM) | 2 | *See NT Pneumococcal schedule* / *See NT Pneumococcal schedule* |

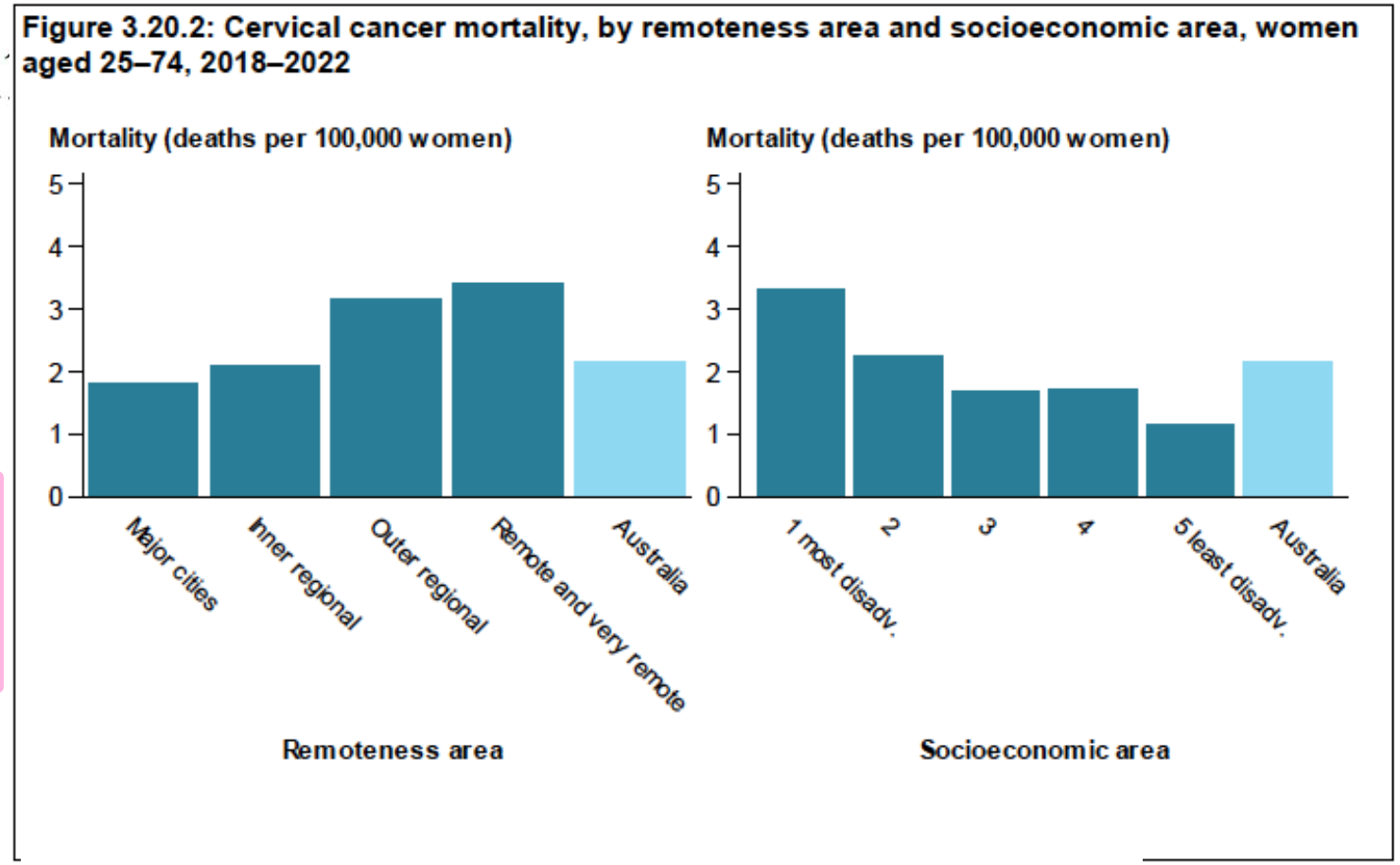
*Adolescents 14 years and over are recommended to receive 2 doses of meningococcal B vaccine 8 weeks apart, regardless of previous doses of Men B vaccine received under 14 years of age

## Immunisation Schedule Queensland - Adolescent and Adult Immunisation

| | | | | | |
|---|---|---|---|---|---|
| **Year 10 students (or age equivalent)** | Meningococcal ACWY | MenQuadfi | R | IM / DL | Meningococcal ACWY is funded for Year 10 Students (or age equivalent) AND adolescents aged 15–19 years inclusive. |
| | Meningococcal B | Bexsero | | IM / DL | 2 doses given a minimum of 8 weeks apart.<br>Meningococcal B is funded for Year 10 students (or age equivalent) AND adolescents aged 15–19 years inclusive. |

# Cervical cancer is a disease of inequity

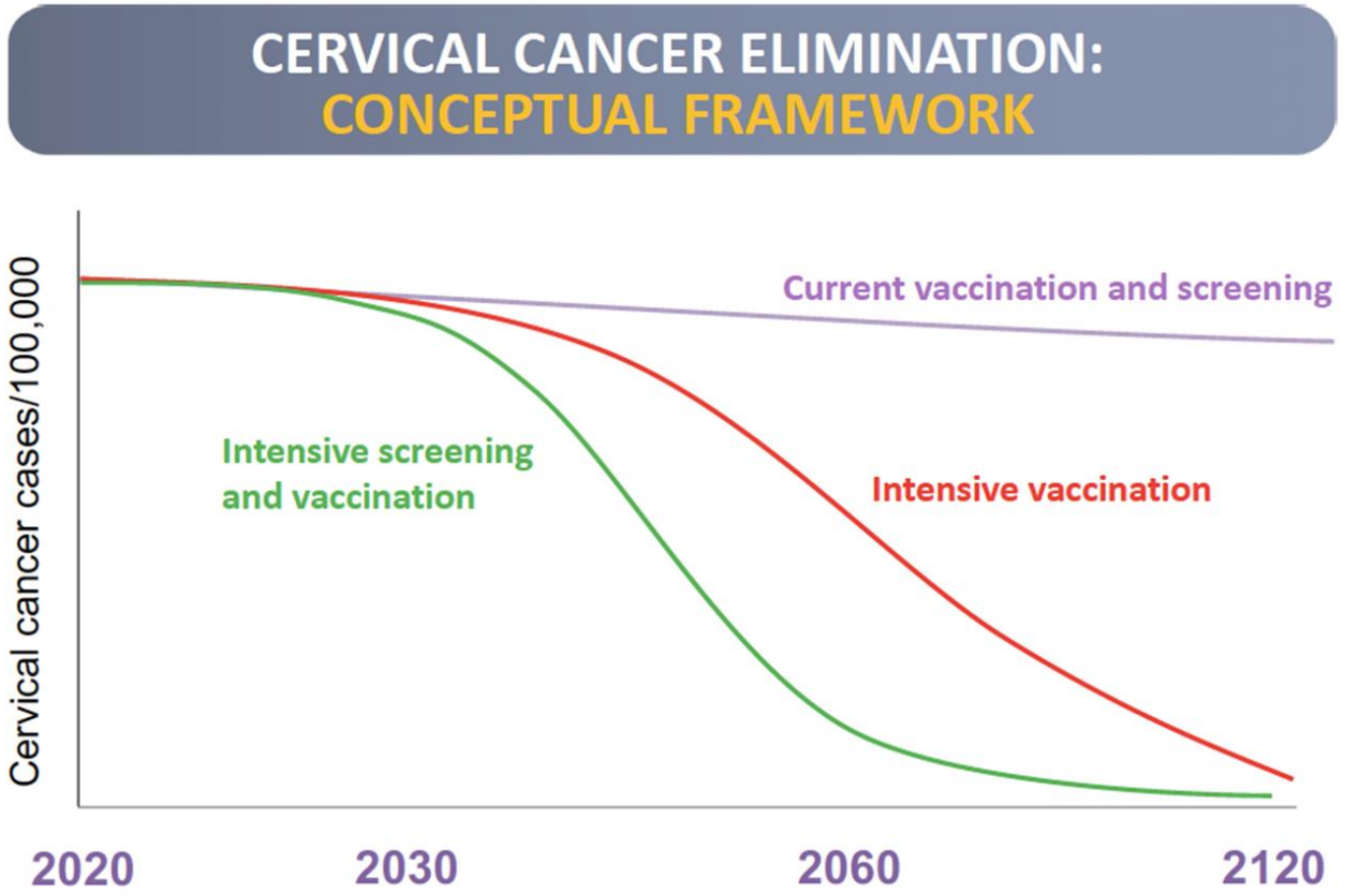
- 4th commonest cancer globally but 2nd most common in females 15-44 years
- Treatable if diagnosed early
- Late-stage disease associated with severe suffering, and often highly stigmatised and socially isolating
- Incidence and mortality, and their ratio, strongly correlated with human development index
- Inequities exists within Australia too, despite cervical cancer being *almost completely preventable*.




*Bruni et al, Lancet Glob Health 2023 ;*
*Singh et al. Int J MCH AIDS 2012; AIHW 2024*

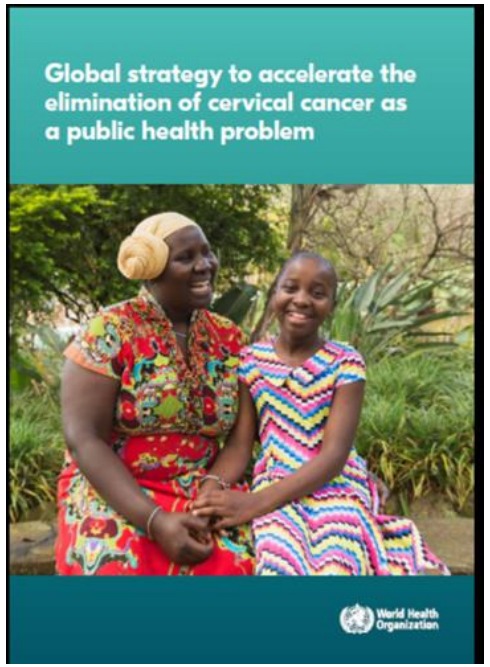
# We are at an incredible moment in time…

- We understand the natural history of HPV and cervical cancer
- Primary prevention with HPV vaccines incredibly effective and safe (19+ years of rigorous global data)
- Secondary prevention with HPV screening far more effective than previous methods
- Even once or twice in a lifetime screening greatly reduces risk




World Health Organization

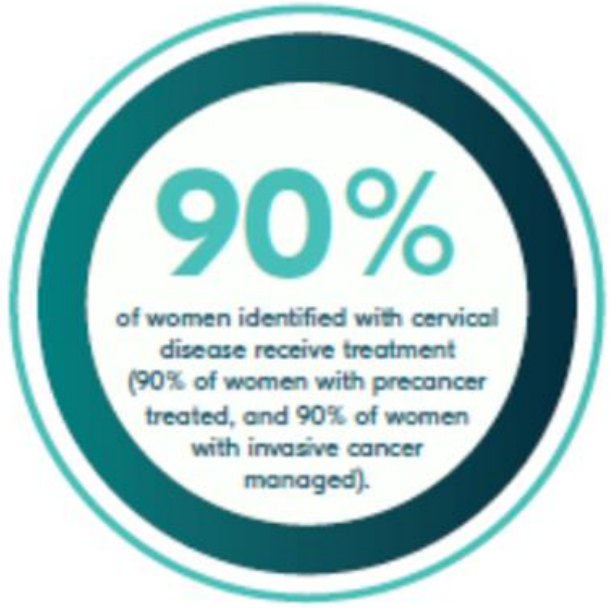
# The Global Effort to Eliminate Cervical Cancer




## This global strategy to eliminate cervical cancer proposes:

- a vision of a world where cervical cancer is eliminated as a public health problem;
- a threshold of 4 per 100 000 women-years for elimination as a public health problem;
- the following 90-70-90 targets that must be met by 2030 for countries to be on the path towards cervical cancer elimination:



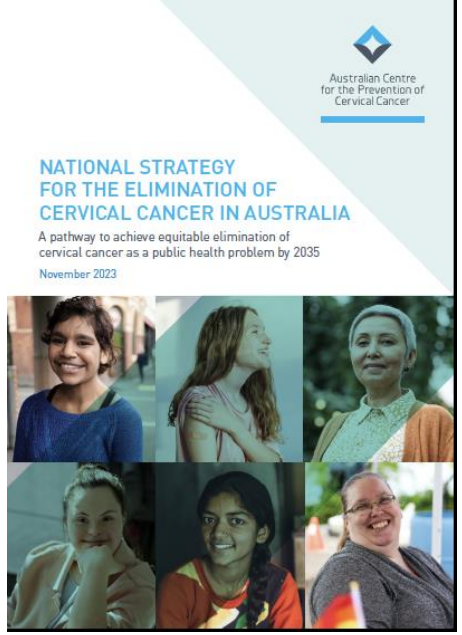



**Predicted to avert**

- **>74 million cases**
- **>62 million cervical cancer deaths**

# A strategy focused on equity

**An Australia where preventable cervical cancer is a disease of the past, in which Australia's diverse communities have equitable access to information and to culturally safe and inclusive vaccination, screening and treatment services.**




This Strategy recognises the right to equitable prevention and care for all people, including but not limited to:

- Aboriginal and Torres Strait Islander people
- People from culturally and linguistically diverse backgrounds (including immigrants, refugees, and asylum seekers)
- People who identify as lesbian, gay, bisexual, transgender, queer, and/or asexual or who are intersex
- People with disability, and
- People living in remote and rural areas.

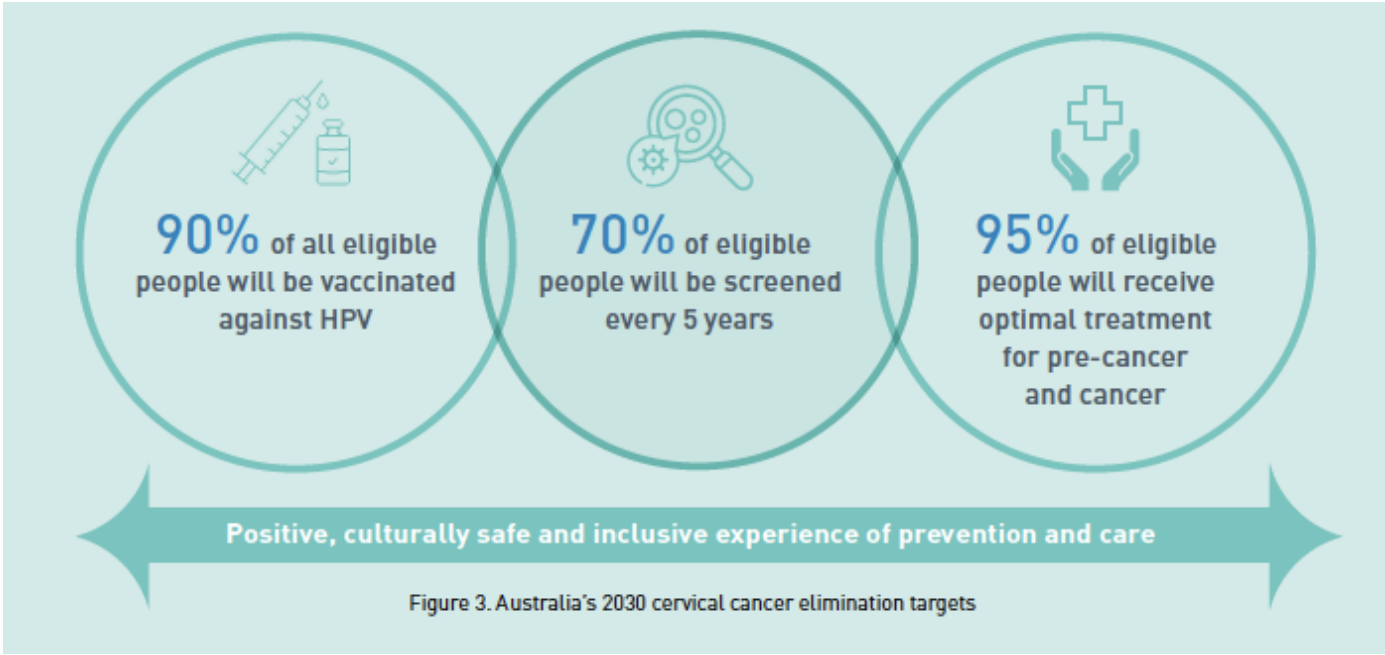
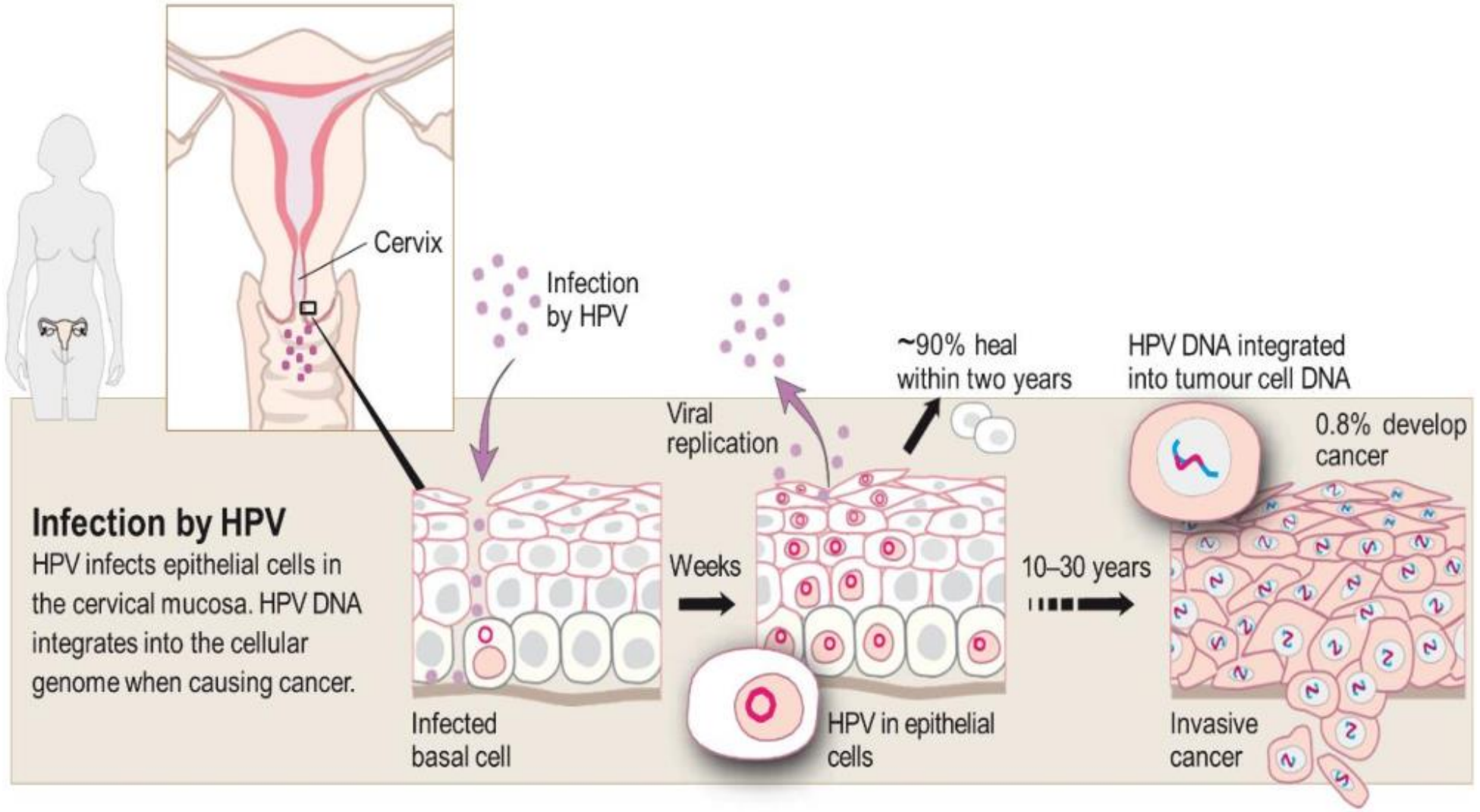


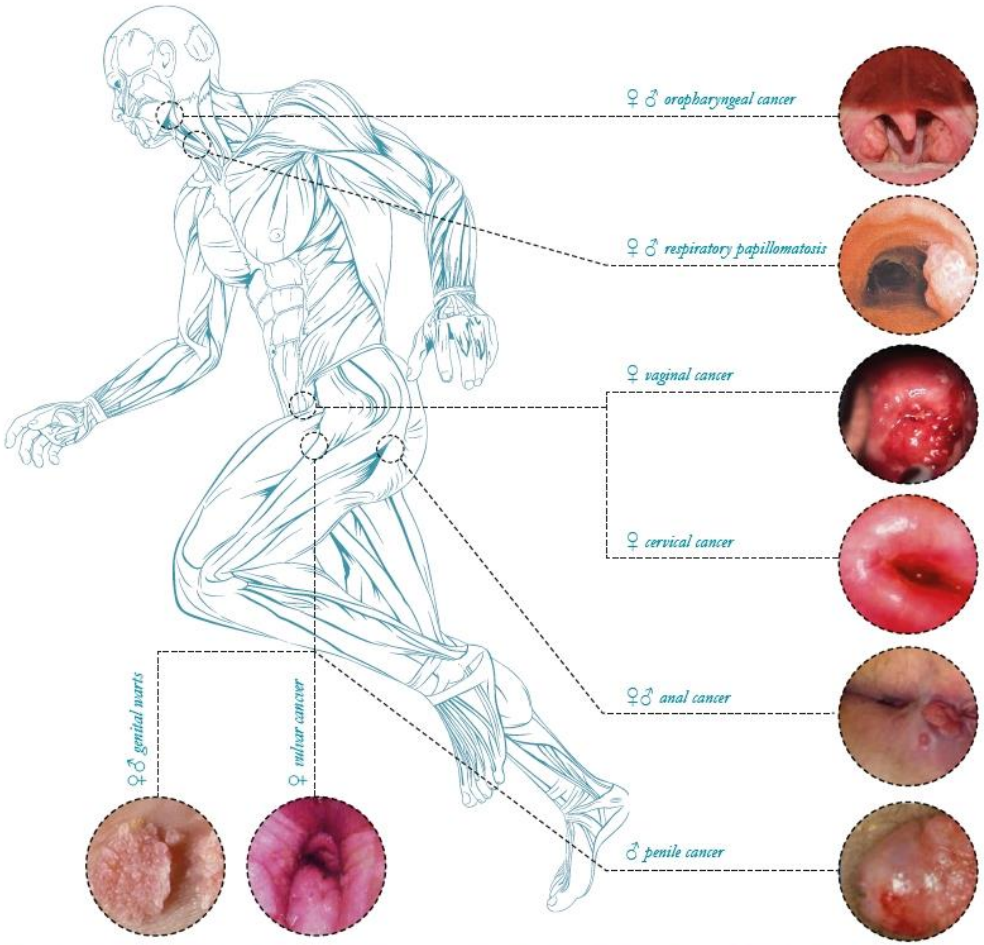

Figure 3. Australia's 2030 cervical cancer elimination targets

Source: National Strategy https://www.health.gov.au/resources/publications/national-strategy-for-the-elimination-of-cervical-cancer-in-australia?language=en

# Pathogenesis of HPV in cervical cancer



# Other HPV-related diseases




Annually, in women HPV infections cause 530,000 cancer cases in the cervix, 18,000 in the anus, 8,500 in the vulva, 12,000 in the vagina and 5,500 in the oropharynx. In men, HPV infections cause 17,000 cancer cases in the anus, 13,000 in the penis and 24,000 in the oropharynx. Ref. (1)

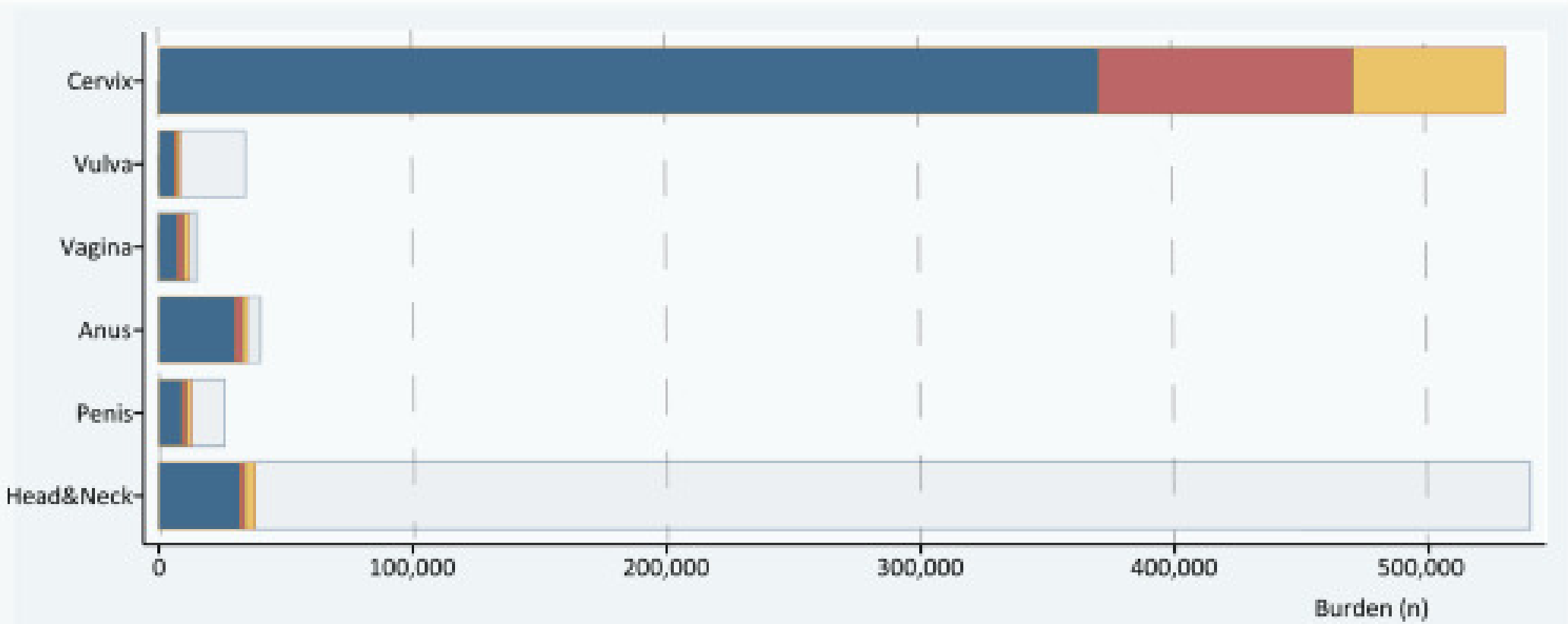
*Source: Sanjose & Tsu. Spectrum of HPV related diseases, HPV world no.36*

## HPV attribution

- Anogenital warts -100%
- Recurrent respiratory papillomatosis - 100%
- Anal cancer – 88%
- Vaginal cancer – 78%
- Penile cancer -50%
- Vulval cancer – 25%
- Oropharyngeal cancer – 30% globally. Up to 80% in some settings.

*de Martel C, et al Worldwide burden of cancer attributable to HPV by site, country and HPV type. Int J Cancer 2017; 141(4): 664-70.*
*de Martel C, et al. Global burden of cancer attributable to infections in 2018: a worldwide incidence analysis. Lancet Glob Health 2020; 8(2): e180-e90.*

# Global HPV related cancer burden by HPV type

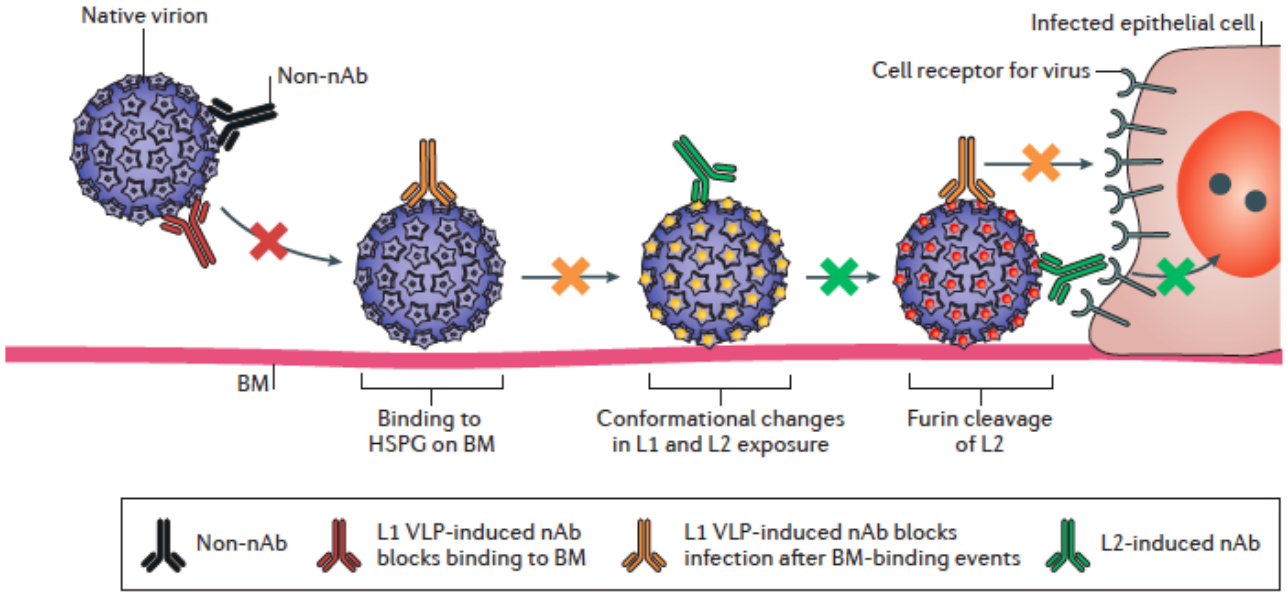



| | Cervix | Vulva | Vagina | Anus | Penis | Head&Neck |
|---|---|---|---|---|---|---|
| HPV16/18 | 370,000 | 6,200 | 7,400 | 30,000 | 9,100 | 32,000 |
| HPV31/33/45/52/58/6/11 | 100,000 | 1,200 | 2,500 | 3,000 | 1,900 | 2,000 |
| Other HPV | 60,000 | 1,100 | 2,100 | 2,000 | 2,000 | 4,000 |
| No HPV | 0 | 25,000 | 3,000 | 5,000 | 13,000 | 502,000 |

Serrano et al 2018

# How do HPV vaccines work?

HPV vaccines *prevent* infection with targeted types by antibody binding to the virus, preventing it from entering the basal epithelial cell



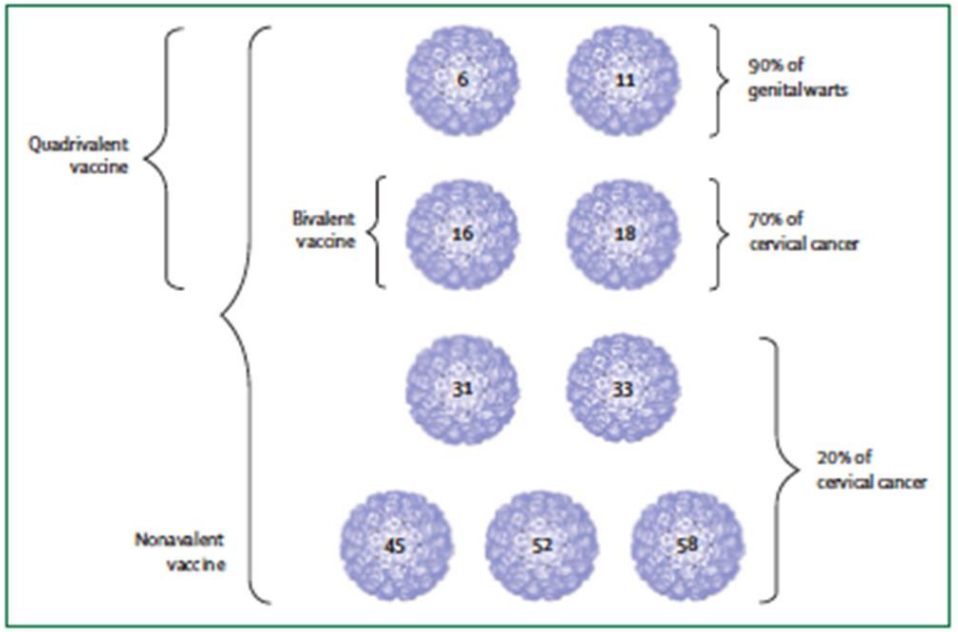




***Figure 2:*** **HPV VLP types in the nonavalent VLP vaccine**
VLPs in the bivalent, quadravalent, and the nonavalent vaccines are shown with the proportion of neoplasistic disease attributed to each group. HPV=human papillomavirus. VLP=virus-like particle.

Roden R, Stern P. *Nat Rev Cancer* 18, 240–254 (2018)

Schiller & Muller. *Lancet Oncol*. 2015 May;16(5):e217 - e225

# HPV vaccines are very effective

Initial RCTs - 94% +efficacy against persistent infection in those uninfected at baseline (2vHPV 94%, 4vHPV and 9vHPV 96%)

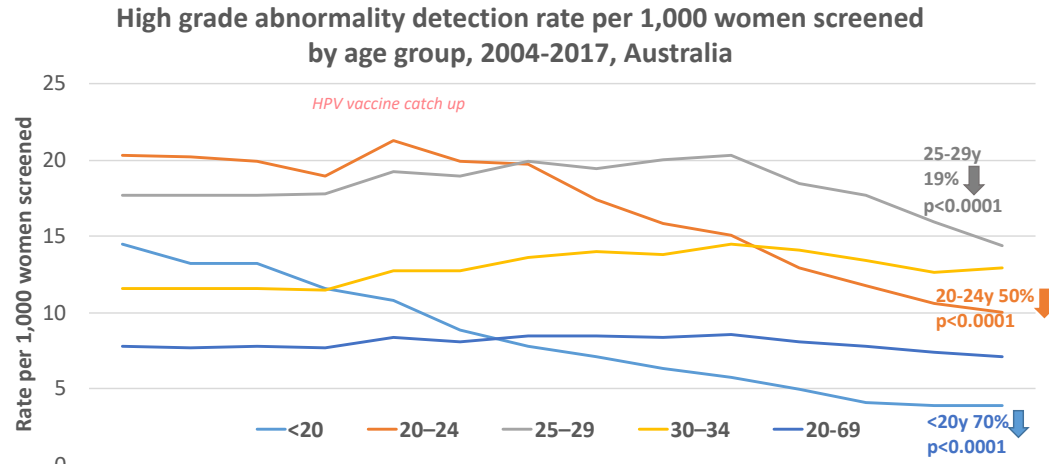
In Australia (and elsewhere) large declines seen in

- HPV infection
- Genital warts
- Cervical precancer
- Recurrent respiratory papillomatosis

Impact accelerated by multicohort vaccination at introduction

*WHO recommends vaccination of 9-14 year old girls, with an initial multi-age cohort catch up at commencement*

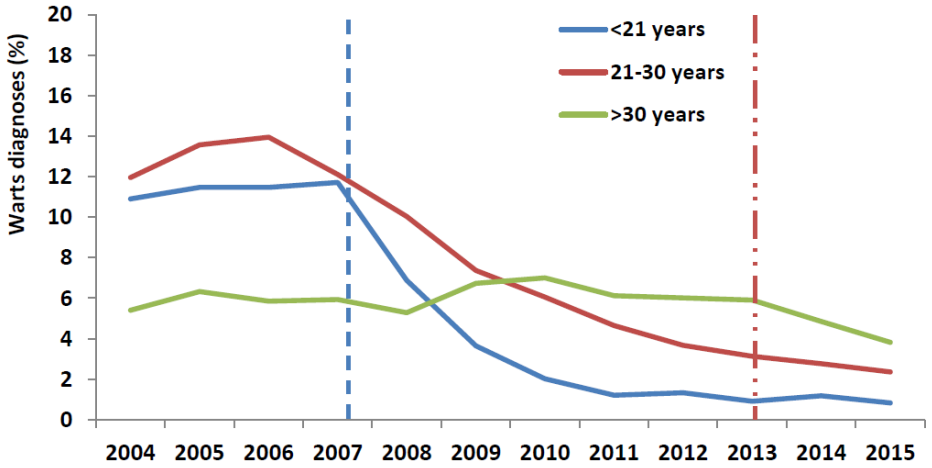
Harper Gyne Onc 2017; Patel et al EuroSurveillance 2018




| | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| <20 | 14.5 | 13.2 | 13.2 | 11.6 | 10.8 | 8.9 | 7.8 | 7.1 | 6.4 | 5.7 | 5.0 | 4.1 | 3.9 | 3.9 |
| 20–24 | 20.3 | 20.2 | 19.9 | 18.9 | 21.3 | 19.9 | 19.7 | 17.4 | 15.8 | 15.0 | 12.9 | 11.8 | 10.6 | 10.0 |
| 25–29 | 17.7 | 17.7 | 17.7 | 17.8 | 19.3 | 19.0 | 19.9 | 19.4 | 20.0 | 20.3 | 18.5 | 17.7 | 15.9 | 14.4 |
| 30–34 | 11.6 | 11.6 | 11.6 | 11.5 | 12.7 | 12.8 | 13.6 | 14.0 | 13.8 | 14.5 | 14.1 | 13.5 | 12.6 | 12.9 |
| 20-69 | 7.7 | 7.7 | 7.8 | 7.7 | 8.3 | 8.1 | 8.5 | 8.4 | 8.4 | 8.5 | 8.1 | 7.8 | 7.4 | 7.1 |

Data source: AIHW 2020

**Figure 1: Proportion of Australian born women diagnosed with genital warts at first visit, by age group, 2004-2015**




* The first dotted line represents the start of the national HPV vaccination program for women in mid-2007 and the second dotted line represents the start of the national HPV vaccination program for boys in 2013

Source: Genital Warts Surveillance Network report 2016

# Evidence of cervical cancer prevention

**Lei et al. HPV Vaccination and the Risk of Invasive Cervical Cancer**

N Engl J Med 2020;383:1340-8

->1.6 million females in Sweden

IRR vax <17 years

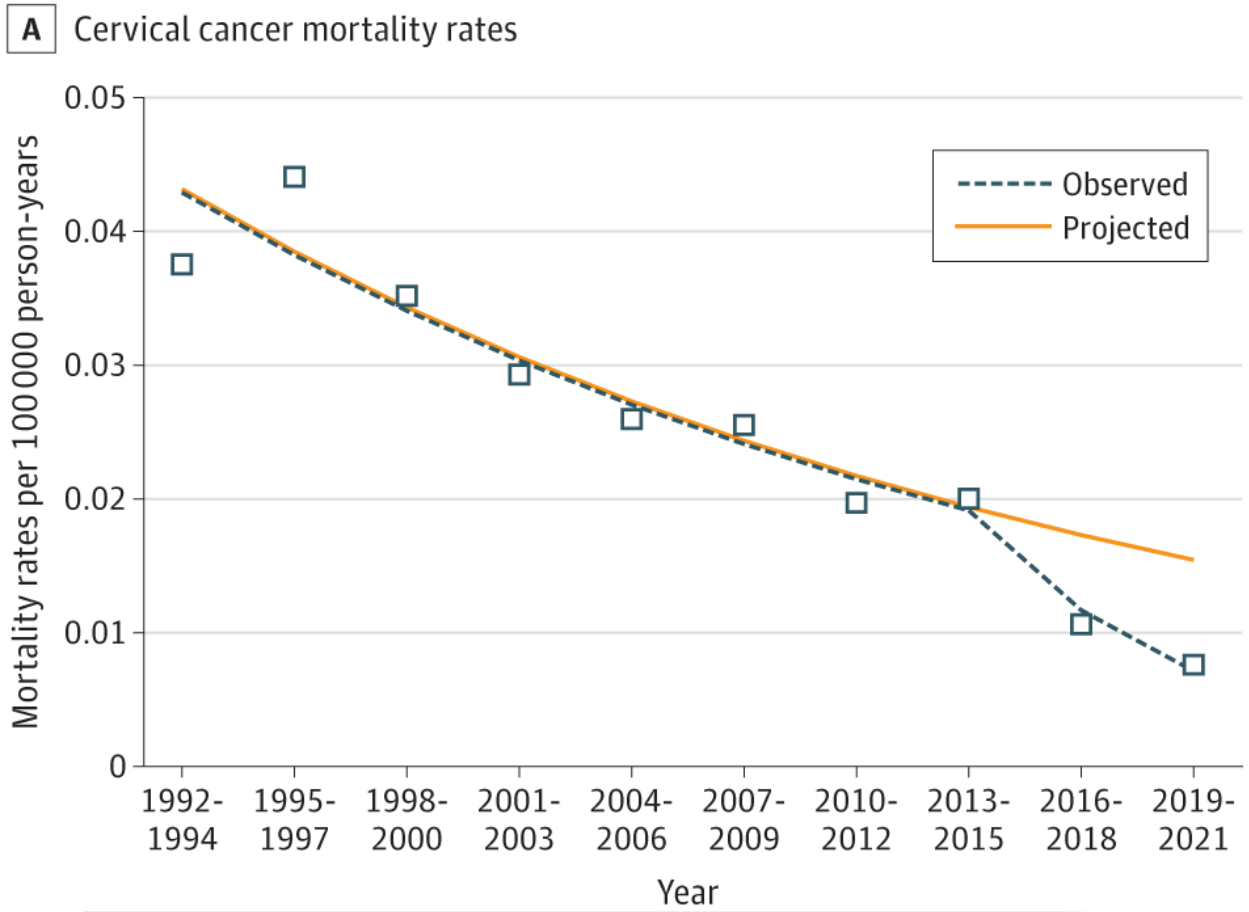
0.12 (95%CI 0.00-0.34)

IRR vax 17-30 years

0.47 (95%CI 0.27-0.75)

ALSO SHOWN IN DENMARK, UK, NETHERLANDS and USA

Recent US data shows significant decline in cervical cancer mortality in women under 25




Dorali P et al. Cervical Cancer Mortality Among US Women Younger Than 25 Years, 1992-2021. JAMA. 2025;333(2):165-166.

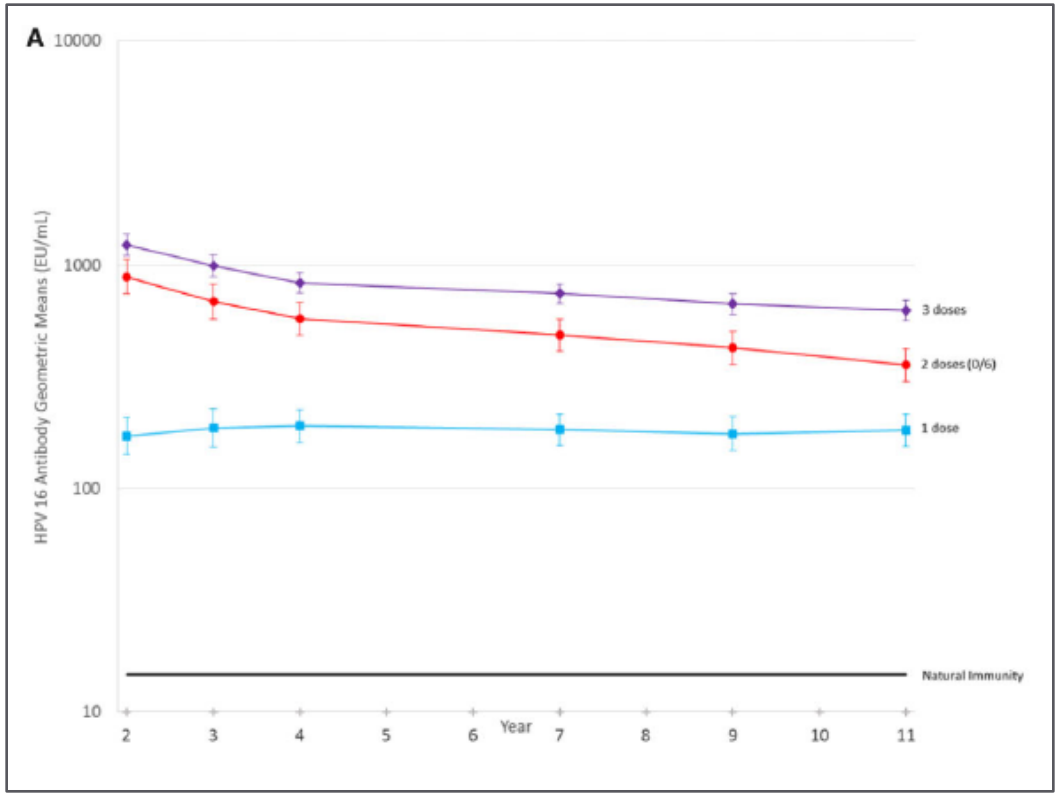
# A single dose is enough…high and equal efficacy

- Single dose HPV vaccination endorsed by WHO up to age 20 years (Dec 2022)
  - (2 doses for age 21+, 3 doses for immunocompromised)

See: Human papillomavirus vaccines: WHO position paper, December 2022. Weekly Epidemiological Record No 50, 2022, 97, 645–672

**Key evidence**

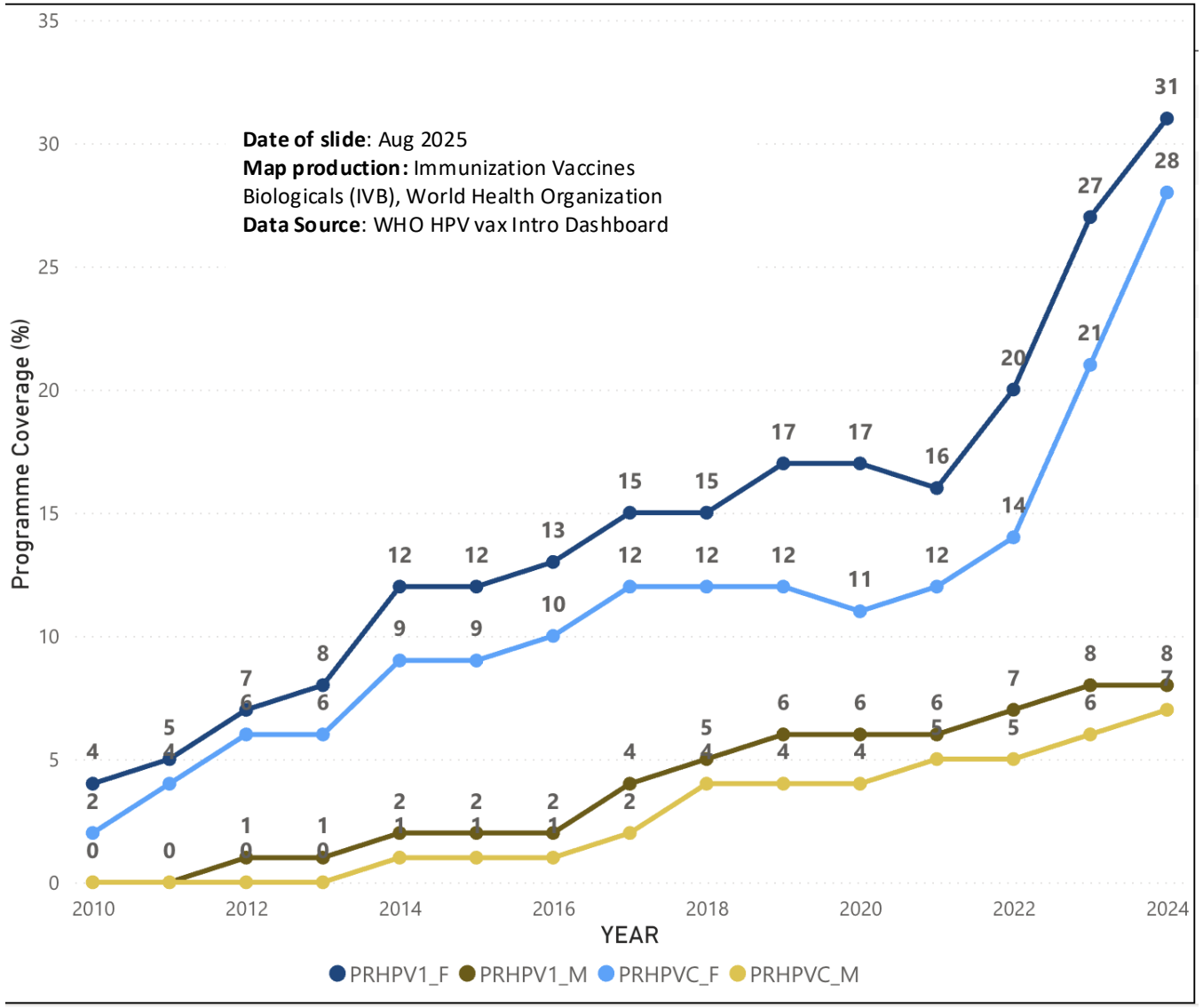
- Kenya RCT women 15-20 years, 2vHPV or 9vHPV vs meningococcal *(Barnabas et al, 2023)*
- 3 yr incident persistent HPV16/18 infection VE 98% 2vHPV, 99% 9vHPV; 16/18/31/33/45/52/58 infection 96% 9vHPV)
- India IARC study- girls aged 10-18 at vax 4vHPV *(Basu et al, 2021; Joshi et al 2023, Malvi et al 2025)* 10 yr incident persistent 16/18 infection (detected >=10 months apart) VE **95·4%** (95% CI 85·0-99·9%)
- DoRIS trial 2vHPV, 9vHPV non-inferiority and immunobridging 10-14 yr olds, Tanzania (*Watson-Jones et al 2022, 2025; Baisley et al 2022, 2024)*




Sustained high level antibody after 1 dose 2vHPV vaccine and associated VE from Costa Rica trial (Kreimer et al JNCI 2020. See also Porras et al, JNCI Monograph2024)

*Barnabas et al Nat Med. 2023, Joshi et al Vaccine 2023, Basu et al Lancet Oncol. 2021, Watson Jones et al. Lancet Glob Health. 2022, 2025, Baisley et al. Lancet Glob Health. 2022.Baisley et al, Lancet Global Health 2024. See also Whitworth et al, Vaccine X, 2024, Malvi et al JNCI 2024, Porras et al JNCI 2024*

# HPV vaccine global coverage




## New introductions

2024 n=4

2023 n=13

2022 n=14

Support from GAVI and HAPPI consortium

- GAVI aims to reach 86 million girls by 2025
- HPV Vaccine Acceleration Program Partners Initiative (HAPPI) Consortium (BMGF funded) for LMICs

## Need to optimise the use and distribution of the available supply

- Supply constraints now easing
- New vaccines entering market from India and China
- GLOBAL: 2vHPV (Cervarix), 4vHPV (Gardasil), 9vHPV (Gardasil9)
- CHINA: 2vHPV (Cecolin), 2vHPV (Walrinvax)
- INDIA: 4vHPV (Cervavac)
- 5 prequalified by WHO at Oct 24
  - 4 for use as single dose

# 150 Countries have HPV vaccine in national program

**Date of slide**: August 2025
**Map production:** Immunization Vaccines Biologicals (IVB), World Health Organization
**Data Source**: WHO HPV vax Intro Dashboard

2030 Target: 194 countries

194

Total countries reported

| HPV national schedule | No. of countries |
|---|---|
| A. Yes | 148 |
| B. Yes (Partial) | 2 |
| C. No | 44 |

**150 (77%)**

**44 (23%)**

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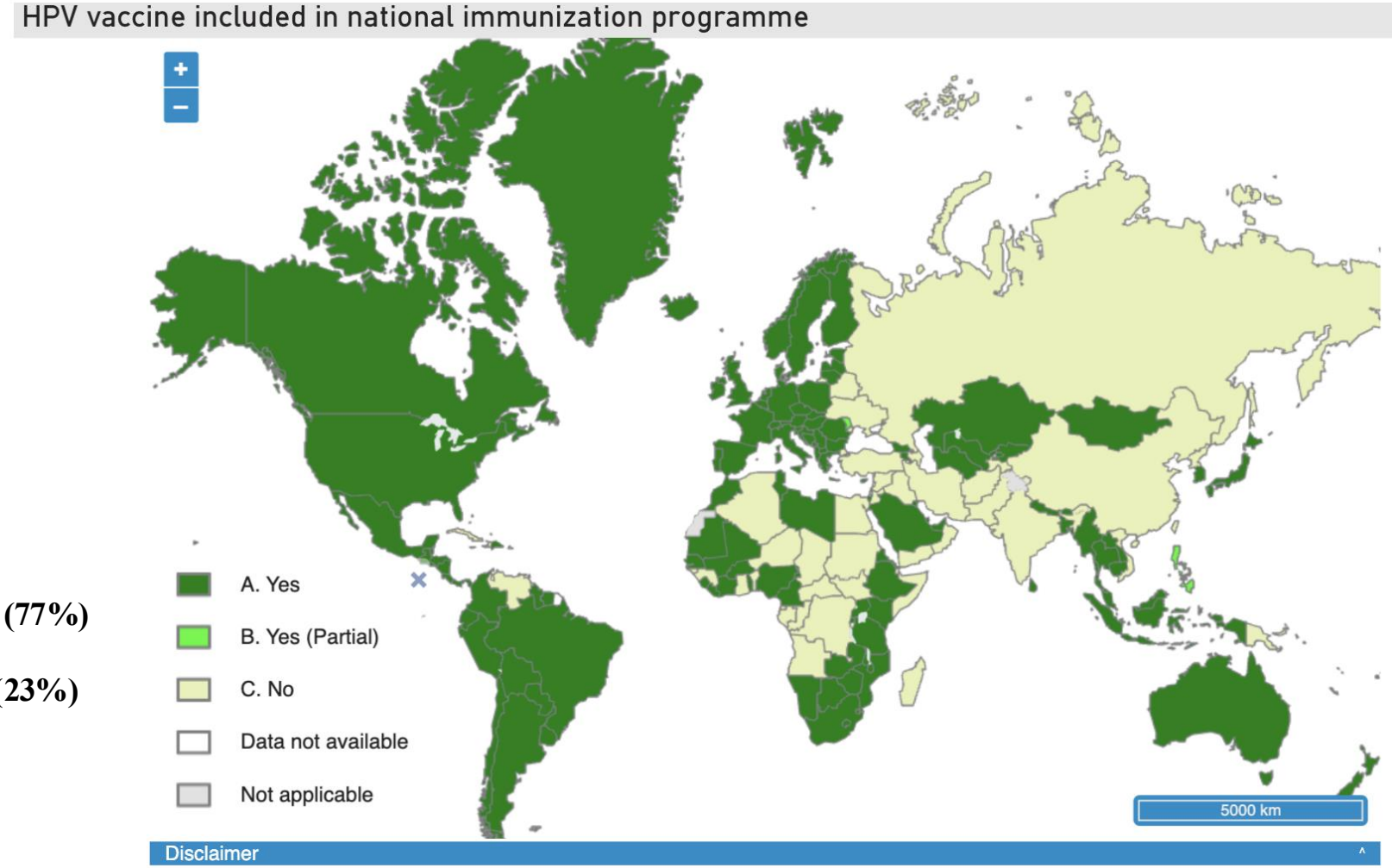


# 77 Countries have one dose in national program

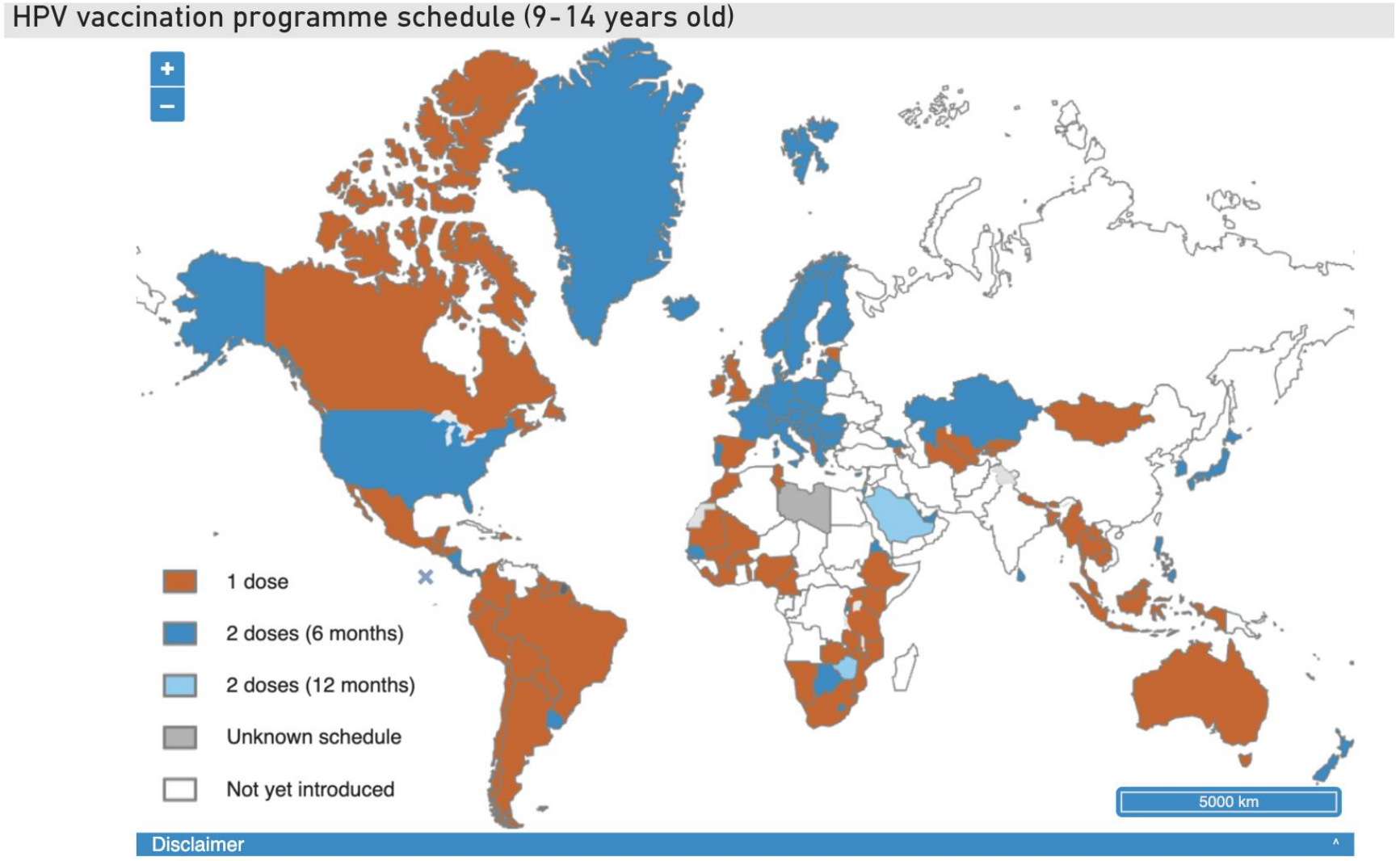
**Date of slide**: Aug 2025
**Map production:** Immunization Vaccines Biologicals (IVB), World Health Organization
**Data Source**: WHO HPV vax Intro Dashboard

| Interval_doses | No. of countries |
|---|---|
| 1 dose | 77 |
| 2 doses (12 months) | 2 |
| 2 doses (6 months) | 69 |
| Not yet introduced | 44 |
| Unknown schedule | 2 |

Last update:
8/22/2025 10:12:27 AM

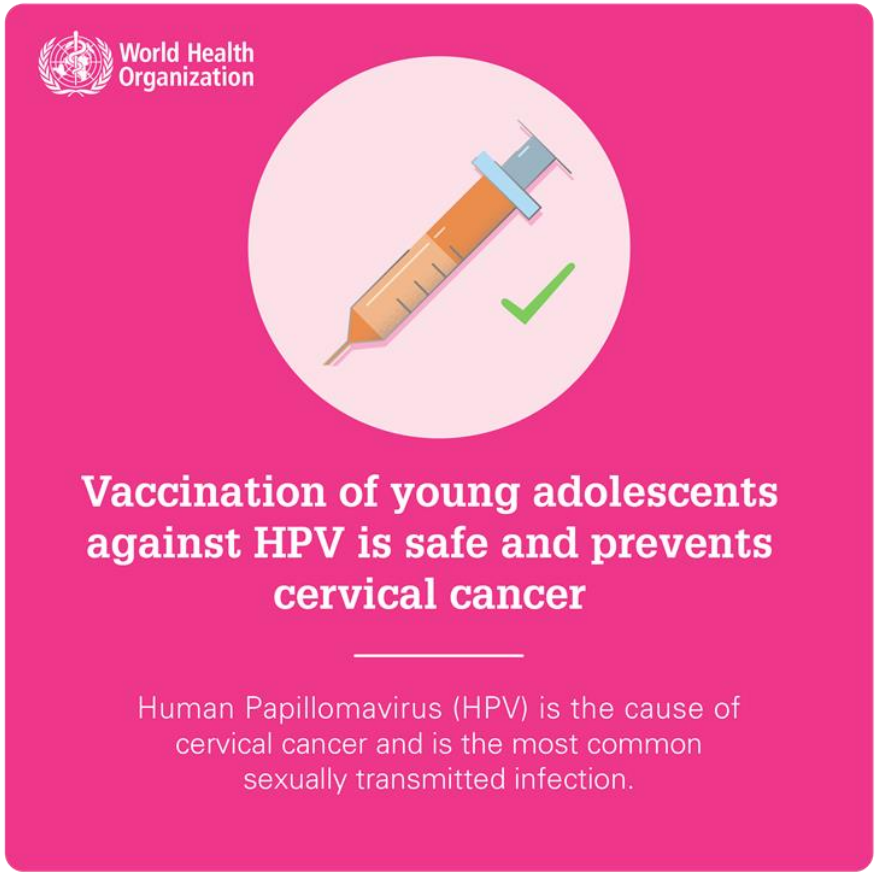
**77/149 (51.3%) one dose**

**And 83 /150 (55.3%) Both sex**



# So where are we with HPV vaccine….

- Extremely effective and safe prophylactic vaccines in use since 2006
- Over 500 million doses, proven to prevent cervical cancer
- Supply constraints easing, one dose schedule in use
- Primary pillar of the global cervical cancer elimination strategy
  - Very cost effective in almost all settings
- Can be successfully implemented at scale at any income level
  - School based delivery, with systems for out of school girls, and clear eligibility criteria
  - Micro plan, involve teachers and multisector collaborations
  - Proactive, early community mobilisation essential
  - Messaging focused on cancer prevention, govt endorsement, safety and efficacy, when and where delivered




*Tsu et al Prev Med 2021, Gallagher PlosOne 2017, Howard PVR 2017, Kabakama BMC Public Health 2016, Soi et al Implementation Science 2018, Gallagher PVR 2017, LaMontagne IntJGyneObst 2017, WHO Elimination Strategy 2020*

# Invasive meningococcal disease in adolescents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THE UNIVERSITY of ADELAIDE

# Invasive meningococcal disease in adolescents

- Second highest incidence to infants
- ~10% case fatality rate in adolescents
- sequelae – blindness, deafness, limb amputation
- Most cases (85%) of meningococcal disease in adolescents are due to the B strain (A, B, C , W, Y  strains)
- 10% of adolescents carry the meningococcus in their oropharynx
- MenACWY conjugate vaccine has been funded through the National Immunisation Program(NIP) for adolescents
- MenB protein-based vaccines are not included on the NIP for adolescents and are available for private purchase.
- SA, NT, Queensland, Tasmania (to commence) have state funded programs

**Adelaide teenager Jack Klemich dies of meningococcal disease**

JILL PENGELLEY AND JOANNA VAUGHAN THE ADVERTISER MAY 26, 2009 9:00PM

SHARE SAVE THIS STORY

**JACK Klemich was popular, talented and fortunate – he had it all.**

But three days after developing meningococcal disease, the vibrant, athletic son of real estate identity Oren Klemich was gone.

The savage speed of the disease has stunned mates who saw Jack, 18, play football for his St Peter's College team on Saturday. Twenty-four hours later, he was fighting for his life and early today, he quietly slipped away.

Despite emergency treatment with antibiotics and being put on life support, the fit sportsman could not be saved.

Wang et al. Vaccine 2019; 37(21):2768-82

# AMEND (Adolescent MENingococcal Disease) study; the lived experience

*I drove home …., which is about 20 minutes, and I was crying the whole time because I knew something wasn't right, and by the time I got home I couldn't get the key in the backdoor - P15 Female, 16.*

*So normally when I'm sick and I don't go to work, mum just leaves me, shuts my door, doesn't even come in, but for some reason she came in my room that day. I was covered in vomit, my eyes were rolling back and she rang the ambulance. - P11, Female, 20*

*[The] doctor saw me and she said oh, it looks like you're coming down with the flu, just go home, take some Nurofen, you'll be fine – P25, Female, 18*

*And then by the time the home doctor comes, I can't really use my legs anymore. So I'm kind of like crawling or like, you know, holding on to things drag myself through the door to let him in. He said that he thought I might have a bladder infection. So to wait until tomorrow and get some antibiotics. So [he] gave me a prescription and left. – P6, Female 23*

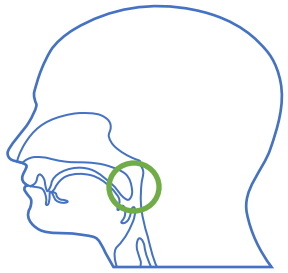
*My mum's probably like the worst affected by it. She can't really even talk about it. She just starts crying. – P18, female, 19*

*There's still like a limit on how much I can do in the day without just crashing for a week afterwards. Placement was really hard this year. – P4, female, 16*

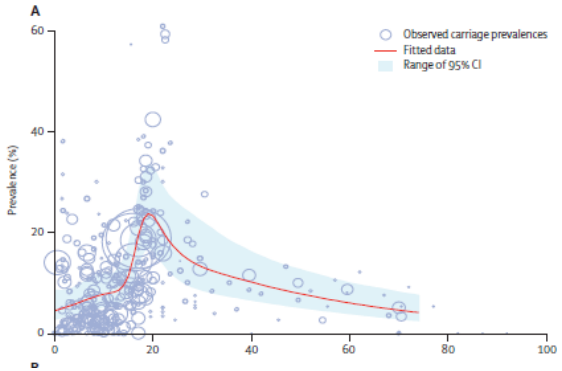


McMillan M et al. Healthcare 2024;12(11):1075

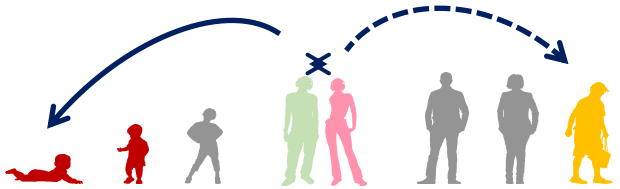
# Oro-pharyngeal carriage of *Neisseria meningitidis*



*N. Meningitidis* colonises the nasopharynx of healthy individuals[1,2]




~10% of the general population are asymptomatic carriers rates are highest in older adolescents and young adults[1,2]

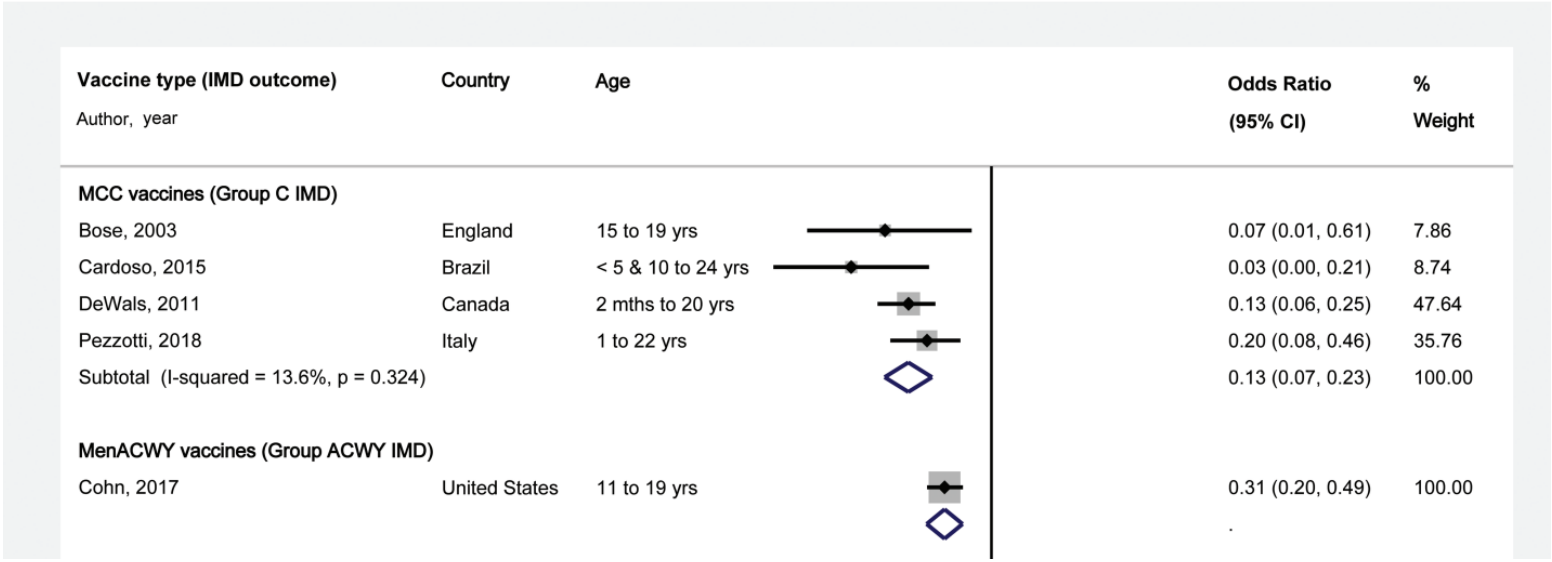



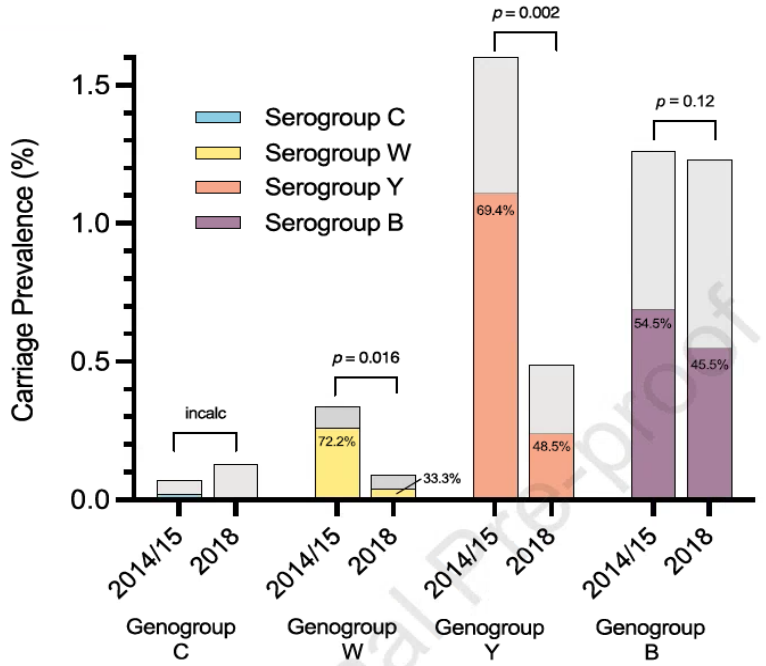
Asymptomatic carriers are a major source of transmission [4]



1. Christensen H et al. Lancet Infect Dis 2010;10:853–861; 2. Vetter V et al. Expert Rev Vaccines 2016;15:641–658; 3. MacLennan et al. Emerg Infect Dis. 2006 Jun;12(6):950-7. 4. Yazdankhah SP et al. J Med Microbiol 2004;53:821–832

# Meningococcal ACWY vaccines are safe and effective against IMD and have a herd immunity impact






1. McMillan et al. Clinical Infectious Diseases 2021;73(3):e609–19 2. Jeremy P. Carr, Clin Microbiol Infect 2022;28:1649.e1e1649.e8

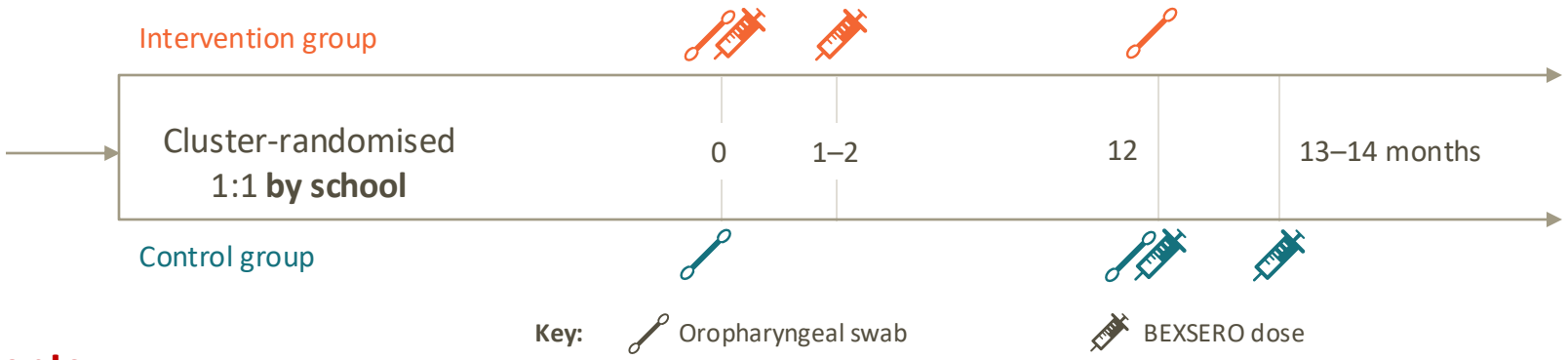
# Meningococcal B vaccine effectiveness in adolescents against IMD and carriage


# Randomised, controlled trial to assess the impact of 4CMenB on carriage of *Neisseria meningitidis*

**The '*B Part of It*' study administered 4CMenB to high-school students in South Australia, 2017/18[1]**

**62%** of all South Australian students in Years 10 and 11 (ages 15–17 years) enrolled

**91%** of South Australian schools participated in the school-based programme (237/260)




**Total enrolment 34,489 students**

Marshall H et al. NEJM 2020;382:318-27

# No impact of 4CMenB on carriage of meningococcal strains associated with disease (capsule) but reduction in carriage of unencapsulated strains

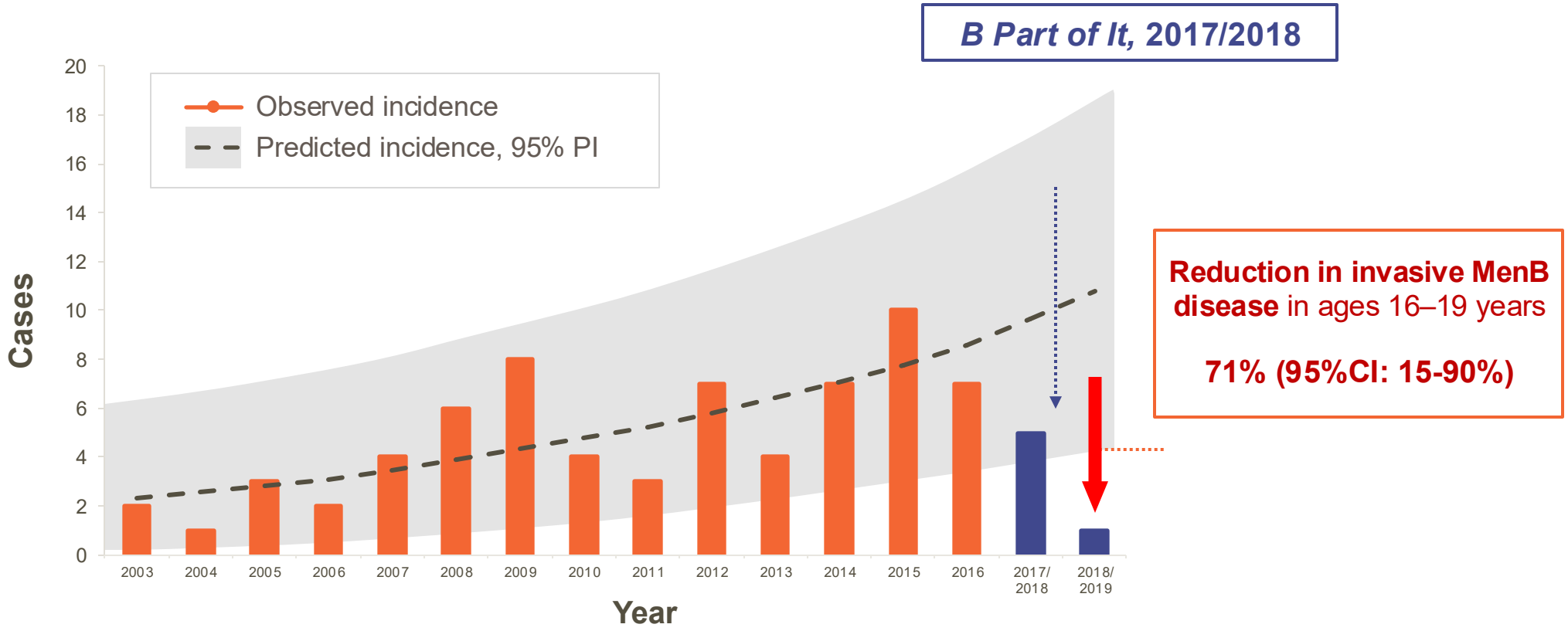
| *N. meningitidis* | Vaccinated | | Unvaccinated | | aOR (95% CI) | ap-value |
|---|---|---|---|---|---|---|
| All | 4.3 % | 547/12746 | 4.9% | 561/11523 | 0.85 (0.70, 1.04) | 0.117 |
| Disease causing | 2.6% | 326/12746 | 2.5% | 291/11523 | 1.02 (0.8, 1.31) | 0.845 |

| Secondary analysis carriage | Vaccinated % | n | Control % | n | aOdds ratio 95% CI | ap-value |
|---|---|---|---|---|---|---|
| Non-groupable (unencapsulated) | 1.65 | 179/10841 | 2.23 | 229/10285 | 0.71 (0.54, 0.91) | 0.008 |
| Group W | 0.16% | 17/10841 | 0.18% | 18/10285 | 0.89 (0.43, 1.85) | 0.751 |
| Group C | 0.11% | 12/10841 | 0.07% | 7/10285 | 1.87 (0.63, 5.55) | 0.260 |
| Group X | 0.07% | 8/10841 | 0.01% | 1/10285 | - | - |

| *Acquisition N. meningitidis* | vaccinated | | unvaccinated | | aOR (95% CI) | ap-value |
|---|---|---|---|---|---|---|
| All groups | 3.38 % | 430/12746 | 3.7% | 427/11523 | 0.91 (0.73, 1.13) | 0.298 |
| Disease causing groups | 2.13% | 272/12746 | 2.07% | 238/11523 | 1.03 (0.79, 1.34) | 0.954 |

Marshall H et al. NEJM 2020;382:318-27.

# Reduction in meningococcal B disease, following the state-wide study, evidence for direct protection




McMillan M, Marshall H et al. Clin Infect Dis 2021;ciaa1636.

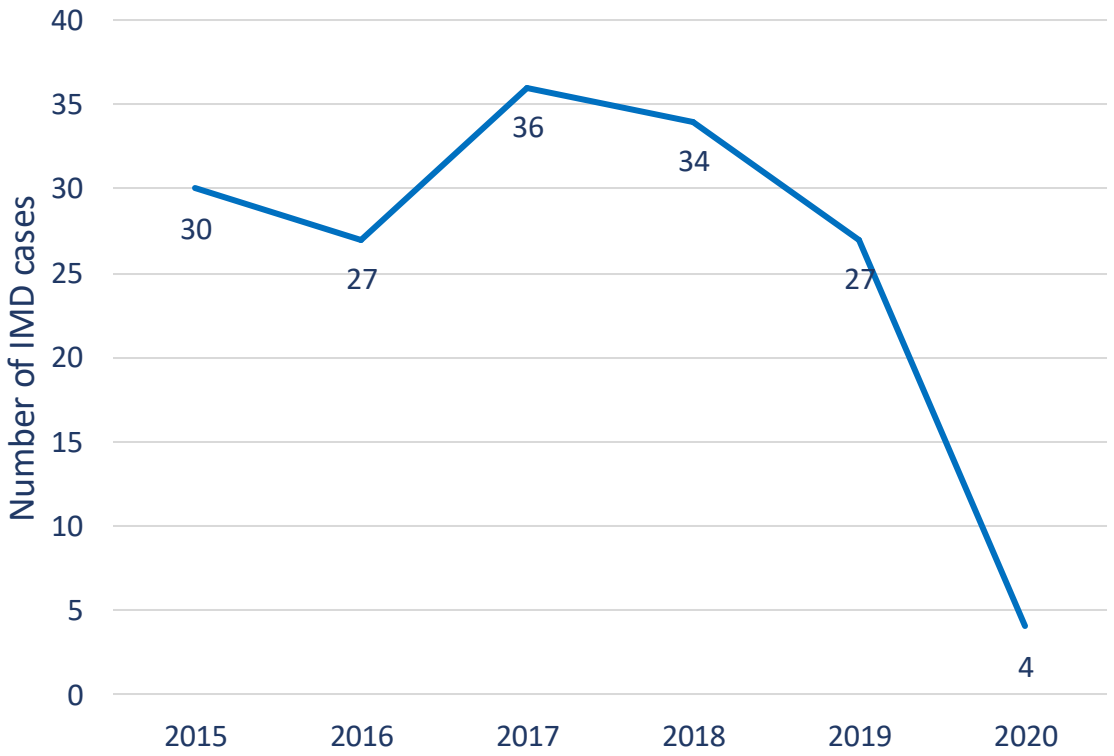
# Vaccine effectiveness two years after introduction of the funded 4CMenB vaccine program in SA 2018–2020

## Vaccine effectiveness against meningococcal B disease in infants

- **94.7%** (95% CI: 40.3–99.5, *P*=0.025) for two doses

## Vaccine effectiveness against meningococcal B disease in adolescents

- **~100%** for two doses (Variance and confidence intervals for VE cannot be calculated because of the lack of vaccinated cases)




IMD in South Australia following introduction of 4CMenB (state funded) and MenACWY (NIP)

Wang B, Marshall HS. *Lancet infectious diseases 2022;22:1011-1020*.

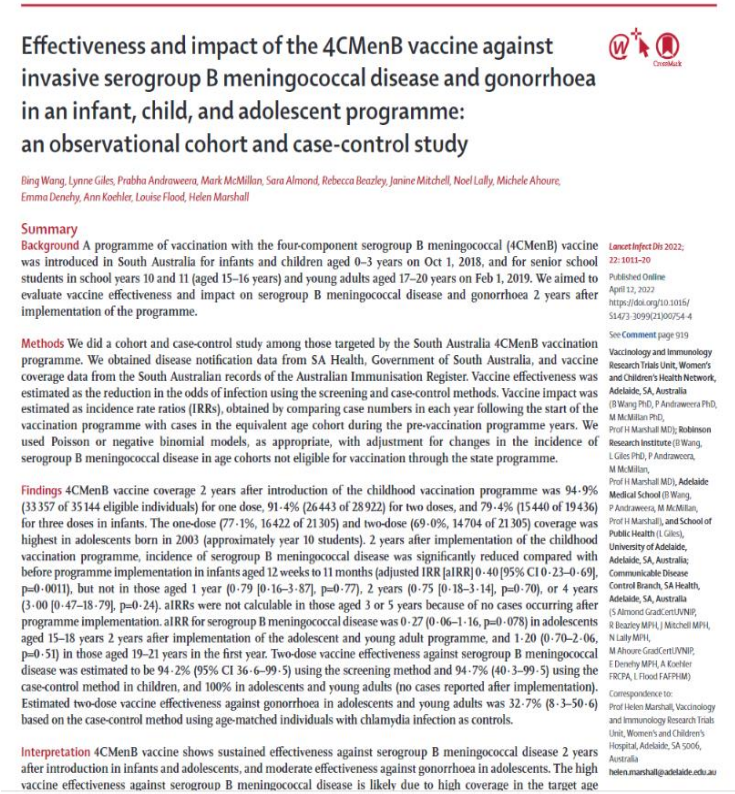
# Moderate effectiveness of 4CMenB against gonorrhoea at 2 years post 4CMenB vaccine introduction

Previous evidence of VE against gonorrhoea with OMV vaccines

- MenB-OMV vaccines showed a post vaccine program reduction in gonorrhoea in Cuba
- MeNZB vaccine showed VE=31%[1]

Cohort and case control study in SA assessing effect of 4CMenB against gonorrhoea [2]

- Population: 15-20 yr olds in SA, 2 years post-introduction of 4CMenB
- VI=24% (aIRR=0.76 (0.48, 1.22) reduction in gonorrhoea incidence
- VE=33% (8.3, 50.6) against gonorrhoea



Effectiveness and impact of the 4CMenB vaccine against invasive serogroup B meningococcal disease and gonorrhoea in an infant, child, and adolescent programme: an observational cohort and case-control study

Bing Wang, Lynne Giles, Prabha Andraweera, Mark McMillan, Sara Almond, Rebecca Beazley, Janine Mitchell, Noel Lally, Michele Ahoure, Emma Denehy, Ann Koehler, Louise Flood, Helen Marshall

Summary

Background A programme of vaccination with the four-component serogroup B meningococcal (4CMenB) vaccine was introduced in South Australia for infants and children aged 0–3 years on Oct 1, 2018, and for senior school students in school years 10 and 11 (aged 15–16 years) and young adults aged 17–20 years on Feb 1, 2019. We aimed to evaluate vaccine effectiveness and impact on serogroup B meningococcal disease and gonorrhoea 2 years after implementation of the programme.

Methods We did a cohort and case-control study among those targeted by the South Australia 4CMenB vaccination programme. We obtained disease notification data from SA Health, Government of South Australia, and vaccine coverage data from the South Australian records of the Australian Immunisation Register. Vaccine effectiveness was estimated as the reduction in the odds of infection using the screening and case-control methods. Vaccine impact was estimated as incidence rate ratios (IRRs), obtained by comparing case numbers in each year following the start of the vaccination programme with cases in the equivalent age cohort during the pre-vaccination programme years. We used Poisson or negative binomial models, as appropriate, with adjustment for changes in the incidence of serogroup B meningococcal disease in age cohorts not eligible for vaccination through the state programme.

Findings 4CMenB vaccine coverage 2 years after introduction of the childhood vaccination programme was 94·9% (33 357 of 35 144 eligible individuals) for one dose, 91·4% (26 443 of 28 922) for two doses, and 79·4% (15 440 of 19 436) for three doses in infants. The one-dose (77·1%, 16 422 of 21 305) and two-dose (69·0%, 14 704 of 21 305) coverage was highest in adolescents born in 2003 (approximately year 10 students). 2 years after implementation of the childhood vaccination programme, incidence of serogroup B meningococcal disease was significantly reduced compared with before programme implementation in infants aged 12 weeks to 11 months (adjusted IRR [aIRR] 0·40 [95% CI 0·23–0·69], p=0·0011), but not in those aged 1 year (0·79 [0·16–3·87], p=0·77), 2 years (0·75 [0·18–3·14], p=0·70), or 4 years (3·00 [0·47–18·79], p=0·24). aIRRs were not calculable in those aged 3 or 5 years because of no cases occurring after programme implementation. aIRR for serogroup B meningococcal disease was 0·27 (0·06–1·16, p=0·078) in adolescents aged 15–18 years 2 years after implementation of the adolescent and young adult programme, and 1·20 (0·70–2·06, p=0·51) in those aged 19–21 years in the first year. Two-dose vaccine effectiveness against serogroup B meningococcal disease was estimated to be 94·2% (95% CI 36·6–99·5) using the screening method and 94·7% (40·3–99·5) using the case-control method in children, and 100% in adolescents and young adults (no cases reported after implementation). Estimated two-dose vaccine effectiveness against gonorrhoea in adolescents and young adults was 32·7% (8·3–50·6) based on the case-control method using age-matched individuals with chlamydia infection as controls.

Interpretation 4CMenB vaccine shows sustained effectiveness against serogroup B meningococcal disease 2 years after introduction in infants and adolescents, and moderate effectiveness against gonorrhoea in adolescents. The high vaccine effectiveness against serogroup B meningococcal disease is likely due to high coverage in the target age

Lancet Infect Dis 2022; 22: 1011–20
Published Online April 12, 2022 https://doi.org/10.1016/S1473-3099(21)00754-4
See Comment page 919

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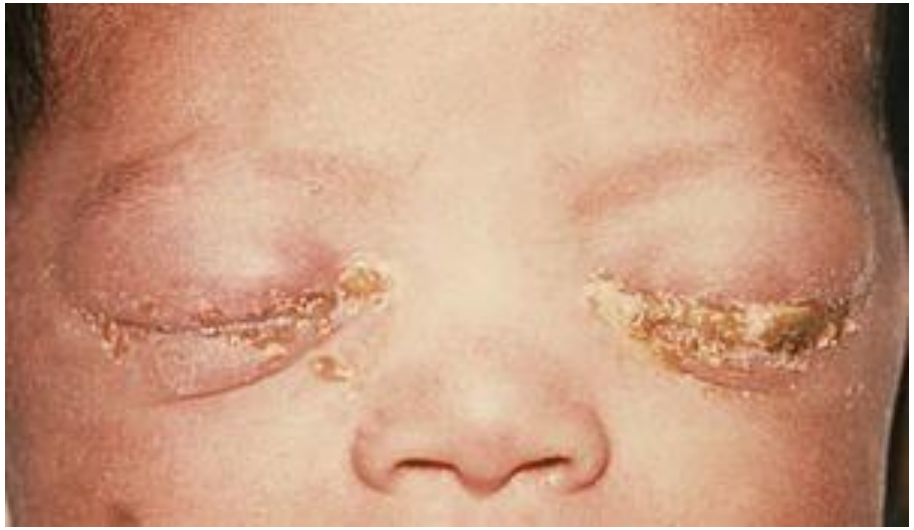
helen.marshall@adelaide.edu.au

**There is currently no indication for 4CMenB to be used for protection against gonorrhoea**

1. Petousis-Harris H. et al Lancet 2017;390:1603-1610. 2. Wang B, Marshall H Lancet ID 2022;22(7):1011-20

# Gonococcal infection burden of disease

- 82 million new infections annually [1], increasing globally, despite WHO's global strategy for 90% reduction by 2030
- **Burden of disease affects mostly women and children**; pelvic inflammatory disease - infertility, ophthalmia neonatorum – blindness
  - -Up to 80% of gonococcal infections in women are asymptomatic
  - -50% risk of infertility if ≥3 infections [2]
- **Increasing development of antibiotic resistance** with potential for gonorrhoea to become untreatable [3]



High risk populations: MSM, sex workers, people in prison, people living with HIV, adolescents and young adults, Indigenous populations (complex social and cultural determinants, barriers and access to healthcare)

- **x24 higher risk for Aboriginal and Torres Strait Islander people, Australia**
- 8.2% prevalence in adolescent girls and young women, East Africa

1. https://www.who.int/news-room/fact-sheets/detail/sexually-transmitted-infections-(stis) 2. Sciarra JJ. ORGYN 1994;3:12-15. 3. Unemo M et al. Lancet Microbe 2021;2(11). E627.4. Silver BJ, et al. Sex Transm Infect 2015;91:135–141.

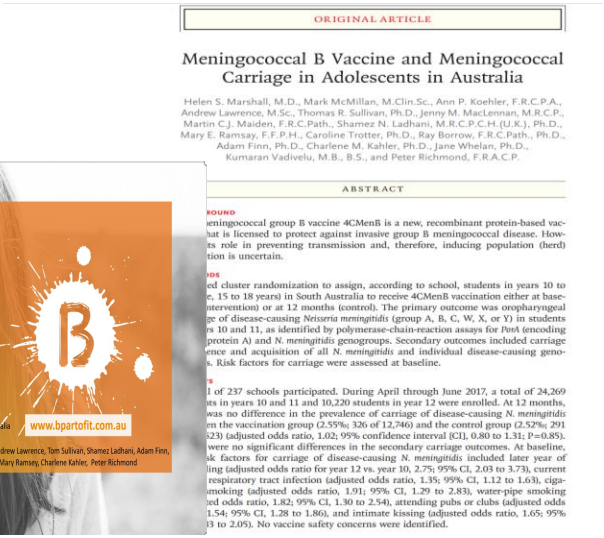
# Mechanism for 4CMenB vaccine protection against gonorrhoea

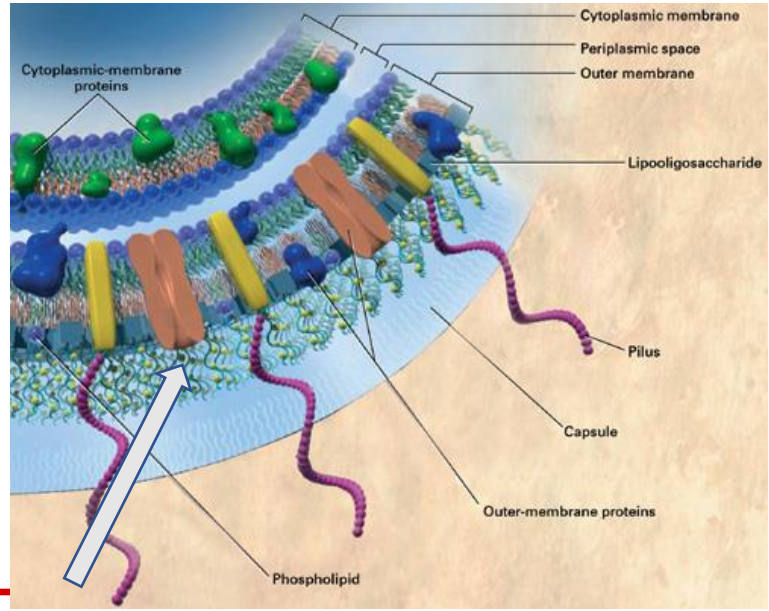
- ~ 90% genetic homology, both mucosal pathogens
- 4CMenB vaccine induced antibodies have been shown to recognise gonococcal proteins [2]
- reduction in carriage of unencapsulated meningococci in the vaccinated group[1]

  - **vaccine-type outer membrane proteins are potentially more exposed without a capsule**

  - the gonococcus is an unencapsulated Neisseria bacteria

proteins targeted by 4CMenB vaccine expressed on *N. meningitidis* as well as *N. gonorrhoeae (*OMV, NHBA) and have high homology [2]




1. Marshall H et al. NEJM 2020;382(4):318-327 2. Semchenko EA et al. CID 2018;69:1101-11

# Gonorrhoea notifications are highest in 15-19 year olds in the NT which is also a high risk age group for invasive meningococcal disease

Table D.1 Gonorrhoea notifications in the NT by age

| Age group | Prior 5-year mean for Jan-Jun (2016-2020) | |
|---|---|---|
| | Number | Proportion (%) |
| <10 | 0.4 | 0.0 |
| 10-14 | 39.2 | 4.6 |
| 15-19 | 230.6 | 27.2 |
| 20-24 | 178.6 | 21.1 |
| 25-29 | 134.2 | 15.9 |
| 30-34 | 101.0 | 11.9 |
| 35-39 | 65.0 | 7.7 |
| 40-44 | 42.4 | 5.0 |
| 45-49 | 26.8 | 3.2 |
| 50-54 | 13.0 | 1.5 |
| 55-59 | 6.2 | 0.7 |

Surveillance Update for Notifiable STI and BBV in the Northern Territory Vol. 24, No. 2 July to December 2023

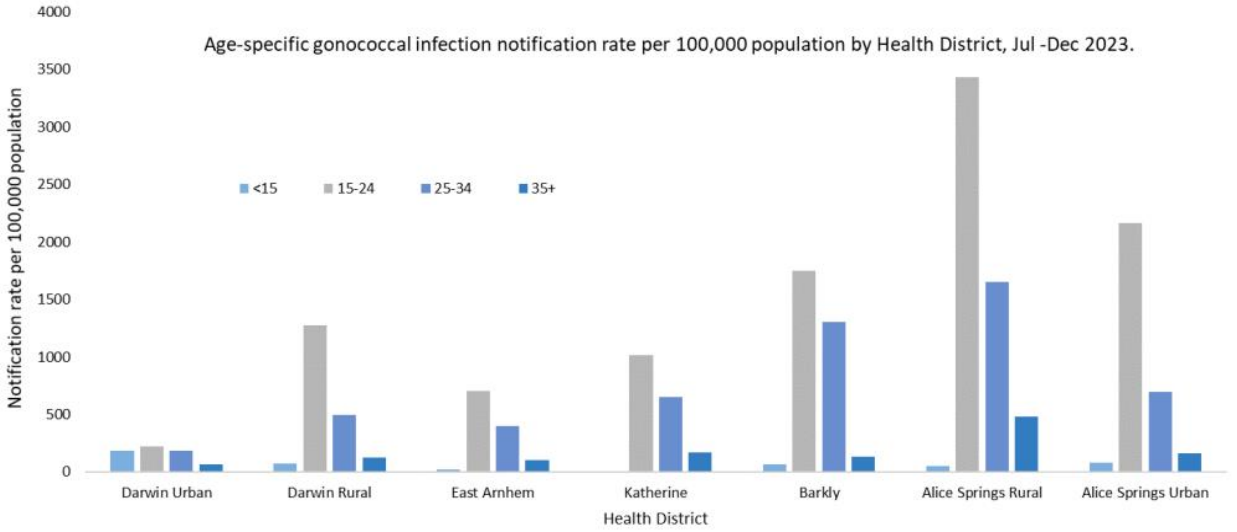



**Figure C1:** Age-specific gonococcal infection notification rate per 100,000 population by Health District, Jul-Dec 2023

1.Surveillance Update for Notifiable STIs and BBVs in the NT. Vol. 22(1), Jan-Jun 2021 2. Vol. 24(1) Jan-June 2023 Surveillance Update for Notifiable STI and BBV in the Northern Territory Vol. 24, No. 2 July to December 2023

# B Part Of It NT study

**Population:** 14-19 year olds in urban, rural and remote regions of the Northern Territory

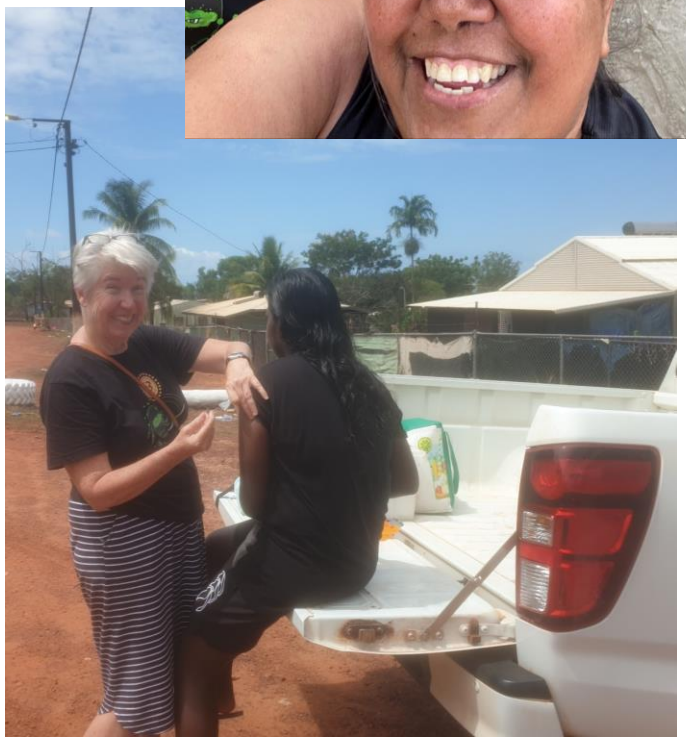
**Aims:** Assess impact of 4CMenB vaccine on

1. ***Neisseria gonorrhoeae***
2. **Oro-pharyngeal carriage of *Neisseria meningitidis***

**Intervention:** 4CMenB vaccine offered to all eligible adolescents

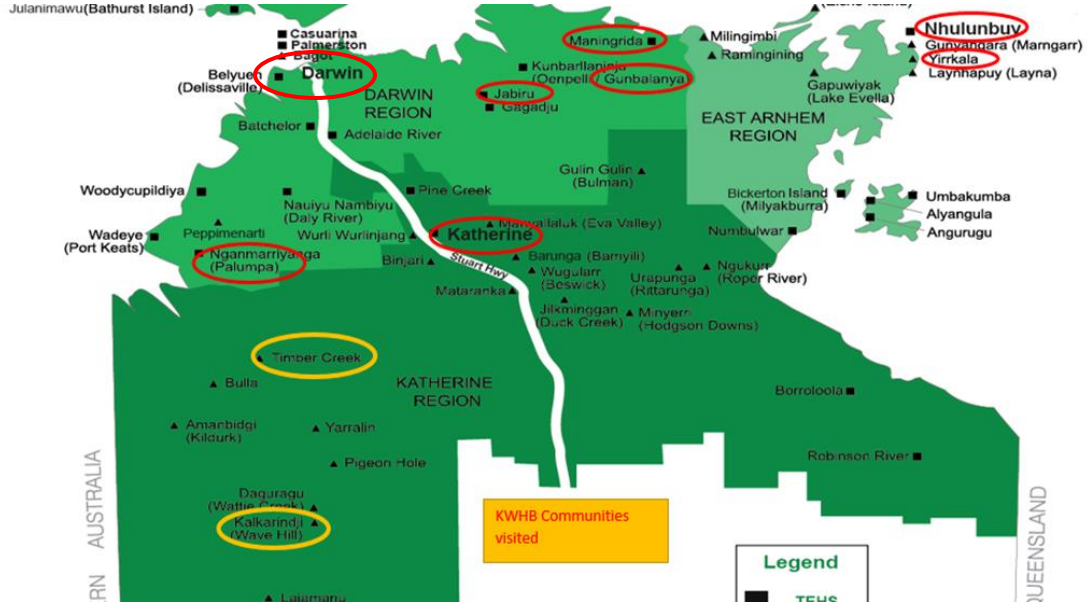
**Outcome:** Time to gonococcal notification

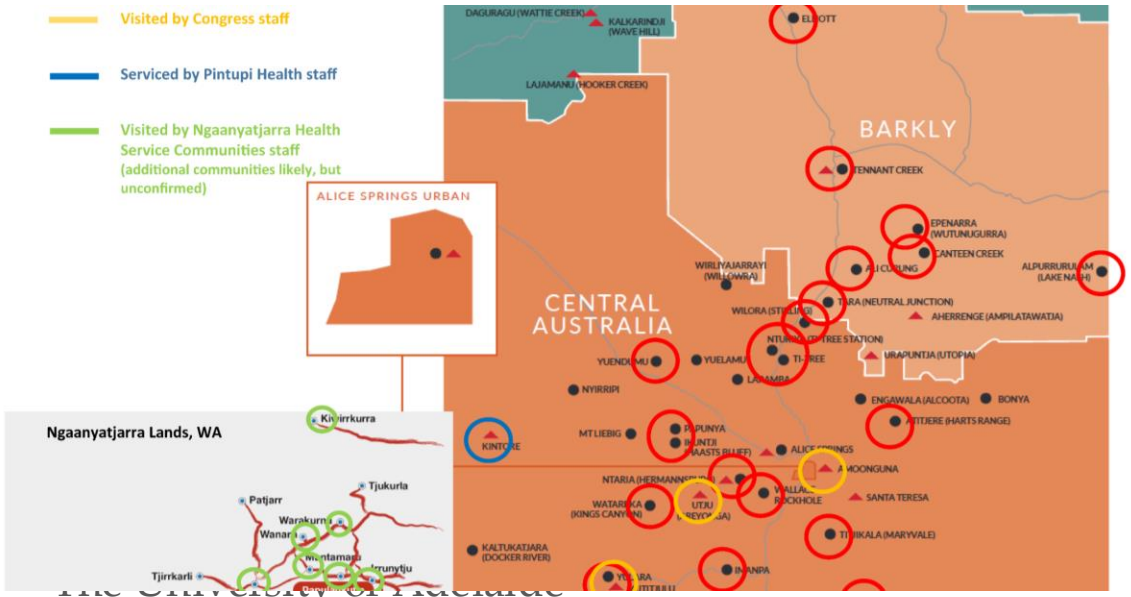
**Time to event analysis:** VE was assessed using a Cox proportional hazards model



1. Marshall H et al. Vaccines 2022;10(2): 309

# B Part of it NT study results




- Of 1,324 individuals diagnosed with gonorrhoea, 97.5% were Indigenous young people, 59.4% were females
- Overall vaccine uptake in 14-19 year old cohort was 8.5% (up to 18% in 15 year olds)
- **VE =38.1% (95%CI: 18.1-53.4%) against gonorrhoea**

**A 4CMenB vaccine program has now been introduced in the NT for infants and adolescents with ongoing evaluation in a high uptake program**

# Long term vaccine effectiveness and impact against IMD and gonorrhoea in adolescents 5 years post 4CMenB program introduction

## IMD

Vaccine Effectiveness

- VE=92.6% (95%CI 37.5, 99.1; p=0.017)

Vaccine impact

- 76.2% relative reduction in IMD in adolescents 15-18 years of age

IMD cases =19 in adolescents
- 14-24 years of age
- 63% male
- 84% unvaccinated
- 10% First Nations young people

## Gonorrhoea

Vaccine Effectiveness:

- 40.1 % (95%CI: 31.3-46.0) p<0.001

Vaccine Impact:

- 35.5% relative reduction in incidence of gonococcal infection

Wang et al. CID 2015 (In Press)

# Vaccine effectiveness results (chlamydia controls) subgroup analysis suggest waning by 5 years

| Two-dose 4CMenB vs unvaccinated | Adjusted OR (95%CI) | Vaccine effectiveness (%) (95%CI) |
|---|---|---|
| Duration of protection | | |
| 3-60 months since vaccination | 0.582 (0.513-0.660) p<0.001 | 41.8 (34.0 to 48.7) |
| >60 months since vaccination | 1.063 (0.782-1.445) p=0.695 | -6.3 (-44.5 to 21.8) |
| Sex | | |
| Female | 0.596 (0.507-0.699) p<0.001 | 40.4 (30.1 to 49.3) |
| Male | 0.630 (0.525-0.755) p<0.001 | 37.0 (24.5 to 47.5) |
| Co-infection | | |
| Cases co-infected, chlamydia controls | 0.525 (0.430-0.643) p<0.001 | 47.5 (35.7-57.0) |
| Gonorrhoea only, chlamydia controls | 0.653 (0.568-0.751) p<0.001 | 34.7 (24.9-43.2) |

1Wang et al. CID 2025 In Press

# Impact of 4CMenB on repeat gonococcal infection

Survival analysis using a multivariable Cox proportional hazards regression model

- Adjusted hazard ratio for repeat gonococcal infections in vaccinated vs unvaccinated gonococcal cases (adjusted for sex, SES with stratification by age)

**The risk of a second episode of gonococcal infection was lower in gonococcal cases who were vaccinated with two doses**

- **VE=29.1%  aHR=0.730 (95%CI 0.540, 0.988) p=0.042**

**No difference was observed for multiple repeat gonococcal infections**

- VE=7.8% (aHR= 0.922; 95% CI, 0.643–1.320; p=0.656)

1. Wang et al. CID 2025 In Press

# Mounting global real world evidence for a moderate effectiveness of 4CMenB against gonorrhoea

ORIGINAL STUDY

Meningococcus B Vaccination Effect
*Neisseria gonorrhoeae* Infection in Pe
HIV: A Case-Control Stu

*Angelo Roberto Raccagni, MD,* Laura Galli, MSc,† Vincenzo Spagnu
Camilla Muccini, MD,† Simona Bossolasco, MD,† Martina Ranzenig
Riccardo Lolatto, MSc,† Antonella Castagna, MD,*† and*

**Background:** We assessed the vaccination effectiveness (VE) of multi-component meningococcal serogroup B (4CMenB) vaccine against gonorrhea among people living with HIV (PLWH) with a previous diagnosis of sexually transmitted infection.

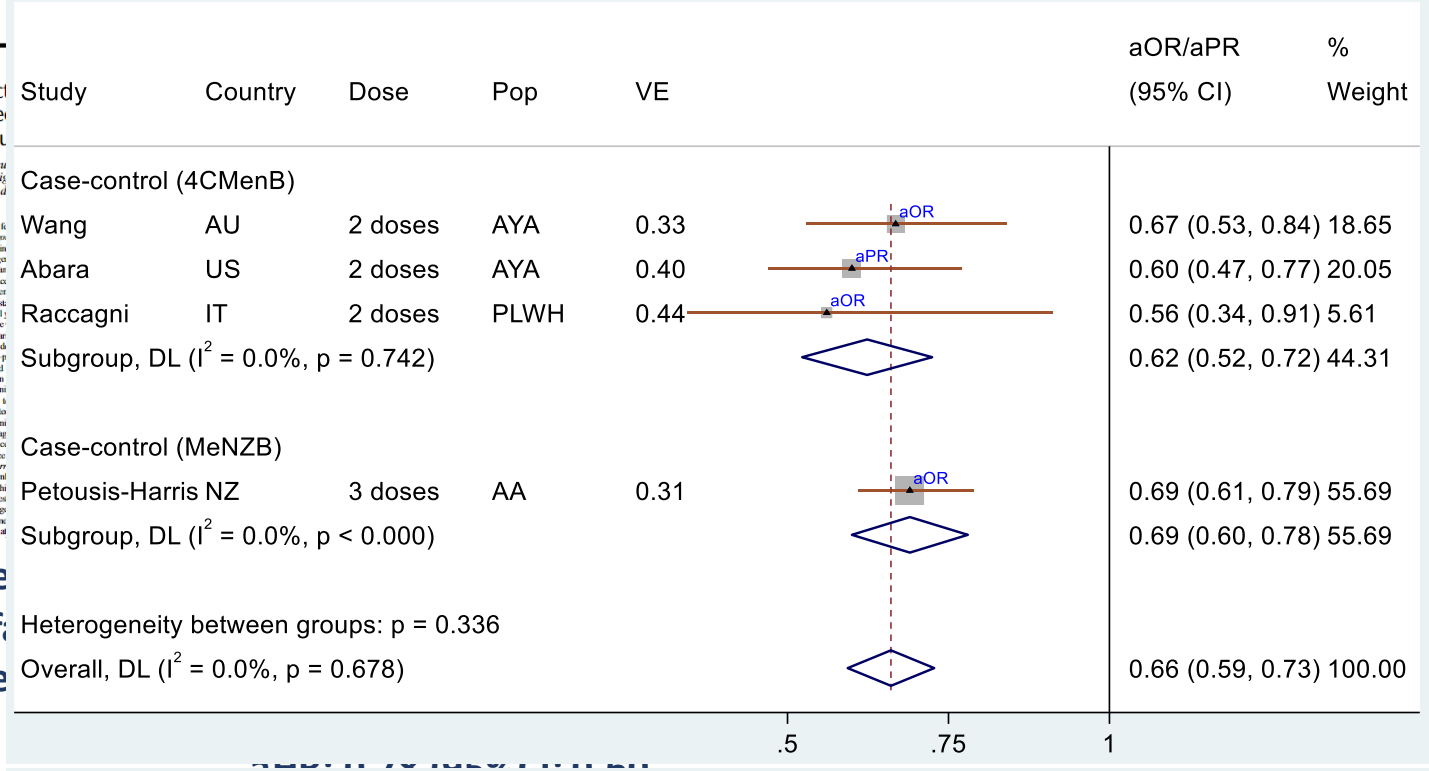
**Methods:** Unmatched case control study on men who have sex with men living with HIV, in care at San Raffaele Scientific Institute, Milan, Italy, with gonorrhea, syphilis, chlamydia, or anal human papillomavirus between July 2016 (beginning of 4CMenB vaccination) and February 2021 (date of freezing). For the analysis, cases were people with ≥1 gonorrhea infection since July 2016, and controls were people with ≥1 syphilis, chlamydia, or anal human papillomavirus infection since July 2016. Logistic regression was used to provide the estimate of 4CMenB VE against gonorrhea.

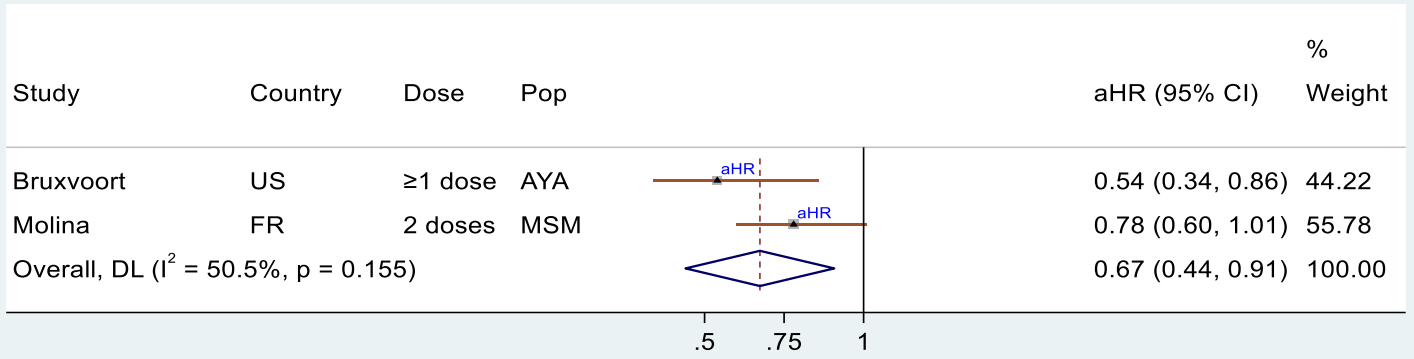
**Results:** Included people living with HIV were 1051 (103 cases, 948 controls); 349 of 1051 (33%) received 2 doses of 4CMenB vaccination. The median follow up was 3.8 years (2.1 4.3 years). The unadjusted estimate for VE against gonorrhea was 42% (95% confidence interval, 6% 64%; $P = 0.027$). Logistic regression showed that VE against gonorrhea remained significant (44%; 95% confidence interval, 9% 65%; $P = 0.020$) after adjusting for some factors that might have a potential influence on VE or those with significant unbalanced distributions between cases and controls at univariable analysis.

**Conclusions:** 4CMenB vaccination is associated with a lower risk of gonorrhea in the setting of men who have sex with men living with HIV with a previous sexually transmitted infection.

Gonorrhea, a sexually transmitted infection (STI), is a major public health problem worldwide, causing serious morbidity

- **Unmatched case control, (San Raffa scientific institute 2016-2021**
- **103 cases in 105 living with HIV**
- **37-51 yrs**
- **VE=44% (95%CI**
- **Italy**




Effectiveness of a serogroup B outer membrane vesicle meningococcal vaccine against gonorrhoea: a retrospective observational study

Winston E Abara, Kyle T Bernstein, Felicia M T Lewis, Julia A Schillinger, Kristen Feemster, Preeti Pathela, Susan Hariri, Aras Islam, Michael Eberhart, Iris Cheng, Alexandra Ternier, Jennifer Sanderson Slutsker, Sarah Mbaeyi, Robbie Madera, Robert D Kirkcaldy

**Summary**

**Background** Declining antimicrobial susceptibility to current gonorrhoea antibiotic treatment and inadequate treatment options have raised the possibility of untreatable gonorrhoea. New prevention approaches, such as vaccination, are needed. Outer membrane vesicle meningococcal serogroup B vaccines might be protective against gonorrhoea. We evaluated the effectiveness of a serogroup B meningococcal outer membrane vesicle vaccine (MenB-4C) against gonorrhoea in individuals aged 16–23 years in two US cities.

**Methods** We identified laboratory-confirmed gonorrhoea and chlamydia infections among individuals aged 16–23 years from sexually transmitted infection surveillance records in New York City and Philadelphia from 2016 to 2018. We linked gonorrhoea and chlamydia case records to immunisation registry records to determine MenB-4C vaccination status at infection, defined as complete vaccination (two MenB-4C doses administered 30–180 days apart), partial vaccination (single MenB-4C vaccine dose), or no vaccination (serogroup B meningococcal vaccine naive). Using log-binomial regression with generalised estimating equations to account for correlations between multiple infections per patient, we calculated adjusted prevalence ratios (APR) and 95% CIs to determine if

- **Retrospective case-control study (CDC), 2016-2018**
- **167,706 gonorrhoea infections, 16-23 yrs**
- **VE=40%(23, 53) against gonorrhoea (2 dose)**
- **VE=26% (12, 37) (1 dose)**
- **Philadelphia, USA**

1. Raccagni et al. Sexually transmitted Diseases 2023;50(5):247-251. 2. Molina J-M et al, CROI conference, March 2024 . 3.Bruxvoort KJ et al. CID 2023;76:e1341-49. 4. Abara WE et al. Lancet ID 2022;22(7):1021-9
5. Wang B et al. Journal of Infection 2024; 106225

# Policy recommendations for use of 4CMenB to reduce the risk of gonorrhoea in high risk groups, UK

**JCVI, UK recommendation, 10 November 2023 and funded program launched on 22nd May 2025.**

**Recommendation for a targeted programme using 4CMenB to prevent gonorrhoea among individuals at higher risk of infection attending sexual health services.**

These risk criteria may include but not be limited to:

- a recent history of gonorrhoea or other bacterial STI diagnosis, individuals should also be offered vaccination
- after a gonorrhoea diagnosis (whether symptomatic or asymptomatic)
- reporting high-risk sexual behaviours with multiple partners during sexual health screening and assessment

**Selectively vaccinating high risk groups was the most cost-effective intervention.**

# In conclusion

- Although uncommon, IMD is a life-threatening disease associated with long term disability in adolescents
- Meningococcal vaccines are available to reduce the risk of IMD
- Population programs of meningococcal ACWY and B vaccine are highly effective
- Evidence suggest cross protection against gonorrhoea
- Policy considerations - 4CMenB for groups at higher risk of both diseases including Aboriginal and Torres Strait Islander young people

neis CRE Centre for Research Excellence in Neisseria disease control

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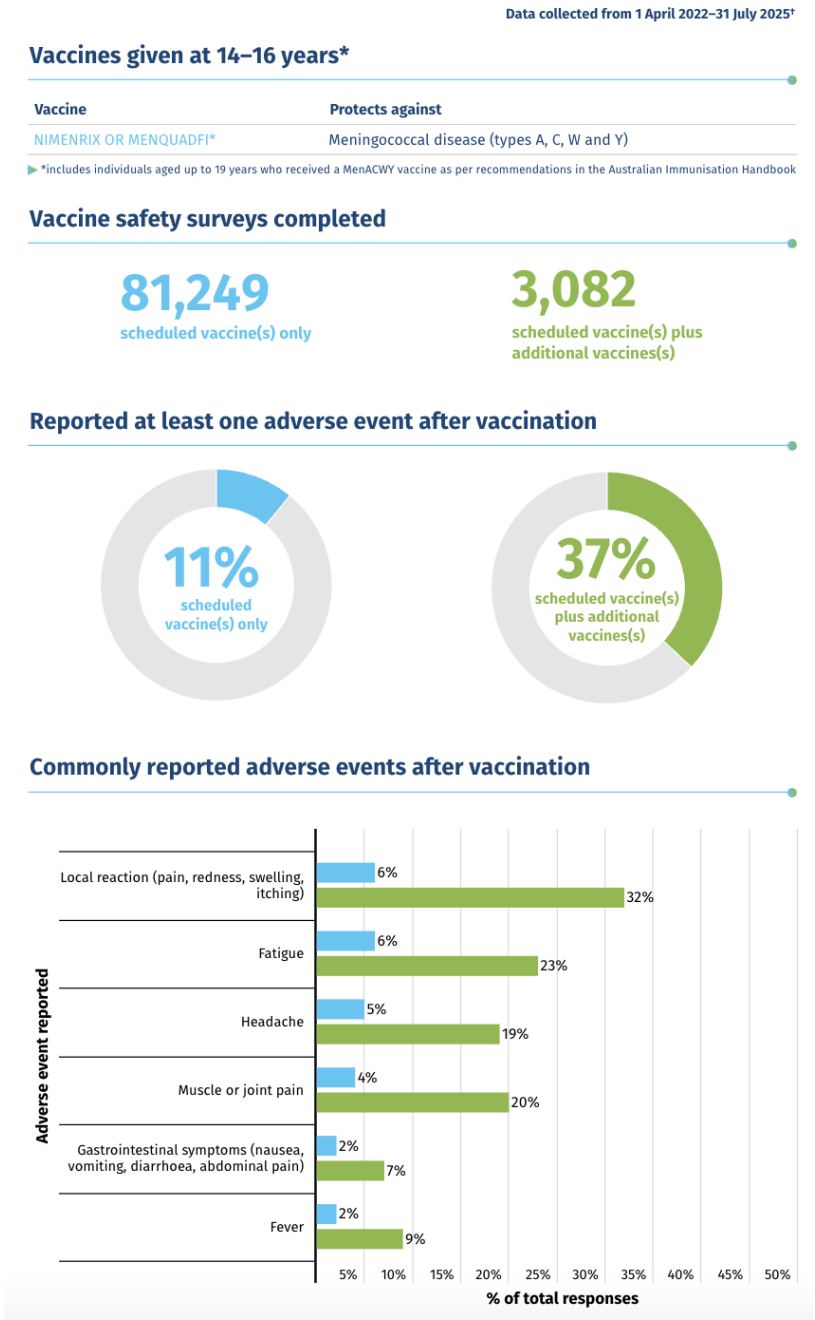
AIM is to determine the most effective immunisation program for prevention of meningococcal disease and gonorrhoea in Australia and globally

By 2030, the NEIS CRE will deliver a roadmap to eliminate meningitis and drive down gonorrhoea globally

https://neiscre.com.au

# Safety of adolescent vaccines

- School immunization programs have protocols in place to ensure safety of adolescents vaccinated in the school setting (eg to avoid mass reactions)
- Passive TGA surveillance
- Active surveillance through AusVaxSafety
- Incident diseases in adolescence differ from those in infancy early childhood
    - Signal investigation often around diseases with new onset or frequent occurrence in adolescence eg autoimmune diseases, migraine



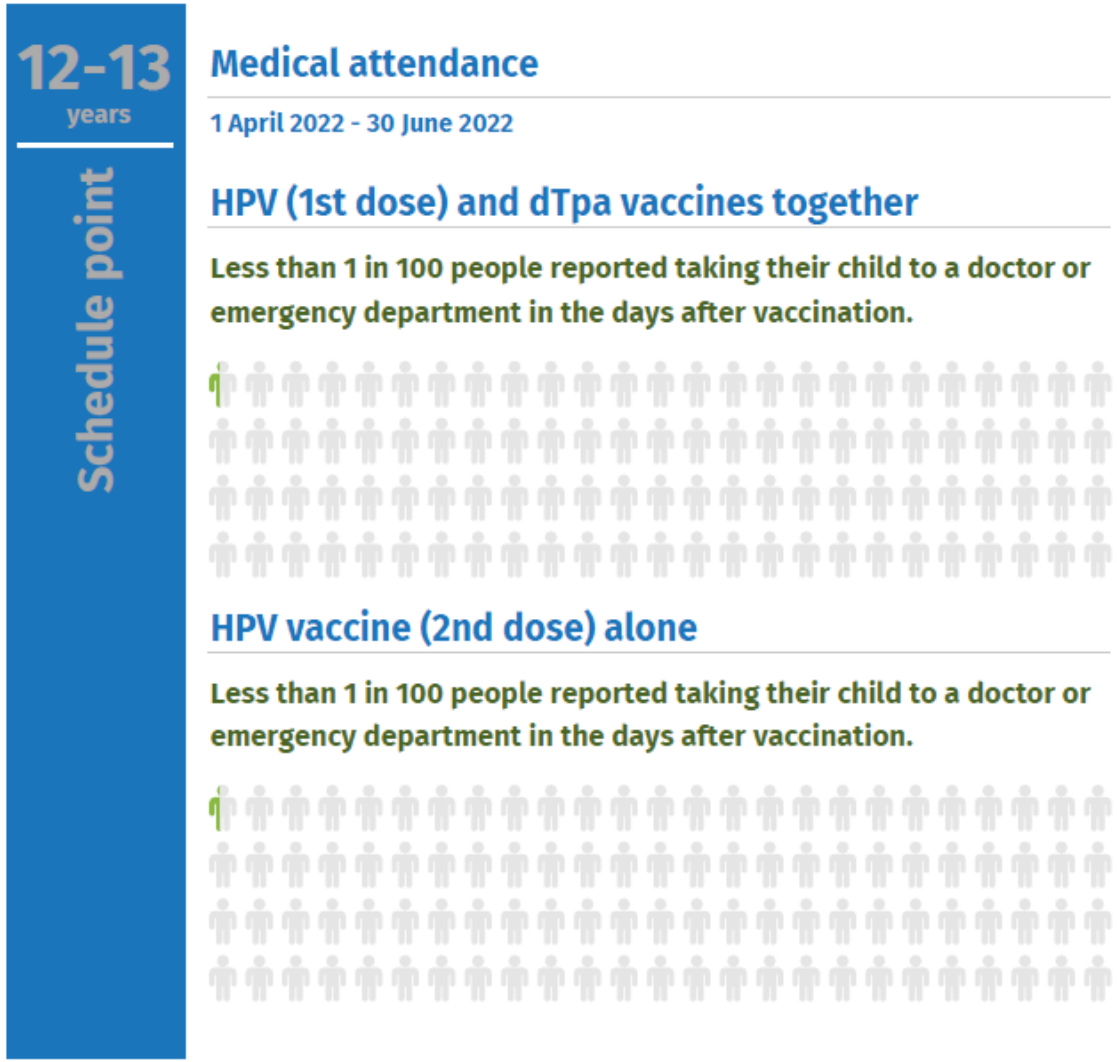
# Ongoing HPV vaccine safety evaluations

- Over 9 million doses to December 2017
- Purposeful enhanced surveillance 2013 and 2014 – increased rates of syncope noted

*"Over an 11-year period, reporting rates of AE following 4vHPV administration in Australia were consistent with data from similar surveillance systems internationally and did not reveal any new or concerning safety issues."* Phillips et al, Vaccine 2020; 38:6038–46

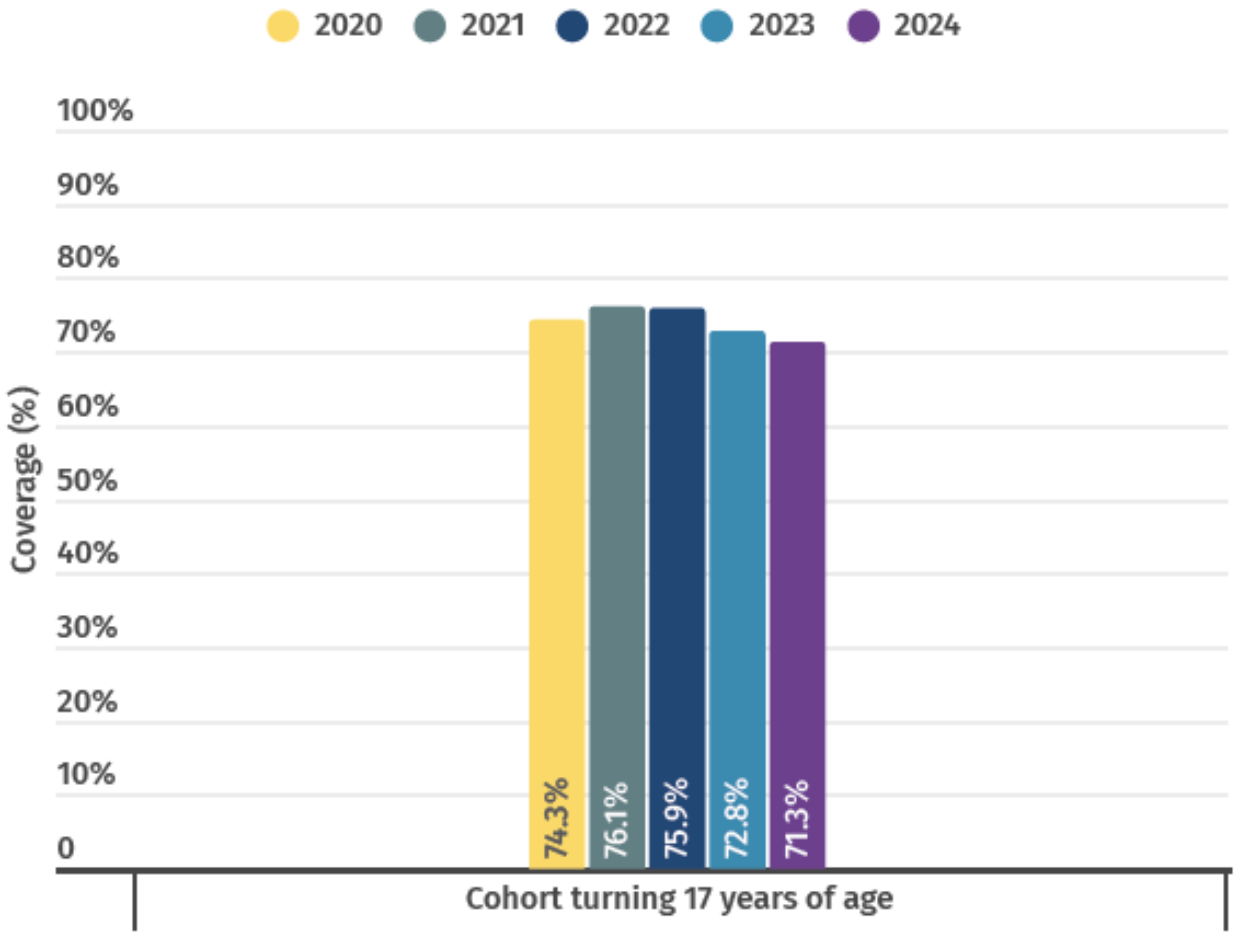
- Ongoing passive national surveillance
- State based clinical support services
- Active real time surveillance via text

https://ausvaxsafety.org.au/national-immunisation-program-schedule-vaccines/12-13-years-schedule-point




See also: Macartney K et al, Drug Safety 2013
Phillips et al, Drug Safety 2018

# COVERAGE IN ADOLESCENCE




## Meningococcal ACWY vaccine

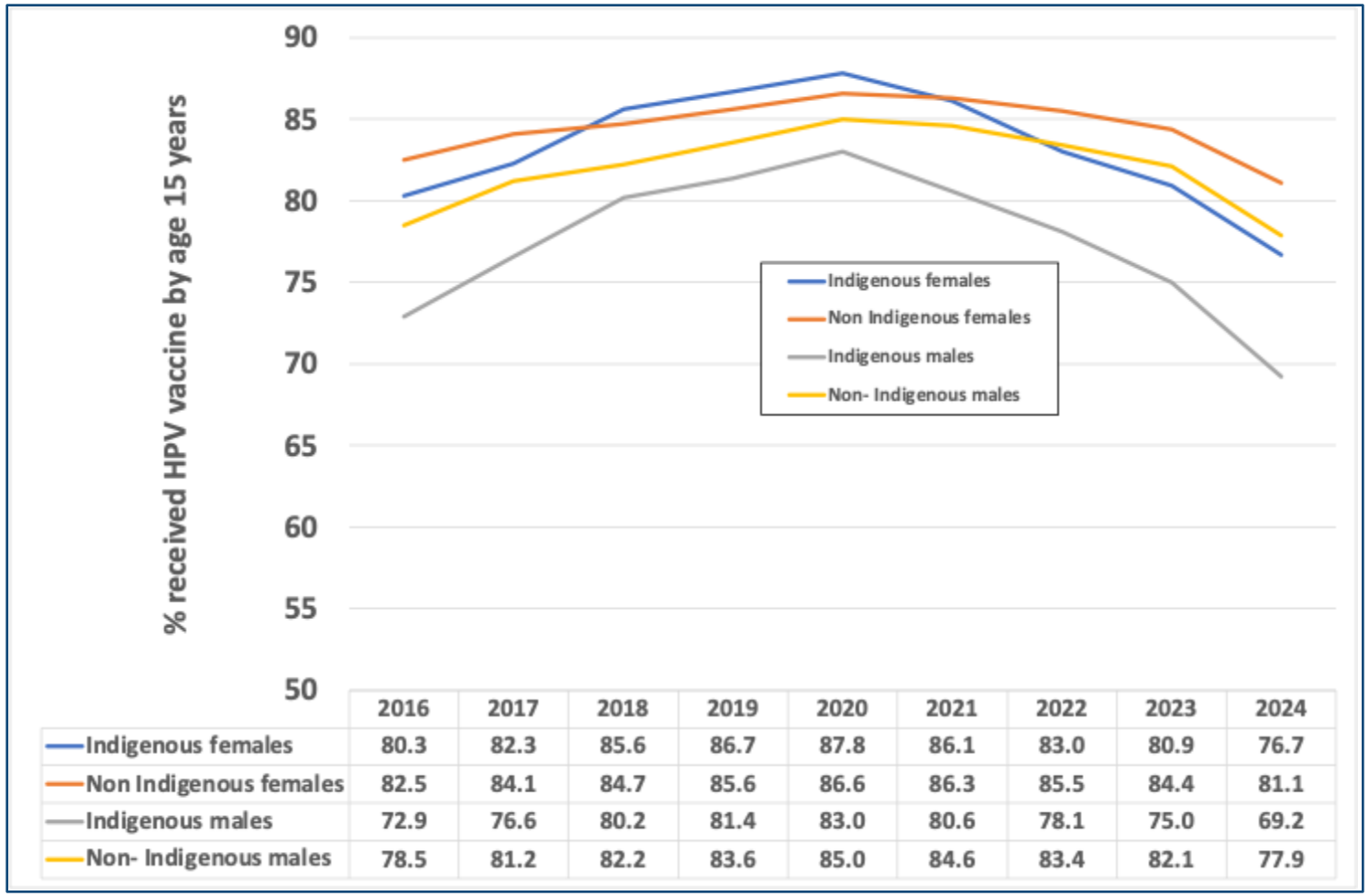
**Coverage of adolescent meningococcal ACWY vaccine** in adolescents turning 17 years of age has also decreased in recent years and was lower than for other adolescent vaccines.

**Annual Immunisation Coverage Report 2024 – interim data release** © NCIRS 2025

3

# HPV vaccine rates are trending down

- HPV vaccine coverage peaked in Australia in 2020
- Ongoing small declines across childhood and adolescent vaccine schedule
- Also seen in similar countries post pandemic – USA, Canada, UK



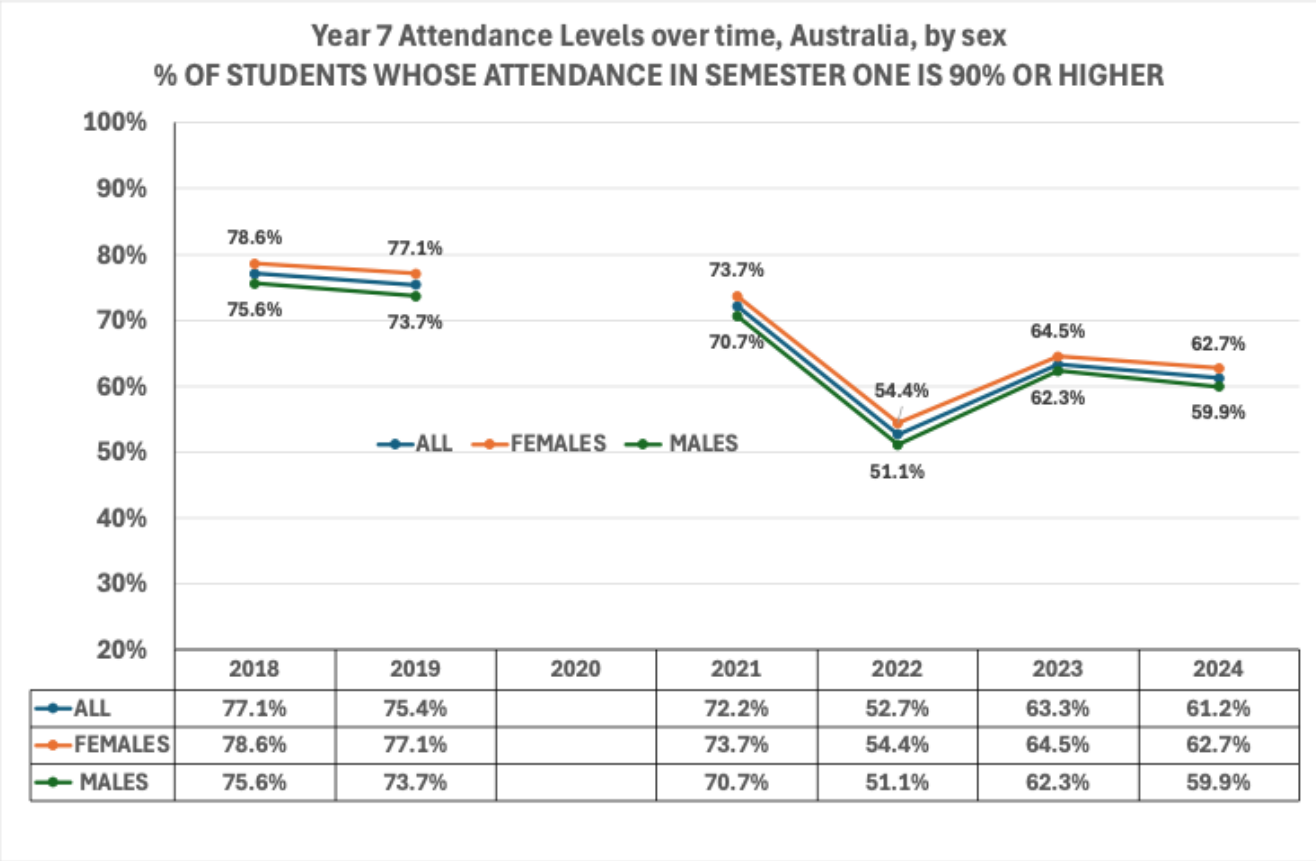

| | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 |
|---|---|---|---|---|---|---|---|---|---|
| Indigenous females | 80.3 | 82.3 | 85.6 | 86.7 | 87.8 | 86.1 | 83.0 | 80.9 | 76.7 |
| Non Indigenous females | 82.5 | 84.1 | 84.7 | 85.6 | 86.6 | 86.3 | 85.5 | 84.4 | 81.1 |
| Indigenous males | 72.9 | 76.6 | 80.2 | 81.4 | 83.0 | 80.6 | 78.1 | 75.0 | 69.2 |
| Non- Indigenous males | 78.5 | 81.2 | 82.2 | 83.6 | 85.0 | 84.6 | 83.4 | 82.1 | 77.9 |

*Data from Brotherton J, Machalek D, Smith M et al., 2024 Cervical Cancer Elimination Progress Report: Australia's progress towards the elimination of cervical cancer as a public health problem. Published online 14/03/2025, Melbourne, Australia, at https://www.cervicalcancercontrol.org.au. Updated with NCIRS interim report data for 2024*

NHMRC Centre of Research Excellence in Cervical Cancer Control

# Hypotheses

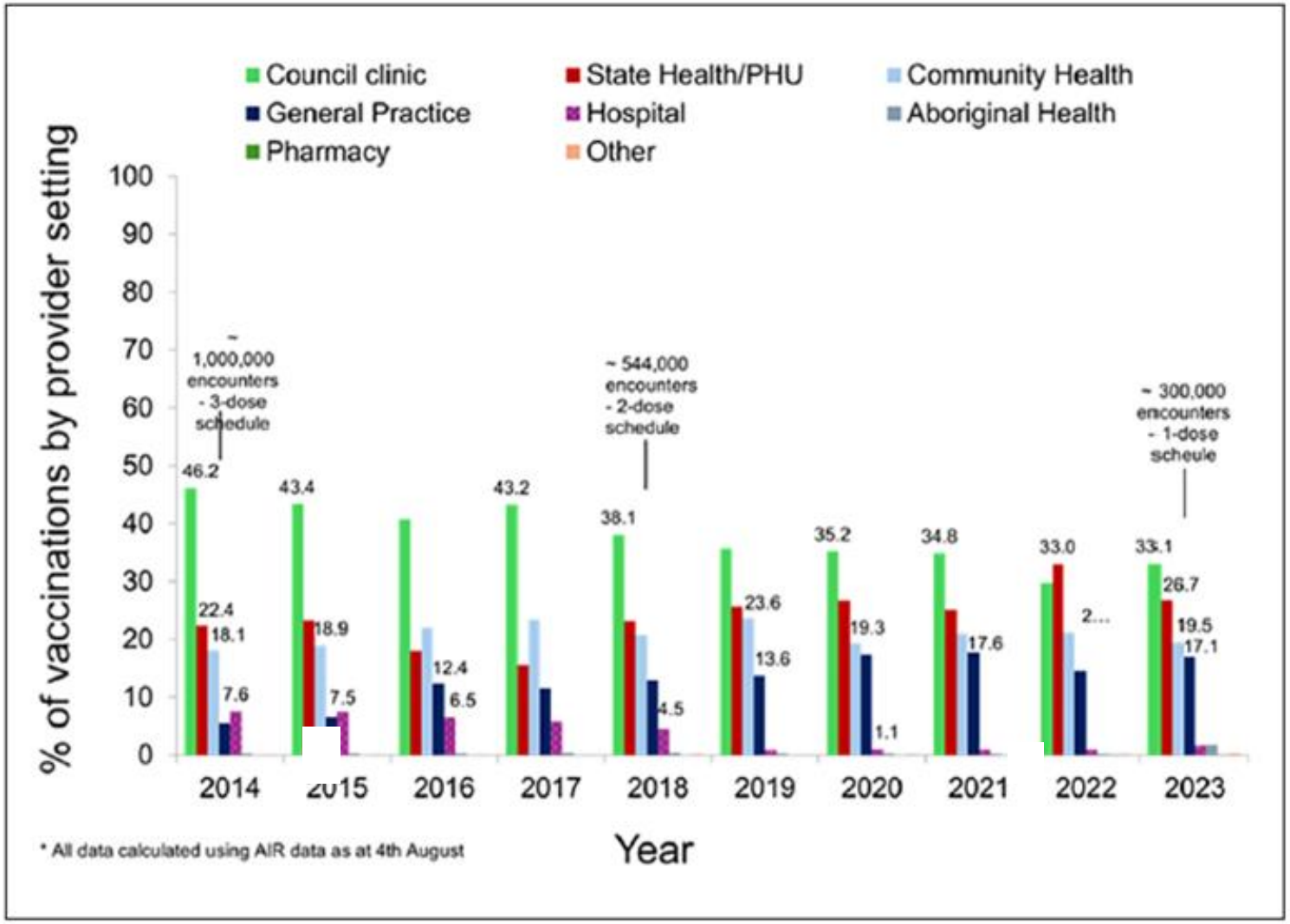
- Kids at school less, more anxious
- Consent processes are challenging (mix of electronic and paper)
- Education/schools overwhelmed – staffing challenges and hands full. Limited resources/engagement
- Loss of/difficulty maintaining second visit in Year 7
- Parents ?hesitancy – overwhelmed, disengaged from vaccination, antigovernment




| | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 |
|---|---|---|---|---|---|---|---|
| ALL | 77.1% | 75.4% | | 72.2% | 52.7% | 63.3% | 61.2% |
| FEMALES | 78.6% | 77.1% | | 73.7% | 54.4% | 64.5% | 62.7% |
| MALES | 75.6% | 73.7% | | 70.7% | 51.1% | 62.3% | 59.9% |

Source: ACARA data; Steffens et al, manuscript in preparation; McIndoe L, et al. Exploring Communication Barriers and Facilitators in School Vaccination: A Case Study in South Eastern Sydney, Australia. Vaccines (Basel). 2024 Oct 31;12(11):1243.

# Proportion of HPV vaccine by provider, adolescents 10-19, 2014-2023, Australia



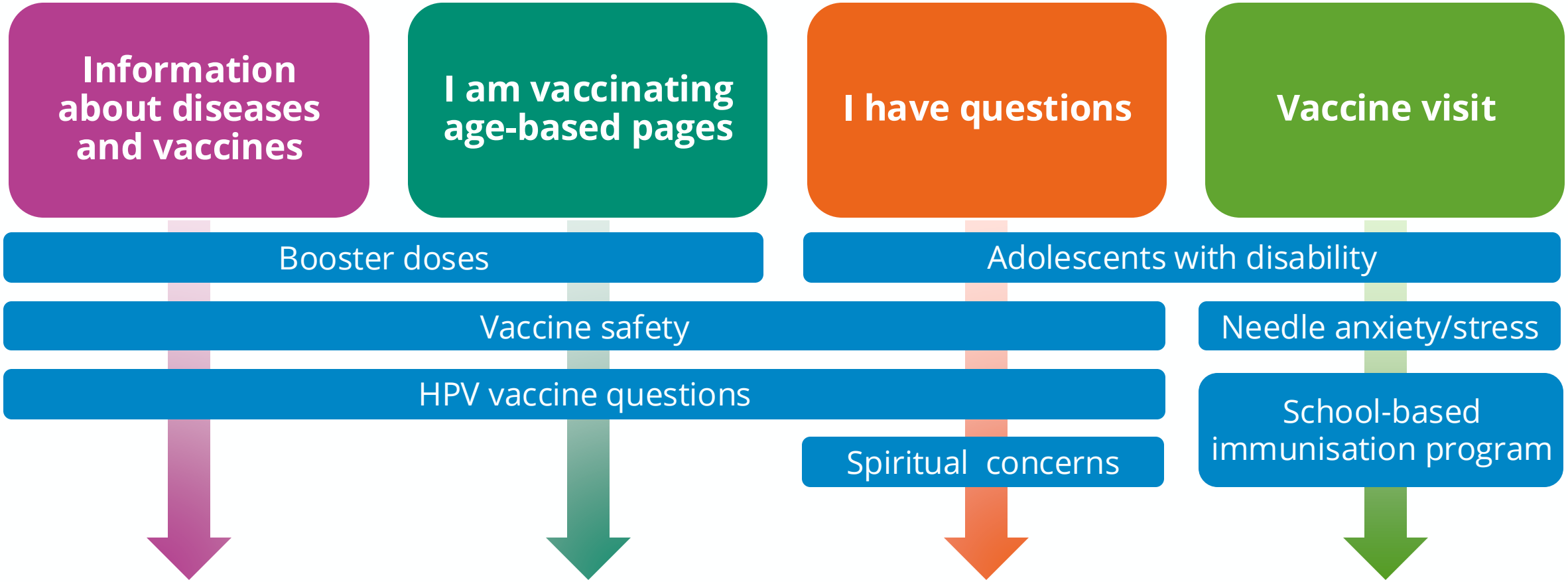

**Reference:** Hull BP, Hendry A, Beard F, Dey A. The Australian Immunisation Register (AIR): Insights from working with AIR data. Health Information Management Journal, 2025

# **SKAI Adolescent:** empowering conversations about adolescent immunisation

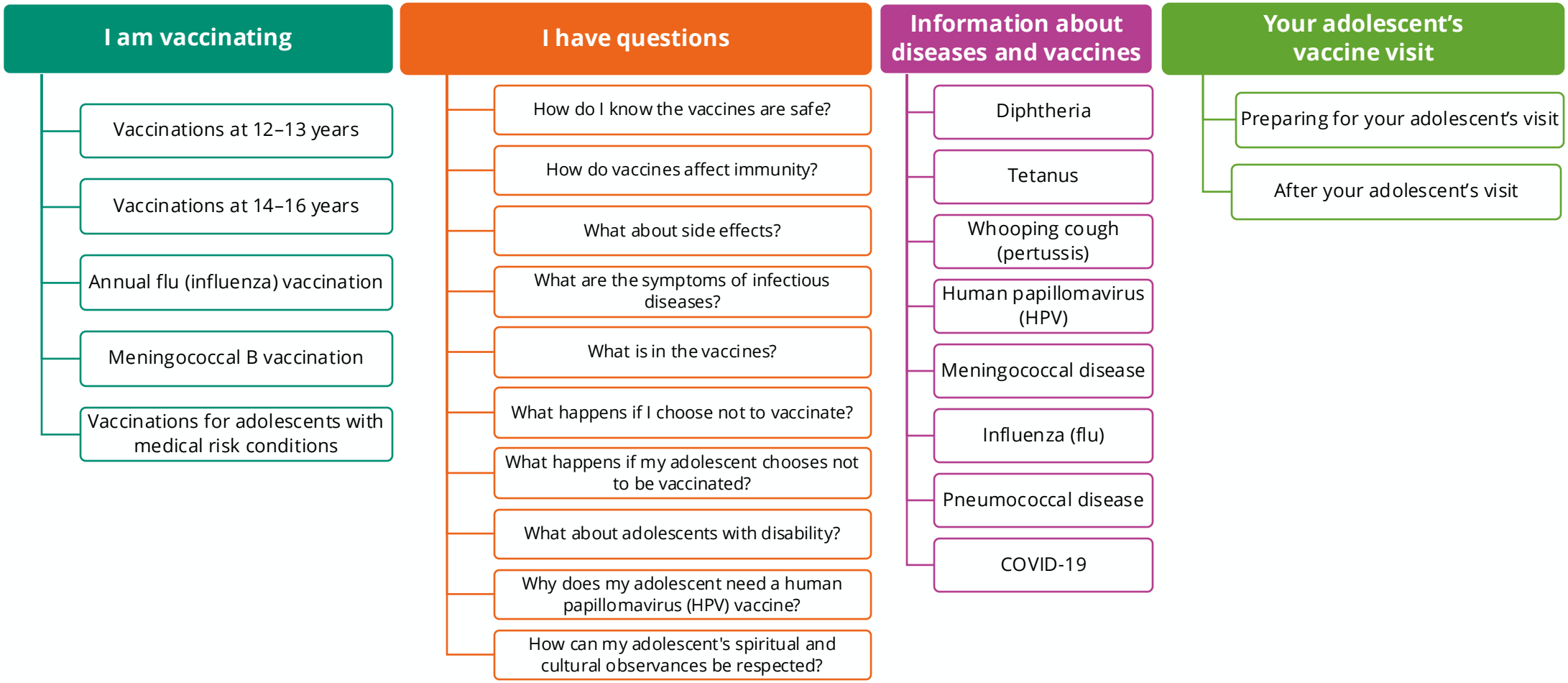

**Providing practical guidance and answers to common questions related to:**

- human papillomavirus (HPV) vaccination
- diphtheria-tetanus-pertussis (dTpa)m booster vaccination
- meningococcal B and meningococcal ACWY vaccination
- influenza vaccination
- vaccination for adolescents with medical risk factors
- vaccination for adolescents with disability

# **SKAI Adolescent:** meeting the need for quality vaccination information

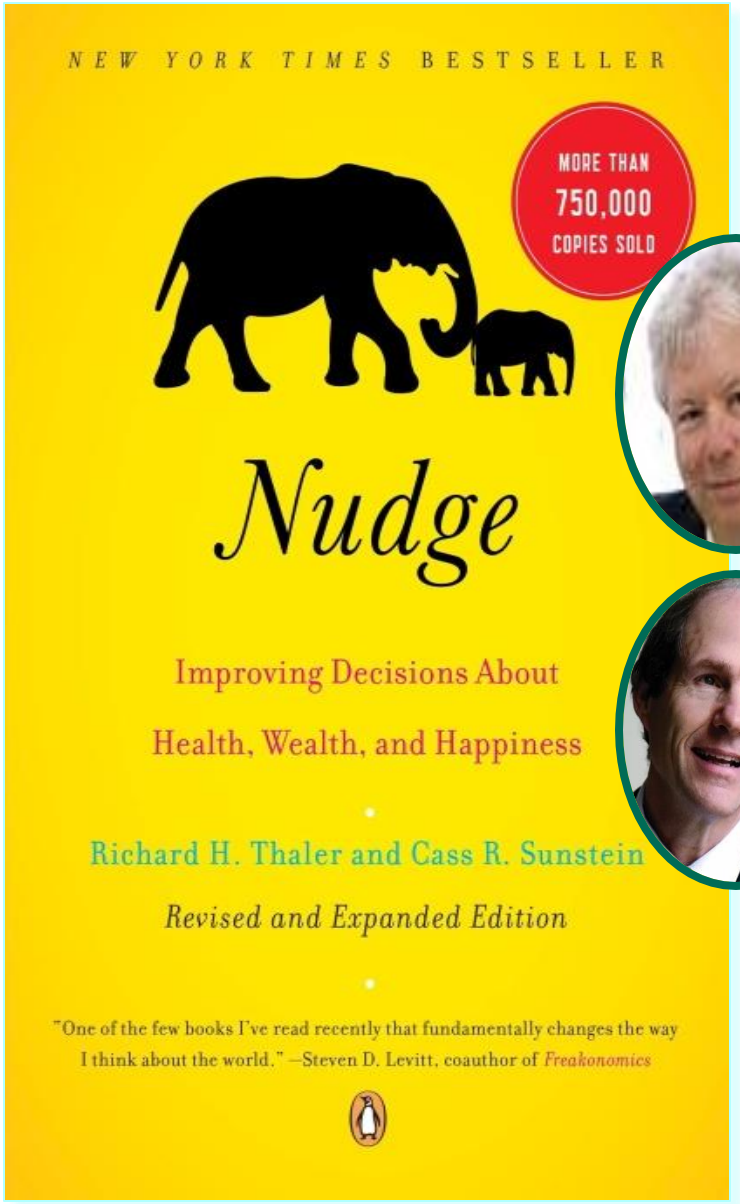


# **SKAI Adolescent:** website content map

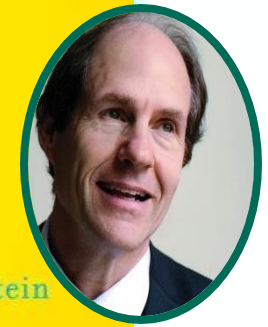


# Novel strategies to improve uptake of vaccines in young people

THE UNIVERSITY of ADELAIDE




**Richard Thaler**
Professor of Economics
University of Chicago
Behavioural Insight Team, UK
Cabinet Office



**Cass Sunstein**
Professor of Law
Harvard University
Regulatory Czar, Obama Administration

**Nudge** is "any aspect of the choice architecture that ***alters people's behaviour in a predictable way*** without forbidding any options or significantly changing their economic incentives".

**Choice architecture** is the environments within which people make choices.

Consider this…

Schiphol Airport,
Amsterdam
80% decline
in ‘spillage’

And this...

Lake Shore Drive
Chicago
36% fewer crashes


CHICAGO
GSB
The University
te School of Business

# The 9 general MINDSPACE principles of human behaviour change allow us to influence people

**We are heavily influenced by who communicates information to us**

Messenger

**Our responses to incentives are shaped by predictable mental shortcuts e.g. strongly avoiding losses**

Incentives

**We are strongly influenced by what others do**

Norms


**We go with the flow of pre-set options**

Defaults

**Our attention is drawn to what is novel and what seems relevant to us**

Salience

**Our acts are often influenced by subconscious cues**

Priming

**Our emotional associations can powerfully shape our actions**

Affect

**We seek to be consistent with our public promises, and reciprocate acts**

Commitment

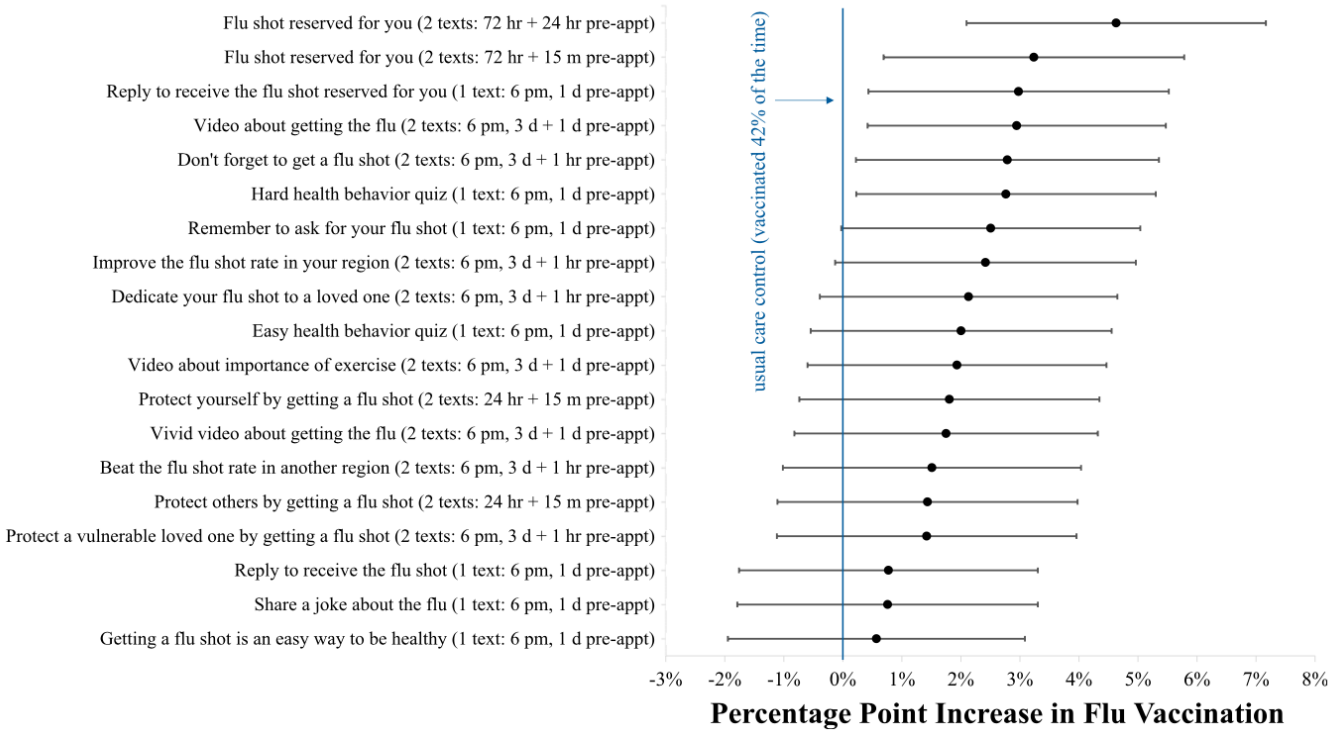
**We act in ways that make us feel better about ourselves**

Ego

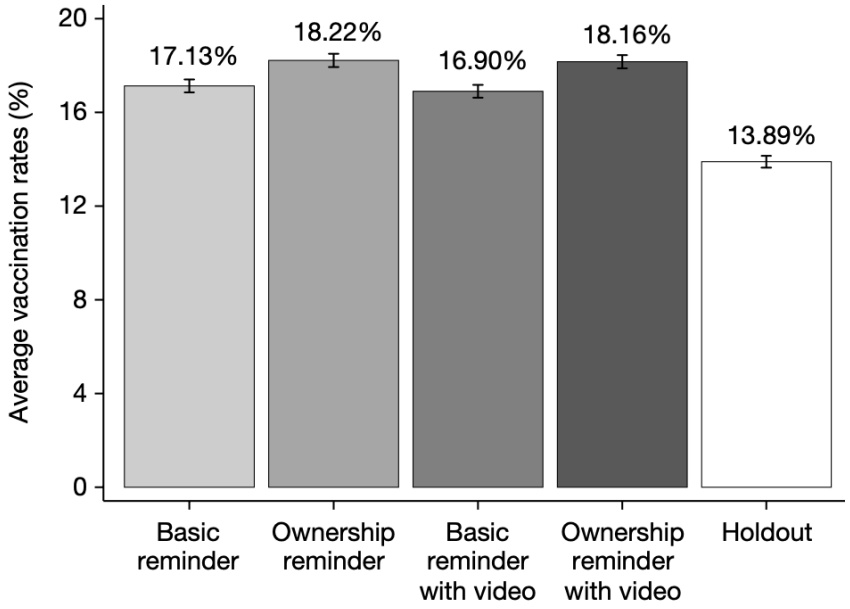
**The value of an incentive depends on where we see it from – its reference point**

# Psychological Ownership nudges increase flu and COVID-19 vaccinations

N=47,306, 19 different text messages




**UCLA Health: John Smith, a COVID-19 vaccine has just been made available to you at UCLA Health. Claim your dose today by making a vaccination appointment here: uclahealth.org/schedule vs you can get the COVID vaccine at UCLA health**




https://www.pnas.org/content/118/20/e2101165118

Dai et al. Nature 2021:597:404

# FluText4U nudge study

- Assess whether a SMS intervention could increase influenza vaccine uptake in children with chronic medical conditions
- SMS sent 1 week prior to WCH appointment, 1 week after appointment and 2 weeks after the 2nd me

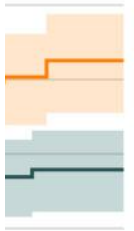
Influenza may be serious for children with medical conditions. The Women's and Children's Hospital recommends the influenza vaccine for all medically at-risk children.

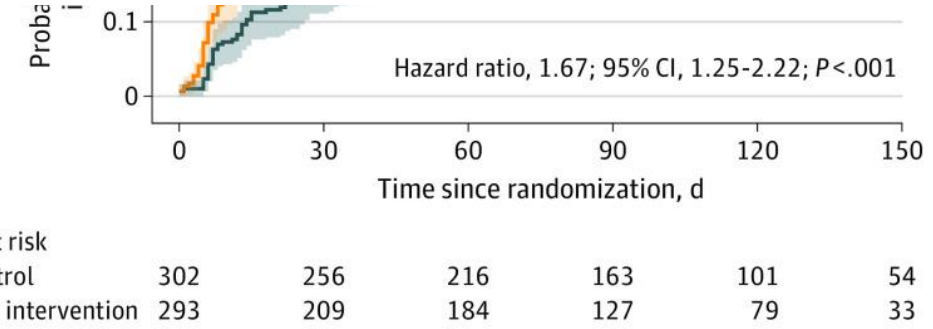
[name, lastname] is recommended to receive the influenza vaccine.

- Resu
- In p gr
- Ti fc 1
- A greater proportion receiving the flutext-4U were vaccinated during the optimal period (April-June) [48% vs 34%; aOR=1.97 (95%CI 1.28, 3.06 P<0.001]

**Table 2a** Effect of intervention on receipt of COVID-19 vaccine within 3 months of randomization.

| *Variable* | *Intervention* | *Standard care* | *Odds ratio (95% CI)* | *P-value* | *Risk ratio (95% CI)* | *Absolute risk difference (95% CI)* |
|---|---|---|---|---|---|---|
| COVID-19 vaccine received within 3 months of randomization, *N* (%) | 8/554 (1.4) | 9/551 (1.6) | 0.89 (0.34, 2.35) | .82 | 0.90 (0.35, 2.29) | −0.17 (−1.61, 1.27) |

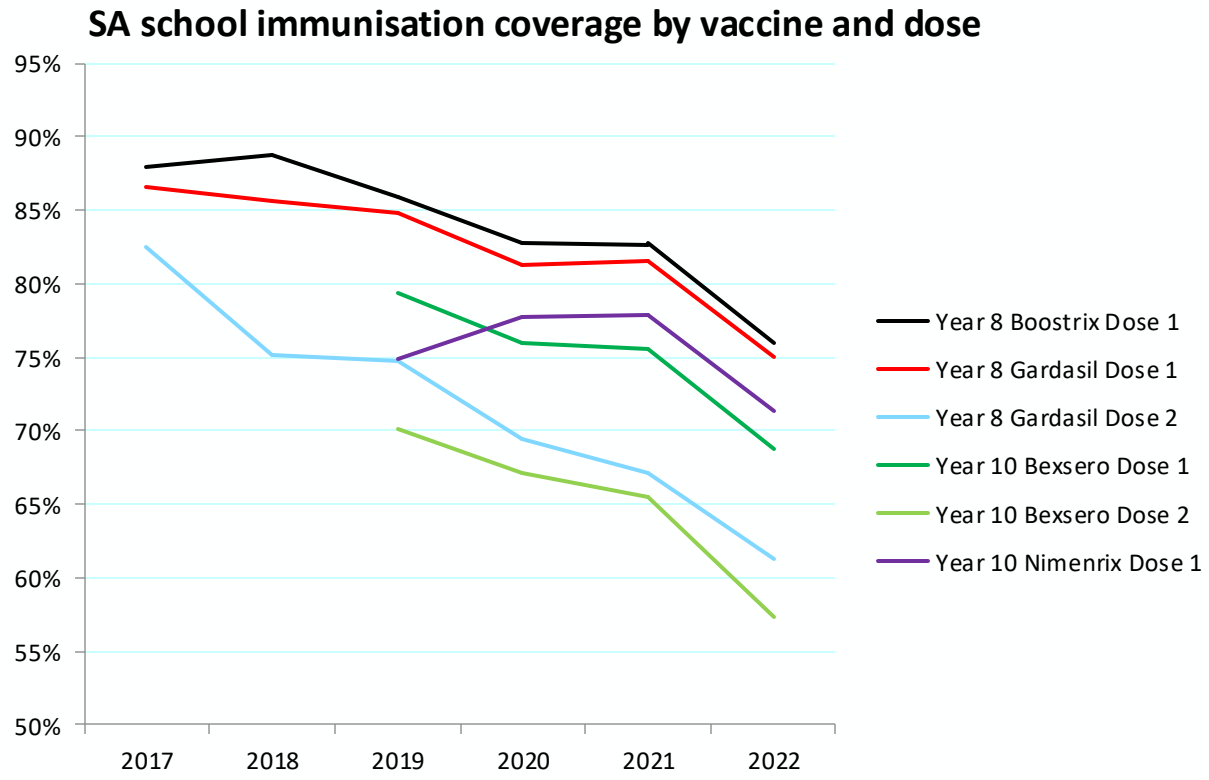





| No. at risk | | | | | | |
|---|---|---|---|---|---|---|
| Control | 302 | 256 | 216 | 163 | 101 | 54 |
| SMS intervention | 293 | 209 | 184 | 127 | 79 | 33 |

# Nudges to increase uptake of vaccines delivered to young people

- Co-design a nudge intervention with students at “low uptake” schools
- Implement the nudge in a cluster randomised controlled trial in schools



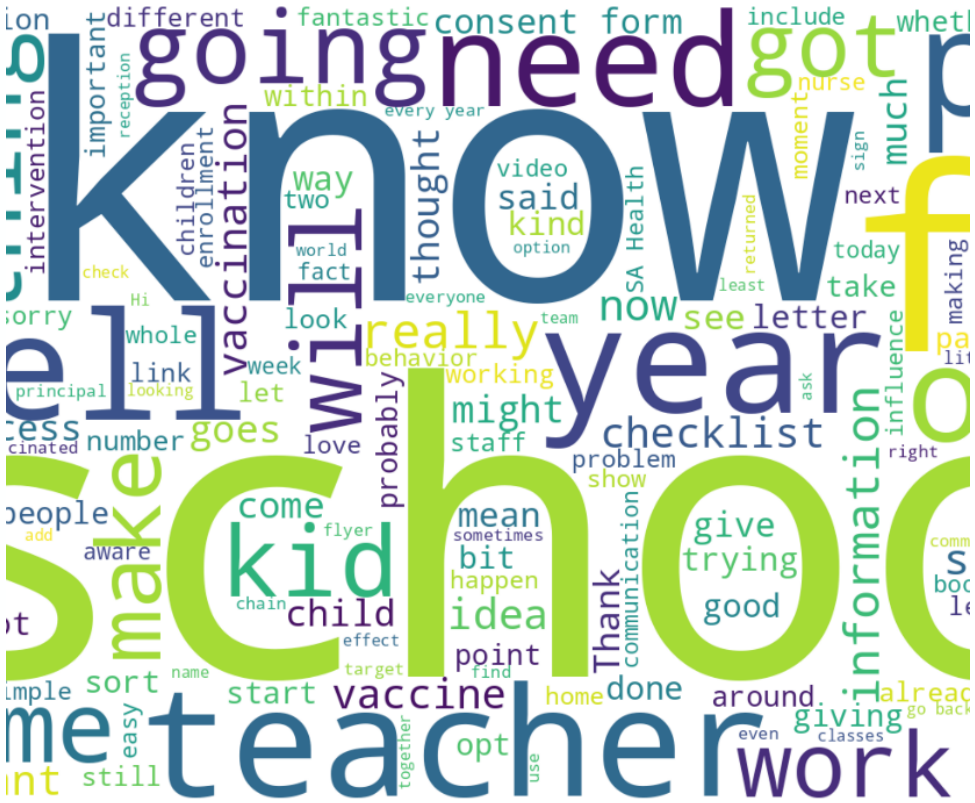

Slide courtesy of Noel Lally, Executive Director, CDC, SA Health

# Co-designed nudge solutions

- ✅ Nudgeathon Workshop (Dec 2024)
- ✅ Framework: MINDSPACE principles
- ✅ 58 Participants:
  - Consumers: Year 7 and 10 students and their parents, representing a range of ethnicities and culturally and linguistically diverse backgrounds.
  - Key stakeholders: staff members from SA Health, Department for Education, private vaccination and health service providers, local councils and school
  - academia
  - psychologist
  - graph designer
- ✅ Evaluation: APEASE criteria[1] (Affordability, Practicability, Effectiveness/Cost-Effectiveness, Acceptability, Side-Effects/Safety, and Equity)

Michie, S., Atkins, L. & West, R. (2014) The Behaviour Change Wheel: A Guide to Designing Interventions. London: Silverback Publishing.

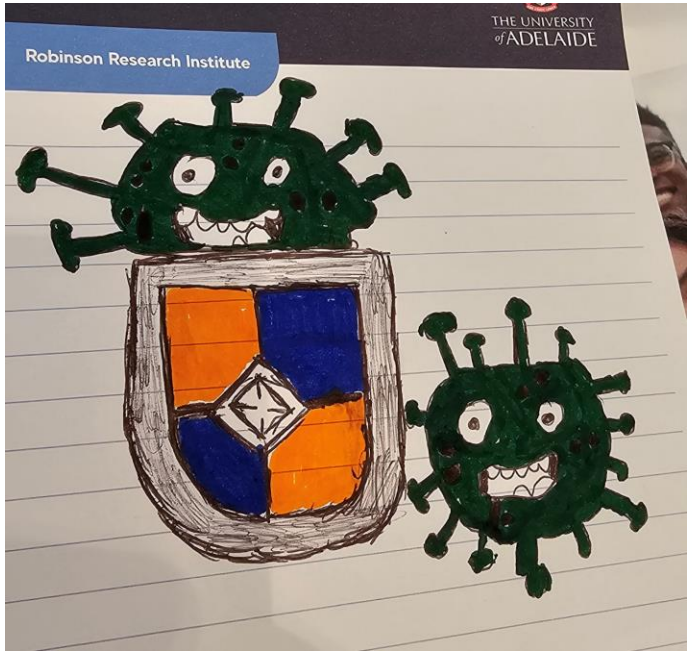
# Key Nudgeathon Ideas

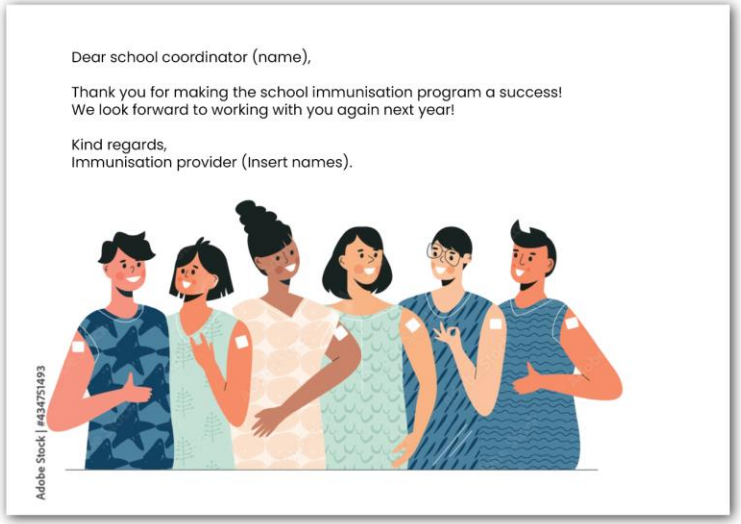



1. Incentives (prizes, pizza)
2. Social norms (school comparisons)
3. Defaults (opt-out consent).
4. Simplification (checklists, form redesign)
- 5. Education (videos, curriculum)

# Teacher-Focused Nudges

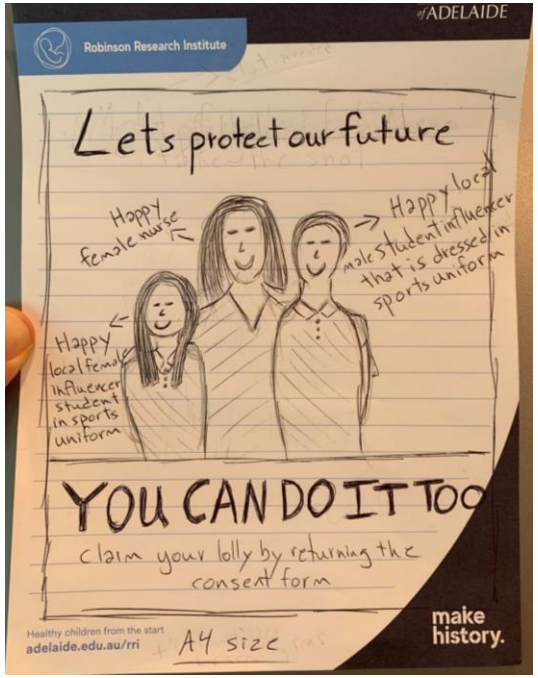
- Checklist & Commitment:
  - ✓ Teachers receive a letter and checklist, encouraging them to support consent form distribution and collection.
  - ✓ Commitment signing and recognition (e.g. school-wide prize for highest return rate).
- Posters & Reminders:
  - ✓ Visual prompts in staff rooms
  - ✓ SMS/email reminders
- Comparison Data:
  - ✓ Share return rates across schools to stimulate motivation through friendly competition.
- Ego Appeal:
  - ✓ “Thank you” e-cards to acknowledge teacher efforts.



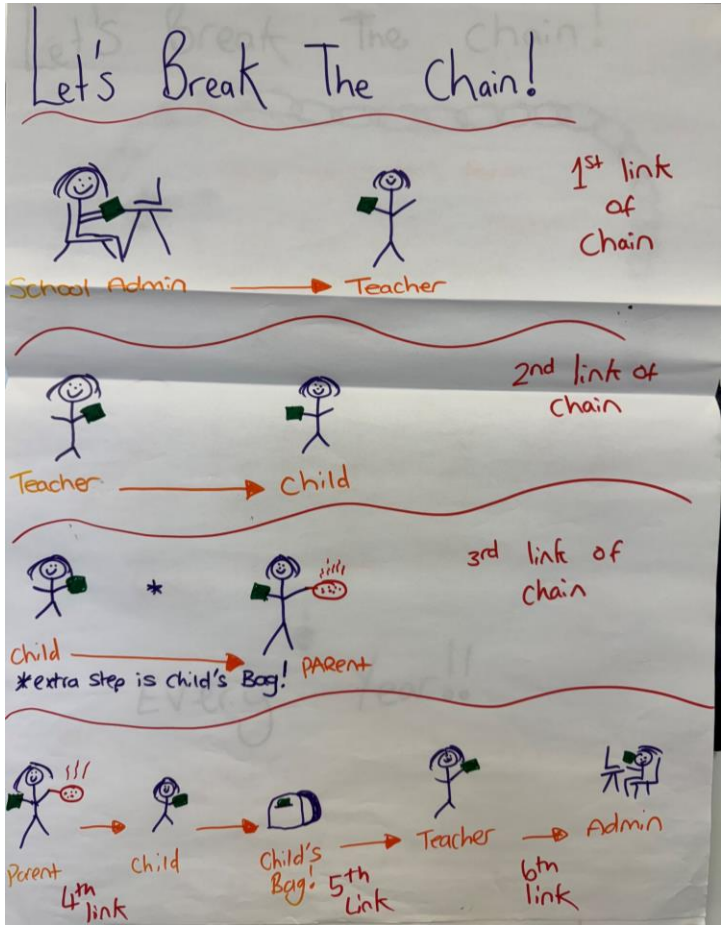



# Student-Focused Nudges

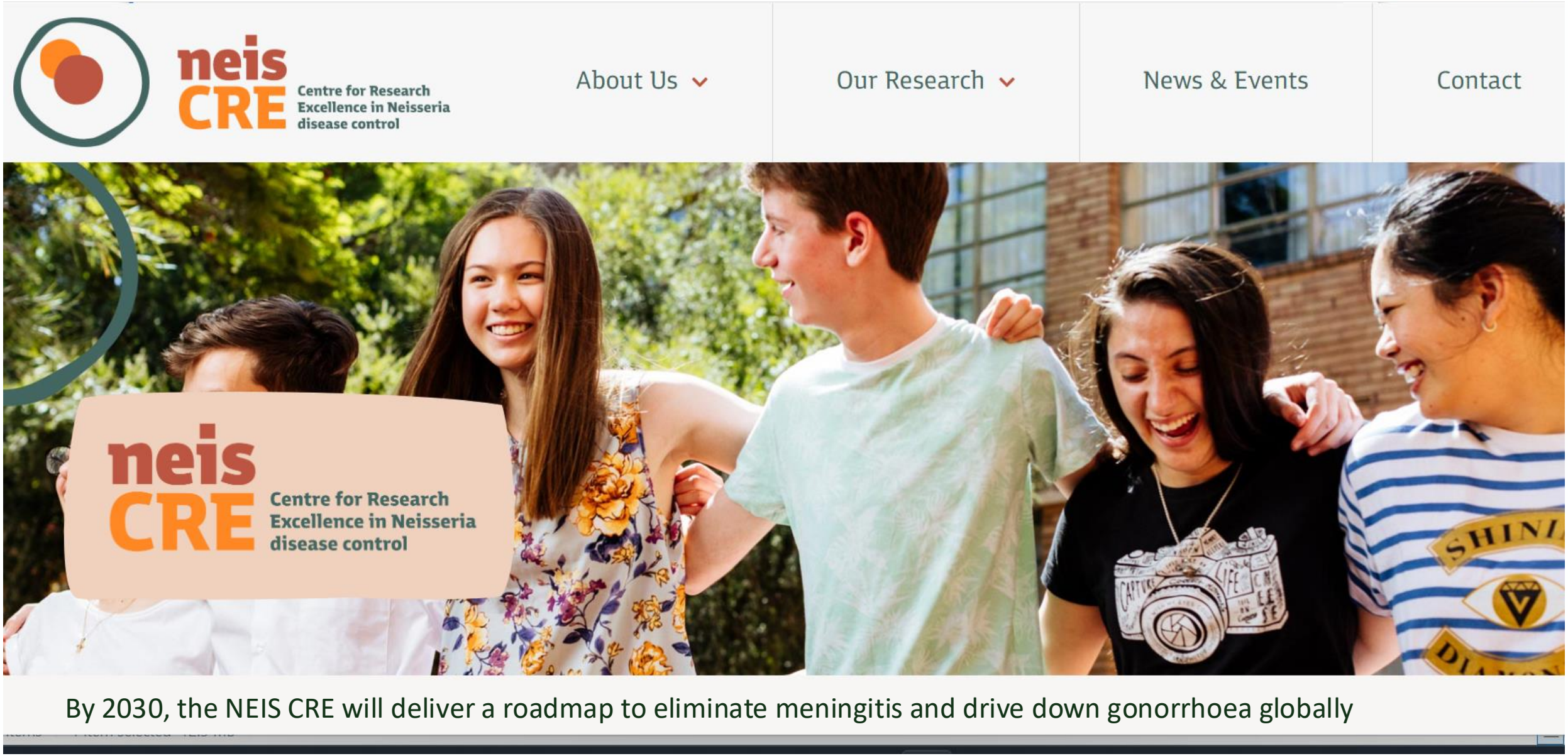

- Immunisation Day = Positive Day:
  - ✓ Make vaccination day engaging (casual clothes, games, treats, competitions, etc.)
- Peer Norms & Social Proof:
  - ✓ Showcase videos with peer messengers and highlight group success (e.g. class pizza party if >85% vaccinated)
- Reminders:
  - ✓ Bright flyers, school app messages, and SMS reminders to parents
- **Student-friendly forms:**
  - ✓ visuals, slogans like "Protect Your Future"



# System-Level Nudges




- **Streamlined Consent Process**:
  - ✓ Normalise consent as a routine school activity
  - ✓ Include immunisation consent forms in school enrolment packs
  - ✓ Send reminders or updates before year 7 & 10 vaccinations based on prior consent.
  - ✓ Explore default consent models requiring legal review & transparency
  - ✓ Priority scheduling: block immunisation days in calendars
- **Curriculum Integration**:
  - ✓ Include immunisation education in health or science classes
- **Centralised Coordination**:
  - ✓ Improve school-provider coordination through calendar reminders, clearer timelines, and reduced form handling.




By 2030, the NEIS CRE will deliver a roadmap to eliminate meningitis and drive down gonorrhoea globally