
ADOLESCENT SCHOOL-BASED VACCINATION IN AUSTRALIA

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Abstract

Adolescents have become an increasingly prominent target group for vaccination in Australia and other developed countries. Over the past decade, voluntary school-based vaccination programs have evolved to become the primary method of delivering adolescent vaccines funded under Australia's National Immunisation Program (NIP). These programs operate at a state and territory level and offer NIP vaccines to adolescents in specific school grades using local teams of trained vaccine providers. This paper summarises the current operation of voluntary school-based vaccination programs in Australia. Information was obtained through a literature review, semi-structured interviews with those managing and implementing school-based vaccination programs in each jurisdiction and a review of program resources. Available coverage data was obtained from each state or territory. Vaccines are delivered at the school, during school hours, and typically target late primary or early secondary school grades. Written parental consent is required for any vaccine to be administered. Operation of the programs is influenced by various factors at the school and provider level. Despite variability in program implementation, collection and analysis of coverage data, comparable coverage has been achieved across all states and territories. Coverage is higher than that reported by other countries where adolescent vaccines are mandated for school entry or available only through community vaccination providers. Voluntary school-based vaccination programs are an established mechanism for the delivery of adolescent vaccines in Australia and vaccines offered will continue to evolve in light of national recommendations. Current gaps in evidence include a detailed understanding of the influence of procedural factors on uptake, the best ways to maximise consent form return and, standardisation of coverage data reporting.

Key words: immunisation, vaccination, adolescent, school vaccination

Introduction

Vaccination has long been a successful strategy in the control and elimination of communicable diseases predominantly those affecting children.¹ However, morbidity continues to occur in adolescents due to vaccine-preventable diseases such as hepatitis B, varicella and pertussis.² In light

of this and the availability of new vaccines best delivered in adolescence (i.e. human papillomavirus - HPV), they have become a prominent target group for routine vaccination both in Australia and internationally.³⁻⁵ Vaccination of adolescents aims to maximise protection against future disease risk, to boost existing but waning immunity, or to catch-up those who may not have been adequately vaccinated as children.⁶ To contribute to disease reduction, adolescent vaccination programs must be successfully implemented and achieve coverage for each vaccine sufficient to control disease.⁷ To do so, efficient and effective ways of delivering vaccines to this often hard to reach group are needed. Current evidenced-based approaches to achieving this include school-linked mandates and voluntary on-site school-based vaccination.⁸

Since the 1970s voluntary, school-based vaccination programs have been implemented in Australia, although their use has been varied due to differences in political support, legislative and public health systems between states and territories.⁹ Provision of vaccines through schools has the potential to reach the majority of adolescents in Australia, as school attendance is mandatory until mid to late adolescence and attendance rates are high, particularly in lower school grades.¹⁰ School-based vaccination is popular with parents,^{11,12} and has achieved higher levels of coverage compared with vaccinating adolescents in the primary care setting.¹³ In addition, school-based vaccination largely overcomes the issue of cost and access to vaccines for adolescents, as they are not required to make a specific appointment with a doctor, there is no consultation fee and the vaccines are free.

This approach to adolescent vaccination is not without its challenges. Some barriers to the vaccination of adolescents are similar to those of vaccinating younger children (e.g. vaccine refusal and low awareness).¹⁴ However there are additional challenges unique to this group, such as obtaining appropriate and valid parental consent in the light of the increasingly autonomous decision making capacity of adolescents.^{8,15}

This paper summarises the Australian approach to school-based vaccination, highlighting successes, challenges and future considerations with this approach.

Methods

Review of school-based vaccination implementation in Australia

Information about the history and current operations of school-based vaccination programs in Australia was collected through a review of published literature, semi-structured interviews with those managing and implementing school-based vaccination programs in each state or territory and a review of program resources available in 2010. Descriptive content analysis and thematic analysis were used to objectively identify relevant information from these data and systematically group it into key themes,^{16,17} constructing an overview of school-based vaccination program implementation in Australia.

Coverage

Coverage data by calendar year, vaccine, dose number and school grade were requested from each state and territory at the time of interview. Data were requested for all calendar years in which a vaccine was routinely offered through school-based vaccination programs in the state or territory. Due to known differences in data sources and methods of collection and analysis, an explanation of these was also requested. In addition, coverage data for HPV vaccine for 2007 was sourced from the published literature.¹⁸

As available coverage data was not uniform in presentation, had different denominators and was limited to aggregated proportions of jurisdiction-wide coverage, manipulation was required to develop standard estimates for comparison. The Australian Bureau of Statistics (ABS) estimates of annual full-time equivalent school enrolments in Australia were used as a standard denominator.¹⁰ Available proportions of state or territory-wide annual coverage was used to estimate the number of students vaccinated by vaccine, dose number, jurisdiction and calendar year (numerator). These were pooled to obtain estimates of average national coverage for each vaccine, dose and calendar year which were then weighted by the enrolled population and averaged across 2004 to 2009.

Results

Implementation of school-based vaccination in Australia

Interview participants

Interviews were conducted with all state and territory immunisation program managers (n=8), along with other health department staff associated with immunisation program management in some jurisdictions (Victoria, Western Australia, South

Australia and Tasmania). Seven staff primarily responsible for coordinating the implementation of school-based vaccination programs in their relevant jurisdiction were interviewed in: the Australian Capital Territory (n=1), Western Australia (n=1), Victoria (n=1), Northern Territory (n=2) and Queensland (n=2). Staff were not interviewed in New South Wales, South Australia or Tasmania as sufficient detail on program implementation had been obtained from earlier interviews. Of the 19 interviewees, the majority had been involved in program management and/or delivery for 6 to 10 years (n=7) or more than 10 years (n=7).

Policy

From 2007 all states and territories used routine voluntary school-based vaccination as the primary mechanism to deliver adolescent vaccines on the NIP although some jurisdictions had previously implemented these programs.⁹ Based on the nationally recommended age range for administration each state or territory health department decides on the school grade(s) in which vaccines will be offered and develops policies and procedures for these programs in their jurisdiction. Adolescent vaccines offered through school-based vaccination programs are not mandated for secondary school entry or attendance. The education sector allows vaccination programs to operate in schools on a goodwill basis, recognising the important public health benefit of these programs.¹⁹ Vaccines currently offered through school-based vaccination programs in Australia are a mixture of newly introduced vaccines (e.g. HPV), booster doses (e.g. diphtheria-tetanus-pertussis - dTpa), and time limited, catch-up programs for particular age cohorts (e.g. Hepatitis B, varicella; Table 1).³

Funding

Until recently the Australian Government funded each state and territory to purchase vaccines on the NIP through a tender process. The responsibility for purchasing NIP vaccines is currently being transferred to the Australian Government, which will directly provide states and territories with vaccines for school-based vaccination programs.²⁰ Over the years, the Australian Government has also provided time-limited funding to support school-based delivery of some vaccines.

Each state and territory government provides varying levels of funding to support the implementation of their own school-based vaccination program. The immunisation area in each state and territory health department is primarily responsible for the overall management and operation of the program. Most provide funds to regional organisations, such as local or regional government health services to implement the program (Table 2). Funding formulas vary

Table 1: Vaccines offered through school-based vaccination programs, 2012, by state and territory

Vaccine	Nationally recommended age group	School grade	Jurisdiction
Hepatitis B (2 doses, adult formulation)	10–13 years*	Last year primary First year secondary	WA, TAS† NSW, ACT, VIC, QLD, SA, TAS†
Varicella‡	10–13 years*	Last year primary First year secondary Second year secondary	WA, TAS† NSW, ACT, VIC, QLD, SA, TAS† NT
Human papillomavirus (HPV) (3 doses)	12–13 years (females only)	Last year primary First year secondary	WA, TAS† NSW, ACT, VIC, NT, QLD, SA, TAS†
Diphtheria-tetanus-acellular pertussis (dTpa)	11–17 years*§	Last year primary First year secondary Second year secondary Third year secondary Fourth year secondary	WA, TAS† NSW NT, SA ACT, QLD VIC, TAS†, NSW
Pneumococcal 23vPPV¶	15–49 years (Indigenous only)	Fourth year secondary	NT

Abbreviations for each state/territory: ACT = Australian Capital Territory, NSW = New South Wales, NT = Northern Territory, QLD = Queensland, SA = South Australia, TAS = Tasmania, VIC = Victoria and WA = Western Australia.

* Recommended for one cohort only within the specified age range. Dose schedules may vary between jurisdictions.

† In Tasmania each local government decides in which school grades vaccines are offered.

‡ Varicella vaccine is recommended for those who have not already received the vaccine or have no clinical history of chicken-pox. A second dose is recommended for students ≥ 14 years of age but not funded or provided routinely through school-based vaccination programs, except in Qld where the follow up vaccination is offered by a school-based vaccination provider or general practitioner.

§ From October 2009, Australian Technical Advisory Group on Immunisation (ATAGI) recommended that the adolescent booster dose of pertussis be given in the first year of secondary school, which is from 11 years of age.

|| From 2010 dTpa was routinely offered in grade 7 (first year secondary school) in NSW. This vaccine will also be offered as a catch-up in grade 10 from start 2009 to end 2012. From 2013 this vaccine will be routinely offered only in grade 7 in NSW.

¶ Pneumococcal polysaccharide vaccine, 23-valent.

between jurisdictions with some offering additional funds to support the operation of these programs in rural/remote areas.

Program reach

The age-based structure of school grades varies between states and territories.¹⁰ Most school-based vaccination programs target lower secondary school grades (ages 11–14 years). The exception is Western Australia and Tasmania, where most vaccines are offered in the final year of primary school when children are equivalent in age to those in the first year of secondary school in other jurisdictions (Table 1).

Nationally recommended vaccines for adolescents are also offered in some ‘non-traditional’ schools at the discretion of each state and territory. These include schools that cater for students who have special educational needs and those that provide tuition to school-aged youth who have recently arrived in Australia and whose first language is not English.²¹ Students attending these schools are vaccinated based on age, as opposed to school grade. Routine school-based vac-

cination programs may not reach adolescents in some remote communities who do not regularly attend school or those who are home-schooled. Adolescents in these communities are offered nationally recommended vaccines for their age by local public health providers and/or their local doctor. There have been isolated reports of schools refusing to participate in school-based vaccination programs, often due to a philosophical objection to vaccination.²²

Program delivery

School-based vaccination programs are delivered at a regional level, with local teams of trained vaccine providers offering vaccines in schools within a defined geographical region (Table 2). Vaccines are offered at the school, during school hours, and more than one vaccine may be offered at each vaccination clinic. Dates for school visits are organised by local program providers annually, with each school receiving a minimum of three visits per school year although some have up to five.

Table 2: School-based vaccination program delivery in Australia, by state and territory

	Australian Capital Territory	New South Wales	Northern Territory	Queensland	South Australia	Tasmania	Victoria	Western Australia
Local coordination	Maternal and Child Health Unit of ACT Health Department	PHU*	Community Health and Remote Health units	3 area coordinators based at PHU* (Northern, Central, Southern)	Local government or area health services (metro) Country Health SA (rural)	Local government	Local government	Local government or Child and Adolescent Health (metro), PHUs* (rural)
Vaccines administered by	Maternal and Child Health nurses	Nurses employed via local health districts† (metro), Community Health nurses (rural)	Health Promoting School Nurses‡ and Community/Health Department nurses	Community Health nurses, council Immunisation Program Nurses§ or general practitioners/practice nurses	Council and Community Health nurses§ and general practitioners/practice nurses	Council nurses§	Council nurses§	Community Health & council nurses (metro), PHU* nurses (rural)§
Age of student where parental consent required	<15yrs ⁶²	all school students regardless of age ²⁴	all students vaccinated on school grounds	<15yrs ²⁵	<16yrs ⁶³	<18yrs ⁶⁵	<18yrs ⁶⁶	

* Public health units are located within regional offices of some state/territory health departments. They are responsible for surveillance activities and public health response within their geographical region.

† The NSW Health service is divided into 15 Local Health Districts, which are regional units of the state health department, and which direct and manage publically funded health services within their geographical areas.

‡ Nurse located within public high schools in the Northern Territory providing holistic health care to the school community through management of clinical and health promotion services within the high school and the feeder primary schools.

§ Predominantly registered nurses (Registered Nurses/Division 1) or Immunisation Program Nurses (in Qld who have completed an accredited course). Also includes endorsed enrolled nurses (Endorsed Enrolled Nurses/Division 2) in some areas.

|| Personal communication: Immunisation Senior Project Officer, Centre for Disease Control, Department of Health and Families, Northern Territory: 2010

Operational issues such as the number of schools visited each day, the number of visits to each school and the order in which vaccines are offered are influenced by numerous factors including school size, geographic location of schools, curriculum activities and numbers of schools in the area served by each local school-based vaccination provider.

Arrangements to catch up students who miss out on scheduled vaccines offered through school-based vaccination programs are varied. Some jurisdictions enable vaccines requiring multiple doses to be administered at subsequent visits to the school but this is often only possible for earlier doses. Most commonly, any age-eligible students can obtain missed doses for free from their local vaccination provider (consultation fees may apply).

State and territory policy and procedure documents detail the planning, set up, operation and reporting procedures for school-based vaccination programs.²³⁻²⁵ Clinics at the school are set-up to maximise the flow of students from the pre-defined waiting area where they read and/or hear pre-vaccination information. They then move to the nurse's station where they are vaccinated out of sight from other students (where possible) and then to the designated observation area where they wait for a minimum of 15 minutes before returning to the classroom. Clinic operation and set-up is designed to maximise efficiency and optimise the vaccination experience for all involved,²⁶ whilst reducing the potential for errors and mass psychogenic responses which may occur in such programs.²⁷

Each jurisdiction develops their own information materials (e.g. brochures) that are primarily targeted at parents and/or guardians and delivered *en masse* as part of, or along with, consent forms. Written information about the operational aspects of the program and the vaccines offered is provided to school teachers and/or principals in only half of the states and territories. There is no requirement for jurisdictional health (as of 2010) or education departments to provide education about the vaccines offered or the diseases that they protect against.¹⁹ However half of the states and territories provide some education to students or offer materials for teachers to do so (Table 3).^{28,29} There is frequently limited opportunity to provide meaningful education to students in their first year of secondary school due to the need for vaccination clinics to commence early in the school year in order to offer all vaccines and complete multi-dose schedules.

State and territory health departments maintain comprehensive records of vaccines delivered through their school-based vaccination programs. However reporting mechanisms, the type of data, and the timing of collection varies. Queensland and

the Northern Territory have state and territory-wide vaccination registers that store records of all NIP vaccines administered in these jurisdictions.^{30,31} More recently, Western Australia and New South Wales have developed statewide adolescent school-based vaccination registers (Table 3).^{32,33} In jurisdictions without registers, individual line listings or aggregate numbers of students vaccinated are reported to state and territory health departments. Recording of adolescent vaccines administered outside school-based vaccination programs is variable. In some jurisdictions, there are established mechanisms for voluntary reporting of these data to either the state and territory health department (e.g. fax-back form) or directly to state and territory immunisation registers. State and territory health departments are required to report individual records of HPV vaccines administered in school-based vaccination programs to the National HPV Vaccination Program Register (NHPVR).³⁴

Coverage data are most frequently used by each state and territory health department to allocate funding to those organisations responsible for implementing the program and to monitor program performance. They are often shared on request with those making decisions about vaccination programs at a state and national level.

Consent

Each state and territory has their own legislation governing the age of consent to medical treatment. In some jurisdictions the education department also influences school-based vaccination program consent policy. Thus, the age at which adolescents have the right to provide consent for themselves, and are permitted to do so in a school-based vaccination program, varies between states and territories (Table 2).

In general, written parental consent is required for all vaccines delivered through school-based vaccination programs in Australia, though in the absence of this verbal consent documented and witnessed by the school-based vaccination provider is acceptable in most states and territories. Each jurisdiction develops standard consent forms that are either vaccine-specific (e.g. for HPV vaccine only) or grade-specific (i.e. all vaccines offered in a selected grade on one consent form), or a combination of these. Consent for multiple doses of the same vaccine (e.g. hepatitis B) is provided on the same consent form. With the exception of New South Wales, 'neutral consent' is employed in all jurisdictions whereby consent forms are returned regardless of the consent decision. In New South Wales, 'opt-in' consent is employed whereby consent forms are returned only if the parent/guardian consents to their child receiving the vaccine covered by that form.²⁴

Table 3: School-based vaccination program materials and resources 2010, by state and territory

Materials and recourse	ACT	NSW	NT	QLD	SA	TAS	VIC	WA
Policy and procedures document*	✓	✓		✓	✓	✓	✓	✓
Standard consent form across state/territory†	✓	✓	✓	✓	✓	HPV only	✓	✓
Vaccine-specific parent information‡	✓	✓	✓	✓	✓	✓	✓	✓
Post-vaccination care information‡	✓	✓	✓	✓	✓	✓	✓	✓
Student record of vaccination	✓	✓	✓	✓	✓	✓	✓	✓
Parent notification card/letter for missed vaccine		✓	✓					✓
Policy for independent nurse immunisers§		✓		✓	✓	✓	✓	✓
Jurisdictional immunisation register incl. adolescent vaccines		✓	✓	✓				✓
School-based vaccination program information on dedicated page of the state/territory health department website	Schedule only	✓	Schedule only	✓	✓	On local government websites	Schedule only	✓
Education material/resources for students¶			✓		✓	✓	✓	
Specific system for notification of adolescent vaccines administered outside the school-based vaccination program**			NT immunisation register	VIVAS††	✓			✓
Standard information for principals/schools	✓	✓		✓				✓
Student pre-vaccination checklist/advice card		✓			✓			

Abbreviations for each state/territory: ACT = Australian Capital Territory, NSW = New South Wales, NT = Northern Territory, QLD = Queensland, SA = South Australia, TAS = Tasmania, VIC = Victoria and WA = Western Australia.

* Overarching document outlining jurisdictional policy and procedures for preferred model of delivery. Usually includes standard forms and templates.

† In SA, ACT, Qld and NT the consent form and disease/vaccine information for parents is provided in the same resource, not two separate pieces of paper.

‡ This is either included on the student record of vaccination or provided on a separate piece of paper following vaccination.

§ This document links to specific state/territory poisons legislation and outlines scope of practice for the delivery of vaccines in school-based vaccination program by nurses qualified to administer vaccines independent of a doctor, usually under standing orders at a jurisdictional, local or organisational level.

|| This website has since been updated to include more detail on vaccines available, school grades in which these are offered and consent forms.

¶ Education materials (i.e. classroom lessons, videos) made available through the state/territory health department for those implementing the program or classroom teachers to educate students about vaccines offered through school-based vaccination programs and the diseases they protect against. Education may be provided in some, but not necessarily all areas of the state/territory. This excludes pre-vaccination information sheets for students provided just prior to vaccination.

** For community vaccination providers (e.g. general practitioners) to report nationally recommended vaccines administered to adolescents to the relevant state/territory health department.

†† Vaccination Information and Vaccination Administration System.

Most commonly, the jurisdictional health department provides hard copies of standard consent forms to local school-based vaccination provider/s. They disseminate these to schools in their area, with timing and practices largely dependent upon the population and geographic size of the service provider's area. Teachers predominantly assume the responsibility of disseminating consent forms to students in their class. Students are responsible for taking consent forms home and returning them to school once completed.

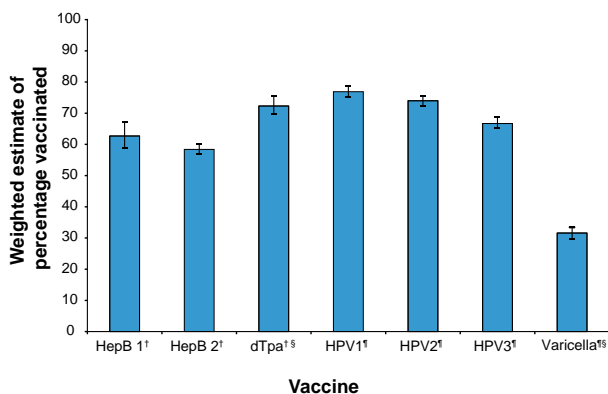
Several strategies have been trialed to increase consent form return by school-based program providers in Australia, but there is limited published evidence for these. Resending the consent form/information package to non-responders was shown to be significantly associated with increased return rates in Western Australia.³² Some interviewees reported that distributing consent forms at the beginning of the school year yielded a greater response than posting them with school enrolment forms at the

end of the school year. In one jurisdiction, telephoning non-responders to request a completed form or obtaining verbal consent frequently led to a 100% response rate and posting consent forms with a reply paid envelope did not alter return rates and resulted in fewer opportunities for reminders, as school teachers were not directly involved.

Coverage

Coverage data for the school-based vaccination program was somewhat complete across jurisdictions for all vaccines offered from 2004 to 2007, with complete coverage data for all vaccines and jurisdictions available for 2008 and 2009 (Table 4). In most jurisdictions, coverage data for vaccines offered through school-based vaccination programs prior to 2004 was insufficient or not available. Data for Tasmania were not available from all local government areas with the number providing data varying by calendar year and vaccine. Whilst the estimates for the Northern Territory are based on doses received in the school setting, a considerable number of age eligible dTpa and varicella vaccine doses were recorded on the Northern Territory immunisation register as being delivered in the community. Coverage estimates for South Australia, Queensland, Western Australia and Victoria included an unknown number of vaccine doses administered to age-eligible adolescents outside the school-based vaccination program, as reported to the relevant state and territory health department, but these were understood to be minimal. As not all doses are routinely reported by community vaccination providers (e.g. general practitioners), reported coverage for subsequent doses, may be higher than for previous doses. Dose assumptions, as have been described in the calculation of Australian childhood immunisation coverage rates,³⁵ are used when calculating school-based vaccination coverage in some jurisdictions (e.g. Victoria).

Figure 1: Average national coverage for adolescent vaccines routinely delivered through school-based vaccination programs in Australia, 2004 to 2009*



- * Error bars are the lowest and highest weighted national coverage estimate recorded from 2004 to 2009.
- † Hepatitis B1 and Hepatitis B2 includes data from 2004–2009, excluding ACT (2007), SA (2004–2007), Qld (2004–2006) and NT (All years).
- ‡ dTpa includes data from 2005–2009, excluding NSW (2006–2008), Tas (2005–2006), SA (2007), Qld (2005–2006).
- § Data for dTpa and Varicella vaccines from the NT includes only those students vaccinated in the school-based vaccination program. Adding eligible adolescents vaccinated in the community to those vaccinated at school considerably increased overall coverage (Table 4).
- ¶ HPV dose 1–3 (HPV1–HPV3) includes data from 2007–2009 only. Estimates include all school grades offered the vaccine across these calendar years.
- ¶ Varicella includes data from 2006–2009, excluding ACT (2007), WA (2006), Qld (2006). Coverage estimates exclude students who reported a clinical history of chickenpox or having received the vaccine prior to being offered it through school-based vaccination program.

There is no published coverage data for vaccines delivered through schools in Australia prior to the National Measles Control Campaign in 1998, which predominantly focussed on primary school children.³⁶ Data from early adolescent school-based vaccination programs in South Australia shows coverage for the grade 8 (13 to 14 years) school-girl rubella program (1990–94) ranged from 71% to 78%, which was similar to that achieved when the measles-mumps-rubella (MMR) vaccine was delivered to all grade 8 students from 1995 to 1997 (78 to 81%). Coverage from time-limited catch-up national adolescent school-based vaccination campaigns for meningococcal C and dTpa show variation in coverage by school grade. When multiple school grades are vaccinated in the same year, higher uptake is evident in younger age groups,

Table 4: Percentage coverage for vaccines delivered through routine school-based vaccination programs, 2004 to 2009, by state or territory and vaccine

Year	ACT	NSW	NT	QLD	SA	TAS*	VIC	WA	National†
Hepatitis B dose 1‡									
2004	77	56	–	n/a	n/a	n/a	82	n/a	67
2005	77	59	–	n/a	n/a	n/a	61	n/a	60
2006	76	57	–	n/a	n/a	76	58	n/a	59
2007	–	58	–	61	n/a	79	60	69	61
2008	82	65	–	65	74	76	56	69	65
2009	66	63	–	65	80	63	56	70	61
Hepatitis B dose 2‡									
2004	69	43	–	n/a	n/a	n/a	76	n/a	57
2005	72	48	–	n/a	n/a	n/a	74	n/a	59
2006	69	46	–	n/a	n/a	69	70	n/a	57
2007	–	49	–	50	n/a	72	74	67	59
2008	69	48	–	58	70	63	72	64	60
2009	59	50	–	78	73	58	75	65	59
dTpa									
2005	83	72	58 (25)§	n/a	86	n/a	78	77	76
2006	81	–	73 (36)§	n/a	84	n/a	78	69	77
2007	80	–	81 (45)§	61	–	70	78	71	71
2008	89	–	82 (55)§	63	75	59	76	76	71
2009	81	68	88 (59)§	62	77	59	74	81	70
Varicella									
2006	15	33	33 (13)§	n/a	37	n/a	13	n/a	30
2007	–	36	28 (13)§	32	33	11	33	29	32
2008	12	34	32 (18)§	32	22	20	41	44	32
2009	19	34	36 (23)§	35	43	23	34	29	34
HPV dose 1 									
2007	80	83	80	74	70	68	83	71	76
2008	80	77	75	74	80	49	77	69	75
2009	73	80	79	76	83	59	80	82	79
HPV dose 2 									
2007	75	80	71	79	65	65	78	67	74
2008	78	75	72	69	77	46	74	66	72
2009	71	77	73	72	80	59	77	79	76
HPV dose 3 									
2007	63	74	64	62	64	56	71	60	65
2008	65	68	62	64	72	40	67	60	66
2009	58	69	67	66	71	55	72	72	69

Abbreviations for each state/territory: ACT = Australian Capital Territory, NSW = New South Wales, NT = Northern Territory, QLD = Queensland, SA = South Australia, TAS = Tasmania, VIC = Victoria and WA = Western Australia.

Other abbreviations: n/a = data not available and – = vaccine not offered.

* The school enrolment population used for Tasmania is the average of grade 6 and 7 enrolments. Data for Tasmania does not include all council areas.

† National estimates are weighted by Australian Bureau of Statistics (ABS) full-time equivalent school enrolment population for the grade/s targeted for each year and vaccine. Estimates exclude states/territories for which data was not available for that year/vaccine

‡ The NT does not offer hepatitis B in routine school-based vaccination programs due to a long standing universal infant vaccination program in which the adolescent cohort has been vaccinated.

§ The first figure is proportion of age-eligible students enrolled in targeted school grade(s) (as per ABS enrolments) vaccinated in either the school or community setting, with the figure in brackets the proportion of these vaccinated in the school-based vaccination program only.

|| HPV vaccine was offered across multiple school grades in 2007 and 2008 though this varied by state/territory.⁹The denominator is the total ABS enrolments for all grades offered the vaccine in each calendar year. The numerator is the number of enrolled students from all grades offered the vaccine who reported receiving it.

¶ Jurisdictional coverage estimates obtained from Brotherton et al.¹⁸

with the highest uptake being achieved in the last two years of primary school and first two years of secondary school.^{33,37}

The average weighted national coverage estimates for adolescent vaccines routinely delivered through school-based vaccination program varied (6%–10%) within a jurisdiction for each vaccine across calendar years (Figure 1, Table 4). Coverage differed somewhat across jurisdictions for each vaccine, most notably for dTpa, hepatitis B (dose 2) and varicella. For most vaccines, coverage was generally lower in the first year the vaccine was offered, compared to any subsequent years, though this was not the case in all states and territories (Table 4). Across the calendar years, national coverage for the two-dose hepatitis B catch-up program ranged from 57% to 60% nationally, which is slightly lower than dTpa (70% to 77%) and the first dose of HPV (75% to 79%). The uptake of a single catch-up dose of varicella vaccine has been consistently low (30% to 34%) as it is influenced by the number of students reporting a history of chickenpox or previous vaccination. Although most jurisdictions routinely request parents to report a student's previous history of the disease and/or vaccination, this is not validated, complete or routinely included in coverage estimates. In the Northern Territory, a comparison of school versus community delivered varicella and dTpa vaccines from 2005–09 showed a declining trend in community vaccination (e.g. 37% in 2006 to 29% in 2009 for dTpa), however for the observed period there was an increase in the number vaccinated overall (Table 4).

For 2009, the 3 dose coverage estimate for HPV vaccine was slightly lower (1.8%) than that reported by the NHPVR.³⁸ This may be due to differences in data collection and analysis methods and/or inclusion of more reported doses delivered outside of routine school-based vaccination programs in NHPVR estimates. Thus, data presented here should be considered minimum estimates of coverage for the adolescent population.

Discussion

In Australia, school-based vaccination is now the primary method to deliver nationally recommended vaccines to adolescents. However there is substantial variation between states and territories in how programs are funded, managed and implemented. This is largely due to differences in state and territory health systems, legislation, geography, and population size and characteristics. Despite this, the approach has largely overcome missed opportunities for vaccinating adolescents in traditional healthcare settings and good coverage has been achieved in all states and territories.

Whilst there is currently no national benchmark for the implementation of adolescent school-based vaccination programs, existing arrangements align with international standards for child and adolescent immunisation practices in terms of vaccine availability, communication, patient assessment, vaccine storage, administration and documentation.³⁹ Integral to the success of these programs are refined policy and procedural guidelines, highly skilled and well-trained vaccine service providers, and comprehensive and efficient consent processes. Maximising consent form return rates is a continuing challenge facing school-based programs in Australia and internationally.^{40,42} The need for national consistency regarding the inclusion and wording of some questions on school-based vaccination program consent forms (e.g. Indigenous status) warrants future consideration. Dissemination of the results of trialed implementation approaches and strategies may enhance the current evidence base. However gaps still remain in understanding the association between many procedural factors and vaccine uptake/completion.

Gaining support from parents and teachers, and ensuring that they are adequately informed are ongoing challenges, as is working with the education sector who may not view schools as an appropriate place for the delivery of health care in an already crowded school curriculum.^{26,43} There is international evidence to support an increase in parental knowledge following the provision of an information sheet as well as increased rates of parental consent following education.^{44,48} However, challenges with ensuring written information about vaccination for adolescents reaches parents and that they read and understand it have been identified.^{49,50}

The coverage achieved in Australia's school-based vaccination program is higher than in settings where adolescent vaccines are delivered through the community sector or private practice.^{51,52} Australia's coverage for HPV vaccine is one of the highest in the world to date.^{53–55} Coverage for dTpa, varicella and hepatitis B were higher than that achieved through routine school-based vaccination in British Columbia, Canada,⁵³ despite the inclusion in their estimates of those with prior natural infection and those who self-reported receiving vaccines outside the school setting. A nationally agreed standard for the collection of coverage data from school-based vaccination programs in Australia would assist in developing a more accurate understanding of nationwide coverage achieved in these programs, which is imperative for future monitoring and evaluation of adolescent vaccination programs.

As has been demonstrated in previous studies, there is higher uptake of vaccines in lower school grades, particularly the final year of primary school

and first year of high school.^{33,37} This may be due to higher attendance rates in lower school grades,⁵⁶ or that parental consent is less frequently required for older adolescents and where it is, it may be more challenging to obtain due to reduced rates of school attendance and increasing independence and cognitive maturity at this age. The trend of lower coverage for newly introduced vaccines, especially in the first year of the program has been observed previously in both Australia and other countries.^{33,37,57} This may be due to a lack of awareness or misconceptions about the vaccine and/or its availability in the school-based vaccination program that may be overcome with time and use of sound communication strategies.

Obtaining details of adolescent vaccines delivered outside school-based vaccination programs remains a challenge. Various methods have been employed to capture these data, though they rely heavily on provider initiative to report doses administered to their state/territory immunisation register or health department without any financial incentive, as is provided for routine reporting of childhood vaccines.⁵⁸ In the absence of a national register for adolescent vaccines, a computer-assisted telephone interview (CATI) survey, as is used to determine population-wide coverage in adults could be an alternative mechanism to determine population-wide coverage.⁵⁹ However, there are numerous limitations (e.g. responder bias) with this method as have been experienced in the United States.⁶⁰ For some diseases, serosurveillance would be an alternative way of assessing vaccine-derived and population immunity, though it too has limitations.⁶¹

Future vaccination, disease surveillance and control programs will need to take into consideration adolescent cohorts vaccinated through routine school-based vaccination programs. The continuation of hepatitis B catch-up vaccination for the cohort of adolescents who received the universal birth dose at the commencement of this program will require consideration to ensure an acceptable level of seroprevalence is achieved in this cohort. Future pertussis revaccination strategies for adults will need to incorporate guidelines for those who received dTpa as an adolescent. HPV vaccination status will be important when following up disease and when developing future cervical cancer screening practices. In addition, monitoring acceptance and uptake of school-based vaccination programs among future generations of parents and students as well as addressing identified gaps in evidence will be important to ensure the continued success of voluntary school-based vaccination in Australia.

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References

1. Feery B. One hundred years of vaccination. *NSW Public Health Bull.* 1997;8(8-9):61-63.
2. Chiu C, Dey A, Wang H, et al. Vaccine preventable diseases in Australia, 2005 to 2007. *Commun Dis Intell.* 2010;34(Supplement):1-167.

3. Australian Government Department of Health. National Health (Immunisation Program Designated Vaccines) Determination 2009 (No.3) [Internet]. 2010. Accessed on 22 March 2011. Available from: www.comlaw.gov.au/ComLaw/Legislation/LegislativeInstrument1.nsf/0/0911C65CE90C8CB3CA2576A1001F3558?OpenDocument.
4. Finn A, Clarke E, Mytton J. Adolescent immunisation: The next big thing? *Arch Dis Child*. 2011;96(6):497-499.
5. Advisory Committee on Immunization Practices (ACIP). Recommended immunization schedules for persons aged 0 through 18 years --- United States, 2012. *Morbidity & Mortality Weekly Report*. 2012;61(5):1-4.
6. World Health Organization. Summary of WHO Position Papers - Recommendations for routine immunization [Internet]. 2012. Accessed on 18 October 2012. Available from: http://www.who.int/immunization/policy/immunization_tables/en/.
7. United States Department of Health and Human Services. Healthy People 2020 Topics and Objectives - Immunization and Infectious Diseases [Internet]. 2012. Accessed Available from: <http://www.healthypeople.gov/2020/topicsobjectives2020/objectiveslist.aspx?topicid=23>.
8. Skinner SR, Cooper-Robbins SC. Voluntary school-based human papillomavirus vaccination: an efficient and acceptable model for achieving high vaccine coverage in adolescents. *J Adolesc Health*. 2010;47(3):215-218.
9. Ward K, Quinn H, Menzies R, et al. A history of school-based vaccination in Australia. *Commun Dis Intell*. 2012;In press.
10. Australian Bureau of Statistics (ABS). Schools, Australia, 2010. Cat. No 4221.0. Canberra: ABS, 2010.
11. Middleman AB, Tung JS. At what sites are parents willing to have their 11 through 14-year-old adolescents immunized? *Vaccine*. 2010;28(14):2674-2678.
12. Rose SB, Lawton BA, Lanumata T, et al. HPV/cervical cancer vaccination: parental preferences on age, place and information needs. *J Prim Health Care*. 2010;2(3):190-198.
13. Heron L, O'Connor B, Chant K, et al. A cluster randomized trial of three hepatitis B vaccination programs targeting children in late primary school. Communicable Disease Control Conference 2003: Communicable Diseases A fight we can win?; 31 March - 1 April 2003; Canberra, Australia.
14. Blair A, Davies E. Parental reasons for discontinuing the Australian vaccination schedule. National, Paediatric and Child Health Nursing (NPCHN). 2003;6(1):6-12.
15. Kaplan DW. Barriers and potential solutions to increasing immunization rates in adolescents. *J Adolesc Health*. 2010;46(Suppl 2):S24-S33.
16. Neuendorf KA. The content analysis guidebook. London: Sage Publications, 2002.
17. Taylor SJ, Bogdan R. Introduction to qualitative research methods: the search for meanings. New York: John Wiley and Sons, 1984.
18. Brotherton JM, Deeks SL, Campbell-Lloyd S, et al. Interim estimates of human papillomavirus vaccination coverage in the school-based program in Australia. *Commun Dis Intell*. 2008;32(4):457-461.
19. Garland SM, Skinner SR, Brotherton JM. Adolescent and young adult HPV vaccination in Australia: achievements and challenges. *Prev Med*. 2011;53 Suppl 1:S29-35.
20. Council of Australian Governments (COAG). National partnership agreement on essential vaccines [Internet]. 2009. Accessed on 20 January 2011. Available from: www.federalfinancialrelations.gov.au/content/national_partnership_agreements/HE001/National_Partnership_agreement_on_Essential_Vaccines.pdf.
21. Milne B, Raman S, Thomas P, et al. Immunisation of refugee and migrant young people: can schools do the job? *Aust N Z J Public Health*. 2006;30(6):526-528.
22. Watson M, Shaw D, Molchanoff L, et al. Challenges, lessons learned and results following the implementation of a human papillomavirus school vaccination program in South Australia. *Aust N Z J Public Health*. 2009;33(4):365-370.
23. Government of South Australia Department of Health. Adolescent School Based Immunisation Program [Internet]. 2008. Accessed on 16 December 2010. Available from: www.publications.health.sa.gov.au/cgi/viewcontent.cgi?article=1020&context=cdc.
24. NSW Ministry of Health. NSW Adolescent Vaccination Program 2012 protocols. Sydney: NSW Government, 2012.
25. Queensland Government. School-based vaccination program. A resource kit for service providers, 3rd edition [Internet]. 2011. Accessed on 13 June 2012. Available from: www.health.qld.gov.au/immunisation/sbvp/information.asp.
26. Cooper-Robbins S, Bernard D, McCaffery K, et al. 'It's a logistical nightmare!' Recommendations for optimising human papillomavirus school-based vaccination experience. *Sex Health*. 2010;7(3):271-278.
27. Buttery JP, Madin S, Crawford NW, et al. Mass psychogenic response to human papillomavirus vaccination. *Med J Aust*. 2008;189(5):261-262.
28. Government of South Australia Department of Health. School-based immunisation program - education program for students/teachers/parents [Internet]. 2010. Accessed on 8th February 2011. Available from: www.health.sa.gov.au/pehs/Immunisation/School-Based-Programs-10/Student-Teacher-Parent-Edu.htm.
29. Northern Territory Department of Health and Families. School immunisation programs [Internet]. 2011. Accessed on 22 February 2011. Available from: www.health.nt.gov.au/Centre_for_Disease_Control/Immunisation/index.aspx#Schoolimmunisationprograms.
30. Northern Territory Government. NT Immunisation Database. [Internet] 2012. Accessed on 6 February 2012. Available from: www.health.nt.gov.au/Centre_for_Disease_Control/Immunisation/NT_Immunisation_Database/index.asp.
31. Queensland Government. Vaccine Information and Vaccination Administration System (VIVAS) [Internet]. 2012. Accessed on 6 February 2012. Available from: www.health.qld.gov.au/immunisation/health_professionals/vivas.asp.
32. Mak DB, Bulsara M, Goggin LS, et al. Resending a consent form and information package to non-responders increases school-based consent return rate. *Aust N Z J Public Health*. 2011;35(1):89-90.
33. Ward KF, Menzies RL, Quinn HE, et al. School-based vaccination in NSW. *N S W Public Health Bull*. 2010;21(10):237-242.
34. Victorian Cytology Service (VCS). The National Human Papillomavirus (HPV) Vaccination Program Register [Internet]. 2010. Accessed on 7 March 2011. Available from: www.hpvregister.org.au.

35. Hull BP, Lawrence GL, MacIntyre CR, et al. Estimating immunisation coverage: is the 'third dose assumption' still valid? *Commun Dis Intell.* 2003;27(3):357-361.
36. Turnbull FM, Burgess MA, McIntyre PB, et al. The Australian Measles Control Campaign, 1998. *Bull.W.H.O.* 2001;79(9):882-888.
37. Quinn HE, McIntyre PB. The impact of adolescent pertussis immunisation 2004 to 2009 – lessons from Australia. *Bull.W.H.O.* 2011;89:666–674.
38. Australian Government Department of Health. Immunise Australia Program: Human Papillomavirus (HPV) [Internet]. 2011. Accessed on 18 May 2011. Available from: www.immunise.health.gov.au/internet/immunise/publishing.nsf/Content/immunise-hpv.
39. National Vaccine Advisory Committee. Standards for child and adolescent immunization practices. *Pediatrics.* 2003;112(4):958-963.
40. Guajardo AD, Middleman AB, Sansaricq KM. School nurses identify barriers and solutions to implementing a school-based hepatitis B immunization program. *J Sch Health.* 2002;72(3):128-130.
41. Stewart P, MacDonald N, Manion I. School-based hepatitis B immunization program: follow-up of non-participants at first school clinic. *CJPH.* 1997;88(3):192-196.
42. Reeve C, Rue SDL, Pashen D, et al. School-based vaccinations delivered by general practice in rural north Queensland: an evaluation of a new human papilloma virus vaccination program. *Commun Dis Intell.* 2008;32(1):94-98.
43. Braunack-Mayer A, O'Keefe M, Skinner S, et al. ARC Linkage Grant project proposal for funding to commence in 2010: Optimising intersectoral collaboration between health and education sectors [Internet]. 2011. Accessed on 6 February 2012. Available from: www.arc.gov.au/pdf/LP10_R2/The_University_of_Adelaide.pdf.
44. Dempsey AF, Zimet GD, Davis RL, et al. Factors that are associated with parental acceptance of human papillomavirus vaccines: a randomized intervention study of written information about HPV. *Pediatrics.* 2006;117(5):1486-1493.
45. Pelletier L, Duclos P, Daly P, et al. Evaluation of the promotional materials used during the measles mass immunization campaign in Ontario and British Columbia. *CJPH.* 1998;89(5):329-332.
46. Middleman AB. Race/ethnicity and gender disparities in the utilization of a school-based hepatitis B immunization initiative. *J Adolesc Health.* 2004;34(5):414-419.
47. Tung CS, Middleman AB. An evaluation of school-level factors used in a successful school-based hepatitis B immunization initiative. *J Adolesc Health.* 2005;37(1):61-68.
48. Wilson T. A bi-state, metropolitan, school-based immunization campaign: lessons from the Kansas City experience. *J Pediatr Health Care.* 2001;15(4):173-178.
49. Cates JR, Shafer A, Carpentier FD, et al. How parents hear about human papillomavirus vaccine: implications for uptake. *J Adolesc Health.* 2010;47(3):305-308.
50. Queensland Government. Evaluation of the school-based vaccination program (2007–2009). Stakeholders' Report [Internet]. 2010. Accessed on 20 July 2011. Available from: www.health.qld.gov.au/immunisation/sbvp/information.asp.
51. Centres for Disease Control and Prevention. National and State Vaccination Coverage Among Adolescents Aged 13–17 Years — United States, 2011. *Morbidity & Mortality Weekly Report.* 2012;61(34):671-677.
52. Correll PK, Hayen A, Eyeson-Annan M. Hepatitis B immunisation in children aged 10-13 years in New South Wales, 2001. *N S W Public Health Bull.* 2003;14(1-2):17-20.
53. British Columbia Centre for Disease Control. Immunisation coverage: school age children [Internet]. 2010. Accessed on 8th March 2011. Available from: www.bccdc.ca/imm-vac/BCImmizationCov/school-agecoverage/default.htm.
54. LaMontagne DS, Barge S, Le NT, et al. Human papillomavirus vaccine delivery strategies that achieved high coverage in low- and middle-income countries. *Bull World Health Organ.* 2011;89(11):821-830B.
55. Sheridan A, White J. Annual HPV vaccine coverage in England: 2009/10 [Internet]. 2011. Accessed on 27 January 2011. Available from: www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_123795
56. The Ministerial Council for Education Early Childhood Development and Youth Affairs (MCEECDYA). National report on schooling in Australia, 2008 [Internet]. 2008. Accessed on 29 September 2011. Available from: <http://cms.curriculum.edu.au/anr2008/index.htm>.
57. Public Health Agency of Canada. Canadian National Report on Immunization, 2006. *CCDR.* 2006;32(Suppl 3):1-44.
58. Hull BP, Deeks SL, McIntyre PB. The Australian Childhood Immunisation Register – a model for universal immunisation registers? *Vaccine.* 2009;27(37):5054-5060.
59. Australian Institute of Health and Welfare. 2009 adult vaccination survey. Summary results. Canberra: *AIHW*, 2011.
60. Jain N, Singleton JA, Montgomery M, et al. Determining accurate vaccination coverage rates for adolescents: the National Immunization Survey-Teen 2006. *Public Health Rep.* 2009;124(5):642-651.
61. Lessler J, Metcalf CJ, Grenfell BT. Measurement of vaccine-derived immunity: how do we use all the data? Expert review of vaccines. 2012;11(7):747-749.
62. ACT Health. Consent to medical treatment policy (CED 08 – 073). Canberra: ACT Government, 2008.
63. Government of South Australia. Consent to Medical Treatment and Palliative Care Act. Adelaide: Government of South Australia, 1995.
64. National Health and Medical Research Council (NHMRC). The Australian Immunisation Handbook. 9th edition. Canberra: Australian Government Department of Health, 2008.
65. Fitzroy Legal Service, State Government of Victoria Department of Justice. The Law Handbook Online [Internet]. 2010. Accessed on 12 March 2012. Available from: www.lawhandbook.org.au.
66. The Parliament of Western Australia. Acts Amendment (Consent to Medical Treatment) Act 2008. Perth: Government of Western Australia, 2008.