OVERVIEW OF THE IMMUNISATION PROGRAMMES IN SINGAPORE

The National Childhood Immunisation Schedule (NCIS) in Singapore comprises childhood vaccinations recommended as the standard of care for protection against vaccine preventable diseases that are of significant healthcare burden to Singapore or would be so without these vaccinations. In consultation with the Expert Committee on Immunisation (ECI), MOH regularly reviews vaccination policies and inclusion of vaccines into the schedule, taking into consideration local disease burden, vaccine safety, efficacy and cost effectiveness of vaccines. This ensures that the national recommendations for childhood vaccinations are up to date.

The NCIS covers vaccinations against TB (BCG); hepatitis B (HepB); diphtheria, pertussis and tetanus (DTaP/Tdap); poliomyelitis (IPV); *Haemophilus influenzae* type b (Hib); measles, mumps and rubella (MMR); pneumococcal disease (PCV); and human papillomavirus (HPV) (Table 7.1). Vaccinations against diphtheria and measles are compulsory under the Infectious Diseases Act. In 2019 and 2020, following changes were made to the NCIS: i) new addition of varicella-containing vaccines (monovalent and MMRV); ii) schedule- or vaccine type-changes to 5-in-1 (DTaP-IPV-Hib) and 6-in-1 (DTaP-IPV-Hib-HepB) combination vaccines, poliovirus and HPV vaccines; and iii) incorporation of existing recommendations for influenza and pneumococcal polysaccharide vaccines.

BCG vaccination began in 1957 as part of the National Childhood Immunisation Programme (NCIP) and newborns were vaccinated at birth. Although parental consent is required, acceptance has been high and close to 100% of newborns have been vaccinated in the last decade (Table 7.3). The introduction of BCG vaccination has contributed significantly to the elimination of TB meningitis in young children. Since July 2001, guidelines have been revised to discontinue BCG in Mantoux non-reactors as well as BCG booster doses.

Diphtheria vaccination was introduced in 1938, initially as a monovalent vaccine and later formulated together with pertussis and tetanus vaccines from 1959. Over the years, numerous changes were made to diphtheria-tetanus-pertussis vaccinations following reviews of latest evidence or vaccine availability, including the number of booster doses, switch in vaccine types and changes to the recommended age in the schedule. In June 2013, diphtheria, tetanus and acellular pertussis (DTaP) vaccine recommended for infants and pre-school children at 3, 4, 5 and 18 months of age was replaced with 5-in-1 vaccine containing IPV and Hib in addition to DTaP. Most recently in November 2020, 6-in-1 vaccine had replaced 5-in-1 vaccine for the first and third dose of the recommended schedule. In tandem with this change, the schedule for the first three doses was changed from 3, 4, and 5 months to 2, 4 and 6 months of age; the fourth dose remained unchanged at 18 months of age. For the fifth and last dose of diphtheria-containing vaccine, Tdap vaccine continued to be recommended at 10-11 years of age (primary five). Since 2021, Tdap has been given in the form of Tdap-IPV vaccine (Table 7.1).

Another vaccine scheduled at the same timing as diphtheria-containing vaccine is polio vaccine. Oral polio vaccine (OPV) was first used on a mass scale in 1958 to control the 1958-1959 epidemic caused by poliovirus type 1. Monovalent Sabin type 2 OPV was administered to 200,000 children aged between 3 months and 10 years on a voluntary basis in an attempt to abort a raging epidemic of 415 paralytic cases. Following another vaccination campaign in 1962, OPV was incorporated as part of routine immunisation programme in March 1963. Over the years, a number of changes were made to the schedule and vaccine types. Notable changes to polio vaccinations in the NCIS in the last decade include: i) the switch from a six-dose OPV schedule to a five-dose IPV-OPV schedule comprising four doses at 3, 4, 5 and 18 months of age using IPV-containing vaccine and one OPV dose at 10-11 years of age (primary five) in June 2013 (the OPV dose at age 6-7 years (primary one) was discontinued then); ii) the replacement of trivalent OPV (tOPV, containing poliovirus types 1, 2 and 3) for the fifth dose with bivalent OPV (bOPV, containing poliovirus types 1 and 3) in 2016 to meet the World Health Organization's (WHO) requirement to switch from tOPV to bOPV globally; and iii) replacement of bOPV for the fifth dose with an IPV-containing vaccine (Tdap-IPV) in 2021. With this latest change, IPV is recommended for all doses in the NCIS.

Hepatitis B vaccination for infants born to hepatitis B carrier mothers was incorporated into the NCIS in October 1985, thereafter extended to all newborns in September 1987. Three doses were recommended using monovalent HepB vaccine at birth, 1 month and 5-6 months of age. To protect

those born before 1987 against hepatitis B, a four-year catch-up vaccination programme was implemented for students in secondary schools and tertiary institutions as well as full-time national servicemen (NSFs) from 2001 to 2004. With the introduction of 6-in-1 vaccine in November 2020, the monovalent HepB vaccine for the second and third dose was replaced with 6-in-1 vaccine and the timing for these doses was changed to 2 months and 6 months of age, respectively. For infants born to hepatitis B carrier mothers, monovalent HepB vaccine continues to be recommended for the second dose and at age one month to reduce the risk of vertical transmission of hepatitis B infection.

Hib vaccination was introduced into the NCIS in June 2013 to reduce the risk of invasive disease such as meningitis and sepsis which may lead to long-term disabilities or death. A four-dose schedule was recommended using 5-in-1 vaccine at 3, 4, and 5 months of age and a single booster dose at 18 months of age. The timing for the first three doses was changed to 2, 4, 6 months of age in November 2020 with 6-in-1 replacing 5-in-1 vaccine for the dose at 2 and 6 months of age.

First introduced into the NCIS in October 1976, the monovalent measles vaccine given to one-year-old children was replaced by the trivalent MMR vaccine in January 1990. From January 1998, a second dose of MMR vaccine was introduced into the programme for primary six students (11-12 years of age), replacing the monovalent rubella vaccine earlier introduced for primary six female students in November 1976 (extended to males in 1982). The timing of second MMR dose was subsequently brought forward to primary one (6-7 years of age) in 2008. The MMR vaccination schedule was further reviewed and the revised schedule was implemented in December 2011. With these changes, both doses of MMR vaccine were brought forward to 12 months and 15-18 months of age, respectively. The timing of the second dose was changed from 15-18 months to 15 months in November 2020 with the replacement of MMR with MMRV. The Health Promotion Board (HPB) continues to provide MMR vaccination as a catch-up for primary one students (6-7 years of age) who did not receive the second dose in their pre-school years.

Varicella vaccination was introduced into the NCIS in November 2020 to decrease the incidence of the disease and its complications. The first dose at 12 months of age is recommended using a monovalent formulation, i.e. separate from MMR vaccine but both vaccines can be given at the same visit. The second dose is recommended at 15 months using combined MMR and varicella (MMRV) vaccine.

Pneumococcal conjugate vaccine (PCV) was incorporated into the NCIS in November 2009 to reduce the morbidity and mortality of invasive pneumococcal disease (IPD) in Singapore. At the point of introduction, a three-dose schedule was recommended with two doses for the primary series at age 3 and 5 months, and one booster dose at age 12 months (2+1 schedule). As part of the schedule changes in November 2020, the timing for the first two doses was changes to 4 and 6 months of age, respectively, with no change to the timing of booster dose at 12 months of age. Another change involved the incorporation of existing recommendations for 23-valent pneumococcal polysaccharide vaccine (PPSV23), for children aged 2 to 17 years with specific medical condition or indication and therefore at increased risk of developing severe pneumococcal disease. These recommendations hitherto existed as standalone recommendations and have been incorporated into the NCIS since November 2020.

Similar to PPSV23, the recommendations for influenza vaccination for children in high-risk groups had existed as standalone recommendations prior to November 2020. Henceforth, the recommendations for influenza vaccination in children, including all children aged 6 months to <5 years (i.e. 6 to 59 months) and those aged 5 to 17 years with specific medical condition or indication have been incorporated into the NCIS.

Human papillomavirus (HPV) vaccination was first introduced into the NCIS in November 2010 and recommended for females aged 9 to 26 years old for the prevention of cervical cancer. The HPV vaccination for adult females (aged 18 to 26 years) was subsumed into the National Adult Immunisation Schedule (NAIS) upon its establishment in 2017 together with other recommended vaccination for adults.

In April 2019, HPV vaccination was rolled out as a national school-based programme for secondary 1 female students. The routine schedule for the school-based programme consists of two doses, with the first dose at 12-13 years of age (secondary 1) and the second dose at 13-14 years of age (secondary 2); the third dose is recommended only if the first dose was given at 15 years of age or older. Outside of school-based programme, HPV vaccination continue to be recommended in both NCIS and NAIS as

a catch-up with age-appropriate doses for females up to and through 26 years of age.

Table 7.1
Singapore's National Childhood Immunisation Schedule (NCIS), 2020
(from birth to age 17 years)

Vaccine	Birth	2 mths	4 mths	6 mths	12 mths	15 mths	18 mths	2-4 yrs	5-9 yrs	10-11 yrs	12-13 yrs	13-14 yrs	15-17 yrs
Bacillus Calmette-Guérin (BCG)	D1												
Hepatitis B (HepB)	D1	D2		D3									
Diphtheria, tetanus and acellular pertussis (paediatric) (DTaP)		D1	D2	D3			B1						
Tetanus, reduced diphtheria and acellular pertussis (Tdap)										B2			
Inactivated poliovirus (IPV)		D1	D2	D3			B1			B2			
***Haemophilus influenzae* type b (Hib)**		D1	D2	D3			B1						
Pneumococcal conjugate (PCV10 or PCV13)			D1	D2	B1								
Pneumococcal polysaccharide (PPSV23)								One or two doses for children and adolescents aged **2-17 years with specific medical condition or indication**					
Measles, mumps and rubella (MMR)					D1	D2							
Varicella (VAR)					D1	D2							
Human papillomavirus (HPV2 or HPV4)											D1 **(Females)**	D2	
Influenza (INF)				Annual vaccination or per season for <u>all children</u> aged **6 months to <5 years (6-59 months)**					Annual vaccination or per season for children and adolescents aged **5-17 years with specific medical condition or indication**				

Recommended ages and doses for all children

Recommended for persons with specific medical condition or indication

Footnotes:

D1, D2, D3:	Dose 1, dose 2, dose 3	**10-11 years**:	Primary five
B1, B2:	Booster 1, booster 2	**12-13 years**:	Secondary one
-	**-**	**13-14 years**:	Secondary two

HepB: recommended vaccine types and doses
Dose 1: Monovalent HepB (birth dose, within 24 hours)
Dose 2: 6-in-1 vaccine at 2 months (DTaP-IPV-Hib-HepB)
Dose 3: 6-in-1 vaccine at 6 months
5-in-1 (DTaP-IPV-Hib), 6-in-1 and Tdap: recommended vaccine type and doses
Dose 1: **6-in-1** vaccine at 2 months
Dose 2: **5-in-1** vaccine at 4 months
Dose 3: **6-in-1** vaccine at 6 months
Dose 4: **5-in-1** vaccine at 18 months (booster 1)
Dose 5: **Tdap-IPV** at 10-11 years (booster 2)
MMR and varicella: recommended vaccine type and doses
Dose 1: Separate **MMR** and **VAR** at 12 months
Dose 2: Combined **MMRV** at 15 months
Tdap, IPV, HPV (for females) and **MMR (as catch-up)** vaccines are provided as part of Health Promotion Board's school-based vaccination programme

The National Adult Immunisation Schedule (NAIS) was established in November 2017 to provide guidance on vaccines recommended for persons aged 18 years and above and increase awareness on the importance of adult vaccinations for personal protection (Table 7.2). The NAIS was developed based on international best practice and the recommendations of the ECI. The considerations include:

(a) local disease burden;
(b) age, pre-existing medical conditions, vaccination history; and
(c) vaccine safety, clinical efficacy and cost effectiveness of the vaccines in preventing infections among susceptible individuals and reducing complications, morbidity and mortality.

The vaccines in the NAIS protect against 11 diseases: influenza, pneumococcal disease, human papillomavirus, tetanus, diphtheria, pertussis, measles, mumps, hepatitis B, and varicella (chickenpox). The recommendations in the NAIS are categorised as follows: i) adults who meet age requirement; ii) adults with specific medical condition or indication; and iii) adults who have not been previously vaccinated, or lack evidence of past infection or immunity.

Table 7.2
Singapore's National Adult Immunisation Schedule (NAIS), 2020
(for age 18 years or older)

<table>
<tr><th>Vaccine</th><th>18-26 years</th><th>27-64 years</th><th>≥ 65 years</th></tr>
<tr><td>Influenza (INF)</td><td colspan="2">1 dose annually or per season</td><td>1 dose annually or per season</td></tr>
<tr><td>Pneumococcal conjugate (PCV13)</td><td colspan="2">1</td><td>dose</td></tr>
<tr><td>Pneumococcal polysaccharide (PPSV23)</td><td colspan="2">1 or 2 doses (depending on indication)</td><td>1 dose</td></tr>
<tr><td>Tetanus, reduced diphtheria and acellular pertussis (Tdap)</td><td colspan="3">1 dose during each pregnancy</td></tr>
<tr><td>Human papillomavirus (HPV2 or HPV4)</td><td>3 doses (Females)</td><td colspan="2"></td></tr>
<tr><td>Hepatitis B (HepB)</td><td colspan="3">3 doses</td></tr>
<tr><td>Measles, mumps and rubella (MMR)</td><td colspan="3">2 doses</td></tr>
<tr><td>Varicella (VAR)</td><td colspan="3">2 doses</td></tr>
</table>

Recommended for adults who meet age requirement

Recommended for adults with specific medical condition or indication

Recommended for adults who have not been previously vaccinated, or lack evidence of past infection or immunity

IMPLEMENTATION OF THE IMMUNISATION PROGRAMMES

The NCIP is carried out by:

(a) Public and private hospitals with neonatal immunisation services;
(b) National Healthcare Group Polyclinics (NHGP), National University Polyclinics (NUP) and Singhealth Polyclinics (SHP);
(c) Private general practitioner (GP) clinics;
(d) Paediatric clinics in the private sector and at KK Women's and Children's Hospital (KKH) and National University Hospital (NUH);
(e) Youth Preventive Services Division (YPSD), Health Promotion Board (HPB).

Vaccination of newborns for birth doses is carried out at public and private hospitals with neonatal immunisation services. Vaccination of infants and children is carried out at polyclinics, private GP clinics and paediatric clinics in the private sector and public hospitals. The target population is based on notification of births obtained from the Registry of Births and Deaths.

Vaccination of primary and secondary school children is mainly carried out by HPB. The target population is based on student population data from the Ministry of Education.

Vaccination for adults is offered by GP clinics, polyclinics, and some specialist clinics in public and private sectors.

Notification of vaccination

The data utilised in this report was based on:

(a) Notification of all vaccinations carried out in infants and children by healthcare institutions in both the public and private sectors to the National Immunisation Registry (NIR) at HPB. Notification of diphtheria and measles vaccinations are compulsory by law; and
(b) Vaccination records maintained by YPSD for vaccinations administered in schools and at the Immunisation Clinic,
(c) Student Health Centre, HPB.

All data are updated annually (including figures for the preceding years).

Vaccination against TB

In 2020, BCG vaccination was given to 29,842 infants, with a coverage of 93.9%†, compared to 31,585 infants vaccinated with 98.5% coverage in 2019 (Table 7.3).

Table 7.3
BCG vaccination of infants, 2011-2020

Year	Public hospitals (%)	Polyclinics (%)	Private clinics & hospitals (%)	Total	Coverage for children at 2 years of age* (%)
2011	13,358 (41.8)	67 (0.2)	18,515 (58.0)	31,940	99.5
2012	12,324 (41.1)	111 (0.4)	17,578 (58.6)	30,013	99.4
2013	12,672 (40.9)	49 (0.2)	18,279 (59.0)	31,000	99.3
2014	13,089 (39.3)	43 (0.1)	20,184 (60.6)	33,316	99.0
2015	12,540 (40.4)	54 (0.2)	18,423 (59.4)	31,017	99.4
2016	14,122 (41.6)	74 (0.2)	19,731 (58.2)	33,927	99.2
2017	14,336 (42.9)	68 (0.2)	18,994 (56.9)	33,398	98.9
2018	14,872 (44.9)	4 (0.0)	18,271 (55.1)	33,147	98.8
2019	14,991 (47.5)	1 (0.0)	16,593 (52.5)	31,585	98.5
2020	15,047 (50.4)	9 (0.0)	14,786 (49.5)	29,842	93.9†

* Coverage refers to vaccination given to Singaporean and Singapore Permanent Resident (PR) children.
† The coverage for 2020 is preliminary and a finalised figure will be published in next year's report.

Vaccination against diphtheria, pertussis and tetanus

Infants and pre-school children

In 2020, the primary course of vaccination was given to 30,984 children, with a coverage of 97.5%, compared to 31,018 children vaccinated with 96.7% coverage in 2019. The first booster dose was given to 29,563 children by two years of age with a coverage of 93% in 2020, compared to 29,206 children vaccinated with 91% coverage in 2019 (Table 7.4).

Table 7.4
Diphtheria, pertussis and tetanus vaccination (DTaP) of infants and pre-school children, 2011-2020

Year	Coverage for children at 2 years of age*			
	Completed primary course		1st booster dose given	
	No.	Coverage (%)	No.	Coverage (%)
2011	31,132	97.0	29,482	91.9
2012	29,490	97.7	27,889	92.4
2013	30,468	97.6	28,898	92.6
2014	32,811	97.5	30,933	91.9
2015	30,390	97.4	28,617	91.7
2016	33,359	97.6	31,562	92.3
2017	32,675	96.7	31,028	91.9
2018	32,643	97.3	30,554	91.0
2019	31,018	96.7	29,206	91.0
2020	30,984	97.5	29,563	93.0

* Coverage refers to vaccinations given to Singaporean and Singapore PR children.

School children

In 2020, the second booster dose (using Tdap) was given to 37,660 primary five students with a coverage of 94.1%, compared to 37,579 students vaccinated with 91.8% coverage in 2019 (Table 7.5).

Table 7.5
Diphtheria, tetanus and pertussis vaccination (Tdap) of primary five students (10-11 years of age), 2011-2020

Year	Total no. of primary five students	2nd booster dose given*	
		No.	Coverage (%)
2011	48,878	45,890	93.9
2012	43,651	40,147	92.0
2013	43,086	39,359	91.3
2014	39,952	36,484	91.3
2015	39,858	36,888	92.5
2016	39,982	36,745	91.9
2017	40,736	37,471	92.0
2018	41,319	38,094	92.2
2019	40,942	37,579	91.8
2020	40,019	37,660	94.1

* Coverage refers to vaccinations given to primary five students in national schools, comprising resident and non-resident students. It is inclusive of vaccinations given outside of HPB's programme, e.g. at polyclinics and private GP clinics.

Vaccination against *Haemophilus influenzae* type b

In 2020, the primary course of *Haemophilus influenzae* type b (Hib) vaccination was given to 30,970 children, with a coverage of 97.4%, compared to 30,786 children vaccinated with 96% coverage in 2019. The booster dose was given to 29,534 children by two years of age with a coverage of 92.9% in 2020, compared to 29,169 children vaccinated with 90.9% coverage in 2019 (Table 7.6).

Table 7.6
Haemophilus influenzae* type b vaccination of infants and pre-school children, 2011-2020

Year	Coverage for children at 2 years of age†			
	Completed primary course		Booster dose given	
	No.	Coverage (%)	No.	Coverage (%)
2011	25,959	80.9	24,827	77.4
2012	24,909	82.5	23,825	78.9
2013	26,459	84.8	25,550	81.9
2014	29,130	86.5	28,459	84.5
2015	30,178	96.7	28,257	90.5
2016	33,289	97.4	31,476	92.1
2017	32,612	96.5	30,968	91.7
2018	32,608	97.1	30,354	90.4
2019	30,786	96.0	29,169	90.9
2020	30,970	97.4	29,534	92.9

* Hib vaccination was introduced into the NCIS in 2013.
† Coverage refers to vaccinations given to Singaporean and Singapore PR children.

Vaccination against poliomyelitis

Infants and pre-school children

In 2020, the primary course of polio vaccination was given to 30,990 children, with a coverage of 97.5%, compared to 31,013 children vaccinated with 96.7% coverage in 2019. The first booster dose was given to 29,541 children by two years of age with a coverage of 93% in 2020, compared to 29,171 children were vaccinated with 90.9% coverage in 2019 (Table 7.7).

School children

In 2020, the second booster dose was given to 38,507 primary five students with a coverage of 96.2%, compared to 39,306 students were vaccinated with 96% coverage in 2019 (Table 7.8).

Table 7.7
Polio vaccination of infants, pre-school and school children, 2011-2020

Year	Coverage for children at 2 years of age*				School Children		
	Completed primary course		1st booster dose given		2nd booster dose given§		
	No.	Coverage (%)	No.	Coverage (%)	School entrants	No.	Coverage (%)
2011	31,119	97.0	29,392	91.6	39,591	36,618	92.5
2012	29,485	97.7	27,810	92.1	40,127	36,787	91.7
2013	30,459	97.6	28,835	92.4	40,783	37,252	91.3
2014	32,792	97.4	30,857	91.7	-	-	-
2015	30,379	97.3	28,492	91.3	-	-	-
2016	33,346	97.5	31,506	92.2	-	-	-
2017	32,666	96.7	30,972	91.7	-	-	-
2018	32,640	97.2	30,508	90.9	-	-	-
2019	31,013	96.7	29,171	90.9	-	-	-
2020	30,990	97.5	29,541	93.0	-	-	-

* Coverage refers to vaccinations given to Singaporean and Singapore PR children.
§ Coverage refers to vaccinations given to primary one students in national schools, comprising resident and non-resident students. It is inclusive of vaccinations given outside of HPB's programme, e.g. at polyclinics and private GP clinics. The OPV booster dose for school entrants was discontinued at the end of 2013.

Table 7.8
Polio vaccination of primary five students (10-11 years of age), 2011-2020

Year	Total no. of primary five students	Booster dose given*	
		No.	Coverage (%)
2011	48,878	47,587	97.4
2012	43,651	42,060	96.4
2013	43,086	41,749	96.9
2014	39,952	38,812	97.1
2015	39,858	38,716	97.1
2016	39,982	38,816	97.1
2017	40,736	39,523	97.0
2018	41,319	39,043	94.5
2019	40,942	39,306	96.0
2020	40,019	38,507	96.2

* Coverage refers to vaccinations given to primary five students in national schools, comprising resident and non-resident students. It is inclusive of vaccinations given outside of HPB's programme, e.g. at polyclinics and private GP clinics.

Vaccination against measles, mumps and rubella

Pre-school children

In 2020, the first dose of measles, mumps and rubella vaccination was given to 30,681 children, with a coverage of 96.5%, compared to 30,861 children vaccinated with 96.2% coverage in 2019. The second dose was given to 29,733 children by two years of age with a coverage of 93.6% in 2020, compared to 29,541 children vaccinated with 92.1% coverage in 2019 (Table 7.9).

Table 7.9
Measles, mumps and rubella vaccination of pre-school and primary school children, 2011-2020

Year	Coverage for children at 2 years of age*				Primary school children†	
	Dose 1		Dose 2§		Dose 2§	
	No.	Coverage (%)	No.	Coverage (%)	No.	Coverage (%)
2011	30,611	95.4	-	-	35,797	90.4
2012	28,903	95.7	-	-	35,685	88.9
2013	30,013	96.2	27,455	88.0	-	-
2014	32,422	96.3	30,281	89.9	-	-
2015	29,968	96.0	28,465	91.2	-	-
2016	32,945	96.4	31,463	92.0	-	-
2017	32,458	96.1	31,119	92.1	-	-
2018	32,354	96.4	30,547	91.0	-	-
2019	30,861	96.2	29,541	92.1	-	-
2020	30,681	96.5	29,733	93.6	-	-

* Coverage refers to vaccinations given to Singaporean and Singapore PR children.

† Coverage refers to vaccination given to primary one students in national schools, comprising resident and non-resident students. Coverage is inclusive of vaccinations given outside of HPB's programme, e.g. at polyclinics and private GP clinics.

§ Dose 2 was administered in primary schools at 11-12 years of age (primary six) up to 2007, 6-7 years of age (primary one) from 2008 to November 2011 (reported up to 2012) and 15-18 months of age from December 2011 to October 2020 (reported from 2013). Since November 2020, dose 2 is recommended at 15 months of age.

Vaccination against hepatitis B

In 2020, the primary course of hepatitis B vaccination was given to 30,819 children, with a coverage of 97%, compared to 30,929 children vaccinated with 96.4% coverage in 2019 (Table 7.10).

Table 7.10
Hepatitis B vaccination of infants and pre-school children, 2011-2020

Year	Coverage for children at 2 years of age who completed primary course*	
	No.	Coverage (%)
2011	30,969	96.5
2012	29,416	97.4
2013	30,367	97.3
2014	32,722	97.2
2015	30,303	97.1
2016	33,236	97.2
2017	32,640	96.6
2018	32,562	97.0
2019	30,929	96.4
2020	30,819	97.0

* Coverage refers to vaccinations given to all Singaporean and Singapore PR children.

Vaccination against pneumococcal disease

In 2020, the primary course of pneumococcal vaccination was given to 28,948 children, with a coverage of 91.1%, compared to 28,690 children vaccinated with 89.4% coverage in 2019. The booster dose was given to 27,503 children by two years of age with a coverage of 86.5% in 2020, compared to 26,971 children vaccinated with 84.1% coverage in 2019 (Table 7.11).

Table 7.11
Pneumococcal vaccination of infants and pre-school children, 2011-2020

Year	Coverage for children at 2 years of age*			
	Completed two-dose primary course†		Booster (3rd) dose given	
	No.	Coverage (%)	No.	Coverage (%)
2011	16,667	51.9	13,153	41.0
2012	19,780	65.5	15,935	52.8
2013	22,644	72.5	19,042	61.0
2014	26,735	79.4	23,422	69.6
2015	25,952	83.2	23,719	76.0
2016	29,309	85.7	27,009	79.0
2017	29,734	88.0	27,767	82.2
2018	29,825	88.9	28,138	83.8
2019	28,690	89.4	26,971	84.1
2020	28,948	91.1	27,503	86.5

* Coverage refers to vaccinations given to Singaporean and Singapore PR children.

† Starting from 2017 publication, the coverage for the completion of primary course is reported at 2 years of age, instead of 1 year as reported in previous publications up to 2016.

EFFECTIVENESS OF THE IMMUNISATION PROGRAMME

The effectiveness of childhood immunisation programme against poliomyelitis and diphtheria is shown in Figures 7.1 and 7.2, respectively. In 2019-2020, no indigenous case of poliomyelitis or neonatal tetanus was reported.

Figure 7.1
Incidence of reported poliomyelitis cases and vaccination coverage in Singapore, 1946-2020

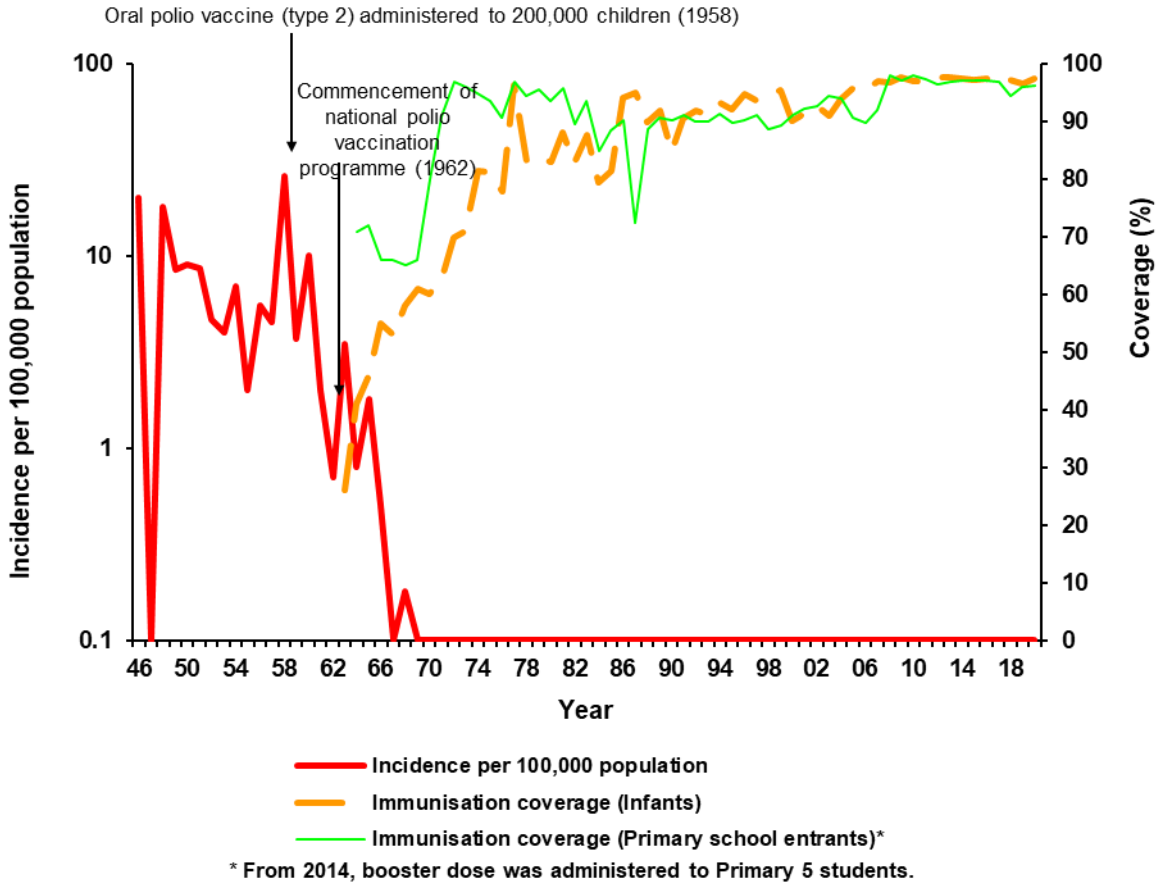
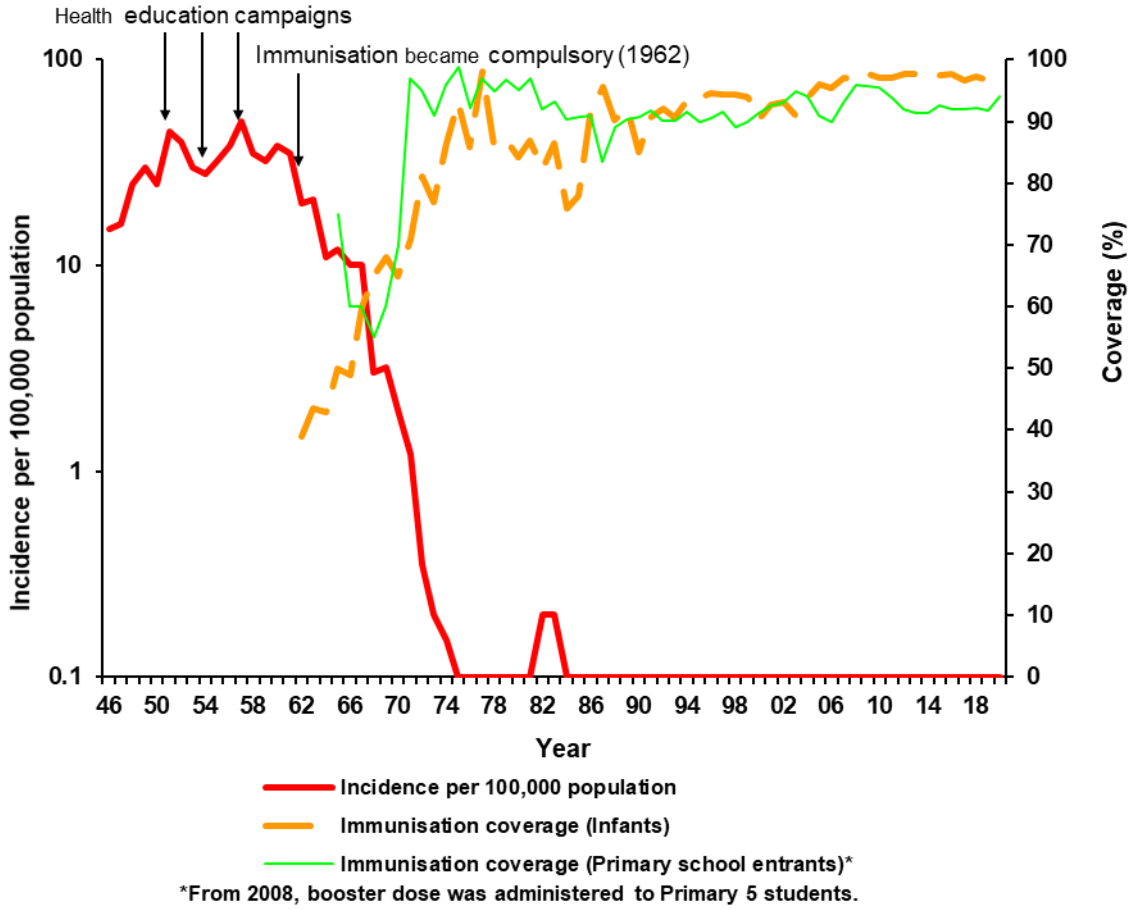
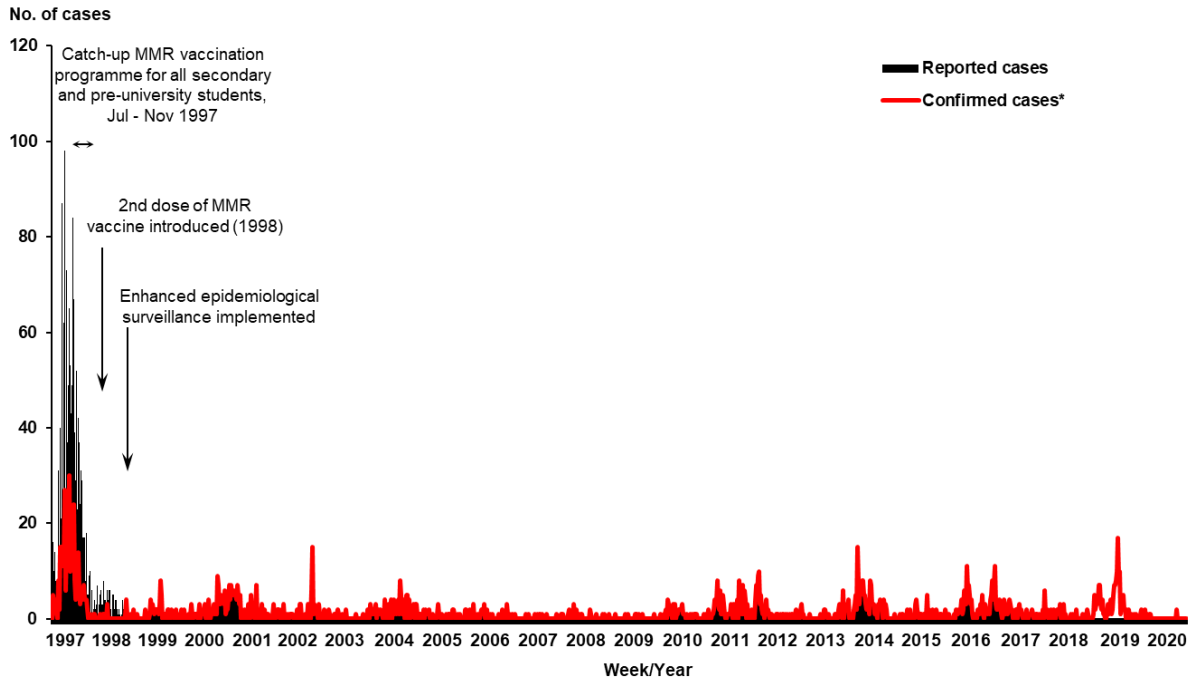


Figure 7.2
Incidence of reported diphtheria cases and vaccination coverage in Singapore, 1946-2020



With the implementation of 'catch-up' measles vaccination programme using MMR vaccine in 1997, and the introduction of the second dose of MMR vaccine to all primary six school children (11-12 years of age) in 1998 and subsequent changes to the immunisation schedule for the second dose (to primary one school children aged 6-7 years in 2008, 15-18 months of age in 2011 and 15 months of age in 2020), the number of reported cases of measles decreased from 1,413 cases in 1997 to 34, 152 and 12 cases in 2018, 2019 and 2020, respectively (Figure 7.3). The increase in measles incidence in 2019 was consistent with the surge in measles cases regionally and globally.

Figure 7.3
Impact of catch-up MMR vaccination programme and introduction of second dose of MMR vaccine on the number of reported measles cases in Singapore, 1997-2020



* Measles-specific IgM antibody positive or measles virus PCR positive

The number of reported cases of rubella decreased from 48 cases in 2013 to 10, two and one cases in the last three reporting years. There was no reported case of indigenous congenital rubella in 2019 and 2020. Two termination of pregnancy due to rubella infection were carried out in 2019; none in 2020 (Table 7.12).

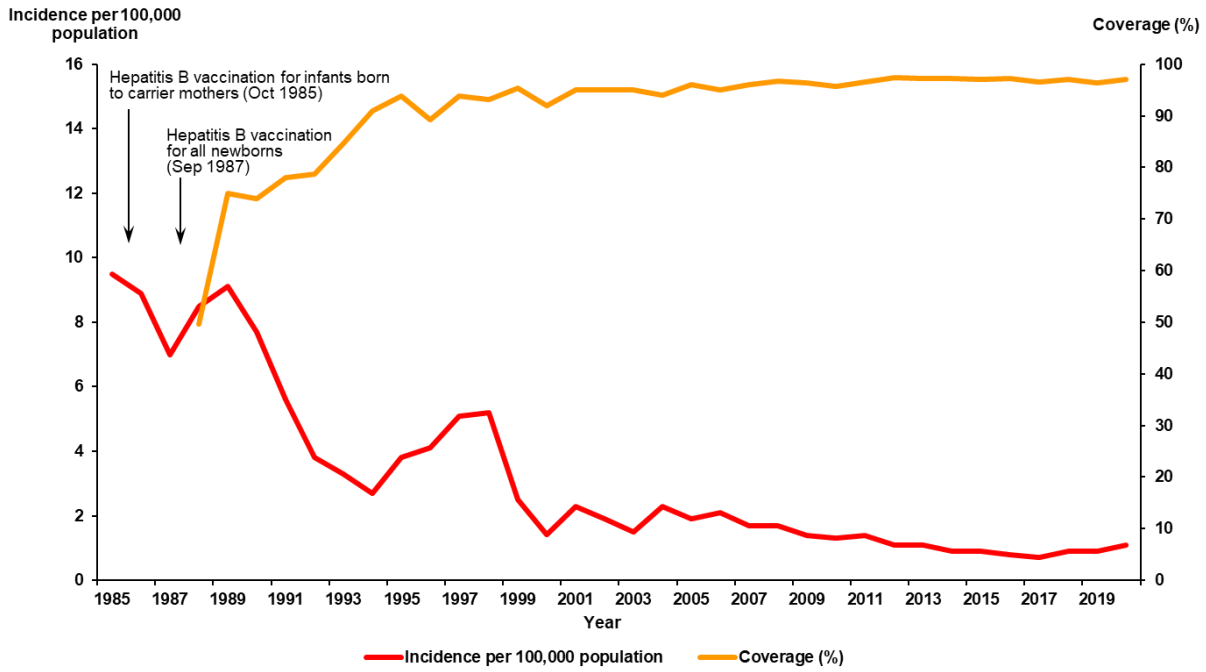
The resurgence of mumps which began in 1998 continued till 2002. The resurgence was due to poor protection conferred by the Rubini strain of the MMR vaccine which was subsequently de-registered in 1999. The number of reported mumps cases remained largely unchanged in recent years; there were 474 and 422 cases in 2018 and 2019, respectively, while relatively fewer cases were reported in 2020 at 285 cases (Table 7.13).

Table 7.12
No. of therapeutic abortions performed for rubella infection, 2011-2020

Year	Total no. of abortions	No. of therapeutic abortions performed for rubella infections
2011	11,940	0
2012	10,624	1
2013	9,282	2
2014	8,515	0
2015	7,942	1
2016	7,237	0
2017	6,834	2
2018	6,413	2
2019	6,067	2
2020	6,648	0

The incidence of reported acute hepatitis B cases for all age groups declined from 9.5 per 100,000 population in 1985 to 0.9 and 1.1 per 100,000 population in 2019 and 2020, respectively (Figure 7.4). There has been no indigenous case among children <15 years since 1996 (Table 7.13).

Figure 7.4
Incidence of reported acute hepatitis B cases and vaccination coverage in Singapore, 1985-2020



National Seroprevalence Survey

A national seroprevalence survey was conducted in 2018 to determine the prevalence of antibodies against vaccine preventable diseases and other diseases of public health importance in the adult Singapore resident population aged 18-74 years. Residual sera collected from the National Population Health Survey 2017 were used for this survey.

The seroprevalence of measles and rubella among adult residents in Singapore was 99.4% and 90.8% respectively. While 100% of females aged 18 to 29 years were seropositive against rubella, 4.4% of females in the 30-49 age group remained susceptible to rubella infection.

For diphtheria, the seroprevalence of diphtheria antitoxin levels (basic protection, ≥0.01 IU/mL) was 96.7%. The 60-74 age group had the lowest diphtheria antitoxin levels conferring basic protection at 93.0%. The seroprevalence of protective level of tetanus antitoxin (≥ 0.1 IU/mL) was 79.3%. The seroprevalence of tetanus antitoxin levels (≥ 0.1 IU/mL) declined significantly with increased age from 97.2% in 18-29 age group to 58.2% in those aged 60-74 years. The seroprevalence in males (90.4%) was significantly higher than in females (68.4%).

For hepatitis B, the prevalence of anti-HBs (≥10 mIU/mL) was 46.0%. The overall HBsAg prevalence was 2.1%.

Table 7.13
Reported cases of diphtheria, poliomyelitis, measles, mumps, rubella, acute hepatitis B, neonatal tetanus, pertussis, congenital rubella, and childhood tuberculous meningitis in Singapore, 1991-2020

Year	Diphtheria	Poliomyelitis	Measles	Mumps*	Rubella*	Acute hepatitis B[†]	Neonatal tetanus[‡]	Pertussis[§]	Congenital rubella[¶]	Childhood tuberculous meningitis[#]
1991	1(1)	0	216	636	51	3	0	5[††]	1	0
1992	1	0	606	1,981	370	3	0	14[††]	4	0
1993	0	0	665	1,962	423	2	0	1[††]	4	0
1994	0	0	159	1,636	299	2	1	2[††]	2	0
1995	0	0	185	786	326	0	0	1[††]	2[‡]	2[‡]
1996	1(1)	0	308	765	487	3	0	4(1)[‡‡]	2[‡]	2[‡]
1997	0	0	1,413	674	360	0	0	2[††]	0[‡]	2[‡]
1998	0	0	114	1,183	179	0	0	1**	0[‡]	0
1999	0	0	65[††]	6,384(28)	432	0	0	1[††]	2[‡]	1[‡]
2000	0	0	141[††]	5,981**	312**	0	0	2(1)[‡‡]	0	1[‡]
2001	0	0	61[††]	1,399**	242**	0	0	1**	2[‡]	0
2002	0	0	57[††]	1,090**	152**	0	0	0	1	1
2003	0	0	33[††]	878**	88**	0	0	1[‡‡]	0	0
2004	0	0	96[††]	1,003**	141**	0	0	1[‡‡]	0	0
2005	0	0	33[††]	1,004**	139**	0	0	2[††]	1	0
2006	0	1(1)[§§]	28[††]	844**	90**	0	0	3[‡‡]	0	0
2007	0	0	15[††]	780**	83**	0	0	38[††]	0	0
2008	0	0	18[††]	801**	180**	0	0	33[††]	2	0
2009	0	0	13[††]	631**	178**	0	0	13	0	0
2010	0	0	49[††]	452[‡‡]	158[‡‡]	0	0	8[††]	2[§§]	2
2011	0	0	148[††]	501[‡‡]	110[‡‡]	0	0	29[††]	2	0
2012	0	0	38[††]	521[‡‡]	64[‡‡]	0	0	24[††]	2[§§]	0
2013	0	0	46[††]	495[‡‡]	48[‡‡]	0	0	17[††]	1[§§]	0
2014	0	0	148[††]	478[‡‡]	17[‡‡]	0	0	21[††]	0	0
2015	0	0	42[††]	473[‡‡]	15[‡‡]	0	0	57[††]	0	0
2016	0	0	126[††]	540[‡‡]	10[‡‡]	0	0	82[††]	0	0
2017	1	0	70[††]	524[‡‡]	15[††]	0	0	79[††]	0	0
2018	0	0	34[††]	474[‡‡]	10[††]	0	0	108[††]	0	0
2019	0	0	152[††]	422[‡‡]	2[††]	0	0	62[††]	0	0
2020	0	0	12[††]	285[‡‡]	1[††]	0	0	10[††]	0	0

( ) Imported cases.
* Notifiable with effect from April 1990.

† Indigenous cases below 15 years of age.
‡ Source: Central Claims Processing System, Ministry of Health.
§ All pertussis cases reported prior to 1986 were based on clinically diagnosed cases seen at the Communicable Disease Centre.
¶ Cases diagnosed in KK Women's and Children's Hospital, Singapore General Hospital and National University Hospital.
# Below 10 years of age.
** Based on clinically diagnosed cases.
†† Based on laboratory confirmed cases.
‡‡ Based on laboratory confirmed and clinically diagnosed cases.
§§ Foreigner who came for treatment

PUBLIC EDUCATION

HPB educates the public on the importance of vaccinations through various efforts. In 2019, HPB implemented an immunisation campaign 'Prevent What's Preventable with Vaccination' to reinforce the message that vaccines are effective and safe. A documentary was commissioned and aired in four languages, depicting real-life experiences to raise awareness around the risks and consequences of contracting vaccine preventable diseases as well as how one could be protected through vaccination. In 2020, the 'Stay One Step Ahead with Vaccinations' immunisation campaign was implemented to encourage people to get vaccinated against vaccine-preventable diseases such as influenza and pneumococcal diseases. The campaign also raised awareness on MOH's newly rolled-out subsidies and greater accessibility of subsidised vaccinations for eligible Singaporeans and Community Health Assist Scheme Genera Practitioners (CHAS GP) clinics and polyclinics. The NIR sends reminder letters to parents of children who have missed vaccinations, along with additional information about childhood vaccinations.

In addition, HPB runs social posts on immunisation during the World Immunisation Week which falls on the last week of April every year. These social posts remind the public to get the necessary vaccinations.