Government of **Western Australia**
North Metropolitan Health Service
Mental Health, Public Health and Dental Services

Epidemiology of notifiable infectious diseases in metropolitan Perth

Annual report 2019

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Epidemiology of notifiable infectious diseases in metropolitan Perth: Annual report 2019.

Metropolitan Communicable Disease Control

Mental Health, Public Health and Dental Services

North Metropolitan Health Service

Note: For this report, the geographical boundaries of metropolitan Perth are defined by the area within the East, North and South Metropolitan Health Services (EMHS, NMHS and SMHS). The use of the term 'Aboriginal' within this document refers to Australians of both Aboriginal and Torres Strait Islander people.

For enquiries, please contact:

Metropolitan Communicable Disease Control

PO Box 332 Northbridge WA 6865

Ph: 08 9222 8588

Email: rebecca.hogan@health.wa.gov.au

The NMHS acknowledges the traditional owners of the land, the Noongar people.

We pay our respects to the elders past and present and recognise the continuing cultural and spiritual practices of the Noongar people.

Metropolitan Communicable Disease Control would like to acknowledge the assistance of medical, nursing and scientific staff working in general practices, hospitals and laboratories, for their assistance with public health follow-up of persons with notifiable diseases, and their essential contributions to prevention and control of communicable diseases in the Perth metropolitan area.

Suggested citation:

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Contents

Executive summary

Metropolitan Communicable Disease Control (MCDC) is responsible for the public health management of notifiable infectious diseases in metropolitan Perth. This report aims to inform health care providers and stakeholders about local trends in communicable disease epidemiology in 2019, and related public health programs and highlight issues requiring attention.

42 649
infectious disease notifications in metropolitan Perth in 2019

(↑ of 53% from 2018)

On the rise:

Influenza
Sexually Transmitted Infections
Measles

94.1%
of 1 year-olds fully immunised across metropolitan Perth

(benchmark 95%)

- The 2019 **influenza season was unprecedented** with higher than average rates of inter-seasonal influenza, an earlier start and peak to the season, and peak notification numbers over four times those reported in any other year. Health care workers, pregnant women, Aboriginal people, children aged 6 months to 5 years, adults aged 65 years or older, and those medically at risk are encouraged to have the annual influenza vaccination, timed to precede the start of the usual winter season. Moreover, in 2020, the Western Australian Department of Health (WA DOH) began funding free influenza vaccine to primary school aged children.
- Numbers of **chlamydia, gonorrhoea and infectious syphilis notifications reached their highest recorded levels**. Whilst chlamydia notification rates have stabilised in recent years (with some fluctuation), the overall level of transmission remains high, there has been a sharp increase in gonorrhoea notifications, and the increase in notifications of infectious syphilis is concerning.
- Of particular concern is an insidious rise in the number of cases of **infectious syphilis among vulnerable and high priority groups** – pregnant women, homeless people, Aboriginal people, and women of childbearing age; this is a new issue for metropolitan Perth and has led to the formulation of a public health outbreak response.
- The number of **measles cases in metropolitan Perth increased** in 2019, with 22 of the 42 notified cases linked to an incursion from a large outbreak in New Zealand. While endemic transmission has been eliminated in Australia, imported cases and associated small outbreaks occur when incoming visitors and returning WA travellers arrive from overseas with the virus. Measles is highly infectious and potentially severe, and each case requires considerable public health effort to prevent local transmission.
- With a resurgence of measles cases internationally, WA remains vulnerable to ongoing importations, and maintaining high vaccine coverage is essential. In 2019, the WA DOH announced **free measles vaccines for adults** who were born after 1965 and have not previously received two documented doses of measles-containing vaccine. People are urged

to ensure that children are vaccinated on time[1], and that their own vaccinations are up-to-date.

- The total number of invasive meningococcal disease cases was almost 50% lower than in 2018 (down from 23 to 12 cases in 2019), and **cases due to recently emerging W135 and Y strains have declined**. The timely addition of the meningococcal ACWY vaccine to the WA Immunisation Schedule for infants and secondary school children has likely contributed to the overall reduction in notifications.
- The number of **pertussis notifications in metropolitan Perth decreased** from 916 notifications in 2018 to 440 in 2019. Additionally, decreased notifications of pertussis in high risk infants aged under 6 months is consistent with the uptake of pertussis boosters among pregnant women.
- Childhood immunisation is key component of communicable disease prevention in our community. **Immunisation coverage in children across metropolitan Perth remained below the national benchmark of 95%.** No local government area (LGA) or geographical health service provider (HSP) achieved the 95% benchmark in all three of the measured age groups (1, 2, and 5 year-olds). Six LGAs met the target in at least one age group (Joondalup, Kalamunda, Peppermint Grove, Subiaco and Swan for 1 year-olds, and Armadale for 5 year-olds).

[1] Government of Western Australia, Department of Health. Immunisation schedule and catch-up immunisations [accessed 29 March 2019] https://ww2.health.wa.gov.au/Articles/F_I/Immunisation-schedule-and-catch-up-immunisations

Background

Purpose

The aim of this annual report is to inform healthcare providers about important trends in notifiable infectious diseases in metropolitan Perth in 2019. The **Metropolitan Communicable Disease Control (MCDC)** team was established on 1 July 2016 and has responsibility for the public health management of notifiable diseases for the East, North and South Metropolitan Health Services (EMHS, NMHS, SMHS). Related information, including childhood immunisation rates and provision of post-exposure prophylaxis for rabies and Australian Bat Lyssavirus infection, is also presented.

Notifiable diseases

Under the *Public Health Act 2016*[2] (Part 9), any medical practitioner or nurse practitioner attending a patient who is known, or suspected, to have a notifiable infectious disease or related condition has a legal obligation to report it to the Western Australian Department of Health (WA DOH), in practice to the Communicable Disease Control Directorate (CDCD) within the Public and Aboriginal Health Division. Similar obligations apply to pathology laboratories where test results indicate a notifiable disease or related condition.

Information on persons with notifiable diseases and related conditions is entered into the **Western Australian Notifiable Infectious Diseases Database (WANIDD)**, excepting for Human Immunodeficiency Virus (HIV) infection, antibiotic resistant organisms, acute rheumatic fever and rheumatic heart disease, for which separate databases are maintained. Communicable disease notifications are used to inform public health policy and interventions and enhance prevention and control of these diseases. A list of current notifiable infectious diseases and related conditions in Western Australia, along with case definitions, fact sheets, guidelines and data, is available online.[3]

Data sources

Notification data

Notifiable diseases data for metropolitan Perth and WA was extracted from the WANIDD on 11 August 2020 and are subject to revision. Data was retrieved using an **optimal date of onset** of disease (ODOO) from 1 January 2019 to 31 December 2019. Exceptions to this were diseases with a long delay between diagnosis and onset of disease, namely, non-infectious syphilis, tuberculosis, leprosy, Creutzfeldt–Jakob disease, and unspecified hepatitis B and hepatitis C. These diseases were retrieved by the **date of receipt** of notification (DOR) from 1 January 2019 to 31 December 2019. National notification rates for 2019 were obtained from the **National Notifiable Diseases Surveillance System (NNDSS)** website[4], which is maintained by the Australian Government Department of Health and Ageing, on 11 August 2020. Summary statistics for enteric disease outbreaks in the metropolitan area in 2019 were cross-referenced

[2] Government of Western Australia, Department of Justice. Western Australian Legislation – Public Health Act 2016 [accessed 29 March 2019] https://www.legislation.wa.gov.au/legislation/statutes.nsf/main_mrtitle_13791_homepage.html

[3] Government of Western Australia, Department of Health. Notification of infectious diseases and related conditions [accessed 25 May 2020] https://ww2.health.wa.gov.au/Articles/N_R/Notification-of-infectious-diseases-and-related-conditions

[4] Australian Government, Department of Health. National Notifiable Diseases Surveillance System [accessed 11 August 2020] http://www9.health.gov.au/cda/source/cda-index.cfm

with **OzFoodNet**. a program unit within CDCD that is responsible for enteric disease surveillance in WA.

Population data

Projected population data for metropolitan Perth and for the state of WA, as well as Aboriginal-specific population projections, were obtained from the Epidemiology Branch, Public and Aboriginal Health Division, WA DOH.[5] Overall population estimates for 2019 in metropolitan Perth and WA were 2 085 801 and 2 614 262 respectively.

Immunisation data

The **Australian Immunisation Register (AIR)** provides quarterly reports of immunisation coverage for three age groups: 12–<15 months, 24–<27 months, and 60–<63 months. CDCD provided collated data on vaccine wastage and rabies post-exposure prophylaxis during 2019.

Overview of notifiable diseases

In metropolitan Perth, there were 42 649 mandatory notifications for listed infectious diseases in 2019. This was an increase of 53% from 27 956 notifications in 2018, almost entirely driven by a large increase in influenza notifications. Consequently, the largest upwards trend occurred in the vaccine preventable disease category. In addition, there were upward trends in sexually transmitted infections, and some key diseases requiring intense public health follow-up such as measles. There were downwards trends across the blood-borne viruses, and some vaccine-preventable diseases such as meningococcal disease and pertussis.

The relative proportion of notifications by disease category is shown in **Figure 1**. The major contributors to disease notifications in 2019 were vaccine preventable diseases (54%) and sexually transmitted infections (29%).

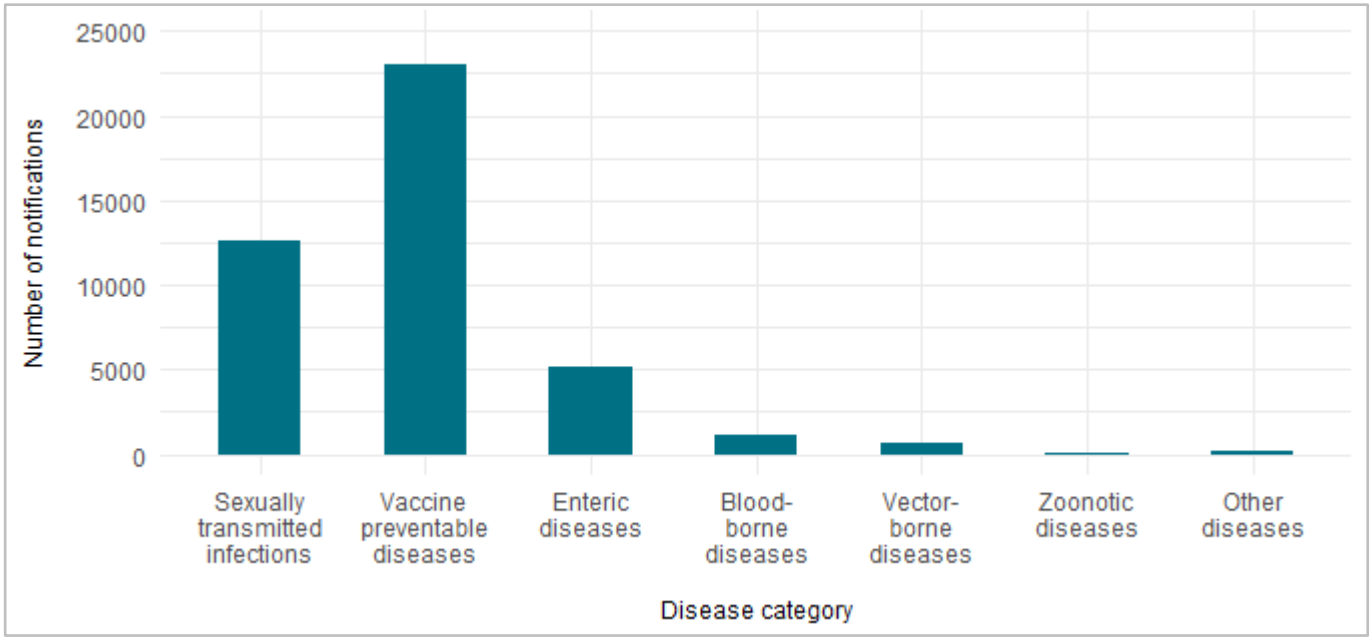

Figure 1: Number of notifications by disease category in 2019

[5] Grace Yun (personal communication), Epidemiology Branch, Public and Aboriginal Health Division, WA DOH, on 05/06/2020.

The total number of notifications for each disease notified in metropolitan Perth between 2015 and 2019 is presented in **Table 1**. The 2019 crude notification rates for each disease are also presented and compared to crude state and national rates (where available). Communicable disease notification data by geographical health service area is presented in **Appendix 1**.

Table 1: Metropolitan Perth notifications (numbers) 2015–19, & 2019 metropolitan, WA & national crude notification rates

	Number of notifications/year					2019 notification rate/100 000		
Notifiable disease	**2015**	**2016**	**2017**	**2018**	**2019**	**Metro**	**WA**	**National**
Blood-borne diseases								
Hepatitis B (newly acquired)	24	22	13	20	16	0.8	0.9	0.6
Hepatitis B (unspecified)	449	547	428	395	374	17.9	16.3	22.8
Hepatitis C (newly acquired)	143	94	94	97	88	4.2	4.6	3.2
Hepatitis C (unspecified)	679	800	775	659	602	28.9	33.2	33.6
Hepatitis D	0	1	2	7	10	0.5	0.4	0.3
Enteric diseases								
Campylobacteriosis	2250	2715	2679	2729	2881	138.1	136.3	143.6
Cholera	0	0	1	0	0	0	0	0
Cryptosporidiosis	124	168	292	65	122	5.8	8.1	10.7
Hepatitis A	22	16	10	11	22	1.1	1.0	1.0
Hepatitis E	1	2	4	2	4	0.2	0.2	0.2
Listeriosis	6	5	6	5	7	0.3	0.3	0.2
Paratyphoid fever	10	11	4	9	9	0.4	0.3	0.5
Salmonellosis	1258	1509	1999	1602	1698	81.4	83.3	58.7
Shiga toxin-producing *E.coli*	0	20	44	79	119	5.7	5.9	2.6
Shigellosis	41	59	56	123	277	13.3	15.1	12.6
Typhoid fever	7	9	19	12	18	0.9	0.8	0.8
Vibrio parahaemolyticus	5	22	18	14	12	0.6	0.7	NN
Yersiniosis	23	12	14	10	22	1.1	0.9	NN
Sexually transmitted infections								
Chlamydia	8595	9115	8978	9016	9173	439.8	445.8	410.4
Lymphogranuloma venereum	13	7	8	5	0	0	0	NN
Gonorrhoea	1434	2274	2177	2327	2910	139.5	151.8	137.2
Syphilis (infectious)	114	263	240	304	328	15.7	21.8	23.4
Syphilis (non-infectious)	59	49	138	167	155	7.4	8.3	10.2
Syphilis (congenital)	0	0	0	1	0	0	0	0
Vaccine preventable diseases								
Diphtheria	0	0	1	0	0	0	0	0
Haemophilus influenzae type B	1	0	0	0	1	0	0.1	0.1
Influenza	4703	6115	4475	4663	18466	885.3	894.4	1254.1
Measles	6	11	16	33	42	2.0	2.1	1.1
Meningococcal disease (invasive)	12	12	34	23	12	0.6	1.0	0.8
Mumps	46	28	19	17	17	0.8	1.3	0.7
Pertussis	1326	1178	1037	916	440	21.1	21.2	48.1
Pneumococcal disease (invasive)	100	112	127	124	150	7.2	9.6	8.5

Rotavirus	433	152	327	237	458	22.0	20.8	24.7
Rubella	2	1	2	1	1	0	0	0.1
Tetanus	0	0	0	1	0	0	0	0
Varicella–Zoster	2766	3163	3436	3580	3419	163.9	164.6	131.1
Vector-borne diseases								
Murray Valley encephalitis virus	0	0	0	1	0	0	0	0
Japanese encephalitis virus	0	0	0	1	0	0	0	0
Barmah Forest virus	15	5	11	7	5	0.2	0.5	1.0
Chikungunya virus	8	14	9	1	9	0.4	0.3	0.3
Dengue virus	451	455	149	118	275	13.2	12.8	5.9
Malaria	42	43	49	44	52	2.5	2.3	1.5
Rickettsial disease (typhus)	19	29	11	10	20	1.0	1.1	NN
Ross River Virus	568	232	609	347	261	12.5	14.8	11.9
Zika virus	2	13	1	1	0	0	0	NN
Zoonotic diseases								
Leptospirosis	1	3	1	5	4	0.2	0.2	0.3
Psittacosis	1	0	1	0	0	0	0	0.1
Q Fever	2	5	5	6	3	0.1	0.3	2.3
Brucellosis	0	2	0	0	0	0	0	0
Other diseases								
Botulism	1	0	0	0	0	0	0	0
Creutzfeldt–Jakob disease	4	5	4	6	7	0.3	0.3	NN
Haemolytic uraemic syndrome	1	2	3	0	0	0	0	0.1
Legionellosis	50	50	30	37	30	1.4	1.4	1.7
Leprosy	2	4	1	1	1	0	0	0
Melioidosis	2	1	3	2	2	0.1	0.2	NN
Tuberculosis	105	128	115	115	127	6.1	4.4	6.0

Data retrieved from WANIDD; disease rows were excluded where no cases occurred locally, statewide and nationally in the previous 5 years. Data for rheumatic heart disease, antibiotic resistant organisms and HIV are collected and managed separately; NN=not notifiable. Varicella–Zoster includes chickenpox and shingles, as well as those unspecified. From July 2018, the case definitions for shigella and rotavirus were altered; the former contributing to a larger number of notifications, and the latter having no substantial impact on number of notifications. From September 2018, the case definition for pertussis was made more stringent, likely contributing to a smaller number of notifications.[6]

[6] Government of Western Australia, Department of Health. Case definitions of notifiable infectious diseases and related conditions [accessed 11 August 2020] https://ww2.health.wa.gov.au/~/media/Files/Corporate/general%20documents/communicable%20diseases/Word/wa_notifiable_infectious_disease_case_definitions.docx

1. An unprecedented influenza season

1.1 Inter-seasonal summer flu a harbinger of things to come

The total number of influenza notifications in 2019 was almost four times that in 2018, with 18 466 and 4663 notifications respectively. Higher than average rates of inter-seasonal influenza during November and December 2018, continued into the early months of 2019, and were compounded by an unusually early and intense start to the 2019 influenza season (**Figure 2**). Similar trends were seen across most of Australia. The seasonal peak in notifications in metropolitan Perth typically occurs between July and October, but in 2019 notifications peaked at 8703 in June, with more notifications in this month alone than total influenza notifications in any year in the previous decade. There was higher than usual activity of both influenza A and influenza B (73% and 27% of notifications, respectively), with influenza A/H3 making up the vast majority of typed A cases (88%) and relatively low levels of A/H1 circulation (12% of typed A cases).

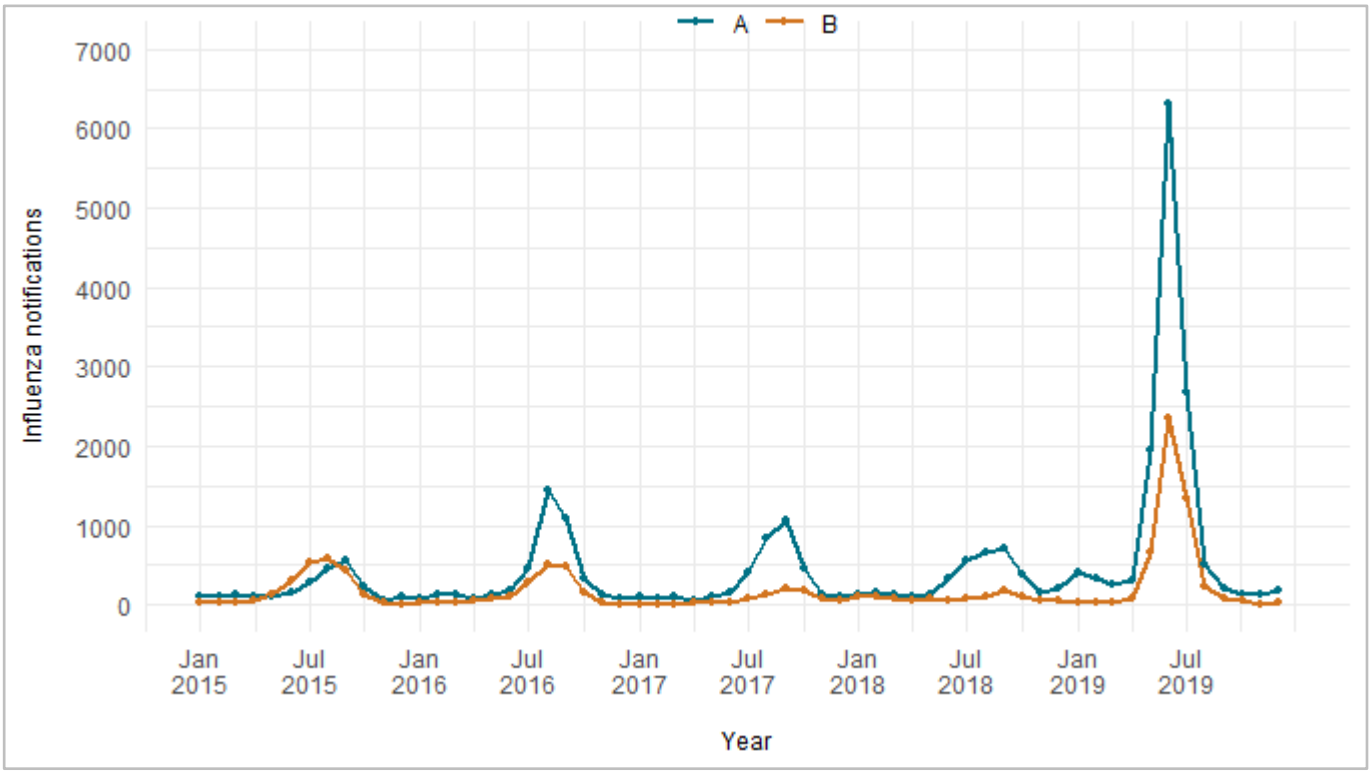

Figure 2: Seasonal trends in influenza notifications over 5 years, by type

The notification rates of influenza by age group in 2019 demonstrated a typical bi-modal distribution, whereby rates were highest among young children and the elderly (**Figure 3**). In children aged under 5 years (where data are most reliable), most notified cases were unvaccinated (73%) or only partially vaccinated (7.6%) with the annual influenza vaccine.

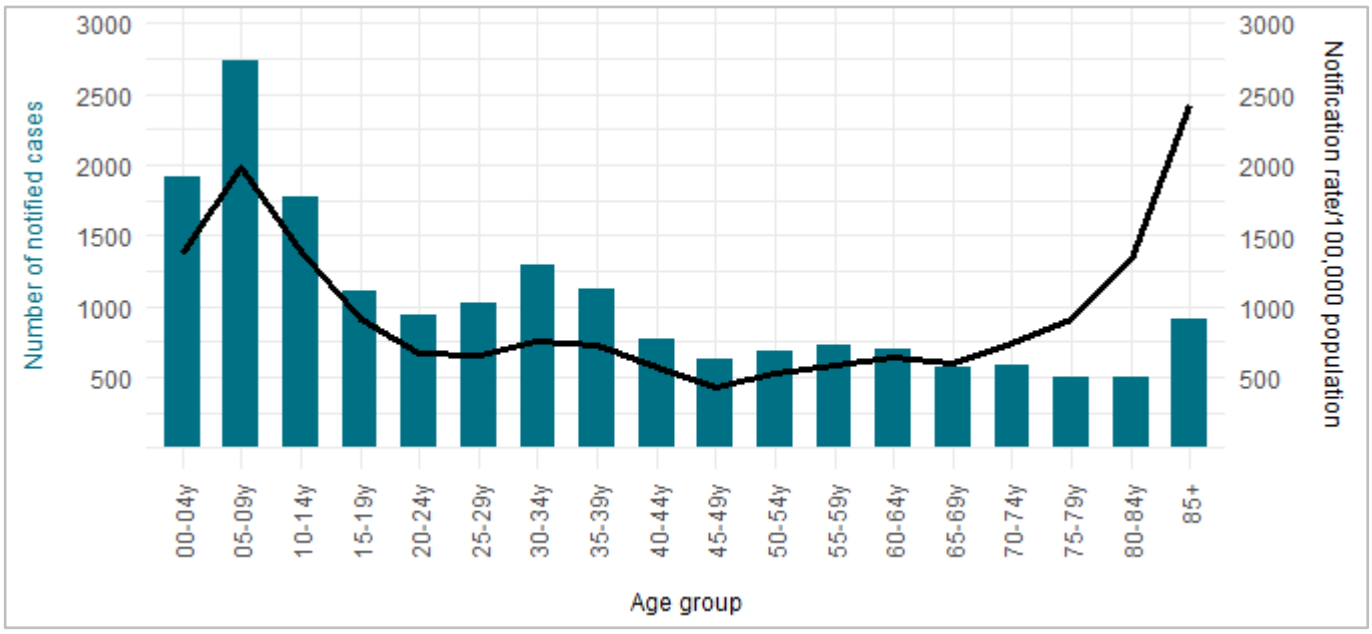

Figure 3: Influenza notifications in 2019; bar plot shows number of notifications (left y axis) and line plot shows notification rate per 100 000 population (right y axis)

Overall, there was a lower proportion of notified cases that were hospitalised in 2019 (13%, n=2491) compared to 2018 (19%, n=899), reflecting the differential impact of influenza A/H3 (predominant in 2019) and A/H1 (predominant in 2018) on hospitalisation in children and younger adults. As demonstrated in **Figure 4**, the proportion of cases hospitalised in 2019 was approximately half that of 2018 in all age groups under 60 years, but was similar in 2018 and 2019 for age groups above 60 years. However, given the extraordinary incidence of influenza in 2019, the impact on the health system was much higher, exemplified by the fact that there was a 177% increase in the overall numbers of notified cases requiring hospitalisation.

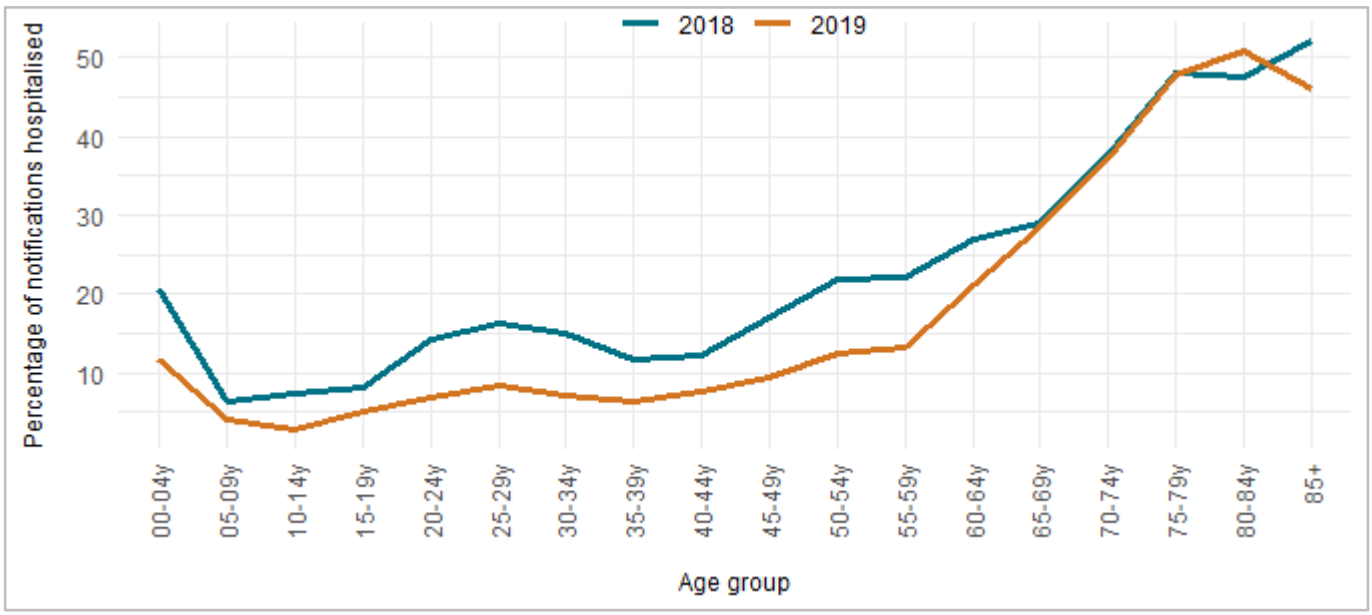

Figure 4: Proportion of influenza notifications that were hospitalised in 2018 and 2019, by age group

A debrief with key stakeholders within the WA healthcare system was conducted in response to the unprecedented 2019 influenza season, to identify issues that arose and develop an action

plan for future high impact influenza seasons.[7] Planned actions included reviewing existing seasonal influenza communication strategies; review of surge capacity for clinical services; lifting health care worker influenza vaccination coverage; implementing a WA DOH funded influenza vaccination program for primary school-aged children in 2020; and providing further guidance to clinicians regarding influenza testing and treatment.

1.2 Institutional outbreaks of influenza

There were 113 outbreaks of influenza-like illness in residential care facilities in 2019. Of these, 85 were confirmed influenza outbreaks, far exceeding the 13 confirmed outbreaks in 2018, and 24 confirmed outbreaks in 2017. Influenza A was implicated in all 85 outbreaks, although influenza B was also identified in 4 facilities. These influenza outbreaks were associated with 59 deaths reported by 39 residential care facilities.

Other causative organisms isolated from outbreaks of influenza-like illness in residential care facilities included respiratory syncytial virus (4 facilities), rhinovirus (3 facilities), human metapneumovirus (3 facilities), and adenovirus (1 facility); no organism was detected in the remainder. MCDC supports facilities to confirm diagnoses and implement infection control measures, monitors outbreak progress, and advises on antiviral prophylaxis and treatment for residents and staff. In 2019, 50 of the 85 facilities with confirmed influenza outbreaks used antiviral treatment for cases and/or prophylaxis for contacts.

There were also eight reported outbreaks of influenza-like illness in prisons in 2019, two outbreaks in hospitals, and two outbreaks in schools – all confirmed influenza outbreaks. One prison outbreak was due to influenza B, and the remaining 11 outbreaks were influenza A subtypes. Antiviral treatment (and/or prophylaxis) was used for all prison outbreaks as well as for one hospital outbreak. No deaths were associated with influenza outbreaks in prisons, hospitals or schools.

1.3 Influenza vaccination

In 2019, the following individuals in WA were eligible to receive government-funded influenza vaccine:

- persons aged 65 years or older
- children aged 6 months to less than 5 years
- pregnant women
- Aboriginal people aged 6 months or older
- people 6 months or older with a medical condition increasing the risk of complications of influenza.

In metropolitan Perth, 51% of children aged 6 months to less than 5 years, 63% of people aged 65 years or older, and 34% of Aboriginal people had an influenza vaccine in 2019.[8] Across WA, 56% of pregnant women were known to have received an influenza vaccine at some time during their pregnancy, compared with 33% in 2017 and 44% in 2018.[9]

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[7] Government of Western Australia, Department of Health. 2019 Influenza Season Debrief Workshop Report and Action Plan.
[8] Chloe Thomson (personal communication), Communicable Disease Control Directorate, Immunisation, Surveillance and Disease Control, WA DOH, on 13 August 2020.
[9] Government of Western Australia, Department of Health. Western Australia's Mothers and Babies summary information: Influenza vaccination [accessed 14 August 2020] https://ww2.health.wa.gov.au/Reports-and-publications/Western-Australias-Mothers-and-Babies-summary-information/data?report=mns_fluv_y

2. Sexually transmissible infections – increases and changing patterns

2.1 Number of notifications continue to increase

The number of notifications for chlamydia, gonorrhoea and syphilis increased in metropolitan Perth in 2019, compared to 2018. The 9173 notifications for chlamydia, 2910 notifications for gonorrhoea, and 328 notifications for infectious syphilis, were in each instance the highest on record. While chlamydia notifications have been relatively stable since 2011 after rising steeply from the late 1990s, there was a sharp 24% increase in gonorrhoea notifications in metropolitan Perth in 2019, doubling since 2015 (**Figure 5**). The increase in the number of gonorrhoea notifications between 2018 and 2019 was seen across both sexes and across all age groups. While gonorrhoea notifications among Aboriginal people decreased in 2019, Aboriginal people continue to experience a disproportionate burden of sexually transmitted infections (STIs), comprising 8.9% of gonorrhoea notifications, and 6.3% of chlamydia notifications in 2019, while representing only 2.1% of the metropolitan population.[10]

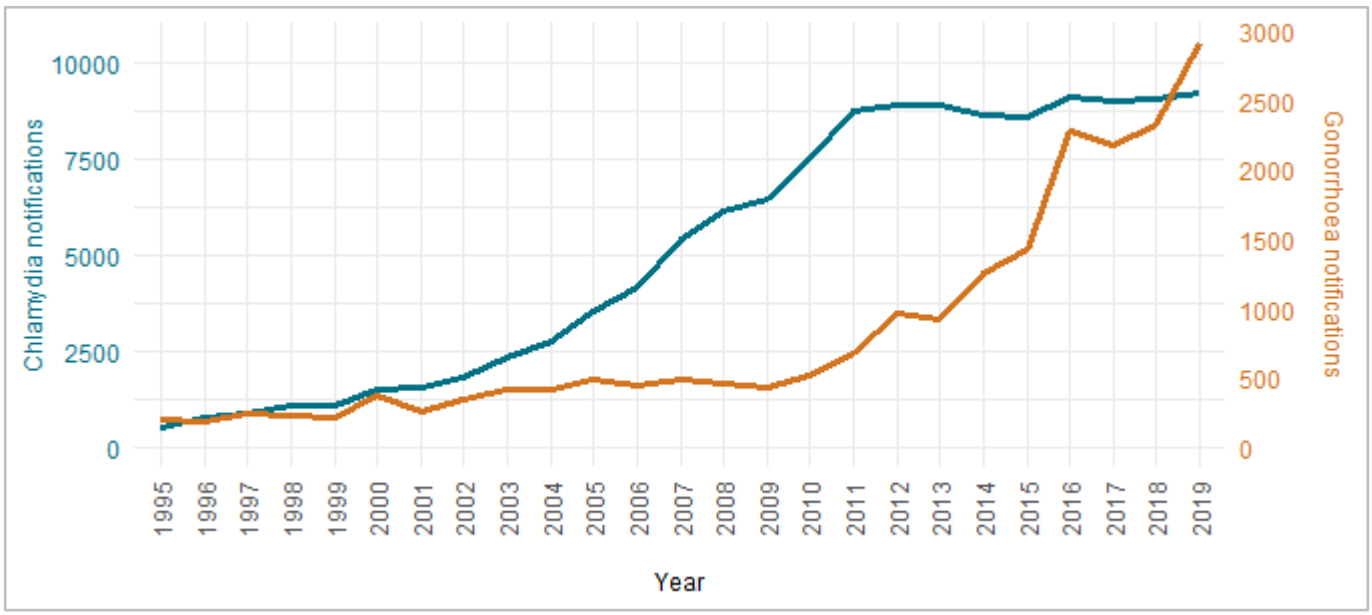

Figure 5: Number of notifications of chlamydia (left axis, blue line) and gonorrhoea (right axis, orange line) over time, 1995–2019

As the majority of STI cases are diagnosed in general practice, in 2019 MCDC offered targeted education to practices with a large throughput of patients with STIs, and contributed to the training of GP registrars in relation to the investigation and treatment of STIs in metropolitan Perth. A real-time, faxed mail-out was sent to GPs for all notified cases of gonorrhoea, with advice on treatment, contact tracing, and routine follow-up. A faxed information sheet was also sent to GPs for notified cases of chlamydia belonging to high risk groups (including all cases aged 16 to 24 years). MCDC continues to provide a support service when additional resources are required for complex contact tracing or management and referral issues.

[10] Grace Yun (personal communication), Epidemiology Branch, Public and Aboriginal Health Division, WA DOH, on 05/06/2020.

2.2 Changing profile of groups at risk for syphilis

Syphilis remains a key concern in metropolitan Perth. No longer a rare disease, there were 328 notifications of infectious syphilis in 2019, representing a three-fold increase since 2015; 87% of cases were men (**Figure 6**). Testing rates have increased over this same period, but there has been a proportionally larger increase in both the notification and positivity rates, suggesting increased disease transmission.

Although syphilis in metropolitan Perth over the past decade has occurred primarily among men who have sex with men (MSM) or returned travellers, there is increasing diversity among those affected. In recent years, there has been an insidious increase in infectious syphilis among vulnerable and high priority groups including homeless people, Aboriginal people, pregnant women, and women of childbearing age (**Figure 7**). Both the absolute number and proportion of notifications of infectious syphilis have increased among these groups. For example, there were 28 infectious syphilis notifications among Aboriginal people in 2019 (8.5% of notifications), compared to only 7 notifications in 2018 (2.3% of notifications). This increase included proportionally more women, with 11 notifications among Aboriginal women in 2019 compared with 2 notifications in 2018.

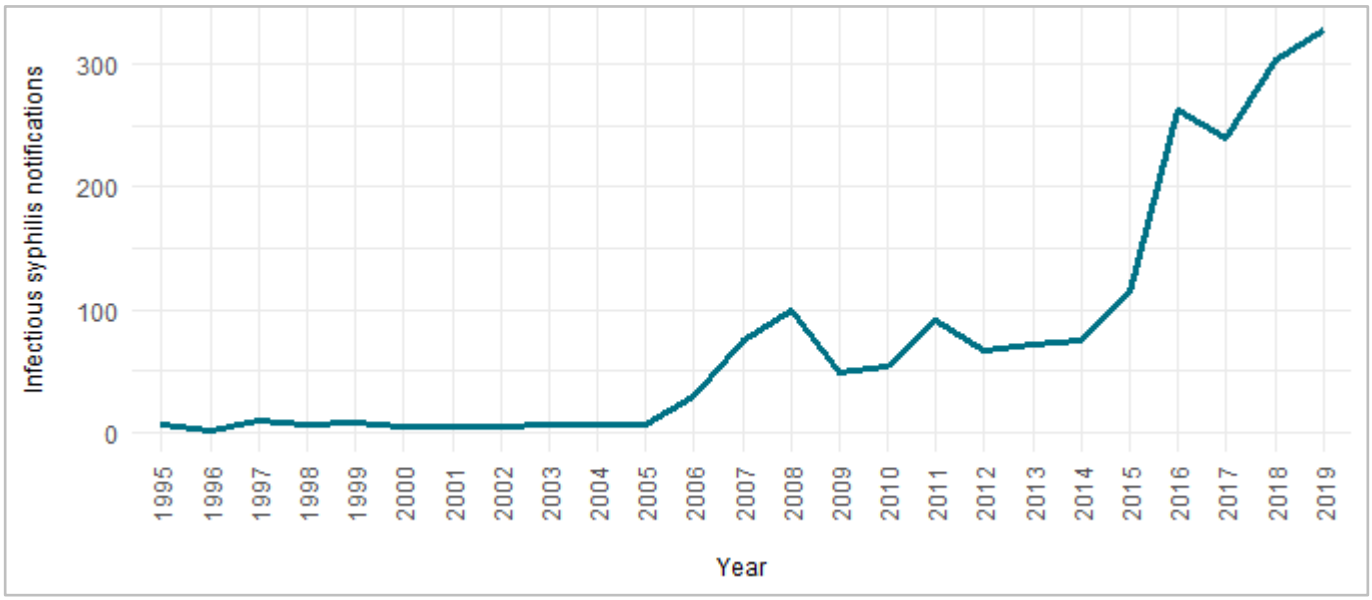

Figure 6: Number of notifications of infectious syphilis over time, 1995–2019

There were also 10 infectious syphilis notifications in homeless people in 2019, compared to 6 notifications in the previous 4 years combined. Moreover, these data are likely to underestimate the true number of infectious syphilis cases among homeless individuals, given under-ascertainment of homeless status in notified cases. Management of homeless people with infectious syphilis and identification of their contacts is often complex, as they may not have a regular doctor, can be difficult to contact or locate, and are more likely to have co-existing mental health issues, substance use, or exposure to domestic violence.[11] Additionally, homeless people may concurrently belong to other high priority groups, such as women of childbearing age or an Aboriginal person.

[11] Wood L, Gazey A, Vallesi S, Cumming C, Chapple N. Tackling Health Disparities among People Experiencing Homelessness – The Impact of Homeless Healthcare. School of Population and Global Health, The University of Western Australia, Perth Western Australia. 2018. [accessed 07 September 2020] http://homelesshealthcare.org.au/wp-content/uploads/2018/11/Final-HHC-Report-electronic-version.pdf

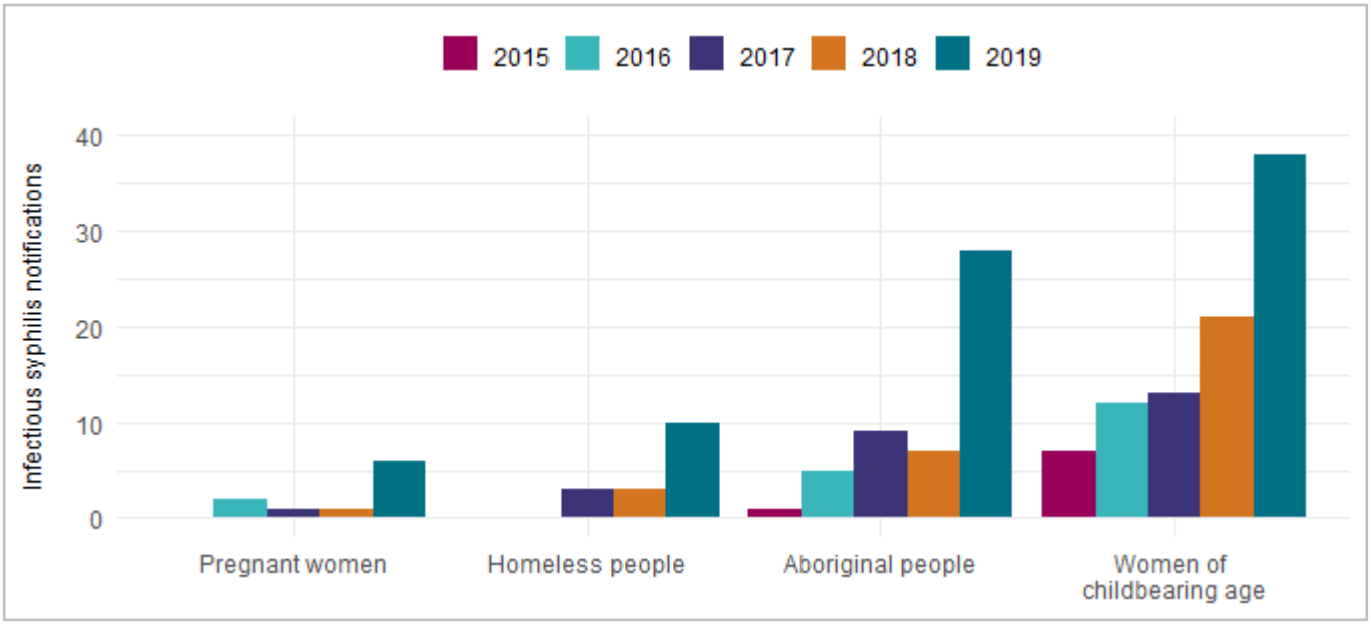

Figure 7: Number of notifications of infectious syphilis in pregnant women, homeless persons, Aboriginal people, and women of childbearing age, 2015–2019 (categories are not mutually exclusive)

MCDC actively follows up all notifications of syphilis. This process is resource-intensive, involving review of current and previous test results, and liaison with the requesting practice or clinic to obtain required information for staging, confirmation of adequate treatment, and contact tracing. For cases under GP care, MCDC also completes enhanced surveillance forms, and phones infectious syphilis cases and contacts to assess public health risk, provide education, and offer empirical testing and treatment. Additional follow-up may be required for cases that are pregnant, homeless, or from culturally or linguistically diverse backgrounds.

2.3 Syphilis during pregnancy increasing

Syphilis in women of childbearing age requires a high priority public health response, most particularly in women who are known or suspected to be pregnant, given the high risk of transmission to the foetus in utero (70% during primary and secondary syphilis).[12] Notifications of infectious syphilis in women of childbearing age have increased nearly 6-fold between 2015 and 2019, and nearly doubled between 2018 and 2019 (**Figure 7**) – an issue that has been raised by MCDC at a number of local forums. Syphilis in pregnancy is an emerging issue for metropolitan Perth, where such occurrences were previously rare and sporadic. In 2019, six women were diagnosed with infectious syphilis, and a further four with non-infectious syphilis, during their pregnancy.

These cases require extensive follow-up by MCDC and others, with regular specialist consultations and ongoing testing to prevent risk of congenital syphilis to the foetus. Difficulties engaging and retaining women in antenatal care are common, especially when there are additional access issues such as cultural factors or socioeconomic challenges. MCDC actively monitors pregnant women diagnosed with infectious syphilis for the duration of their pregnancy: confirming treatment of both the case and her partners to prevent risk of reinfection; supporting

[12] Government of Western Australia, Women and Newborn Health Service. Syphilis: Investigation and management of the neonate born to a mother with syphilis [accessed 19 October 2020] https://www.kemh.health.wa.gov.au/~/media/Files/Hospitals/WNHS/For%20health%20professionals/Clinical%20guidelines/NEO/WNHS.NEO.Syphilis_Investigationandmanagementoftheneonateborntoamotherwithsyphilis.pdf

antenatal clinic referrals and appointment attendance; encouraging regular RPR monitoring and following up results; and recording neonatal outcome after delivery. Given increasing workload in this area, MCDC developed a REDCap database in 2019 to manage this information.

Congenital syphilis is preventable, and health professionals should consider re-screening for syphilis during pregnancy in high-risk individuals. In response to increasing rates of syphilis notifications in Australia, including cases of congenital syphilis, changes were made to the King Edward Memorial Hospital *Syphilis in pregnancy*[13] guidelines with MCDC input. These include recommendations for more frequent screening for syphilis in high risk groups, such as enhanced screening in pregnant women from areas experiencing syphilis outbreaks; and processes to improve coordination between obstetric, neonatal teams, MCDC and the Communicable Diseases Control Directorate.

In addition to contributing to the revision of the *Syphilis in pregnancy* guidelines, MCDC was also part of the antenatal and postnatal care working group under the WA Syphilis Outbreak Response Group. The changing epidemiology of infectious syphilis, in conjunction with strengthened stakeholder engagement, informed a significant metropolitan public health outbreak response in 2020.

[13] Government of Western Australia, Women and Newborn Health Service. Syphilis in pregnancy [accessed 16 September 2020] https://www.kemh.health.wa.gov.au/~/media/Files/Hospitals/WNHS/For%20health%20professionals/Clinical%20guidelines/OG/WNHS.OG.SyphilisinPregnancy.pdf

3. Vaccine preventable diseases – largely contained but challenges remain

3.1 Imported measles remains a risk, with resurgence internationally

Measles is a highly infectious viral illness with potentially severe complications. There were 869 770 reported cases of measles worldwide in 2019, far exceeding the 353 236 reported cases in 2018, and more than in any year since the 1990s.[14] The concerning trend was seen in all regions, with near neighbours New Zealand, Samoa and Tonga declaring outbreaks in 2019 (**Figure 8**).

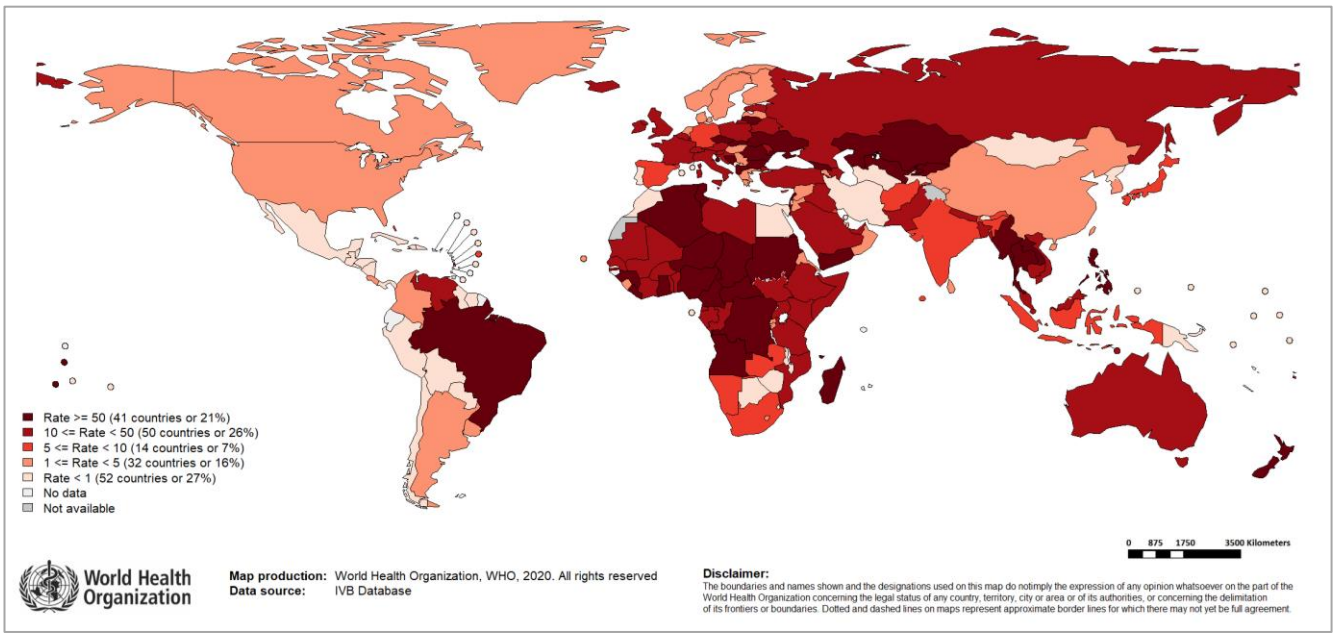

Figure 8: Measles incidence rate per million population, using data from January 2019 – December 2019; reproduced from the World Health Organization's Global Measles and Rubella Update, February 2020[15]

Endemic transmission of measles has been eliminated in Australia as a result of our high immunisation coverage and strong public health responses. However, reflecting the global trend, there were 42 measles notifications in metropolitan Perth in 2019 (a steady increase in notifications since 2015), comprising 11 overseas importations and 7 which resulted in at least 1 case of local transmission. Cases ranged in age from 4 months to 53 years.

A large outbreak (in local terms) in the Perth metropolitan area in 2019 originated from an index case visiting from New Zealand, and resulted in 16 secondary cases, and 6 tertiary cases ranging in age from 6 months to 43 years (**Figure 9: Part A**). The majority (82%) of the cases in this outbreak were unvaccinated or had no documented measles vaccination, while the remainder were partially vaccinated with only one documented dose. The index case was on holidays and highly mobile while infectious, attending sporting events, large family gatherings, and other excursions.

[14] World Health Organization. Immunization, Vaccines and Biologicals: Measles [accessed 31 August 2020] https://www.who.int/immunization/monitoring_surveillance/burden/vpd/surveillance_type/active/measles/en/

[15] World Health Organization. Global measles and Rubella Update, February 2020 [accessed 01 September 2020] https://www.who.int/immunization/monitoring_surveillance/burden/vpd/surveillance_type/active/Global_MR_Update_February_2020.pptx?ua=1

In addition to this outbreak, there were a further eleven index cases that were imported from overseas (**Figure 9: Part B**). Five of these did not transmit the infection to others; however six index cases collectively led to seven secondary infections. An index from regional WA also gave rise to two secondary cases in metropolitan Perth. Three index cases and four secondary cases were known to have had two doses of measles-containing vaccine and would typically have been considered immune to the disease. Additionally, two of these immunised cases transmitted the infection to another person – one to a non-immunised case, and one to a fully immunised case. Cases that had previously received two doses of measles-containing vaccine were all adults, and tended to have a milder illness than those who were not vaccinated – consistent with partial but waning immunity in the 14–20 years since their last measles-containing vaccine was given.

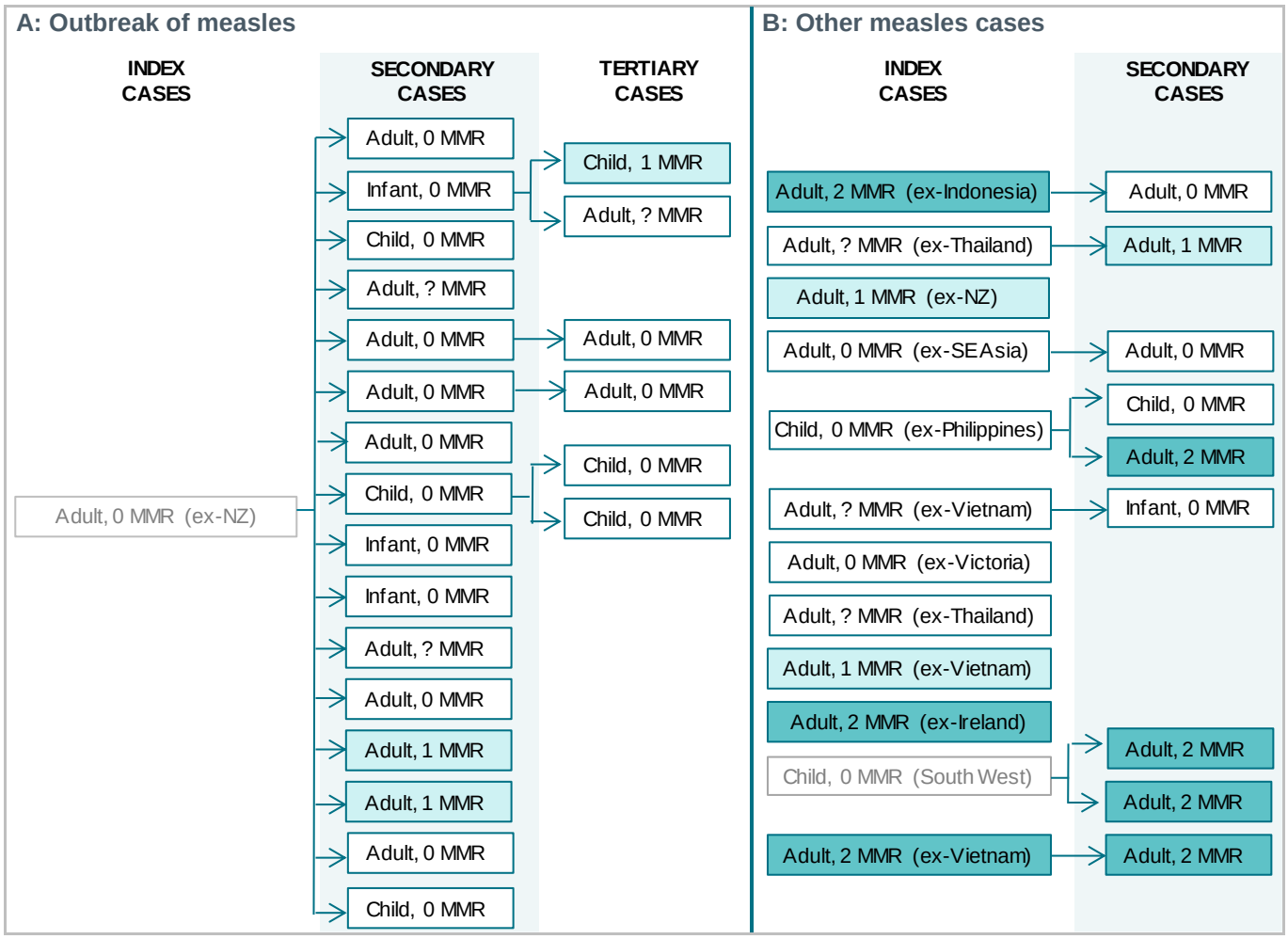

Figure 9: Transmission patterns of measles in metropolitan Perth in 2019; columns reflect generations of infection; infant refers to <12 months old, child refers to 12 months to <18 years old, adult refers to 18 years or older; MMR = documented evidence of measles-containing vaccinations; shading of boxes represents vaccination status: white=nil or unknown, blue=partially vaccinated, green=fully vaccinated.

Each measles case is resource intensive, requiring urgent work to mitigate the risk of local transmission. Over 7200 people were identified as being potentially exposed to one of the 42 measles cases in 2019; MCDC staff performed intensive contact tracing to identify high risk and non-immune contacts. As a result, over 600 measles-containing vaccinations and over 30 doses of intramuscular Normal Human Immunoglobulin were administered to protect the most vulnerable. MCDC also co-wrote 14 media releases (and 7 updates) in 2019, designed to reach potential contacts who could not be identified personally. In 2019, the WA DOH introduced free

MMR vaccine for adults born after 1965 with inadequate or unclear vaccination history – an important initiative, as many adults may have received none or only one dose of measles-containing vaccine due to changing schedules over the years.

3.2 Changing patterns of invasive cocci

There were 12 notifications of **invasive meningococcal disease** in metropolitan Perth in 2019, compared with 34 and 23 notifications in 2017 and 2018, respectively. Three quarters of all cases were male, and a third were Aboriginal. Cases were aged between 0 and 85 years, with 42% aged 5 years or less.

Serogroups W_{135} and (to a lesser extent) Y meningococci emerged as significant causes of invasive meningococcal disease in WA from 2015, peaking in 2017 when they comprised 71% of all cases in the metropolitan area (**Figure 10**). In response, the WA DOH introduced a meningococcal ACWY vaccination program for the two most at risk age groups; 15–19 year-olds since April 2017, and 1–4 year-olds since January 2018. The vaccine was then added to the National Immunisation Program (NIP) for 1 year-olds in July 2018, and for 14–19 year-olds in April 2019. Gratifyingly, the number and proportion of serogroup W_{135} and Y cases has declined in the past two years, and together comprised 42% of all meningococcal cases in metropolitan Perth in 2019.

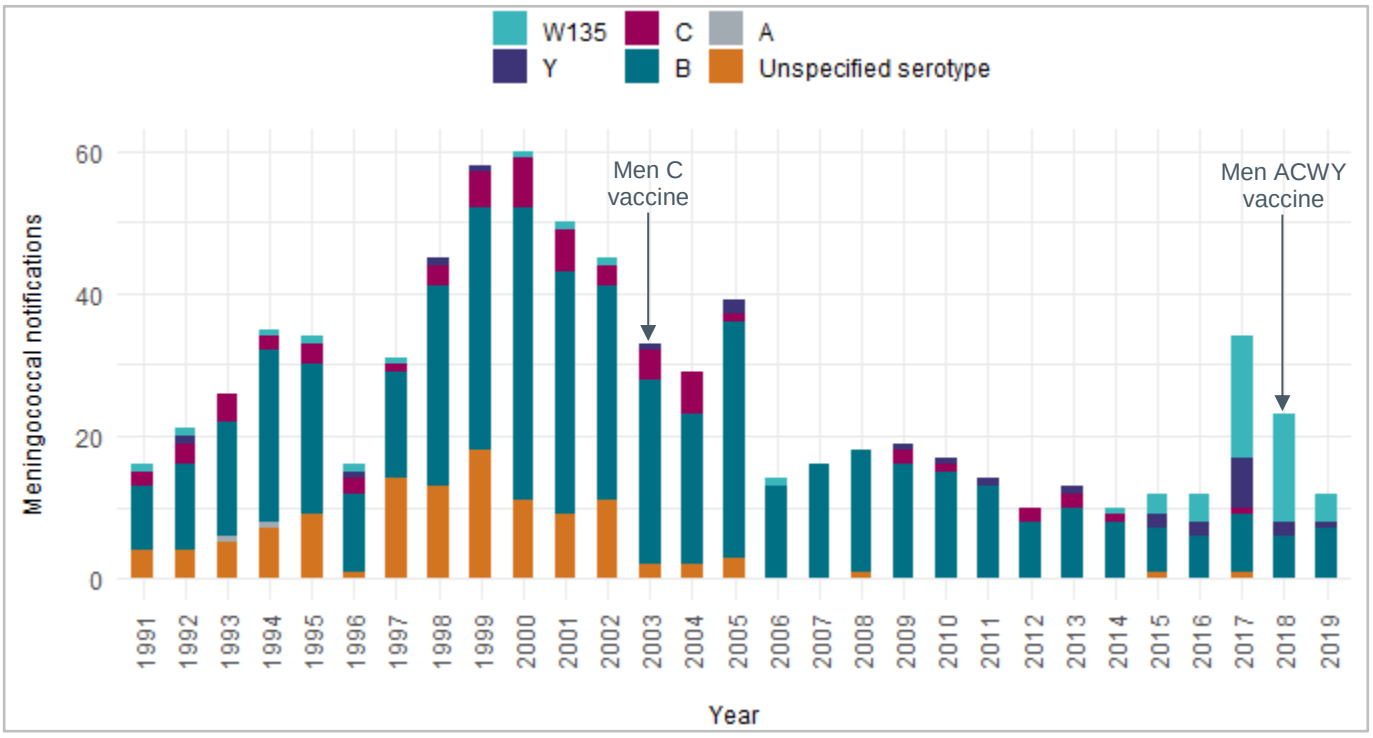

Figure 10: Number of notifications of invasive meningococcal disease since surveillance commenced (1991–2019), by serotype

After declining steeply from its peak incidence in 2000, the number of serogroup B meningococcal disease cases in Perth has been relatively steady at historically low levels since 2012. Vaccines targeting serogroup B disease have been registered in Australia since 2013 but are not government-funded for most people, thus coverage is low with only 15% of Perth children under 5 years having received at least one dose by the end of 2019.[16] Most recently,

[16] Data extracted from Australian Immunisation Register, and received from Jenny Vo (personal communication), Perth Public Health Intelligence, North Metropolitan Health Service, on 01 September 2020.

serogroup B vaccine was added to the NIP for commencement in July 2020, for Aboriginal children aged less than 12 months (with 3 years of funded catch-up vaccinations available for those aged less than 2 years), and all Australians with specified immunocompromising conditions.[17] Monovalent serogroup C meningococcal vaccines were added to the NIP for 1 year-olds in January 2003, and serogroup C disease (always relatively rare in WA), was virtually eliminated in subsequent years.

Invasive pneumococcal disease includes bacteraemic pneumonia, meningitis or sepsis caused by the many different serotypes of *Streptococcus pneumoniae*, some of which are vaccine preventable. There were 150 notifications of invasive pneumococcal disease in metropolitan Perth in 2019. There were slightly more males (55%) than females (45%) among cases, and Aboriginal people were over-represented (7.3% of cases). There was a dual peak in affected age ranges, with 25% aged less than 5 years, and 38% aged 65 years or older.

The serotypes contributing to the burden of invasive pneumococcal disease in metropolitan Perth are changing over time (**Figure 11**). PCV7 is a conjugate vaccine targeting seven serotypes, listed on the Australian NIP for Aboriginal infants in 2001, and all children in 2005. The burden of disease attributed to PCV7 serotypes declined considerably following introduction of the vaccine, however new invasive serotypes emerged (a 'serotype replacement' phenomenon). PCV13, which covered an additional six serotypes, superseded PCV7 in July 2011, and also led to a reduction in cases attributed to these serotypes.

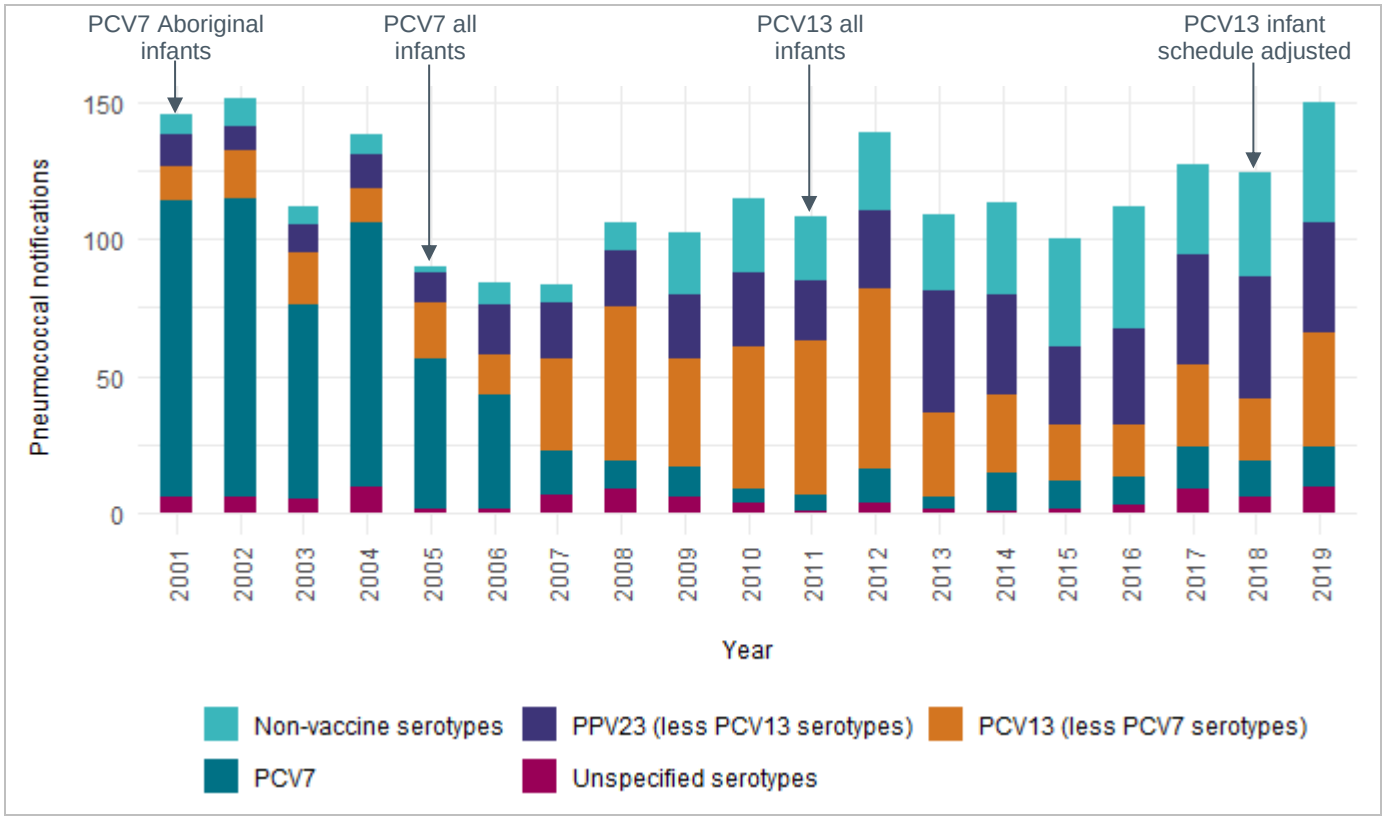

Figure 11: Notifications of invasive pneumococcal disease since becoming notifiable in 2001, by serotype

Adjustment to the timing of PCV13 vaccines on the infant schedule may yet have a greater effect on these serotypes. In July 2018, the third dose of PCV13 vaccine was moved from 6

[17] National Centre for Immunisation Research and Surveillance. Significant events in meningococcal vaccination practice in Australia [accessed 16 September 2020] http://ncirs.org.au/sites/default/files/2020-07/Meningococcal-history-July%202020.pdf

months to 12 months in response to increased cases of PCV13 vaccine failure in toddlers older than 12 months of age. The most common serotypes causing invasive disease in 2019 were 3, 19A, 19F (19%, 8.0% and 8.7% respectively, all contained in PCV13), and 22F (7.3%, contained in PPV23). Although there was a large increase in the number of cases caused by serotype 3 between 2018 and 2019, notifications did not change in the 6–12 month age group, thus the increase is unlikely to be related to the recent adjustment in the infant schedule.

PPV23 is a vaccination containing pneumococcal capsular polysaccharides for 23 serotypes. It is poorly immunogenic in infants, and is not a routine childhood vaccination. However, PPV23 has been funded in Australia to Aboriginal adults aged over 50 years and those medically at risk over 15 years since 1999, medically at risk children at 4 years since 2001, and all adults aged over 65 since 2005.

3.3 Decreasing notifications of pertussis explained

While the national notification rate for pertussis remained steady between 2018 and 2019 (51.1 and 48.1 notifications per 100,000 respectively), notifications decreased in the Perth metropolitan area and more widely across WA. There were 440 notifications in the metropolitan Perth in 2019 compared with 916 notifications in 2018. This coincided with a change in the case definition for pertussis in WA in late 2018, contributing to a smaller number of notifications. Prior to this, mucosal IgA results were used to provide laboratory suggestive evidence for pertussis cases in WA – a practice not consistent with other states. Mucosal IgA tests for pertussis were rescinded in late 2018 due to high false positive rates. However, the change in case definition explains only some of the decrease in notifications; there were also fewer cases diagnosed using nucleic acid testing or isolation of *Bordetella pertussis* in 2019 (n=205) than in 2018 (n=305).

There were only 2 notifications of pertussis in infants under the age of 6 months in 2019, compared with 12 notifications in 2018 and 24 notifications in 2017. These infants are too young to be fully vaccinated (the third dose in the primary vaccination course is due at 6 months) and typically experience a more severe course of disease. Placental transfer of maternal antibodies can aid early protection, therefore maternal pertussis vaccination between 20 and 32 weeks gestation in every pregnancy is recommended to maximise antibody transfer. Neither mother of the two infants notified in 2019 was vaccinated for pertussis in pregnancy. Across WA, 75% of mothers were known to be vaccinated for pertussis at some time during their pregnancy in 2019.[18] This rate has steadily increased since 2016. While pertussis has a cyclical nature with characteristic peaks every 4–6 years, the proportion of women now receiving pertussis boosters in pregnancy is likely to have contributed to the lower number of cases observed among infants in metropolitan Perth during 2019.

3.4 A rare communicable disease

There was a notified case of *Haemophilus influenzae* type B (HiB) in a 4.5 month-old infant in 2019 – the first notification of this preventable, potentially life-threatening illness since 2015. Although the first dose of HiB vaccine was given as per the WA immunisation schedule, the second dose was delayed. This highlights the importance of timeliness of vaccinations as per the immunisation schedule wherever possible.

[18] Government of Western Australia, Department of Health. Western Australia's Mothers and Babies summary information: Pertussis vaccination [accessed 12 August 2020] https://ww2.health.wa.gov.au/Reports-and-publications/Western-Australias-Mothers-and-Babies-summary-information/data?report=mns_pertv_y

4. Continued success for hepatitis B and C

4.1 Hepatitis C declining with availability of curative treatment

There were 690 notifications of hepatitis C virus in metropolitan Perth in 2019. This is the lowest figure recorded (**Figure 12**); a decline of 23% since 2016 when new treatments for hepatitis C became widely available in Australia. Hepatitis C is spread through contact with infected blood. Although there is no vaccination for hepatitis C, the new antiviral treatments are curative in up to 95% of patients[19], raising a real opportunity for treatment as prevention to be leveraged in efforts to eliminate hepatitis C. However, despite widely-available, low cost and effective treatment options, the proportion of infected patients accessing treatment remains low. Treatment uptake for chronic hepatitis C in WA was 34% in mid-2019 (23% uptake March 2016 to December 2017, and 11% uptake January 2018 to June 2019).[18] This is in part because Hepatitis C disproportionately affects already marginalised populations, including Aboriginal people, people who inject drugs, the homeless, people who engage in high-risk sexual behaviour and people who are incarcerated.

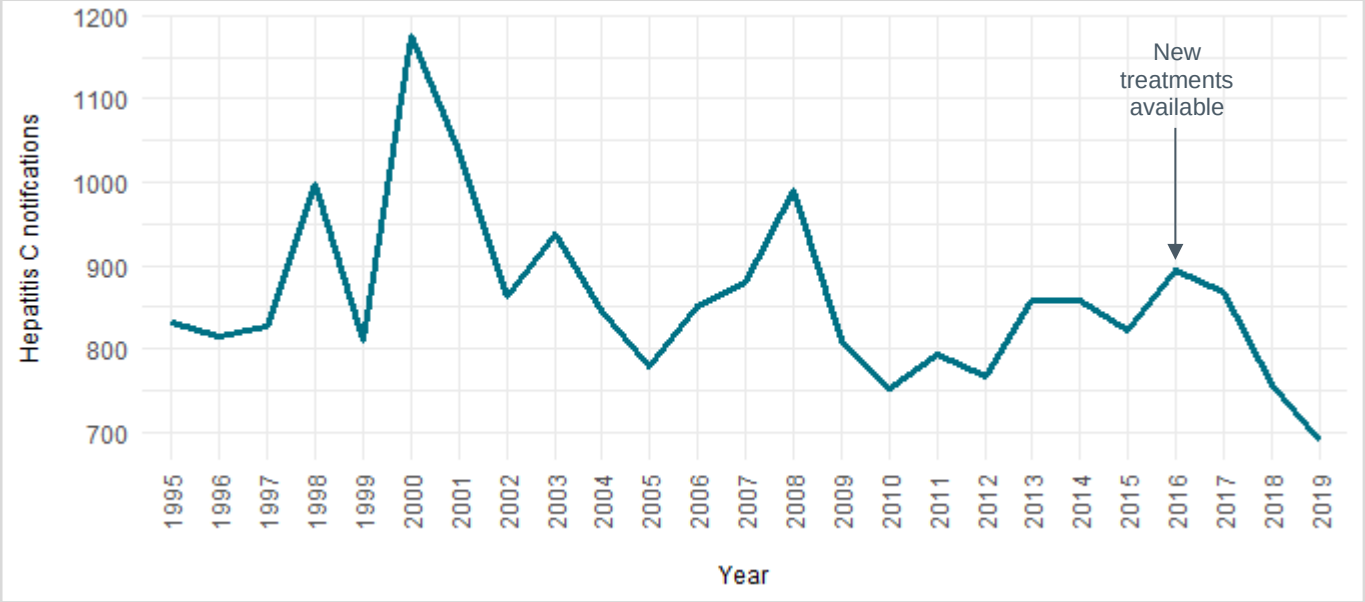

Figure 12: Number of notifications of hepatitis C over time, 1995–2019

Among those newly diagnosed with hepatitis C in 2019 in metropolitan Perth, 67% were men, 25% were Aboriginal, and the mean age was 39.6 years. At least 23% were prisoners within the criminal justice system at the time of notification. The WA Department of Justice has a hepatitis C management and treatment program in place.

4.2 Hepatitis B declining with vaccination

There were 390 notifications of hepatitis B in metropolitan Perth in 2019 (of which 16 were known to be newly acquired; 1 of whom was fully vaccinated), compared with 415 notifications in 2018. Unlike hepatitis C, there is a safe and effective vaccine that can prevent hepatitis B, and it is recommended that infants receive this vaccine at birth, with further doses at 2, 4 and 6 months of age. Hepatitis B is mainly spread through direct contact with bodily fluids (usually

[19] MacLachlan JH, Smith C, Towell V, Cowie BC. Viral Hepatitis Mapping Project: National Report 2018–19 [accessed 09 September 2020] https://ashm.org.au/resources/hcv-resources-list/viral-hepatitis-mapping-project-national-report-2018-2019/

blood), although it can also survive over 7 days on contaminated surfaces.[20] Babies can contract hepatitis B from their infected mother during pregnancy or delivery, with a risk of transmission of up to 95% without hepatitis B vaccine and immunoglobulin intervention.[21] Although most adults recover completely from hepatitis B, 80–90% of infants and 30–50% of children aged less than 6 years develop lifelong chronic infections that can lead to cirrhosis, liver cancer or premature death.[20] Furthermore, chronic hepatitis B carriers may not have symptoms for many years, but are still capable of transmitting the virus to other people without knowing that they are infected.

The NIP funded vaccine was added to the infant schedule in May 2000, although school-based vaccination programs also targeted some adolescents.[22] The NIP also funds catch-up vaccinations for people up to 19 years of age, as well as refugees and humanitarian entrants. Hence, most children and adolescents are now vaccinated.[14] Hepatitis B vaccination is also recommended for those with an increased risk of exposure, such as Aboriginal people and those within the criminal justice system.

Consistent with this, notifications of hepatitis B have declined in the younger age groups, while remaining steady or increasing in the older age groups; there were only 7 cases aged 0–19 years in 2019, compared with 58 cases in 2000, and no cases notified in children less than 10 years of age since 2017. Additionally, there were 6 cases in Aboriginal people in 2019 compared with 14 cases in 2000 – although the prevalence of hepatitis B is still higher among Aboriginal people than non-Aboriginal people. Only 6 cases were prisoners within the criminal justice system at the time of notification in 2019, compared with 23 cases in 2000.

[20] World Health Organization. Hepatitis B [accessed 25 September 2020] https://www.who.int/news-room/fact-sheets/detail/hepatitis-b

[21] Australasian Society for HIV, Viral Hepatitis and Sexual Health Medicine. Hepatitis B and Primary Care Providers [accessed 25 September 2020] https://ashm.org.au/resources/HBV-Resources-list/hepatitis-b-and-primary-care-providers/

[22] Australian Government, Department of Health. Vaccine Preventable Diseases and Vaccination Coverage in Australia, 2003 to 2005: Hepatitis B [accessed 14 September 2020] https://www1.health.gov.au/internet/publications/publishing.nsf/Content/cda-cdi31suppl.htm~cda-cdi31suppl-3.htm~cda-cdi31suppl-3d.htm

5. Enteric diseases and food outbreaks are steady

5.1 Gastroenteritis in child care, schools and residential care

Perth child care centres, schools and residential care facilities report gastrointestinal outbreaks to MCDC who provide advice on collection of specimens to identify the outbreak cause, hygiene precautions, and isolation and restriction of movement of patients and visitors. Foodborne outbreaks are referred to OzFoodNet for further investigation.

There were 43 outbreaks of gastroenteritis in child care centres, and a further 3 in schools, across metropolitan Perth in 2019. Most outbreaks were not sampled, although norovirus and rotavirus were implicated in at least two outbreaks. There were two hospital admissions associated with outbreaks in child care centres and schools, but no deaths.

There were 71 outbreaks in residential care facilities (up from 57 in 2018, but down from 92 in 2017); 59% of these had a causative organism isolated; norovirus was implicated in 54%, with adenovirus, rotavirus or sapovirus contributing in only a small number of outbreaks. Collectively, 39 hospital admissions and 12 deaths were associated with outbreaks in residential care facilities.

5.2 Clusters and outbreaks of enteric diseases

There was only a small overall increase in the rate of notifiable enteric diseases from 2018. A significant proportion of enteric diseases are imported from overseas (**Figure 13**), and travellers are advised to take precautions in developing countries or areas of poor hygiene.[23] All cases of typhoid and paratyphoid fever were acquired from overseas, with India being the most common source country.

Although campylobacteriosis was responsible for the majority of enteric infections in 2019 (2881 notifications), salmonellosis was responsible for almost all outbreaks of notifiable enteric diseases. *Salmonella* notifications remained stable between 2018 and 2019, after peaking in 2017 with a large increase in locally acquired infections. Of the 1698 cases of salmonellosis across metropolitan Perth in 2019, 163 were associated with one of 18 *Salmonella* Typhimurium outbreaks, including an outbreak linked to a bakery affecting at least 30 people. Further outbreaks occurred in restaurants (12 outbreaks), accommodation settings (2), a hospital (1), a supermarket (1), and another bakery (1). Additional cases of gastroenteritis associated with these outbreaks did not have *Salmonella* Typhimurium isolated or detected. There were also two multi-jurisdictional outbreaks of salmonellosis in 2019: an outbreak of *Salmonella* Heidelberg with six cases reported in metropolitan Perth but no established cause of illness; and *Salmonella* Weltevreden among 84 people consuming frozen microwave meals, with 11 of these cases from metropolitan Perth.[24]

[23] Government of Western Australia, Department of Health. Gastroenteritis [accessed 08 September 2020] https://healthywa.wa.gov.au/Articles/F_I/Gastroenteritis

[24] Food Standards Australia New Zealand. Salmonella linked to frozen microwave meals [accessed 07 September 2020] https://www.foodstandards.gov.au/industry/FoodIncidents/Pages/Salmonella-linked-to-frozen-microwave-meals.aspx

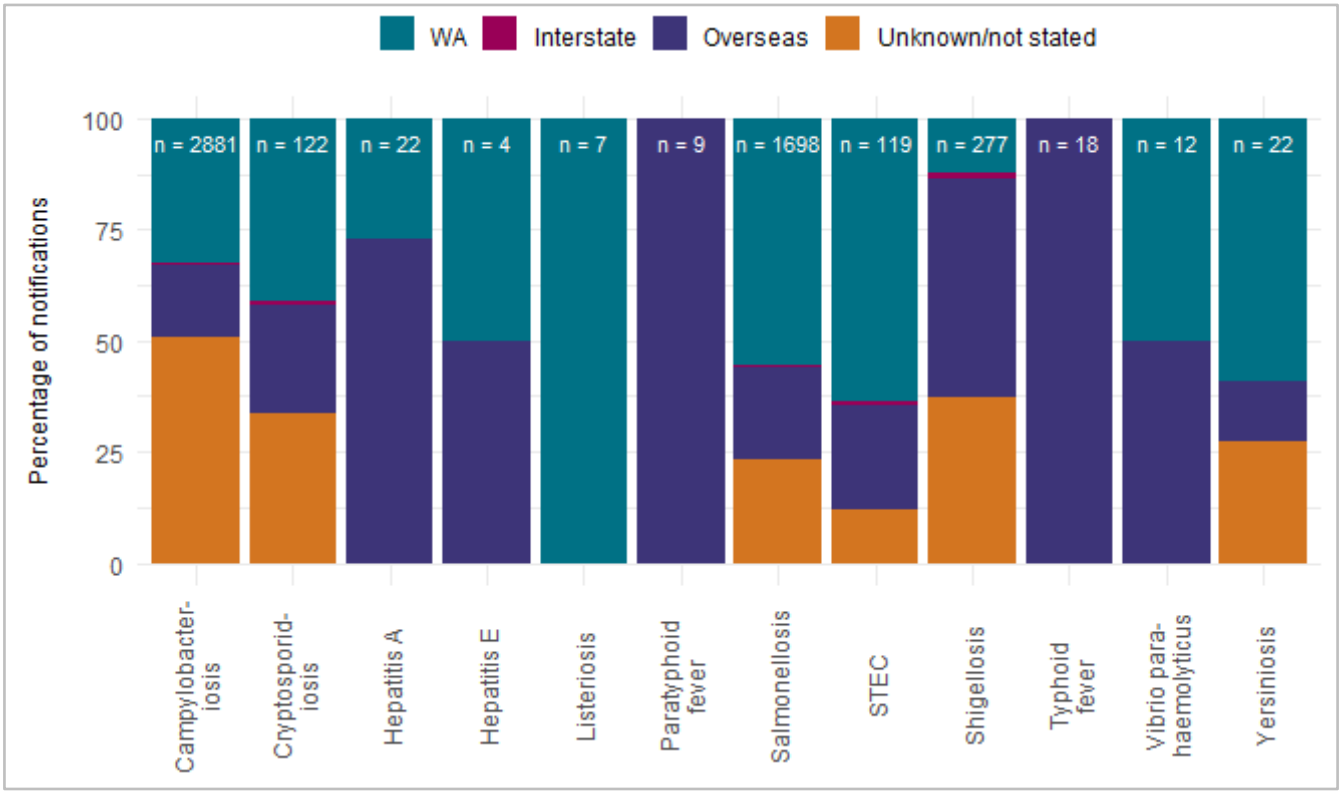

Figure 13: Enteric disease by place of acquisition in 2019; STEC=Shiga-toxin producing *E.coli*

There were increases in the rate of both yersiniosis and hepatitis A in 2019. There were 22 notified cases of yersiniosis in 2019 (compared with 10 cases in 2018), with a cluster of 11 cases occurring between July and August and only one of those cases occurring in a returned traveller. However, investigation by OzFoodNet did not identify any common venues or exposures, and no cause for illness was established.[25] Twenty-two cases of hepatitis A were notified in metropolitan Perth in 2019, with six of these cases being locally acquired. Twelve cases were linked to one of four clusters of hepatitis A. One of these clusters involved three locally acquired cases linked to two cases with overseas acquired disease from Somalia, and another involved three linked locally acquired cases of hepatitis A with nil clear source for the index case; the remaining two clusters involved family pairs of overseas acquired infections.

Changes in case definitions and laboratory testing can also impact number of notifications. There was an apparent increase in shigellosis with 277 notified cases in 2019 (up from 123 cases in 2018). However, the national case definition for *Shigella* changed as of 1 July 2018 to include notifications of PCR positive probable cases, as well as culture positive confirmed cases. The inclusion of probable cases explains almost all of this increase. Similarly, there were 119 cases of Shiga toxin-producing *E. coli* (STEC) notified in metropolitan Perth in 2019, an increase from 79 notified cases in 2018. This large increase is likely to be due to increased PCR testing by a WA laboratory since late 2018.[25] Most notified cases acquired their infection locally; however, there were no point source outbreaks or clusters identified among interviewed locally acquired cases. A rare but serious complication of STEC is haemolytic uraemic syndrome (HUS) which can result in acute renal failure; no cases of HUS have been notified since 2017.

[25] Government of Western Australia, Department of Health. Foodborne disease surveillance and outbreak investigations in Western Australia 2019 annual report [accessed 08 September 2020] https://ww2.health.wa.gov.au/-/media/Corp/Documents/Health-for/Infectious-disease/OZfoodnet/Word/WA-OzFoodnet-annual-report-2019.docx

5.3 Vertical transmission of Listeria

There were seven cases of listeriosis in metropolitan Perth in 2019 (all locally acquired), including two cases in pregnant women, and a further maternal/foetal pair where there was vertical transmission from a symptomatic mother to a 29 week foetus who did not survive. The remaining three cases had immunocompromising comorbidities. Nearly all cases of listeriosis result from the consumption of contaminated food or vertical transmission during gestation.[26] An infected mother may be asymptomatic or experience mild influenza-like symptoms, and foetal infection can result in foetal death, spontaneous abortion, stillbirth, or neonatal infection. Pregnant women and other people at greater risk of infection are advised to avoid high risk foods, and prepare and store food safely.[27]

[26] Communicable Diseases Network Australia. Listeriosis CDNA National Guidelines for Public Health Units [accessed 14 August 2020] https://www1.health.gov.au/internet/main/publishing.nsf/Content/B53D1710E169EF42CA257FAB00062670/$File/listeriosis-SoNG-2018.pdf

[27] Government of Western Australia, Department of Health. Listeria infection [accessed 14 August 2020] https://healthywa.wa.gov.au/Articles/J_M/Listeria-infection

6. Immunisation

6.1 Annual immunisation data summary

Annual immunisation data for 1 year-olds, 2 year-olds and 5 year-olds was calculated by combining the quarterly AIR data, and represents the proportion of children who were up to date by age during 2019 (**Table 2**). Aboriginal-specific data is also presented, as immunisation coverage in Aboriginal children has historically been lower. MCDC helps to identify and facilitate catch up for Aboriginal children who are not up-to-date.

An immunisation coverage rate of 95% (or more) is considered the Australian benchmark. No region achieved the benchmark in 1 and 2 year-olds; however Aboriginal children aged 5 years in WA and Australia (but not metropolitan Perth) exceeded 95% coverage. Additionally, immunisation coverage for fully vaccinated children across metropolitan Perth generally exceeded the 90% coverage targets of the *Western Australian Immunisation Strategy 2016–2020*.[28] Overall, immunisation coverage was similar in 2018 and 2019, although immunisation coverage rates for 2 year-olds in SMHS and WA dropped below 90% in 2019, while immunisation coverage rates for Aboriginal 2 year-olds improved across WA overall and the metropolitan regions.

Table 2: Immunisation coverage by region and age cohort in 2019

Age group	Region	No. of fully vaccinated children	Total children	Immunisation coverage (%)	Aboriginal immunisation coverage (%)
1 year	Metro	24845	26392	94.14	87.19
	NMHS	8213	8691	94.50	86.10
	EMHS	9180	9741	94.24	87.77
	SMHS	7452	7960	93.62	87.10
	WA	30871	32884	93.88	89.06
	Australia	281654	298460	94.37	92.92
2 years	Metro	24779	27527	90.02	82.97
	NMHS	8095	8957	90.38	85.83
	EMHS	9064	10050	90.19	81.39
	SMHS	7620	8520	89.44	83.33
	WA	30736	34223	89.81	84.61
	Australia	279128	305193	91.46	89.70
5 years	Metro	26142	28031	93.26	94.00
	NMHS	8706	9357	93.04	92.96
	EMHS	9313	9973	93.38	94.11
	SMHS	8123	8701	93.36	94.51
	WA	32924	35202	93.53	95.53
	Australia	307136	324193	94.74	96.86

Immunisation coverage below 90% is shown in red, coverage between 90 and <95% is shown in blue, and coverage of >95% is shown in black.

[28] Government of Western Australia, Department of Health. Western Australian Immunisation Strategy 2016–2020 [accessed 16 October 2020] https://ww2.health.wa.gov.au/-/media/Files/Corporate/general-documents/Immunisation/PDF/wa_immunisation_strategy_2016-2020.pdf

There are 33 Local Government Areas (LGAs) in metropolitan Perth. **Appendix 2** shows the percentage of children up to date in each age cohort by LGA in 2019. No LGA achieved the benchmark of 95% or above in all or even two age categories. Joondalup, Kalamunda, Peppermint Grove, Subiaco and Swan achieved >95% coverage in 1 year-olds; Armadale achieved >95% coverage in 5 year-olds.

6.2 Metropolitan immunisation coverage over time

Trends in immunisation coverage across metropolitan Perth between 2016 and 2019 are presented in **Figure 14**. Coverage appears to be improving in children across all age cohorts, and for Aboriginal 2 year-olds. The improvements are not consistent for Aboriginal 1 year-olds and 5 year-olds. The AIR uses definitions to determine whether each child is classified as fully immunised. These criteria have changed over time, so trends must be interpreted with caution.

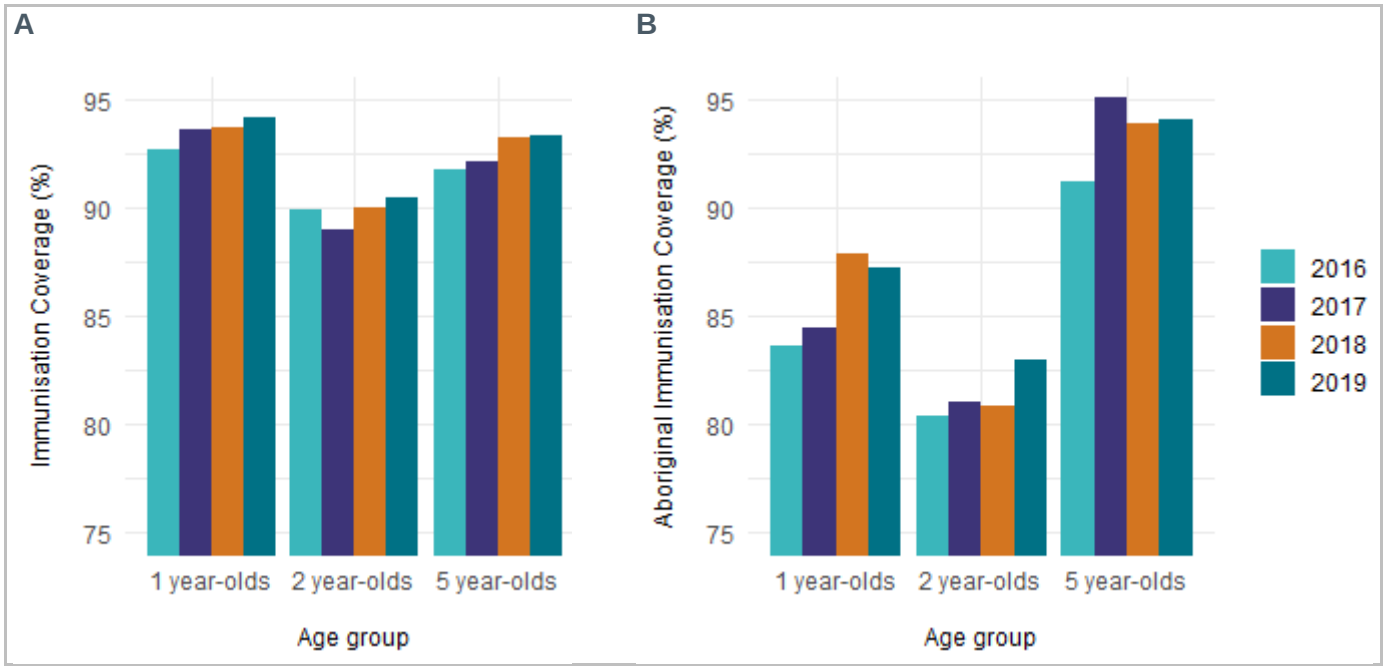

Figure 14: Immunisation coverage in metropolitan Perth, 2016 to 2019; graph A includes all children in the three measured age groups, graph B includes Aboriginal children only.

To be considered fully vaccinated in 2019:

Since mid-2018, a 12–<15 month-old child requires three doses of diphtheria, tetanus, pertussis (DTPa), polio and hepatitis B vaccines; two or three doses of HiB vaccine; and two or three doses of PCV13. This change occurred because the infant vaccine schedule was changed from three PCV13 doses at 2, 4 and 6 months, to three doses at 2, 4 and 12 months from 1 July 2018. Thus, a child requires only two PCV13 doses to be considered fully vaccinated at 1 year of age. Some of the increase in vaccination coverage in 1 year-olds since mid-2018 may be attributable to this change.

A 24–<27 month-old child requires four doses of DTPa vaccine; three doses of polio, hepatitis B, and PCV13 vaccine; three or four doses of HiB vaccine; two doses of MMR; and one dose of meningococcal C and varicella vaccines. This has been altered twice since the beginning of 2016. First, a fourth dose of DTPa was added to the schedule at 18 months in March 2016, and to the AIR definitions in December 2016, causing a decrease in the number of children classified as fully vaccinated from the last quarter of 2016. Second, from September 2018, the

definition required the third PCV13 dose (typically at 12 months of age) to be recorded, possibly contributing to a decline in coverage among 2 year-olds from the latter half of 2018.

A 60–<63 month-old child requires five doses of DTPa vaccine, and four doses of polio vaccine. This has changed twice since the beginning of 2016. First, when the booster dose of DTPa at 18 months commenced, this age group was required to have a fifth dose of DTPa vaccine recorded from December 2016, rather than the previous four, possibly causing an artificial decline in coverage. Second, the second dose of MMR was removed from the criteria in December 2017 (already featuring in criteria for 2 year-olds), possibly contributing to more 5 year-old children classified as fully vaccinated from final quarter of 2017.

6.3 Rabies and Australian Bat Lyssavirus post-exposure prophylaxis

MCDC provides advice to doctors and practice nurses regarding post-exposure prophylaxis (PEP) for rabies, and authorises the use of DOH-funded supplies according to national guidelines. In metropolitan Perth in 2019, 193 courses of rabies PEP were arranged for 102 males and 91 females, aged between 21 months and 76 years of age.[29] The rate of rabies PEP of 9.3 per 100 000 population in 2019 was lower than that in recent years (11.1 per 100 000 population in 2018). Indonesia was the most common location for rabies prone exposures, and dogs were the most commonly implicated animal (**Table 3**).[29]

Table 3: Persons sustaining rabies prone injuries, by animal and location, 2019

Country of exposure	Dog	Monkey	Cat	Bat	Squirrel	Rat	Civet	Total
Indonesia	48	51	7	0	3	2	2	**113**
Thailand	10	13	8	0	1	0	0	**32**
India	4	1	1	0	0	0	0	**6**
China	2	3	0	0	0	0	0	**5**
Sri Lanka	4	0	1	0	0	0	0	**5**
Vietnam	4	1	0	0	0	0	0	**5**
Australia	0	0	0	4	0	0	0	**4**
Cambodia	3	0	1	0	0	0	0	**4**
Philippines	2	0	2	0	0	0	0	**4**
Malaysia	1	2	0	0	0	0	0	**3**
Burma	2	0	0	0	0	0	0	**2**
Colombia	1	1	0	0	0	0	0	**2**
Total	**85**	**73**	**22**	**4**	**4**	**2**	**2**	**193**

Table includes only locations implicated in more than one exposure event, so Total is more than the sum of the contributing rows. Year is based on date reported to public health, not date of exposure.

6.4 Immunisation catch ups

MCDC provided general practices with immunisation catch up plans for 1465 metropolitan children in 2019. The written catch up plans for overdue or unvaccinated children also include information on the correct spacing between dosing. For children born overseas now living in WA, MCDC liaises with health care providers to ensure vaccines administered abroad are added to the AIR. MCDC also facilitates access to translation services, so that immunisation records in foreign languages can be added to the AIR. This process improves assessment of

[29] Sharon Gough (personal communication), Communicable Disease Control Directorate, Public and Aboriginal Health Division, WA DOH, on 26 May 2020.

the individual's vaccination needs, and assists families whose children were identified as not fully immunised to access Commonwealth support services.

6.5 Cold chain breaches and vaccine wastage

In 2019, MCDC managed 724 cold chain breaches. A vaccine cold chain breach occurs when vaccine storage temperatures have been outside the recommended range of +2 to +8 °C.[30] Immunisation providers are required to report cold chain breaches to MCDC as part of their supply agreement with the WA DOH for government-funded vaccines. Depending on the nature of the breach, cumulative breach time, and the vaccines involved, outcomes can include no action or discarding vaccines, as well as advice on appropriate cold chain management and monitoring. MCDC provides this advice to ensure that vaccines retain safety and potency, while minimising costly vaccine wastage.

There were 69 336 doses of vaccine wasted in the metropolitan area in 2019, with an estimated value of $1,344,733.[31] The two main reasons for this wastage were failure to use the dose before expiry (71% of doses), followed by cold chain breaches (27% of doses). The increase in vaccine wastage in 2019 compared with 2018 (where there were 38 788 doses of vaccine wasted) occurred predominantly due to increased expiry of influenza doses.

[30] Australian Government, Department of Health. National Vaccine Storage Guidelines: Strive for 5 [accessed 25 May 2020] https://www.health.gov.au/sites/default/files/documents/2020/04/national-vaccine-storage-guidelines-strive-for-5.pdf

[31] Sharon Gough (personal communication), Communicable Disease Control Directorate, Public and Aboriginal Health Division, WA DOH, on 14 October 2020.

Appendix 1: Communicable disease notification rate by geographical health service area

Notifiable disease	2019 notification rate/100 000					
	North	East	South	Metro	WA	National
Blood-borne diseases						
Hepatitis B (newly acquired)	0.6	1.0	0.8	0.8	0.9	0.6
Hepatitis B (unspecified)	15	23.4	15.2	17.9	16.3	22.8
Hepatitis C (newly acquired)	1.7	5.8	5.4	4.2	4.6	3.2
Hepatitis C (unspecified)	18.9	36.6	31.5	28.9	33.2	33.6
Hepatitis D	0.6	0.6	0.3	0.5	0.4	0.3
Enteric diseases						
Campylobacteriosis	135.1	130.9	149.5	138.1	136.3	143.6
Cholera	0	0	0	0	0	0
Cryptosporidiosis	6.8	6.5	4.2	5.8	8.1	10.7
Hepatitis A	0.6	2.1	0.5	1.1	1.0	1.0
Hepatitis E	0	0.4	0.2	0.2	0.2	0.2
Listeriosis	0.3	0.3	0.5	0.3	0.3	0.2
Paratyphoid fever	0.3	0.7	0.3	0.4	0.3	0.5
Salmonellosis	80.9	83.2	80.0	81.4	83.3	58.7
Shiga toxin-producing *E.coli*	5.4	7.2	4.5	5.7	5.9	2.6
Shigellosis	11.2	14.1	14.8	13.3	15.1	12.6
Typhoid fever	0.1	1.7	0.8	0.9	0.8	0.8
Vibrio parahaemolyticus	0.7	0.6	0.5	0.6	0.7	NN
Yersiniosis	1.1	0.6	1.5	1.1	0.9	NN
Sexually transmitted infections						
Chlamydia	397.4	482.3	440.6	439.8	445.8	410.4
Gonorrhoea	106.8	172.0	140.6	139.5	151.8	137.2
Syphilis (infectious)	10.3	23.2	13.5	15.7	21.8	23.4
Syphilis (non-infectious)	7.0	10.4	4.6	7.4	8.3	10.2
Syphilis (congenital)	0	0	0	0	0	0
Vaccine preventable diseases						
Diphtheria	0	0	0	0	0	0
Haemophilus influenzae type B	0.1	0	0	0	0.1	0.1
Influenza	924.2	857.3	872.6	885.3	894.4	1254.1
Measles	0.6	1.7	4.0	2.0	2.1	1.1
Meningococcal disease (invasive)	0.3	0.8	0.6	0.6	1.0	0.8
Mumps	0.7	0.7	1.1	0.8	1.3	0.7
Pertussis	19.3	13.2	31.7	21.1	21.2	48.1
Pneumococcal disease (invasive)	6.1	8.5	7.1	7.2	9.6	8.5
Rotavirus	20.1	24.5	21.2	22.0	20.8	24.7
Rubella	0	0.1	0	0	0	0.1
Tetanus	0	0	0	0	0	0
Varicella–Zoster	162.2	143.5	188.1	163.9	164.6	131.1
Vector-borne diseases						
Murray Valley encephalitis virus	0	0	0	0	0	0

Kunjin/West Nile virus	0	0	0	0	0	0
Japanese encephalitis virus	0	0	0	0	0	0
Barmah Forest virus	0	0.3	0.5	0.2	0.5	1.0
Chikungunya virus	0.4	0.3	0.6	0.4	0.3	0.3
Dengue virus	12.8	10.7	16.3	13.2	12.8	5.9
Malaria	3.0	3.1	1.2	2.5	2.3	1.5
Rickettsial disease (typhus)	1.2	0.6	1.1	1.0	1.1	NN
Ross River Virus	8.4	10.8	18.9	12.5	14.8	11.9
Zika virus	0	0	0	0	0	NN
Zoonotic diseases						
Leptospirosis	0.3	0.3	0	0.2	0.2	0.3
Psittacosis	0	0	0	0	0	0.1
Q Fever	0	0.1	0.3	0.1	0.3	2.3
Brucellosis	0	0	0	0	0	0
Other diseases						
Botulism	0	0	0	0	0	0
Creutzfeldt–Jakob disease	0.4	0.4	0.2	0.3	0.3	NN
Haemolytic uraemic syndrome	0	0	0	0	0	0.1
Legionellosis	1.9	1.0	1.4	1.4	1.4	1.7
Leprosy	0	0	0.2	0	0	0
Melioidosis	0	0.1	0.2	0.1	0.2	NN
Tuberculosis	5.5	8.0	4.6	6.1	4.4	6.0

Data retrieved from WANIDD; NN=not notifiable. Varicella–Zoster includes chickenpox and shingles, as well as those unspecified. From July 2018, the case definitions for shigella and rotavirus were altered; the former contributing to a larger number of notifications, and the latter having no substantial impact on number of notifications. From September 2018, the case definition for pertussis was made more stringent, likely contributing to a smaller number of notifications.[32]

[32] Government of Western Australia, Department of Health. Case definitions of notifiable infectious diseases and related conditions [accessed 11 August 2020] https://ww2.health.wa.gov.au/~/media/Files/Corporate/general%20documents/communicable%20diseases/Word/wa_notifiable_infectious_disease_case_definitions.docx

Appendix 2: Immunisation coverage by Local Government Area (LGA)

Local Government Area (LGA)	Age Group	Number of Fully Vaccinated Children	Total children in region	Immunisation coverage (%)
Armadale	1 year	1459	1536	94.99
	2 years	1377	1512	91.07
	5 years	1516	1594	95.11
Bassendean	1 year	177	198	89.39
	2 years	198	217	91.24
	5 years	186	198	93.94
Bayswater	1 year	776	821	94.52
	2 years	791	869	91.02
	5 years	710	757	93.79
Belmont	1 year	548	594	92.26
	2 years	467	533	87.62
	5 years	482	532	90.60
Cambridge	1 year	236	251	94.02
	2 years	227	250	90.80
	5 years	317	343	92.42
Canning	1 year	985	1045	94.26
	2 years	1077	1197	89.97
	5 years	1237	1322	93.57
Claremont	1 year	94	99	94.95
	2 years	80	89	89.89
	5 years	124	131	94.66
Cockburn	1 year	1439	1527	94.24
	2 years	1517	1683	90.14
	5 years	1518	1604	94.64
Cottesloe	1 year	63	68	92.65
	2 years	70	82	85.37
	5 years	65	69	94.20
East Fremantle	1 year	66	72	91.67
	2 years	67	73	91.78
	5 years	71	77	92.21
Fremantle	1 year	303	334	90.72
	2 years	279	322	86.65
	5 years	293	328	89.33
Gosnells	1 year	1615	1708	94.56
	2 years	1639	1832	89.47
	5 years	1755	1878	93.45
Joondalup	1 year	1601	1672	95.75
	2 years	1557	1732	89.90
	5 years	1846	1974	93.52
Kalamunda	1 year	618	647	95.52
	2 years	612	676	90.53
	5 years	642	701	91.58
Kwinana	1 year	738	783	94.25
	2 years	766	853	89.80
	5 years	672	724	92.82
Mandurah	1 year	753	810	92.96
	2 years	743	841	88.35

	5 years	806	854	94.38
Melville	1 year	956	1019	93.82
	2 years	1011	1142	88.53
	5 years	1091	1176	92.77
Mosman Park	1 year	65	75	86.67
	2 years	62	74	83.78
	5 years	69	74	93.24
Mundaring	1 year	353	389	90.75
	2 years	369	422	87.44
	5 years	419	456	91.89
Murray	1 year	234	253	92.49
	2 years	228	251	90.84
	5 years	276	298	92.62
Nedlands	1 year	135	146	92.47
	2 years	165	185	89.19
	5 years	212	230	92.17
Peppermint Grove	1 year	6	6	100.0
	2 years	15	21	71.43
	5 years	14	16	87.50
Perth	1 year	196	212	92.45
	2 years	144	167	86.23
	5 years	126	149	84.56
Rockingham	1 year	1886	2018	93.46
	2 years	1842	2062	89.33
	5 years	2005	2151	93.21
Serpentine–Jarrahdale	1 year	505	542	93.17
	2 years	530	579	91.54
	5 years	490	520	94.23
South Perth	1 year	380	406	93.60
	2 years	392	436	89.91
	5 years	377	413	91.28
Stirling	1 year	2643	2817	93.82
	2 years	2589	2872	90.15
	5 years	2459	2661	92.41
Subiaco	1 year	190	198	95.96
	2 years	200	231	86.58
	5 years	204	227	89.87
Swan	1 year	2081	2188	95.11
	2 years	2131	2330	91.46
	5 years	2281	2404	94.88
Victoria Park	1 year	432	458	94.32
	2 years	379	417	90.89
	5 years	372	405	91.85
Vincent	1 year	373	394	94.67
	2 years	320	366	87.43
	5 years	309	338	91.42
Wanneroo	1 year	2874	3029	94.88
	2 years	2856	3117	91.63
	5 years	3103	3320	93.46
Waroona	1 year	29	33	87.88
	2 years	39	46	84.78
	5 years	43	49	87.76

Immunisation coverage below 90% is shown in red, coverage between 90 and <95% is shown in blue, and coverage of >95% is shown in black.

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