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 2020

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Epidemiology of notifiable infectious diseases in metropolitan Perth: Annual report 2020.

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.

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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.

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Executive summary

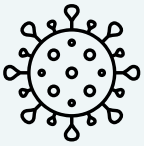
Metropolitan Communicable Disease Control (MCDC) is responsible for the public health management of notifiable infectious diseases in metropolitan Perth. This report is to inform health care providers and stakeholders about local trends in communicable disease epidemiology in 2020 and highlight related public health actions and issues requiring attention.

23 130 infectious disease notifications in metropolitan Perth in 2020; down 46%

On the rise:

Syphilis
Cryptosporidiosis

94.5 % of 12 month-olds fully immunised in metropolitan Perth; benchmark 95%



New and Emerging:

COVID-19

- In 2020, there were **871 notifications for confirmed COVID-19** cases in Western Australia (WA); 55.2% acquired their infection overseas, 33.4% at sea and 11.4% locally. The first case reported in WA had disease onset on 20 February 2020 and WA reached its peak number of daily notifications (33) on 20 March.
- **WA flattened the curve** using a coordinated multiagency response that included contact tracing, access to testing, border restrictions and quarantine requirements, social gathering restrictions, and promotion of respiratory virus hygiene etiquette.
- The measures taken in response to **COVID-19 likely contributed to the decrease in several other notifiable communicable diseases** including influenza, measles and pertussis.
- Notifications for **infectious syphilis continued to rise** in 2020 despite a reduction in the number of tests conducted, with a **higher proportion among vulnerable and priority** populations compared to 2019.
- A **syphilis outbreak was declared in metropolitan Perth** in July 2020 and MCDC undertook a range of actions in response to the outbreak and have helped to support a **collaborative multiagency response**.
- **Infectious syphilis in women of childbearing age is increasing** and now comprise one in five (19.5%) of these notifications. Doctors are advised to do a pregnancy test in this group whenever syphilis is confirmed or suspected.
- **Infectious syphilis notifications in pregnant women continues to rise**. Treatment, contact tracing, and monitoring are vital to reduce the risk of congenital syphilis.
- The number of notifications for **chlamydia and gonorrhoea decreased** for the first time since 2017, though this decline occurred in the setting of a 6% decrease in testing in metropolitan Perth in 2020 from 2019.[1]
- While hepatitis C notifications continued to decline, they continue to **disproportionately affect marginalised populations**.
- There were two **locally acquired cases of typhoid fever** from chronic carriers.
- Immunisation is a key component of communicable disease prevention. Immunisation coverage at 12 months of age improved from 94.1% in 2019 to 94.5% in 2020, compared to a national benchmark of 95%.
- **Coverage remains below the benchmark for Aboriginal children**, with a gap of 8.3% between Aboriginal and non-Aboriginal children at 12 months of age in 2020. To address the gap, MCDC has implemented **multiple partnership projects** to engage families and providers and improve immunisation rates and has recruited an Aboriginal Health team**.** Key projects include Moorditj (Strong) Kids, a GP engagement project, and vaccine hesitancy work.

[1] Kellie Mitchell (personal communication), Immunisation, Surveillance and Disease Control, Communicable Disease Control Directorate, Department of Health, on 17 June 2021

Background

Purpose

The aim of this annual report is to inform healthcare providers about important trends in notifiable infectious diseases in metropolitan Perth in 2020. 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 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 disease surveillance, public health management, policy and interventions, and enhance prevention and control of these diseases. A list of current notifiable infectious diseases and related conditions in Western Australia (WA), 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 were extracted from the WANIDD on 14 April 2021 and are subject to revision. Data were retrieved using an **optimal date of onset** of disease (ODOO) from 1 January 2020 to 31 December 2020. 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 2020 to 31 December 2020. National notification rates for 2020 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 20 May 2021. Summary statistics for enteric disease outbreaks in the metropolitan area in 2020 were cross-referenced with OzFoodNet, a program unit within CDCD that is responsible for enteric disease surveillance in WA. Where minor discrepancies were identified; data from MCDC are used in the report. COVID-19 data for WA were extracted from PHOCUS (the COVID-19 database) on 7 May 2021 using an ODOO from 1 January to 31 December 2020.

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[2] Government of Western Australia, Department of Justice. Western Australian Legislation – Public Health Act 2016 [accessed 14 July 2021] 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 2021] 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 2021] http://www9.health.gov.au/cda/source/cda-index.cfm

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 2020 in metropolitan Perth and WA were 2 090 185 and 2 621 509, respectively. As population projections by age group and Aboriginal status were unavailable for 2020, the actual population data for 2019 were used for these sub-groups.

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 2020.

Respiratory Syncytial Virus data

Respiratory syncytial virus (RSV) is not currently a notifiable disease. PathWest, the public pathology centre for WA, provided their testing data for respiratory syncytial virus (RSV) detections for 2019 and 2020.

Overview of notifiable diseases

In metropolitan Perth, there were 23 130 notifications for listed infectious diseases in 2020. This was a 45.8% decrease from the 42 654 notifications in 2019, predominantly due to a decline in influenza notifications. An unprecedented influenza season in 2019 accounted for most of the 52.7% increase in notifications that year. In 2020, the largest reduction in notifications was seen in the vaccine preventable disease category, with a 76.9% reduction in the number of notifications from 23 007 in 2019 to 5323 in 2020. The largest increase in notifications occurred in the other disease category, with a more than four-fold increase from 167 notifications in 2019 to 748 in 2020; COVID-19 is currently classified under the other disease category and contributed 93.6% of that increase. The relative proportion of notifications by disease category is shown in ***Figure 1***. In 2020, sexually transmitted infections were the leading contributor to disease notifications in metropolitan Perth, accounting for 48.9% of the notifications.

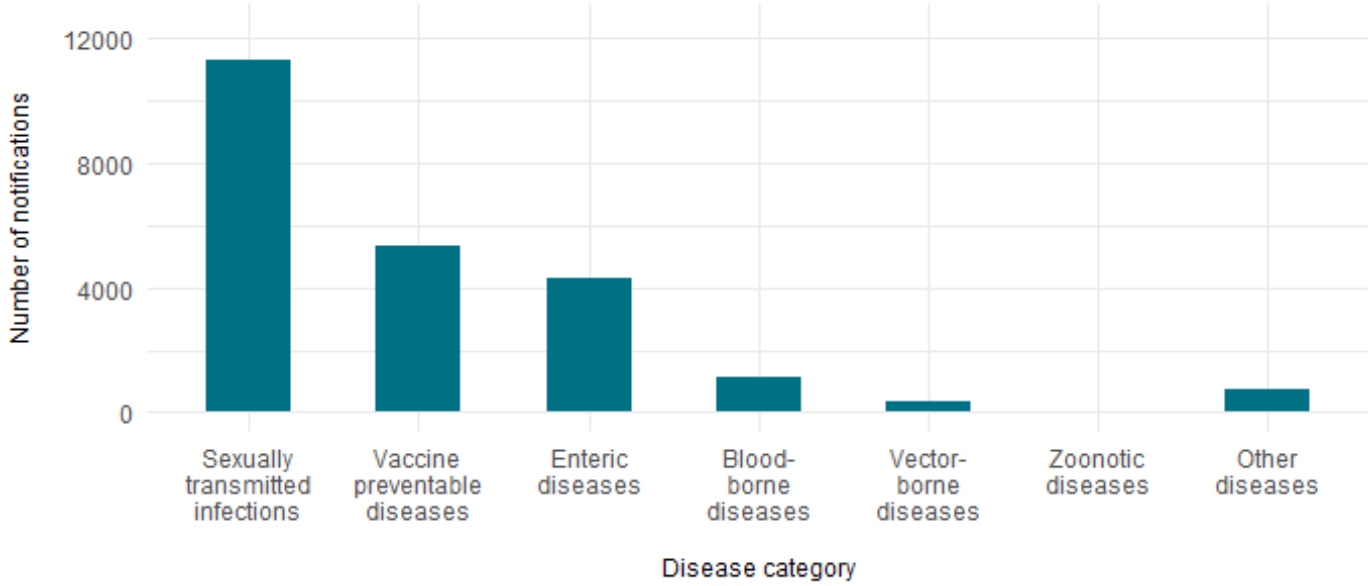

Figure 1: Number of notifications by disease category in 2020

[5] Khan Rahman (personal communication), Epidemiology Branch, Public and Aboriginal Health Division, WA DOH, on 4 May 2021.

The total number of notifications for each disease notified in metropolitan Perth between 2016 and 2020 is presented in **Table 1**. The 2020 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) 2016–20, & 2020 metropolitan, WA & national crude notification rates.

Notifiable disease	Number of notifications per year					2020 notification rate per 100 000 population		
	2016	2017	2018	2019	2020	Metro	WA	National
Blood-borne viruses								
Hepatitis B (newly acquired)	22	13	20	16	11	0.5	20.1	0.5
Hepatitis B (unspecified)	546	428	394	373	426	20	19.7	19.8
Hepatitis C (newly acquired)	94	94	97	89	71	3.3	35.3	2.6
Hepatitis C (unspecified)	800	774	658	600	609	28.6	34.7	29.3
Hepatitis D	1	2	7	10	2	0.1	0.1	0.3
Enteric diseases								
Campylobacteriosis	2715	2679	2729	2881	2283	107.2	108.8	124.6
Cholera	0	1	0	0	0	0	0	0
Cryptosporidiosis	168	292	65	122	425	20	18.6	9.6
Hepatitis A	16	10	11	22	5	0.2	0.2	0.3
Hepatitis E	3	4	2	4	3	0.1	0.1	0.1
Listeriosis	5	6	5	7	6	0.3	0.3	0.2
Paratyphoid fever	11	4	9	9	0	0	0	0.1
Salmonellosis	1509	1999	1602	1699	1369	64.3	66.6	47.5
Shiga toxin-producing E.coli	20	44	79	119	80	3.8	3.9	2.3
Shigellosis	59	56	123	277	103	4.8	8.6	6.3
Typhoid fever	9	19	12	18	7	0.3	0.3	0.3
Vibrio parahaemolyticus	22	18	14	12	3	0.1	0.1	NN
Yersiniosis	12	14	10	22	14	0.7	0.6	NN
Sexually transmitted infections								
Chlamydia	9115	8978	9016	9171	8384	393.7	406.9	360.2
Lymphogranuloma venereum	0	0	0	2	3	0.1	0.1	NN
Gonorrhoea	2274	2177	2327	2910	2280	107.1	134.9	115.4
Syphilis (congenital)	0	0	1	0	3	0.1	0.2	0.1
Syphilis (infectious)	264	242	310	334	466	21.9	27.3	20.8
Syphilis (non-infectious)	49	137	168	154	183	8.6	16.2	8.1
Vaccine-preventable diseases								
Diphtheria	0	1	0	0	0	0	0	0
Haemophilus influenzae type B	0	0	0	1	1	0	0.1	0.1
Influenza	6115	4475	4663	18467	981	46.1	46	84.2
Measles	11	16	33	42	4	0.2	0.2	0.1
Meningococcal disease (invasive)	12	34	23	12	5	0.2	0.4	0.4
Mumps	28	19	17	17	7	0.3	0.4	0.6
Pertussis	1178	1037	916	440	98	4.6	4.7	13.6
Pneumococcal disease (invasive)	112	127	124	150	73	3.4	6.8	4.4
Rotavirus	152	327	220	458	175	8.2	8.1	6.5
Rubella	1	2	1	1	1	0	0	0
Tetanus	0	0	1	0	1	0	0	0
Varicella-Zoster	3163	3436	3580	3419	3977	186.8	184.8	124

Vector-borne diseases								
Murray Valley encephalitis virus	0	0	1	0	0	0	0	0
Japanese encephalitis virus	0	0	1	0	0	0	0	0
Barmah Forest virus	5	11	7	5	3	0.1	0.8	2.9
Chikungunya virus	14	9	1	9	3	0.1	0.3	0.1
Dengue virus	455	149	118	275	48	2.3	2.3	0.9
Malaria	43	49	44	52	22	1	1.1	0.6
Rickettsial disease (typhus)	29	11	10	20	9	0.4	0.8	NN
Ross River Virus	232	609	347	261	236	11.1	19.5	25.2
Zika virus	13	1	1	0	0	0	0	NN
Zoonotic diseases								
Brucellosis	2	0	0	0	0	0	0	0.1
Leptospirosis	3	1	5	4	0	0	0.1	0.4
Psittacosis	0	1	0	0	0	0	0	0.3
Q Fever	5	5	6	3	2	0.1	0.2	1.8
Other diseases								
Botulism	0	0	0	0	0	0	0	0
Creutzfeldt-Jakob disease	5	4	6	7	5	0.2	0.4	NN
COVID-19	0	0	0	0	544*	25.5*	34.5	113
Haemolytic uraemic syndrome	2	3	0	0	0	0	0.2	0.1
Legionellosis	50	30	37	30	60	2.8	3	2.1
Leprosy	4	1	1	1	3	0.1	0.2	0
Melioidosis	1	3	2	2	0	0	0.2	NN
Tuberculosis	128	115	115	127	136	6.4	10.4	6.3

**This number includes 38 historical cases that will not be analysed report.*
Grey bars highlight diseases of interest in 2020.

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.[6]

[6] Government of Western Australia, Department of Health. Case definitions of notifiable infectious diseases and related conditions [accessed 20 May 2021] https://ww2.health.wa.gov.au/~/media/Files/Corporate/general%20documents/communicable%20diseases/Word/wa_notifiable_infectious_disease_case_definitions.docx

1. COVID-19 – a new notifiable disease

1.1 The emergence of COVID-19

On 31 December 2019, an alert from the Wuhan Municipal Health Commission about a cluster of pneumonia cases of unknown aetiology was reported in the Chinese media and ProMED.[7] A new strain of coronavirus, later named SARS-CoV-2, was identified in early January 2020 and the genetic sequence was released publicly on 12 January.[8] On 10 January, the first clinician alert was released by the WA DOH about the viral pneumonia detected in Wuhan, China. MCDC staff started modifying the MERS-CoV Guidelines[9] and Case Surveillance and Contact Tracing Templates to suit what was known about the novel coronavirus at that time.

The first COVID-19 case confirmed outside of China was reported on 13 January;[8] by 30 January, there were 82 confirmed cases reported across 18 countries outside China, 7 of these were in Australia.[10] The WA DOH activated Public Health Emergency Operations Centre (PHEOC) on 23 January. A range of preparations that MCDC was involved in commenced, including: an online suspect case notification system; use of electronic means to collect data on cases and their contacts; liaison with PathWest in relation to their development of, and capacity for, SARS-CoV-2 testing; liaison with all laboratories regarding how cases would be notified urgently; development of plans for testing sites (initially called Fever Clinics); and recruitment of surge staff for contact tracing should the need arise.

In the weeks that followed there were various travel restrictions introduced by the Australian Government based on country travelled from.[11] The World Health Organization (WHO) declared a worldwide pandemic of COVID-19 on 11 March 2020[8] and 4 days later, on 15 March 2020, the Australian Government required all overseas arrivals to isolate for 14 days and banned all cruise ship arrivals.[11] WA declared a State of Emergency under the *Emergency Management Act 2005* effective from midnight on 16 March 2020.[12] These measures remained in place for the remainder of 2020. The WA government also introduced internal border controls, both within the State and between states, the latter remained in place for most of the remainder of 2020.

In this section of the report, all cases of COVID-19 that were notified in WA in 2020 will be referred to because, while some were not residents of metropolitan Perth, many were diagnosed in hotel quarantine in Perth and as such were managed locally, initially by MCDC and later by the Public Health Operations arm of PHEOC. Notably, several MCDC staff worked within PHEOC during 2020. There were also some regional cases that were managed through regional Public Health Units during the early part of the pandemic response.[13]

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[7] ProMED International Society for Infectious Diseases. Undiagnosed Pneumonia -China (Hubei): Request for information [accessed 23 July 2021] https://scholar.harvard.edu/files/kleelerner/files/20191230_promed_-_undiagnosed_pneumonia_-_china_hu-_rfi_archive_number-_20191230.6864153.pdf

[8] World Health Organisation. Archived: WHO Timeline – COVID-19 [accessed 30 June 2021] https://www.who.int/news/item/27-04-2020-who-timeline---covid-19

[9] Australian Government, Department of Health. Middle East Respiratory Syndrome Coronavirus (MERS-CoV) CDNA National Guidelines for Public Health Units [accessed 23 July 2021] https://www1.health.gov.au/internet/main/publishing.nsf/Content/DA7D2B43102293AECA257DC70081C245/$File/MERS-CoV-SoNG-sep2015.pdf

[10] World Health Organisation. Novel Coronavirus (2019-nCoV) Situation Report -10 [accessed 15 July 2021] https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200130-sitrep-10-ncov.pdf

[11] Australian Government, Department of Health, Communicable Diseases Intelligence, COVID-19 National Incident Room Surveillance Team. COVID-19, Australia: Epidemiology Report 12: Reporting week ending 23:59 AEST April 2020 [accessed 14 July 2021] https://doi.org/10.33321/cdi.2020.44.36

[12] Government of Western Australia. COVID-19 coronavirus: State of Emergency Declarations [accessed 14 July 2021] https://www.wa.gov.au/government/document-collections/covid-19-coronavirus-state-of-emergency-declarations

[13] These numbers are also included in this section of the report for completeness.

1.2 Flattening the curve

The first case reported in WA (onset 20 February 2020) acquired their infection at sea on the Diamond Princess cruise and later died from COVID-19 related complications on 1 March 2020. While there was a case who had an earlier disease onset, 17 February 2020, they were not diagnosed until late March. WA's first locally acquired case was confirmed on 7 March 2020 (onset on 2 March 2020).

In WA, there were 920 notifications for COVID-19 in 2020, 871 of these were confirmed COVID-19 cases and 49 were historical cases.[14] Notifications for historical cases are not included in further analysis. Over half of the notifications acquired their infection overseas (55.2%), a third acquired it at sea (33.4%) and around a tenth (11.4%) acquired it locally, ***Figure 2***. Of the 99 notifications that acquired COVID-19 locally, 79% were a contact of a confirmed case(s) and/or in a known cluster, 14% were not a contact of a known case with no interstate travel and 7% were not a contact of a known case but had travelled interstate.[15]

WA started to see an increase in notifications from 12 March 2020, reaching a daily peak of 33 on 20 March 2020 before gradually decreasing to zero on the 17 April for 7 consecutive days. WA used a coordinated multiagency response that included contact tracing, access to testing, border restrictions and quarantine requirements, social gathering restrictions, and promotion of respiratory virus hygiene etiquette. This success is demonstrated by the distribution of notifications across the year, ***Figure 2***; 63.1% of the notifications in WA had disease onset between 17 February and 16 April, with only 7 (2.2%) of the 321 notifications after this date acquiring their infection locally, 43% of whom acquired it in hotel quarantine while chaperoning a minor with COVID-19 who had returned unaccompanied from overseas. In this report, an onset date from 1 February to 16 April will be described as the first wave. During this wave, a proportion of cases will have been missed because strict testing criteria* meant that not everyone with COVID-19 would have had access to testing.

[14] Australian Government, Department of Health, Communicable Diseases network Australia. Coronavirus Disease 2019 (COVID-19) CDNA National Guidelines for Public Health Units [accessed 27 July 2021] https://www1.health.gov.au/internet/main/publishing.nsf/Content/7A8654A8CB144F5FCA2584F8001F91E2/$File/COVID-19-SoNG-v4.7.pdf

[15] Andrew Jardine (personal communication), Public Health Intelligence, Public and Aboriginal Health Division, North Metropolitan Health Service, on 4 June 2021

* Initially, individuals had to have returned from a particular area/country, have symptoms or be a contact of a known case to be tested; criteria evolved over time with further understanding of the virus and disease.

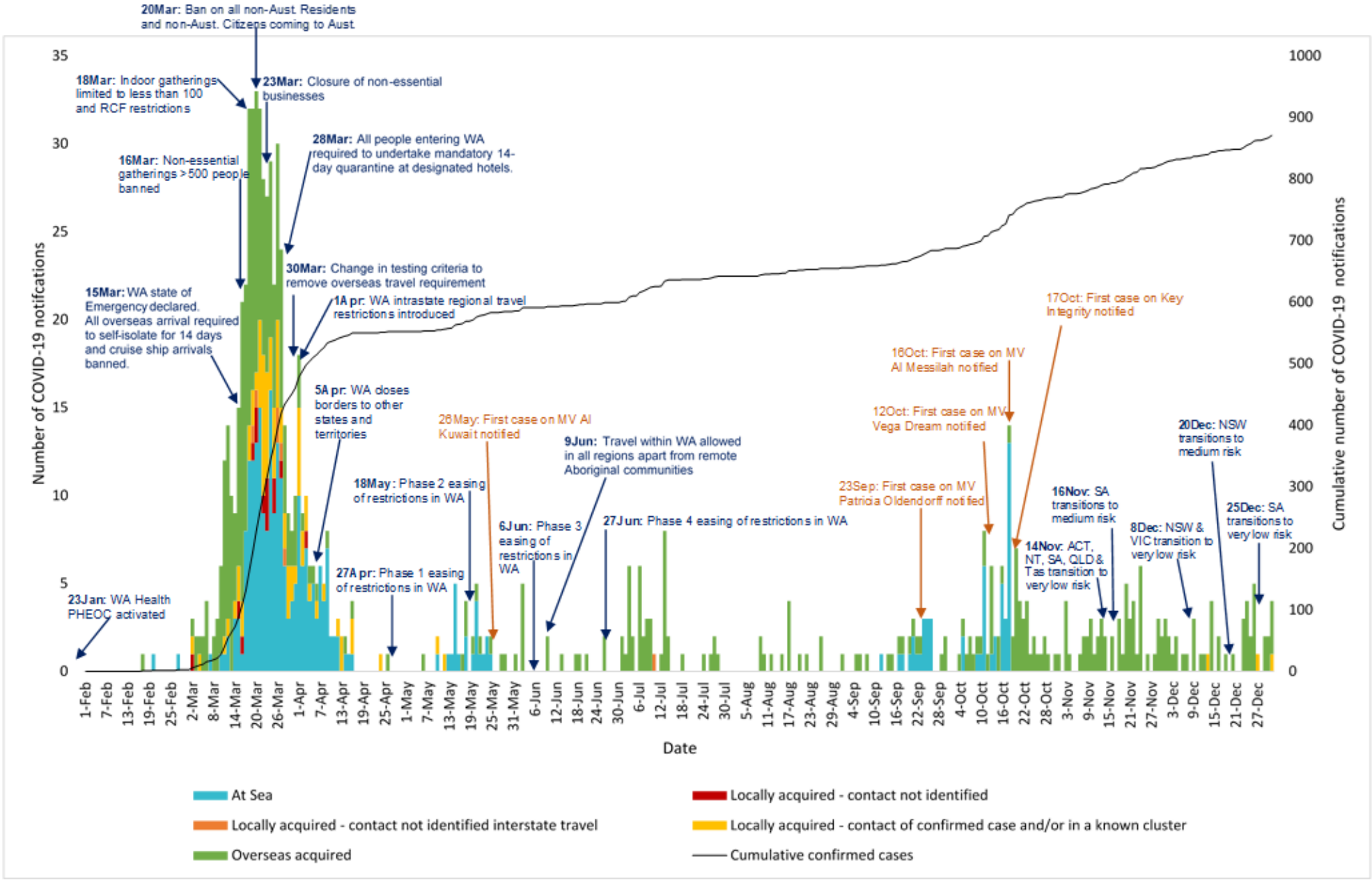


Figure 2: COVID-19 notifications in WA in 2020; bar plot shows number of notifications on specified date (left axis) and line plot shows cumulative number of notifications (right y axis).

In the first wave, 67.1% of the notifications were metropolitan Perth residents, 22.0% were overseas or interstate residents and 10.9% were regional WA residents, ***Figure 3***. Whereas from 17 April to 31 December, a higher proportion, 53.6%, were overseas or interstate residents, 42.7% were metropolitan Perth residents and 3.7% regional WA residents.

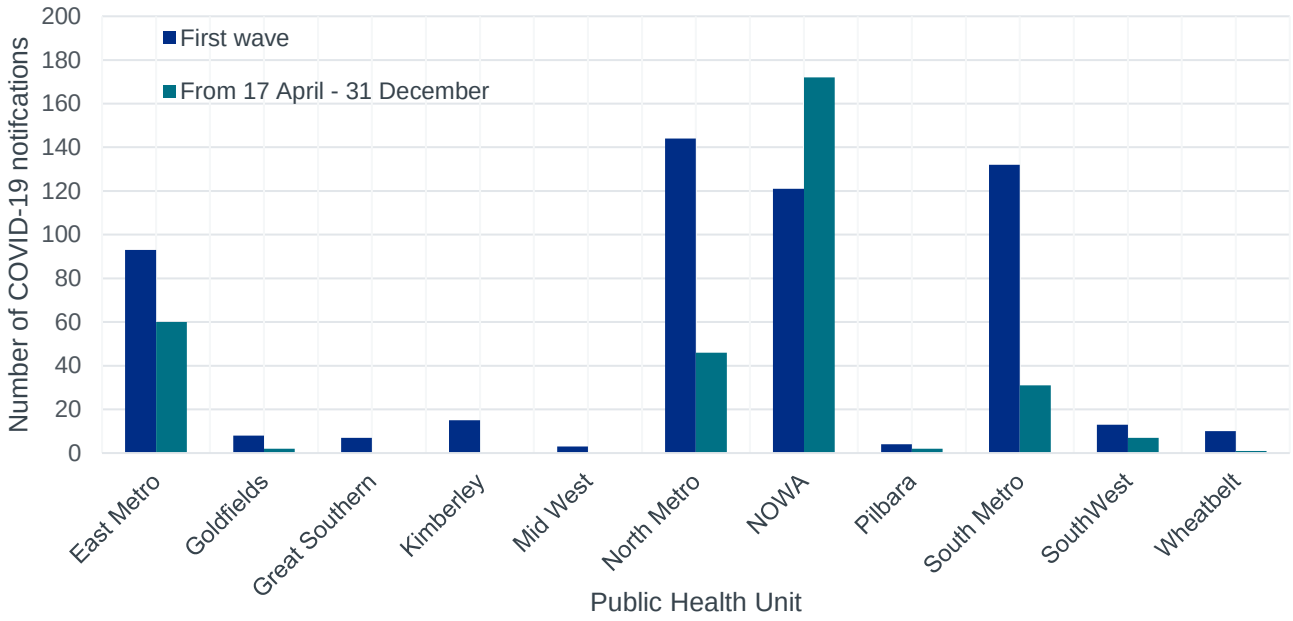


Figure 3: Number of COVID-19 notifications by Public Health Unit of their usual place of residence (*NOWA* = *Not Western Australia (i.e., interstate/overseas)).*

There was one Aboriginal person among the 871 notifications in 2020. This is a testament to efforts to minimise the risk of COVID-19 acquisition in this priority population.

In the first wave, the median age of COVID-19 notifications was 53 years (interquartile range 34) with the highest rate occurring in 70-74 year-olds, 55.9 notifications per 100 000 population; 54.4% of the notifications were male and 45.6% were female, ***Figure 4***.

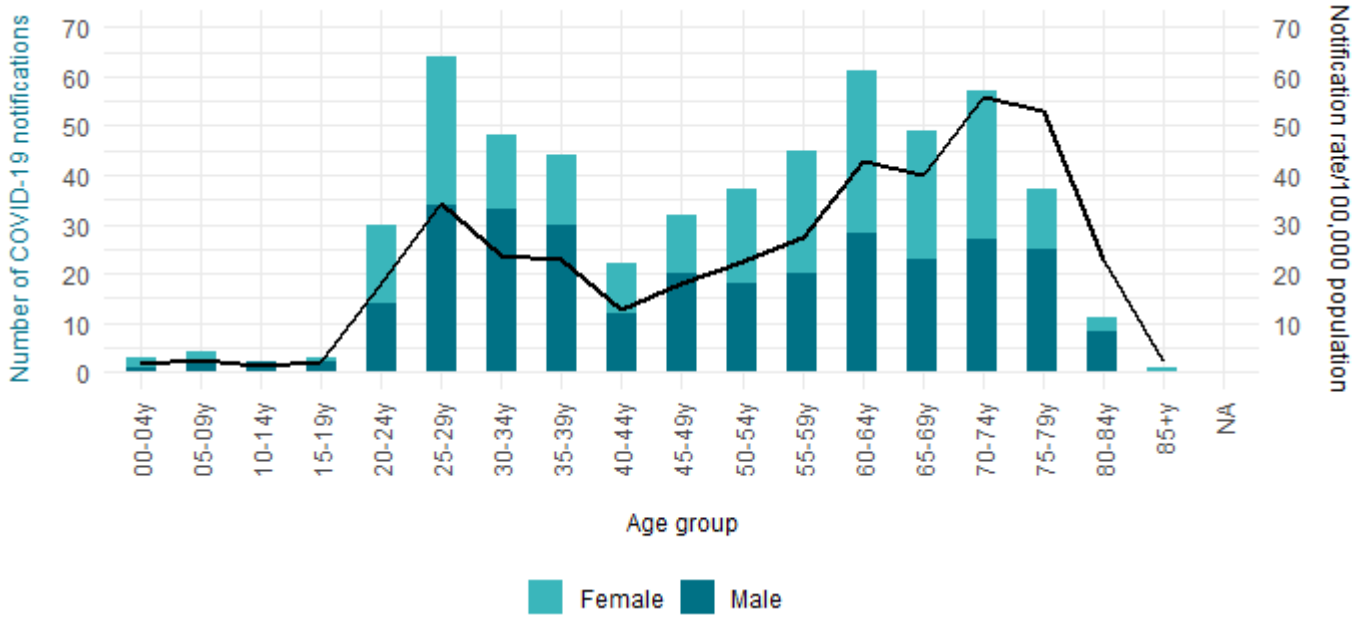


Figure 4: Number of COVID-19 notifications during first wave in WA in 2020; bar plot shows number of notifications stacked by sex (left y axis) and line plot shows notification rate per 100 000 population (right y axis). *Caveat: the rate per 100 000 population is an estimate only as a significant minority of these people were not Australian (e.g. passengers from the Artania cruise).*

In contrast, the median age of COVID-19 notifications from 17 April to 31 December was 37 years (interquartile range 20) with the highest rate occurring in 30-34 year-olds, 24.6 notifications per 100 000; 68.2% of the notifications were male and 31.7% were female, ***Figure 5***. The younger age and higher proportion of male notifications is likely a reflection of the travel restrictions influencing the traveller demographic and the fact that 69 (21.5%) of these notifications were associated with maritime commercial vessel outbreaks, on which all bar one crew member was male.

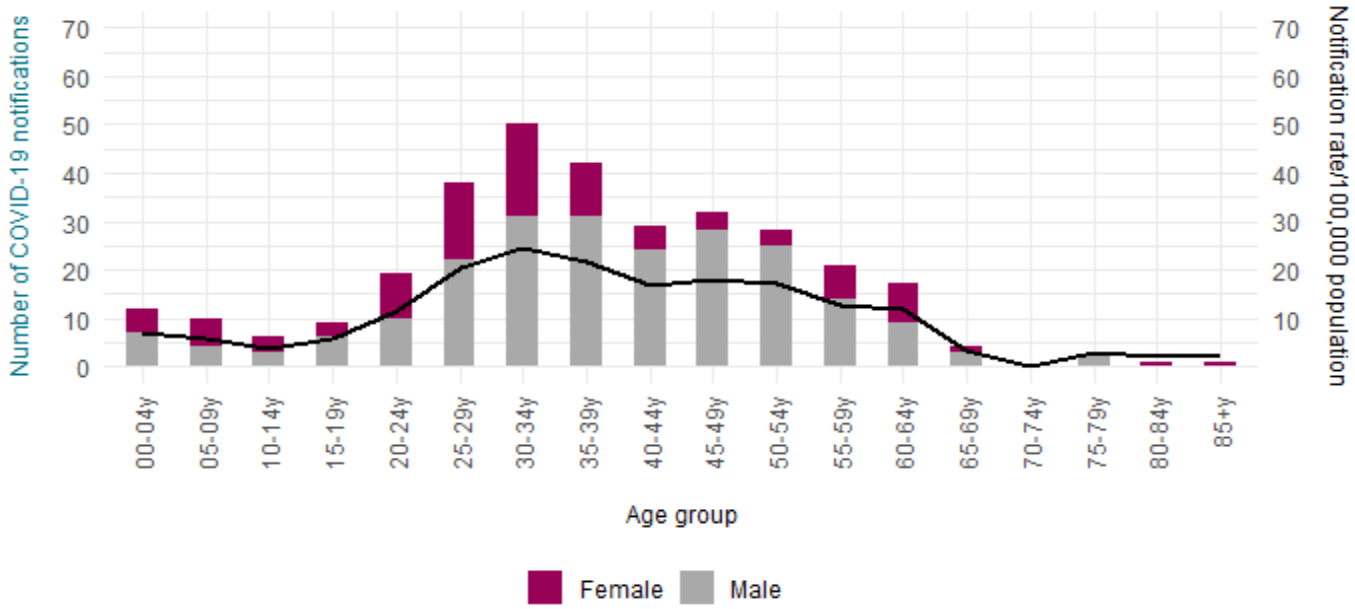


Figure 5: Number of COVID-19 notifications from 17 April to 31 December 2020 in WA; bar plot shows number of notifications stacked by sex (left y axis) and line plot shows notification rate per 100 000 population (right y axis). *Caveat: the rate per 100 000 population is an estimate only as a significant minority of these people were not Australian (e.g., foreign crew members of merchant vessels)*

All the cases that were admitted to an intensive care unit (ICU) or ventilated in 2020 were part of the first wave; 36 of the 871 COVID-19 notifications were admitted to an ICU (4.1%) and 26 were ventilated (3.0%). In 2020, there were nine deaths from COVID-19 related complications in WA, all occurring during the first wave; eight were aged 69 years or older, one aged 42, ***Figure 6***. Hospitalisation data is not presented on account of a number of the notifications having been admitted for non-medical reasons.

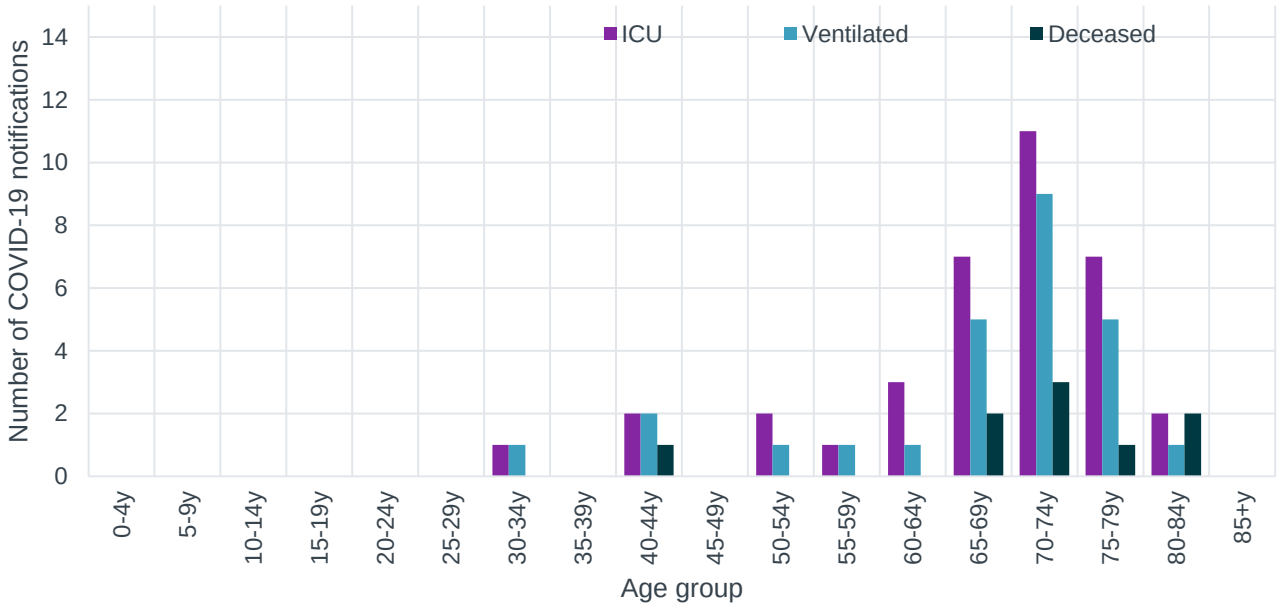


Figure 6: Number of COVID-19 notifications admitted to ICU, ventilated and deceased in first wave.

1.3 Outbreaks and contacts

In 2020 there were 29 outbreaks of COVID-19 reported, with 361 of the notified confirmed cases (41.4%) linked to one of these outbreaks. Cruise ships accounted for the largest proportion of outbreaks and associated cases, with 221 cases across 10 different outbreaks. This was followed by merchant maritime vessels with 69 cases across 5 outbreaks, and flights with 32 cases across 4 outbreaks. There were also two outbreaks that occurred in hospital settings that collectively had seven cases linked to them, and one outbreak in a residential care facility setting that had three cases linked to it.

Public health management of COVID-19 involves detailed history taking from the case to identify close contacts, casual contacts and locations of interest. Moreover, those cases are monitored throughout their infection to ensure that they remain in isolation and seek medical care should they require it. With each case, there are generally several close contacts and locations of interest. Therefore, public health management also includes active monitoring of close contacts to ensure that they remain in quarantine and are tested as indicated (for example, if they develop symptoms). To provide an indication of workload, the number of daily active COVID-19 contacts on each day of the first wave is presented in ***Figure 7***, reaching a peak of 590 contacts on 29 March 2020.[16] Each of these contacts was monitored daily by MCDC and later Public Health Operations.

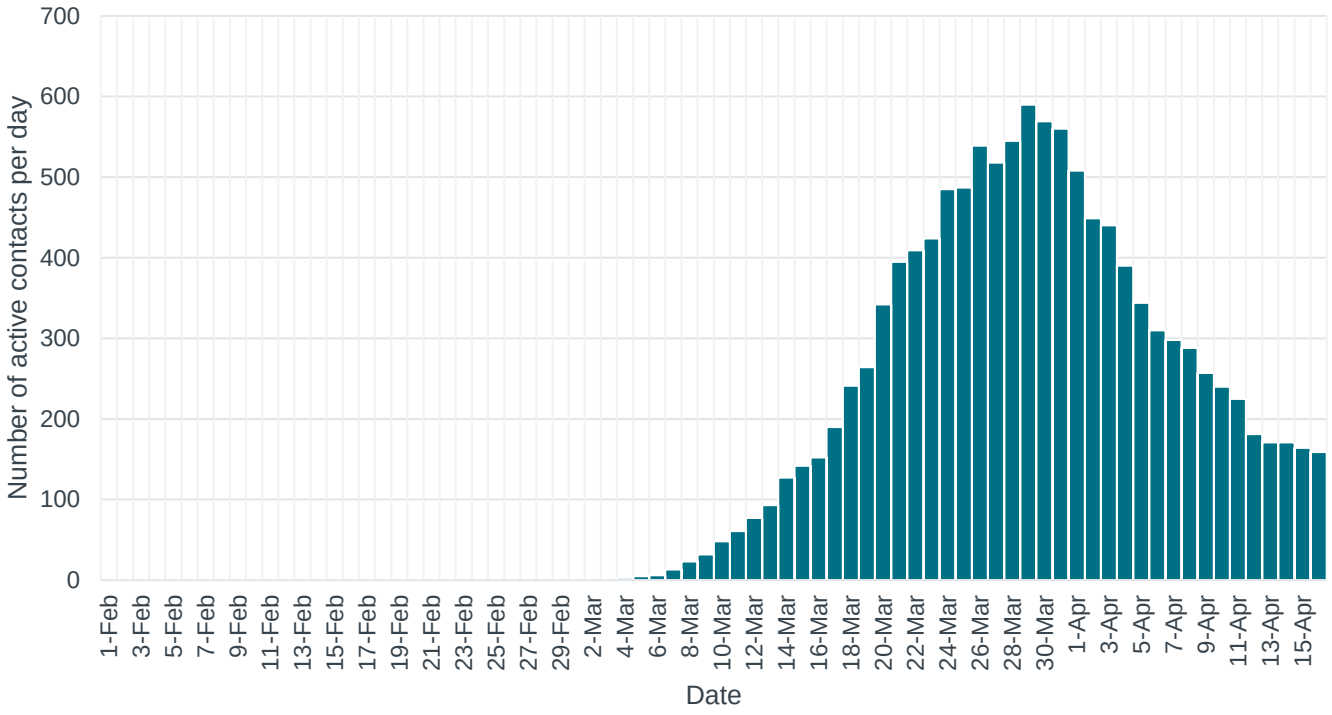


Figure 7: Number of active COVID-19 contacts on each day of the first wave.

[16] Data extracted from PHOCUS, and received from Andrew Jardine (personal communication), Public Health Intelligence, Public and Aboriginal Health Division, North Metropolitan Health Service, on 23 July 2021

2. An unusual year for influenza and RSV

2.1 The impact of COVID-19 on influenza notifications

Metropolitan Perth experienced another unprecedented influenza season in 2020, though very different to that of 2019. There were only 981 influenza notifications in 2020, a 94.7% decrease from the 18 467 notifications in 2019 and 81.8% decrease from the median annual number of notifications (5389) from 2016-19. In 2020, influenza notifications peaked in January at 437 (44.5%), decreased steadily in February and March before flattening out from April to December, with an average of 7.9 notifications per month during this latter period, ***Figure 8***. The marked decrease in influenza notifications from April parallels the introduction of travel restrictions, emphasis on influenza vaccination to prevent dual COVID-19 and influenza outbreaks during the winter, social distancing measures, and promotion of respiratory virus hygiene etiquette as part of the COVID-19 response. All these measures contributed to the marked reduction in influenza notifications in 2020.

While it is important to acknowledge the effect the pandemic had on respiratory virus testing priorities, with many individuals with an influenza-like illness tested for COVID-19 but not for other respiratory viruses including influenza, the low number of influenza notifications is likely to reflect significantly decreased influenza activity.

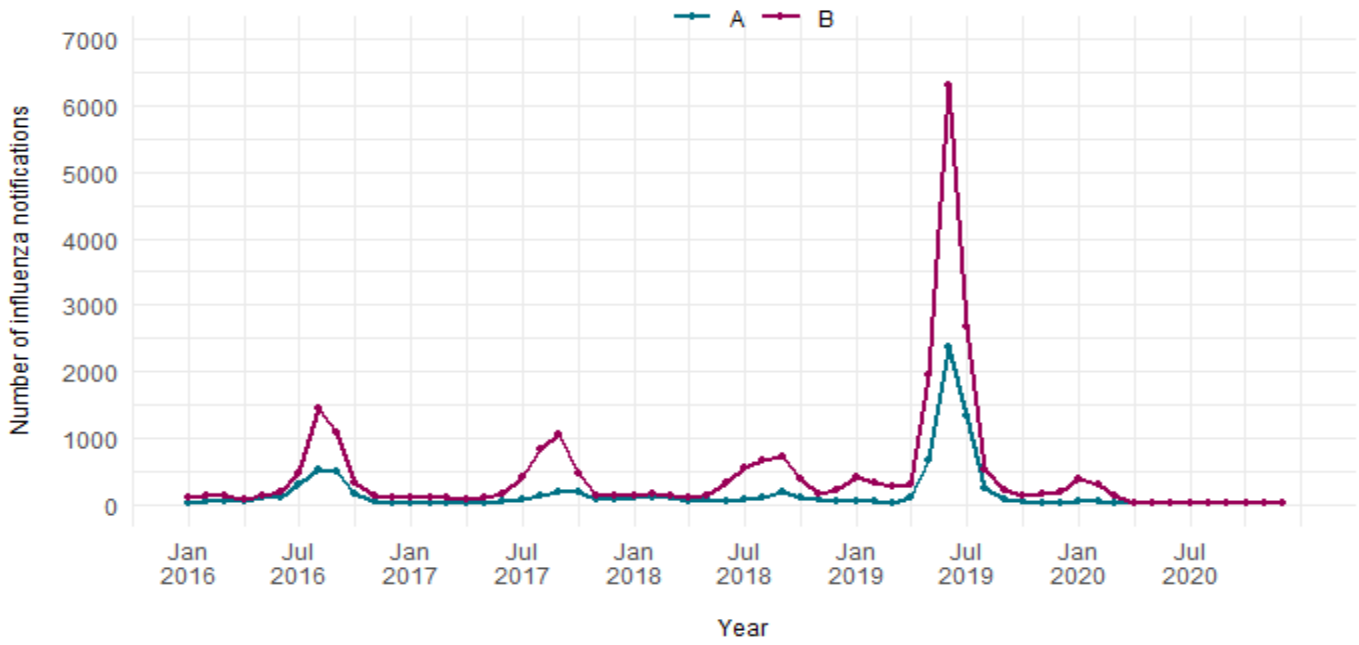


Figure 8: Seasonal trends in influenza notifications over 5 years, by type

In 2020, the 85 year and over age group had the highest rate with 76.2 notifications per 100 000 population, followed by the 80-84 year old age group with 70 notifications per 100 000 population. Interestingly, notification rates per 100 000 population were similar among the 0-4 (55.4), 30-34 (53.6), 50-54 (55.7), 65-69 (56.1) and 70-74 (55.4) year age group, ***Figure 9***.

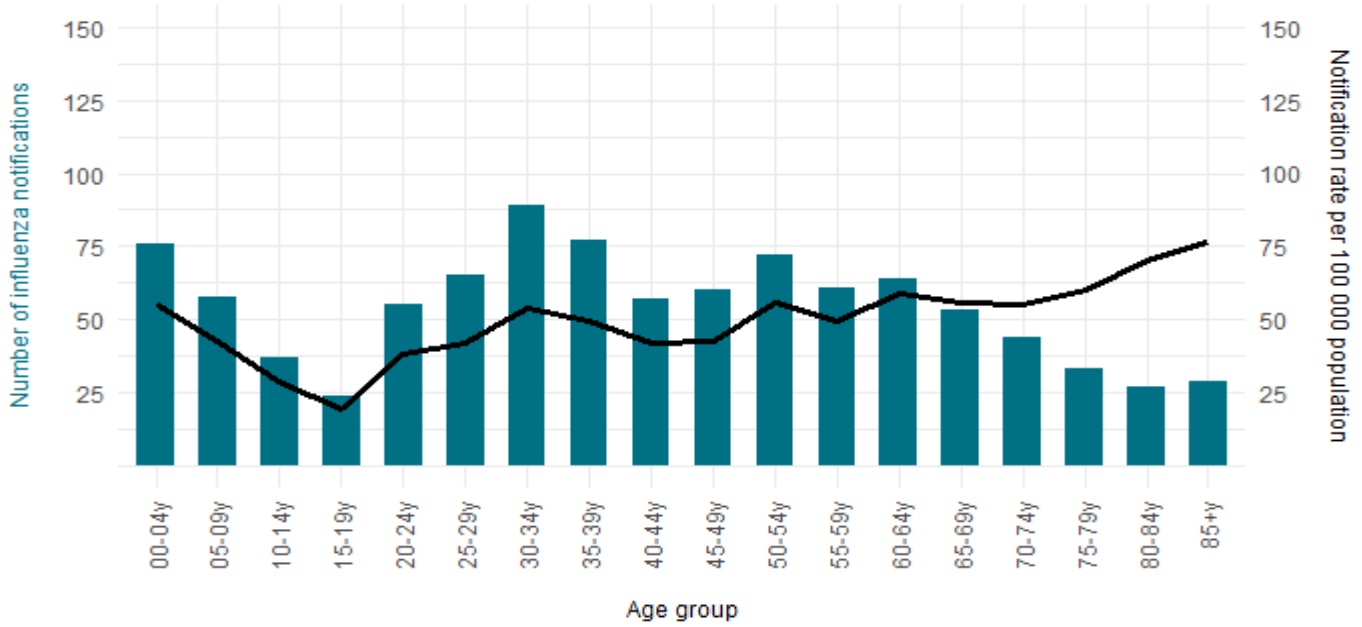


Figure 9: Number of influenza notifications in 2020; bar plot shows number of notifications (left y axis) and line plot shows notification rate per 100 000 population (right y axis).

In metropolitan Perth 51.0% of children aged 6 months to 5 years, 68.4% of people aged 65 years or older, and 35.6% of Aboriginal people had an influenza vaccine in 2020.[17] In WA the proportion of pregnant women who were known to receive an influenza vaccine during their pregnancy continued to increase, 62.2% in 2020, compared with 55.5% in 2019, 44.2% in 2018 and 32.9% in 2017.[18]

Although a higher proportion of notified influenza cases were hospitalised in 2020 (20.3%) than in 2019 (13.5%), the proportion was comparable to the average proportion hospitalised from 2016-18 (20.5%) ***Figure 10***.

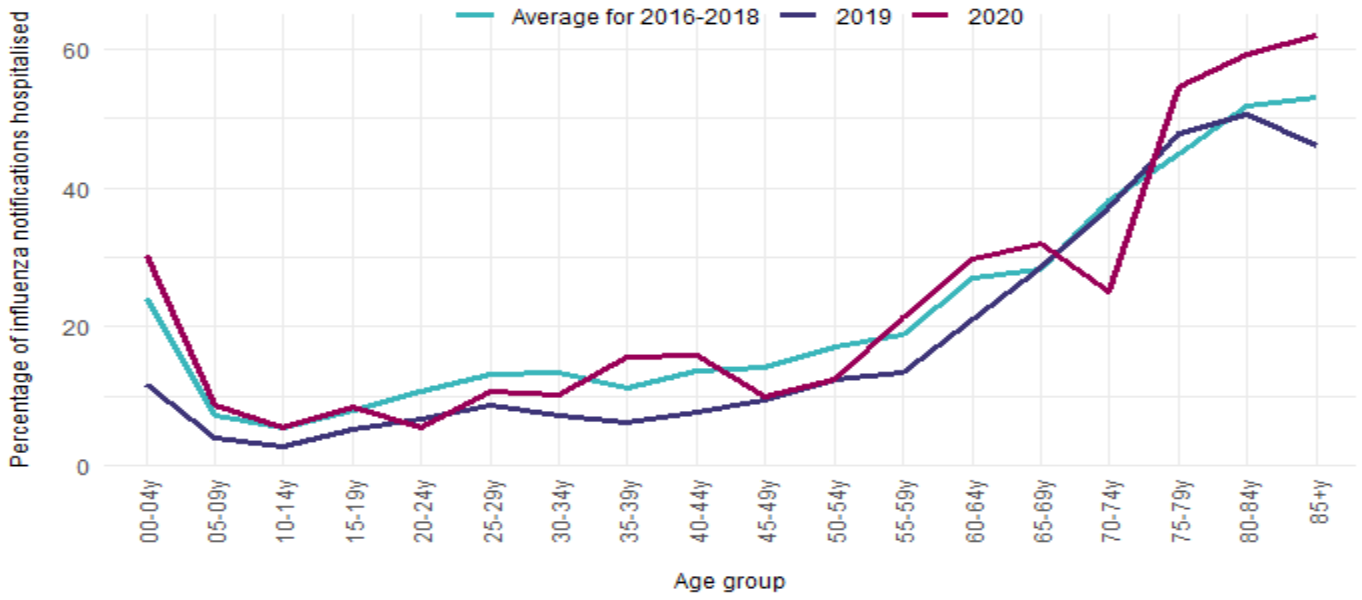


Figure 10: Proportion of influenza notifications that were hospitalised in 2019, 2020, and the average proportion hospitalised from 2016-18, by age group.

[17] Sarah French (personal communication), Data Analysis and Reporting, Immunisation Program, WA DOH, on 27 April 2021
[18] Government of Western Australia, Department of Health. Influenza vaccination [accessed 3 June 2021] https://ww2.health.wa.gov.au/Reports-and-publications/Western-Australias-Mothers-and-Babies-summary-information/data?report=mns_fluv_y

2.3 Institutional outbreaks of influenza-like illness

Residential care facilities (RCFs) are required to notify MCDC regarding any potential influenza outbreaks, defined by the CDNA as three or more staff or residents with an influenza-like illness within 72 hours.[19] As part of the COVID-19 response, RCF's in metropolitan Perth were encouraged to notify MCDC if they had even one resident or staff member with symptoms of an influenza-like illness to ensure appropriate surveillance and testing. While MCDC were notified of 76 potential acute respiratory outbreaks in RCFs during 2020, influenza was not isolated in any of them, reflecting the low community incidence in combination with visiting restrictions, the new requirement that RCF visitors and staff be vaccinated against influenza, and a heightened public awareness of the importance of staying home when sick.

Organisms isolated from outbreaks of influenza-like illness in RCFs included rhinovirus (21 facilities), parainfluenza (11 facilities), respiratory syncytial virus (5 facilities) and human metapneumovirus (1 facility); no organism was detected in 55% of the potential outbreaks. There was one associated death.

In 2020, there was 1 influenza outbreak reported in a hospital which occurred in January and affected at least 20 people. Influenza A was isolated in this outbreak. There were no influenza outbreaks reported in schools or prisons.

2.4 A change in distribution of RSV detections

Although RSV is not currently a notifiable disease, it is an important cause of childhood morbidity and mortality, with the highest risk of severe outcomes among neonates.[20] Characteristically, it causes outbreaks in late autumn and winter. However, in 2020 the disease occurred much later in the year (late spring-early summer) after most restrictions relating to COVID-19 had been relaxed. There were anecdotal reports of outbreaks in childcare facilities. While RSV detections at PathWest were 12.6% lower in 2020 than in 2019, 1590 and 1820 respectively[21], the seasonal distribution across the year was very different, ***Figure 11***. The number of weekly RSV detections reached a peak of 317 in week 52.

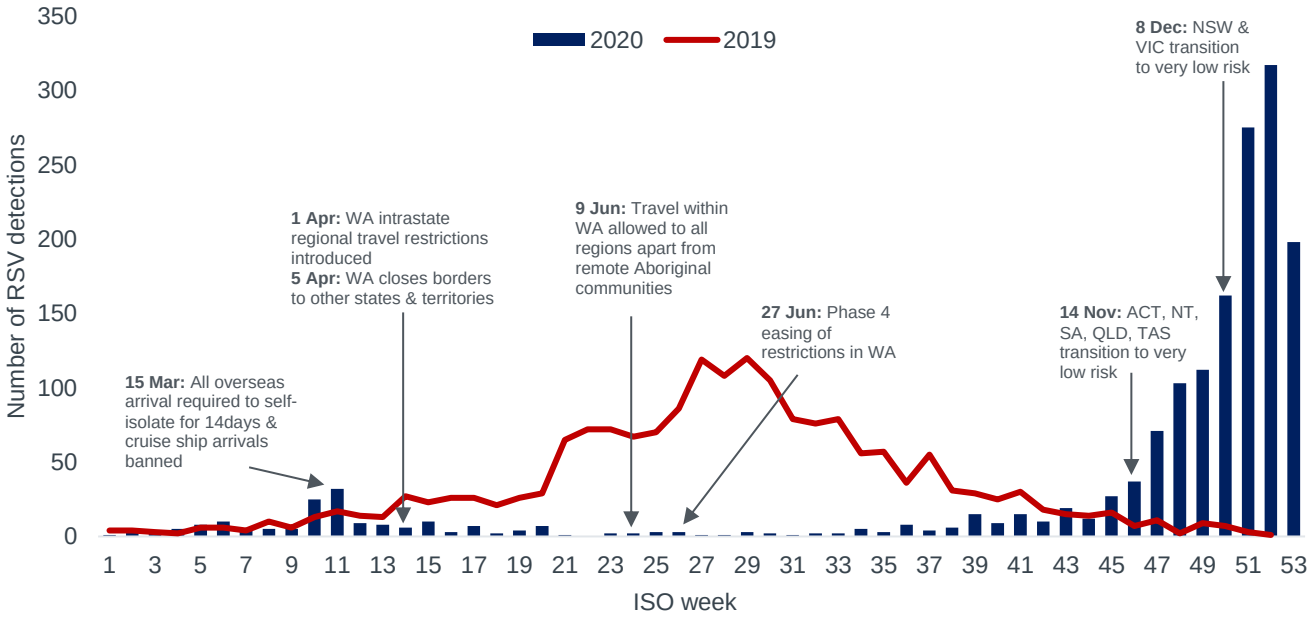


Figure 11: PathWest RSV detections in 2019 and 2020, by ISO week (data provided by PathWest[21]).

[19] Communicable Diseases network Australia. Guidelines for the Prevention, Control and Public Health Management of Influenza Outbreaks in Residential Care Facilities in Australia. [accessed on 30 June 2021] https://www1.health.gov.au/internet/main/publishing.nsf/Content/27BE697A7FBF5AB5CA257BF0001D3AC8/$File/RCF_Guidelines.pdf

[20] World Health Organization. RSV Vaccine Research and Development Technology RoadMap [accessed 16 July 2021] C:\Users\HE171662\Downloads\WHO-IVB-17.12-eng.pdf

[21] Cara Minney-Smith (personal communication), Surveillance Unit, Microbiology, PathWest, on 15 June 2021

3 Sexually transmissible infections – responding to the syphilis outbreak

3.1 Syphilis notifications continue to increase

Notifications for infectious syphilis continued to increase with 466 notifications in metropolitan Perth in 2020, a 39.5% increase from 2019 despite a 7.5% reduction in the number of syphilis tests conducted in metropolitan Perth.[22] Previously a rare infectious disease at the turn of the century, there has been an eight-fold increase in the number of infectious syphilis notifications since 2010, ***Figure 12***. Consequently, a syphilis outbreak in metropolitan Perth was declared by the WA Chief Health Officer in July 2020. MCDC undertook a range of actions in response to the outbreak including delivering education sessions to health care providers; establishing a new database for surveillance and management of high risk cases; engaging and collaborating with vulnerable and priority populations; contributing to the refinement of the King Edward Memorial Hospital *Syphilis in pregnancy* guidelines;[23] advocating for increased routine testing; and facilitating multiagency case management meetings for cases who are pregnant or experiencing homelessness.

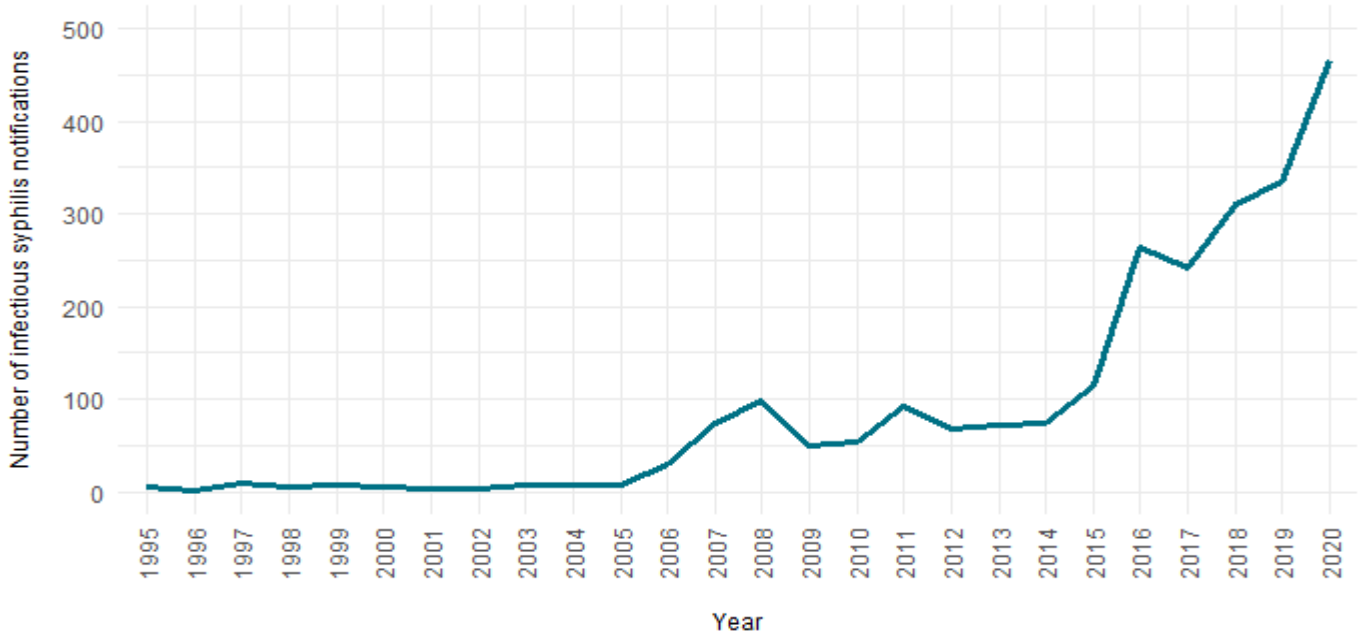


Figure 12: Number of notifications of infectious syphilis over time, 1995–2020

MCDC follows up every syphilis notification. This process is resource-intensive, involving review of current and previous results from all WA laboratories; liaison with regional public health units if previously notified there; and liaison with health professionals at the requesting clinic to determine staging, pregnancy status for women of childbearing age, and to confirm adequate treatment and contact tracing. Additionally, for cases under GP care, MCDC generally calls the infectious syphilis cases and their contacts to assess public health risk, and provide guidance on treatment, testing and prevention. Staff also complete extensive documentation including completion of an enhanced surveillance form.

[22] Kellie Mitchell (personal communication), Immunisation, Surveillance and Disease Control, Communicable Disease Control Directorate, Department of Health, on 19 April 2021

[23] Government of Western Australia, Women and Newborn Health Services. Syphilis in pregnancy [accessed 15 July 2021] https://www.kemh.health.wa.gov.au/~/media/Files/Hospitals/WNHS/For%20health%20professionals/Clinical%20guidelines/OG/WNHS.OG.SyphilisinPregnancy.pdf

3.2 Groups at risk of syphilis

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 increase in infectious syphilis among vulnerable and priority groups including people experiencing homelessness, Aboriginal people, pregnant women, and women of childbearing age; both the number and proportion of notifications have increased among these groups (***Figure 13***).

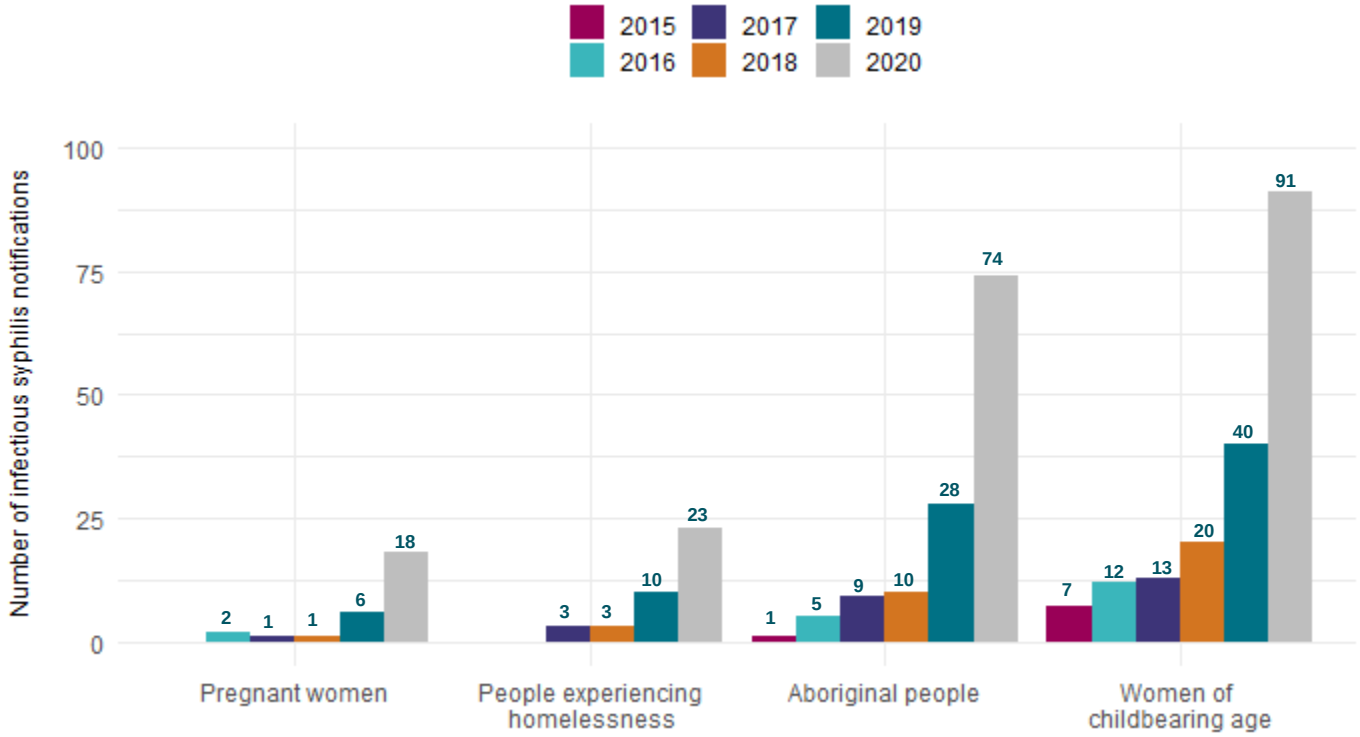


Figure 13: Number of infectious syphilis notifications among pregnant women, people experiencing homelessness, Aboriginal people, and women of childbearing age, 2015–2020 (*categories are not mutually exclusive*).

There were 74 infectious syphilis notifications among Aboriginal people in 2020 (15.9% of notifications), compared to 28 notifications in 2019 (8.4%). This increase included proportionally more women, with 41 notifications (55%) among Aboriginal women in 2020 compared with 11 notifications (39%) in 2019.

In 2020, there were 23 infectious syphilis notifications among people experiencing homelessness (4.9% of notifications), compared to 10 notifications in 2019 (3.0%). Management of people experiencing homelessness 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.[24] Moreover, people experiencing homelessness may concurrently belong to other priority groups, such as women of childbearing age or an Aboriginal person. As part of the syphilis outbreak response, MCDC initiated a regular case management meeting for people with syphilis who are experiencing homelessness in September 2020 to enable public health nursing and medical staff to work in partnership with homeless health service organisations, sexual health specialists, and Aboriginal health services to coordinate management.

[24] 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 14 July 2021] http://homelesshealthcare.org.au/wp-content/uploads/2018/11/Final-HHC-Report-electronic-version.pdf

3.3 Syphilis during pregnancy notifications continued to increase

Syphilis in women of childbearing age requires careful management and follow up, particularly in those known or suspected to be pregnant, because of the high risk of congenital syphilis to any current and/or future foetus. Congenital syphilis can cause miscarriage, stillbirth and serious health problems to the newborn, which can result in lifelong disability including organ, brain and nerve damage, and bony and dental abnormalities. There is a 70% risk of vertical transmission in untreated primary and secondary syphilis, 40% risk in early latent, 10% risk in late latent and a small risk in tertiary syphilis.[25]

There were 91 infectious syphilis notifications among women of childbearing age in 2020 (19.5% of notifications), compared to 40 in 2019 (12.0%). MCDC followed up each of these cases to establish pregnancy status. A pregnancy test should be considered in all women of childbearing age with suspected or confirmed syphilis to enable prompt and appropriate management as well as support through their pregnancy to protect their child.

Syphilis in pregnancy is a growing issue for metropolitan Perth. In 2020, there were 18 women diagnosed with infectious syphilis while pregnant, compared to 6 in 2019, and a further 13 diagnosed 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 barriers. MCDC actively monitors pregnant women diagnosed with infectious and newly-diagnosed non-infectious syphilis for the duration of their pregnancy: confirming treatment of both the case and her partners to prevent risk of reinfection; supporting antenatal clinic referrals and appointment attendance; encouraging regular rapid plasma regain (RPR) monitoring and follow up of results; and recording neonatal outcomes after delivery. In response to the growing number of women diagnosed with syphilis during pregnancy in metropolitan Perth, a monthly case management meeting was initiated in September 2020 for pregnant women with syphilis to facilitate the coordination and collaboration across the different teams involved in managing and supporting these women during their pregnancy, and the neonate once born. The committee comprises public health, sexual health specialists, midwifes from across Perth's maternity hospitals, obstetricians, paediatricians, neonatology, clinical microbiology, and Aboriginal health services.

There were three cases of congenital syphilis in metropolitan Perth in 2020. Congenital syphilis is preventable, and health professionals should screen all pregnant women for syphilis at their antenatal booking visit and, since May 2021, re-screen at 28 and 36 weeks (or at time of birth if delivery is before 36 weeks). In regional outbreak areas, where syphilis notification rates are highest, additional screening is recommended at birth and six weeks post-partum. King Edward Memorial Hospital Syphilis in pregnancy guidelines are available online.

3.4 Are the number of chlamydia and gonorrhoea infections really falling?

The number of notifications for chlamydia and gonorrhoea decreased in 2020 for the first time since 2017, ***Figure 14***. There were 8384 notifications for chlamydia in 2020, an 8.6% decrease from 2019, and 2280 notifications for gonorrhoea, a 21.6% decrease. With a 6% decrease in the number of both chlamydia and gonorrhoea tests conducted in metropolitan Perth in 2020 from 2019[26], it is difficult to know the extent to which the decline reflects fewer tests versus a true reduction in incidence in 2020. With growing anti-microbial resistance and re-infection risk, it is vital that a test of cure is conducted in people with chlamydia and/or gonorrhoea. When a sexually

[25] Government of Western Australia, Women and Newborn Health Services. Syphilis in pregnancy [accessed 15 July 2021] https://www.kemh.health.wa.gov.au/~/media/Files/Hospitals/WNHS/For%20health%20professionals/Clinical%20guidelines/OG/WNHS.OG.SyphilisinPregnancy.pdf

[26] Kellie Mitchell (personal communication), Immunisation, Surveillance and Disease Control, Communicable Disease Control Directorate, Department of Health, on 17 June 2021

transmitted infection (STI) is diagnosed, syphilis serology should also be considered if not already undertaken. Co-infections and re-infections are increasingly being notified in metropolitan Perth.

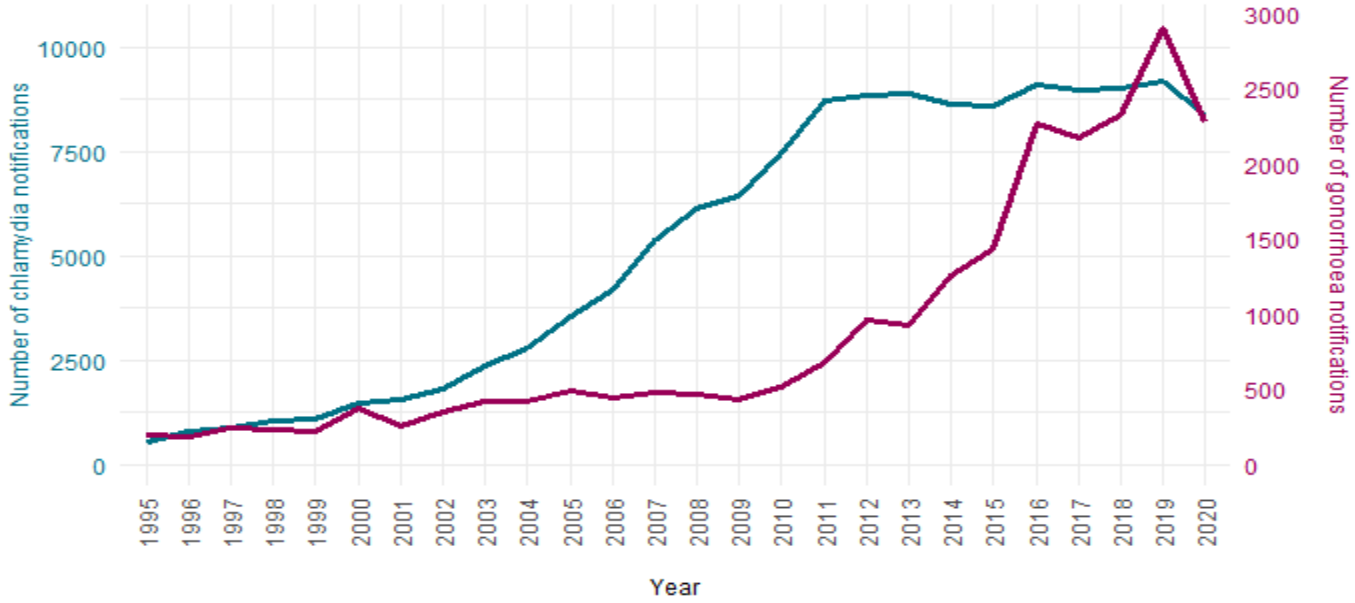


Figure 14: Number of chlamydia (left axis, blue line) and gonorrhoea notifications (right axis, burgundy line) over time, 1995–2020.

3.5 Co-infections with sexually transmitted infections

In 2020, there were 536 people notified to MCDC for two or more notifiable STIs (excluding HIV as this is not notified to MCDC) that were detected on specimens collected within three days of each other; collectively, they accounted for 1099 notifications. Seven of these people had a co-infection with STIs on two occasions during the year, giving a total of 543 occurrences of co-infection with STIs in 2020. Of the 543 occurrences of co-infection: 87.5% were for chlamydia and gonorrhoea, 6.1% were for chlamydia and syphilis, 4.1% were for gonorrhoea and syphilis, and 2.4% were for chlamydia, gonorrhoea and syphilis. Co-infection with STIs were more frequently identified among the younger age groups, ***Figure 15***, with 47.3% of the occurrences occurring in people aged 20-29 years. 58.2% of the occurrences of co-infection were among males, 41.8% were among females and 17.7% of the co-infections were among Aboriginal people.

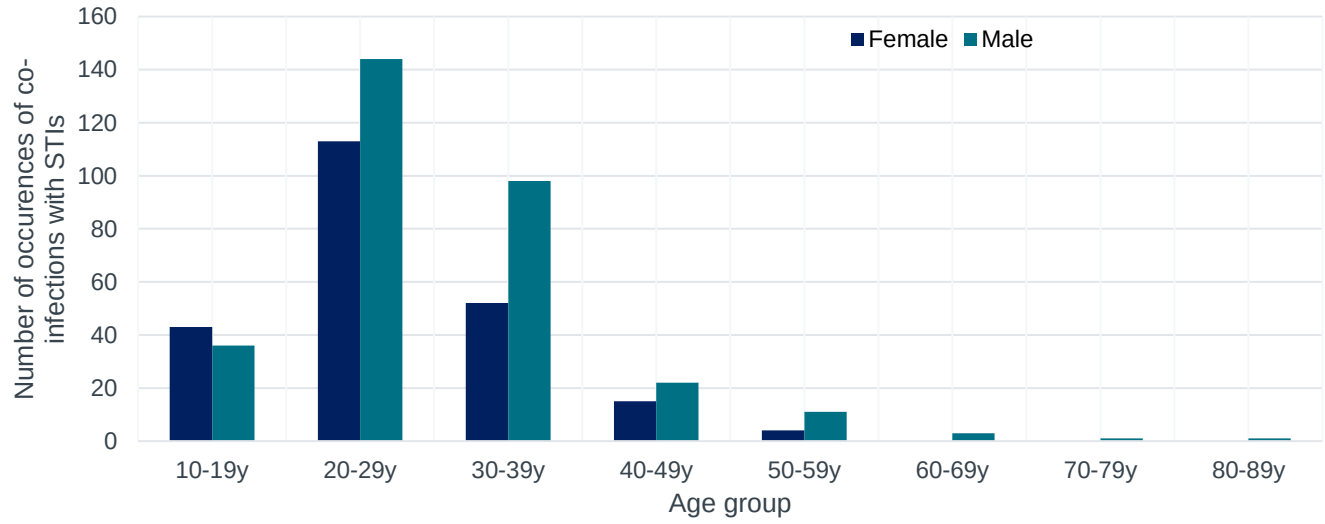


Figure 15: Number of occurrences of co-infections with STIs in metropolitan Perth in 2020 grouped by sex.

The WA Silver Book provides recommendations on STI screening among different priority populations. It recommends testing for combinations of STIs among those who are asymptomatic,

and opportunistic screening for other STIs among those with genital symptoms rather than testing for a single STI in isolation.[27]

In metropolitan Perth, there were 148 870 tests conducted for chlamydia, 144 504 for gonorrhoea and 87 563 for syphilis in 2020[28] which suggests the number of STI co-infections may be underdiagnosed.

[27] Government of Western Australia, Department of Health. STI screening recommendations for priority populations [accessed 21 July 2021] https://ww2.health.wa.gov.au/Silver-book/STI-screening-recommendations-for-high-risk-populations

[28] Kellie Mitchell (personal communication), Immunisation, Surveillance and Disease Control, Communicable Disease Control Directorate, Department of Health, on 19 April and 17 June 2021

4 Vaccine preventable diseases – impact of COVID-19

4.1 Measles

Measles is a highly infectious viral illness with potentially severe complications. There were 149 796 reported cases of measles worldwide in 2020, an 82.8% decrease from the 873 022 reported in 2019.[29]

Endemic transmission of measles has been eliminated in Australia because of high immunisation coverage and strong public health responses, meaning cases in Australia are imported or contacts of imported cases. In 2020, there were only four notifications for measles in metropolitan Perth, all of which had an onset of disease in January, prior to the international travel and Australian border restrictions in response to the global COVID-19 pandemic response.

There were three index cases, two of whom acquired their infection overseas and one who had no personal history of international travel and is thought to have acquired their infection from an unidentified index case. Only one of the index cases resulted in a single secondary case, and there were no resultant tertiary cases, ***Figure 16***. One of the cases was not vaccinated against measles as they were too young, and the vaccination status for the other three cases was unknown.

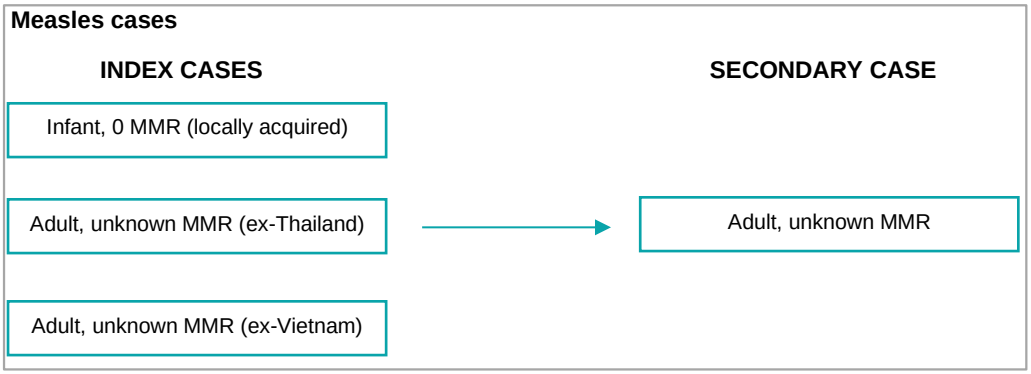


Figure 16: Transmission patterns of measles in metropolitan Perth in 2020; columns reflect generations of infection; infant refers to <12 months old, adult refers to 18 years or older; MMR = documented evidence of measles-containing vaccinations.

Each measles case is resource intensive, requiring urgent work to mitigate the risk of local transmission. A total of 601 people were identified as being potentially exposed to one of the four measles cases in 2020; MCDC staff performed thorough contact tracing to identify high risk and non-immune contacts. As a result, 40 were advised to have measles-containing vaccinations and seven advised to have intramuscular Normal Human Immunoglobulin which is used in the very young, immunocompromised people and in non-immune pregnant women. There were three media releases issued in 2020,[30] designed to reach 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 immunisation schedules over the years.

[29] World Health Organization. Measles reported cases and incidence [Accessed 6 September 2021] https://immunizationdata.who.int/pages/incidence/MEASLES.html?CODE=Global&YEAR=
[30] Government of Western Australia, Department of Health. Media releases [accessed 8 July 2021] https://ww2.health.wa.gov.au/News/Media-releases-listing-page

With the global incidence of measles rapidly increasing from 2016 to 2019,[23] we need to remain vigilant with ensuring our community are adequately immunised and be on high alert when the international borders reopen.

4.2 Invasive meningococcal disease declining with immunisation

There were 5 notifications of invasive meningococcal disease in metropolitan Perth in 2020, compared with 23 in 2018 and 12 in 2019. Cases were aged between 9 and 71 years; one of the notifications was an Aboriginal person and two of the notifications were male.

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 17***). In response, the WA DOH introduced a meningococcal ACWY immunisation 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 12 month-olds in July 2018, and for 14–19 year-olds in April 2019. Consistent with this, the number of serogroup W_{135} and Y notifications has declined in the past 3 years, collectively they were responsible for 3 of the cases (across the age spectrum, all of whom were not vaccinated against meningococcal disease) in metropolitan Perth in 2020, down from 24 in 2017.

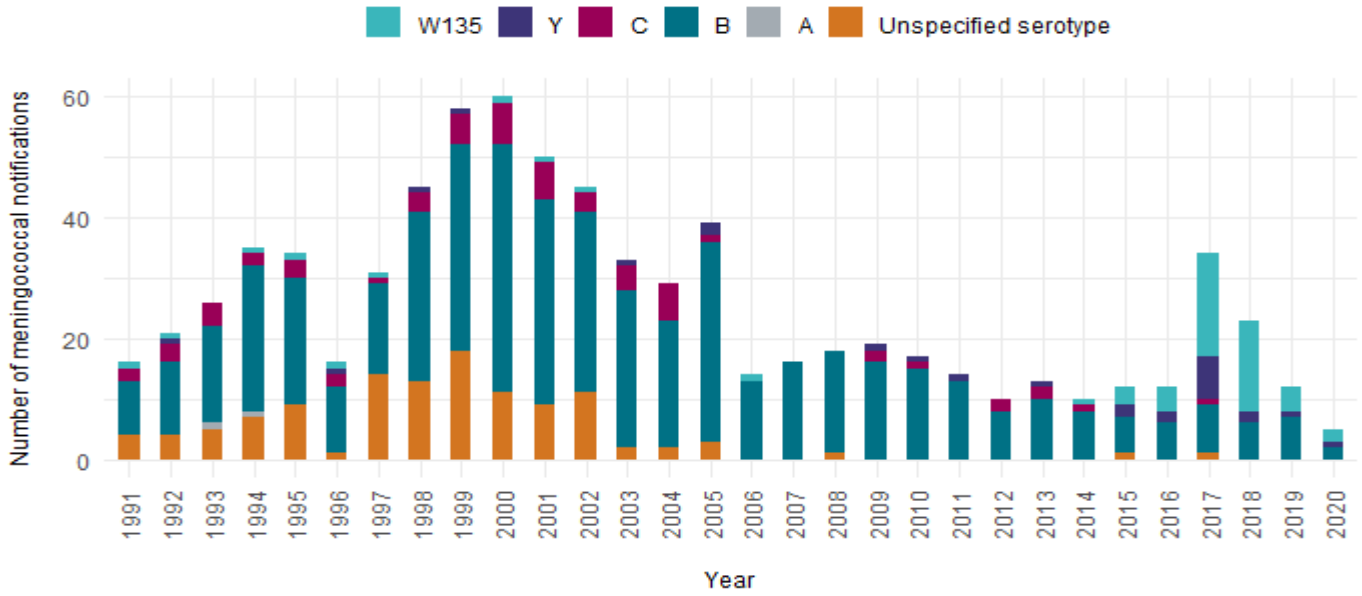


Figure 17: Number of invasive meningococcal disease notifications since surveillance commenced (1991–2020), by serotype.

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 16.2% of Perth children under 60 months having received at least one dose by the end of 2020.[31] From 1 July 2020, meningococcal B vaccine was available on the NIP for all Aboriginal and Torres Strait Islander children aged less than 12 months (with funded catch-up vaccinations available for those under 2 years until 30 June 2023), and all Australians with specified immunocompromising conditions.[32] Monovalent serogroup C meningococcal vaccines were added to the NIP for 12 month-olds in January 2003, and serogroup C disease (always relatively rare in WA), was virtually eliminated in

[31] Data extracted from Australian Immunisation Register, and received from Tracie Chong (personal communication), Perth Public Health Intelligence, North Metropolitan Health Service, on 21 July 2021.
[32] Australian Government, Department of Health. National Immunisation Program Schedule 1 July 2020 [accessed 16 July 2021] https://www.health.gov.au/sites/default/files/documents/2020/09/national-immunisation-program-schedule-for-all-people.pdf

subsequent years, with only one notification since 2015.

4.3 Decreasing invasive pneumococcal disease notifications explored

Invasive pneumococcal disease includes bacterial pneumonia, meningitis or sepsis caused by the many different serotypes of *Streptococcus pneumoniae*, some of which are vaccine preventable. There were 73 notifications of invasive pneumococcal disease in metropolitan Perth in 2020 (a 51% decrease from 150 in 2019); 52% were female, 48% were male, and Aboriginal people were again over-represented with 16% of the notified cases among Aboriginal people. Notified cases were aged 0 to 92 years with 22% of the notifications in children under 5 years.

Frequently an opportunistic infection, pneumococcal notifications characteristically increase in the aftermath of acute respiratory infection outbreaks. In 2020, paralleling influenza there was a marked decrease in pneumococcal notifications after the introduction of social gathering restrictions in mid-March, ***Figure 18***. However, in contrast to influenza but paralleling RSV, pneumococcal notifications increased as restrictions eased, matching that of 2019 by the end of the year.

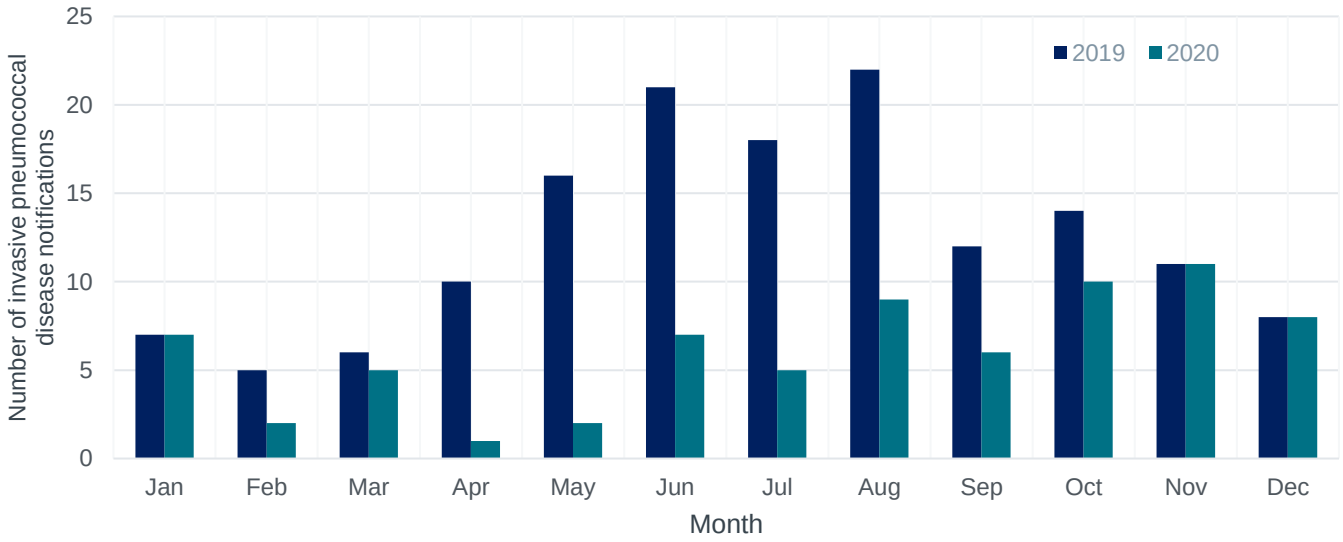


Figure 18: Number of invasive pneumococcal disease notifications in 2019 and 2020, by month.

The serotypes contributing to the burden of invasive pneumococcal disease in metropolitan Perth are changing over time (***Figure 19***). PCV7, a conjugate vaccine targeting seven serotypes, was listed on the 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 led to a reduction in cases attributed to these serotypes.

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 months to 12 months in response to increased cases of PCV13 vaccine failure in toddlers.

PPV23 is a vaccine 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 for 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.

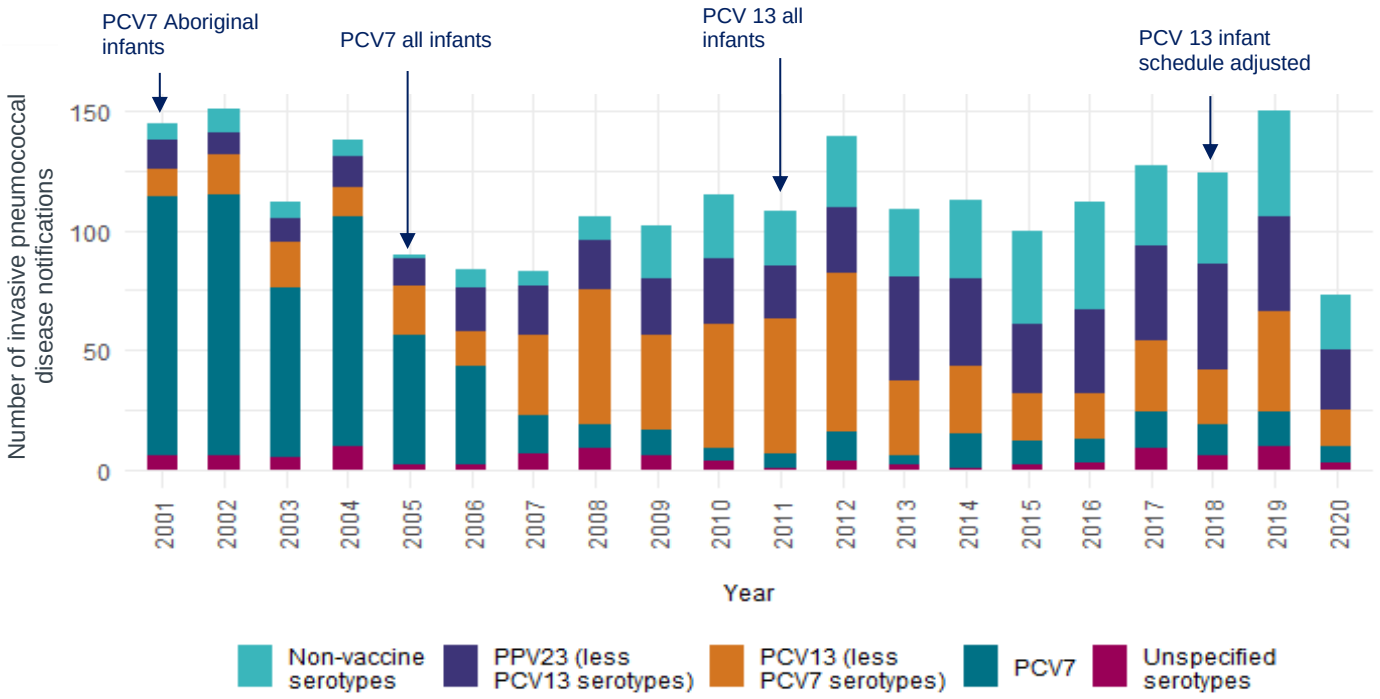


Figure 19: Number of invasive pneumococcal disease notifications since becoming notifiable in 2001, by serotype.

In metropolitan Perth during 2020, the most common serotypes causing invasive disease were 19A (12%, contained in PCV13 and PPV23), 8 and 22F (10% each, both contained in PPV23), and 23B (10%, a non-vaccine serotype).

4.4 Pertussis decreasing

There were 98 notifications for pertussis (whooping cough) in metropolitan Perth in 2020, over a four-fold decrease from 440 notifications in 2019. Almost two-thirds (64%) had disease onset between 1 January and 31 March signifying that the travel restrictions, social distancing measures and promotion of respiratory virus hygiene etiquette as part of the COVID-19 response contributed to a reduction in the number of pertussis notifications from April on. This decrease was mirrored nationally with a decrease in the national notification rate from 2019 to 2020, from 48.1 to 13.6 per 100 000, respectively.

There was only 1 notification of pertussis in infants under the age of 6 months in 2020, compared with 2 notifications in 2019 and 12 notifications in 2018. These infants are too young to be fully vaccinated (the third dose in the primary vaccination course is due at 6 months) and they 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 is recommended in every pregnancy to maximise antibody transfer. The mother of the infant notified in 2020 was not vaccinated for pertussis in pregnancy. Across WA, 76.9% of mothers were vaccinated for pertussis at some time during their pregnancy in 2020. This rate has steadily increased since 2016, however the percentage increase has been tailing off recently; there was only a 1.8% increase in 2020 from 2019 compared to 6.5% increase in 2019 from 2018 and 13.7% increase in 2018 from 2017.[33] Despite COVID-19, the proportion of women now receiving pertussis boosters in pregnancy is likely to have contributed to the lower number of cases observed among infants during 2020.

[33] Government of Western Australia, Department of Health. Western Australias Mothers and Babies summary information: Pertussis vaccination [accessed 19 July 2021] https://ww2.health.wa.gov.au/Reports-and-publications/Western-Australias-Mothers-and-Babies-summary-information/data?report=mns_pertv_y

5 Blood-borne viruses trending down

5.1 Hepatitis C declining, but continuing to disproportionately affect marginalised populations

There were 680 notifications of hepatitis C virus in metropolitan Perth in 2020, a 23.9% decrease from 2016 (***Figure 20***) 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[34], raising a real opportunity to greatly reduce or eliminate hepatitis C. However, despite widely-available, low cost and effective treatment options, the proportion of people with chronic hepatitis C accessing treatment remains at 50%.[35] This is in part because hepatitis C disproportionately affects marginalised populations, including Aboriginal people, people who inject drugs, people experiencing homelessness, people who engage in high-risk sexual behaviour and people who are incarcerated.

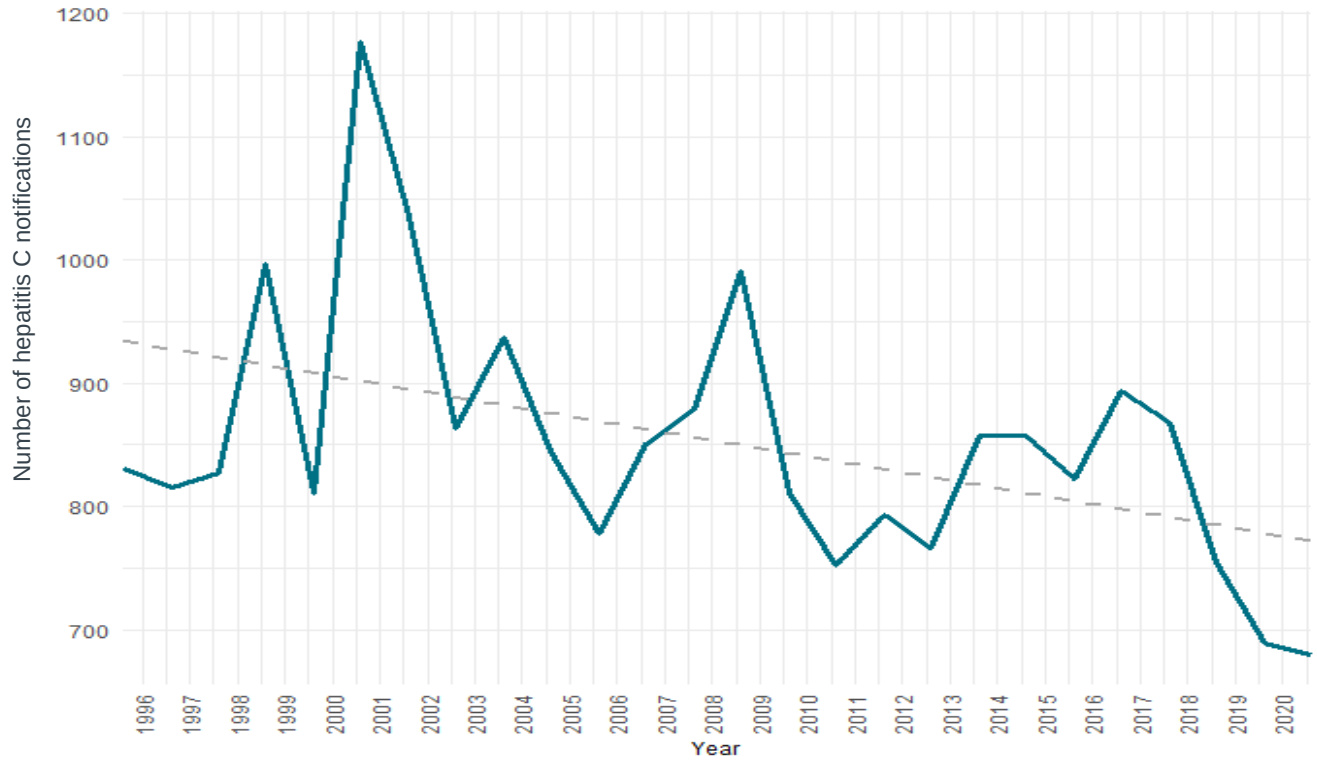


Figure 20: Number of hepatitis C notifications over time, 1995-2020; *dashed line represents the trend* (*y axis commences at n=650).*

Of hepatitis C notifications in metropolitan Perth in 2020, 65.4% were men, 25.7% were Aboriginal people and 26.2% were in people tested while in the criminal justice system. There were 71 newly-acquired cases of hepatitis C in 2020, of which 73% were male, 35% were Aboriginal, and the mean age at diagnosis was 29.4 years. At least 62% of these were people within the criminal justice system at the time of notification. The WA Department of Justice has a hepatitis C testing and treatment program in place.

[34] Australasian Society for HIV, Viral Hepatitis and Sexual Health Medicine. ASHM enews [accessed 19 July 2021] https://ashm.blob.core.windows.net/ashmpublic/ASHM%20eNEWS%20October%202016.pdf
[35] Kirby Institute. Monitoring hepatitis C treatment uptake in Australia Issue #11 July 2021 [accessed 4 August 2021] https://kirby.unsw.edu.au/sites/default/files/kirby/report/Monitoring-hep-C-treatment-uptake-in-Australia_Iss11-JUL21.pdf

5.2 Hepatitis B declining with vaccination

There were 437 notifications of hepatitis B in metropolitan Perth in 2020 (of which 11 were known to be newly-acquired; none of whom was fully vaccinated), a 23.7% decrease from 2000 when vaccination against hepatitis B was first introduced to the NIP in Australia.

The NIP funded vaccine was added to the infant schedule in May 2000 and state-based school immunisation programs targeted adolescents in the early years to immunise this cohort.[36] Currently, the NIP also funds catch-up vaccinations for people up to 19 years of age, as well as refugees and humanitarian entrants.[37] Finally, hepatitis B vaccination is recommended for those with an increased risk of exposure, such as household contacts of people with hepatitis B, Aboriginal people and those within the criminal justice system.

Consistent with this, in 2020 there were 27 notifications of hepatitis B in those who were born in Australia, a 71% decrease from the 93 in 2000; with particular success in those under the age of 25 years among whom notifications have decreased from 35 in 2000 to 0 in 2020, ***Figure 21***.

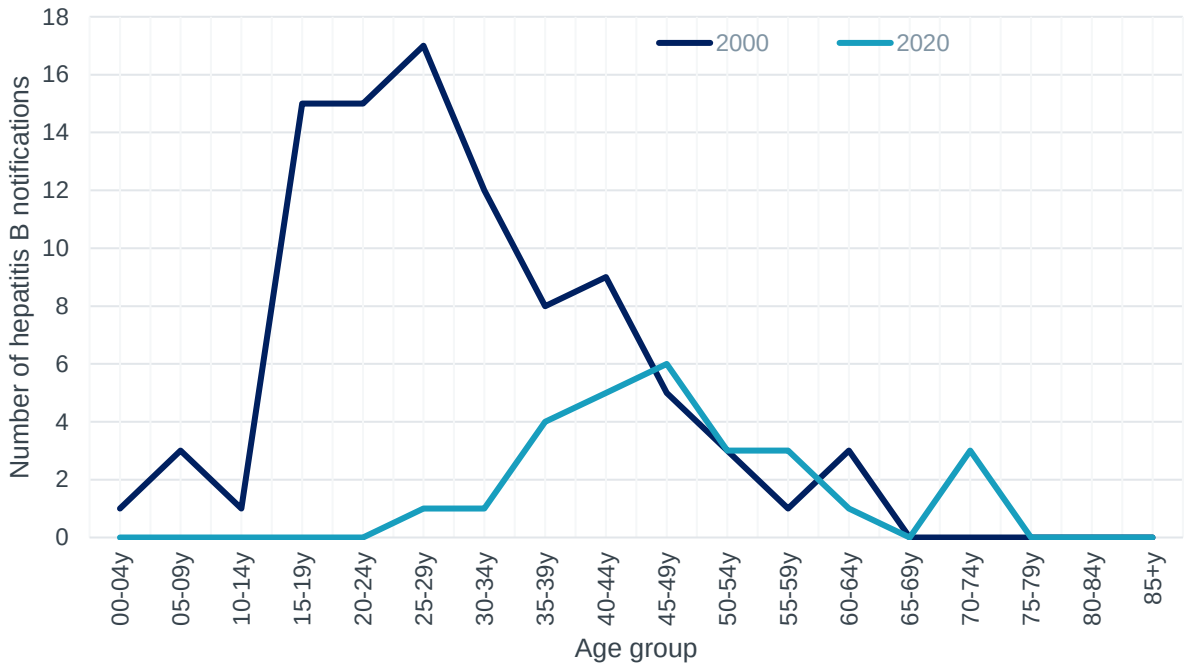


Figure 21: Number of notifications of hepatitis B among people born in Australia by age group in 2000 and 2020.

Of the 437 notifications in metropolitan Perth in 2020, 7 were among Aboriginal people (1.6% of notifications) compared to 14 in 2000 (2.4%) – although in 2018 the prevalence of hepatitis B was still higher among Aboriginal people than non-Aboriginal people.[38] In 2020, 6 notifications were among people within the criminal justice system at the time of notification (1.4% of notifications), compared with 23 in 2000 (4.0%). Unlike hepatitis C, there is a safe and effective vaccination available that can prevent hepatitis B. Infants receive this vaccine at birth, with further doses at 2, 4 and 6 months of age.

[36] Australian Government, Department of Health. Vaccine Preventable Diseases and Vaccination Coverage in Australia, 2003 to 2005: Hepatitis B [accessed 20 July 2021] https://www1.health.gov.au/internet/publications/publishing.nsf/Content/cda-cdi31suppl.htm~cda-cdi31suppl-3.htm~cda-cdi31suppl-3d.htm

[37] Australian Government, Department of Health. Catch-up immunisations [accessed 20 July 2021] https://www.health.gov.au/health-topics/immunisation/health-professionals/catch-up-immunisations#who-can-get-free-catchup-immunisations

[38] Australasian Society for HIV, Viral Hepatitis and Sexual Health Medicine. Viral Hepatitis Mapping Project National Report 2018-2019 [accessed 20 July 2021] https://www.ashm.org.au/resources/hcv-resources-list/viral-hepatitis-mapping-project-national-report-2018-2019/

6 Enteric diseases and food outbreaks

6.1 Gastroenteritis in childcare, schools and residential care

Perth childcare centres, schools and RCFs report gastrointestinal outbreaks to MCDC who provide advice on collection of specimens to identify the outbreak cause, hygiene precautions, and isolation requirements, including restriction of movement of residents and visitors in RCFs. Two or more people with diarrhoea and/or vomiting in an RCF, childcare centre or school within a 24-hour period is considered a gastroenteritis outbreak. Foodborne outbreaks are referred to OzFoodNet for further investigation.

There were 152 outbreaks of gastroenteritis reported in childcare centres across metropolitan Perth in 2020, a more than three-fold increase from 2019, and four outbreaks were reported in schools. Faecal specimens were not collected for most of these outbreaks, although norovirus was implicated in at least three of the childcare centre outbreaks and one of the school outbreaks. There were 17 attendances to hospital associated with outbreaks in childcare centres and schools, and no deaths.

There were 68 outbreaks of gastroenteritis reported in RCFs in 2020 (compared with 71 in 2019 but up from 57 in 2018), with a causative organism isolated in 25 of them; norovirus was implicated in 21 (31% of outbreaks), with aeromonas, *Clostridium difficile*, blastocystis and salmonella contributing to a small number of the outbreaks. Collectively, 27 hospital admissions and 8 deaths were associated with outbreaks in residential care.

6.2 Clusters and outbreaks of enteric diseases

In metropolitan Perth, there were 4298 notifications for enteric diseases in 2020, a 17.2% reduction from 2019, and a lower proportion imported from overseas (***Figure 22***). Diarrhoeal infections are experienced by around 20-50% of travellers, highlighting the importance of advising travellers to take precautions in developing countries or areas of poor hygiene.[39] In 2020, all hepatitis A and E cases acquired their infection from overseas, with South Asia being the most common source and had disease onset prior to April.

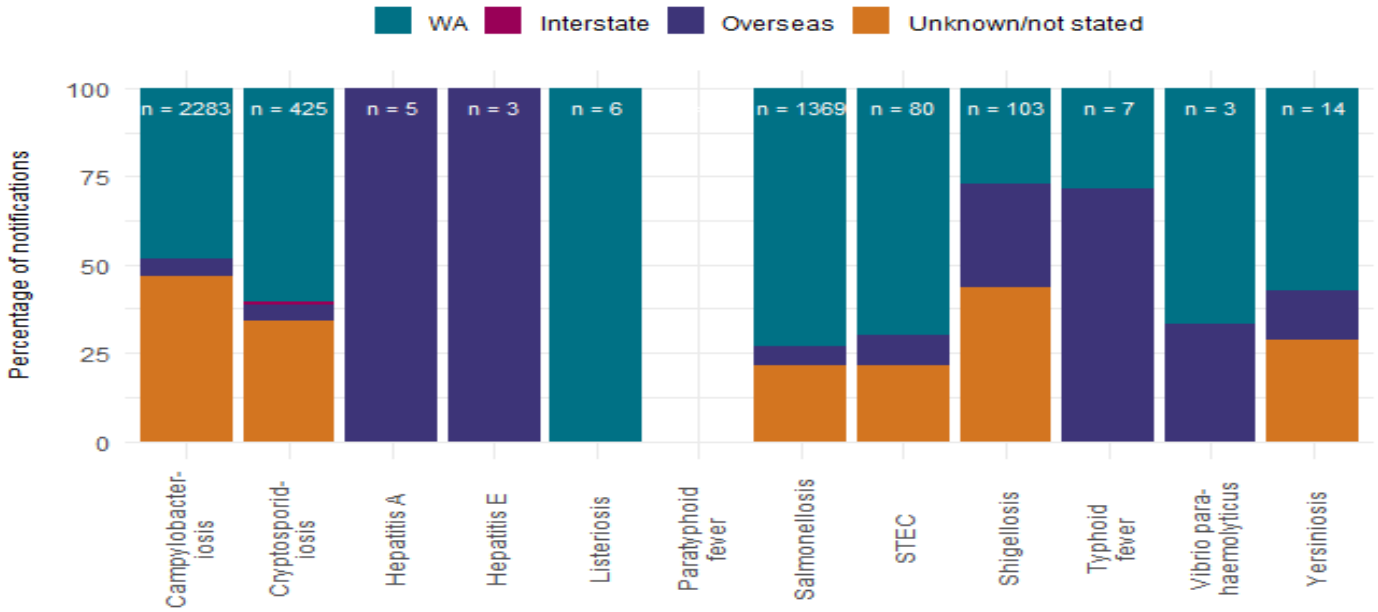


Figure 22: Enteric disease by place of acquisition in 2020; STEC= Shiga-toxin producing *E.coli.*

[39] Government of Western Australia, Department of Health. Gastroenteritis [accessed 25 June 2021] https://www.healthywa.wa.gov.au/Articles/F_I/Gastroenteritis

Although campylobacteriosis was responsible for 53.1% of enteric infections in 2020 (2283), salmonella was responsible for 63% of the 30 outbreaks of notifiable enteric diseases in metropolitan Perth. Of the 1369 salmonella notifications across metropolitan Perth, 180 were associated with one of the 19 Salmonella outbreaks, including an outbreak linked to bahn mi at a takeaway venue that affected at least 51 people and an outbreak linked to raw egg mayonnaise at a prison that affected at least 22 people.

There were 425 notifications for cryptosporidiosis in metropolitan Perth in 2020, over a three-fold increase from the 122 in 2019; 60.7% of the notifications in 2020 acquired their infection in WA with 87.6% of them acquiring it in the first quarter of the year (***Figure 23***). There were 9 cryptosporidiosis outbreaks in metropolitan Perth in 2020 that affected at least 55 people, all occurring in recreational aquatic facilities. In response to the considerable increase in notifications compared to the preceding years, a media release was issued in January 2020 urging individuals with diarrhoea not to enter aquatic facilities until two weeks after resolution of their symptoms.[40]

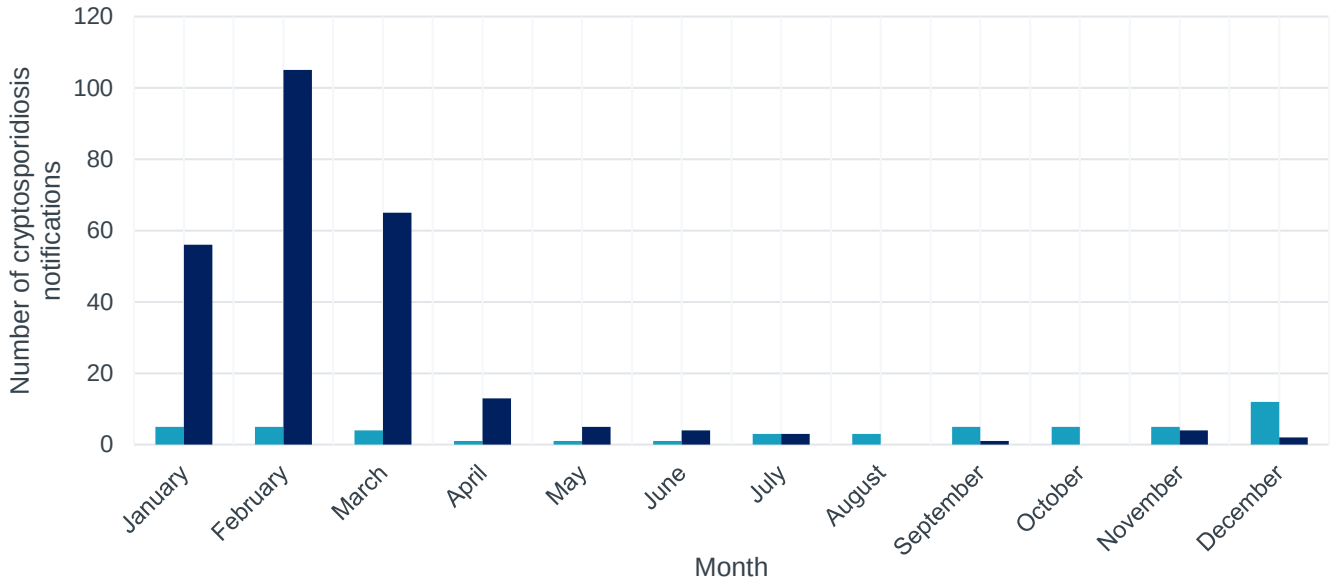


Figure 23: Number of cryptosporidiosis notifications that were acquired in WA in 2019 and 2020, by month.

There was a 62.8% decrease in the number of shigellosis notifications from 2019 to 2020 which likely reflects the reduction in overseas travel, with 49.5% of the notifications in 2019 acquiring their infection overseas.

6.3 Locally acquired typhoid fever

In 2020, there were 7 notifications for typhoid fever, down from 18 in 2019. Typhoid fever is not endemic in Australia and cases generally acquire the infection overseas, with locally acquired clusters and outbreaks in Australia uncommon.[41] However, in 2020, two of the notified cases in metropolitan Perth had no history of recent overseas travel and were not known to be linked to one another. In both cases, testing of their distinct household contacts revealed a chronic carrier in each of the households that had no history of overseas travel in the preceding 11 months, one of whom recalled having typhoid several years earlier while overseas.

In non-endemic countries, such as Australia, locally acquired typhoid is generally acquired from consuming food that has been contaminated by a chronic carrier. A chronic carrier is defined as an

[40] Government of Western Australia, Department of Health. Health warning following increase in Cryptosporidiosis notifications [accessed 29 July 2021] https://ww2.health.wa.gov.au/Media-releases/2020/Health-warning-following-increase-in-Cryptosporidiosis-notifications
[41] Communicable Diseases Network Australia. Typhoid and Paratyphoid Fevers CDNA National Guidelines for Public Health Units [accessed 21 July 2021] https://www1.health.gov.au/internet/main/publishing.nsf/Content/9D1592FDC08E69B6CA2580E3008211B2/$File/Typhoid-Paratyphoid-SoNG.pdf

asymptomatic individual that sheds *S. Typhi* or *S. Paratyphi* for over a year; they may have a history of having had an acute illness in the past or may have always been asymptomatic.[39] MCDC follows up each typhoid notification associated with international acquisition or locally-acquired from a chronic carrier. This process involves review of results and liaison with health professional(s) managing the case, as well as contacting the case and their contacts to assess and manage the public health risk. Those at high-risk (e.g. on account of their occupation or age) require documented clearance (with two negative faecal specimens), a process managed by MCDC.

7 Immunisation

7.1 Annual Immunisation data summary

Annual immunisation data for 12 month-olds, 24 month-olds and 60 month-olds was calculated by combining the quarterly AIR data, and represents the proportion of children who were up to date by age during 2020, ***Table 2***. Rates for children who are Aboriginal is also presented, as immunisation coverage in Aboriginal children has historically been lower.

An immunisation coverage rate of 95% is considered the benchmark in Australia.[42] No region in metropolitan Perth achieved the benchmark for the 12 and 24 month cohorts in 2020. Immunisation coverage for fully vaccinated children across all age-cohorts in metropolitan Perth exceeded the 90% coverage targets of the Western Australian Immunisation strategy 2016-2020.[43] Overall, immunisation coverage for 24 month cohort increased from 2019 to 2020, while coverage for 12 month-olds in 2020 remained similar to 2019.

Table 2: Immunisation coverage by region and age cohort in 2020*, coverage below 90% in red, coverage between 90 and <95% is shown in black and coverage >95% is shown in green.*

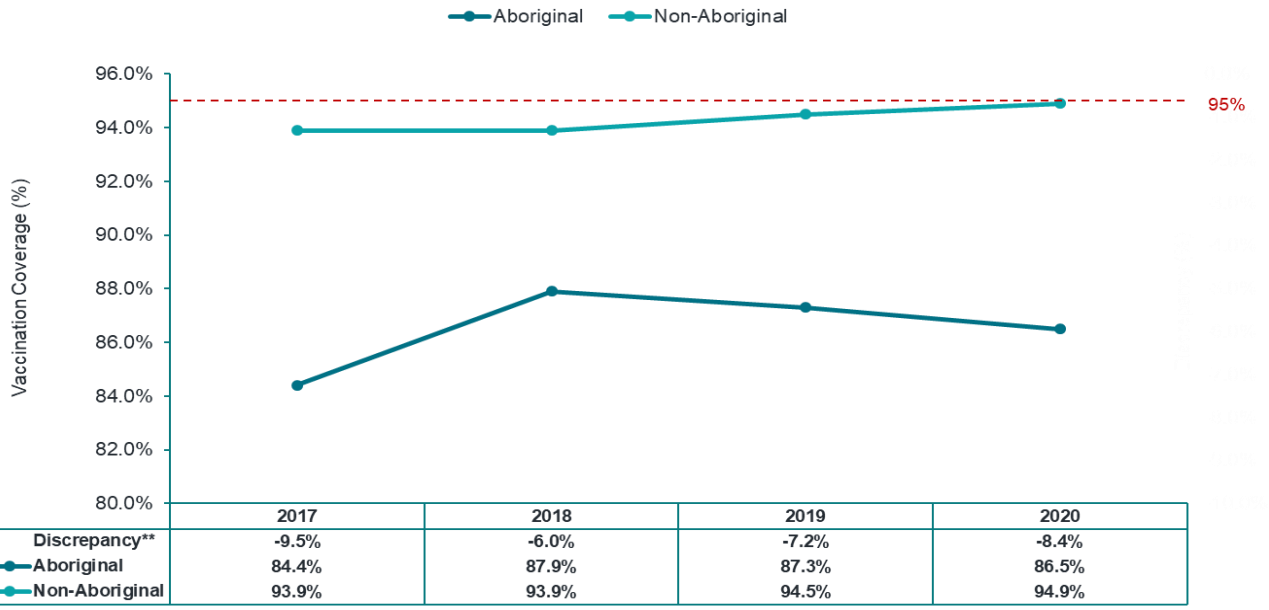
Age Group	Region	No. of fully vaccinated children	Total children	Immunisation coverage (%)	Immunisation coverage among Aboriginal children (%)
12 months	Metro	24856	26309	94.48	86.51
12 months	NMHS	8132	8608	94.47	86.14
12 months	EMHS	9315	9832	94.74	86.32
12 months	SMHS	7409	7869	94.15	87.06
12 months	WA	30689	32507	94.41	89.22
12 months	Australia	279784	294780	94.91	93.7
24 months	Metro	24479	26569	92.13	86.67
24 months	NMHS	8101	8770	92.37	88.81
24 months	EMHS	8938	9730	91.86	86.07
24 months	SMHS	7440	8069	92.2	86.04
24 months	WA	30371	33089	91.79	87.09
24 months	Australia	277444	299851	92.53	91.73
60 months	Metro	26419	28080	94.08	95.42
60 months	NMHS	8776	9329	94.07	95.45
60 months	EMHS	9391	9978	94.12	95.68
60 months	SMHS	8252	8773	94.06	95.04
60 months	WA	33165	35213	94.18	96.05
60 months	Australia	303158	318390	95.22	97.26

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 2020. No LGA achieved the benchmark of 95% or above in all age cohorts, but Armadale, Bayswater, Canning and East Fremantle achieved it in both 12 month and 60 month cohorts; Claremont, Kalamunda, Kwinana, Mosman Park, Perth, Serpentine-Jarrahdale and Wanneroo all achieved over 95% coverage in the 12 month cohort; and Murray achieved over 95% coverage in the 60 month cohort. Immunisation coverage by LGA was compared with the LGA's 2016 Socio-economic Indexes for Areas (SEIFA) rank within WA[44], but there was no correlation between the two.

[42] Australian Government, Department of Health. National Immunisation Strategy for Australia 2019-2024 [accessed 11 August 2021] https://www.health.gov.au/sites/default/files/national-immunisation-strategy-for-australia-2019-2024_0.pdf
[43] Government of Western Australia, Department of Health. Western Australian Immunisation Strategy 2016–2020 [accessed 16 July 2021] https://ww2.health.wa.gov.au/-/media/Files/Corporate/general-documents/Immunisation/PDF/wa_immunisation_strategy_2016-2020.pdf
[44] Australian Bureau of Statistics. SEIFA by Local Government (LGA) [accessed 11 June 2021] https://www.abs.gov.au/websitedbs/censushome.nsf/home/seifa

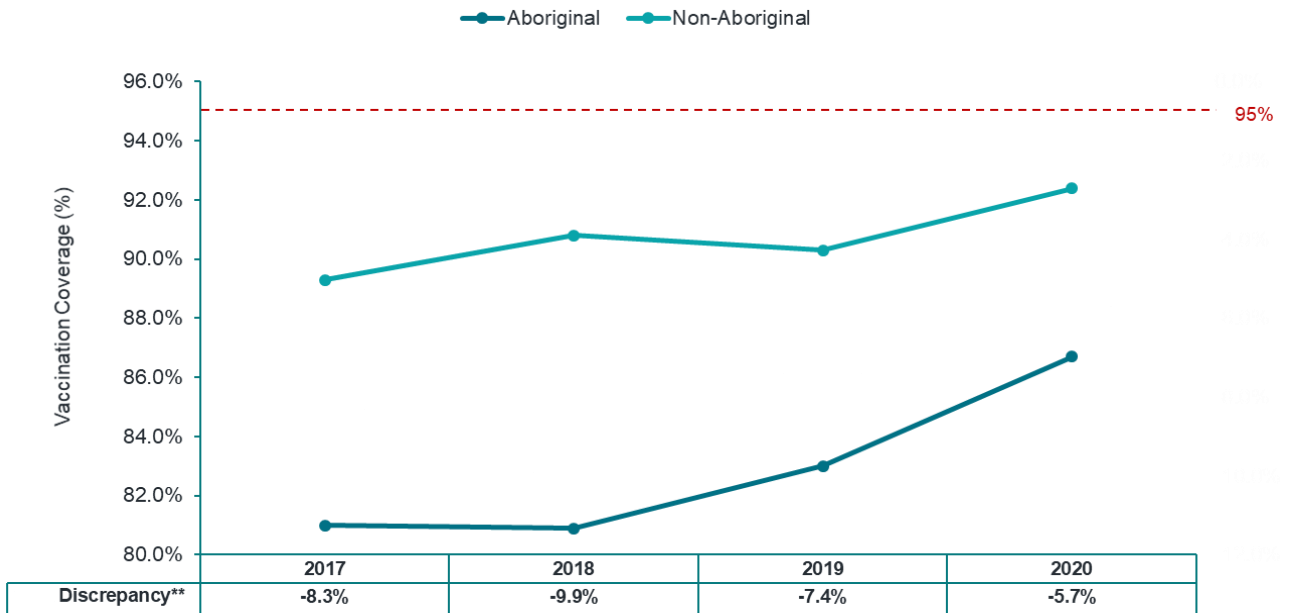
7.2 Metropolitan immunisation coverage over time

Trends in immunisation coverage across metropolitan Perth between 2017 and 2020 are presented in ***Figures 24-26*** [45]. There appears to have been some improvement between 2017 and 2020 in all cohorts of non-Aboriginal children, and for Aboriginal children at 12 and 24 months of age (particularly the latter). However, the gap in coverage between Aboriginal and non-Aboriginal children remains substantial, particularly at 12 months of age. The AIR uses definitions to determine whether each child is classified as fully vaccinated; these criteria have changed over time, so trends must be interpreted with caution, **Appendix 3**. For example, some of the increase at 12 months of age seen in 2018 may relate to a decrease in the doses of pneumococcal vaccination required to be considered fully vaccinated and some of the increase at 60 months may relate to removal of the second dose MMR from criteria in 2017.



	2017	2018	2019	2020
Discrepancy**	-9.5%	-6.0%	-7.2%	-8.4%
Aboriginal	84.4%	87.9%	87.3%	86.5%
Non-Aboriginal	93.9%	93.9%	94.5%	94.9%

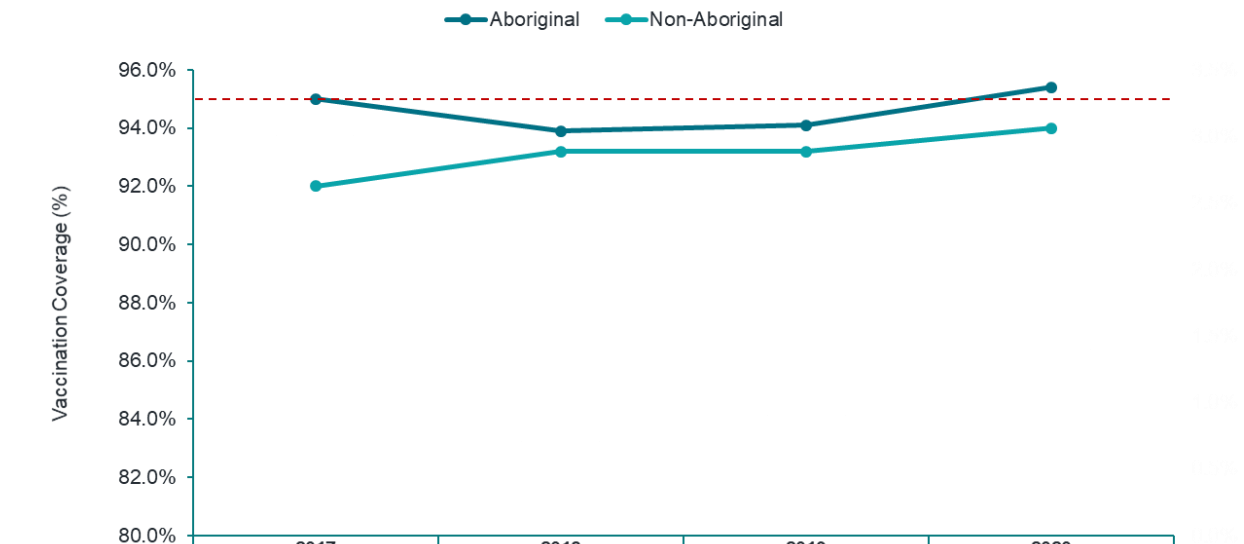
Figure 24: Immunisation in metropolitan Perth, 2017 to 2020, vaccination coverage for 12 month-olds.
Calculated as the difference between Aboriginal cohort coverage and non-Aboriginal coverage.



	2017	2018	2019	2020
Discrepancy**	-8.3%	-9.9%	-7.4%	-5.7%
Aboriginal	81.0%	80.9%	83.0%	86.7%
Non-Aboriginal	89.3%	90.8%	90.3%	92.4%

Figure 25: Immunisation in metropolitan Perth, 2017 to 2020, vaccination coverage for 24 month-olds.
Calculated as the difference between Aboriginal cohort coverage and non-Aboriginal coverage.

[45] Data extracted from Australian Immunisation Register, and received from Tracie Chong (personal communication), Perth Public Health Intelligence, North Metropolitan Health Service, on 18 June 2021.



	2017	2018	2019	2020
Discrepancy**	3.0%	0.7%	0.9%	1.4%
Aboriginal	95.0%	93.9%	94.1%	95.4%
Non-Aboriginal	92.0%	93.2%	93.2%	94.0%

Figure 26: Immunisation in metropolitan Perth, 2017 to 2020, vaccination coverage for 60 month-olds.
Calculated as the difference between Aboriginal cohort coverage and non-Aboriginal coverage.

7.3 Routine provider support for immunisation

7.3.1 Catch ups

MCDC supports families and immunisation providers to develop catch up plans (which include information on the correct spacing between dosing) for any child who is overdue vaccination, and in 2020 facilitated the development of 1146 catch up plans for metropolitan children. For children born overseas now living in WA, MCDC liaises with health care providers to ensure vaccines administered abroad are added to the AIR, facilitating access to translation services to allow immunisation records in foreign languages to be added. This process improves assessment of an individual's vaccination needs and assists families whose children were identified as not fully immunised to access Commonwealth support services.

7.3.2 Cold chain breaches and vaccine wastage

In 2020, MCDC, managed 773 cold chain breaches. A vaccine cold chain breach occurs when vaccine storage temperatures have been outside the recommended range of +2 to +8°C.[46] Metropolitan 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.

In 2020, MCDC also conducted an electronic audit of cold chain management in conjunction with CDCD. All general practitioners and some other immunisation providers in the metropolitan area were invited to participate. A total of 591 providers were invited and eligible to complete the audit survey; of these 526 answered all the cold chain compliance questions and 336 were compliant with all 10 requirements of cold chain management. Issues such as lack of a purpose-built vaccine fridge, absence of a data logger, and failure to report cold chain breaches to MCDC were

[46]Australian Government, Department of Health. National vaccine storage guidelines: Strive for 5 [accessed 19 July 2021] https://www.health.gov.au/sites/default/files/documents/2020/04/national-vaccine-storage-guidelines-strive-for-5.pdf

identified, and this provided opportunity for education and ensuring best practice around cold chain management.[47]

Providers are also required to report wastage. There were 56 495 doses of vaccine wasted in metropolitan Perth in 2020, with an estimated value of $1,121,554; an 18.5% decrease from the 69 336 doses of vaccine wasted in 2019. In 2020 the two main reasons for wastage were cold chain breaches (54.3%), followed by failure to use the dose before expiry (45.1%). The longer shelf life of the 2020 seasonal influenza vaccine may have contributed to some of the decreased vaccine wastage in 2020 compared with 2019.[48]

7.4 Immunisation team projects and partnerships

To enhance MCDC's capacity further, a restructure in late 2020 created a dedicated immunisation team, comprising an Aboriginal health liaison officer, clinical nurse, clinical nurse specialist and public health physician, with support from the Aboriginal project officer and epidemiology team at MCDC.

The Immunisation team has developed several targeted projects to address the gap in immunisation coverage between Aboriginal and non-Aboriginal children. This includes the Moorditj (Strong) Kids project, which supports families of overdue Aboriginal children to access immunisation providers and provides an opportunity for families to discuss their concerns about vaccination. MCDC also commenced a GP practice engagement program in 2020, and a project to address vaccine hesitancy among Aboriginal families.

MCDC also provides targeted support to families and health care providers of children in one of four declared Statistical Area Level 3 areas (a geographical area that generally have a population of 30 000 to 130 000)[49] of low vaccination coverage, as well as children identified as overdue in kindergarten or childcare enrolment through the 'No Jab No Play' policy that came into effect on 22 July 2019.

7.5 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 2020, 62 courses of rabies PEP were arranged for 35 females and 27 males, aged between 6 and 65 years.[47] The rate of rabies PEP of 3.0 per 100 000 people in metropolitan Perth in 2020 was considerably lower than that of recent years (9.25 and 11.1 per 100 000 in 2019 and 2018 respectively) and reflects the decline in international travel and Australian border restrictions resulting from the pandemic during 2020 with only two notifications exposed after March. Indonesia was the most common location for rabies prone exposures for the third year in a row with 89% of the exposures in Indonesia occurring in Bali, and dogs the most commonly implicated animal (**Table 3**).[47]

[47] Susie Ridderhof (personal communication) Immunisation Team at MCDC, Mental health, Public Health and Dental Services, on 12 August 2021.
[48] Sharon Gough (personal communication), Communicable Disease Control Directorate, Public and Aboriginal Health Division, WA DOH, on 30 April 2021.
[49] Australian Bureau of Statistics. Australian Geography Standard (ASGS): Volume 1 - Main Structure and Greater Capital City Statistical Areas, July 2016 [accessed 9 July 2021] https://www.abs.gov.au/ausstats/abs@.nsf/Lookup/by%20Subject/1270.0.55.001~July%202016~Main%20Features~Statistical%20Area%20Level%203%20(SA3)~10015

Table 3: Persons sustaining rabies prone injuries, by animal and location, 2020 (year is based on date reported to public health, not date of exposure).

Country of Exposure	Cat	Dog	Fruit bat	Hyrax	Monkey	Total
Australia	0	0	2	0	0	2
Cambodia	2	1	0	0	1	4
China	0	1	0	0	0	1
Ethiopia	0	1	0	0	0	1
India	1	2	0	0	0	3
Indonesia	4	12	0	0	13	29
Kenya	0	0	0	0	1	1
Malaysia	0	1	0	0	0	1
Morocco	1	0	0	0	0	1
Pakistan	1	0	0	0	0	1
Peru	0	1	0	0	0	1
Philippines	0	1	0	0	0	1
South Africa	0	0	0	1	1	2
Sri Lanka	0	3	0	0	1	4
Thailand	1	5	0	0	2	8
Vietnam	0	2	0	0	0	2
Total	**10**	**30**	**2**	**1**	**19**	**62**

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

Notifiable Disease	2020 notification rate per 100 000 population					
	North	East	South	Metro	WA	National
Blood-borne disease						
Hepatitis B (newly acquired)	0.3	0.7	0.6	0.5	20.1	0.5
Hepatitis B (unspecified)	17.2	24.2	18.5	20	19.7	19.8
Hepatitis C (newly acquired)	1.1	4.9	4.1	3.3	35.3	2.6
Hepatitis C (unspecified)	16.6	36.8	33	28.6	34.7	29.3
Hepatitis D	0	0.3	0	0.1	0.1	0.3
Enteric diseases						
Campylobacteriosis	110.3	105.1	106.1	107.2	108.8	124.6
Cholera	0	0	0	0	0	0
Cryptosporidiosis	28.6	15.7	15.1	20	18.6	9.6
Hepatitis A	0.1	0.4	0.2	0.2	0.2	0.3
Hepatitis E	0.3	0.1	0	0.1	0.1	0.1
Listeriosis	0.4	0	0.5	0.3	0.3	0.2
Paratyphoid fever	0	0	0	0	0	0.1
Salmonellosis	68	68.4	55.7	64.3	66.6	47.5
Shiga toxin-producing E.coli	4.5	4.7	2	3.8	3.9	2.3
Shigellosis	4.7	5.9	3.8	4.8	8.6	6.3
Typhoid fever	0.4	0.4	0.2	0.3	0.3	0.3
Vibrio parahaemolyticus	0	0.1	0.3	0.1	0.1	NN
Yersiniosis	0.9	0.3	0.8	0.7	0.6	NN
Sexually transmitted infections						
Chlamydia	349.1	435.6	397.4	393.7	406.9	360.2
Lymphogranuloma venereum	0.1	0.1	0.2	0.1	0.1	NN
Gonorrhoea	87.5	128	105.8	107.1	134.9	115.4
Syphilis (infectious)	17.2	28.3	20	21.9	27.3	20.8
Syphilis (non-infectious)	8.1	11.8	5.6	8.6	16.2	8.1
Syphilis (congenital)	0	0.3	0.2	0.1	0.2	0.1
Vaccine preventable diseases						
Diphtheria	0	0	0	0	0	0
Haemophilus influenzae type B	0	0.1	0	0	0.1	0.1
Influenza	51.7	43.8	42.3	46.1	46	84.2
Measles	0.3	0	0.3	0.2	0.2	0.1
Meningococcal disease (invasive)	0.1	0.4	0.2	0.2	0.4	0.4
Mumps	0.7	0.1	0.2	0.3	0.4	0.6
Pertussis	4.7	2.9	6.3	4.6	4.7	13.6
Pneumococcal disease (invasive)	3.7	3.6	3	3.4	6.8	4.4
Rotavirus	8.8	9.6	6	8.2	8.1	6.5
Rubella	0	0	0.2	0	0	0
Tetanus	0	0.1	0	0	0	0
Varicella-Zoster	194	154.9	213.6	186.8	184.8	124

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	0.1	0.3	0.1	0.8	2.9
Chikungunya virus	0	0.3	0.2	0.1	0.3	0.1
Dengue virus	2	2.3	2.4	2.3	2.3	0.9
Malaria	0.8	1.6	0.6	1	1.1	0.6
Rickettsial disease (typhus)	0.4	0.5	0.3	0.4	0.8	NN
Ross River Virus	6.2	6.3	21.7	11.1	19.5	25.2
Zika	0	0	0	0	0	NN
Zoonotic diseases						
Leptospirosis	0	0	0	0	0.1	0.4
Psittacosis	0	0	0	0	0	0.3
Q Fever	0	0.3	0	0.1	0.2	1.8
Other diseases						
Brucellosis	0	0	0	0	0	0.1
Botulism	0	0	0	0	0	0
COVID19	28.2	22.7	25.7	25.5	34.5	NN
Creutzfeldt-Jakob disease	0.3	0.3	0.2	0.2	0.4	0.1
Haemolytic uraemic syndrome	0	0	0	0	0.2	2.1
Legionellosis	2.7	3	2.7	2.8	3	0
Leprosy	0.1	0.1	0.2	0.1	0.2	NN
Melioidosis	0	0	0	0	0.2	6.3
Tuberculosis	5.7	7.7	5.7	6.4	10.4	113

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.[50]

[50] Government of Western Australia, Department of Health. Case definitions of notifiable infectious diseases and related conditions [accessed 20 May 2021] 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)	SEIFA* 2016 Rank within WA[51]	Age Group	Number of Fully Vaccinated Children	Total children in region	Immunisation coverage (%)
Armadale	79	12 months	1481	1554	95.3
		24 months	1466	1570	93.38
		60 months	1601	1678	95.41
Bassendean	102	12 months	196	210	93.33
		24 months	168	195	86.15
		60 months	190	203	93.6
Bayswater	113	12 months	797	836	95.33
		24 months	738	797	92.6
		60 months	725	763	95.02
Belmont	81	12 months	490	525	93.33
		24 months	499	554	90.07
		60 months	454	492	92.28
Cambridge	134	12 months	223	239	93.31
		24 months	229	248	92.34
		60 months	287	309	92.88
Canning	117	12 months	1112	1152	96.53
		24 months	960	1039	92.4
		60 months	1136	1193	95.22
Claremont	133	12 months	98	101	97.03
		24 months	100	110	90.91
		60 months	114	124	91.94
Cockburn	118	12 months	1476	1558	94.74
		24 months	1421	1536	92.51
		60 months	1471	1566	93.93
Cottesloe	137	12 months	79	84	94.05
		24 months	65	71	91.55
		60 months	70	75	93.33
East Fremantle	132	12 months	68	71	95.77
		24 months	71	80	88.75
		60 months	79	83	95.18
Fremantle	124	12 months	328	363	90.36
		24 months	286	329	86.93
		60 months	280	310	90.32
Gosnells	74	12 months	1607	1702	94.42
		24 months	1584	1733	91.4
		60 months	1802	1914	94.15
Joondalup	125	12 months	1615	1717	94.06
		24 months	1631	1742	93.63
		60 months	1905	2020	94.31
Kalamunda	115	12 months	579	609	95.07
		24 months	618	666	92.79
		60 months	688	732	93.99
Kwinana	55	12 months	734	766	95.82
		24 months	749	792	94.57
		60 months	786	830	94.7

*SEIFA "is a product developed by the ABS that ranks areas in Australia according to relative socioeconomic advantage and disadvantage." [52]

[51] Australian Bureau of Statistics. SEIFA by Local Government (LGA) [accessed 11 June 2021] https://stat.data.abs.gov.au/Index.aspx?DataSetCode=ABS_SEIFA_LGA

[52] Australian Bureau of Statistics. Australian Geography Standard (ASGS): Volume 1 - Main Structure and Greater Capital City Statistical Areas, July 2016 [accessed 9 July 2021] https://www.abs.gov.au/ausstats/abs@.nsf/Lookup/by%20Subject/1270.0.55.001~July%202016~Main%20Features~Statistical%20Area%20Level%203%20(SA3)~10015

Local Government Area (LGA)	SEIFA* 2016 Rank within WA[51]	Age Group	Number of Fully Vaccinated Children	Total children in region	Immunisation coverage (%)
Mandurah	52	12 months	717	765	93.73
		24 months	759	836	90.79
		60 months	827	886	93.34
Melville	127	12 months	954	1010	94.46
		24 months	988	1077	91.74
		60 months	1190	1266	94
Mosman Park	131	12 months	60	62	96.77
		24 months	68	78	87.18
		60 months	110	116	94.83
Mundaring	120	12 months	337	373	90.35
		24 months	358	405	88.4
		60 months	403	440	91.59
Murray	40	12 months	228	249	91.57
		24 months	237	260	91.15
		60 months	257	270	95.19
Nedlands	135	12 months	154	163	94.48
		24 months	152	169	89.94
		60 months	186	208	89.42
Peppermint Grove	136	12 months	15	16	93.75
		24 months	8	9	88.89
		60 months	10	13	76.92
Perth	126	12 months	244	256	95.31
		24 months	165	192	85.94
		60 months	142	156	91.03
Rockingham	80	12 months	1816	1941	93.56
		24 months	1851	2001	92.5
		60 months	1996	2129	93.75
Serpentine-Jarrahdale	112	12 months	505	524	96.37
		24 months	515	561	91.8
		60 months	529	548	96.53
South Perth	128	12 months	352	374	94.12
		24 months	353	388	90.98
		60 months	426	455	93.63
Stirling	122	12 months	2695	2864	94.1
		24 months	2509	2749	91.27
		60 months	2564	2749	93.27
Subiaco	130	12 months	168	178	94.38
		24 months	190	201	94.53
		60 months	194	208	93.27
Swan	91	12 months	2141	2267	94.44
		24 months	2074	2223	93.3
		60 months	2206	2323	94.96
Victoria Park	121	12 months	411	435	94.48
		24 months	411	436	94.27
		60 months	346	379	91.29
Vincent	129	12 months	369	389	94.86
		24 months	346	382	90.58
		60 months	348	372	93.55
Wanneroo	104	12 months	2733	2872	95.16
		24 months	2845	3063	92.88
		60 months	3005	3164	94.97
Waroona	24	12 months	33	39	84.62
		24 months	29	35	82.86
		60 months	42	48	87.5

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

Appendix 3: AIR criteria for determining whether a child is classified as fully vaccinated

To be considered fully vaccinated in 2020:

A 12–<15 month-old child requires three doses of diphtheria tetanus and pertussis vaccine (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 12 months of age.

A 24–<27 month-old child requires four doses of DTPa vaccine; three doses of polio and hepatitis B; three or four doses of HiB vaccine and PCV13; two doses of MMR; and one dose of meningococcal C and varicella vaccines. From September 2018, the definition required the third PCV13 dose (typically at 12 months of age) to be recorded.

A 60–<63 month-old child requires five doses of DTPa vaccine, and four doses of polio vaccine. The second dose of MMR was removed from the criteria in December 2017 (already featuring in criteria for 24 month-olds).[53]

[53] Sarah French (personal communication), Data Analysis and Reporting, Immunisation Program, WA DOH, on 23 July 2021

Appendix 4: List of acronyms used in this report

AIR:	Australian Immunisation Register
CDCD:	Communicable Disease Control Directorate
EMHS:	East Metropolitan Health Service
DOR:	Date of receipt
DTPa:	Diphtheria tetanus and pertussis vaccine
GP:	General Practitioner
HiB:	Haemophilus influenza type b
LGA:	Local Government Area
MCDC:	Metropolitan communicable disease control
MMR:	Measles, mumps and rubella
NMHS:	North Metropolitan Health Service
NIP:	National Immunisation Program
NNDSS:	National Notifiable Diseases Surveillance System
ODOO:	Optimal date of onset of disease
PEP:	Post-exposure prophylaxis
PHEOC:	Public Health Emergency Operations Centre
PCV13:	Prevenar 13
PPV23:	Pneumovax 23
RCF:	Residential care facility
RPR:	Rapid plasma reagin
RSV:	Respiratory Syncytial Virus
SEIFA:	Social-Economic Indexes for Areas
SMHS:	South Metropolitan Health Service
STI:	Sexually transmitted infection
WA:	Western Australia
WA DOH:	Western Australia Department of Health
WANIDD:	Western Australian Notifiable Infectious Diseases Database
WHO:	World Health Organization

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