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Australian Gonococcal Surveillance Programme Annual Report, 2023

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Australia

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Abstract

The Australian Gonococcal Surveillance Programme (AGSP) has continuously monitored antimicrobial resistance in *Neisseria gonorrhoeae* for more than 40 years. In 2023, a total of 10,105 isolates from patients in the public and private sectors, in all jurisdictions, were tested for *in vitro* antimicrobial susceptibility by standardised methods. Nationally, in 2023, the AGSP captured antimicrobial susceptibility data for 25% of all gonococcal infection notifications.

The current treatment recommendation for gonorrhoea, for the majority of Australia, continues to be dual therapy with ceftriaxone and azithromycin. In 2023, of *N. gonorrhoeae* isolates tested, 0.22% (22/10,105) met the WHO criterion for ceftriaxone decreased susceptibility (DS), defined as a minimum inhibitory concentration (MIC) value ≥ 0.125 mg/L.

Resistance to azithromycin was reported in 4.5% of *N. gonorrhoeae* isolates, proportionally stable since 2019. There were 27 isolates (0.27%) with high-level resistance to azithromycin (MIC value ≥ 256 mg/L) reported in Australia: Victoria (13), New South Wales (11), non-remote Western Australia (2) and Queensland (1). This is the highest number ever detected and reported in a twelve-month period by the AGSP.

In 2023, penicillin resistance was found in 30.7% of gonococcal isolates, and ciprofloxacin resistance in 60.3%, although there was considerable variation by jurisdiction. In some remote settings, penicillin remains recommended as part of an empiric therapy strategy. However, in 2023, in remote Northern Territory, five penicillin-resistant isolates were reported; and in remote Western Australia, 14.1% of gonococcal isolates (10/71) were penicillin resistant. In addition, there were eight ciprofloxacin-resistant isolates reported from remote Northern Territory; ciprofloxacin resistance rates have increased in remote Western Australia (16/71; 22.5%). This increase in penicillin-resistant *Neisseria gonorrhoeae* in the Northern Territory has effected a change in gonococcal treatment recommendations.

Keywords: antimicrobial resistance; disease surveillance; gonococcal infection; *Neisseria gonorrhoeae*

Introduction

The National Neisseria Network (NNN) is a collaborative network, established in the late 1970s, that comprises jurisdictional *Neisseria* reference laboratories across Australia. The NNN laboratories provide reference-level services for the pathogenic *Neisseria* species: *N. gonorrhoeae* (NG) and *N. meningitidis*. The Australian Gonococcal Surveillance Programme (AGSP) is a key activity of the NNN and has been operational for more than 40 years.¹ Over these decades, the AGSP has reported the emergence of resistance to all antibiotics used in the treatment of gonorrhoea, and has detected and reported multi- and extensively-drug-resistant gonococcal strains in recent years. In 2017, the first evidence of sustained spread of multi-drug-resistant gonorrhoea was reported,² followed in 2018 by coincident reports from Australia and the United Kingdom of the first extensively-drug-resistant *N. gonorrhoeae* isolates.³⁻⁵ The emergence of NG antimicrobial resistance (AMR) in Australia has largely occurred following introduction of multi-resistant strains from overseas.^{5,6} The importation and spread of ceftriaxone-resistant gonococcal strains, and/or of new resistance developing, remains an ongoing concern for disease control strategies, and is a focus of the work of the NNN.

The background rate of isolates in Australia with decreased susceptibility to ceftriaxone (defined as a minimum inhibitory concentration (MIC) value ≥ 0.125 mg/L) has remained low, and relatively stable, since the introduction of dual therapy for gonorrhoea in 2014 (ranging from 0.86% to 1.8%). Continuous AMR surveillance remains imperative to detect the emergence and spread of resistant strains, endangering empirical therapeutic regimens.^{6,7} The increased proportion of gonococcal isolates with azithromycin resistance in recent years has also added to concerns about management strategies, and continues to be monitored.

Notification rates of gonococcal infections in Australia increased by 114% between 2013 and 2019 (from 66.1 to 141.5 per 100,000 population per year), and then declined by 23% coincident with the coronavirus disease 2019 (COVID-19) restrictions in 2019 to 2021.⁸ In 2022, the notifications increased by 22% (133.8 per 100,000 population) and rose again in 2023 by 13.5% (151.8 per 100,000 population).^{8,9}

Gonococcal disease rates in the Aboriginal and Torres Strait Islander population are markedly higher than in the non-Indigenous population (547.1 per 100 000 population, five times higher than that of the non-Indigenous population at 108.3 per 100 000 population) in 2023 and were highest in remote and very remote areas (738.6 per 100,000 population).⁸ Notwithstanding the higher gonococcal disease rates in such regions, historically NG AMR in remote and very remote areas has remained low. In 2023, increasing notifications of penicillinase-producing *Neisseria gonorrhoeae* in the Northern Territory has led to treatment recommendations centred on oral penicillin to change to dual therapy with ceftriaxone and azithromycin.¹⁰

In recent years, the heightened international awareness of gonococcal disease has coincided with increased molecular diagnoses replacing bacterial culture and antimicrobial susceptibility testing (AST). The corollary of this is a reduction in gonococcal isolates available for AMR surveillance.^{8,11} Molecular tests for antimicrobial resistance detect known genetic targets associated with resistance; however, these assays do not detect novel resistance mechanisms. Uniquely, in some remote regions of Australia, molecular assays are used to detect penicillin resistance in NG,^{12,13} the first documented use of such testing for NG AMR detection and surveillance.^{13,14} These data inform local treatment guidelines.¹⁴

Strategies for treatment and control of gonorrhoea are based on regimens effecting cure in a minimum of 95% of cases. Surveillance data of antibiotics in clinical use are critical to monitor AMR; to detect imported or novel resistance; and to inform treatment guidelines.¹² The World Health Organization (WHO) has called for enhanced surveillance as a fundamental component of its Global Action Plan to control the spread and impact of gonococcal AMR.¹⁵

Methods

Gonorrhoea infections are notifiable under legislation in Australia to the National Notifiable Diseases Surveillance System (NNDSS). The isolates tested by the NNN, and reported by the AGSP, represent a proportion of the total number of notified cases. The NNN laboratories test gonococcal isolates for susceptibility to ceftriaxone, azithromycin, penicillin, ciprofloxacin, spectinomycin and tetracycline. In addition, many NNN laboratories are testing gentamicin; these data were first reported by the AGSP in 2020, and reporting continues in 2023.

Antimicrobial susceptibility testing is performed using standardised methodology to determine the minimum inhibitory concentration (MIC) value, the lowest antibiotic concentration that inhibits *in vitro* growth under defined conditions. The coordinating lab for the NNN, the World Health Organization Collaborating Centre for Sexually Transmitted Infection and Antimicrobial Resistance (WHO CC, Sydney), conducts a program-specific quality assurance program.¹⁶ Gonococcal AST data from each jurisdiction are submitted quarterly to the WHO CC, Sydney. Where available, the AGSP collects data on the sex of the patient; the country of acquisition of infection; and the site of isolation of gonococcal isolates. Data collected across jurisdictions are predominantly from urban centres. Data from the Northern Territory and Western Australia are further divided into non-remote and remote regions determined at the jurisdictional level.

Results

Proportion of gonococcal infections with antimicrobial susceptibility testing

In 2023, there were 40,429 gonococcal infections notified in Australia;⁹ and of these, 10,105/40,429 (25%) had isolates available for AST performed by the NNN laboratories (Table 1). This is reflected in Figure 1, which plots AGSP (culture-confirmed cases) against national notification data (which includes both the AGSP and culture-independent diagnosis).

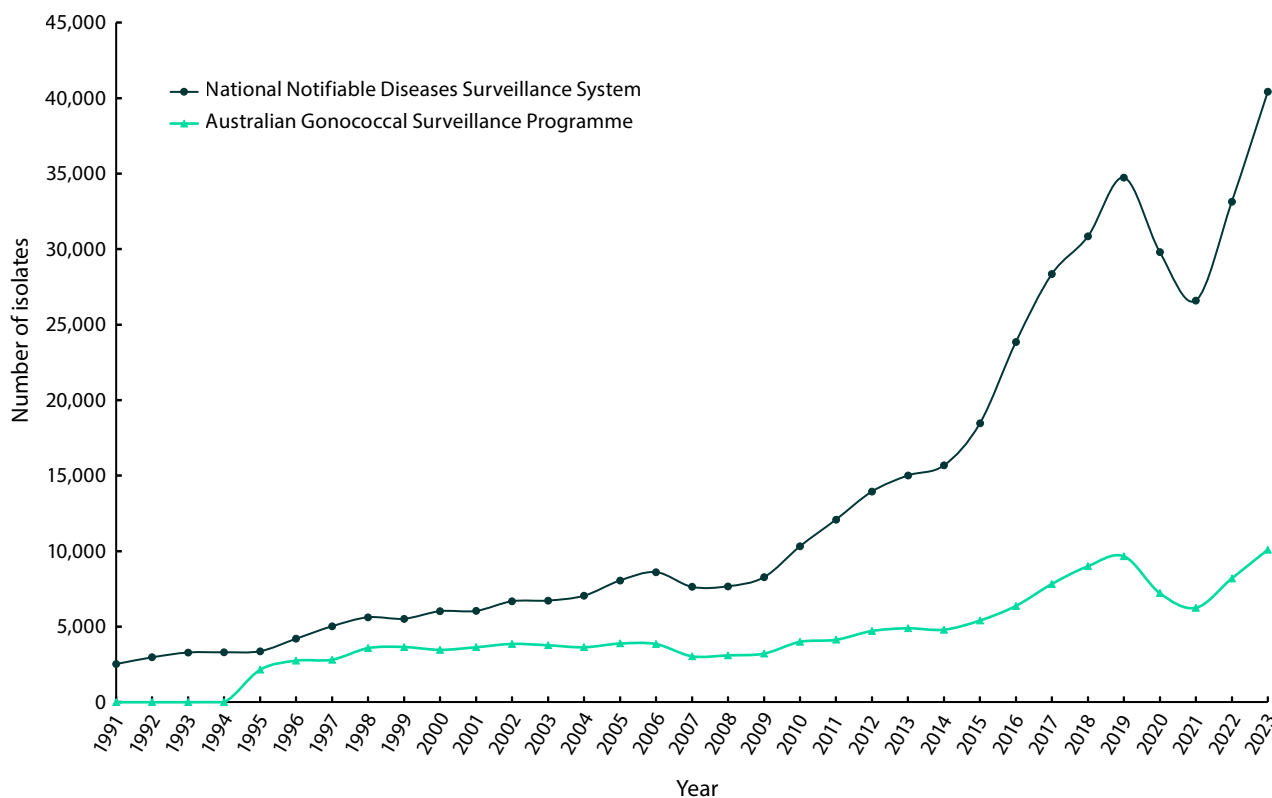
Across jurisdictions, the proportion of diagnoses made by culture varies, ranging from 8% to 56% as shown in Table 1. The lowest proportion is from the remote and very remote communities of the Northern Territory and Western Australia. The proportion is highest from the Australian Capital Territory, and likely reflects the small number of notifications in that jurisdiction.

Table 1: Number of Australian Gonococcal Surveillance Programme gonococcal isolates tested as a proportion of National Notifiable Diseases Surveillance System (NNDSS) gonorrhoea notifications,^a Australia, 2023, by state or territory

State or territory	Number of isolates tested	Number of cases notified	Number of isolates tested/ Number of cases notified (%)
Australian Capital Territory	270	484	56%
New South Wales	3,588	12,457	29%
Northern Territory	205	2,482	8%
Queensland	1,534	7,549	20%
South Australia	589	2,267	26%
Tasmania	136	367	37%
Victoria	2,745	10,090	27%
Western Australia	1,038	4,733	22%
Australia	10,105	40,429	25%

^a Source: National Communicable Disease Surveillance Dashboard (<https://nindss.health.gov.au/pbi-dashboard/>). Accessed 13 March 2024.⁹

Figure 1: Number of gonococcal disease cases reported to the National Notifiable Diseases Surveillance System,^a compared with *Neisseria gonorrhoeae* isolates available for laboratory testing by the Australian Gonococcal Surveillance Programme, Australia, 1991–2023



a Source: National Communicable Disease Surveillance Dashboard (<https://nindss.health.gov.au/pbi-dashboard/>). Accessed 13 March 2024.⁹

Gonococcal isolates, Australia, 2023, by sex, site and jurisdiction tested

There were 7,731 isolates tested in 2023 from males (76.5%) and 2,283 (22.6%) from females (Table 2). There were 91 isolates (0.90%) from patients whose sex was not recorded or recorded as ‘other’. The proportion of gonococcal isolates from males and females has remained stable over recent years (2009–2021), ranging between 17% and 22% for females and between 78% and 83% for males.¹⁷ The infected site was reported as ‘other’ or not specified for 281 isolates from males and for 92 isolates from females (Table 2). Isolates from urine samples were regarded as genital tract isolates.

Antimicrobial resistance profile of *Neisseria gonorrhoeae*

For 2023, the numbers and proportions of gonococcal isolates resistant to azithromycin, ciprofloxacin and penicillin, are shown in Table 3. There continues to be variation across jurisdictions, as well as in remote settings when compared to non-remote settings.

Table 2: Gonococcal isolates, Australia, 2023, by sex, site and jurisdiction^a tested

Sex	Site	ACT ^a	NSW	NT	Qld	SA	Tas.	Vic.	WA	Australia
Male	Genital	100	1,400	112	692	265	52	813	550	3,984
	Rectal	53	929	11	210	82	35	714	62	2,096
	Pharynx	56	554	10	94	28	17	541	42	1,342
	DGI ^b	1	8	3	8	0	0	6	2	28
	Other/NS ^c	0	39	1	35	37	1	156	12	281
	Total		210	2,930	137	1,039	412	105	2,230	668
Female	Genital	39	515	65	425	149	28	350	335	1,906
	Rectal	6	17	0	9	7	0	16	3	58
	Pharynx	8	72	1	32	8	0	72	20	213
	DGI	0	4	1	7	0	0	1	1	14
	Other/NS	0	16	0	20	7	3	36	10	92
	Total		53	624	67	493	171	31	475	369
Other	Genital	2	15	1	0	2	0	14	1	35
	Rectal	2	4	0	0	1	0	16	0	23
	Pharynx	2	11	0	0	0	0	7	0	20
	DGI	0	0	0	0	0	0	0	0	0
	Other/NS	1	0	0	0	0	0	1	0	2
	Total		7	30	1	0	3	0	38	1
Unknown	Genital	0	2	0	2	1	0	2	0	7
	Rectal	0	1	0	0	2	0	0	0	3
	Pharynx	0	1	0	0	0	0	0	0	1
	DGI	0	0	0	0	0	0	0	0	0
	Other/NS	0	0	0	0	0	0	0	0	0
	Total		0	4	0	2	3	0	2	0
Total		270	3,588	205	1,534	589	136	2,745	1,038	10,105

a ACT: Australian Capital Territory; NSW: New South Wales; NT: Northern Territory; Qld: Queensland; SA: South Australia; Tas.: Tasmania; Vic.: Victoria; WA: Western Australia.

b DGI: disseminated gonococcal infection.

c NS: not specified.

Table 3: Number and proportion (%) of gonococcal isolates with resistance to azithromycin, ciprofloxacin and penicillin reported, Australia, 2023, by state or territory

State or territory	Number of isolates tested	Resistance					
		Azithromycin		Ciprofloxacin		Penicillin	
		n	%	n	%	n	%
Australian Capital Territory	270	5	1.9	158	58.5	95	35.2
New South Wales	3,588	165	4.6	2,399	66.9	1,021	28.5
Queensland	1,534	41	2.7	829	54.0	487	31.7
South Australia	589	17	2.9	255	43.3	170	28.9
Tasmania	136	8	5.9	75	55.1	42	30.9
Victoria	2,745	159	5.8	1,785	67.9	960	36.5
Northern Territory non-remote	105	4	3.8	32	30.5	9	8.6
Northern Territory remote	100	0	0	8	8.0	5	5.0
Western Australia non-remote	967	57	5.9	539	55.7	303	31.3
Western Australia remote	71	2	3	16	22.5	10	14.1
Australia	10,105	458	4.5	6,096	60.3	3,102	30.7

Ceftriaxone

Gonococcal isolates with ceftriaxone MIC values ≥ 0.125 mg/L are considered to have decreased susceptibility in accordance with WHO guidelines,¹⁵ and are reported by the AGSP; in addition, isolates with a ceftriaxone MIC value ≥ 0.064 mg/L have been detected and reported in Australia since 2001. The proportion reported by the AGSP, of isolates with ceftriaxone MIC ≥ 0.064 mg/L, increased to 4.4% in 2012 before doubling to 8.8% in 2013. However, from 2014, coincident with the introduction of dual ceftriaxone and azithromycin therapy, there has been an overall declining trend in the proportion of gonococcal isolates with decreased susceptibility to ceftriaxone in Australia, as shown in Table 4 and 5.

In 2022 there was a surge in the number and proportion of isolates with ceftriaxone MIC values of 0.064 and 0.125 mg/L, reported in the majority from New South Wales (Table 4 and Table 5). Genomic investigations in New South Wales identified expansion of a clone of limited genomic diversity of multilocus sequence type (MLST) ST-7827, detected in male and female patients across the state.¹⁸ All these were susceptible to azithromycin, but resistant to ciprofloxacin. ST-7827 isolates were also reported in 2022 in lower numbers from South Australia.^{18,19} In 2023, the proportion of *N. gonorrhoeae* with these MIC values fell to 3.29% (332/10,105) and 0.10% (10/10,105), respectively.

There were 22 isolates reported with ceftriaxone MIC values ≥ 0.125 mg/L in 2023: New South Wales (8); Victoria (8), Queensland (3); non-remote Western Australia (2) and South Australia (1). Fourteen isolates (14/22) with ceftriaxone MICs ranging from 0.125 to 1 mg/L had the *penA* allele 60.001 (one isolate with a partial match), which encodes key alterations in the penicillin binding protein 2 associated with ceftriaxone resistance, detected on genomic analysis by the NNN Laboratories. Public Health investigations were conducted at the jurisdictional level, with four of the fourteen cases reporting overseas contact or travel to the Asia Pacific.

Four of the eight isolates with ceftriaxone MIC values ≥ 0.125 mg/L reported from Victoria had an extensively drug resistant (XDR) profile²⁰ with resistance to penicillin and ciprofloxacin and high-level azithromycin resistance (MIC value ≥ 256 mg/L). Jurisdictional investigations including genomics are ongoing, with the sequence type ST-16406 identified in all four isolates, the same sequence type reported in 2022,¹⁹ and where available reported Asia-Pacific contact.

Table 4: Number and proportion (%) of gonococcal isolates with ceftriaxone MIC values ≥ 0.064 mg/L, Australia, 2014 to 2023, by state or territory

State or territory	Decreased susceptibility to ceftriaxone (MIC ≥ 0.064 mg/L)																			
	2014		2015		2016		2017		2018		2019		2020		2021		2022		2023	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Australian Capital Territory	2	2.7	0	0	1	0.9	0	0	4	1.9	1	0.5	0	0	1	0.5	6	2.8	1	0.4%
New South Wales	119	7.1	52	2.7	45	2.0	13	0.5	30	0.8	44	1.2	30	1.2	18	0.9	332	12	238	6.6%
Queensland	21	3.2	7	1.0	32	3.7	11	0.9	18	1.3	16	1.0	17	1.1	4	0.4	8	0.6	32	2.1%
South Australia	2	1.0	9	3.6	2	0.6	2	0.6	3	1.3	9	1.6	0	0	4	1.4	18	3.9	8	1.4%
Tasmania	0	0	0	0	1	3.6	0	0	4	7.3	1	2.1	0	0	1	1.4	0	0	0	0%
Victoria	95	6.6	25	1.5	19	1.1	48	2.1	83	3.2	42	1.6	18	1.1	25	1.3	82	3.3	66	2.4%
Northern Territory non-remote	3	3.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1.1	3	2.9%
Northern Territory remote	1	0.8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0%
Western Australia non-remote	14	3.6	5	1.3	9	1.3	9	1.4	14	2.1	11	1.5	3	0.4	1	0.2	9	1.9	6	0.6%
Western Australia remote	1	0.9	0	0	0	0	0	0	0	0	2	2.4	0	0	0	0	0	0	0	0%
Australia	258	5.4	98	1.8	109	1.7	83	1.1	156	1.7	126	1.3	68	0.9	54	0.9	456	5.6	354	3.5%

Table 5: Proportion (%) of gonococcal isolates tested in Australia with ceftriaxone MIC values at 0.064 mg/L and ≥ 0.125 mg/L¹⁴ and resistance to azithromycin, 2010 to 2023

Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Number of isolates tested nationally	4,100	4,230	4,718	4,897	4,804	5,411	6,378	7,835	9,006	9,668	7,222	6,254	8,199	10,105
Ceftriaxone MIC 0.064 mg/L	4.80%	3.20%	4.10%	8.20%	4.80%	1.70%	1.65%	1.02%	1.67%	1.19%	0.87%	0.83%	5.05%	3.29%
Ceftriaxone DS ^a MIC ≥ 0.125 mg/L	0.10%	0.10%	0.30%	0.60%	0.60%	0.10%	0.05%	0.04%	0.06%	0.11%	0.07%	0.03%	0.51%	0.22%
Ceftriaxone total (MIC values ≥ 0.064 mg/L)	4.90%	3.30%	4.40%	8.80%	5.40%	1.80%	1.70%	1.06%	1.73%	1.30%	0.94%	0.86%	5.56%	3.51%
Azithromycin resistance	n/a	1.1%	1.3%	2.1%	2.5%	2.6%	5.0%	9.3%	6.2%	4.6%	3.9%	4.7%	3.9%	4.5%

^a DS: decreased susceptibility.

Table 6: Number and proportion (%) of gonococcal isolates with resistance to azithromycin, Australia, 2012 to 2023, by state or territory

Jurisdiction ^a	2012		2013		2014		2015		2016		2017		2018		2019		2020		2021		2022		2023	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
ACT	0	0	1	2.2	7	9.3	0	0	8	7.1	3	2.1	18	8.7	14	7.1	9	6.1	6	3.2	7	3.2	5	1.9
NSW	9	0.5	14	0.9	33	2.0	43	2.3	82	3.6	261	9.3	230	6.5	215	6.0	181	7.0	191	9.9	109	4.0	165	4.6
Qld	15	2.1	38	5.7	23	3.5	42	5.8	10	1.2	61	4.9	68	4.9	32	1.9	43	2.9	14	1.2	32	2.3	41	2.7
SA	1	0.7	6	2.8	1	0.5	7	2.8	68	19.5	46	12.8	7	3.0	11	2.0	1	0.3	3	1.0	3	0.7	17	2.9
Tas.	0	0	0	0	1	3.3	1	4.3	4	14.3	5	9.0	3	6.0	1	2.0	0	0	4	5.8	5	5.2	8	5.9
Vic.	34	2.7	35	2.3	33	2.3	30	1.8	93	5.4	304	13.5	217	8.3	161	6.2	29	1.7	59	3.1	144	5.8	159	5.8
NT non-remote	0	0	1	1.0	0	0	0	0	1	1.9	1	1.7	1	1.5	1	1.8	2	3.9	1	2.0	1	1.1	4	3.8
NT remote	0	0	0	0	0	0	0	0	0	0	1	0.6	0	0	0	0	0	0	0	0	0	0	0	0
WA non-remote	3	0.6	9	1.9	21	5.3	15	3.8	51	7.6	40	6.4	16	2.5	12	1.6	18	2.6	18	3.7	16	3.3	57	5.9
WA remote	0	0	0	0	0	0	0	0	1	0.8	4	3.4	1	0.9	1	1.2	1	0.9	0	0	0	0	2	3
Australia	62	1.3	104	2.1	119	2.5	138	2.6	318	5.0	726	9.3	561	6.2	448	4.6	284	3.9	296	4.7	317	3.9	458	4.5

^a ACT: Australian Capital Territory; NSW: New South Wales; Qld: Queensland; SA: South Australia; Tas.: Tasmania; Vic.: Victoria; NT: Northern Territory; WA: Western Australia.

Azithromycin

Nationally, in 2023, azithromycin resistance was detected in 4.5% of isolates (Table 3), an increase from 3.9% in 2022.¹⁹ Since 2012, rates of azithromycin resistance increased from 1.3% to a peak of 9.3% in 2017, then declined to 3.9% in 2020 (Table 6). Rates of azithromycin-resistant NG were highest in non-remote Western Australia (5.9%), Tasmania (5.9%), Victoria (5.8%), and New South Wales (4.6%) (Tables 5 and 6). In 2023, twenty-seven isolates exhibited high-level resistance to azithromycin (MIC \geq 256 mg/L), reported from Victoria (13), New South Wales (11), non-remote Western Australia (2) and Queensland (1).

Penicillin

Penicillin resistance results from β -lactamase production (i.e., penicillinase) and/or from the aggregation of chromosomally-controlled resistance mechanisms. These are denoted respectively as penicillinase-producing *N. gonorrhoeae* (PPNG) and chromosomally-mediated resistance to penicillin (CMRP).

In 2023, in Australia, 3,102 isolates (30.7%) were penicillin resistant (Table 3), a decrease from 2022 (38.8%).¹⁹ The proportion of penicillin-resistant isolates has fluctuated in the range 22% to 44% between 2008 and 2022.¹⁷ In 2023, of the 3,102 penicillin-resistant isolates, there were 861 (27.8%) with CMRP; 2,241 (72.2%) were PPNG.

Penicillin resistance in remote Australia

In 2023, there were 205 isolates tested from the Northern Territory, with 100 referred from remote areas (including Alice Springs, Katherine, Tennant Creek, and Arnhem Land region) and 105 from Darwin and surrounding urban areas (non-remote). In 2023, there were 1,038 isolates tested from Western Australia, with 71 referred from remote regions and 967 from urban and suburban Perth (non-remote).

Of the 100 isolates from remote Northern Territory, five were penicillin resistant, PPNG (5%). Of the 71 isolates from remote Western Australia, ten (14.1%) were penicillin resistant, of which four were CMRP and six were PPNG.

Ciprofloxacin

In 2023, ciprofloxacin resistance was reported in 6,096 isolates (60.3%), lower than in 2022 (63.3%)¹⁹ (Table 3). Ciprofloxacin has not been recommended in Australia as first-line therapy for gonococcal infections since the late 1990s. As reported by the AGSP, the rate of ciprofloxacin resistance progressively declined in Australia since 2008, peaking at 71%, before reaching a nadir of 25.6% in 2018.⁷ The increase in ciprofloxacin resistance from 52.9% in 2021 to 63.3% in 2022 can be attributed to an extent to the expansion of the ST-7827 clone, particularly in New South Wales.¹⁸

Tetracyclines

To optimise reporting of tetracycline resistance in *N. gonorrhoeae*, from 2018, NNN reference laboratories have performed tetracycline MIC testing where possible. This replaces historical breakpoint testing for high-level tetracycline-resistant *N. gonorrhoeae* (TRNG) (MIC \geq 16 mg/L) reported by the AGSP as an epidemiological marker for plasmid-mediated resistance. Tetracycline resistance is defined as MIC \geq 2 mg/L. Nationally in 2023, fifty-six percent of isolates (5,674/10,105) were tested, and 31% of tested isolates (1,755/5,674) were tetracycline resistant. Tetracycline resistance data are presented by jurisdiction and aggregated for Australia as shown in Table 7.

Spectinomycin

In 2023, all isolates tested (n = 9,174; 90.8%) were susceptible to spectinomycin.

Gentamicin

In 2023, gentamicin susceptibility testing data was available for 5,328 isolates originating from the Australian Capital Territory, New South Wales, Tasmania, Western Australia and the Northern Territory. The median MIC value was 4 mg/L; and the range was \leq 1.0–16 mg/L. There are no gentamicin breakpoints defined for *N. gonorrhoeae*.

Table 7: Number and proportion (%) of gonococcal isolates with resistance to tetracycline (MIC \geq 2 mg/L), Australia, 2023, by state or territory

State or territory	Number of isolates tested 2023	Tetracycline resistance MIC \geq 2 mg/L	
		n	%
Australian Capital Territory	228	64	28%
New South Wales	201	49	24%
Queensland	1,479	524	35%
South Australia ^a	NT	NT	NT
Tasmania	136	53	39%
Victoria	2,571	802	31%
Northern Territory non-remote	6	0	0%
Northern Territory remote	18	0	0%
Western Australia non-remote	965	251	26%
Western Australia remote	70	12	17%
Australia	5,674	1,755	31%

a NT: not tested.

Discussion

In 2023, the number of notifications of *N. gonorrhoeae* infections in Australia was 40,429, an increase of 16% from the pre-pandemic notifications to the NNDSS in 2019 (34,743).⁹ The NNN jurisdictional reference laboratories reported data from clinical testing of 10,105 *N. gonorrhoeae* isolates (representing 25% of infections) from urban and remote settings in both public and private health sectors. The remote regions of Western Australia and the Northern Territory continue to report the highest rates of gonococcal disease, relatively low rates of AMR, and low numbers of isolates available for AST.

From 2016 to 2018, the proportion of isolates with ceftriaxone decreased susceptibility (MIC value \geq 0.125 mg/L)¹⁵ reported by the AGSP remained stable in the range 0.04–0.06%. However, in 2019, this increased to 0.11% (Table 5) then further decreased during 2020–2021 coincident with public health containment measures for COVID-19. In 2022, the AGSP reported a surge in the number and proportion of isolates with ceftriaxone MIC values \geq 0.06 mg/L, largely attributed to the expansion of a clone of limited genomic diversity of sequence type ST-7827 in 24/27 (89%) isolates detected in male and female patients in New South Wales. These ST-7827 isolates had a non-mosaic *penA* allele, and all were susceptible to azithromycin, but were resistant to ciprofloxacin

(reflected in the increase in ciprofloxacin resistance in New South Wales, in the range 29–36% in the period 2015–2019 then increasing to 76% in 2022).¹⁸ In 2023, the detection of ST-7827 *N. gonorrhoeae* in New South Wales subsided. Similarly, in Norway, *N. gonorrhoeae* ST-7827 rates increased rapidly in the population from 2% to 20% in two years (2016–2018) and then waned.²¹

Of concern, in 2023 there were 22 isolates reported nationally by the AGSP with ceftriaxone MIC values \geq 0.125 mg/L:¹⁵ New South Wales (8); Victoria (8); Queensland (3), Western Australia (2) and South Australia (1). Of these, 14/22 from multiple jurisdictions (Victoria (7), New South Wales (3); Queensland (3) and Western Australia (1)) were confirmed by whole genome sequencing to harbour the mosaic *penA* allele 60.001 (encoding key alterations in the penicillin binding protein 2 associated with ceftriaxone resistance). These 14 isolates had ceftriaxone MIC values ranged from 0.125 to 1.0 mg/L. Of these, where travel history was available, there was confirmed travel history or association with the Asia Pacific region. A 2022 report from the United Kingdom (UK),²² describing a surge in detection of *N. gonorrhoeae* isolates harbouring the *penA* 60.001 allele, heightened concerns regarding emergence of gonococcal AMR.

Four of the eight ceftriaxone MIC \geq 0.125 mg/L isolates reported from Victoria in 2023 had an extensively drug resistant (XDR) profile²⁰ (ceftriaxone MIC 0.25 mg/L; azithromycin MIC \geq 256 mg/L), with all four harbouring the mosaic *penA* 60.001 allele. The first reports of XDR *N. gonorrhoeae* were from Australia (two unrelated cases, one with a travel history in the Asia-Pacific) and one from the UK (with travel link to Thailand) in 2018.^{23,24} On genomic analysis, there was limited diversity between the 2018 UK and Australian XDR isolates, suggesting these isolates belonged to the same gonococcal clone.²⁵ In 2022, two further cases were reported, one in Austria with travel links in Cambodia,²⁶ and another in the UK with contact in the Asia-Pacific.²⁴ Genomic analysis found the 2022 UK and European isolates to be identical²⁴ and related to the case reported in the UK in 2018. These findings strongly suggest these strains are in circulation in the Asia-Pacific.²⁴ The detection of such isolates in Victoria is extremely concerning; further investigations at the jurisdictional level are ongoing and will be reported.

Azithromycin resistance has been reported by the AGSP since 2007. Following the introduction of dual therapy in 2014, resistance to azithromycin in all jurisdictions of Australia has been observed (Table 6), increasing from 2016, and peaking at 9.3% in 2017. However, rates halved in 2019 (4.6%), and have remained relatively stable for the last four years (Table 6). In 2023, azithromycin resistance was highest in non-remote Western Australia (5.9%), Tasmania (5.9%), Victoria (5.8%), and New South Wales (4.6%).

In 2013, high-level resistance (HLR; MIC \geq 256 mg/L) to azithromycin in gonococci was reported for the first time. Since then, there have been sporadic reports of *N. gonorrhoeae* isolates with HLR to azithromycin in Australia annually; none were reported in 2021. In 2022, nine such isolates were reported nationally and notably this number increased to 27 in 2023, this being the highest number reported to date. These isolates were largely contributed from Victoria and New South Wales and the majority isolated from male patients. Data from the jurisdictions, where available, has indicated some of these were associated with overseas travel to South America, Africa and Europe.

In 2023, penicillin resistance was reported in 30.7% of isolates (3,102/10,105) (Table 3), an increase from 2020 (26.6%). The proportion of penicillin-resistant isolates has been reported in the range 22% to 44% between 2008 and 2022. In 2023, of the penicillin-resistant isolates, there were 861 isolates (27.8%) with CMRP; 2,241 isolates (72.2%) were PPNG.

With regards to the isolates from remote regions, of the 100 isolates from remote Northern Territory, five were penicillin resistant, PPNG (5%). There were 71 isolates from remote Western Australia, ten (14.1%) were penicillin resistant, four with CMRP and six were PPNG.

In 2023, ciprofloxacin resistance was reported in 60.3% of tested isolates, lower than 63.3% in 2022 (Table 3).¹⁹ The rate of ciprofloxacin resistance reported in Australia had progressively declined since 2008 (71%) to 25.6% in 2018. The increase in ciprofloxacin resistance from 2021 can be attributed to an extent to the expansion of the ST-7827 clone, particularly in New South Wales.¹⁸ With regards to the remote regions of Australia, of the 100 isolates from remote Northern Territory, eight were ciprofloxacin resistant (8%), and of the 71 isolates from remote Western Australia, 16 were ciprofloxacin resistant (22.5%).

In 2023, gentamicin susceptibility testing data were available for 5,328 *N. gonorrhoeae* isolates from New South Wales, Tasmania, Western Australia, the Australian Capital Territory and the Northern Territory. The median MIC value was 4 mg/L; the range was \leq 1.0–16 mg/L. There are no gentamicin breakpoints defined for *N. gonorrhoeae*. The inclusion of gentamicin as an indicator for ongoing surveillance by the AGSP is in line with the WHO Global Antimicrobial Resistance Surveillance System (GLASS).

Nationally in 2023, fifty-six percent of isolates (5,674/10,105) were tested for tetracycline resistance; 31% (1,755/5,674) were tetracycline resistant. Tetracycline resistance data are presented by jurisdiction and aggregated for Australia as shown in Table 7. The highest rate was reported from Tasmania (39%), with resistance reported in other jurisdictions (excluding remote Northern Territory and Western Australia) in the range 24–39%, noting there are no data from South Australia. There has been recent interest in the proportion of tetracycline resistance in NG in Australia, due to considerations of using this agent for possible pre- and post-exposure prophylaxis of bacterial sexually transmitted infections in high-risk populations.

A number of concerning observations are reported by the AGSP in 2023. Of the greatest concern are the surge in *N. gonorrhoeae* isolates detected nationally with the *penA* 60.001 allele; the detection of four isolates with an XDR profile from Victoria; and the increase in notifications of isolates with high level resistance to azithromycin from New South Wales and Victoria.

Additional clinical, public health and laboratory investigations, including genomic analysis at the jurisdictional level, have been implemented as part of the response to these events. These include follow up, test of cure and investigations regarding travel history. The findings from this report underscore the ongoing importance of surveillance based on bacterial culture and AST of *N. gonorrhoeae*. These data are critically important to inform future therapeutic strategies; to monitor for the presence and spread of resistant isolates; and to detect instances of treatment failure.

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