

Enhanced gonorrhoea antimicrobial susceptibility testing surveillance: enabling detailed contextual analyses and understanding of priority population resistance patterns

Epidemiological analysis of *Neisseria gonorrhoeae* antimicrobial susceptibility testing (AST) surveillance data in Australia, 2020-2021

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Background

In 2020 the Communicable Diseases Network Australia (CDNA) endorsed the collection of enhanced gonococcal antimicrobial susceptibility testing (AST) data in the National Notifiable Diseases Surveillance System (NNDSS). National AST data collection along with core and enhanced data provides the opportunity to contextualise *N.gonorrhoeae* notifications and emerging antimicrobial resistance in Australia. This is the first review of NNDSS AST data since collection commenced.

Methods

Following assessment of the completeness and representativeness of the data, a descriptive analysis was undertaken of the epidemiology of *N.gonorrhoeae* antimicrobial resistance (AMR) in Australia as recorded on the NNDSS from 1 January 2020 to 31 December 2021. Associations between AMR or intermediate susceptibility to a first line treatment for *N.gonorrhoeae* and exposures were sought. First line treatment was defined as treatment with azithromycin and/or ceftriaxone.

Results

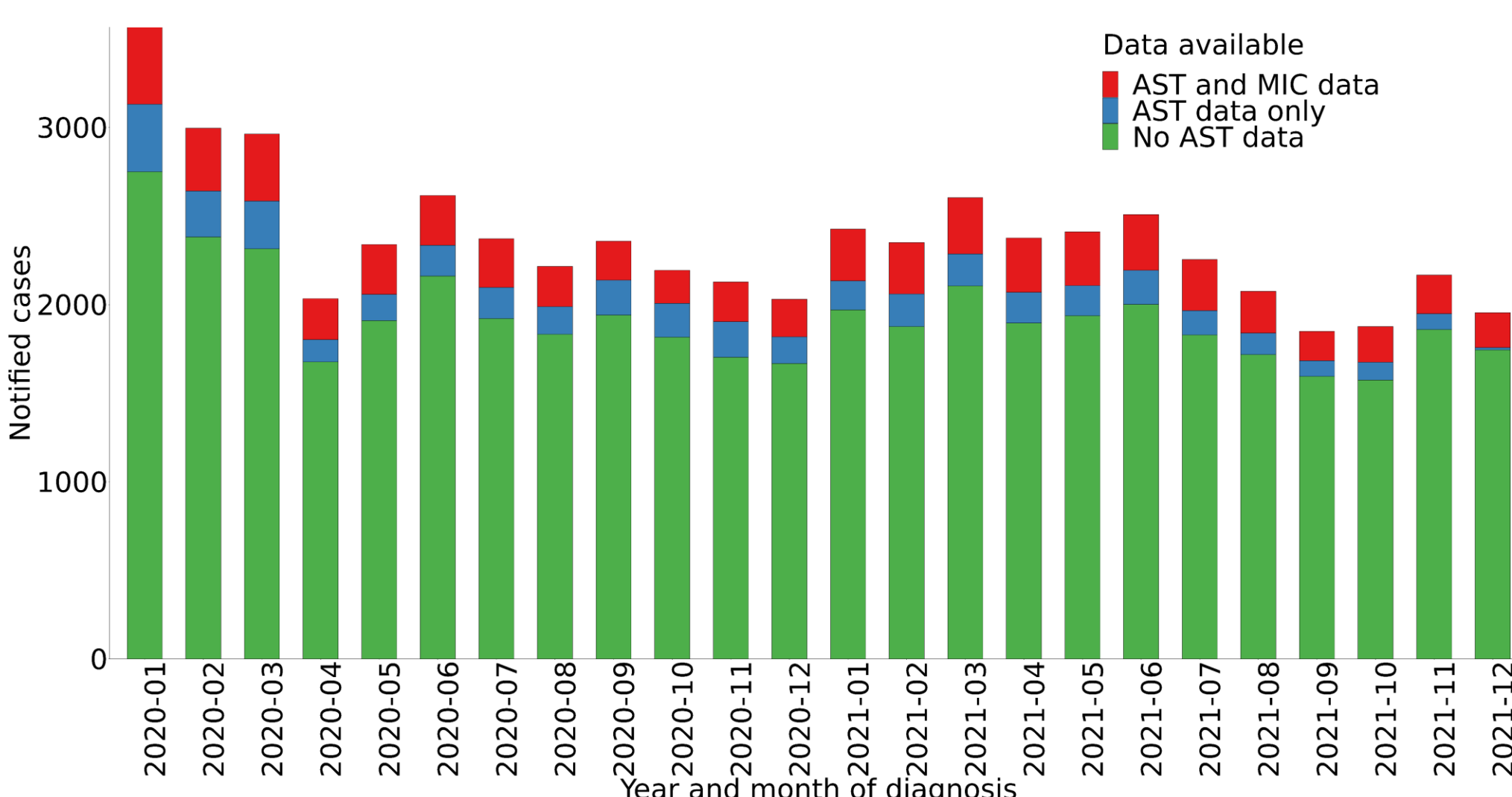
10,466/56,680 (18.5%) *N.gonorrhoeae* notifications reported to the NNDSS from 1 January 2020 to 31 December 2021 included AST data with a further 6,442 notifications including Minimum Inhibitory Concentration (MIC) values (Figure 1).

Of those notifications with AST data:

- 8,303/10,431 (79%) were male
- Median age was 31 years (IQR 26 -39 years)
- 1,924/2,786 (66%) had sexual exposure to person(s) of the same sex only
- 744/1,583 (47%) were detected in a sexual health clinic

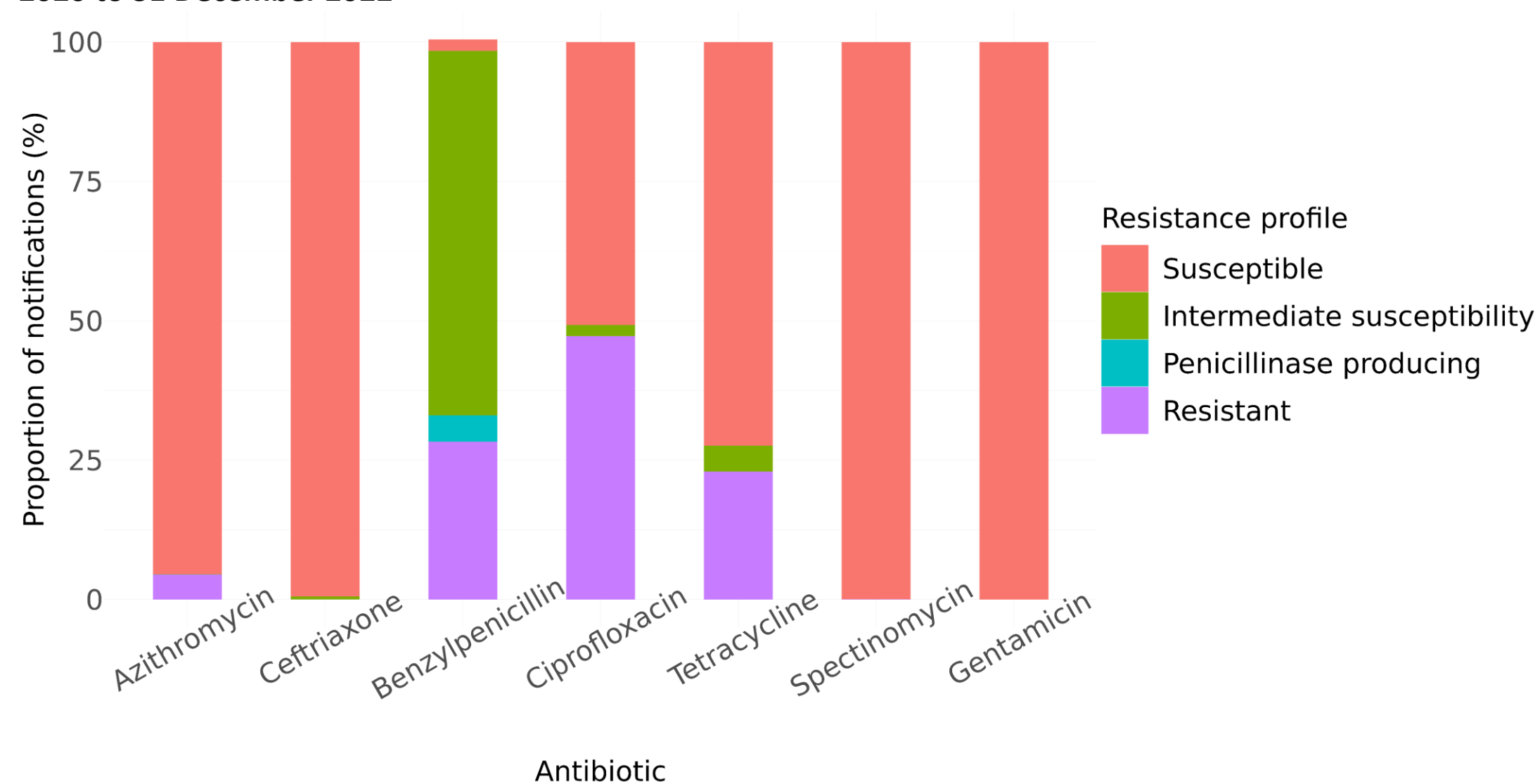
Data was not yet representative as South Australia and Western Australia were not submitting AST data for *N.gonorrhoeae* to the NNDSS during this period and there were statistically significant differences between data that included and did not include AST data for all variables.

Figure 1. *N.gonorrhoeae* notifications by month and year and availability of AST data, Australia, 1 January 2020 to 31 December 2021



Of the notifications with AST data (10,466) the antimicrobials with the highest proportion of resistant cases were ciprofloxacin (47.3%), benzylpenicillin (33.1%) and tetracycline (22.9%) (Figure 2). 4.5% of notifications were resistant to azithromycin. There was one notification with resistance to ceftriaxone or cefotaxime and 55/10,421 (0.5%) notifications with intermediate susceptibility. There were 3 notifications with both intermediate susceptibility to ceftriaxone and resistance to azithromycin. Overall, 518/10,466 (5.0%) notifications were classified as having resistance to a first line antibiotic for the treatment of *N.gonorrhoeae*.

Figure 2. Percent of notifications of *N.gonorrhoeae* by antibiotic susceptibility testing result, Australia, 1 January 2020 to 31 December 2022



Risk factors for resistance to first line treatments for *N.gonorrhoeae*

After adjusting for confounders, the odds of having resistance to a first line treatment for *N.gonorrhoeae* were higher for the following age groups in comparison to the 40+ age group:

- 15 –19 years (adjusted odds ratio [aOR], 2.1, 95% confidence interval [95%CI], 1.1 - 3.7, p = 0.02)
- 20 – 24 years (aOR 2.0, 95%CI 1.4 - 2.9, p<0.001)
- 25 –29 (aOR 2.0, 95%CI 1.4 - 2.9, p<0.001)
- 30 –34 years (aOR 1.6, 95%CI 1.1 - 2.3, p = 0.02) (Table 1).

The odds of resistance to a first line antibiotic was significantly lower in outer regional Australia compared to a major city (aOR 0.2, 95% CI 0.04 – 0.8, p = 0.04) and there were no notifications with resistance to a first line antibiotic from remote or very remote Australia.

The proportion of resistance to a first line antibiotic was highest among notifications with an 'other' site of infection (11.4%), followed by the pharynx (8.1%) and rectum (6.7%) (Table 2). After adjusting for potential confounding factors, the odds of having resistance to a first line antibiotic was 1.4 times higher for a pharyngeal infection compared to any other infection (95% CI 1.1 – 1.8, p = 0.01).

Table 1: Demographic characteristics associated with decreased susceptibility or resistance (DSR) to first line treatments for *N.gonorrhoeae*, 2020 – 2021, Australia

Characteristic	DSR n/N (%)	Univariate analysis		Multivariable analysis	
		OR(95% CI)	P	aOR(95% CI)	P
Age Group (years)					
0-14	1/41 (2.4)	0.6 (0.0 – 2.9)	0.6	0.0	>0.9
15-19	19/431 (4.4)	1.2 (0.7 – 1.9)	0.6	2.1 (1.1 – 3.7)	0.02
20-24	91/1,665 (5.5)	1.4 (1.1 – 1.9)	0.02	2.0 (1.4 – 2.9)	<0.001
25-29	152/2,422 (6.3)	1.7 (1.3 – 2.2)	<0.001	2.0 (1.4 – 2.9)	<0.001
30-34	103/2,057 (5.0)	1.3 (0.99 – 1.8)	0.06	1.6 (1.1 – 2.3)	0.02
35-39	63/1,412 (4.5)	1.2 (0.8 – 1.6)	0.3	1.4 (0.9 – 2.1)	0.1
40+	94/2,416 (3.9)	1 (ref)			
Sex					
Male	439/8,276 (5.3)	1.4 (1.1 – 1.8)	0.007	1.2 (0.9 – 1.6)	0.3
Female	82/2,116 (3.9)	1 (Ref)			
Indigenous status					
Non-indigenous	347/7,125 (4.9)	1 (Ref)			
Indigenous	6/658 (0.9)	0.2 (0.1 – 0.4)	<0.001	0.3 (0.1 – 0.6)	0.004
Remoteness area*					
Major cities of Australia	463/8,737 (5.3)	1 (Ref)			
Inner Regional Australia	34/758 (4.5)	0.8 (0.6 – 1.2)	0.3	1.1 (0.7 – 1.6)	0.8
Outer Regional Australia	4/431 (0.9)	0.2 (0.1 – 0.4)	<0.001	0.2 (0.04 – 0.8)	0.04
Remote Australia	0/94 (0)	0.0 (0.0 – 0.0)	>0.9	0.0	> 0.9
Very Remote Australia	0/53 (0)	0.0 (0.0 – 0.7)	>0.9	0.0	> 0.9

*Remoteness area calculated from postcodes using the Australian Bureau of Statistics (ABS) Australian Statistical Geography Standard (ASGS) Edition 3 remoteness areas for Australia.

Table 2: Clinical characteristics associated with decreased susceptibility or resistance (DSR) to first line treatments for *N.gonorrhoeae*, 2020 – 2021, Australia

Characteristic	DSR n/N (%)	Univariate analysis		Multivariable analysis	
		OR(95% CI)	P	aOR(95% CI)	P
Site of infection					
Urogenital	201/4,551 (4.4)	0.5 (0.4 – 0.7)	<0.001	0.7 (0.5 – 0.9)	0.01
Rectum	205/3,077 (6.7)	1.3 (1.1 – 1.6)	0.01	0.9 (0.7 – 1.1)	0.3
Pharynx/Throat	198/2,442 (8.1)	1.8 (1.5 – 2.1)	<0.001	1.4 (1.1 – 1.8)	0.01
Other	9/79 (11.4)	2.1 (0.8 – 4.0)	0.04	2.2 (0.7 – 5.3)	0.1
Sexual exposure					
Opposite sex only	29/750 (3.9)	1 (Ref)			
Same sex only	74/1,924 (3.8)	1.0 (0.7 – 1.6)	>0.9	1.3 (0.7 – 2.5)	0.4
Both sexes	3/108 (2.8)	0.7 (0.2 – 2.0)	0.6	1.1 (0.3 – 3.8)	>0.9
None	1/4 (25)	8.3 (0.4 – 67.0)	0.07		
Sex worker					
Current Sex worker	1/65 (1.5)	1 (Ref)			
Not a sex worker	106/2,658 (4.0)	2.7 (0.6 – 47.2)	0.3		
Hospitalised					
No	9/135 (6.7)	1 (Ref)			
Yes	3/22 (13.6)	2.2 (0.5 – 8.2)	0.5		

Conclusion

AMR in *N.gonorrhoeae* is of increasing concern as evidenced by high rates of resistance in commonly used antimicrobials and the identification of gonococcal isolates resistant or with decreased susceptibility to the last options for first-line empirical therapy. Enhanced *N.gonorrhoeae* AST surveillance enables detailed contextual analyses of *N.gonorrhoeae* AMR and an improved understanding of priority population resistance patterns. Efforts should be made to improve the completeness and representativeness of these data with a view to improve evidence to inform public health and treatment guidance.

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