Received: 12 June 2025 | Accepted: 28 December 2025

DOI: 10.1111/jdv.70316

JEADV JOURNAL OF THE EUROPEAN ACADEMY OF DERMATOLOGY & VENEREOLOGY

LETTER TO THE EDITOR

Antimicrobial resistance in *Neisseria gonorrhoeae* and co-infections (Vienna, Austria; 2015–2024)

Dear Editor,

Gonorrhoea, caused by *Neisseria gonorrhoeae*, is a global health threat with an estimated 87 million new cases annually. In the EU/EEA, over 96,000 cases were reported in 2023, with the UK, France, the Netherlands and Spain seeing the highest numbers.[1] Vienna, Austria has also observed an increase of gonococcal infections—from 573 cases in 2005 to 1678 in 2023. A temporary decline was noted during the COVID-19 pandemic.[2] Treatment is increasingly challenged by *N. gonorrhoeae's* ability to rapidly acquire antimicrobial resistance (AMR). Historically, penicillin was replaced by ciprofloxacin and then cephalosporins due to increasing resistances. Currently, ceftriaxone remains worldwide the recommended antibiotic.[3] Due to emerging resistance mechanisms—including plasmid acquisition and horizontal gene transfer from commensal *Neisseria* species—monitoring AMR is critical.[4]

This study analysed AMR trends in 3504 *N. gonorrhoeae* isolates collected from 2015 to 2024 in the Outpatients Centre in Vienna. In this study, 3081 isolates were obtained from men and 423 from women. Most isolates originated from urogenital samples, a low number from the oropharynx and anorectum. Antimicrobial susceptibility was tested using Etest strips for six antibiotics and interpreted according to the EUCAST guidelines.[5] Molecular testing included the detection of co-infections with *Chlamydia trachomatis*, *Mycoplasma genitalium* and *Trichomonas vaginalis*.

The proportion of isolates susceptible to all tested antibiotics declined from 26% in 2015 to 4.6% in 2024. Resistance patterns are shown in Figure 1. One detected ceftriaxone resistant strain (2023) was linked to a travel in Thailand. This isolate also showed multi-drug resistance but remained susceptible to the new agents zoliflodacin (0.032 mg/L) and gepotidacin (0.5 mg/L). Cefixime resistance reached 12% in both 2016 and 2017, dropped to zero by 2020 and increased again. In contrast, azithromycin resistance showed an increase from 1% (2015) to 16% (2023), with high-level resistance (≥256 mg/L) observed from 2019 onwards, and a 10-fold increase of borderline minimal inhibitory concentrations (MICs) (>0.5–1 mg/L) over the decade. Resistance to ciprofloxacin was high (50%–75%), whereas it was moderate for benzylpenicillin (8–19%). Penicillinase-producing strains accounted for 75% of resistant strains on average, increasing to 93% in 2024. Tetracycline resistance remained consistently high (~35%). Focusing on oropharyngeal strains, they did not show increased AMR in this study, but sample sizes were small ($n = 54$).

Evaluating co-infections with other sexually transmitted infection (STI) microbes, *C. trachomatis* was diagnosed in 14.2%, whereas *M. genitalium* and *T. vaginalis* co-infections were rarely observed (Table 1). The data provided lower rates of co-infections with *C. trachomatis* compared to other countries,[6] suggesting that presumptive co-treatment cannot

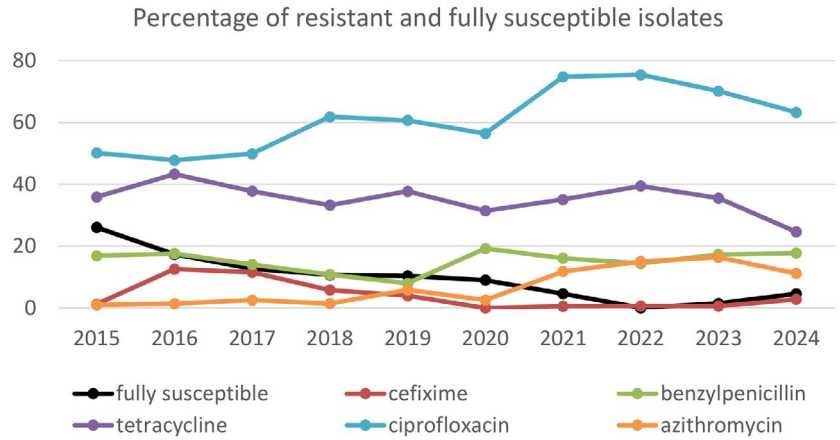

FIGURE 1 Antimicrobial resistant and fully susceptible *Neisseria gonorrhoeae* isolates from all locations (urogenital, oropharyngeal and anorectal) and both sexes according to EUCAST v14.0.

TABLE 1 Co-infections detected in *Neisseria gonorrhoeae* positive patients; *n*|%.

		Chlamydia trachomatis		Mycoplasma genitalium		Trichomonas vaginalis	
		N	%	*N*	%	*N*	%
2015	Total	58	14.1	n.a.		0	
	Men	47	13.0	n.a.		0	
	Women	11	22.0	n.a.		0	
2016	Total	56	13.9	n.a.		0	
	Men	46	12.5	n.a.		0	
	Women	10	27.7	n.a.		0	
2017	Total	48	13.5	n.a.		0	
	Men	37	11.9	n.a.		0	
	Women	11	24.4	n.a.		0	
2018	Total	40	11.7	n.a.		0	
	Men	35	11.0	n.a.		0	
	Women	5	18.5	n.a.		0	
2019	Total	61	16.2	7	1.9	0	
	Men	55	16.6	5	1.5	0	
	Women	6	13.3	2	4.4	0	
2020	Total	48	15.4	11	3.5	1	0.3
	Men	39	14.6	9	3.3	1	0.4
	Women	9	20.5	2	4.5	0	
2021	Total	44	12.4	10	2.8	2	0.6
	Men	39	12.8	8	2.6	2	0.7
	Women	5	11.4	2	4.5	0	
2022	Total	47	15.0	13	4.2	0	
	Men	32	12.6	13	5.1	0	
	Women	15	25.4	0		0	
2023	Total	53	15.8	13	3.8	0	
	Men	47	15.7	13	4.3	0	
	Women	6	16.2	0		0	
2024	Total	45	14.0	11	4	2	1.0
	Men	40	13.4	10	3.5	0	
	Women	5	13.2	1	2.6	2	5.2

Abbreviation: n.a., not available.

be recommended in Austria and may rather contribute to unnecessary antibiotic use and an increase of resistances.

Resistance patterns in Vienna reflect that ceftriaxone resistance remains rare. Cefixime and azithromycin resistance varied over time, assuming influence by prescription practices and the COVID-19 pandemic. In 2020, fewer resistant strains coincided with reduced travel and antibiotic use.[7] High ciprofloxacin and tetracycline resistances in Vienna suggest that fluoroquinolones and tetracyclines should not be chosen as treatment options without susceptibility testing. It also adds to the controversial discussion whether doxycycline post-exposure prophylaxis is suitable to prevent transmission of *N. gonorrhoeae*.[8,9] According to European guidelines (2024), which recommend ceftriaxone as first-line treatment, also in Austria this treatment schedule is the first treatment of choice, followed by cefixime and azithromycin as secondary options.

In summary, gonococcal resistance especially to azithromycin, ciprofloxacin and tetracycline increased in Vienna during the last 10 years, while it remained a rare occasion for ceftriaxone. The data support ceftriaxone as the treatment of choice and emphasize the need for continued performance of gonococcal culture and AMR testing. Considering the low co-infection rates with *C. trachomatis*, co-treatment of *C. trachomatis* cannot be recommended without a positive laboratory test result.

KEYWORDS

ceftriaxone, co-infections, drug resistance-bacterial, *Neisseria gonorrhoeae*

FUNDING INFORMATION

None.

CONFLICT OF INTEREST STATEMENT

None to declare.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

ETHICAL APPROVAL

This study was approved by the ethic commission of the medical University of Vienna; EK Nr: 1430/2022.

ETHICS STATEMENT

As this is a retrospective study, the patients in this manuscript were not obliged to give written informed consent to publication of their case details.

Ursula Fürnkranz[1]
Maria Haller[1]
Katharina Schwarz[1]
Tamara Gagic[1]
Magnus Unemo[2,3]
Angelika Stary[1]

[1]*Outpatients Centre for Diagnosis of Infectious Venereo-Dermatological Diseases, Pilzambulatorium Schlösselgasse, Vienna, Austria*
[2]*WHO Collaborating Centre for Gonorrhoea and Other STIs, Örebro University, Örebro, Sweden*
[3]*Institute for Global Health, University College London, London, UK*

Correspondence
Ursula Fürnkranz, Outpatients Centre for Diagnosis of Infectious Venereo-Dermatological Diseases, Schlösselgasse 19, 1080, Vienna, Austria.
Email: ursula.fuernkranz@pilzambulatorium.at

ORCID

Ursula Fürnkranz https://orcid.org/0000-0002-6730-5971

REFERENCES

1. European Centre for Disease Prevention and Control. Surveillance Atlas of Infectious Diseases. Available from: https://atlas.ecdc.europa.eu/public/index.aspx?Dataset=27&HealthTopic=21 [Accessed 24 October 2025].
2. Hilbrand G, Jäger K, Mayerhofer M, Morawec R, Remmel W, Skalnyk C, et al. Statistisches Jahrbuch der Stadt Wien. Magistrat der Stadt Wien (2024), MA 35 – Wirtschaft, Arbeit, Statistik. Available from: https://www.wien.gv.at/statistik/publikationen/jahrbuch.html. [Accessed 24 October 2025]
3. Jensen JS, Unemo M. Antimicrobial treatment and resistance in sexually transmitted bacterial infections. Nature Reviews. Microbiology. 2024;22(7):435–50. https://doi.org/10.1038/s41579-024-01023-3
4. de Block T, Laumen JGE, Van Dijck C, Abdellati S, De Baetselier I, Manoharan-Basil SS, et al. WGS of commensal Neisseria reveals acquisition of a new ribosomal protection protein (MsrD) as a possible explanation for high level azithromycin resistance in Belgium. Pathogens. 2021;23:10–384. https://doi.org/10.3390/pathogens10030384
5. EUCAST Clinical Breakpoint Tables v. 14.0, valid from 2024-01-01. Available from: https://www.eucast.org/eucast_news/news_singleview?tx_ttnews%5Btt_news%5D=566&cHash=db55f3a8829726044512a1fe74cce41b [Accessed 24 October 2025]
6. Creighton S, Tenant-Flowers M, Taylor CB, Miller R, Low N. Co-infection with gonorrhoea and chlamydia: how much is there and what does it mean? International Journal of STD & AIDS. 2003;14(2):109–13. https://doi.org/10.1258/095646203321156872
7. Craggs J, Anderson R. Antibiotic Research UK. Available from: https://www.antibioticresearch.org.uk/wp-content/uploads/2021/11/Antibiotic-prescribing-falls-in-England-press-release-FINAL.pdf. [Accessed 24 October 2025]
8. Unemo M, Cole MJ, Kodmon C, Day M, Jacobsson S, European Gonococcal Tetracycline-Resistance Study Group. High tetracycline resistance percentages in *Neisseria gonorrhoeae* in Europe: is doxycycline post-exposure prophylaxis unlikely to reduce the incident gonorrhoea cases? Lancet Reg Health Eur. 2024;13:100871. https://doi.org/10.1016/j.lanepe.2024.100871
9. Stratman S, Zampella JG. Rewiev of doxycycline for prophylaxis of sexually transmitted infections. Journal of the European Academy of Dermatology and Venereology. 2024;39:1068–9. https://doi.org/10.1111/jdv.20387