

SURVEILLANCE

Gonococcal antimicrobial susceptibility surveillance in the European Union/European Economic Area

Summary of results for 2023

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This report was commissioned by the European Centre for Disease Prevention and Control (ECDC), coordinated by Csaba Ködmön, and produced by UK Health Security Agency, London, United Kingdom and Örebro University Hospital, Örebro, Sweden.

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Abbreviations

AMR	Antimicrobial resistance
CI	Confidence interval
Doxy-PEP	Doxycycline post-exposure prophylaxis
ECDC	European Centre for Disease Prevention and Control
ECOFF	Epidemiological cut-off value
EEA	European Economic Area
EQA	External quality assessment
EU	European Union
EUCAST	European Committee on Antimicrobial Susceptibility Testing
Euro-GASP	European Gonococcal Antimicrobial Surveillance Programme
HIV	Human immunodeficiency virus
HL-AziR	High-level azithromycin resistance (MIC $\geq$ 256 mg/L)
MDR	Multidrug-resistant
MGS	MIC gradient strip test
MIC	Minimum inhibitory concentration
OR	Odds ratio
STI	Sexually transmitted infection
TESSy	The European Surveillance System
UK	United Kingdom
UKHSA	UK Health Security Agency
WGS	Whole-genome sequencing
WHO	World Health Organization
XDR	Extensively drug-resistant
ÖUH	Örebro University Hospital

Executive summary

The surveillance of *Neisseria gonorrhoeae* antimicrobial susceptibility in the European Union/European Economic Area (EU/EEA) is essential for detecting emerging and increasing antimicrobial resistance as the quality-assured data produced can be used to inform treatment guidelines. Since 2009, this surveillance has been co-ordinated by the European Centre for Disease Prevention and Control (ECDC).

During 2023, as in previous years, the European Gonococcal Antimicrobial Surveillance Programme (Euro-GASP) followed an annual decentralised and centralised testing model, requesting participating laboratories to collect gonococcal isolates during September–November 2023. Susceptibility testing was performed on all isolates (MIC gradient strip test, mostly Etest) for the following antimicrobials (where available): ceftriaxone, cefixime, azithromycin, and ciprofloxacin, as well as testing for β -lactamase production for detection of high-level penicillin resistance. Tetracycline was also tested in 2023 to monitor the impact of doxycycline post-exposure prophylaxis (doxy-PEP) in the EU/EEA. Decentralised testing took place on the premise of participating laboratories fulfilling set quality criteria.

In 2023, 24 EU/EEA Member States participated in Euro-GASP, 19 via decentralised testing. In total, 5 269 isolates were submitted to the European Surveillance System (TESSy), 3 184 of which were analysed for this report. The majority of specimens were from male patients (82.6%), and patient age ranged from under one year to 82 years (median age of 30 years). Overall, 29.6% of patients were under 25 years, and males were significantly older than females (median ages of 30 and 25 years, respectively). The anatomical site of specimen collection was mainly genital (73.6%), followed by rectal (14.9%) and pharyngeal (9.3%). In 2023, data were also captured on eye (0.7%), blood (0.2%), joint fluid (0.1%), and cerebrospinal fluid (0.03%) samples. Among patients with known route of transmission and where data on sex was available (59.3%), 53.4% were female or heterosexual males, and 46.6% were men who have sex with men. Where there was information on previous diagnosis of gonorrhoea (24.7%) among cases, 33.3% had previously been diagnosed with the infection. Among patients with a known HIV status (31.2%), 9.7% were living with HIV. Among patients where there was a known route of transmission, 97.6% were men who have sex with men. In terms of the probable country of infection, 7.6% of cases where this information was available (34.2%) were likely acquired outside the reporting country.

In 2023, one isolate with resistance to ceftriaxone (MIC=0.25 mg/L) was detected in France. The isolate was extensively-drug resistant with an azithromycin MIC $\geq$ 256 mg/L and was also resistant to cefixime (MIC=1 mg/L), ciprofloxacin (MIC=4 mg/L), and tetracycline (MIC=32 mg/L). The percentage of cefixime-resistant (MIC >0.125 mg/L) isolates detected in 2023 (0.2%) was comparable to that observed in 2022, and resistant isolates were reported by five countries. The percentage of isolates with azithromycin MICs above the epidemiological cut-off (ECOFF, MIC >1 mg/L) gradually increased from 7.6% in 2018 to 25.6% in 2022 but decreased to 23.2% in 2023. Isolates with an azithromycin MIC above the ECOFF were reported in all but two participating countries. Additionally, the proportion of isolates with high-level azithromycin 'resistance' (HL-AziR, MIC $\geq$ 256 mg/L) was greater in 2023: 39 (1.2%) HL-AziR isolates were detected in 15 countries in 2023, compared to 13 (0.3%) HL-AziR isolates reported by five countries in 2022. The percentage of ciprofloxacin-resistant isolates increased from 46.5% in 2017 to 65.9% in 2022, but decreased to 63.0% in 2023. Resistance to tetracycline was 58.4% in 2023.

Dual ceftriaxone and azithromycin resistance remains rare in the EU/EEA, but the proportion of isolates above the azithromycin ECOFF, as well as ongoing sporadic reports of ceftriaxone resistance, is concerning. Therefore, the European gonorrhoea treatment guideline recommends high-dose ceftriaxone plus azithromycin dual therapy or ceftriaxone high-dose monotherapy, which is now most frequently used, as shown in this report. Resistance to cefixime has decreased significantly over the past decade; however, cefixime resistance still needs to be monitored closely, particularly as gonococcal strains resistant to both cefixime and ceftriaxone continue to spread globally. The high level of tetracycline resistance suggests that doxy-PEP is unlikely to reduce the incidence of gonorrhoea across the EU/EEA. Ongoing quality-assured antimicrobial susceptibility surveillance activities, alongside the development of alternative gonococcal treatment regimens are essential to ensure gonorrhoea remains a treatable infection.

1 Introduction

1.1 Background

The emergence and spread of antimicrobial resistance (AMR) in *Neisseria gonorrhoeae* is a serious threat to the treatment and control of gonorrhoea. The extended-spectrum cephalosporin ceftriaxone is the last remaining option for effective empiric first-line antimicrobial monotherapy and is the main therapeutic agent currently recommended in Europe [1–7]. The 2020 European gonorrhoea treatment guideline recommend combination treatment with high-dose ceftriaxone (1g) plus azithromycin (2g) or high-dose ceftriaxone (1g) monotherapy but only in well controlled settings (see guideline for details [2]). Surveillance of the susceptibility to these agents is essential to ensure effective patient management and monitor current and emerging trends in AMR [2–7].

ECDC has co-ordinated epidemiological and microbiological surveillance activities for sexually transmitted infections (STIs) in Europe since 2009. The microbiological components mainly focusing on the European Gonococcal Antimicrobial Surveillance Programme (Euro-GASP) have been outsourced and are supported by an international network led by Örebro University Hospital (ÖUH) (Sweden) and the UK Health Security Agency (UKHSA) (United Kingdom). Activities have included:

- centralised and decentralised *N. gonorrhoeae* isolate collection and antimicrobial susceptibility testing;
- Establishment of the European Surveillance System (TESSy) reporting for Euro-GASP surveillance data;
- external quality assessment (EQA) schemes;
- molecular typing of *N. gonorrhoeae* (whole-genome sequencing (WGS) since 2013);
- laboratory capacity assessment across the European Union/European Economic Area (EU/EEA);
- training on STI diagnostic and typing methods.

1.2 Objectives

The overall aim of Euro-GASP is to strengthen the surveillance of gonococcal antimicrobial susceptibility in EU/EEA countries to provide quality-assured data to inform gonorrhoea treatment guidelines. The objectives are as follows:

- Monitoring the susceptibility of *N. gonorrhoeae* isolates in participating countries by conducting surveillance for antimicrobial resistance in gonococci.
- Support participating countries in developing technical skills and capacity for high quality antimicrobial susceptibility testing and molecular typing including WGS.
- Support participating countries in improving the quality of epidemiological data reported through Euro-GASP.
- Assess the accuracy of quantitative *N. gonorrhoeae* antimicrobial susceptibility testing reported by participating laboratories and the comparability of results between laboratories through an EQA scheme, to identify needs for targeted capacity building.
- Perform analysis of WGS data of *N. gonorrhoeae* strains to better understand the geographical and temporal distribution patterns of public health relevant strains of *N. gonorrhoeae* in the EU/EEA, including associations between genotype, antimicrobial resistance and patient characteristics.
- Assess the quality of *N. gonorrhoeae* molecular typing data generated by participating laboratories through an EQA scheme and a bioinformatic ring trial, and the comparability of results between laboratories to identify needs for targeted capacity building.
- Provide training on STI laboratory diagnostics, *N. gonorrhoeae* susceptibility testing and molecular typing including WGS.

This report presents the results from the 2023 gonococcal antimicrobial susceptibility sentinel surveillance.

2 Methods

2.1 Participating laboratories and isolate collection

Euro-GASP member laboratories from 30 EU/EEA countries were invited to collect *N. gonorrhoeae* isolates from consecutive patients. The official collection window was from September to November 2023, but countries could extend the collection window if necessary to attempt to reach the isolate target. Countries were asked to test up to 100 isolates each. For countries where 100 isolates represented less than 10% of the total number of cases, up to 200 isolates were tested (Austria, Belgium, Czechia, Denmark, France, Germany, Hungary, Ireland, Italy, the Netherlands, Norway, Portugal, Spain, and Sweden). Countries were restricted to the target number of isolates to ensure that the dataset was representative of the EU/EEA. Isolates from each country were ordered chronologically from September to December, and in reverse chronological order from August to January. They were included in order until the applicable per-country maximum was reached.

Euro-GASP collection criteria and methodology remained the same as in previous years [8,9]. Isolates from five (20.8%) countries were tested centrally at ÖUH, Sweden, while the remaining 19 (79.2%) countries performed antimicrobial susceptibility testing in their own laboratories. All Euro-GASP laboratories are invited to participate in an annual EQA programme [10,11] to ensure comparability of data. Countries that perform decentralised testing have fulfilled established quality criteria prior to commencing their own testing.

2.2 Antimicrobial susceptibility testing

Antimicrobial susceptibility testing was performed using MIC gradient strip tests (MGS; mainly Etest) for ceftriaxone, cefixime, azithromycin, ciprofloxacin, and tetracycline. Tetracycline susceptibility testing was added in 2023 after the introduction of doxycycline post-exposure prophylaxis (doxy-PEP) [12-14] in the EU/EEA. Production of penicillinase resulting in high-level penicillin resistance was tested using nitrocefin, as previously described [8,9]. The results were interpreted using current breakpoints from the European Committee on Antimicrobial Susceptibility Testing (EUCAST): cefixime/ceftriaxone resistance, MIC >0.125 mg/L; azithromycin epidemiological cut-off value (ECOFF), MIC >1 mg/L; ciprofloxacin resistance, MIC >0.06 mg/L; and tetracycline resistance, MIC >0.5 mg/L [15]. Gentamicin and spectinomycin were removed from the routine antimicrobial panel in 2014 as these antimicrobials are not in routine use. These are only tested in 'snapshot' studies every three years, with 2022 being the most recent 'snapshot' study year.

2.3 Data collection and analysis

The following data were collected for each isolate, where available: specimen site, gender, age, route of transmission, previous gonorrhoea diagnosis, HIV status, country of birth, probable country of infection and treatment used. All antimicrobial susceptibility and epidemiological data were uploaded to TESSy by Member States and then approved.

To evaluate the reporting completeness of epidemiological data for each country, the number of nil responses and unknowns entered for each variable were subtracted from the total number of isolates received, and this number was used to calculate a percentage completeness value (number of responses/total isolates received x 100). An overall response rate for each country was then calculated by taking the average of the percentage completeness for all nine epidemiological fields.

2.4 Statistical analysis

Statistical analysis was performed using Stata v17.0. The Z-test was used to determine the difference between epidemiological and AMR data collected in 2023 versus 2022, and a Mann-Whitney test was used to test whether the differences in age distribution were statistically significant. Where datasets contained sufficient numbers, the odds ratios (OR) and 95% confidence intervals (CI) were calculated and Pearson's χ^2 test was used to measure if these ORs differed significantly from one. For small cell numbers, Fisher's exact test was performed. Using a forward step-wise approach, the most significant and strongest associations from the univariate analysis were added to a multivariable logistic regression model sequentially. Statistical significance for all tests was assumed when $p < 0.05$. No trend results are presented for tetracycline given that collection of tetracycline started for cases notified in 2023, and no EU/EEA level data are available for earlier years.

In the maps, the 5% threshold for antimicrobial resistance in *Neisseria gonorrhoeae* was used according to the benchmark set by the World Health Organization (WHO) to guide treatment decisions.

3 Results

In 2023, 5 269 gonococcal isolates were submitted to TESSy by 24 EU/EEA countries. This represents an increase of 873 isolates (19.9%) compared to 2022, with countries submitting between one and 1 499 isolates each. In 2022, all submitted isolates were included in the annual report. In 2023, ten countries exceeded their target number of isolates, accounting for 69.9% of all submitted isolates. Therefore, the dataset was trimmed to ensure compliance with Euro-GASP reporting protocol. Overall, 2 085 isolates from ten countries were excluded, ranging from one to 1 299 isolates per country.

The target total number of isolates for the 30 EU/EEA countries is 4 400. The trimmed dataset included 3 184 isolates from 24/30 EU/EEA countries, equating to 83.8% of the target of 3 800 isolates for participating countries. Croatia, Latvia, Liechtenstein, Lithuania, Luxembourg, and Romania did not participate with 2023 data, as in 2022. Cyprus participated in 2023, after not participating in 2022. The number of isolates included per country ranged from one to 200. Overall, 2 507 (78.7%) isolates were collected during the official collection period (September to November). Nine countries collected isolates only during the official collection period, while the remaining 15 extended beyond this window to attempt to reach the target number of isolates.

3.1 Epidemiological data

The overall completeness of all epidemiological data was 55.7%, which represented an improvement compared to the decline in completeness observed between 2018 (62.1%) and 2022 (53.3%). As in 2022, completeness was highest for sex (99.6%) and lowest for previous gonorrhoea diagnosis (24.7%). The completeness of the following variables increased significantly relative to 2022: route of transmission (50.4%, $p < 0.001$); country of birth (40.9%, $p = 0.004$); probable country of infection (34.2%, $p < 0.001$); and previous gonorrhoea diagnosis (24.7%, $p < 0.001$). No significant changes were observed among the remaining variables. Full details on the completeness of epidemiological variables are available in Annex 1.

As in previous years, the majority (82.6%) of isolates collected in 2023 were from males and the proportion of isolates from this group increased from 80.9% in 2022 ($p = 0.048$) (Table 1). Conversely, the proportion of isolates from females decreased between 2022 (19.1%) and 2023 (17.4%) (Table 1). The majority of cases (70.4%) were among patients ≥ 25 years old, which was consistent with previous years (Table 1). Data on sex and route of transmission were available for 59.3% ($n = 1\,889$) of cases (Table 1; Annex 1). Among these cases, 46.6% of the isolates were from men who have sex with men, which was comparable to the proportion observed in 2022 (46.0%, $p = 0.694$); however, the percentage of isolates from heterosexual males increased from 20.0% in 2022 to 24.3% in 2023 ($p < 0.001$) (Table 1). Conversely, the percentage of isolates from females decreased between 2022 (34.4%) and 2023 (29.1%, $p < 0.001$). The predominant site of infection was genital, as in previous years, but the proportion increased from 69.0% in 2022 to 73.6% in 2023 ($p < 0.001$) (Table 1). The proportion of isolates from 'other' specimens also increased from 1.2% in 2022 to 2.1% in 2023 ($p = 0.003$), including eye, blood, joint fluid, and cerebrospinal fluid samples (Table 1). In comparison, there were corresponding decreases in the proportion of anorectal (17.8% to 14.9%, $p = 0.001$) and pharyngeal specimens (12.0% to 9.3%, $p < 0.001$). Information on previous gonorrhoea diagnosis was available for 24.7% ($n = 787$) of cases (Annex 1). Among patients with information on previous gonorrhoea diagnosis, 33.3% had had a previous infection, which was an increase relative to 2022 (27.8%, $p = 0.015$) and preceding years (Table 1). Among 995 cases (31.2%) with a known HIV status (Annex 1), 9.7% were living with HIV in 2023, which was not significantly different to 2022 (8.8%, $p = 0.419$). Of those patients living with HIV who had a known transmission type ($n = 82$), in 2023, 97.6% were men who have sex with men. The probable country of infection was available for 1 088 cases (34.2%) from 14 different countries (Annex 1); overall, only 7.6% of these cases were likely acquired outside the reporting country, which was comparable to 2022 ($p = 0.362$) (Table 1).

Table 1. Patient characteristics reported for Euro-GASP gonococcal isolates, 2014–2023

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Total number of isolates	2 151	2 134	2 660	3 248	3 299	4 166	3 291	3 541	4 396	3 184
Sex										
Male	1 821 (85.1)	1 736 (81.8)	2 256 (85.1) ^a	2 737 (84.5)	2 795 (85.3)	3 389 (83.0)	2 762 (84.4)	3 023 (86.1)	3 534 (80.9)	2 614 (82.6)
Female	318 (14.9)	385 (18.2)	395 (14.9)	502 (15.5)	483 (14.7)	695 (17.0)	509 (15.6)	488 (13.9)	837 (19.1)	549 (17.4)
Unknown	11	13	9	9	21	82	20	30	25	21
Age (years)										
<25	605 (28.7)	617 (29.5)	720 (27.5)	898 (28.2)	925 (28.4)	1 133 (28.4)	844 (25.8)	814 (23.2)	1 244 (28.4)	938 (29.6)
≥25	1 501 (71.3)	1 476 (70.5)	1 902 (72.5)	2 283 (71.8)	2 332 (71.6)	2 853 (71.6)	2 428 (74.2)	2 690 (76.8)	3 130 (71.6)	2 228 (70.4)
Unknown	44	41	38	67	42	180	19	37	22	18
Route of transmission and sex										
Females	318 (22.7)	385 (26.4)	395 (22.9)	502 (22.6)	483 (21.3)	695 (29.5)	509 (28.1)	488 (23.5)	837 (34.0)	549 (29.1)
Heterosexual males	485 (34.7)	419 (28.7)	632 (36.7)	663 (29.9)	595 (26.3)	588 (24.9)	455 (25.1)	519 (25.0)	491 (20.0)	459 (24.3)
Men who have sex with men	594 (42.5)	657 (45.0)	696 (40.4) ^a	1 055 (47.5) ^b	1 186 (52.4)	1 074 (45.6)	847 (46.8) ^c	1 069 (51.5)	1 133 (46.0)	881 (46.6)
Unknown	754	673	937	1 028	1 035	1 809	1 480	1 465	1 935	1 295
Site of infection										
Genital	1 549 (76.3)	1 517 (72.9)	1943 (75.5)	2 166 (72.8)	2 155 (70.4)	2 578 (68.1)	2 175 (71.6)	2 296 (69.9)	2 894 (69.0)	2 224 (73.6)
Pharyngeal	154 (7.6)	180 (8.7)	165 (6.4)	254 (8.5)	259 (8.5)	368 (9.7)	182 (6.0)	304 (9.2)	503 (12.0)	282 (9.3)
Anorectal	192 (9.5)	280 (13.5)	366 (14.2)	435 (14.6)	570 (18.6)	743 (19.6)	608 (20.0)	642 (19.5)	747 (17.8)	451 (14.9)
Other	135 (6.6)	103 (5.0)	100 (3.9)	120 (4)	77 (2.5)	97 (2.6) ^d	72 (2.4) ^e	45 (1.4) ^f	52 (1.2) ^g	64 (2.1) ^h
Unknown	121	54	86	273	238	380	254	254	200	163
Previous gonorrhoea										
Yes	163 (19.7)	157 (17.5)	171 (17.2)	235 (21.8)	264 (26.9)	251 (24.7)	140 (23.6)	176 (24.0)	242 (27.8)	262 (33.3)
No	663 (80.3)	739 (82.5)	824 (82.8)	845 (78.2)	718 (73.1)	767 (75.3)	452 (76.4)	558 (76.0)	629 (72.2)	525 (66.7)
Unknown	1 325	1 238	1 665	2 168	2 317	3 148	2 699	2 807	3 525	2 397
HIV status										
Positive	172 (19.3)	132 (15.3)	156 (15.9)	188 (15.4)	224 (15.7)	179 (14.1)	124 (12.3)	133 (10.8)	126 (8.8)	97 (9.7)
Negative	720 (80.7)	733 (84.7)	823 (84.1)	1 029 (84.6)	1 204 (84.3)	1 088 (85.9)	887 (87.7)	1 099 (89.2)	1 308 (91.2)	898 (90.3)
Unknown	1 259	1 269	1 681	2 031	1 871	2 899	2 280	2 309	2 962	2 189
Probable country of infection										
Same as reporting country	552 (94.0)	800 (92.2)	614 (87.0)	795 (88.6)	1 155 (87.6)	1 167 (89.8)	1 089 (94.7)	1 169 (94.0)	1 015 (93.4)	1 005 (92.4)
Different from reporting country	35 (6.0)	68 (7.8)	92 (13.0)	102 (11.4)	163 (12.4)	133 (10.2)	61 (5.3)	75 (6.0)	72 (6.6)	83 (7.6)
Unknown	1 564	1 266	1 954	2 351	1 981	2 866	2 141	2297	3 309	2 096

Percentages calculated from known values. Cells shaded blue indicate a significant difference compared to 2022 ($p < 0.05$).

^a Includes one individual with route of transmission reported as MSM, but with gender reported as unknown.

^b Includes two individuals with route of transmission reported as MSM, but with gender reported as unknown.

^c Includes one individual with route of transmission reported as MSM, but with gender reported as other.

^d Includes 3 eye, 1 blood and 4 joint fluid samples – included in other site for analysis due to low numbers.

^e Includes 8 eye and 3 joint fluid samples.

^f Includes 8 eye, 1 blood and 4 joint fluid samples.

^g Includes 25 eye, 4 blood and 4 joint fluid samples.

^h Includes 21 eye, 5 blood, 4 joint fluid, and 1 cerebrospinal fluid samples.

Patient ages ranged from <1 year to 82 years, with a median age of 30 years (Table 2). Males (median age 30 years) were significantly older than females (median age 25 years) (Mann Whitney, $p < 0.001$).

Table 2. Patient age distribution by sex and route of transmission, 2023[#]

Variable	N†	Age (years)		<25 years (N (%))
		Range	Median	
All patients	3 166	0-82	30	938 (29.6)
Females	547	3-82	25	268 (49.0)
Males*	2 605	0-82	30	663 (25.5)
Heterosexual males	458	15-75	30	135 (29.5)
Men who have sex with men	878	17-72	31	164 (18.7)

[#]Cases with missing information on sex or age are not included in this table.

†Where information was available.

*Including all males, irrespective of route of transmission.

3.2 Antimicrobial susceptibility and resistance

Resistance to cefixime, ciprofloxacin and azithromycin (using breakpoints from EUCAST for cefixime and ciprofloxacin and ECOFF for azithromycin) over time is summarised in Figure 1 and Table 3.

Figure 1. Percentage of resistant *Neisseria gonorrhoeae* by antimicrobial and year, Euro-GASP, 2014–2023

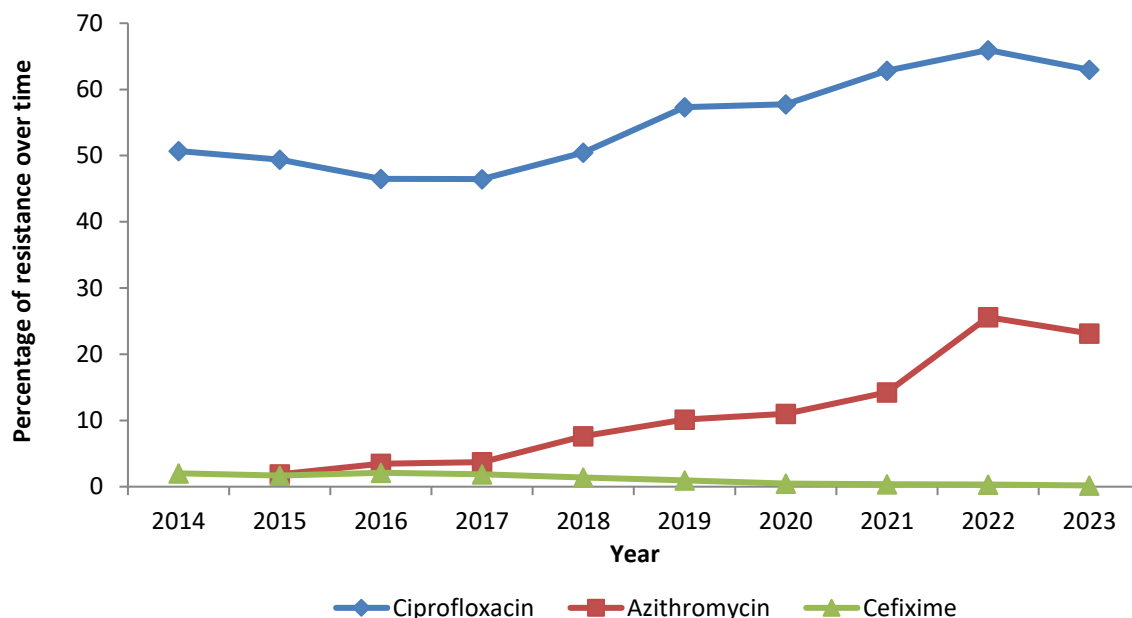


Table 3. Resistance to cefixime, ciprofloxacin and azithromycin (using resistance breakpoints from EUCAST for cefixime and ciprofloxacin and ECOFF for azithromycin) by country, Euro-GASP, 2023

Country	Number of isolates 2023	Number of isolates 2009–2023	Cefixime resistance			Azithromycin resistance			Ciprofloxacin resistance			Method of testing
			No.	%	% 2014–2023	No.	%	% 2015–2023	No.	%	% 2014–2023	
Austria	200		0	0.0		37	18.6		138	69.0		Decentralised
Belgium	197		1	0.5		88	44.7		135	68.5		Decentralised
Bulgaria	23		0	0.0		3	13.0		17	73.9		Centralised
Cyprus	1		0	0.0		0	0.0		1	100.0		Decentralised
Czechia	87		0	0.0		15	17.2		62	71.3		Centralised
Denmark	200		0	0.0		10	5.0		93	46.5		Decentralised
Estonia	5		0	0.0		0	0.0		3	60.0		Decentralised
Finland	100		0	0.0		4	4.0		47	47.0		Decentralised
France	200		1	0.5		13	6.5		142	71.0		Decentralised
Germany	200		0	0.0		45	22.5		142	71.0		Decentralised
Greece	100		0	0.0		29	29.0		59	59.0		Decentralised
Hungary	196		2	1.0		27	13.8		125	63.8		Centralised
Iceland	100		1	1.0		53	53.0		69	69.0		Decentralised
Ireland	200		0	0.0		83	41.5		103	51.5		Decentralised
Italy	100		0	0.0		22	22.0		79	79.0		Decentralised
Malta	45		0	0.0		15	33.3		22	48.9		Decentralised
Netherlands	200		0	0.0		87	43.5		126	63.0		Decentralised
Norway	200		0	0.0		40	20.0		82	41.0		Decentralised
Poland	30		0	0.0		5	16.7		23	76.7		Centralised
Portugal	200		0	0.0		65	32.5		136	68.0		Decentralised
Slovakia	100		0	0.0		14	14.0		65	65.0		Centralised
Slovenia	100		0	0.0		16	16.0		83	83.0		Decentralised
Spain	200		0	0.0		10	5.0		139	69.5		Decentralised
Sweden	200		1	0.5		56	28.0		114	57.0		Decentralised
Total:	3184											
Cefixime	3184		6	0.2								
Azithromycin	3183					737	23.2					
Ciprofloxacin	3184								2005	63.0		
95% CI				0.1–0.4			21.7–24.7			61.3–64.6		

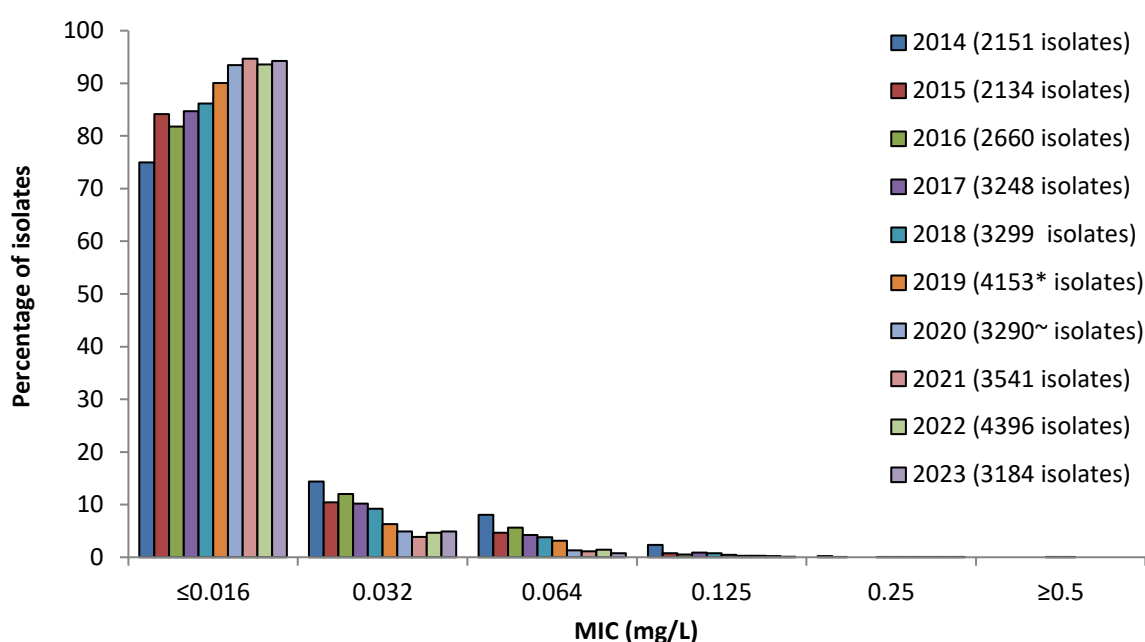
Croatia, Latvia, Liechtenstein, Lithuania, Luxembourg, and Romania did not report data in 2023. Proportion with azithromycin MICs above ECOFF displayed from 2015 to 2023 due to earlier use of breakpoint plates.

3.2.1 Ceftriaxone

In 2023, one isolate from the trimmed dataset displayed ceftriaxone resistance in comparison with two isolates in 2022, one each in 2021 and 2020, three each in 2019 and 2018, and zero in both 2017 and 2016 (Figure 2). The ceftriaxone resistant isolate (MIC=0.25 mg/L) was detected in France and was a genital isolate from a heterosexual male in his 60s. The isolate exhibited high-level azithromycin 'resistance' (HL-AziR, MIC ≥ 256 mg/L) and was also resistant to cefixime (MIC=1 mg/L), ciprofloxacin (MIC=4 mg/L), and tetracycline (MIC=32 mg/L). Three additional ceftriaxone-resistant isolates (MIC=0.25 mg/L (n=1) and MIC=0.5 mg/L (n=2)) were submitted to TESSy in 2023 but were not part of the trimmed dataset. All three isolates were detected in Norway and were genital isolates recovered from three male patients with unknown route of transmission aged 30–45 years. All three isolates were also resistant to cefixime and ciprofloxacin, and two were resistant to tetracycline.

The MIC distribution for ceftriaxone has been stable since 2020 (Figure 2). The proportion of highly susceptible isolates (MIC ≤ 0.016 mg/L) remained stable relative from 2020 to 2022 ($p=0.255$), as did the proportion of isolates with an MIC of 0.032 mg/L ($p=0.714$) (Figure 2). In contrast, the proportion of isolates with an MIC of 0.064 mg/L decreased between 2022 and 2023 (1.5% to 0.8%, $p=0.008$).

Figure 2. Distribution of MIC for ceftriaxone in Euro-GASP, 2014–2023

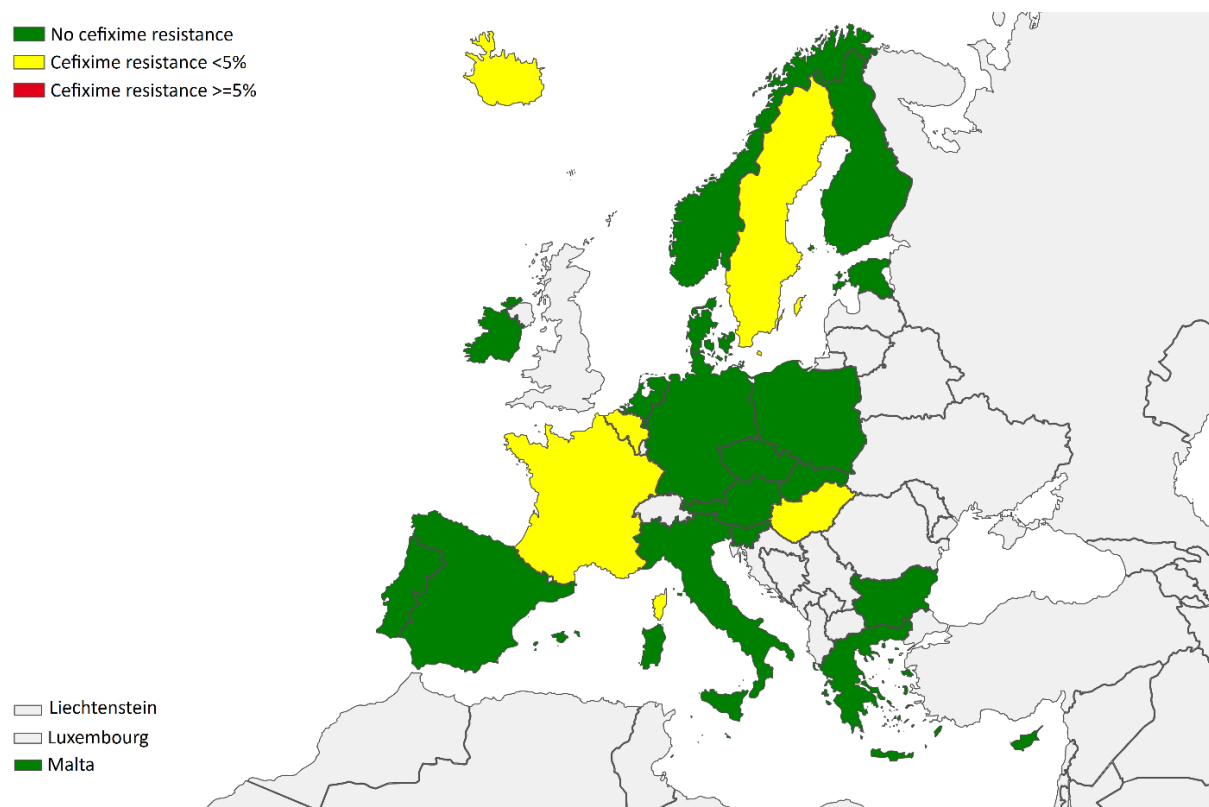


*Note: * 4 166 isolates were tested in 2019; 13 isolates were reported with an MIC of ≤ 0.125 mg/L and were excluded from the MIC distribution analysis as they did not fit into one discrete MIC category.*

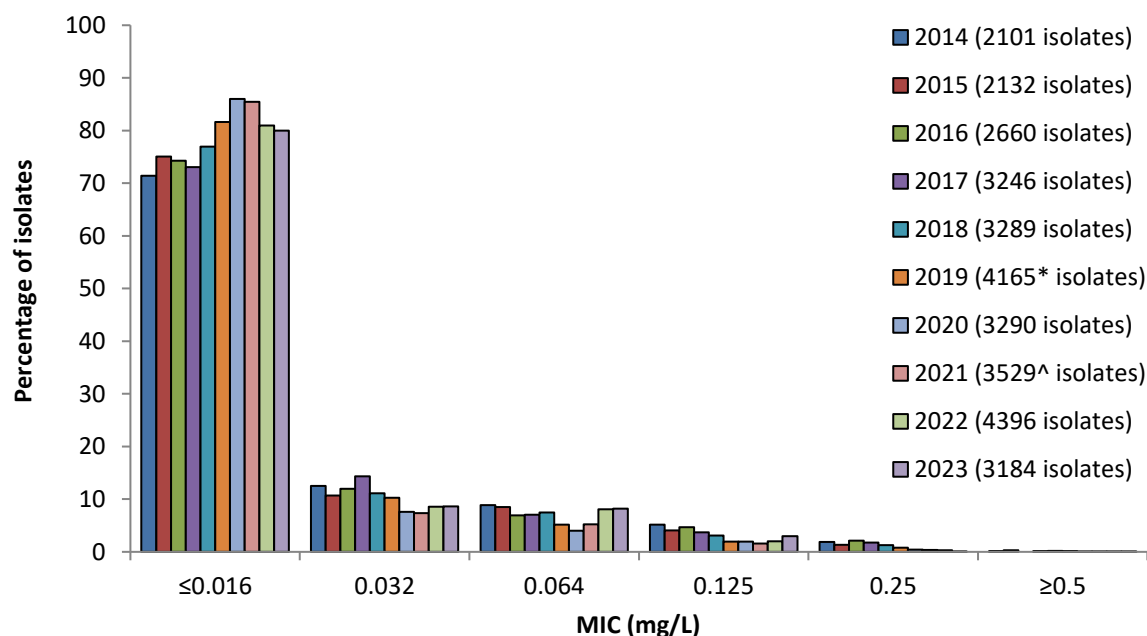
~ 3 291 isolates were tested in 2020; one had an MIC ≤ 0.032 mg/L and was excluded from the MIC distribution analysis as it did not fit into one discrete MIC category.

3.2.2 Cefixime

A total of six isolates (0.2%) from five countries were resistant to cefixime in 2023, and this level of resistance has been stable since 2020 (Figures 1 and 3, Table 3). Percentages of cefixime-resistant isolates are visualised by country in Figure 3. The cefixime MIC distribution was stable relative to 2022 (Figure 4), except for a small but significant increase in the proportion of isolates with an MIC of 0.125 mg/L (2.0% to 3.0%, $p=0.006$).

Figure 3. Proportion of gonococcal isolates with cefixime resistance by country, EU/EEA, 2023*

* Cyprus and Estonia reported fewer than 20 isolates each in 2023.

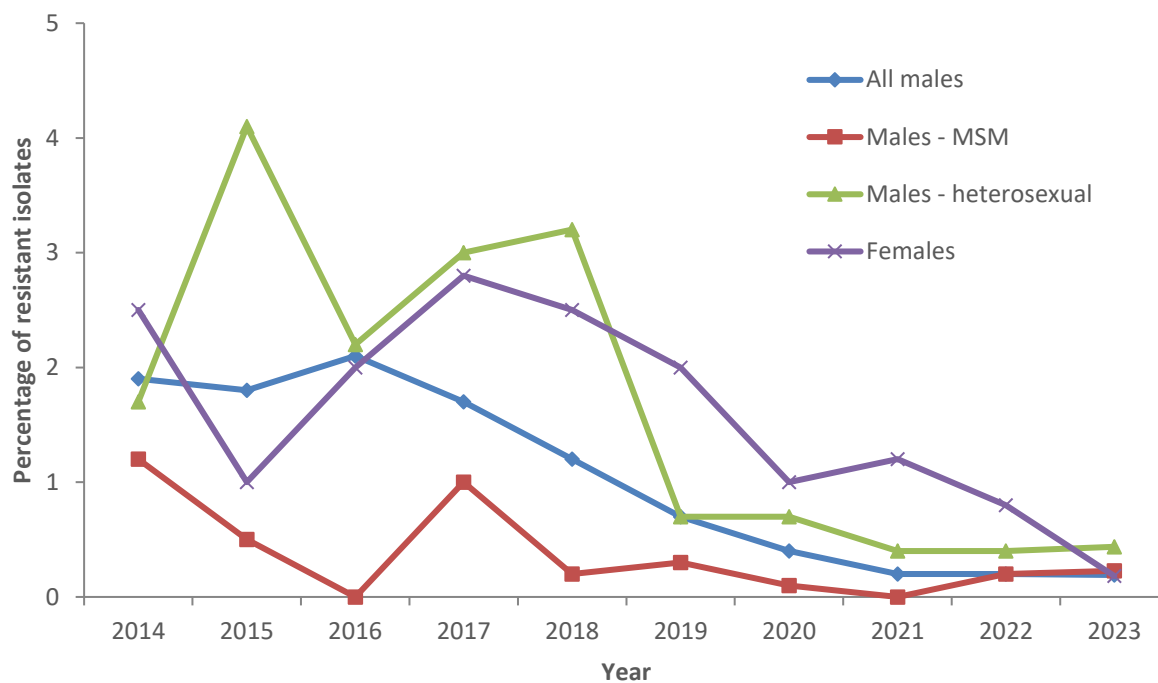
Figure 4. Distribution of MIC for cefixime in Euro-GASP, 2014–2023

Note: * 4 166 isolates were tested in 2019; 1 isolate was reported with an MIC of ≤0.125 MIC and was excluded from the MIC distribution analysis as it did not fit into one discrete MIC category.

~ 3 531 isolates were tested in 2021; 2 isolates had an MIC of ≤0.023 mg/L and were excluded from the MIC distribution analysis as they did not fit into one discrete MIC category.

Cefixime resistance in isolates from male patients was stable in 2023 compared to 2022 (0.2% in both years, $p=0.939$) (Figure 5). Between 2022 and 2023, changes in resistance in females, men who have sex with men and heterosexual males could not be assessed for statistical significance due to the small numbers of resistant isolates. No significant associations were identified in the univariate analyses in 2023 (Annex 2). This marks a change from recent years when cefixime resistance was significantly higher in isolates from females compared to those from men who have sex with men and heterosexual males.

Figure 5. Percentage of isolates with cefixime resistance by sex and route of transmission among males, Euro-GASP, 2014–2023

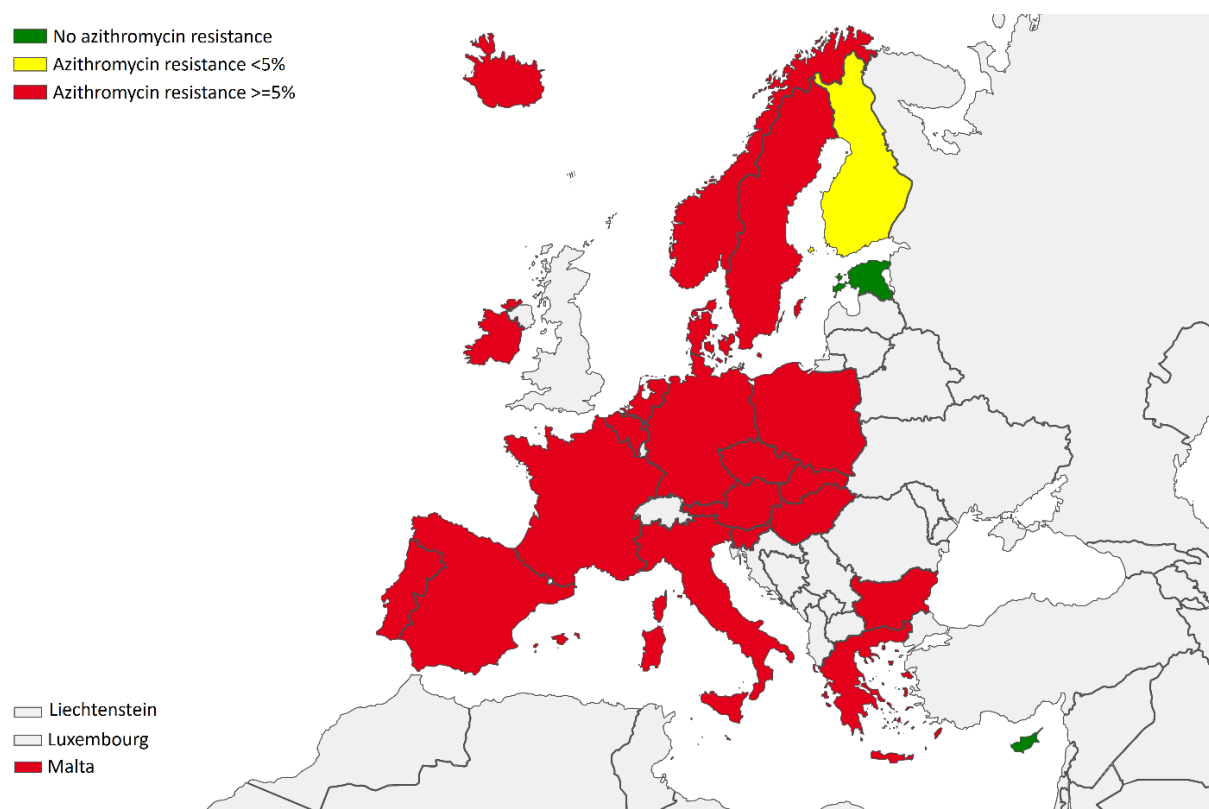


3.2.3 Azithromycin

In 2023, 737 isolates (23.2%) had an azithromycin MIC above the ECOFF (MIC >1 mg/L), which was a significant decrease relative to 2022 (25.6%, $p=0.015$) (Figure 1; Table 3). Isolates with an azithromycin MIC above the ECOFF were detected in 22/24 countries in 2023, as visualised in Map 2.

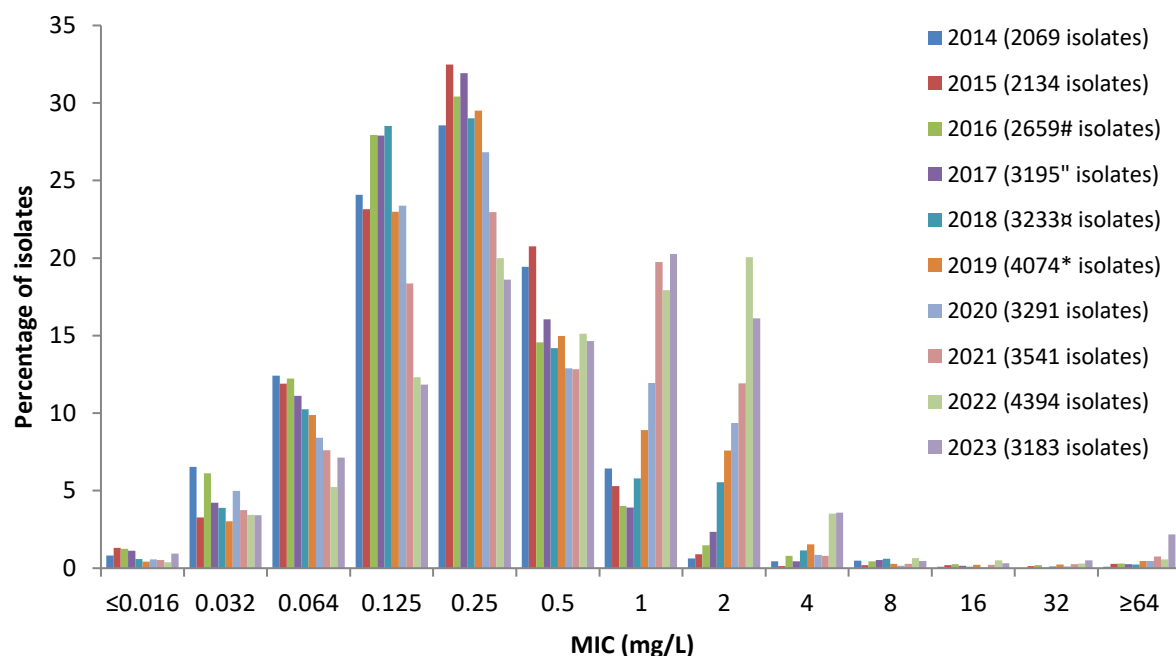
Trends in the azithromycin MIC distribution were largely consistent between 2020 and 2022, but these patterns were disrupted across several MIC categories in 2023 (Figure 7). Within the more 'susceptible' population, the proportion of isolates with MICs of 0.064 mg/L, 0.125 mg/L, and 0.25 mg/L had steadily decreased between 2020 and 2022; however, the proportion of isolates with an MIC of 0.064 mg/L increased between 2022 and 2023 (5.2% to 7.1%, $p < 0.001$), as did the proportion of isolates with an MIC of ≤ 0.016 mg/L (0.4% to 0.9%, $p=0.002$). With respect to the population with an MIC greater than or equal to the ECOFF, the proportion of isolates with an MIC of 2 mg/L had steadily increased between 2020 and 2022, but there was a significant decrease in 2023 (20.1% in 2022 to 16.1% in 2023, $p < 0.001$). Conversely, the proportion of isolates with an MIC of 1 mg/L increased between 2022 and 2023 (17.9% to 20.3%, $p=0.011$). There was also a significant increase in the proportion of isolates with an MIC of ≥ 64 mg/L (0.6% in 2022 to 2.2% in 2023, $p < 0.001$). Thirty-nine (1.2%) isolates showed HL-AziR (MIC ≥ 256 mg/L) in 2023, compared to 13 (0.3%) in 2022, 19 (0.5%) in 2021, 15 (0.5%) in 2020, and 15 (0.4%) in 2019. In 2023, HL-AziR isolates were reported by 15 countries (compared to five countries in 2022), with one to nine isolates detected per country. Seven (17.9%) and 32 (82.1%) HL-AziR isolates were from female and male patients, respectively. Among the 21/39 (53.8%) HL-AziR isolates with data on sex and route of transmission, one (4.8%) was from a heterosexual male, seven (33.3%) from females, and 13 (61.9%) from men who have sex with men. Only a single HL-AziR isolate was also resistant to ceftriaxone and cefixime.

Figure 6. Proportion of gonococcal isolates with azithromycin MICs above the ECOFF (>1 mg/L) by country, EU/EEA, 2023*



* Cyprus and Estonia reported fewer than 20 isolates each in 2023.

Figure 7. Distribution of MIC for azithromycin in Euro-GASP, 2014–2023



Note: Isolates that did not fit into a discrete MIC category were excluded from the MIC distribution analysis as outlined below

* 2 811 isolates were susceptibility tested with azithromycin in 2016; 24 isolates had an MIC ≤ 0.032 mg/L.

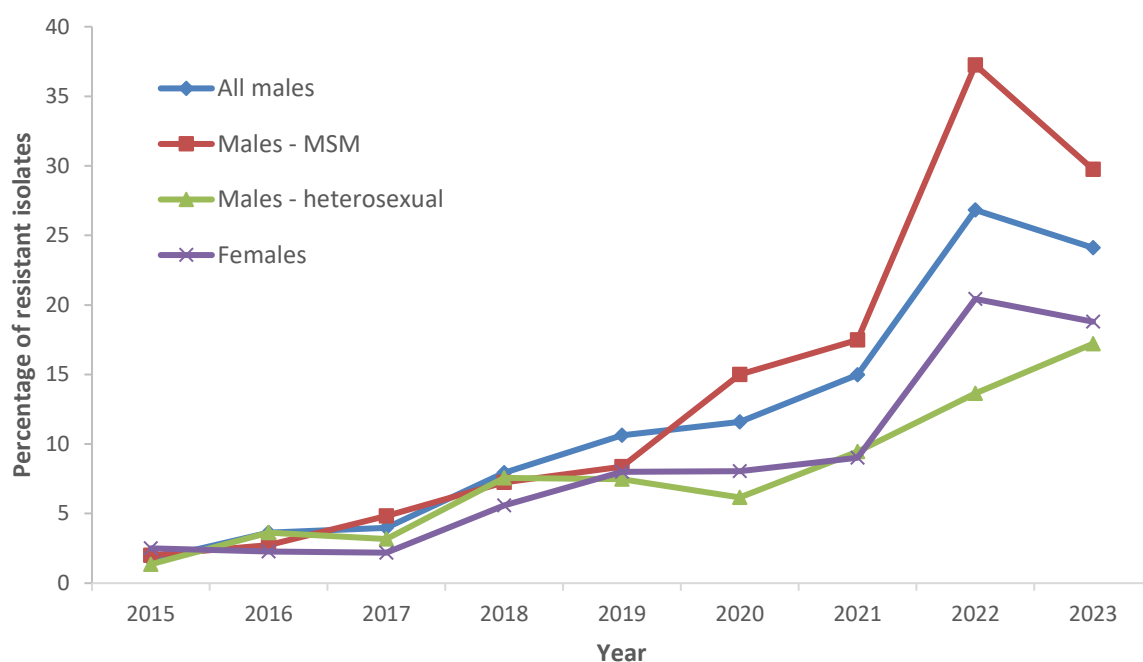
~ 3 250 isolates were susceptibility tested with azithromycin in 2017; 52 isolates had an MIC ≤ 0.06 mg/L.

3 301 isolates were susceptibility tested with azithromycin in 2018; 66 isolates had an MIC ≤ 0.06 mg/L.

^ 4 151 isolates were susceptibility tested with azithromycin in 2019; one isolate had an MIC > 32 mg/L, and 77 isolates had an MIC ≤ 0.06 mg/L.

In 2023, isolates with an azithromycin MIC above the ECOFF (>1 mg/L) were more common in males (24.1%) than females (18.8%), as has been the case since 2019 (Figure 6). Significant decreases in resistance were seen in all males between 2022 and 2023 (26.8% to 24.1%, $p=0.016$), and in men who have sex with men (37.2% to 29.7%, $p<0.001$) (Figure 8). Univariate analyses showed that azithromycin MICs above the ECOFF were associated with isolates from patients who were men who have sex with men, as well as anorectal and pharyngeal site of infection (Annex 2). The route of transmission was the only significantly associated patient characteristic; therefore, no multivariable analyses were carried out for azithromycin.

Figure 8. Percentage of isolates with azithromycin MIC above ECOFF (>1 mg/L) by sex and route of transmission among males, Euro-GASP, 2015–2023



3.2.4 Ciprofloxacin

Ciprofloxacin resistance (MIC >0.06 mg/L) steadily increased between 2017 (46.5%) and 2022 (65.9%) (Figure 1). In 2023, however, there was a small but significant decrease in ciprofloxacin resistance compared to 2022 (63.0% vs 65.9%, $p=0.008$) (Figure 1; Table 3). Univariate analyses indicated that ciprofloxacin resistance was associated with isolates from men who have sex with men and male heterosexual patients, patients 25 years or older, and anorectal site of infection (Annex 2). Following multivariable analysis, ciprofloxacin resistance remained associated with men who have sex with men (OR 2.39, CI 1.90–3.00, $p<0.001$) and heterosexual males (OR 1.50, CI 1.17–1.94, $p=0.002$) compared to females, as well as with patients 25 years and older (OR 1.56, CI 1.27–1.93, $p<0.001$) compared to patients under 25 years of age.

3.2.5 Tetracycline

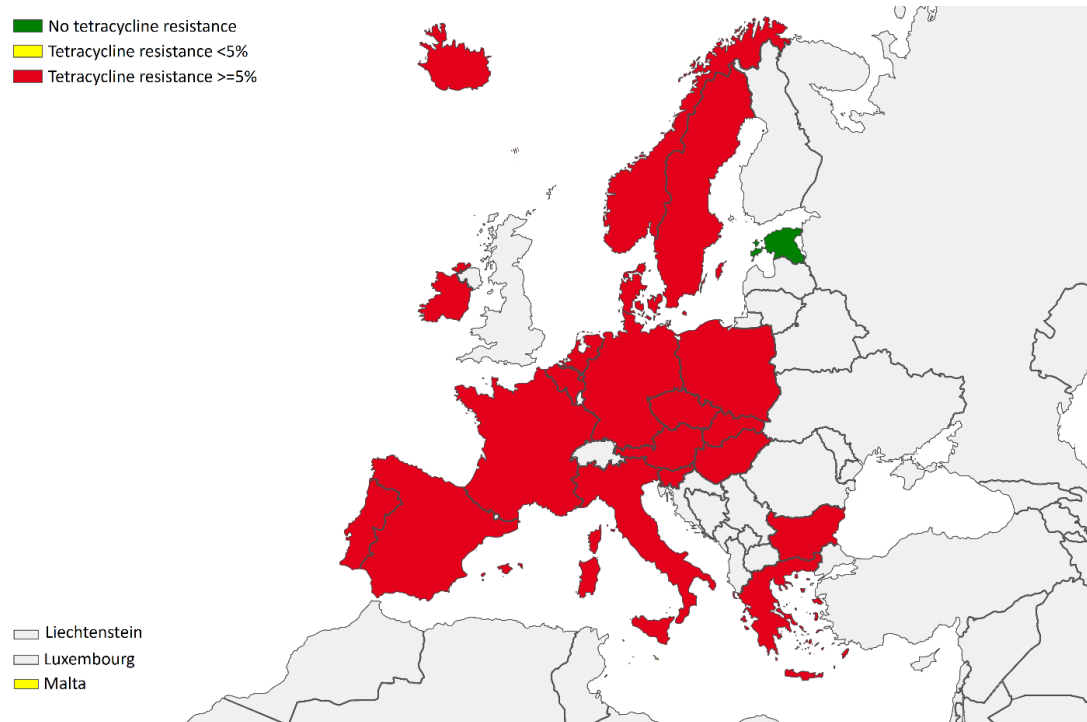
Tetracycline susceptibility results were available for 3014 (94.7%) isolates from 22/24 participating countries. Overall, 58.4% of isolates were resistant to tetracycline (MIC >0.5 mg/L) (Table 4). Percentages of tetracycline-resistant isolates are visualised by country in Figure 9.

Table 4. Resistance to tetracycline (using resistance breakpoint from EUCAST) by country, Euro-GASP, 2023

Country	Number of isolates tested	Tetracycline resistance	
		No.	%
Austria	200	131	65.5
Belgium	197	155	78.7
Bulgaria	23	21	91.3
Cyprus	0	N/A	N/A
Czechia	87	65	74.7
Denmark	200	59	29.5
Estonia	4	0	0.0
Finland	0	N/A	N/A
France	200	183	91.5
Germany	200	190	95.0
Greece	100	33	33.0
Hungary	196	179	91.3
Iceland	44	36	81.8
Ireland	200	75	37.5
Italy	100	62	62.0
Malta	45	2	4.4
Netherlands	199	98	49.2
Norway	200	45	22.5
Poland	26	25	96.2
Portugal	200	190	95.0
Slovakia	100	73	73.0
Slovenia	100	28	28.0
Spain	200	22	11.0
Sweden	193	87	45.1
Total	3014	1759	58.4
95% CI			56.6-60.1

* Estonia reported fewer than 20 isolates in 2023, while tetracycline susceptibility results were not available for isolates from Cyprus or Finland.

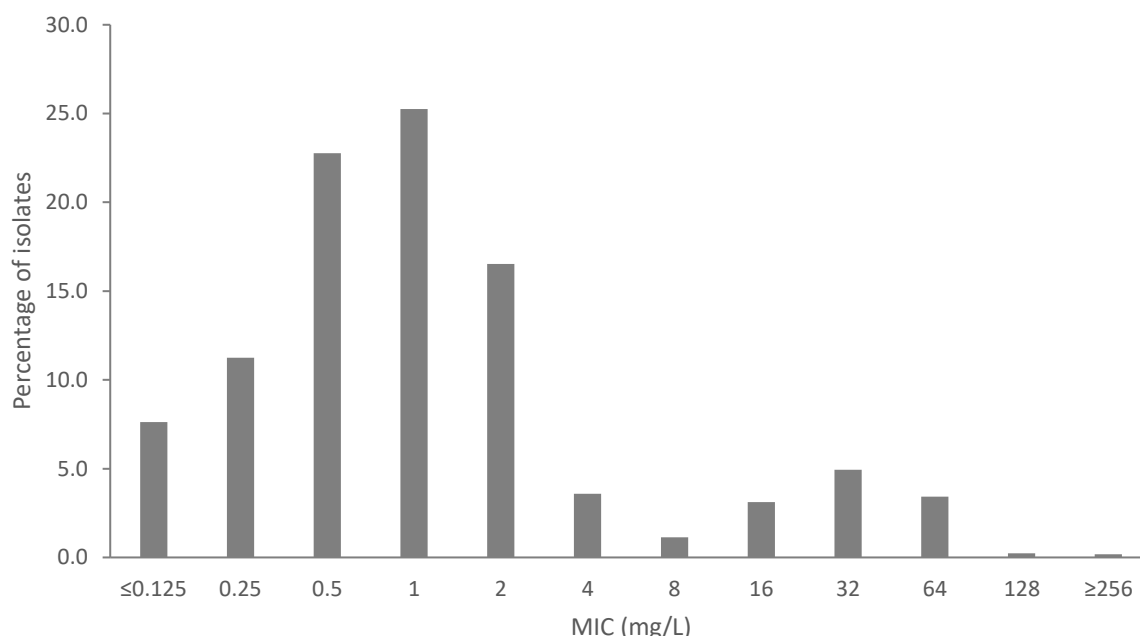
~ N/A = not available

Figure 9. Proportion of gonococcal isolates with tetracycline resistance by country, EU/EEA, 2023*

* Estonia reported fewer than 20 isolates in 2023, while tetracycline susceptibility results were not available for isolates from Cyprus or Finland.

The tetracycline MIC distribution was bimodal, with the largest peak at an MIC of 1 mg/L (25.3%) and a smaller secondary peak at 32 mg/L (4.9%) (Figure 10). The majority (46.5%) of isolates exhibited 'low-level' chromosomal tetracycline resistance (MIC of 1-8 mg/L), but 11.9% exhibited 'high-level' plasmid-mediated resistance (MIC >8 mg/L). Isolates with high-level tetracycline resistance were detected in 20/22 countries. A further 22.8% of isolates had MICs just below the tetracycline breakpoint (MIC of 0.5 mg/L).

Figure 10. Distribution of MIC for tetracycline in Euro-GASP, 2023



In 2023, tetracycline resistance was higher in males than females, particularly among men who have sex with men (Table 5). Univariate analyses showed that tetracycline resistance was associated with genital, anorectal, and 'other' sites of infection, and in the men who have sex with men population group, and those over 25 years (Annex 2). Following multivariable analysis for mode of transmission, gender and age, tetracycline resistance remained significantly associated with men who have sex with men (OR 1.96, CI 1.54-2.49, $p < 0.001$) and females (OR 1.37, CI 1.05-1.78, $p = 0.021$) compared to heterosexual males, and patients over 25 years (OR 1.32, CI 1.07-1.64, $p = 0.011$) compared with those under 25 years.

Table 5. Tetracycline resistance by sex and route of transmission among males, Euro-GASP, 2023

Variable	No. tested†	No. resistant	% resistant
Females	512	234	45.7
Males*	2481	1511	60.9
Heterosexual males	427	169	39.6
Men who have sex with men	838	478	57.0

* Where information was available.

~ Including all males, irrespective of route of transmission.

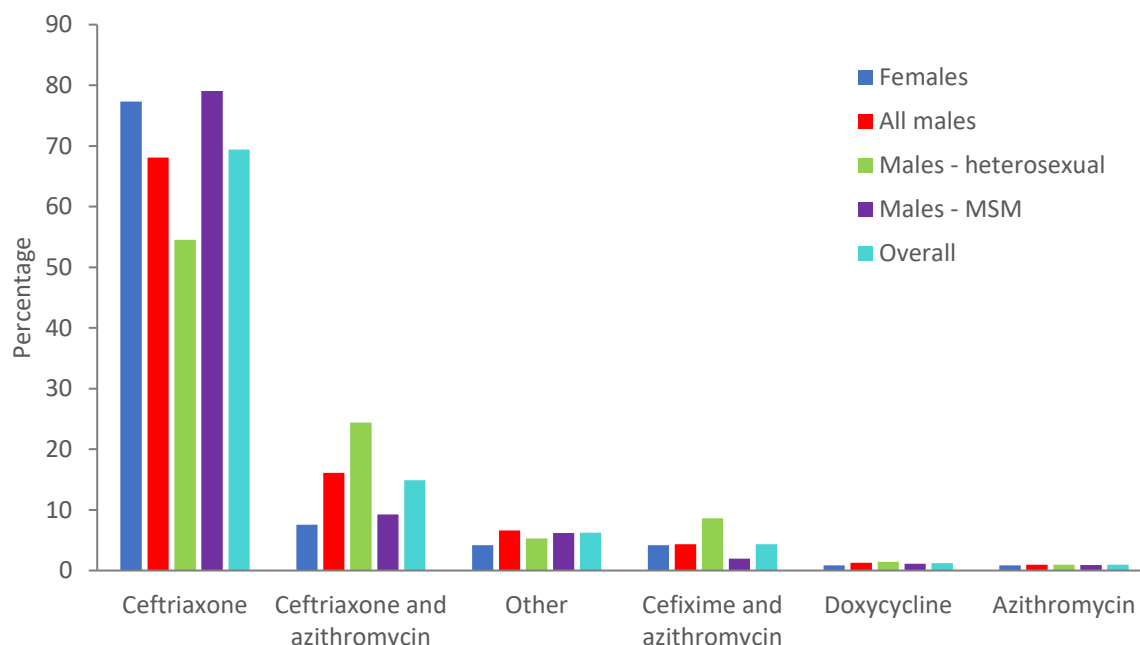
3.3 Treatments used

Treatment data were reported for 838 (26.3%) cases, 833 (26.2%) and 782 (24.6%) of which also had information on sex and route of transmission, respectively. These cases were reported by 11 countries and details on completeness of reporting on treatment type are available in Annex 1. Data on concurrent STIs, which might have been treated at the same visit, were not available. Twelve different combinations of antimicrobial agents and dose regimens were reported in 2023. The most used treatments or combinations of treatments are shown in Figure 11. Each of these treatments were reported in $\geq 1\%$ of cases and together accounted for 97.0% of analysed cases.

Consistent with previous years, ceftriaxone monotherapy was the most reported treatment (69.4% in 2023, 76.1% in 2022, 66.4% in 2021, 70.1% in 2020, and 74.0% in 2019), followed by ceftriaxone and azithromycin dual therapy (14.9% in 2023, 13.5% in 2022, 18.8% in 2021, 10.4% in 2020, and 7.9% in 2019). The third and fourth most common treatments in 2023 were 'other' antimicrobials (6.2%, sixth in 2022 at 0.9%) and cefixime and azithromycin dual therapy (4.3%, fourth in 2022 at 2.1%). Doxycycline monotherapy was more common in 2023 (1.2% compared to 0.7% in 2022). Conversely, azithromycin monotherapy was the sixth most used treatment in

2023 at 1.0%, which was lower than in 2022 (third, at 3.9%). As shown in Figure 11, treatments varied in patients of different sex and route of transmission. Males were more commonly prescribed ceftriaxone and azithromycin dual therapy than females (16.1% vs 7.6%), and heterosexual males more commonly received this treatment than men who have sex with men (24.4% vs 9.3%). Similarly, heterosexual males more commonly received cefixime and azithromycin than men who have sex with men (8.6% vs 2.0%).

Figure 11. Percentage of known treatments used for patients by sex and route of transmission for the most frequently used therapies, 2023



Note: Twelve different combinations of antimicrobials were recorded in 2023. The six most commonly used treatments are shown, comprising all treatments reported in $\geq 1\%$ of cases overall (differences in concentration of antimicrobials were grouped for analysis).

4 Conclusions

Susceptibility to the antimicrobials tested in Euro-GASP appeared to be stabilising in 2023 compared to recent years [8,9,16-19]. Reassuringly, ceftriaxone resistance remained rare. It is, however, of concern that one (0.03%) ceftriaxone-resistant isolate was detected in France, and three additional ceftriaxone isolates from Norway were submitted to TESSy but were not included in data presented here as they were part of the trimmed data. All four isolates were resistant to multiple classes of antibiotics; two isolates were multidrug-resistant (MDR), and one was extensively drug-resistant (XDR). Similarly, two (0.05%) ceftriaxone-resistant isolates were detected in Austria [20] and Germany in 2022, both of which were resistant to multiple classes of antibiotics. In 2021 and 2020, there was one (0.03%) ceftriaxone resistant isolate from Spain and another from Belgium, compared to three (0.1%) isolates each in 2019 and 2018 and none in 2017 and 2016. Although no ceftriaxone treatment failures were reported to the EpiPulse platform in 2023, six ceftriaxone-resistant isolates were reported by Norway (n=2), Belgium (n=1), and the United Kingdom (n=3).

Cefixime resistance levels appear to be stabilising within the EU/EEA: 0.2% of isolates were cefixime-resistant in 2023, compared to 0.3% in 2022, 0.4% in 2021, 0.5% in 2020, 0.9% in 2019, and 1.4% in 2018, which contrasted with the previously stable higher levels of resistance observed between 2014 (2%) and 2017 (1.9%). Cefixime-resistant isolates were reported by 5/24 (20.8%) participating countries in 2023, which marked a reduction compared to the number of countries reporting resistant isolates since 2019 (8/23 (34.8%) countries in 2022, 9/24 (37.5%) in 2021, 6/23 (26.1%) in 2020, and 14/26 (53.8%) in 2019). In previous years, cefixime resistance was higher among females than males, especially among men who have sex with men. In 2023, cefixime resistance remained stable among males (0.2%), but could not be compared across different population groups such as men who have sex with men, heterosexual males, and females due to small numbers of resistant isolates.

The continuing low levels of cephalosporin resistance is promising, but the detection of ceftriaxone-resistant isolates is worrying because ceftriaxone is the last remaining option for empiric first-line monotherapy. Among patients for whom treatment data were available, 69.4% were prescribed ceftriaxone monotherapy, while 15.8% were given ceftriaxone in combination with azithromycin, ciprofloxacin, or doxycycline. Treatment data should be interpreted with caution though, as the reporting completeness for this variable remains low (26.3%) with only 11 countries providing data. Furthermore, information about dose of ceftriaxone given was limited. It is important to follow the European gonorrhoea treatment guidelines and give ceftriaxone 1 g [2].

The percentage of isolates with azithromycin MIC above the ECOFF (>1 mg/L) decreased in 2023, but the overall level of resistance remained high at 23.3% with resistant isolates reported by 22/24 (91.2%) countries. Despite the overall decrease in resistance, there was a significant increase in the proportion of HL-AziR isolates in 2023 (1.2%) compared to 2022 (0.3%). HL-AziR isolates were also more widely dispersed in 2023: fifteen countries reported one to nine isolates each compared to five countries in 2022. Azithromycin monotherapy is not recommended unless the isolate is first shown to be susceptible. Overall, 1% of patients were prescribed azithromycin monotherapy in 2023, which was lower than in 2022 (3.9%), but one of these patients carried an azithromycin-resistant isolate. Azithromycin monotherapy was prescribed evenly among heterosexual males (1.0%), men who have sex with men (0.9%), and females (0.8%), whereas in 2022 usage was more common among heterosexual males (10.6%) than men who have sex with men (0.8%) and females (3.5%).

Ciprofloxacin resistance also decreased from 65.9% in 2022 to 63.0% in 2023. Ciprofloxacin is not recommended for monotherapy unless the isolates are first shown to be susceptible. In 2023, 0.8% of patients were prescribed ciprofloxacin monotherapy, which was comparable to 2022 (0.5%); however, two of these patients carried ciprofloxacin-resistant isolates.

Tetracycline resistance was at 58.4%, which was similar to the level of resistance (63.4%) reported for 19 EU/EEA countries in 2022 [21]. In 2023, tetracycline-resistant isolates were reported by 20/22 (90.9%) countries. Continuous monitoring of tetracycline resistance remains essential to evaluate the potential impact of doxy-PEP in the EU/EEA [12–14]. However, the high prevalence of gonococcal tetracycline resistance raises concerns regarding the effectiveness of doxy-PEP in reducing gonorrhoea incidence in the region.

With respect to patient characteristics, the percentage of samples from females had increased significantly in 2022. In 2023, this reversed with a small but significant decrease in the percentage of samples from females (17.4% in 2023 vs 19.1% in 2022), although this was still greater than in 2021 (13.9%), and 2020 (15.6%). In terms of route of transmission and gender, there was a significant increase in the percentage of heterosexual male patients in 2023 (24.3%) compared to 2022 (20.0%). The proportion of pharyngeal isolates significantly decreased in 2023 (12.0% in 2022 to 9.3% in 2023), as did the proportion of anorectal isolates (17.8% to 14.9%).

Since 2020, men who have sex with men have consistently had the highest levels of azithromycin resistance. This remained the case in 2023 (29.7%), although there was a significant reduction compared to the percentage observed in 2022 (37.2%). Isolates with azithromycin MICs above the ECOFF were significantly associated with men who have sex with men compared to heterosexual males. Isolates from patients who were men who have sex with men were also associated with ciprofloxacin and tetracycline resistance. It should be noted that the completeness of the route of transmission data was 50.4%.

The continued detection of ceftriaxone resistance and the large proportion of gonococcal isolates with azithromycin MICs above the ECOFF underscore the importance of the European response plan to control the threat of MDR and XDR *N. gonorrhoeae* in Europe [22], with indicators reviewed in 2020 [23,24] and 2024. Indicator monitoring carried out in 2024 compared progress made by 30 EU/EEA countries between 2019 and 2023. The results (detailed results will be published in a separate report) suggested that, although some progress has been made at both the EU/EEA and national levels, the ability of the EU/EEA to respond to the threat of MDR/XDR gonorrhoea had weakened overall. The response plan should continue to be implemented and monitored to help identify and report treatment failures and ensure that gonorrhoea remains a treatable infection. Euro-GASP has a major role in fulfilling the objectives of the response plan, which include:

- Strengthening surveillance of gonococcal antimicrobial susceptibility in EU/EEA countries by providing sufficient epidemiological information to inform national treatment guidelines and public health interventions. Overall completeness of variables was 55.7% in 2023 compared to 53.3% in 2022 and 56.0% in 2020. Significant improvements in reporting are urgently required for multiple variables if statistical analysis of the linked antimicrobial susceptibility and patient data is to be robust.
- Ensuring that appropriate capacity for culture and antimicrobial susceptibility testing in EU/EEA countries is available or further developed. Training in STI diagnostics and antimicrobial susceptibility testing is provided and Member State experts (or related staff) are encouraged to participate. A Euro-GASP STI and AMR training course was delivered in December 2024, with participants from 10 EU/EEA countries and four Western Balkan countries. The results of indicator monitoring carried out in 2024 suggested that access to and use of gonococcal culture and AST decreased at the national level between 2019 and 2023, which is an issue that needs to be addressed.
- Effectively disseminate results from AMR surveillance in order to increase awareness and inform authorities, professional societies, clinicians and other health care workers and persons at risk about the threat of MDR and XDR *N. gonorrhoeae*. Euro-GASP AMR surveillance data are freely accessible online via the ECDC Surveillance Atlas [19], which is updated annually prior to the publication of the annual surveillance data report. Data from the project are frequently published in peer-reviewed journals and presented at international conferences.
- Introduce strategies to reduce the burden of gonorrhoea, such as implementation of appropriate gonorrhoea management, prevention, control and AMR policies/guidelines, including enhanced focus on high-risk groups, as well as mandatory reporting of gonorrhoea. The use of recommended therapies to treat gonorrhoea is advocated by Euro-GASP project. Response plan indicator monitoring carried out in 2024 found that 27/30 (90%) EU/EEA countries had patient management guidelines in place, all of which recommended antimicrobial agents listed in the 2020 European treatment guideline. Encouragingly, the 2023 Euro-GASP data also showed that there was continued use of ceftriaxone with or without azithromycin in 84.3% of treatments initiated (69.4% ceftriaxone alone; 14.9% plus azithromycin). Nevertheless, it is of major concern that some patients continue to be inappropriately treated, e.g. with azithromycin or ciprofloxacin monotherapy, in particular in those patients with resistant strains.

The representation of EU/EEA countries in Euro-GASP 2023 was good; however, six countries did not participate (Croatia, Latvia, Liechtenstein, Lithuania, Luxembourg, and Romania), while two countries submitted fewer than 20 isolates each (Cyprus and Estonia). Efforts to encourage countries to participate in Euro-GASP are ongoing, as is work to improve the reporting of epidemiological variables. The lack of reporting, particularly certain epidemiological variables, limits the precision of estimates when population group sample sizes are small, affecting a subset of analyses presented in this report.

Euro-GASP detected stabilising or decreasing trends in susceptibility to cefixime, azithromycin, and ciprofloxacin in 2023. It is, however, of concern that resistance levels to azithromycin, ciprofloxacin, and tetracycline remain high overall and that ceftriaxone-resistant isolates continue to be detected. Ceftriaxone treatment failures have been documented [25], together with sustained transmission of 'high-level azithromycin-resistant' (MIC ≥ 256 mg/L) strains [26]. International spread of gonococcal strains with resistance to ceftriaxone and/or azithromycin has also been detected [4,20,25–33]. In this context, continuous implementation of quality-assured antimicrobial surveillance activities and monitoring of the response plan, is essential. Finally, the development of alternative therapy regimens is urgently needed to ensure gonorrhoea remains a treatable infection.

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Annex 1. Percentage completeness of epidemiological variables

Table A 1. Completeness of epidemiological variable reporting, 2023

Country	Number of isolates	Gender	Age	Route of transmission	Site of infection	Treatment	Previous gonorrhoea	Country of birth	Probable country of infection	HIV status	Overall response rate*
Austria	200	100	100	0	100	0	21.5	17	0	0	37.6
Belgium	197	99.5	100	44.7	99.5	38.6	53.8	51.8	15.2	41.6	60.5
Bulgaria	23	100	91.3	87	100	87	78.3	100	78.3	87	89.9
Cyprus	1	100	100	0	100	0	0	0	0	0	33.3
Czechia	87	100	98.9	81.6	85.1	0	73.6	83.9	0	82.8	67.3
Denmark	200	100	100	80	100	73.5	0	82	82.5	34.5	72.5
Estonia	5	100	100	40	80	0	20	0	0	0	37.8
Finland	100	100	100	69	0	0	0	96	52	0	46.3
France	200	100	100	23	100	24.5	33.5	33	34.5	61	56.6
Germany	200	100	100	19.5	96	22	22	13.5	20	10	44.8
Greece	100	100	97	60	72	76	66	85	69	0	69.4
Hungary	196	100	100	14.8	100	0	0	0	0	0	35
Iceland	100	100	100	42	100	0	0	98	0	0	48.9
Ireland	200	100	100	58.5	100	26.5	32	29.5	31	76	61.5
Italy	100	91	93	84	88	87	85	85	65	78	84
Malta	45	97.8	100	100	100	77.8	93.3	100	100	86.7	95.1
Netherlands	200	100	100	99	100	100	0	99	0	90	76.4
Norway	200	99.5	100	0	100	0	0	0	0	0	33.3
Poland	30	100	100	40	100	0	0	96.7	96.7	16.7	61.1
Portugal	200	100	100	24	100	0	0.5	12.5	0	1	37.6
Slovakia	100	100	99	53	100	51	95	94	51	69	79.1
Slovenia	100	100	100	35	100	0	90	0	0	84	56.6
Spain	200	100	98	95	100	0	0.5	0	100	0.5	54.9
Sweden	200	99.5	100	98	100	0	0	0	96.5	0	54.9
Average completeness	3184	99.6	99.4	50.4	94.9	26.3	24.7	40.9	34.2	31.2	55.7
Cell shading: green, 100%; red, 0%; light red, below average; white, above average but <100%.											

* Overall response rate = average of completeness of epidemiological variables

Annex 2. Statistical tables

Table A 2. Univariate association of cefixime resistance/susceptibility and patient characteristics, Euro-GASP, 2023

	Cefixime resistance N (%; 95% CI)	P value
Site of infection (n=3021)		
Genital (2224)	4 (0.2, 0.1-0.5)	0.403*
Anorectal (451)	2 (0.4, 0.1-1.6)	
Pharyngeal (282)	0 (0.0, 0.0-1.3)	
Other (64)	0 (0.0, 0.0-5.7)	
Route of transmission & gender (n=1889)		
Men who have sex with men (881)	2 (0.2, 0.1-0.8)	0.722*
Male heterosexual (459)	2 (0.4, 0.1-1.6)	
Female (549)	1 (0.2, 0.0-1.0)	
Previous gonorrhoea (n=787)		
Yes (262)	0 (0.0, 0.0-1.4)	1.000*
No (525)	1 (0.2, 0.0-1.1)	
HIV status (n=995)		
Positive (97)	0 (0.0, 0.0-3.8)	1.000*
Negative (898)	1 (0.1, 0.0-0.6)	
Age (n=3166)		
<25 years (938)	1 (0.1, 0.0-0.6)	0.677*
≥25 years (2228)	5 (0.2, 0.1-0.5)	

* Expected value for at least one cell < 5, so Fisher's Exact test performed.

~ N=number, CI=confidence interval.

Table A 3. Univariate association of azithromycin MICs above/below ECOFF (>1 mg/L) and patient characteristics, Euro-GASP, 2023

	Azithromycin resistance N (%; 95% CI)	Odds ratio	95% CI	P value
Site of infection (n=3020)				
Genital (2223)	472 (21.2, 19.6-23.0)	Reference		
Anorectal (451)	140 (31.0, 26.9-35.5)	1.67	1.33-2.09	<0.001
Pharyngeal (282)	86 (30.5, 25.4-36.1)	1.63	1.24-2.14	<0.001
Other (64)	17 (26.6, 17.3-38.5)	1.34	0.76-2.36	0.305
Route of transmission & gender (n=1888)				
Men who have sex with men (881)	262 (29.7, 26.8-32.8)	2.04	1.53-2.71	<0.001
Male heterosexual (459)	79 (17.2, 14.0-20.9)	Reference		
Female (548)	103 (18.8, 15.7-22.3)	1.11	0.81-1.54	0.515
Previous gonorrhoea (n=786)				
Yes (262)	69 (26.3, 21.4-32.0)	1.07	0.76-1.51	0.685
No (524)	131 (25.0, 21.5-29.0)	Reference		
HIV status (n=995)				
Positive (97)	35 (36.1, 27.2-46.0)	1.50	0.96-2.32	0.071
Negative (898)	246 (27.4, 24.6-30.4)	Reference		
Age (n=3165)				
<25 years (938)	199 (21.2, 18.7-23.9)	Reference		
≥25 years (2227)	537 (24.1, 22.4-25.9)	1.18	0.98-1.42	0.078

* N=number, CI=confidence interval.

Table A 4. Univariate association of ciprofloxacin resistance/susceptibility and patient characteristics, Euro-GASP, 2023

	Ciprofloxacin resistance N (%; 95% CI)	Odds ratio	95% CI	P value
Site of infection (n=3021)				
Genital (2224)	1 396 (62.8, 60.7-64.8)	1.16	0.90-1.49	0.247
Anorectal (451)	309 (68.5, 64.1-72.6)	1.50	1.10-2.05	0.010
Pharyngeal (282)	167 (59.2, 53.4-64.8)	Reference		
Other (64)	43 (67.2, 55.0-77.4)	1.41	0.79-2.51	0.239
Route of transmission & gender (n=1889)				
Men who have sex with men (881)	613 (69.6, 66.5-72.5)	2.72	2.16-3.41	<0.001
Male heterosexual (459)	267 (58.2, 53.6-62.6)	1.65	1.28-2.12	<0.001
Female (549)	251 (45.7, 41.6-49.9)	Reference		
Previous gonorrhoea (n=787)				
Yes (262)	180 (68.7, 62.9-74.0)	Reference		
No (525)	361 (68.8, 64.7-72.6)	1.00	0.73-1.38	0.986
HIV status (n=995)				
Positive (97)	70 (72.2, 62.5-80.1)	1.31	0.82-2.08	0.258
Negative (898)	597 (66.5, 63.3-69.5)	Reference		
Age (n=3166)				
<25 years (938)	501 (53.4, 50.2-56.6)	Reference		
≥25 years (2228)	1 492 (67.0, 65.0-68.9)	1.77	1.51-2.07	<0.001

* N=number, CI=confidence interval.

Table A 5. Univariate associate of tetracycline resistance/susceptibility and patient characteristics, Euro-GASP, 2023

	Tetracycline resistance N (%; 95% CI)	Odds ratio	95% CI	P value
Site of infection (n=2951)				
Genital (2171)	1 315 (60.6, 58.5-62.6)	2.20	1.70-2.85	<0.001
Anorectal (441)	256 (58.0, 53.4-62.6)	1.98	1.45-2.71	<0.001
Pharyngeal (275)	113 (41.1, 35.4-47.0)	Reference		
Other (64)	40 (62.5, 50.3-73.3)	2.39	1.35-4.22	0.002
Route of transmission & gender (n=1777)				
Men who have sex with men (838)	478 (57.0, 53.7-60.4)	2.03	1.59-2.58	<0.001
Male heterosexual (427)	169 (39.6, 35.1-44.3)	Reference		
Female (512)	234 (45.7, 41.4-50.0)	1.29	0.99-1.67	0.059
Previous gonorrhoea (n=787)				
Yes (262)	150 (57.3, 51.2-63.1)	Reference		
No (525)	314 (59.8, 55.6-63.9)	1.11	0.82-1.50	0.492
HIV status (n=994)				
Positive (97)	61 (62.9, 53.0-71.8)	1.29	0.83-1.98	0.254
Negative (897)	510 (56.9, 53.6-60.1)	Reference		
Age (n=2096)				
<25 years (900)	483 (53.7, 50.4-56.9)	Reference		
≥25 years (2096)	1 265 (60.4, 58.2-62.4)	1.31	1.12-1.54	<0.001

* N=number, CI=confidence interval.

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