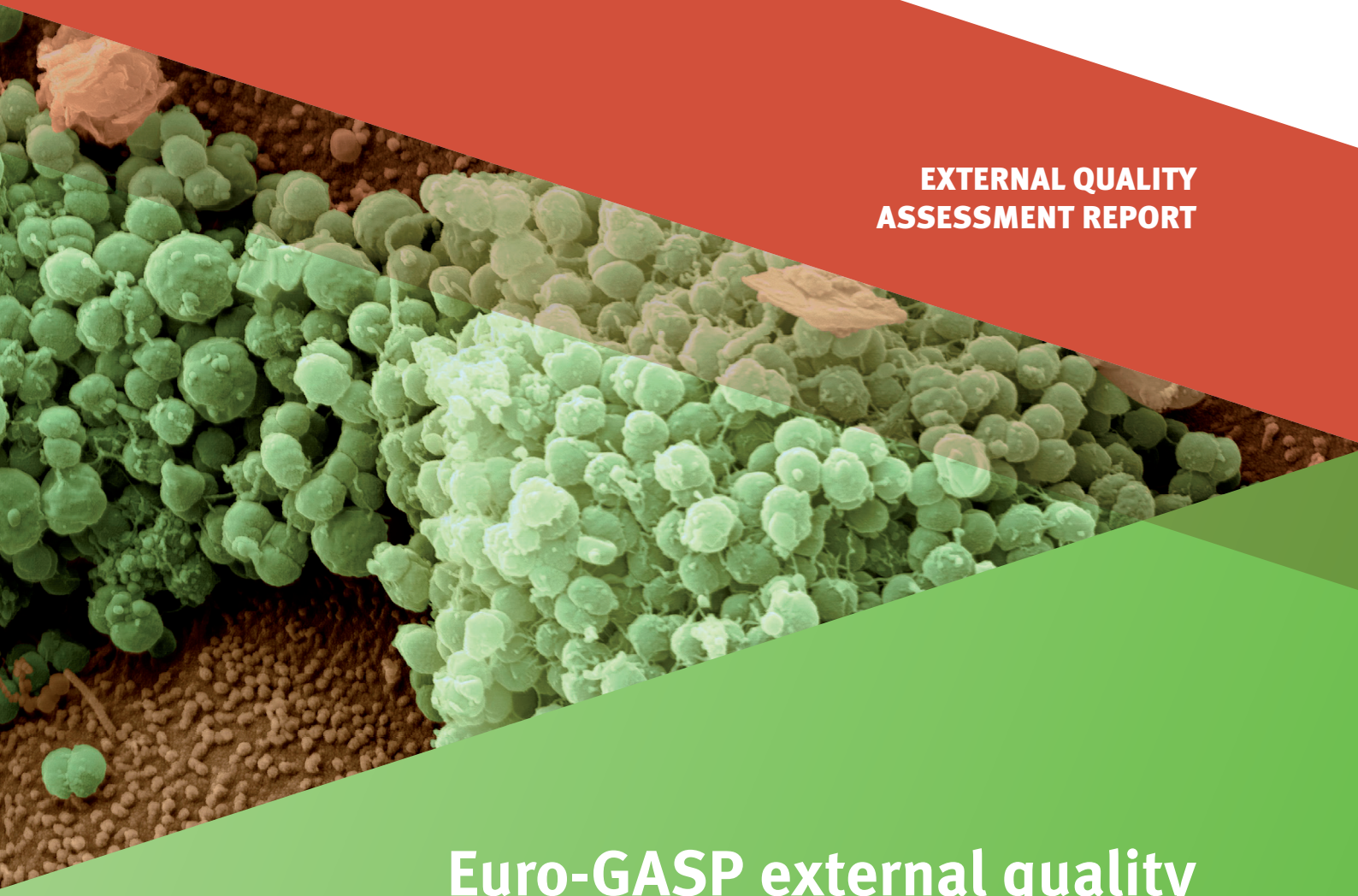
EXTERNAL QUALITY ASSESSMENT REPORT



Euro-GASP external quality assessment scheme for *Neisseria gonorrhoeae* antimicrobial susceptibility testing 2023

ECDC TECHNICAL REPORT

Euro-GASP external quality assessment scheme for *Neisseria gonorrhoeae* antimicrobial susceptibility testing

2023

This report was commissioned by the European Centre for Disease Prevention and Control (ECDC), coordinated by Csaba Ködmön and produced by Melissa Jansen van Rensburg, Michaela Day and Michelle Cole, UK Health Security Agency, London, and Susanne Jacobsson, Daniel Schröder and Magnus Unemo, Örebro University Hospital, on behalf of the EURO-GASP network participants.

Suggested citation: European Centre for Disease Prevention and Control. Euro-GASP external quality assessment scheme for *Neisseria gonorrhoeae* antimicrobial susceptibility testing – 2023. Stockholm: ECDC; 2024.

Stockholm, June 2024

ISBN
DOI:
Catalogue number

Contents

Figures

Tables

Abbreviations

AST	Antimicrobial susceptibility testing
CLSI	Clinical and Laboratory Standards Institute
DSN	Dedicated surveillance network
ECDC	European Centre for Disease Prevention and Control
ECOFF	Epidemiological cut-off
EEA	European Economic Area
EQA	External quality assessment
ESSTI	European Surveillance of Sexually Transmitted Infections Project
EU	European Union
EUCAST	European Committee on Antimicrobial Susceptibility Testing
Euro-GASP	European Gonococcal Antimicrobial Surveillance Programme
GC	Gonococcal
I	Susceptible, increased exposure
MIC	Minimum inhibitory concentration
R	Resistant
S	Susceptible
STI	Sexually transmitted infection
UK	United Kingdom
UKHSA	United Kingdom Health Security Agency
UK NEQAS	United Kingdom National External Quality Assessment Service
WHO	World Health Organization
ÖUH	Örebro University Hospital

Executive summary

Introduction

External quality assessment (EQA) is an essential part of any laboratory-based surveillance system, allowing for the monitoring of performance and comparability of results from participating laboratories, identification of potential issues and deployment of resources and training, where necessary. An EQA scheme for antimicrobial susceptibility testing in *Neisseria gonorrhoeae* has been available to laboratories participating in ECDC's European Sexually Transmitted Infections (STI) surveillance network since 2010. This EQA scheme has so far shown high levels of inter-laboratory comparability in the presence of differing methodologies.

Materials and methods

The EQA specimen panel of 10 gonococcal isolates was selected by UK Health Security Agency (UKHSA) and Örebro University Hospital (ÖUH) and was distributed by the United Kingdom National External Quality Assessment Service (UK NEQAS). Of the 10 gonococcal isolates provided, one strain was in triplicate and two strains were in duplicate to test intra-laboratory concordance. The remaining isolates were all provided singly, meaning that the *N. gonorrhoeae* antimicrobial susceptibility EQA panel comprised of six different strains in total. The isolates were representative of a range of different antimicrobial susceptibility profiles and consisted of the three WHO reference strains, WHO F, M and O, and three clinical isolates obtained in the UK in 2022 (n=2) and 2023 (n=1). Participating laboratories were asked to test the EQA panel using local methodology (i.e. MIC gradient strip test, agar dilution, or disc diffusion) and relevant breakpoints (i.e. EUCAST, CLSI, etc.) against a range of antimicrobial agents. These agents included azithromycin, cefixime, ceftriaxone, ciprofloxacin, gentamicin and spectinomycin, as well as tetracycline, which was tested for the first time in 2023. Results were submitted directly to UK NEQAS, who issued individual laboratory reports. The raw results were supplied to UKHSA, which decoded and analysed the results based on the categories of susceptibility assigned. Susceptibility category concordance (categorical agreement) was assessed using the consensus category (most often reported category) of susceptibility for each tested strain. MIC concordance was assessed by examining MIC results within one (essential agreement) and two doubling dilutions of the modal MIC. Intra-laboratory concordance was examined using the triplicate and the two duplicate strains.

Results

In November 2023, 26 laboratories in 26 European Union/European Economic Area (EU/EEA) countries were dispatched 10 gonococcal isolates for antimicrobial susceptibility testing. All laboratories except two returned EQA results to UK NEQAS (one that did not receive the isolates and one that did not have capacity to perform the testing to meet the UK NEQAS deadline due to laboratory reorganisation). All laboratories used MIC gradient strip tests for at least a subset of the tested antimicrobials and all stated that they used EUCAST breakpoints. When reviewing the categorical susceptibilities along with the MIC data, it was established that two laboratories adhered to CLSI breakpoints for tetracycline. The highest level of categorical agreement was seen with ciprofloxacin (100%), while the lowest was seen with tetracycline (87.1%). Compared to the previous distribution in 2021, the largest increase for categorical agreement was observed for ciprofloxacin (100% in 2023, 92.9% in 2021) and the largest decrease for azithromycin (92.6% in 2023, 96.4% in 2021).

Overall, 89.1% and 97.8% of the reported minimum inhibitory concentrations (MICs) were within one (essential agreement) and two doubling dilutions of the modal MIC, respectively, demonstrating essential agreement has significantly decreased since 2021 (91.5%, p=0.03). Without tetracycline, 89.8% and 98.1% of reported MICs were in essential agreement (vs. 2021 p=0.15) and within two doubling dilutions of the modal MIC, respectively. Significant changes in essential agreement for individual antimicrobials were observed between the 2021 EQA (QA21) and the 2023 EQA (QA23), with decreases for azithromycin (p=0.01), gentamicin (p=0.01), and spectinomycin (p=0.04). Of the 22 laboratories that reported MIC values, 18 (81.8%) reached an inter-laboratory MIC concordance percentage score of 95% or higher, with six laboratories obtaining a score of 100%.

Most laboratories performed well, with 81.8% of laboratories (18/22) scoring 95% concordance or higher, including six laboratories obtaining a perfect score of 100%.

Discussion and conclusion

The harmonisation of susceptibility testing methodologies and breakpoints used by participating laboratories has was maintained in 2023, with all laboratories using MIC gradient strip tests for at least one antimicrobial and most applying EUCAST breakpoints for interpretation of MIC results. Overall, the laboratories participating in the EQA scheme QA23 performed well and showed good levels of competency in testing *N. gonorrhoeae* isolates of unknown phenotype. In general, categorical agreement remained consistently high or increased in this distribution compared with 2021, especially for ciprofloxacin. The exceptions were azithromycin and ceftriaxone, where a slight decrease was observed. The inter- and intralaboratory concordance was high in most cases, demonstrating comparability between different testing methodologies and allowing confidence in decentralised testing for surveillance purposes. Most susceptibility category discrepancies were attributable to strains with MICs on or close to a breakpoint, which highlights the need to consider the actual MIC as well as susceptibility category when interpreting susceptibility results. Analysis of the individual results submitted by the participating laboratories highlighted two centres in need of further guidance to help bring them into line with the European Gonococcal Antimicrobial Surveillance Programme (Euro-GASP) recommended target of 95% of MICs within two doubling-dilutions of the modal MICs and beta-lactamase assessment.

These results indicate that the Euro-GASP antimicrobial surveillance quality is of a good standard.

1. Introduction

The European Centre for Disease Prevention and Control (ECDC) is a European Union (EU) agency with a mandate to operate the dedicated surveillance networks (DSNs) and to identify, assess, and communicate current and emerging threats to human health from communicable diseases. 'Within its mission, ECDC shall foster the development of sufficient capacity within the Community for the diagnosis, detection, identification and characterisation of infectious agents which may threaten public health. The Centre shall maintain and extend such cooperation and support the implementation of quality assurance schemes.' (Article 5.3, EC 851/2004[1]).

As part of its mandate, ECDC commissions and supports External Quality Assessment (EQA) exercises across public health microbiology laboratories in the EU/European Economic Area (EEA) Member States with the objective of:

- verifying the quality and comparability of surveillance data reported at European level; and
- ensuring threat detection capability for emerging and epidemic disease or drug resistance.

EQAs are conducted within a quality management system and evaluate the performance of laboratories. They are carried out by an outside agency and with materials supplied specifically for this purpose. ECDC's disease-specific networks organise a series of EQAs for EU/EEA countries. In some networks, ECDC also includes non-EU/EEA countries in its EQA activities. The aim of these EQAs is to identify weak points in the diagnostic capacities of EU/EEA laboratories that are relevant to the surveillance of diseases listed in Commission Implementing Decision (EU) 2018/945; another aim is to ensure comparability of laboratory results from all EU/EEA countries.

The main purposes of EQA schemes include:

- assessment of the general standard of performance ('state of the art');
- assessment of the effects of analytical procedures (method principle, instruments, reagents, calibration);
- evaluation of individual laboratory performance;
- identification of vulnerabilities;
- provision of continuing education for participating laboratories; and
- identification of needs for training activities.

A major aim of the European Sexually Transmitted Infections (STI) surveillance network is to strengthen the surveillance of *Neisseria gonorrhoeae* antimicrobial susceptibility in EU/EEA Member States. An EQA scheme for *N. gonorrhoeae* antimicrobial susceptibility testing was established in 2007 as part of the European Surveillance of STIs (ESSTI) programme funded by the European Commission's Directorate-General for Health and Consumers (DG-SANCO). The EQA has been part of the ECDC STI microbiology project since 2009, with the first ECDC EQA distributed in 2010.

The EQA scheme is available to all laboratories in the STI surveillance network. An EQA scheme is an essential component of the laboratory-based surveillance programme, ensuring comparability of data between and within testing centres, and successful performance in EQA is a requirement for laboratories participating in decentralised testing as part of antimicrobial resistance surveillance across Europe [1, 2].

Between 2010 and 2023, the number of laboratories participating in the *N. gonorrhoeae* antimicrobial susceptibility testing EQA increased from 18 to 26; in general, the EQAs have revealed high levels of inter-laboratory comparability even in the presence of different antimicrobial susceptibility testing methodologies. Problems identified in previous EQA distributions included reduced comparability of results determined using discs compared with those determined by agar dilution and minimum inhibitory concentrations (MIC) gradient strip tests, agar media not suitably supporting gonococcal growth, and reduced comparability of results among laboratories using MIC gradient strip tests from a particular manufacturer.

The United Kingdom National External Quality Assessment Service (UK NEQAS) collaborated with United Kingdom Health Security Agency (UKHSA), Örebro University Hospital (ÖUH) and ECDC for the EQA described in this report. UK NEQAS is accredited by the United Kingdom Accreditation Service to ISO 17043 (Conformity Assessment – General Requirements for Proficiency Testing). Participation in this EQA scheme for *N. gonorrhoeae* antimicrobial susceptibility provides a mechanism for laboratories in the network to meet the requirements of their local standards, such as ISO 15189:2012 or ISO 15189:2022.

[1] Regulation (EC) no 851/2004 of the European Parliament and of the Council of 21 April 2004 establishing a European Centre for Disease Prevention and Control

2. Materials and methods

2.1 Antimicrobial susceptibility testing external quality assessment panel

Members of the STI network and Euro-GASP contact points were invited by ECDC to participate in the EQA scheme. All laboratories that expressed interest in the EQA received 10 gonococcal isolates from UK NEQAS. The isolates included in the panel were selected by UKHSA and ÖUH to demonstrate a range of susceptibility profiles for relevant therapeutic antimicrobial agents and consisted of three WHO reference gonococcal strains, WHO F, M and O [3], and three clinical isolates from the UK isolated in 2022 (n=2) and 2023 (n=3). To measure intra-laboratory reproducibility, one of these strains was supplied in triplicate (Strain 5 (H22-494), coded in the EQA as 8477/8478/8479), and two strains were supplied in duplicate (Strain 1 (WHO F), EQA codes 8471/8472 and Strain 2 (WHO M), EQA codes 8473/8474). The remaining three strains were supplied as individual isolates (Strain 3 (WHO O), EQA code 8475; Strain 4 (H22-722), EQA code 8476 and Strain 6 (H23-657), EQA code 8480). Therefore, a total of six different strains were included in the distribution.

Participating laboratories tested the EQA panel of isolates using their own routine methodologies against the following therapeutic antimicrobials where possible:

- Azithromycin
- Cefixime
- Ceftriaxone
- Ciprofloxacin
- Gentamicin
- Spectinomycin
- Tetracycline.

Azithromycin, cefixime, ceftriaxone, and ciprofloxacin are the 'core' antimicrobials, which are tested annually. Gentamicin and spectinomycin are 'snapshot' antimicrobials, which are tested every three years. Tetracycline data was collected for the first time in 2023 due to the interest in whether doxycycline post-exposure prophylaxis could reduce incident gonorrhoea cases across Europe [4]. Where possible, participating laboratories also tested the EQA panel of isolates for beta-lactamase production.

The antimicrobials listed are those detailed in 'ECDC Instructions, External Quality Assessment v7' [5].

2.2 Susceptibility testing methods

The methodology and the clinical breakpoints/guidelines (e.g. European Committee on Antimicrobial Susceptibility Testing (EUCAST) breakpoints (Table 1) [6]) used to determine the category of susceptibility for each antimicrobial tested were requested. Antimicrobial susceptibility testing results for each isolate were reported as both the category of susceptibility (resistant (R), susceptible, increased exposure (I), susceptible (S)), and the MIC for the MIC gradient strip and agar dilution methods.

Table 1. 2024 European Committee on Antimicrobial Susceptibility Testing (EUCAST) breakpoints

Antimicrobial	MIC breakpoint (mg/L)		
	S ≤	I	R >
Azithromycin	*		*
Cefixime	0.125		0.125
Ceftriaxone	0.125		0.125
Ciprofloxacin	0.03	0.06	0.06
Spectinomycin	64		64
Tetracycline	0.5		0.5

**: From January 2019, the EUCAST SIR categories have been removed for azithromycin and replaced with an epidemiological cut-off (ECOFF) value of 1 mg/L. Isolates with azithromycin MIC >1 mg/L are hereinafter referred to as resistant. Please note there are currently no EUCAST interpretive criteria for gentamicin [6].*

2.3 Analysis and interpretation of the results

Raw results for the EQA were submitted by each participating laboratory directly to UK NEQAS for the production of individual laboratory reports. The results were also forwarded to UKHSA for further collated analysis.

For the analysis, all MIC results that fell between the MIC gradient strip full-dilution scale were rounded up to the next full MIC gradient strip dilution, as this was the most commonly used testing method. The minimum, maximum, and modal MIC for each strain was established. The number of MIC measurements within two MIC dilutions of the modal MIC were established for each strain, along with the number of MIC measurements above or below two MIC dilutions of the modal MIC.

A percentage of overall MIC concordance for each laboratory was calculated based on the number of isolates within two doubling dilutions of the modal MIC for all antimicrobials, including beta-lactamase from each laboratory. Essential agreement (MICs within one doubling dilution of the modal MIC) was also examined and used as the basis for an overall MIC score for each participating laboratory. The overall MIC score for each laboratory was calculated based on minor and major faults in the MIC for the core antimicrobials ceftriaxone, cefixime, azithromycin, and ciprofloxacin. Where the MIC result matched the modal result, a score of five was assigned; a one MIC doubling dilution difference from the modal was considered a minor fault and a score of four was given; a difference of two doubling dilutions from the modal MIC was classed as a major fault and given a score of one. An MIC greater than two doubling dilutions from the modal was classed as a very major fault and a score of zero was given. The total score was then converted into a percentage of the maximum score achievable (200 = (10x5) + (10x5) + (10x5) + (10x5)).

Consensus categories of susceptibility (categorical agreement) for each strain tested (six in total in this distribution; consensus calculated from all isolates in the triplicate or duplicate sets) were determined once all participating laboratories had reported results back. The 'consensus' was assigned to the category reported most often. The overall concordance for each antimicrobial was established by taking the average of each strain's percentage concordance. The total categorical concordance score was calculated by assigning a score of five for results the same as the consensus, four for a minor fault (susceptible or resistant miscategorised as intermediate or vice versa), three for a major fault (susceptible miscategorised as resistant), and one for a very major fault (resistant miscategorised as susceptible). The overall categorical concordance score for each laboratory was based on the core antimicrobials and beta-lactamase production, and the score was normalised based on the number of agents tested.

Intra-laboratory concordance was examined using the triplicate (strain five) and two duplicate strains (strains one and two). All MIC results for these strains were assigned a score based on the core antimicrobials: five if the same as the other results, four if one MIC doubling dilution different (minor fault), three if two MIC doubling dilutions different (major fault) and zero if greater than two MIC doubling dilutions different (very major fault). These results were then averaged for the total number of results observed and given a percentage error score by comparison to the maximum score possible if there were no faults i.e. 5 = ((5+5+5)/3) + (5+5/2) + (5+5/2))/3). The higher the percentage, the more consistent the laboratory MIC test results were.

3. Results

3.1 QA23 panel strain characteristics

Table 2 shows the overall consensus category, the modal/range MIC for all tests, and the percentage concordance for each strain in the EQA panel. Consensus categories of susceptibility for each strain tested are also shown. The strains tested demonstrated a range of phenotypes:

- one strain was fully susceptible to all antimicrobials tested (Strain 1: WHO F);
- one strain was resistant to both ciprofloxacin and tetracycline (Strain 2: WHO M);
- one strain was resistant to both spectinomycin and tetracycline (Strain 3: WHO O)
- two strains were multidrug-resistant with resistance to ceftriaxone, cefixime and tetracycline, one with high-level resistance to ciprofloxacin (Strain 4: H22-722) and the other had ciprofloxacin resistance and a high-level azithromycin MIC (>256 mg/L, Strain 5; H22-494);
- one strain had ciprofloxacin and tetracycline resistance and an MIC above the azithromycin ECOFF (1 mg/L) (Strain 6; H23-657).

3.2 Susceptibility testing methods

In November 2023, 26 laboratories in 26 countries were dispatched 10 gonococcal isolates (QA23) for susceptibility testing from UK NEQAS. No EQA was distributed in 2022 due to a break in Euro-GASP contracts. Only 24 laboratories returned results to UK NEQAS. Latvia did not receive the freeze-dried specimens for testing although they were dispatched by UK NEQAS, and, due to laboratory reorganisations, Poland was not able to perform susceptibility testing at the time of the EQA (Figure 1). Therefore there were two countries less participating than in the 2021 EQA report, as Romania and Lithuania did not participate in the antimicrobial susceptibility testing (AST) EQA in 2023. None of these four laboratories performs decentralised testing, so the overall percentage of decentralised Euro-GASP laboratories included in the analysis for 2023 has increased to 79% from 47% in 2021. All laboratories provided details on breakpoints/guidelines used, 22 provided data on use of gradient strips, and 20 on media used to test the isolates in the EQA (Table 3). MIC gradient strip tests (100%) and GC agar (35%) were the most common testing methodology and medium used, respectively. However, the use of GC agar, the media recommended for use with most gradient strips, has decreased from 42% in 2021 and 44% in 2020.

Figure 1. Countries participating in the 2023 *N. gonorrhoeae* susceptibility testing EQA scheme

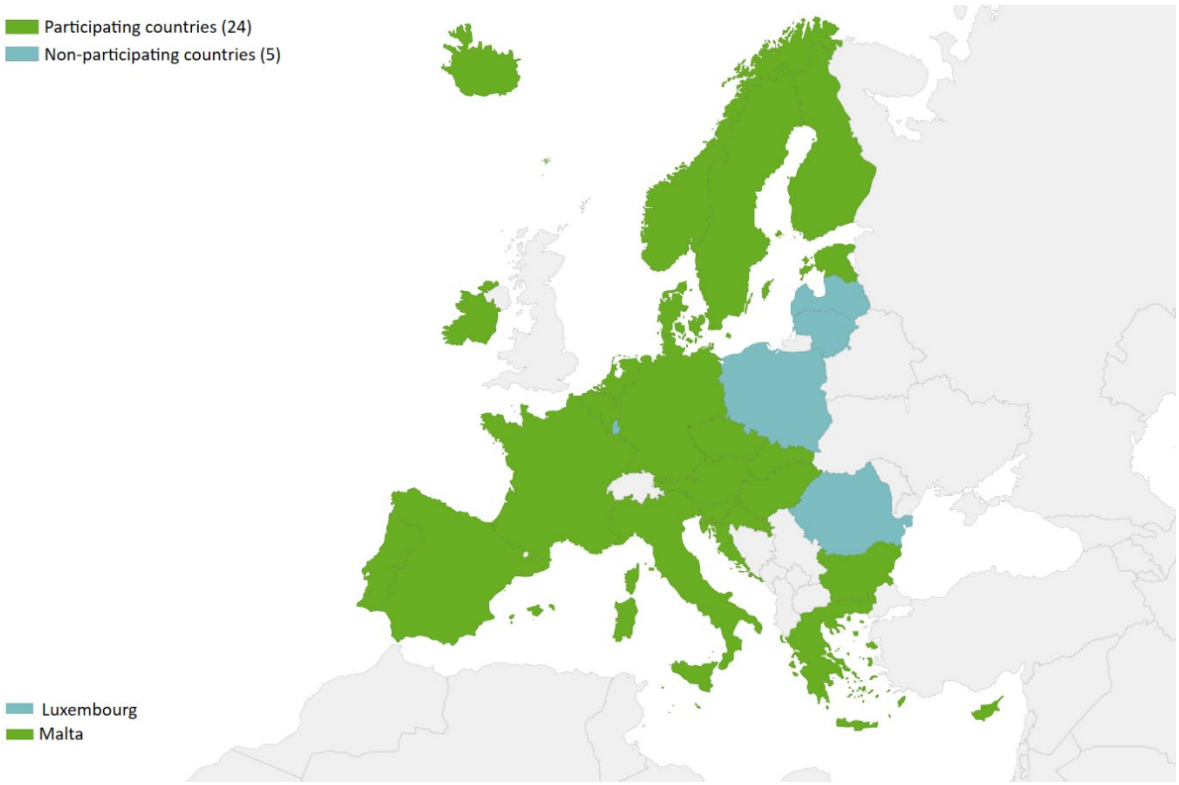


Table 2. Consensus category, modal MIC (range) for MIC gradient strip test and agar dilution (mg/L) and the percentage concordance of susceptibility category for the 2023 EQA panel

Strain		Azithromycin consensus	Cefixime consensus	Ceftriaxone consensus	Ciprofloxacin consensus	Gentamicin consensus	Spectinomycin consensus	Tetracycline consensus	Beta-lactamase consensus
Strain 1: 8471/8472 (WHO F [3])	Consensus category	S	S	S	S	N/A	S	S	NEG
	Modal MIC (range)	0.125 (0.032–0.25)	≤0.016 (0.004–0.016)	≤0.016 (≤0.002–≤0.016)	0.002 (≤0.002–0.016)	4 (1–8)	16 (2–32)	0.125 (0.064–4)	N/A
	Susceptibility category concordance (%)	100	100	100	100	N/A	100	95.5	100
	Reference MIC [3]	0.125	≤0.016	≤0.002	0.004	4	16	0.25	NEG
Strain 2: 8473/8474 (WHO M [3]) CipR, TetR	Consensus category	S	S	S	R	N/A	S	R	POS
	Modal MIC (range)	0.5 (0.125–16)	≤0.016 (≤0.016)	≤0.016 (0.004–0.016)	1 (0.25–4)	8 (2–8)	16 (1–32)	2 (0.5–32)	N/A
	Susceptibility category concordance (%)	100	100	100	100	N/A	100	95.5	97.6
	Reference MIC [3]	0.25	≤0.016	0.016	2	4	16	2	POS
Strain 3: 8475 (WHO O [3]) SpecR, TetR	Consensus category	S	S	S	S	N/A	R	R	POS
	Modal MIC (range)	0.5 (0.125–1)	0.016 (0.016–0.032)	0.016 (0.004–0.032)	0.008 (0.004–0.032)	4 (2-8)	>1024 (>1024)	2 (0.5–16)	N/A
	Susceptibility category concordance (%)	100	100	100	100	N/A	100	95.5	100
	Reference MIC [3]	0.25	0.016	0.032	0.008	4	>1024	2	POS
Strain 4: 8476 (H22–722) CfmR, CroR, CipR, TetR	Consensus category	S	R	R	R	N/A	S	R	NEG
	Modal MIC (range)	0.5 (0.125–0.5)	2 (0.125–4)	0.5 (0.125–1)	>32 (4–>32)	8 (2–8)	16 (2–32)	2 (0.5–16)	N/A
	Susceptibility category concordance (%)	100	95.7	95.7	100	N/A	93.8	86.4	100
	Reference MIC*	0.25	2	1	>32	8	8	1	NEG
Strain 5: 8477/8478/84	Consensus category	R	R	R	R	N/A	S	R	POS

Strain		Azithromycin consensus	Cefixime consensus	Ceftriaxone consensus	Ciprofloxacin consensus	Gentamicin consensus	Spectinomycin consensus	Tetracycline consensus	Beta-lactamase consensus
79 (H22–494) CfmR, CroR, Azi>256 mg/L, CipR, TetR	Modal MIC (range)	>256 (256–>256)	2 (0.5–≥2)	0.25 (0.125–0.5)	8 (1–>32)	8 (1–16)	16 (1–64)	16 (2–64)	N/A
	Susceptibility category concordance (%)	100	100	84.1	100	N/A	97.9	100	100
	Reference MIC*	>256	1	0.25	8	2	8	8	POS
Strain 6: 8480 (H23-657) Azi> 1 mg/L, CipR, TetR	Consensus category	S	S	S	R	N/A	S	R	NEG
	Modal MIC (range)	1 (0.016–4)	≤0.016 (≤0.016–0.032)	≤0.016 (0.002–0.016)	4 (1–>32)	4 (1–8)	16 (2–32)	1 (0.25–8)	N/A
	Susceptibility category concordance (%)	55.6	100	100	100	N/A	100	50	100
	Reference MIC*	1	≤0.016	≤0.016	4	4	8	0.5	NEG

** MICs taken from UK NEQAS reference MIC results.*
Note: No consensus category of susceptibility was assigned to gentamicin as there are currently no published breakpoints for this antimicrobial.
S: susceptible; N/A: not available; MIC: minimum inhibitory concentration; WHO: World Health Organization; BLP: beta-lactamase production; Azi: azithromycin; CfmR: cefixime-resistant; CroR: ceftriaxone-resistant; CipR: ciprofloxacin-resistant; SpcR: spectinomycin-resistant; TetR: tetracycline-resistant; R: resistant; NEG: negative; POS: positive. [3]: see 3 in reference list.

3.3 Interpretation of MICs

All 24 laboratories reported adherence to the EUCAST breakpoints (Table 1) [6]. Most laboratories that tested gentamicin did not interpret categories of susceptibility as there are currently no internationally defined interpretive criteria for this antimicrobial. Although three laboratories did submit categories of susceptibility for gentamicin using local interpretive criteria, these data were not analysed in this report.

Table 3. Susceptibility testing methods used by participating laboratories, November 2023 EQA

	Number of participating laboratories (%)	
Type of susceptibility test used	**2021**	**2023**
MIC gradient strip tests	25 (96%)	22 (100%)
Agar dilution	2 (8%)	2 (9%)*
Testing guidelines used		
EUCAST	26 (100%)	24 (100%)
Agar base used†		
GC agar base	11 (42%)	7 (35%)
Chocolatised blood agar	9 (35%)	6 (30%)
Diagnostic sensitivity agar	1 (4%)	0 (0%)
Thayer-Martin/Mueller-Hinton	3 (12%)	4 (20%)
Other	2 (8%)	3 (15%)‡

** Countries that reported using agar dilution also reported use of some gradient strips.*
† Four countries did not respond to the question on media used in 2023.
‡ All 'other' media used in 2023 were PolyViteX 2023.

3.4 Coded breakdown of concordance

Due to the confidential nature of the EQA scheme, only coded laboratory breakdowns for beta-lactamase assessment concordance, category of susceptibility concordance, and MIC values for MIC gradient strip tests and agar dilution method are shown in the Annex (Tables A1.1–A1.14). Analysis of the results breakdown highlighted seven laboratories that reported isolates with MICs greater than two doubling dilutions different from the modal MIC, which is a large improvement on 12 in 2021. Two laboratories reported more than 5% of results greater than two doubling dilutions from the modal MIC. One of these participates in Euro-GASP via centralised testing. The other had issues with spectinomycin and gentamicin, which are non-core antimicrobials so will have minimal impact on the Euro-GASP data. These laboratories will be supported to improve the quality of their susceptibility testing.

In the 2021 EQA (QA21), five laboratories reported more than 5% of results greater than two doubling dilutions from the modal MIC. All those participating in the 2023 EQA improved their results in this EQA and now have less than 5% of results more than two doubling dilutions from the modal.

3.5 Susceptibility category concordance

Susceptibility category data for ciprofloxacin were submitted from all 24 laboratories, cefixime and ceftriaxone from 23 laboratories, tetracycline from 22 laboratories, beta-lactamase production from 21 laboratories, azithromycin from 20 laboratories (plus one that reported only above ECOFF) and spectinomycin from 16 laboratories. Two laboratories submitted incomplete susceptibility category results.

Incomplete data were submitted for:

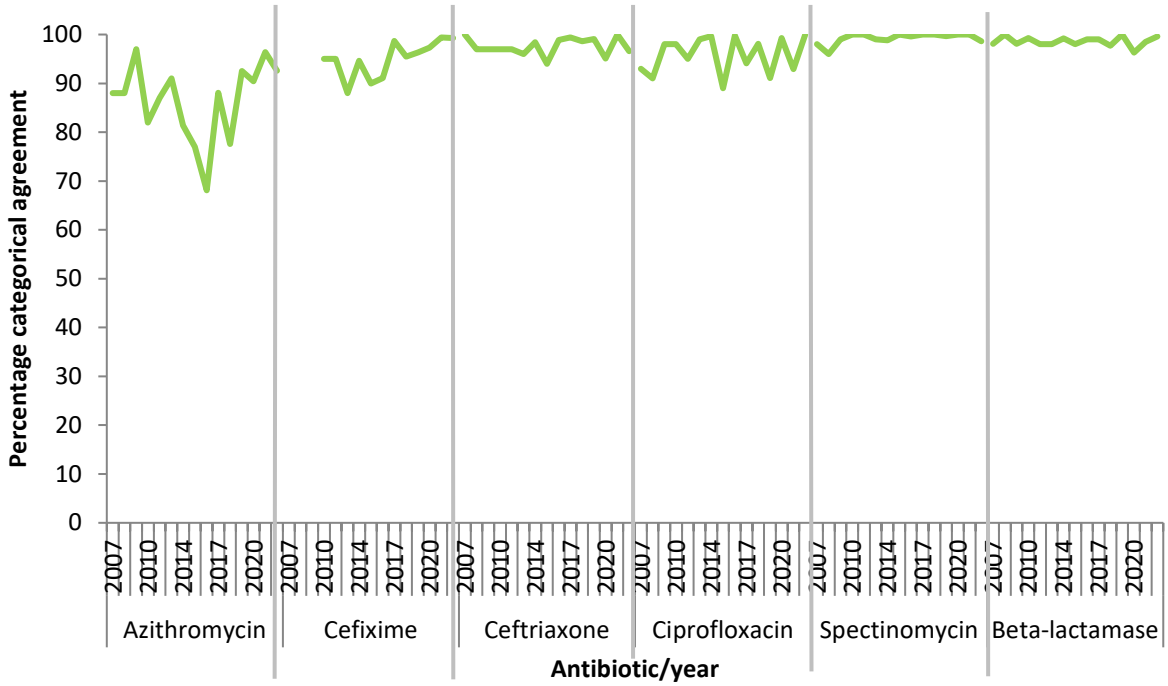
- Azithromycin (laboratory 92626 did not assign an SIR category for isolates with MICs below the ECOFF, and laboratories 90984, 92623 and 94937 did not interpret any azithromycin MICs);
- Cefixime (laboratory 90984 did not interpret any cefixime MICs);
- Ceftriaxone (laboratory 93997 (isolate 8471 only));
- Ciprofloxacin (laboratory 93997 (isolate 8475 only)).

One laboratory (92629) did not test for azithromycin (Tables A1.1-A1.2). Laboratory 92628 did not test for ceftriaxone (Table A1.5-A1.6). Laboratories 90984, 92613, 92621, 92624, 92629, 93997, 94936, and 94938 did not test for spectinomycin susceptibility (Table A1.9-A1.10). Three laboratories (92629, 94936 and 95589) did not test for the production of beta-lactamases (Table A1.12). Two laboratories (92624 and 92629) did not test for tetracycline (Table A1.13-A1.14).

The highest levels of categorical agreement were seen for ciprofloxacin (100%), closely followed by beta-lactamase detection (99.6%) and cefixime (99.3%). The lowest level was seen for tetracycline, with 87.1% concordance (Tables A1.1, A1.3, A1.5, A1.7, A1.9, A1.12, and A1.13). Consensus susceptibility categories were not assigned for gentamicin as there are currently no published breakpoints for interpretation of results.

When categorical agreement data are compared with previous EQA distributions from both ESSTI (QA2007, QA2008 and QA2009) [7] and ECDC Euro-GASP (QA2010-21) [8-17], there is consistency or a slight increase in concordance for most antimicrobials tested (Figure 2). The exceptions are azithromycin, decreased from 96.4% to 92.6%, and ceftriaxone which decreased from 100% to 96.6%. Azithromycin and ceftriaxone concordance both fluctuate annually and are still at a higher level in this EQA distribution than in 2020 (90.4% and 95.1% respectively).

Figure 2. Longitudinal comparison of EQA interlaboratory antimicrobial categorical agreement, EU/EEA, 2007–2023



Note: Cefixime was added to the EQA scheme in 2010. Tetracycline is not shown as it was added to the EQA in 2023.
ESSTI EQA distributions (2007 – 2009) constituted 30 isolates (10 strains in triplicate).
The number of laboratories participating in the EQA changed over time: 19 laboratories (2007 and 2008), 16 laboratories (2009), 18 laboratories (2010), 20 laboratories (2011), 19 laboratories (2012), 21 laboratories (2014), 26 laboratories (2015), 27 laboratories (2016), 28 laboratories (2017), 27 laboratories (2018), 28 laboratories (2019), 25 laboratories (2020), 26 laboratories (2021) and 24 laboratories (2023).

3.6 MIC concordance

Overall, MIC essential agreement (MIC results within one doubling dilution of the modal MIC) was at 89.1% for all antimicrobials tested (Table 4), which is a significant decrease from the level of essential agreement achieved with the previous EQA panel distribution in 2021 (91.5%, p=0.03) [17]. Tetracycline was included for the first time in 2023; therefore, MIC essential agreement was recalculated without tetracycline to allow comparison of agents tested in both 2021 and 2023. Without tetracycline, 89.8% of reported MICs were in essential agreement and there was no significant difference compared to 2021 (91.5%, p=0.15). The highest level of essential agreement was seen for ceftriaxone (99.5%) and lowest for tetracycline (84.8%) (Table 4). This is a change from QA21 results in which the highest essential agreement was observed for cefixime (98.8%) and the lowest for ceftriaxone (84.8%) [17]. For all MICs combined, 97.8% were within two doubling dilutions of the modal MIC. After excluding tetracycline, 98.1% of reported MICs were within two doubling dilutions of the modal MIC. Spectinomycin had the highest proportion of isolates with an MIC greater than two doubling dilutions from the modal MIC (5.6%), and ceftriaxone had the lowest (0.0%). The decreases observed for azithromycin, gentamicin, and spectinomycin were all significant compared to the 2021 EQA distribution (p=0.01, p=0.01 and p=0.04, respectively). Most errors reported for these agents were from a subset of laboratories, which will be supported to improve the quality of their susceptibility testing.

When MIC concordance data are compared with previous ECDC Euro-GASP EQA distributions (QA2010-21) [8-17], the MIC concordance for all antimicrobials tested except ceftriaxone have decreased since 2021 (Figure 3).

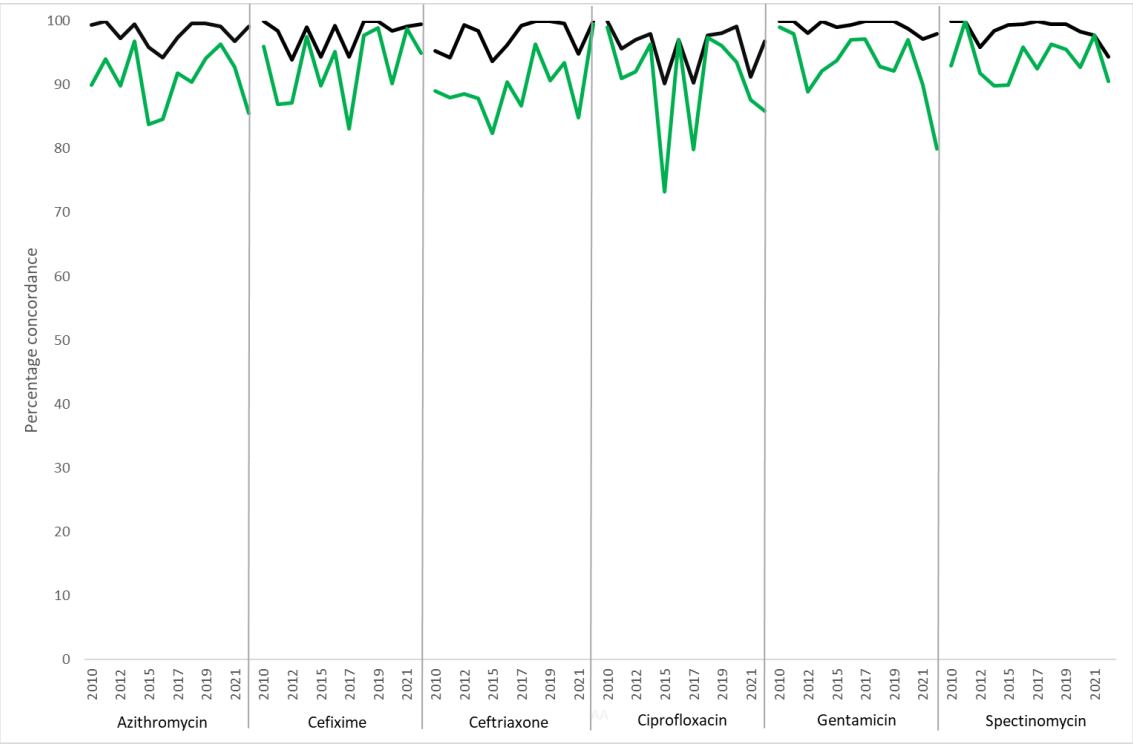
Table 4. Variation from modal MIC for EQA QA23

QA23	Azi		Cfm		Cro		Cip		Gen		Spc		Tet		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Within +/- 1 doubling dilution	188	85.5	209	95.0	209	99.5	189	85.9	120	80.0	145	90.6	178	84.8	1238	89.1
Within +/- 2 doubling dilutions	218	99.1	219	99.5	210	100.0	213	96.8	147	98.0	151	94.4	201	95.7	1359	97.8
More than +/- 2 doubling dilutions	2	0.9	1	0.5	0	0.0	7	3.2	3	2.0	9	5.6	9	4.3	31	2.2
Total no. of isolates with MIC data	220		220		210		220		150		160		210		1390	

Azi: azithromycin; Cfm: cefixime; Cro: ceftriaxone; Cip: ciprofloxacin; Gen: gentamicin; Spc: spectinomycin; Tet: tetracyline; No.: number of isolates.

Some percentages may not add up to 100% due to rounding.

Figure 3. Longitudinal comparison of EQA interlaboratory MIC concordance, percentage of essential agreement (green line) and percentage of results within two doubling dilutions of the modal MIC (black line), EU/EEA, 2010–2023

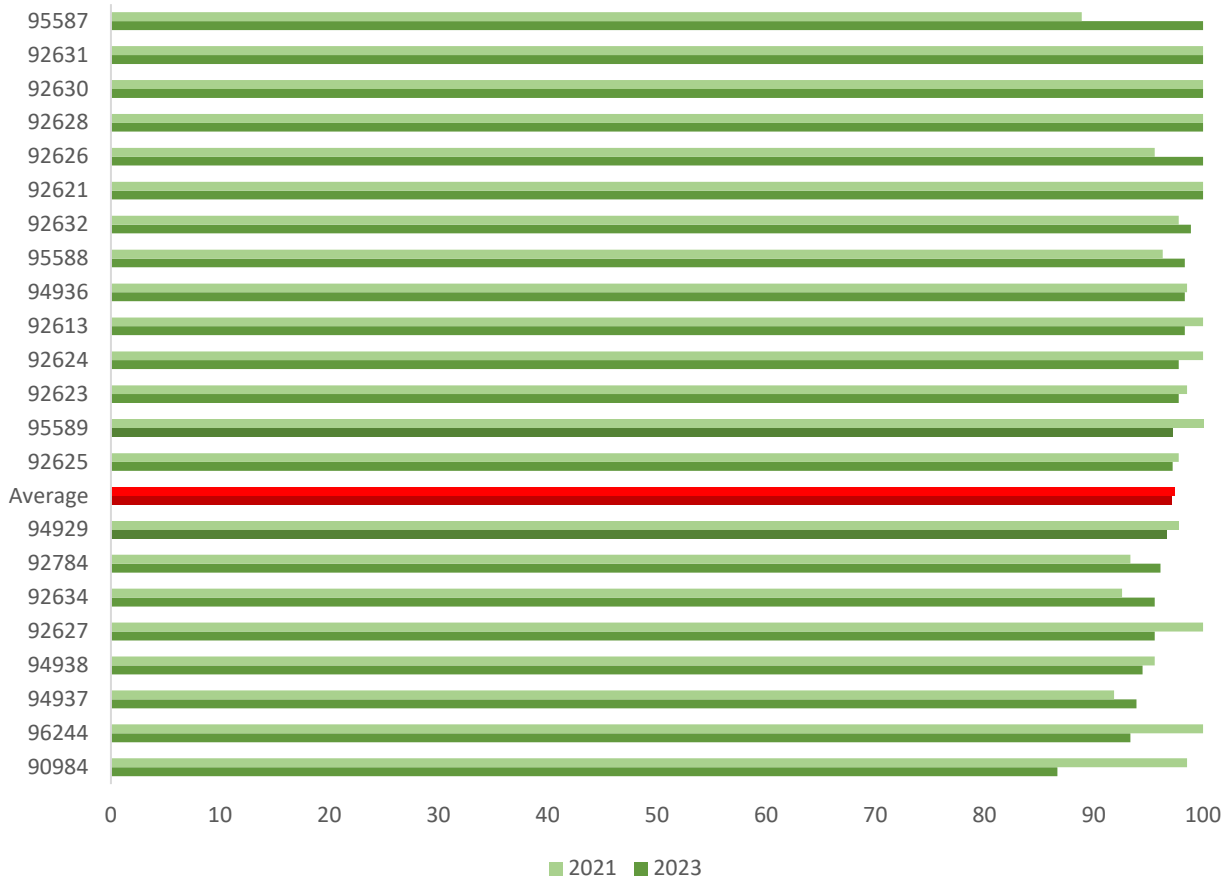


Note: The number of laboratories participating in the EQA changed over time: 18 laboratories (2010), 20 laboratories (2011), 19 laboratories (2012), 21 laboratories (2014), 26 laboratories (2015), 27 laboratories (2016), 28 laboratories (2017), 27 laboratories (2018), 28 laboratories (2019), 25 laboratories (2020) and 26 laboratories (2021), and 24 laboratories (2023). Tetracycline is not shown as it was added to the EQA in 2023.

3.7 Intralaboratory concordance

Intra-laboratory concordance was examined using the triplicate (strain five) and two duplicate strains (strains one and two). Figure 4 shows the results for the 2023 concordance scores in comparison with average scores for 2023 (97.1%) and 2021 (97.4%, calculated for the subset of laboratories participating in QA23). Most laboratories performed well, with 81.8% of laboratories (18/22) scoring 95% concordance or higher, including six laboratories obtaining a perfect score of 100%. Of the four laboratories scoring less than 95%, three participate in Euro-GASP via decentralised testing. All four laboratories achieved essential agreement, except for one laboratory with one very major fault and one major fault, and another laboratory with one major fault. There is low risk for data provided to the TESSy database because these laboratories submit small numbers of isolates or participate via centralised testing. Only one laboratory (a centralised testing laboratory) with an intra-laboratory concordance score below 95% in the 2021 EQA distribution also scored less than 95% concordance in the 2021 distribution. Two laboratories with an intra-laboratory concordance score of less than 95% in the 2021 EQA improved in the 2023 distribution and scored over 95% concordance.

Figure 4. Intra-laboratory MIC concordance percentage 2021 versus 2023

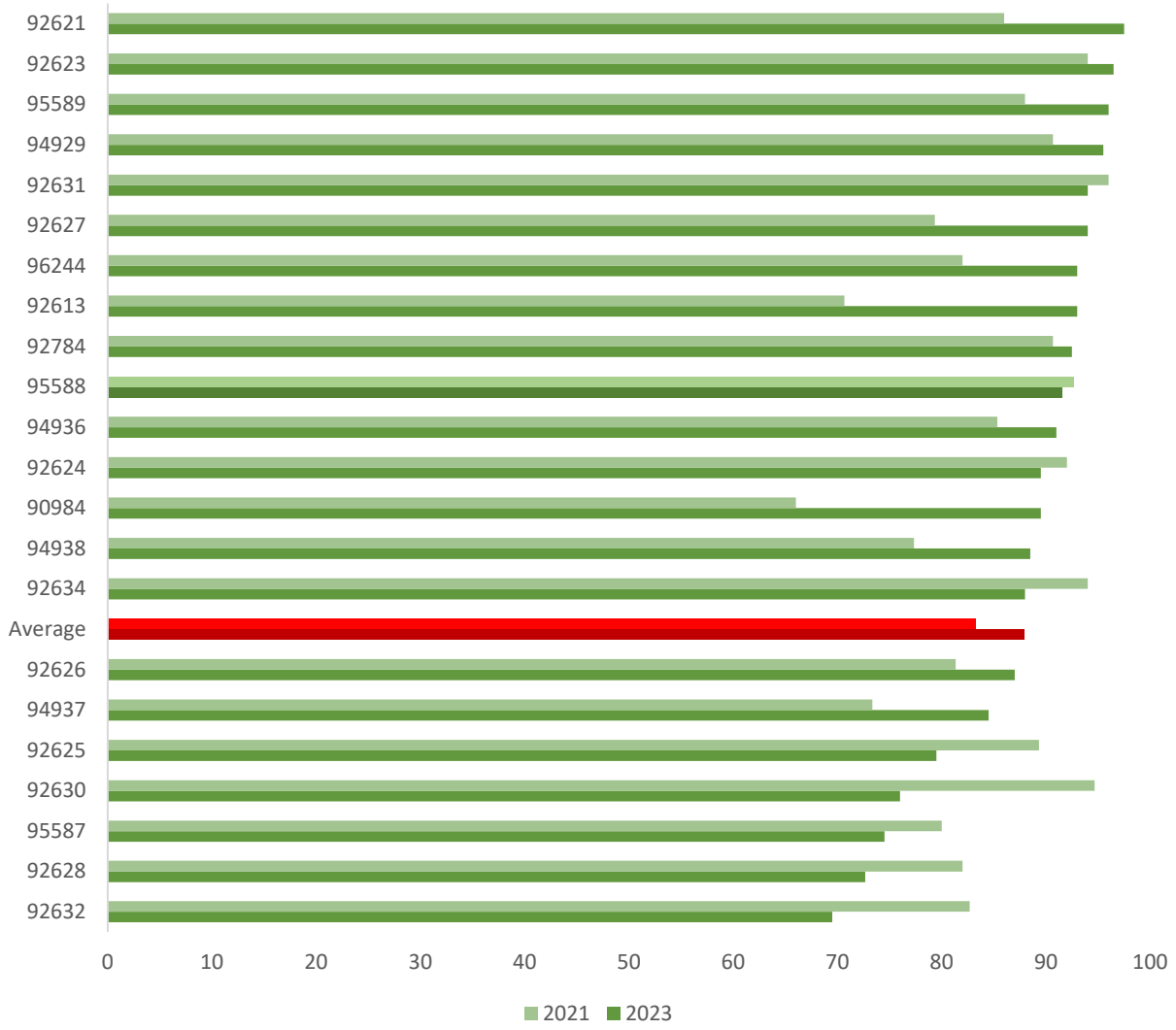


Laboratories 93997 and 92629 are not included in the chart as MIC values were not available for the core antimicrobials in 2023.

3.8 Overall EQA scores

Figure 5 shows the overall MIC scores for the 2023 EQA versus the 2021 EQA, with the average score shown in red (2023: 87.9% (dark red); 2021: 83.3% (light red)). For the 2023 EQA, seven laboratories scored a below average result, two of which had over 5% of results more than two doubling dilutions from the modal MIC. The scores for overall categorical agreement are shown in Figure 6. The total score achieved by each laboratory out of a potential 250 is shown by the bars, which are coloured to show the composition of the score by none, minor, major, and very major faults, with the overall percentage score value shown at the base of each bar.

Figure 5. EQA overall MIC scores, 2021 versus 2023



Laboratories 93997 and 92629 are not included in the chart as MIC values were not available for the core antimicrobials in 2023.

Figure 6. EQA overall categorical agreement scores, 2023

Maximum possible score for all laboratories was 250, unless otherwise specified.

** Maximum possible score was 200.*

† Maximum possible score was 235.

‡ Maximum possible score was 150.

§ Maximum possible score was 215.

4. Discussion

The 2023 Euro-GASP EQA distribution was sent out to 26 laboratories in 26 participating countries, most laboratories (92.3%, 24/26) reported results for all or most of the requested tests. One laboratory unfortunately did not receive the specimens to test (due to issues with customs) and one laboratory did not have capacity to perform the testing to meet the UK NEQAS deadline. All laboratories (100%) used MIC gradient strip tests to perform antimicrobial susceptibility testing for at least one antimicrobial in *N. gonorrhoeae*. All laboratories stated that they used EUCAST guidelines to interpret MIC results; however, it was established that two laboratories adhered to CLSI breakpoints for tetracycline. Nonetheless, the results show the continuing implementation of the EUCAST guidelines and MIC gradient strip tests across the EU/EEA. The GC agar base continues to be the most frequently used media, followed by chocolatised blood agar. However, the use of GC agar (the media recommended for *N. gonorrhoeae* susceptibility testing) has decreased over the years and the reason for this requires more exploration.

In general, the categorical agreement increased or remained consistent for most antimicrobials compared to the previous 2021 distribution; the exceptions were azithromycin and ceftriaxone, for which categorical agreement decreased (from 96.4% and 100% in 2021 to 92.6% and 96.6% respectively in 2023). The highest increase was seen in ciprofloxacin (from 92.9% to 100%). For azithromycin, one of the strains had an MIC close to the ECOFF (modal MIC = 1 mg/L, reference MIC = 1 mg/L, ECOFF MIC>1 mg/L) so the lower categorical agreement was not unexpected. Similarly for ceftriaxone, one of the strains distributed in triplicate had an MIC close to the breakpoint (modal MIC = 0.25 mg/L, reference MIC = 0.25 mg/L, resistance breakpoint MIC>0.125 mg/L) so the lower categorical agreement was not unexpected. The increase in categorical concordance for ciprofloxacin is probably due to the lack of isolates included in the 2023 distribution with an MIC close to the resistance breakpoint (>0.06 mg/L).

Overall, categorical agreement scores were high for the core antimicrobials and beta-lactamase, with only one laboratory scoring less than 95%. This was due to one failure to detect beta-lactamase activity and one incorrect interpretation of an MIC result, which was probably a transcription error (same MIC value correctly interpreted for two other isolates). Eight laboratories had a very major fault (calling a resistant isolate susceptible). Six laboratories correctly interpreted the reported ceftriaxone MIC for strain 5; however, the MIC detected was just one doubling dilution lower than the modal MIC (0.25 mg/L), resulting in a very major error in the resistance category interpretation. One laboratory had a very major fault for strain 8476 for cefixime, and another had a very major fault for failure to detect beta-lactamase activity for strain 8473. Two of these laboratories participate in Euro-GASP via centralised testing and one participates via decentralised testing but only reports very low numbers of results annually. The average categorical concordance for the core antimicrobials was 98.7%, an improvement on the 83.3% observed in 2021 (calculated for laboratories participating in QA23). Essential MIC agreement was improved from the 2021 distribution (87.9% compared to 83.3%). The increase observed for 2023 is possibly a consequence of the different laboratories participating in each distribution, with an increase in the proportion of decentralised countries which have more experience of MIC testing, in 2023 (79% decentralised compared to 67% in 2021). Concordance of beta-lactamase detection increased slightly in 2023, from 98.5% to 99.6%.

Breakdown of EQA susceptibility testing results by laboratory allowed for detailed analysis of individual laboratory performance. In the 2023 EQA, in general laboratories performed well, with a good level of interlaboratory and intralaboratory concordance of results. Two laboratories reported more than 5% of results greater than two MIC doubling dilutions from the modal MIC, a decrease from five in 2021, which is partially explainable by the differences in participating laboratories included in the two years with a decrease in non-decentralised testing laboratories. One of these laboratories participates via centralised testing and in the other the majority of very major faults (12/13) occurred for the non-core antimicrobials spectinomycin and gentamicin. This gives confidence for the quality of data for core antimicrobials in TESSy.

It should be noted that the methods used for the antimicrobial susceptibility testing and the breakpoints used have changed over time, although there has been greater consistency in recent years. A full analysis of the different methods and breakpoints used in Euro-GASP EQAs over the years has been published [18].

5. Conclusion

The laboratories participating in the QA23 EQA scheme for antimicrobial susceptibility testing of *N. gonorrhoeae* showed good levels of competency and capability in recovering and testing strains of unknown phenotype. Intra-laboratory essential agreement for the different strains remained high for the QA23 EQA distribution, showing consistency of testing within laboratories. Inter-laboratory essential agreement increased in 2023 compared to 2021, promoting confidence in Euro-GASP decentralised antimicrobial susceptibility testing and comparison of surveillance data from the members of the Euro-GASP network. These results indicate that the Euro-GASP antimicrobial surveillance quality is of a good standard.

This Euro-GASP EQA is important for ensuring that results from different submitting laboratories are comparable and that significant over- and under-reporting of antimicrobial resistance does not occur. It is also important that reference laboratories have access to appropriate internal quality control (IQC) strains, such as the WHO control panel (3), to routinely ensure their own quality assurance in a variety of diagnostic and antimicrobial susceptibility testing. Antimicrobial susceptibility results from Euro-GASP contribute to the evidence base of gonorrhoea treatment guidelines and local susceptibility testing can be used for individual patient management, which is why confidence in reporting is essential.

References

1. European Centre for Disease Prevention and Control (ECDC). Gonococcal Antimicrobial Surveillance Reporting Protocol 2021. Stockholm: ECDC; 2021. (Available upon request.)
2. European Centre for Disease Prevention and Control (ECDC). Gonococcal antimicrobial susceptibility surveillance in Europe 2019. Stockholm: ECDC; 2021. Available at: https://www.ecdc.europa.eu/sites/default/files/documents/Gonococcal-antimicrobial-susceptibility-surveillance-2019.pdf
3. Unemo M, Golparian D, Sánchez-Busó L, Grad Y, Jacobsson S, Ohnishi M, et al. The novel 2016 WHO *Neisseria gonorrhoeae* reference strains for global quality assurance of laboratory investigations: phenotypic, genetic and reference genome characterization. J Antimicrob Chemother. 2016 11;71(11):3096-108.
4. 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;38:100871. Available at https://www.thelancet.com/pdfs/journals/lanepe/PIIS2666-7762(24)00037-1.pdf
5. European Centre for Disease Prevention and Control (ECDC). ECDC Instructions. External Quality Assessment. European Gonococcal Antimicrobial Surveillance Programme 2023–2027. Stockholm: ECDC; 2023. (Available upon request).
6. The European Committee on Antimicrobial Susceptibility Testing. Breakpoint tables for interpretation of MICs and zone diameters. Version 13.1, 2023. Available at: http://www.eucast.org
7. European Surveillance of Sexually Transmitted Infections (ESSTI). EuroGASP Annual Report 3. Health Protection Agency, London, UK. 2008. (Available upon request.)
8. European Centre for Disease Prevention and Control (ECDC). European gonococcal antimicrobial resistance quality assurance programme, 2010 – 2011. EuroGASP External Quality Assurance Report. Stockholm: ECDC; 2011. (Available upon request).
9. European Centre for Disease Prevention and Control (ECDC). European gonococcal antimicrobial resistance quality assurance programme, October 2011. EuroGASP External Quality Assurance Report. Stockholm: ECDC; 2011. (Available upon request).
10. European Centre for Disease Prevention and Control (ECDC). External quality assessment (EQA) scheme for *Neisseria gonorrhoeae* as part of the European Sexually Transmitted Infections (STI) surveillance network, 2012. Stockholm: ECDC; 2013. (Available upon request).
11. European Centre for Disease Prevention and Control (ECDC). External quality assessment (EQA) scheme for *Neisseria gonorrhoeae* as part of the European Sexually Transmitted Infections (STI) surveillance network, 2014. Stockholm: ECDC; 2014. (Available upon request).
12. European Centre for Disease Prevention and Control (ECDC). Euro-GASP external quality assessment scheme for *Neisseria gonorrhoeae* antimicrobial susceptibility testing, 2015. Stockholm: ECDC; 2017. Available at: https://ecdc.europa.eu/sites/portal/files/media/en/publications/Publications/EQA-Eur-GASP-2015-Gono.pdf
13. European Centre for Disease Prevention and Control (ECDC). Euro-GASP external quality assessment scheme for *Neisseria gonorrhoeae* antimicrobial susceptibility testing, 2016. Stockholm: ECDC; 2017. Available at: https://ecdc.europa.eu/sites/portal/files/documents/EQA%20Report%202016%20final.pdf
14. European Centre for Disease Prevention and Control (ECDC). Euro-GASP external quality assessment scheme for *Neisseria gonorrhoeae* antimicrobial susceptibility testing, 2017. Stockholm: ECDC; 2018. Available at: https://ecdc.europa.eu/sites/portal/files/documents/Neisseria-gonorrhoeae-Euro-GASP-EQA-2017-final.pdf
15. European Centre for Disease Prevention and Control (ECDC). Euro-GASP external quality assessment scheme for *Neisseria gonorrhoeae* antimicrobial susceptibility testing, 2018. Stockholm: ECDC; 2019. Available at: https://www.ecdc.europa.eu/sites/default/files/documents/Euro-GASP-EQA%202018.pdf
16. European Centre for Disease Prevention and Control (ECDC). Euro-GASP external quality assessment scheme for *Neisseria gonorrhoeae* antimicrobial susceptibility testing, 2019. Stockholm: ECDC; 2021. Available at: https://www.ecdc.europa.eu/sites/default/files/documents/Euro-GASP-EQA-2019-Neisseria-gonorrhoeae-antimicrobial-susceptibility-testing.pdf
17. European Centre for Disease Prevention and Control (ECDC). Euro-GASP external quality assessment scheme for *Neisseria gonorrhoeae* antimicrobial susceptibility testing, 2020. Stockholm: ECDC; 2021. Available at: https://www.ecdc.europa.eu/sites/default/files/documents/Euro-GASP-EQA-2020-for-Neisseria-gonorrhoeae-antimicrobial-susceptibility-testing.pdf
18. Cole MJ, Quaye N, Jacobsson S, Day M, Fagan E, Ison C, et al. Ten years of external quality assessment (EQA) of *Neisseria gonorrhoeae* antimicrobial susceptibility testing in Europe elucidate high reliability of data. BMC Infect Dis. 2019 Mar 25;19(1):281. Available at: https://bmcinfectdis.biomedcentral.com/articles/10.1186/s12879-019-3900-z

Annex 1. QA23 detailed results

Table A1.1. **Country coded category of susceptibility concordance – azithromycin**

		Laboratory codes																											
	Strain	90984	92613	92621	92623	92624	92625	92626	92627	92628	92629	92630	92631	92632	92634	92784	93997	94929	94936	94937	94938	95587	95588	95589	96244	Total	No. S	No. I	No. R	Consensus	Concordance (%)
1	8471	N	S	S	N	S	S	N	S	S	N	S	S	S	S	S	S	S	S	N	S	S	S	S	S	38	38	0	0	S	100.0
	8472	N	S	S	N	S	S	N	S	S	N	S	S	S	S	S	S	S	S	N	S	S	S	S	S						
2	8473	N	S	S	N	S	S	N	S	S	N	S	S	S	S	S	S	S	S	N	S	S	S	S	S	38	38	0	0	S	100.0
	8474	N	S	S	N	S	S	N	S	S	N	S	S	S	S	S	S	S	S	N	S	S	S	S	S						
3	8475	N	S	S	N	S	S	N	S	S	N	S	S	S	S	S	S	S	S	N	S	S	S	S	S	19	19	0	0	S	100.0
4	8476	N	S	S	N	S	S	N	S	S	N	S	S	S	S	S	S	S	S	N	S	S	S	S	S	19	19	0	0	S	100.0
5	8477	N	R	R	N	R	R	R	R	R	N	R	R	R	R	R	R	R	R	N	R	R	R	R	R	60	0	0	60	R	100.0
	8478	N	R	R	N	R	R	R	R	R	N	R	R	R	R	R	R	R	R	N	R	R	R	R	R						
	8479	N	R	R	N	R	R	R	R	R	N	R	R	R	R	R	R	R	R	N	R	R	R	R	R						
6	8480	N	R	R	N	S	S	N	S	S	N	S	R	S	S	R	N	R	R	N	S	R	S	S	R	18	10	0	8	S	55.6
																														Total	92.6

N: no result; not retrieved or susceptibility category not supplied.

Table A1.2. **Country coded MIC values (mg/L) – azithromycin**

		Laboratory codes																											
	Strain	90984	92613	92621	92623	92624	92625	92626	92627	92628	92629	92630	92631	92632	92634	92784	93997	94929	94936	94937	94938	95587	95588	95589	96244	Modal MIC	Min MIC	Max MIC	2 dilutions different	>2 dilutions different
1	8471	0.125	0.125	0.125	0.125	0.064	0.032	0.125	0.125	0.064	N	0.032	0.125	0.064	0.25	0.25	N	0.125	0.25	0.032	0.125	0.25	0.064	0.125	0.25	0.125	0.032	0.25	5	0
	8472	0.125	0.125	0.125	0.125	0.064	0.064	0.125	0.064	0.064	N	0.032	0.125	0.064	0.25	0.25	N	0.125	0.25	0.032	0.064	0.25	0.125	0.125	0.25					
2	8473	0.25	0.5	0.5	0.5	0.25	0.25	0.5	0.25	0.125	N	0.125	0.25	0.125	0.5	1	N	0.5	1	0.125	0.125	1	0.25	0.5	0.5	0.5	0.125	16	9	1
	8474	16	0.5	0.5	0.5	0.25	0.25	0.5	0.25	0.125	N	0.125	0.25	0.125	0.5	0.5	N	0.25	1	0.125	0.25	1	0.25	0.5	1					
3	8475	0.25	0.5	0.5	0.5	0.125	0.25	0.25	0.25	0.125	N	0.125	0.25	0.125	0.5	0.5	N	0.5	1	0.125	0.125	0.5	0.125	0.5	0.5	0.5	0.125	1	7	0
4	8476	0.25	0.5	0.5	0.25	0.125	0.125	0.25	0.25	0.125	N	0.125	0.5	0.125	0.25	0.5	N	0.25	0.5	0.125	0.125	0.5	0.25	0.5	0.5	0.5	0.125	0.5	7	0
5	8477	256	>256	>256	>256	>256	>256	>256	>256	>256	N	>256	>256	>256	>256	>=256	N	>256	256	>256	>256	>256	>256	>256	>256	>256	256	>256	0	0
	8478	256	>256	>256	>256	>256	>256	>256	>256	>256	N	>256	>256	>256	>256	>=256	N	>256	256	>256	>256	>256	>256	>256	>256					
	8479	>256	>256	>256	>256	>256	>256	>256	>256	>256	N	>256	>256	>256	>256	>=256	N	>256	256	>256	>256	>256	>256	>256	>256					
6	8480	0.016	4	2	2	1	1	1	1	1	N	0.5	2	0.5	1	2	N	2	2	0.5	1	4	1	1	2	1	0.016	4	2	1

N: no result; not retrieved, not tested or MIC not supplied.

Note: Laboratories 92629 and 93997 did not submit azithromycin data.

Table A1.3. Country coded category of susceptibility concordance – cefixime

		Laboratory codes																												
	Strain	90984	92613	92621	92623	92624	92625	92626	92627	92628	92629	92630	92631	92632	92634	92784	93997	94929	94936	94937	94938	95587	95588	95589	96244	Total	No. S	No. I	No. R	Consensus	Concordance (%)
1	8471	N	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	46	46	0	0	S	100.0
	8472	N	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S						
2	8473	N	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	46	46	0	0	S	100.0
	8474	N	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S						
3	8475	N	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	23	23	0	0	S	100.0
4	8476	N	R	R	R	R	R	R	R	S	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	23	1	0	22	R	95.7
5	8477	N	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	69	0	0	69	R	100.0
	8478	N	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R						
	8479	N	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R						
6	8480	N	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	23	23	0	0	S	100.0
																														Total	99.3

N: no result; not retrieved or susceptibility category not supplied.

Table A1.4. Country coded MIC values (mg/L) – cefixime

		Laboratory codes																												
	Strain	90984	92613	92621	92623	92624	92625	92626	92627	92628	92629	92630	92631	92632	92634	92784	93997	94929	94936	94937	94938	95587	95588	95589	96244	Modal MIC	Min MIC	Max MIC	2 dilutions different	>2 dilutions different
1	8471	<0.016	<0.016	0.004	<0.016	<0.016	<0.016	<0.016	<0.016	<0.016	N	<0.016	<0.016	<0.016	<0.016	<0.016	N	<0.016	0.016	0.016	<0.016	<0.016	<=0.016	<0.016	0.016	<0.016	0.004	0.016	0	0
	8472	<0.016	<0.016	0.004	<0.016	<0.016	<0.016	<0.016	<0.016	<0.016	N	<0.016	<0.016	<0.016	<0.016	<0.016	N	<0.016	0.016	0.016	<0.016	<0.016	<=0.016	<0.016	0.016					
2	8473	0.016	<0.016	0.016	<0.016	<0.016	<0.016	<0.016	<0.016	<0.016	N	<0.016	<0.016	<0.016	0.016	<0.016	N	<0.016	0.016	0.016	<0.016	<0.016	<=0.016	<0.016	0.016	<0.016	0.016	0.016	0	0
	8474	<0.016	<0.016	0.016	<0.016	<0.016	<0.016	<0.016	<0.016	<0.016	N	<0.016	<0.016	<0.016	0.016	<0.016	N	<0.016	0.016	0.016	<0.016	<0.016	<=0.016	<0.016	0.016					
3	8475	0.016	0.032	0.016	0.032	0.016	<0.016	0.016	0.016	<0.016	N	<0.016	0.016	<0.016	0.032	<0.016	N	0.016	0.016	0.016	0.016	<0.016	<=0.016	0.016	0.016	0.016	0.016	0.032	0	0
4	8476	2	4	>=2	2	2	0.5	2	4	0.125	N	1	1	0.5	2	2	N	2	2	2	1	2	1	2	2	2	0.125	4	2	1
5	8477	1	2	>=2	1	2	0.5	1	2	0.5	N	0.5	2	1	1	2	N	2	1	2	1	2	1	2	1	2	0.5	>=2	8	0
	8478	2	2	>=2	2	1	0.5	1	2	0.5	N	0.5	2	1	2	2	N	2	1	2	1	2	1	1	1					
	8479	2	2	>=2	2	2	1	1	2	0.5	N	0.5	2	1	2	1	N	2	1	2	1	2	1	2	1					
6	8480	0.032	0.016	0.016	0.016	<0.016	<0.016	<0.016	<0.016	<0.016	N	<0.016	<0.016	<0.016	<0.016	<0.016	N	<0.016	0.016	0.032	<0.016	<0.016	<=0.016	<0.016	0.016	<0.016	<0.016	0.032	0	0

N: no result; not retrieved, not tested or MIC not supplied.
Note: Laboratories 92629 and 93997 did not submit cefixime data.

Table A1.5. Country coded category of susceptibility concordance – ceftriaxone

		Laboratory codes																											
	Strain	90984	92613	92621	92623	92624	92625	92626	92627	92628	92629	92630	92631	92632	92634	92784	93997	94929	94936	94937	94938	95587	95588	95589	96244	Total	No. S	No. I	No. R	Consensus	Concordance (%)
1	8471	S	S	S	S	S	S	S	S	N	S	S	S	S	S	S	N	S	S	S	S	S	S	S	S	45	45	0	0	S	100.0
	8472	S	S	S	S	S	S	S	S	N	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S						
2	8473	S	S	S	S	S	S	S	S	N	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	46	46	0	0	S	100.0
	8474	S	S	S	S	S	S	S	S	N	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S						
3	8475	S	S	S	S	S	S	S	S	N	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	23	23	0	0	S	100.0
4	8476	R	R	R	R	R	R	R	R	N	R	R	R	S	R	R	R	R	R	R	R	R	R	R	R	23	1	0	22	R	95.7
5	8477	S	R	R	R	R	R	R	R	N	R	S	R	R	R	R	R	R	R	R	R	R	S	R	R	69	11	0	58	R	84.1
	8478	R	R	R	R	S	R	R	R	N	R	S	R	R	R	R	R	R	R	R	R	S	R	S	R						
	8479	R	R	R	R	S	R	R	S	N	R	S	R	R	R	R	R	R	R	R	R	R	S	R	R						
6	8480	S	S	S	S	S	S	S	S	N	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	23	23	0	0	S	100.0
																														Total	96.6

N: no result; not retrieved or susceptibility category not supplied.

Table A1.6. Country coded MIC values (mg/L) – ceftriaxone

		Laboratory codes																											
	Strain	90984	92613	92621	92623	92624	92625	92626	92627	92628	92629	92630	92631	92632	92634	92784	93997	94929	94936	94937	94938	95587	95588	95589	96244	Modal MIC	Min MIC	Max MIC	2 dilutions different	>2 dilutions different
1	8471	<0.002	<0.002	<0.002	<0.002	<0.002	<0.016	<0.002	<0.002	N	N	<0.016	<0.002	<0.002	<0.002	<0.002	N	<0.016	0.002	0.002	<0.002	<0.002	<=0.002	<0.002	0.002	<0.016	<0.002	<0.016	0	0
	8472	<0.002	<0.002	<0.002	<0.002	<0.002	<0.016	<0.002	<0.002	N	N	<0.016	<0.002	<0.002	<0.002	<0.002	N	<0.016	0.002	0.002	<0.002	<0.002	<=0.002	<0.002	0.002					
2	8473	0.004	0.016	0.008	0.008	0.008	<0.016	0.008	0.008	N	N	<0.016	0.004	0.004	0.008	0.004	N	<0.016	0.016	0.008	0.004	0.016	0.008	0.004	0.008	<0.016	0.004	0.016	0	0
	8474	0.008	0.008	0.008	0.008	0.008	<0.016	0.008	0.008	N	N	<0.016	0.004	0.004	0.016	0.004	N	<0.016	0.016	0.004	0.004	0.016	0.008	0.008	0.016					
3	8475	0.016	0.032	0.016	0.016	0.008	0.016	0.008	0.016	N	N	<0.016	0.016	0.008	0.032	0.016	N	0.032	0.032	0.016	0.004	0.016	0.008	0.016	0.016	0.016	0.004	0.032	0	0
4	8476	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	N	N	0.25	0.5	0.125	0.5	0.25	N	1	1	0.25	0.5	1	0.25	0.5	0.5	0.5	0.125	1	1	0
5	8477	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	N	N	0.125	0.25	0.25	0.25	0.5	N	0.5	0.25	0.25	0.25	0.5	0.125	0.25	0.25					
	8478	0.25	0.25	0.25	0.25	0.125	0.25	0.25	0.25	N	N	0.125	0.25	0.25	0.25	0.5	N	0.5	0.25	0.25	0.125	0.5	0.125	0.25	0.25	0.25	0.125	0.5	0	0
	8479	0.25	0.25	0.25	0.25	0.125	0.25	0.25	0.125	N	N	0.125	0.25	0.25	0.25	0.5	N	0.5	0.25	0.25	0.25	0.5	0.125	0.25	0.25					
6	8480	0.008	0.016	0.008	0.008	0.004	<0.016	0.004	0.004	N	N	<0.016	0.004	0.004	0.008	0.004	N	<0.016	0.016	0.016	0.002	0.008	0.004	0.004	0.008	<0.016	0.002	0.016	0	0

N: no result; not retrieved, not tested or MIC not supplied.

Note: Laboratories 92628, 92629, and 93997 did not submit ceftriaxone data.

Table A1.7. Country coded category of susceptibility concordance – ciprofloxacin

		Laboratory codes																												
	Strain	90984	92613	92621	92623	92624	92625	92626	92627	92628	92629	92630	92631	92632	92634	92784	93997	94929	94936	94937	94938	95587	95588	95589	96244	Total	No. S	No. I	No. R	Consensus	Concordance (%)
1	8471	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	48	48	0	0	S	100.0
	8472	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S						
2	8473	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	48	0	0	48	R	100.0
	8474	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R						
3	8475	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	N	S	S	S	S	S	S	S	S	23	23	0	0	S	100.0
4	8476	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	24	0	0	24	R	100.0
5	8477	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	72	0	0	72	R	100.0
	8478	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R						
	8479	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R						
6	8480	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	24	0	0	24	R	100.0
																														Total	100.0

N: no result; not retrieved or susceptibility category not supplied.

Table A1.8. Country coded MIC values (mg/L) – ciprofloxacin

		Laboratory codes																											
	Strain	90984	92613	92621	92623	92624	92625	92626	92627	92628	92629	92630	92631	92632	92634	92784	93997	94929	94936	94937	94938	95587	95588	95589	96244	Modal MIC	Min MIC	Max MIC	2 dilutions different	>2 dilutions different
1	8471	0.004	0.004	0.002	0.004	0.004	<0.002	0.004	0.002	0.002	N	0.002	0.004	0.002	0.002	<0.002	N	0.002	0.002	0.004	0.002	0.016	<=0.002	0.004	0.002	0.002	<0.002	0.016	0	2
	8472	0.004	0.004	0.002	0.004	0.004	<0.002	0.004	0.004	0.002	N	0.002	0.004	0.002	0.004	0.002	N	0.002	0.004	0.002	0.002	0.016	0.002	0.004	0.002					
2	8473	1	1	1	1	2	1	2	2	2	N	2	2	0.25	4	1	N	1	2	1	1	4	1	1	1	1	0.25	4	7	0
	8474	1	1	1	1	2	1	2	2	2	N	2	2	0.25	4	1	N	2	2	0.5	1	4	1	1	4					
3	8475	0.008	0.008	0.008	0.008	0.016	0.008	0.016	0.016	0.004	N	0.016	0.008	0.004	0.016	0.008	N	0.008	0.008	0.008	0.008	0.032	0.008	0.008	0.008	0.008	0.004	0.032	1	0
4	8476	32	>32	>32	>32	>32	8	>32	32	>32	N	>32	>32	4	>32	8	N	>32	32	32	16	>32	16	8	>32	>32	4	>32	3	1
5	8477	4	8	4	8	8	2	>32	8	4	N	4	4	1	16	8	N	8	16	4	4	>32	8	8	16	8	1	>32	11	1
	8478	16	8	4	8	8	2	>32	8	4	N	4	4	2	16	4	N	8	16	8	4	>32	8	8	16					
	8479	16	8	4	16	8	2	>32	8	4	N	4	4	2	16	8	N	8	16	8	8	>32	8	8	16					
6	8480	2	32	2	4	8	4	16	8	4	N	4	4	1	>32	2	N	4	8	8	2	>32	4	2	4	4	1	>32	2	3

N: no result; not retrieved, not tested or MIC not supplied.

Note: Laboratories 92629 and 93997 did not submit ciprofloxacin data.

Table A1.9. Country coded category of susceptibility concordance – spectinomycin

		Laboratory codes																												
	Strain	90984	92613	92621	92623	92624	92625	92626	92627	92628	92629	92630	92631	92632	92634	92784	93997	94929	94936	94937	94938	95587	95588	95589	96244	Total	No. S	No. I	No. R	Consensus	Concordance (%)
1	8471	N	N	N	S	N	S	S	S	S	N	S	S	S	S	S	N	S	N	S	N	S	S	S	S	32	32	0	0	S	100.0
	8472	N	N	N	S	N	S	S	S	S	N	S	S	S	S	S	N	S	N	S	N	S	S	S	S						
2	8473	N	N	N	S	N	S	S	S	S	N	S	S	S	S	S	N	S	N	S	N	S	S	S	S	32	32	0	0	S	100.0
	8474	N	N	N	S	N	S	S	S	S	N	S	S	S	S	S	N	S	N	S	N	S	S	S	S						
3	8475	N	N	N	R	N	R	R	R	R	N	R	R	R	R	R	N	R	N	R	N	R	R	R	R	16	0	0	16	R	100.0
4	8476	N	N	N	S	N	S	S	S	S	N	S	S	S	S	S	N	S	N	R	N	S	S	S	S	16	15	0	1	S	93.8
5	8477	N	N	N	S	N	S	S	S	S	N	S	S	S	S	S	N	S	N	R	N	S	S	S	S	48	47	0	1	S	97.9
	8478	N	N	N	S	N	S	S	S	S	N	S	S	S	S	S	N	S	N	S	N	S	S	S	S						
	8479	N	N	N	S	N	S	S	S	S	N	S	S	S	S	S	N	S	N	S	N	S	S	S	S						
6	8480	N	N	N	S	N	S	S	S	S	N	S	S	S	S	S	N	S	N	S	N	S	S	S	S	16	16	0	0	S	100.0
																														Total	98.6

N – not retrieved or susceptibility category not supplied.

Table A1.10. Country coded MIC values (mg/L) – spectinomycin

		Laboratory codes																											
	Strain	90984	92613	92621	92623	92624	92625	92626	92627	92628	92629	92630	92631	92632	92634	92784	93997	94929	94936	94937	94938	95587	95588	95589	96244	Modal MIC	Min MIC	Max MIC	2 dilutions different	>2 dilutions different
1	8471	N	N	N	16	N	8	16	16	2	N	8	16	8	16	32	N	32	N	8	N	32	16	32	16	16	2	32	0	2
	8472	N	N	N	16	N	8	16	16	2	N	8	16	8	32	16	N	16	N	8	N	32	16	32	16					
2	8473	N	N	N	16	N	8	16	16	1	N	8	16	8	8	16	N	16	N	8	N	32	16	32	16	16	1	32	0	2
	8474	N	N	N	16	N	8	16	16	1	N	8	16	8	16	32	N	32	N	8	N	32	16	32	16					
3	8475	N	N	N	>1024	N	>1024	>1024	>1024	>1024	N	>1024	>1024	>1024	>1024	>=1024	N	>1024	N	>1024	N	>1024	>1024	>1024	>1024	>1024	>1024	>1024	0	0
4	8476	N	N	N	16	N	4	16	16	2	N	8	16	8	32	16	N	16	N	8	N	16	8	16	16	16	2	32	1	1
5	8477	N	N	N	16	N	4	16	16	1	N	8	16	16	8	32	N	16	N	4	N	16	16	32	16	16	1	64	5	3
	8478	N	N	N	16	N	4	16	16	1	N	8	16	16	16	32	N	32	N	4	N	16	16	32	32					
	8479	N	N	N	16	N	8	16	16	1	N	8	16	16	16	64	N	16	N	8	N	16	16	32	32					
6	8480	N	N	N	16	N	8	16	16	2	N	8	32	8	16	16	N	8	N	8	N	32	16	16	16	16	2	32	0	1

Note: Laboratories 90984, 92613, 92621, 92624, 92629, 93997, 94936, and 94938 did not submit spectinomycin data.
N: no result; not retrieved, not tested or MIC not supplied.

Table A1.11. Country coded MIC values (mg/L) – gentamicin

		Laboratory codes																												
	Strain	90984	92613	92621	92623	92624	92625	92626	92627	92628	92629	92630	92631	92632	92634	92784	93997	94929	94936	94937	94938	95587	95588	95589	96244	Modal MIC	Min MIC	Max MIC	2 dilutions different	>2 dilutions different
1	8471	4	N	N	4	N	2	4	4	1	N	2	4	2	4	N	N	4	N	1	N	N	4	4	4	4	1	8	4	0
	8472	2	N	N	4	N	2	4	2	1	N	2	4	2	4	N	N	4	N	1	N	N	8	2	4					
2	8473	4	N	N	4	N	2	8	8	2	N	4	4	2	8	N	N	8	N	2	N	N	8	4	8	8	2	8	8	0
	8474	8	N	N	4	N	2	8	8	2	N	4	4	2	8	N	N	8	N	2	N	N	8	4	4					
3	8475	4	N	N	4	N	4	8	8	2	N	4	8	2	8	N	N	4	N	2	N	N	8	4	8	4	2	8	0	0
4	8476	8	N	N	8	N	4	8	8	2	N	4	8	2	8	N	N	8	N	2	N	N	8	8	8	8	2	8	3	0
5	8477	4	N	N	4	N	2	8	4	1	N	2	8	4	4	N	N	8	N	2	N	N	4	8	8	8	1	16	10	3
	8478	4	N	N	4	N	2	8	4	1	N	2	8	2	4	N	N	16	N	2	N	N	8	8	8					
	8479	8	N	N	4	N	2	8	4	1	N	2	8	4	4	N	N	16	N	2	N	N	8	8	8					
6	8480	2	N	N	4	N	4	8	4	1	N	2	8	1	4	N	N	4	N	2	N	N	4	4	4	4	1	8	2	0

Note: Laboratories 92613, 92621, 92624, 92629, 92784, 93997, 94936, 94938, and 95587 did not submit gentamicin data.
N: no result; not retrieved, not tested or MIC not supplied.

Table A1.12. Country coded concordance – beta-lactamase

		Laboratory codes																												
	Strain	90984	92613	92621	92623	92624	92625	92626	92627	92628	92629	92630	92631	92632	92634	92784	93997	94929	94936	94937	94938	95587	95588	95589	96244	Total	No. S	No. I	No. R	Consensus	Concordance (%)
1	8471	S	S	S	S	S	S	S	S	S	N	S	S	S	S	S	S	S	N	S	S	S	S	N	S	42	42	0	0	S	100.0
	8472	S	S	S	S	S	S	S	S	S	N	S	S	S	S	S	S	S	N	S	S	S	S	N	S						
2	8473	S	R	R	R	R	R	R	R	R	N	R	R	R	R	R	R	R	N	R	R	R	R	N	R	42	1	0	41	R	97.6
	8474	R	R	R	R	R	R	R	R	R	N	R	R	R	R	R	R	R	N	R	R	R	R	N	R						
3	8475	R	R	R	R	R	R	R	R	R	N	R	R	R	R	R	R	R	N	R	R	R	R	N	R	21	0	0	21	R	100.0
4	8476	S	S	S	S	S	S	S	S	S	N	S	S	S	S	S	S	S	N	S	S	S	S	N	S	21	21	0	0	S	100.0
5	8477	R	R	R	R	R	R	R	R	R	N	R	R	R	R	R	R	R	N	R	R	R	R	N	R	63	0	0	63	R	100.0
	8478	R	R	R	R	R	R	R	R	R	N	R	R	R	R	R	R	R	N	R	R	R	R	N	R						
	8479	R	R	R	R	R	R	R	R	R	N	R	R	R	R	R	R	R	N	R	R	R	R	N	R						
6	8480	S	S	S	S	S	S	S	S	S	N	S	S	S	S	S	S	S	N	S	S	S	S	N	S	21	21	0	0	S	100.0
																														Total	99.6

Note: Laboratories 92629, 94936, and 95589 did not submit any beta-lactamase testing results.
N: no result; not retrieved or beta-lactamase result not supplied.

Table A1.13. Country coded category of susceptibility concordance – tetracycline

		Laboratory codes																											
	Strain	90984	92613	92621	92623	92624	92625	92626	92627	92628	92629	92630	92631	92632	92634	92784	93997	94929	94936	94937	94938	95587	95588	95589	96244	Total	No. S	No. I	No. R	Consensus	Concordance (%)
1	8471	S	S	S	S	N	S	S	S	S	N	S	S	S	S	S	S	S	S	S	S	R	S	S	S	44	42	0	2	S	95.5
	8472	S	S	S	S	N	S	S	S	S	N	S	S	S	S	S	S	S	S	S	S	R	S	S	S						
2	8473	R	R	R	R	N	S	R	R	R	N	R	R	R	R	R	S	R	R	R	R	R	R	R	R	44	2	0	42	R	95.5
	8474	R	R	R	R	N	R	R	R	R	N	R	R	R	R	R	R	R	R	R	R	R	R	R	R						
3	8475	R	R	R	R	N	S	R	R	R	N	R	R	R	R	R	R	R	R	R	R	R	R	R	R	22	1	0	21	R	95.5
4	8476	R	R	R	R	N	S	R	R	R	N	R	R	R	S	R	S	R	R	R	R	R	R	R	R	22	3	0	19	R	86.4
5	8477	R	R	R	R	N	R	R	R	R	N	R	R	R	R	R	R	R	R	R	R	R	R	R	R	66	0	0	66	R	100.0
	8478	R	R	R	R	N	R	R	R	R	N	R	R	R	R	R	R	R	R	R	R	R	R	R	R						
	8479	R	R	R	R	N	R	R	R	R	N	R	R	R	R	R	R	R	R	R	R	R	R	R	R						
6	8480	R	R	I	S	N	S	R	R	R	N	R	R	S	S	S	S	S	S	R	R	R	R	S	I	22	9	2	11	R	50.0
																														Total	87.1

N – not retrieved or susceptibility category not supplied.

Table A1.13. Country coded MIC values (mg/L) – tetracycline

		Laboratory codes																											
	Strain	90984	92613	92621	92623	92624	92625	92626	92627	92628	92629	92630	92631	92632	92634	92784	93997	94929	94936	94937	94938	95587	95588	95589	96244	Modal MIC	Min MIC	Max MIC	2 dilutions different	>2 dilutions different
1	8471	0.25	0.25	0.25	0.125	N	0.064	0.5	0.5	0.125	N	0.125	0.125	0.125	0.125	0.125	N	0.125	0.5	0.25	0.25	4	0.5	0.125	0.25	0.125	0.064	4	8	2
	8472	0.25	0.25	0.25	0.125	N	0.064	0.5	0.5	0.125	N	0.125	0.125	0.125	0.125	0.125	N	0.125	0.5	0.25	0.25	4	0.5	0.125	0.25					
2	8473	4	2	4	2	N	0.5	4	4	2	N	2	2	2	2	2	N	2	4	4	2	32	4	1	2	2	0.5	32	1	2
	8474	4	2	4	2	N	1	4	4	2	N	2	2	1	2	2	N	2	4	2	2	32	4	2	4					
3	8475	2	4	4	2	N	0.5	4	4	2	N	2	2	1	2	2	N	2	4	2	4	16	4	1	2	2	0.5	16	1	1
4	8476	2	2	2	1	N	0.5	4	4	2	N	2	2	1	0.5	2	N	2	2	2	2	16	4	2	2	2	0.5	16	2	1
5	8477	32	32	16	16	N	2	64	32	16	N	8	16	4	8	16	N	16	32	16	32	64	32	16	32	16	2	64	9	2
	8478	16	32	8	16	N	2	64	64	16	N	8	16	16	16	16	N	16	32	16	32	64	32	16	32					
	8479	32	32	16	16	N	4	64	32	16	N	8	16	16	16	16	N	16	32	32	32	64	32	16	32					
6	8480	1	2	1	0.5	N	0.25	2	2	1	N	1	1	0.5	0.5	0.5	N	0.25	0.5	1	1	8	1	0.5	1	1	0.25	8	2	1

Note: Laboratories 92624, 92629, and 93997 did not submit tetracycline data.
N: no result; not retrieved, not tested or MIC not supplied.

European Centre for Disease Prevention and Control (ECDC)

Gustav III:s Boulevard 40
16973 Solna, Sweden

Tel. +46 858601000
ECDC.info@ecdc.europa.eu

www.ecdc.europa.eu

Follow ECDC on social media
Twitter: @ECDC_EU
Facebook: www.facebook.com/ECDC.EU
Linkedin: www.linkedin.com/company/ecdc/

Publications Office
of the European Union