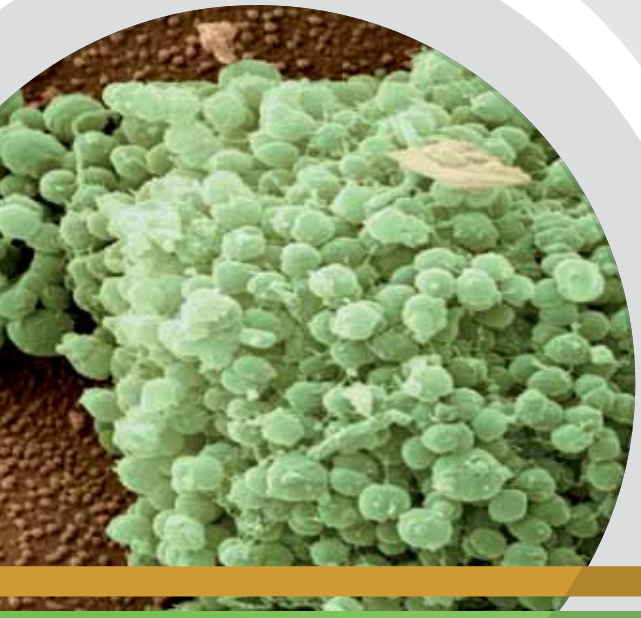

TECHNICAL REPORT

European Gonococcal Antimicrobial Surveillance Programme external quality assessment scheme for *Neisseria gonorrhoeae* antimicrobial susceptibility testing

2015

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2015

This report was commissioned by the European Centre for Disease Prevention and Control (ECDC), coordinated by Gianfranco Spiteri and Andrew J. Amato and produced by Sabrina Weiss, Michelle Cole and Francesco Tripodo, Public Health England, London on behalf of the EURO-GASP network participants. Sabrina Weiss receives a Fellowship by the European Programme for Public Health Microbiology (EUPHEM).

Suggested citation: European Centre for Disease Prevention and Control. Euro-GASP external quality assessment scheme, 2015 for *Neisseria gonorrhoeae* antimicrobial susceptibility testing. Stockholm: ECDC; 2017.

Stockholm, February 2017

PDF
ISBN 978-92-9498-030-4
doi: 10.2900/192664
Catalogue number TQ-02-17-116-EN-N

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Abbreviations

AMR	Antimicrobial Resistance
BSAC	British Society for Antimicrobial Chemotherapy
CLSI	*Clinical and Laboratory Standards Institute*
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
GRASP	*Gonococcal* Resistance to Antimicrobials Surveillance Programme
MIC	Minimum Inhibitory Concentration
PHE	Public Health England
PPNG	Penicillinase-Producing *Neisseria gonorrhoeae*
SFM	Société Française de Microbiologie
STI	Sexually Transmitted Infection
UK NEQAS	United Kingdom National External Quality Assessment Service

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 shown overall high-levels of inter-laboratory comparability in the presence of differing methodologies. Problems identified in previous panel distributions included reduced comparability of discs compared to agar dilution and E-tests, media not suitably supporting gonococcal growth, and the use of different manufacturers of gradient strips which are similar to E-tests.

Materials and methods: The EQA specimen panel was selected by Public Health England (PHE) and was prepared and distributed by the United Kingdom National External Quality Assessment Service (UK NEQAS). In October 2015, 27 laboratories in 25 participating countries received 10 gonococcal isolates for susceptibility testing. Of the 10 gonococcal isolates provided, one was in triplicate and two were in duplicate to test intra-laboratory concordance. The remaining isolates were all provided singularly, meaning that the GC AMR EQA panel comprised of six different isolate strains in total. The isolates chosen by PHE were representative of a range of different antimicrobial susceptibility profiles and were selected from well-characterised and recently isolated clinical strains. Participating laboratories were requested to test the GC AMR EQA panel using local methodology (i.e. E-test, agar dilution or disc diffusion) and breakpoints (e.g. CLSI, EUCAST etc.) against a range of antimicrobial agents where possible. Results were submitted directly to UK NEQAS who issued individual laboratory reports. The results were then supplied to PHE who decoded and analysed the results based on the category of susceptibility assigned.

Results: Twenty-six laboratories returned EQA results to UK NEQAS. The majority of the laboratories used E-tests and EUCAST breakpoints. The highest levels of susceptibility category concordance were seen with spectinomycin (100%) whilst the lowest was seen with azithromycin (77%).

Overall concordance increased for spectinomycin in comparison to the previous two distributions whilst overall concordance for azithromycin decreased to the lowest level yet recorded (77%). Overall 84.6% and 95% of the reported minimum inhibitory concentrations (MICs) were within one and two doubling dilutions of the modal MIC, respectively.

Discussion and conclusion: There has been further harmonisation of susceptibility testing methodologies and breakpoints used by participating laboratories; most laboratories used the E-test method and EUCAST breakpoints for interpretation of MIC results. Overall, the laboratories participating in EQA scheme QA15 performed well and showed good levels of competence in testing *N. gonorrhoeae* strains of unknown phenotype. Even though susceptibility category concordances decreased slightly in this distribution, the inter- and intra-laboratory concordance was high in most cases, demonstrating comparability between different testing methodologies and allowing for confidence in decentralised testing. Most susceptibility category discrepancies, such as those for azithromycin, were attributable to strains that were on or close to a breakpoint which highlights the need to consider the actual MIC of the isolates as well as susceptibility category when interpreting susceptibility results to help avoid the under or over-reporting of resistance. Analysis of the individual results submitted by the participating laboratories highlighted five centres in need of further guidance to help bring them in line with the recommended target of 95% of MICs within two dilutions of the modal MICs. Most laboratories are now using EUCAST breakpoints, which is a positive move as a recent revision of the EU case definitions now includes definitions of antimicrobial resistance and EUCAST clinical breakpoints which should be adhered to.

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[i]).

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

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

External quality assessment (EQA) is part of quality management systems (QMS) and evaluates performance of laboratories by an outside agency on material that is supplied specially for the purpose. ECDC's disease networks organise a series of EQA for EU/EEA countries. In some specific networks, non-EU/EEA countries are also involved in the EQA activities organised by ECDC. The aim of the EQA is to identify needs of improvement in laboratory diagnostic capacities relevant to surveillance of diseases listed in Decision No 2119/98/EC and to ensure comparability of results in laboratories 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 and justification of vulnerabilities
- providing continuing education for participating laboratories
- identification of needs for training activities for EURO-GASP.

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 was established in 2007 as part of the European Surveillance to STIs (ESSTI) programme funded by Directorate General for Health and Food Safety, and has been part of the ECDC STI microbiology project since 2009, with the first ECDC EQA scheme performed in 2010.

The EQA scheme is available for all participating laboratories in the STI surveillance network. An EQA scheme is an essential component of a 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 de-centralised testing as part of antimicrobial resistance (AMR) surveillance across Europe [1, 2].

From 2010 to 2014, the number of participating laboratories ranged from 18 to 22 and in general the EQA revealed high levels of inter-laboratory comparability even in the presence of different antimicrobial susceptibility testing methodologies. Problems identified in previous panel distributions included reduced comparability of discs compared to agar dilution and E-tests, media not suitably supporting gonococcal growth, and the use of different manufacturers of gradient strips which are similar to E-tests.

The United Kingdom National External Quality Assessment Service (UK NEQAS) collaborated with Public Health England (PHE) for the EQA described in this report. UK NEQAS is accredited by the United Kingdom Accreditation Service (UKAS) to ISO 17043 (Conformity Assessment – General Requirements for Proficiency Testing). Participation in this EQA scheme for *Neisseria gonorrhoeae* antimicrobial susceptibility provides a mechanism for laboratories in the network to meet the requirements of these standards.

[i] 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

In October 2015, 27 laboratories within 25 countries received ten gonococcal isolates (QA15) for susceptibility testing from UK NEQAS. The isolates included in the panel were selected by PHE to demonstrate a range of susceptibility profiles to therapeutic antimicrobial agents and were selected from a global panel of well characterised and recently isolated clinical strains. In order to measure intra-laboratory reproducibility one of these ten isolates was supplied in triplicate (3100/3103/3106) two were supplied in duplicate (3098/3102 and 3101/3105). The remaining three isolates were supplied as individual different strains (3099, 3104 and 3107). This resulted in six different isolate strains. During the susceptibility testing of this EQA panel, one laboratory identified that isolates 3098 and 3104 contained mixed cultures. Upon investigation, the freeze-dried vials of 3098 and 3104 each contained both the 3098 and 3104 isolates, and subsequently 3098 and 3102 were not the duplicate set as anticipated. Therefore, data from isolates 3098 and 3104 were not included in any of the concordance calculations. Isolate 3102 was deemed pure and was subsequently included as a single isolate. Final EQA panel; Strain 1 = 3098 and 3104, Strain 2 = 3099, Strain 3 = 3100, 3103 & 3106, Strain 4 = 3101 and 3105, Strain 5 = 3102 and Strain 6 = 3107.

Participating laboratories tested the European GC AMR EQA panel of isolates using their own routine methodology against the following list of therapeutic antimicrobials where possible:

- Azithromycin
- Cefixime
- Ceftriaxone
- Ciprofloxacin
- Gentamicin
- Spectinomycin

Participating laboratories also tested the European gonococcal AMR EQA panel of isolates for beta-lactamase production where possible. The antimicrobials listed are those detailed in the ECDC Instructions, External Quality Assessment v4 [3].

2.2 Susceptibility testing methods

Information was requested on the methodology and the clinical breakpoints/guidelines used for determining the category of susceptibility (resistant, intermediate or susceptible) for each antimicrobial tested. Examples of breakpoints and guidelines used include the European Committee on Antimicrobial Susceptibility Testing (EUCAST) breakpoint[s] [4] (Table 1) and the Clinical and Laboratory Standards Institute (CLSI) guidelines [5] (Table 2). Antimicrobial susceptibility testing results were reported as the category of susceptibility (R/I/S) and the minimum inhibitory concentrations (MIC) for the E-test and agar dilution methods, or the zone of inhibition for the disc diffusion method for each isolate.

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

	MIC breakpoint (mg/L)		
	R >	**I**	**S ≤**
Azithromycin	0.5	0.5	0.25
Cefixime	0.125		0.125
Ceftriaxone	0.125	-	0.125
Ciprofloxacin	0.06	0.06	0.03
Spectinomycin	64		64

Note: Currently there are no interpretive criteria for gentamicin (4)

Table 2. Clinical and Laboratory Standards Institute (CLSI) breakpoints

	MIC breakpoint (mg/L)		
	R >	**I**	**S ≤**
Cefixime			0.25
Ceftriaxone	-	-	0.25
Ciprofloxacin	0.5	0.12 – 0.5	0.06
Spectinomycin	64	64	32

Note: Currently there are no interpretive criteria for azithromycin and gentamicin (5)

2.3 Analysis and interpretation of the results

Raw results for the EQA were submitted directly to UK NEQAS by the participating laboratories for the production of an individual laboratory report. The results were also forwarded to PHE for further analysis.

All MIC results which fell between the E-test full-dilution scale were rounded up to the next full E-test dilution. The E-test dilution scale was used, as E-tests were the most frequently used testing method. The minimum, maximum and modal MIC of each strain tested was established. The number of MICs within two MIC dilutions and greater than two MIC dilutions of the modal MIC of each strain was also established.

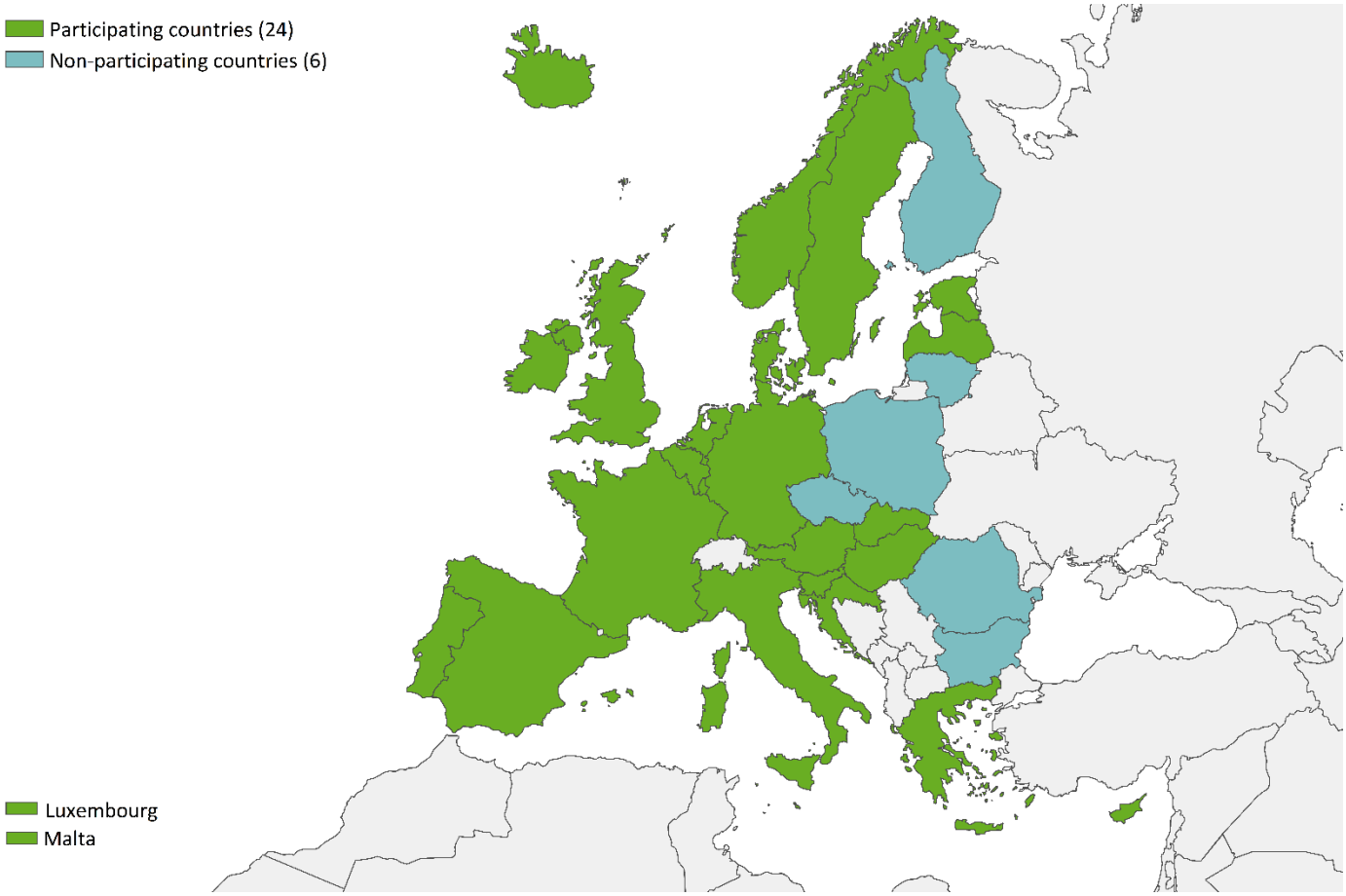
To allow for the differences in local methods and breakpoints used, analysis of blind testing results was performed using the susceptibility categories only. For this report, consensus categories of susceptibility for each strain tested (six in total in this distribution; consensus calculated from all isolates in the triplicate or duplicate sets) were calculated once all participating laboratories had reported results back. The 'consensus' was assigned to the category reported most often, irrespective of breakpoint criteria used. The overall concordance for each antimicrobial was established by taking the average of each strain percentage concordance.

3. Results

3.1 Susceptibility testing methods

Twenty-six laboratories within 24 countries returned results to UK NEQAS (Figure 1). All laboratories provided details on the methodology and breakpoints/guidelines (Table 3) used to test the isolates in the EQA. Use of the E-test (88.5%) and GC agar (53.9%) were the most common testing methodology and media used.

Figure 1. Countries participating in the 2015 *N. gonorrhoeae* susceptibility testing EQA scheme



Note: 26 laboratories participated in the 2015 EQA scheme; the United Kingdom and Austria had two participating laboratories.

Table 3. Susceptibility methods used by participating laboratories, October 2015 EQA scheme

Type of susceptibility test used	Number of participating laboratories (n=26)*
E-test	23
Agar dilution	3
Disc diffusion**	2
Testing guidelines used	
EUCAST [4]	22 (E-test)
CLSI [5]	2 (Agar dilution)
BSAC [6]	1 (Disc diffusion)
SFM [7]	1 (E-test)
GRASP [8]	1 (Agar dilution)
Agar base used	
GC agar base	14
Chocolatised blood agar	6
Thayer-Martin agar[t]	3
Mueller-Hinton agar	1
Diagnostic sensitivity agar	2
Blood agar	1

**One laboratory reported two different testing methods and guidelines, and one laboratory reported two different testing methods.*
***Used by one laboratory for azithromycin (15 µg) and one laboratory for cefixime (5 µg)*
[t]One laboratory used both chocolate blood agar and Thayer-Martin agar

3.2 Minimum inhibitory concentration breakpoints

Twenty-two laboratories reported adherence to the European Committee on Antimicrobial Susceptibility Testing (EUCAST) breakpoints [4] (Table 1). Two participating laboratories reported that they perform susceptibility testing in accordance with the Clinical and Laboratory Standards Institute (CLSI) guidelines [5], (Table 2). One laboratory used a combination of BSAC (for the azithromycin disc) and EUCAST (for E-tests), and the remaining two laboratories used other guidelines (GRASP and SFM; Table 1).

Some laboratories that tested gentamicin did not submit breakpoints or categories of susceptibility as there are no defined interpretive criteria for this antimicrobial at this time. However, three laboratories did submit categories of susceptibility for gentamicin, but these data were not analysed in this report.

3.3 Susceptibility categories concordance

Eight laboratories submitted incomplete susceptibility category results. Incomplete data were submitted for spectinomycin (laboratory codes: 874, 90984, 91431, 92613, 92627 [sample 3103 only], 92629, 92632 [sample 3101 only], 93997), and for the beta-lactamase testing (laboratory 92629). Thirteen laboratories submitted gentamicin data and one laboratory (874) did not submit any data for one isolate (samples 3100, 3103, 3106).

The highest levels of susceptibility category concordance were seen with spectinomycin, with 100% concordance (Table 4), and the lowest level was seen with azithromycin with 77.0% concordance. On average, the E-test and agar dilution methods revealed similar concordances (90.1% vs 90.7%, respectively; Table 4 and Tables A1.1-A1.5).

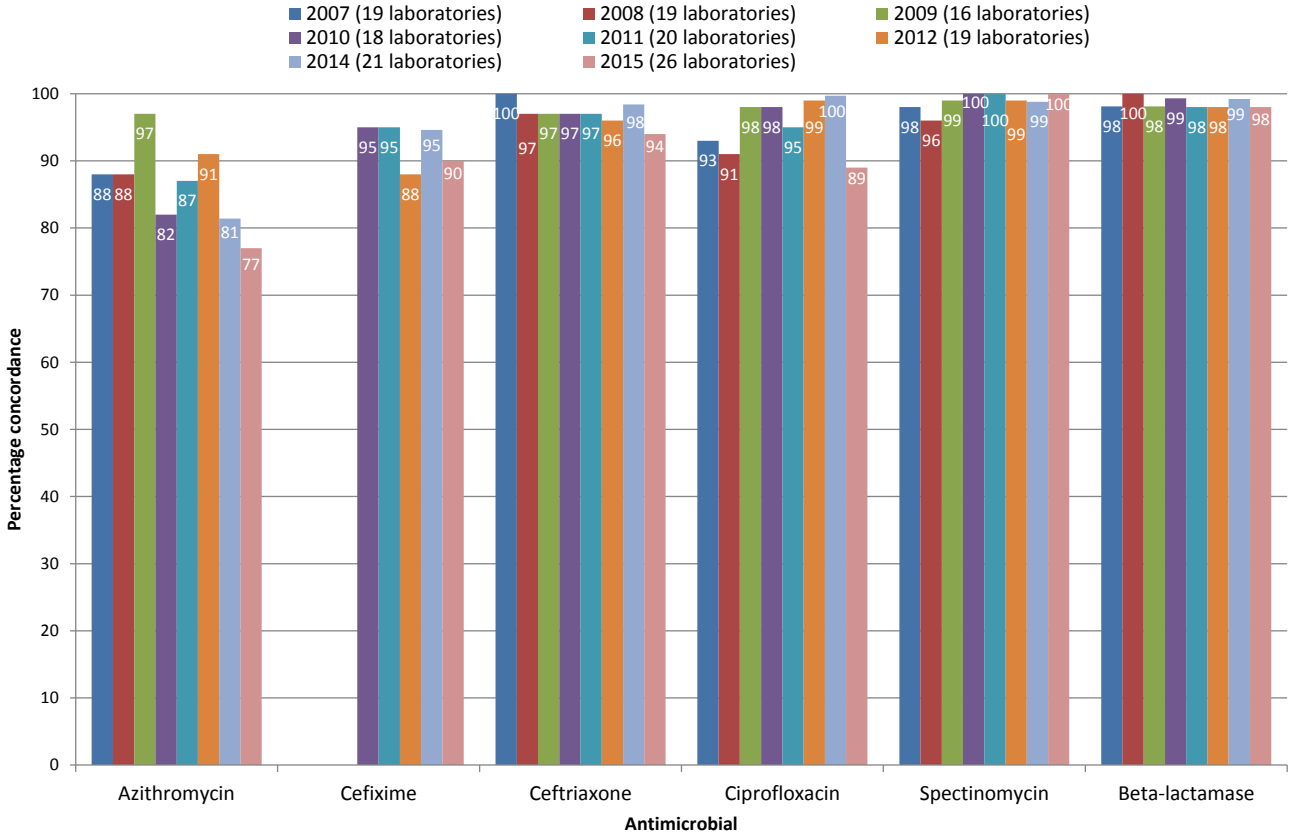
Table 4. Overall concordance (%) of susceptibility categories for EQA panel QA15

	Susceptibility testing methods		
	All methods	E-test	Agar dilution*
Azithromycin	77.0	76.4	80
Cefixime	90.2	89.7	93.3
Ceftriaxone	94.4	95.9	93.3
Ciprofloxacin	88.8	88.6	86.7
Spectinomycin	100	100	100
Overall	90.1	90.1	90.7

**Results from three laboratories only*

When susceptibility category concordance data are compared with previous EQA distributions from both ESSTI (QA2007, QA2008 and QA2009) [49] and ECDC Euro-GASP (QA2010-14) [10-13], there is a slight decrease for most antimicrobials tested (Figure 1) with the exception of spectinomycin with 100% concordance. The highest decrease is observed for ciprofloxacin, showing concordance of 88.8% compared with 100% in the previous year. Beta-lactamase result concordance remains high at 97.5%, but decreased slightly compared with the previous EQA distribution (QA14, 99.2%) (Figure 2). It should be noted that the methods used for the susceptibility testing and the breakpoints used have changed over time, although there has been greater consistency in later years. A full analysis of the different methods and breakpoints used in this EQA over the years is currently underway.

Figure 2. Longitudinal comparison of the inter-laboratory concordance, 2007-2015



Note: Cefixime became part of the EQA scheme from 2010. ESSTI EQA distributions (2007–2009) constituted 30 isolates (10 strains in triplicate)

Tables A1.1 to A1.5 (see annex) show the consensus susceptibility categories for each QA15 strain when tested against the antimicrobials by E-test and agar dilution. Consensus susceptibility categories were not assigned for gentamicin as there are no published breakpoints for interpretation of results at the present time. Category of susceptibility agreed with the consensus (overall) assigned for each antimicrobial testing method in most cases. The azithromycin consensus category assigned for strain 3 (3100/3103/3106) was reported as intermediate by E-test whereas agar dilution and the overall consensus was sensitive (Table A1.1). Agar dilution did not give an azithromycin consensus category for strain 6 (3107) which was due to the modal azithromycin MIC of the strain on the resistance breakpoint (1 mg/L, Table 6). Similarly, there was no consensus for strain 4 (3101/3105) for ciprofloxacin (A1.4) which was on the ciprofloxacin resistance breakpoint (0.125 mg/L, Table 6). For ceftriaxone, the agar dilution methods resulted in reporting strain 3 (3100/3103/3106) as resistant whereas the overall consensus was sensitive (A1.3). One laboratory did not test for the production of beta-lactamase in the EQA panel of strains. Three centres incorrectly identified beta-lactamase production (Table A1.6).

3.5 Minimum inhibitory concentration concordance

Overall, 84.6% of the submitted MIC results were within one doubling dilution of the recorded modal MIC (Table 5) for all tested antimicrobials, showing a decrease in concordance from the previous EQA panel distribution (93.6%) [8]. Highest MIC concordances were seen with gentamicin (93.8%) and cefixime (89.8%), whilst the lowest were seen with ceftriaxone (82.4%) (Table 5). Ten point four percent were within two doubling dilutions of the modal MIC and a further 5.0% differed from the modal MIC by more than two doubling dilutions. Ciprofloxacin had the highest number of isolates with an MIC greater than two dilutions of the modal MIC (9.8%) and spectinomycin had the lowest (0.6%).

3.6 QA15 panel strain characteristics

Table 6 shows the overall consensus category, the modal/range MIC for E-test and agar dilution, and the percentage concordance for each strain in the EQA panel. Consensus phenotypes for each strain tested are also shown. The consensus antimicrobial susceptibility profiles of the tested strains showed a range of phenotypes; one strain was fully sensitive to all antimicrobials tested, two strains were resistant to ciprofloxacin (one lower-level and one higher-level resistance), two strains were resistant to azithromycin (one lower-level and one higher-level resistance), one strain had decreased susceptibility to cefixime and ceftriaxone, with some laboratories reporting resistance (modal MICs close to the resistance breakpoint), and a range of gentamicin and spectinomycin MICs were present.

3.7 Coded country breakdown of concordance

Due to the confidential nature of the EQA scheme, coded laboratory breakdowns for beta-lactam concordance, category of susceptibility concordance and MIC values for E-test and agar dilution method are shown in the annex (Tables A1.6–A1.16). Analysis of the breakdown of results has highlighted that 13 laboratories reported isolates with MICs greater than two doubling dilutions different from the mode MIC. Five laboratories reported more than 5% variation from the modal MIC. Three of the laboratories participate in centralised testing and two in decentralised testing. Overall, the MICs were lower than expected suggesting that the media was not supporting the growth of the isolates sufficiently. Oxoid have identified problems with some batches of their GC agar that does not sufficiently support the growth of gonococcal isolates when only vitox is added, as recommended by the CLSI guidelines. Three of the five laboratories used GC agar so investigations are underway to determine if any laboratories have used the effected Oxoid batches. An additional problem was identified by one of the laboratories; mis-interpretation of the colour change with the Nitrocefin sticks (to detect beta-lactamase production) was suspected so the laboratory will start using the Nitrocefin solution to better detect any colour change.

Table 5. Variation from modal MIC for EQA QA15

QA15	Azithromycin		Cefixime		Ceftriaxone		Ciprofloxacin		Gentamicin		Spectinomycin		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Within 1 doubling dilution	165	83.8	177	89.8	169	82.4	150	73.2	105	93.8	144	90	910	84.6
Within 2 doubling dilutions	24	12.2	9	4.6	23	11.2	35	17.1	6	5.4	15	9.375	112	10.4
>2 doubling dilutions	8	4.1	11	5.6	13	6.3	20	9.8	1	1	1	0.625	54	5.0
Total no. of isolates with MIC data	197		197		205		205		112		160		1076	

No. = Number of isolates with MIC data

Table 6. Consensus category, modal (range) MIC for E-test and agar dilution (mg/L) and the percentage concordance of susceptibility category for the 2015 EQA panel

Strain		Azithromycin consensus	Cefixime consensus	Ceftriaxone consensus	Ciprofloxacin consensus	Gentamicin consensus	Spectinomycin consensus	Beta-lactamase consensus
3099 (WHO F) [14] Fully susceptible	Consensus category	S	S	S	S	N/A	S	NEG
	Modal MIC (range)	0.125 (0.004-0.25)	<0.016 (<0.002-0.016)	<0.002(<0.002-0.002)	0.004 (<0.002-0.016)	4 (2-8)	16 (4-32)	
	Percentage concordance	96.0	100	100	100	N/A	100	96.0
3100/3103/3106 (GE13-040) CipR, cefixime/ceftriaxone DS	Consensus category	S*	R**	S	R	N/A	S	NEG
	Modal MIC (range)	0.5 (0.064-4)	0.125 (0.016-1)	0.125 (0.004-1)	>32 (1->32)	2 (1-4)	8 (1-16)	
	Percentage concordance	46.7	58.7	72	100	N/A	100	91.7
3101/3105 (WHO G) [14] Low-level CipR	Consensus category	S	S	S	R	N/A	S	NEG
	Modal MIC (range)	0.25 (0.064-1)	<0.016 (0.08-0.032)	0.008(0.004-0.032)	0.125 (0.032->32)	4 (1-8)	8 (2-32)	
	Percentage concordance	88.0	100	100	48	N/A	100	100
3102 H151120174 High-level AzR	Consensus category	R	S	S	S	N/A	S	NEG
	Modal MIC (range)	>256 (16->256)	0.032 (<0.016-0.064)	0.016 (0.002-0.032)	0.004 (0.002->32)	4 (0.25-16)	8 (2-32)	
	Percentage concordance	100	100	100	96	N/A	100	100
3107 (G14-2541) AzR (breakpoint)	Consensus category	R	S	S	R	N/A	S	NEG
	Modal MIC (range)	1 (0.25-4)	0.064 (0.016-0.25)	0.016 (0.008-0.125)	>32 (4->32)	8 (2-8)	16 (4-32)	
	Percentage concordance	54	92	100	100	N/A	100	100

Note: No consensus category of susceptibility was assigned to gentamicin as there are no published breakpoint guidelines for this antimicrobial at this time.
Disc diffusion zones not shown as only one laboratory performed this technique
N/A – not available
DS- Decreased susceptibility
**Intermediate according to EUCAST breakpoints and the modal MIC*
***Susceptible according to EUCAST breakpoints and the modal MIC*

4. Discussion

External quality assessments in laboratory surveillance programmes are essential to ensure results from different submitting laboratories are comparable, and significant over and under-reporting of resistance does not occur. 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, so confidence in reporting is essential. The EQA distribution QA15 was sent out to 27 laboratories in 25 participating countries, and 26 laboratories in 24 countries reported back results. Most laboratories (89%) used the E-test method to perform antimicrobial susceptibility testing in *Neisseria gonorrhoeae* (previous year 76%). EUCAST guidelines were used by the majority (85%) of the participating laboratories for interpretation of MIC results (previous year 62%). Where the E-test was used, all but one laboratory used the EUCAST guidelines for interpretation of MICs. When compared with previous EQA distributions, these results show a continuing progression of adoption of the EUCAST guidelines and of E-tests across the Euro-GASP participating laboratories resulting in further harmonisation of gonococcal antimicrobial susceptibility testing.

Susceptibility category concordance increased for spectinomycin in comparison with the previous two distributions whilst overall concordance for azithromycin decreased to the lowest level yet recorded (77%). In general, susceptibility category concordance levels showed a slight decrease compared with those of previous distributions. This may be due to a higher proportion of strains with MICs close to breakpoints in this distribution. In particular, the strain supplied in triplicate (strain 3) had MICs close to a breakpoint to three different antimicrobials (azithromycin, cefixime and ceftriaxone). The choice of strains with MICs close to breakpoints will have an impact on category of susceptibility concordance; however, they were clinically relevant strains and highlight the need to consider the actual MIC of the isolates as well as susceptibility category when interpreting susceptibility results. Concordance of beta-lactamase detection also slightly decreased but remained comparable with previous years' levels. Category of susceptibility agreed with the consensus (overall) assigned for each antimicrobial testing method in most cases and any discordant susceptibility category consensus results were because the isolates had MICs on or near breakpoints. For example, the modal azithromycin MIC of strain 3 (3100/3103/3106) was on the azithromycin intermediate breakpoint (0.5 mg/L) which resulted in discordant E-test (intermediate) and agar dilution (sensitive) results. Similarly the same strain had a modal ceftriaxone MIC just one dilution below the resistance breakpoint (0.125 mg/L) resulting in resistant reporting from the agar dilution methodology while the overall consensus was sensitive. Susceptibility categories were not assigned to gentamicin as there are currently no published breakpoint guidelines available for the interpretation of these results.

Concordance of MIC results was fair with 84.6% of results being within one doubling dilution of the reported modal MIC which is a decrease from the previous distribution where concordance was 93.6%. Gentamicin and cefixime gave the highest levels of concordance whilst ceftriaxone gave the lowest levels of concordance.

Breakdown of EQA susceptibility testing results by country allowed for detailed analysis of individual laboratory performance. On the whole, laboratories performed well with a good level of inter-laboratory and intra-laboratory concordance of results. However, discussions are underway with the five laboratories who reported more than 5% variation from the modal MIC to identify any problems with contamination, reagents and interpretation. Further training will be provided where needed. Most variation was again identified within the strain 3 triplicate (3100/3103/3106) and work is underway to identify if there are any particular biological issues with this strain that can result in variable MICs, however the use of sub-optimal Oxoid GC media may have contributed to this problem.

The gonococcal strains were also typed by the *N. gonorrhoeae* multi-antigen sequence typing (NG-MAST) method by PHE to ensure a NG-MAST EQA is available to Euro-GASP laboratories. To date only one laboratory reported back any NG-MAST results (which all passed). The EQA protocol (3) will be updated to highlight the additional function of this EQA scheme.

5. Conclusion

In conclusion, the laboratories participating in the QA15 EQA scheme for susceptibility testing of *Neisseria gonorrhoeae* showed good levels of competence and capability on the whole in isolating and testing strains of unknown phenotype. Inter-laboratory and intra-laboratory concordance of categories of susceptibility for the different strains were good in most cases, providing reassurance in de-centralised testing and comparison of surveillance data from the members of the STI network. This EQA scheme allows for monitoring of the performance of laboratories, with respect to antimicrobial susceptibility testing. The identification of results, which are out of range, can trigger appropriate troubleshooting to ensure the implemented methodology is appropriate. In turn, quality standards should improve. It is a positive development that more laboratories than in any other EQA distribution adhere to the EUCAST breakpoints.

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Annex. QA15 detailed results

Table A1.1. **Azithromycin – overall susceptibility category concordance for each EQA strain from 26 laboratories**

		All methods (n=205)		E-test (n=165)		Agar dilution (n=24)	
	Strain number	Consensus	% Concordance	Consensus	% Concordance	Consensus	% Concordance
1	**3098/3104***	R		R		R	
2	**3099**	S	96	S	95.2	S	100
3	**3100/3103/3106**	S	46.7	I	42.7	S	66.7
4	**3101/3105**	S	88	S	88.1	S	100
5	**3102**	R	100	R	100	R	100
6	**3107**	R	54	R	57.1	none (one instance each of S/I/R)	33.3
		Overall	77.0	Overall	76.4	Overall	80

Table A1.2. **Cefixime – overall susceptibility category concordance for each EQA strain from 26 laboratories**

		All methods (n=205)		E-test (n=165)		Agar dilution (n=24)	
	Strain number	Consensus	% Concordance	Consensus	% Concordance	Consensus	% Concordance
1	**3098/3104***	S		S		S	
2	**3099**	S	100	S	100	S	100
3	**3100/3103/3106**	R	58.7	R	53.3	R	100
4	**3101/3105**	S	100	S	100	S	100
5	**3102**	S	100	S	100	S	100
6	**3107**	S	92	S	95.2	S	66.7
		Overall	90.2	Overall	89.7	Overall	93.3

**Upon investigation, the freeze-dried vials of 3098 and 3104 each contained both the 3098 and 3104 isolates, and subsequently 3098 and 3102 were not the duplicate set as anticipated. Therefore data from isolates 3098 and 3104 were not included in any of the concordance calculations. Isolate 3102 was deemed to be pure and was subsequently included as a single isolate.*

Table A1.3. **Ceftriaxone – overall susceptibility category concordance for each EQA strain from 26 laboratories**

		All methods (n=205)		E-test (n=173)		Agar dilution (n=24)	
	Strain number	Consensus	% Concordance	Consensus	% Concordance	Consensus	% Concordance
1	**3098/3104***	S		S		S	
2	**3099**	S	100	S	100	S	100
3	**3100/3103/3106**	S	72.0	S	79.4	R	66.7
4	**3101/3105**	S	100	S	100	S	100
5	**3102**	S	100	S	100	S	100
6	**3107**	S	100	S	100	S	100
		Overall	94.4	Overall	95.9	Overall	93.3

Table A1.4. **Ciprofloxacin – overall susceptibility category concordance for each EQA strain from 26 laboratories**

		All methods (n=205)		E-test (n=173)		Agar dilution (n=24)	
	Strain number	**Consensus**	**% Concordance**	**Consensus**	**% Concordance**	**Consensus**	**% Concordance**
1	**3098/3104***	R		R		R	
2	**3099**	S	100	S	100	S	100
3	**3100/3103/3106**	R	100	R	100	R	100
4	**3101/3105**	R	48	R	47.7	None (one instance each of S/I/R)	33.3
5	**3102**	S	96	S	95.5	S	100
6	**3107**	R	100	R	100	R	100
		Overall	88.8	Overall	88.6	Overall	86.7

**Upon investigation, the freeze-dried vials of 3098 and 3104 each contained both the 3098 and 3104 isolates, and subsequently 3098 and 3102 were not the duplicate set as anticipated. Therefore data from isolates 3098 and 3104 were not included in any of the concordance calculations. Isolate 3102 was deemed to be pure and was subsequently included as a single isolate.*

Table A1.5. **Spectinomycin – overall susceptibility category concordance for each EQA strain from 20 laboratories**

		All methods (n=158)		E-test (n=126)		Agar dilution (n=24)	
	Strain number	**Consensus**	**% Concordance**	**Consensus**	**% Concordance**	**Consensus**	**% Concordance**
1	**3098/3104***	S		S		S	
2	**3099**	S	100	S	100	S	100
3	**3100/3103/3106**	S	100	S	100	S	100
4	**3101/3105**	S	100	S	100	S	100
5	**3102**	S	100	S	100	S	100
6	**3107**	S	100	S	100	S	100
		Overall	100	Overall	100	Overall	100

Table A1.6. **Country coded concordance – BETA-LACTAMASE**

		Laboratory codes																									
	Strain	582	874	90984	91431	92613	92621	92622	92623	92624	92625	92626	92627	92628	92630	92631	92632	92634	92636	92784	92945	93994	93995	93996	93997	94603	% Concordance
1	**3098***	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
	3104*	S	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	**3099**	S	S	S	S	S	S	S	S	S	S	S	R	S	S	S	S	S	S	S	S	S	S	S	S	S	96.0
3	**3100**	S	N	S	S	S	S	S	S	S	R	S	S	S	S	S	S	S	S	S	R	S	S	S	S	S	91.7
	3103	S	N	S	S	S	S	S	S	S	R	S	R	S	S	S	S	S	S	S	R	S	S	S	S	S	
	3106	S	N	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	R	S	S	S	S	S	
4	**3101**	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	100.0
	3105	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
5	**3102**	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	100.0
6	**3107**	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	100.0
																										Total	97.5

N – No result; not retrieved or susceptibility category not supplied. Laboratory 92629 did not submit beta-lactamase testing results
**Upon investigation, the freeze-dried vials of 3098 and 3104 each contained both the 3098 and 3104 isolates, and subsequently 3098 and 3102 were not the duplicate set as anticipated. Therefore data from isolates 3098 and 3104 were not included in any of the concordance calculations. Isolate 3102 was deemed to be pure and was subsequently included as a single isolate.*

Table A1.7. **Country coded category of susceptibility concordance – AZITHROMYCIN**

		Laboratory codes																															
	Strain	582	874	90984	91431	92613	92621	92622	92623	92624	92625	92626	92627	92628	92629	92630	92631	92632	92634	92636	92784	92945	93994	93995	93996	93997	94603	Total	No. sensitive	No. inter-mediate	No. resistant	Consensus	% Concordance
1	**3098***	R	R	R	S	S	R	I	R	R	R	R	R	S	R	R	R	R	R	R	R	R	R	R	I	R	R	51	5	3	43	R	
	3104*	R	R	R	S	S	R	R	R	R	R	R	R	R	R	N	R	R	R	R	R	R	R	R	I	R	R						
2	**3099**	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	R	26	25	0	1	S	96
3	**3100**	I	N	S	S	S	R	I	I	I	S	S	I	S	S	R	I	S	R	S	R	S	I	S	S	R	I	75	35	26	14	S	46.7
	3103	I	N	S	S	S	R	I	I	I	I	I	S	S	I	R	I	S	I	S	R	S	S	S	S	R	S						
	3106	I	N	S	S	S	R	I	I	I	I	I	S	S	I	R	I	S	R	S	R	S	S	S	S	R	I						
4	**3101**	S	S	S	S	S	S	S	S	S	S	S	R	S	S	I	S	S	S	S	S	S	S	S	S	S	I	52	46	5	1	S	88
	3105	S	S	S	S	S	S	S	S	S	S	I	S	S	S	I	S	S	S	S	S	S	S	S	S	S	I						
5	**3102**	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	26	0	0	26	R	100
6	**3107**	R	S	R	S	S	R	R	R	R	S	R	R	S	I	R	R	I	R	I	R	S	I	S	S	R	R	26	8	4	14	R	54
																											Total	77.0				

N – No result; not retrieved or susceptibility category not supplied

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

		Laboratory codes																												
	Strain	582	874	90984	91431	92621	92622	92623	92624	92625	92626	92627	92628	92629	92630	92631	92632	92634	92636	92784	92945	93994	93995	93996	93997	94603	Modal MIC	Min MIC	Max MIC	2 MIC dilutions different	>2 MIC dilutions different
1	**3098***	>256	>256	>256	0.125	16	0.5	>256	>0.5	>256	>256	>256	0.25	>256	>256	>256	256	>256	>2	≥256	>2	1	>256	0.5	2	>256					
	3104*	>256	>256	>256	0.125	16	256	>256	>0.5	>256	>256	>256	>256	>256	>256	>256	>256	>256	>2	≥256	>2	1	>256	0.5	>256	>256					
2	**3099**	0.125	0.064	0.125	0.064	0.25	0.125	0.125	0.125	0.125	0.25	0.25	0.064	0.064	0.125	0.125	0.125	0.125	0.064	0.25	0.064	0.25	0.004	0.25	0.25	0.25	0.125	0.004	0.25	0	1
3	**3100**	0.5	NT	0.064	0.125	1	0.5	0.5	0.5	0.5	0.25	0.5	0.125	0.25	4	0.5	0.25	1	0.125	1	0.25	0.5	0.25	0.25	1	0.5					
	3103	0.5	NT	0.064	0.125	1	0.5	0.5	0.5	1	0.5	0.125	0.25	0.5	4	0.5	0.25	0.5	0.125	1	0.25	0.25	0.25	0.25	1	0.25	0.5	0.064	4	8	6
	3106	0.5	NT	0.125	0.064	1	0.5	0.5	0.5	1	0.5	0.25	0.25	0.5	4	0.5	0.25	1	0.125	1	0.25	0.25	0.25	0.25	1	0.5					
4	**3101**	0.25	0.064	0.064	0.064	0.25	0.25	0.25	0.25	0.25	0.25	1	0.125	0.125	0.5	0.25	0.25	0.25	0.064	0.25	0.125	0.125	0.064	0.25	0.125	0.5	0.25	0.064	1	9	0
	3105	0.25	0.064	0.125	0.064	0.25	0.25	0.25	0.25	0.125	0.5	0.125	0.125	0.125	0.5	0.25	0.25	0.25	0.064	0.25	0.125	0.25	0.25	0.125	0.125	0.5					
5	**3102**	>256	>256	>256	>256	16	256	>256	>256	>256	>256	>256	>256	>256	>256	>256	>256	>256	>2	≥256	>2	>256	>256	>256	>256	>256	>256	16	>256	0	1
6	**3107**	1	0.25	1	0.25	1	1	1	1	0.25	1	1	0.25	0.5	4	1	0.5	1	0.5	1	0.5	0.5	0.25	0.25	2	1	1	0.25	4	7	0

Note: Highlighted cell – typo identified: 25 was changed to 0.25
NT – not tested, one laboratory could not retrieve one strain
**Upon investigation, the freeze-dried vials of 3098 and 3104 each contained both the 3098 and 3104 isolates, and subsequently 3098 and 3102 were not the duplicate set as anticipated. Therefore data from isolates 3098 and 3104 were not included in any of the concordance calculations. Isolate 3102 was deemed to be pure and was subsequently included as a single isolate.*

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

		Laboratory codes																														
	Strain	582	874	90984	91431	92613	92621	92622	92623	92624	92625	92626	92627	92628	92629	92630	92631	92632	92634	92636	92784	92945	93994	93995	93996	93997	94603	Total	No. sensitive	No. inter-mediate	No. resistant	Consensus	% Concordance
1	**3098***	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	52	52	0	0	S	
	3104*	S	S	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	**3099**	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	26	26	0	0	S	100
3	**3100**	S	N	S	S	S	R	R	R	S	R	R	S	R	R	R	R	S	R	R	R	R	S	S	R	S	R	75	31	0	44	R	58.7
	3103	S	N	S	S	S	R	R	R	S	R	R	S	R	R	R	R	S	R	R	R	R	S	S	R	S	R						
	3106	S	N	S	S	S	R	R	R	S	R	R	S	R	R	R	R	S	R	R	R	R	S	S	R	S	S						
4	**3101**	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	52	52	0	0	S	100
	3105	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S						
5	**3102**	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	26	26	0	0	S	100
6	**3107**	S	S	S	S	S	S	S	S	S	S	S	S	S	S	R	S	S	S	R	S	S	S	S	S	S	S	26	24	0	2	S	92
																															Total		90.2

Note: Highlighted cells denote strains assigned intermediate sensitivity, for the purposes of this analysis intermediate and resistant strain counts have been combined as there is no published intermediate category for this antimicrobial.
N – No result; not retrieved or susceptibility category not supplied

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

	Laboratory codes																												
Strain	**582**	**874**	**90984**	**92613**	**92621**	**92622**	**92623**	**92624**	**92625**	**92626**	**92627**	**92628**	**92629**	**92630**	**92631**	**92632**	**92634**	**92636**	**92784**	**92945**	**93994**	**93995**	**93996**	**93997**	**94603**	**Modal MIC**	**Min MIC**	**Max MIC**	**2 MIC dilutions different**	**>2 MIC dilutions different**
3098*	<0.016	0.016	<0.016	0.016	0.032	<0.016	0.064	0.016	0.016	<0.016	<0.016	<0.016	0.016	0.064	0.016	<0.016	0.064	0.016	≤0.016	0.064	0.016	<0.016	<0.016	<0.016	<0.016					
3104*	<0.016	0.016	0.016	0.016	0.032	0.016	0.032	0.016	0.016	<0.016	<0.016	0.016	<0.016	0.064	0.016	<0.016	0.064	0.016	≤0.016	0.064	0.032	<0.016	<0.016	<0.016	<0.016					
3099	<0.016	0.016	0.016	<0.016	0.002	<0.016	<0.016	0.016	<0.016	<0.016	<0.016	<0.016	<0.016	<0.002	<0.016	<0.016	<0.016	0.004	≤0.016	<0.016	<0.016	<0.016	<0.016	<0.016	<0.016	<0.016	<0.002	0.016	0	0
3100	0.125	NT	0.064	0.125	1	0.25	0.5	0.125	0.25	0.25	0.064	0.25	0.5	1	0.25	0.125	1	0.125	0.5	>0.125	0.125	0.25	0.25	0.125	0.25					
3103	0.125	NT	0.064	0.125	1	0.25	0.25	0.125	0.5	0.25	0.016	0.25	0.25	1	0.25	0.125	0.5	0.125	0.5	>0.125	0.125	0.125	0.25	0.125	0.25	0.125	0.016	1	7	11
3106	0.125	NT	0.125	0.125	1	0.25	0.5	0.125	0.25	0.25	0.016	0.25	0.25	1	0.25	0.125	1	0.125	0.25	>0.125	0.125	0.125	0.25	0.125	0.125					
3101	<0.016	0.016	<0.016	<0.016	0.016	<0.016	<0.016	0.016	0.016	<0.016	<0.016	<0.016	<0.016	0.016	<0.016	<0.016	<0.016	0.008	≤0.016	<0.016	0.016	<0.016	<0.016	<0.016	<0.016	<0.016	0.008	0.032	0	0
3105	0.016	0.016	0.016	0.016	0.016	<0.016	<0.016	0.016	<0.016	0.016	<0.016	<0.016	<0.016	0.032	<0.016	<0.016	<0.016	0.008	0.016	<0.016	0.016	<0.016	<0.016	<0.016	<0.016					
3102	0.032	0.032	<0.016	0.016	0.032	0.032	0.032	0.016	0.016	0.016	<0.016	0.016	0.032	0.064	0.016	<0.016	0.032	0.016	≤0.016	0.064	0.016	<0.016	0.032	<0.016	<0.016	0.032	<0.016	0.064	0	0
3107	0.032	0.064	0.064	0.064	0.064	0.064	0.064	0.032	0.064	0.125	0.016	0.064	0.064	0.25	0.032	0.032	0.125	0.125	0.064	0.125	0.064	0.032	0.064	0.064	0.032	0.064	0.016	0.250	2	0

NT – not tested, one laboratory could not retrieve one strain

**Upon investigation, the freeze-dried vials of 3098 and 3104 each contained both the 3098 and 3104 isolates, and subsequently 3098 and 3102 were not the duplicate set as anticipated. Therefore data from isolates 3098 and 3104 were not included in any of the concordance calculations. Isolate 3102 was deemed to be pure and was subsequently included as a single isolate.*

Table A1.11. Country coded category of susceptibility concordance – CEFTRIAXONE

		Laboratory codes																														
	Strain	**582**	**874**	**90984**	**91431**	**92613**	**92621**	**92622**	**92623**	**92624**	**92625**	**92626**	**92627**	**92628**	**92629**	**92630**	**92631**	**92632**	**92634**	**92636**	**92784**	**92945**	**93994**	**93995**	**93996**	**93997**	**94603**	**Total**	**No. sensitive**	**No. inter-mediate**	**No. resistant**	**Consensus**	**% Concordance**
1	**3098***	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	52	52	0	0	S	
	3104*	S	S	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	**3099**	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	26	26	0	0	S	100
3	**3100**	S	N	S	S	S	R	R	S	S	S	S	S	S	R	R	S	S	R	S	S	R	S	S	S	S	S						
	3103	S	N	S	S	S	R	R	S	S	R	R	S	S	R	R	S	S	R	S	S	R	S	S	S	S	S	75	54	0	21	S	72.0
	3106	S	N	S	S	S	R	R	S	S	S	R	S	S	R	R	S	S	R	S	S	R	S	S	S	S	S						
4	**3101**	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	52	52	0	0	S	100
	3105	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S						
5	**3102**	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	26	26	0	0	S	100
6	**3107**	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	26	26	0	0	S	100
																															Total	94.4	

Note: Highlighted cells denote strains assigned intermediate sensitivity, for the purposes of this analysis intermediate and resistant strain counts have been combined as there is no published intermediate category for this antimicrobial.
N – No result; not retrieved or susceptibility category not supplied

Table A1.12. Country coded category of susceptibility concordance – CIPROFLOXACIN

		Laboratory codes																														
	Strain	582	874	90984	91431	92613	92621	92622	92623	92624	92625	92626	92627	92628	92629	92630	92631	92632	92634	92636	92784	92945	93994	93995	93996	93997	94603	Total	No. sensitive	No. inter-mediate	No. resistant	Consensus	% Concordance
1	3098*	S	R	I	R	R	R	R	R	R	I	R	I	R	R	R	R	R	R	I	R	R	R	R	R	R	R	52	4	6	42	R	
	3104*	R	R	R	R	R	I	R	R	R	I	R	S	S	R	R	R	R	R	S	R	R	R	R	R	R	R						
2	3099	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	26	26	0	0	S	100
3	3100	R	N	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	75	0	0	75	R	100.0
	3103	R	N	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R						
	3106	R	N	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R						
4	3101	I	R	S	I	S	I	I	I	R	I	R	S	R	R	R	R	I	R	S	R	R	I	R	R	R	I	52	9	18	25	R	48
	3105	I	I	I	S	S	I	I	R	R	I	R	S	R	R	R	R	S	I	S	R	R	I	R	R	R	I						
5	3102	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	R	S	S	S	26	25	0	1	S	96
6	3107	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	26	0	0	26	R	100
																															Total		88.8

N – No result; not retrieved or susceptibility category not supplied

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

		Laboratory codes																												
	Strain	582	874	90984	91431	92613	92621	92622	92623	92624	92625	92626	92627	92628	92629	92630	92631	92632	92634	92636	92784	92945	93994	93995	93996	93997	94603	Modal MIC	Min MIC	Max MIC	2 MIC dilutions different	>2 MIC dilutions different
1	3098*	0.008	0.25	0.064	0.125	0.064	1	0.25	0.25	0.5	0.25	0.5	0.25	0.25	0.25	0.5	0.5	0.125	0.5	1	0.5	0.25	0.25	0.125	0.5	0.5	0.25					
	3104*	0.25	0.25	0.125	0.125	0.064	0.5	0.25	0.25	0.5	0.25	0.5	0.25	0.008	0.25	0.5	0.5	0.125	0.5	0.5	0.5	0.25	0.25	0.25	0.5	0.5	0.125					
2	3099	0.004	0.002	<0.002	<0.002	0.002	0.004	0.002	0.004	0.004	0.004	0.004	0.002	0.004	0.004	0.008	0.004	0.002	0.004	≤0.032	0.008	<0.004	0.002	0.016	0.008	0.002	<0.002	0.004	<0.002	0.016	1	0
3	3100	16	NT	1	8	4	16	16	>32	>32	32	16	>32	>32	16	>32	>32	4	>32	16	≥32	>1.0	16	>32	>32	>32	8					
	3103	16	NT	2	>32	4	16	16	>32	16	>32	16	>32	>32	>32	>32	>32	4	>32	16	≥32	>1.0	16	>32	>32	>32	2	>32	1	>32	21	13
	3106	16	NT	4	16	4	16	16	>32	>32	>32	16	>32	>32	>32	>32	>32	4	>32	16	≥32	>1.0	16	32	>32	>32	4					
4	3101	0.064	0.125	0.032	0.064	0.032	0.125	0.064	0.064	0.125	0.125	0.125	0.125	0.125	0.125	0.25	0.125	0.064	0.125	0.125	0.125	0.125	0.064	>32	0.125	0.064	0.064	0.125	0.032	>32	5	1
	3105	0.064	0.064	0.064	0.032	0.032	0.125	0.064	0.125	0.125	0.064	0.125	0.064	0.125	0.064	0.25	0.125	0.032	0.064	0.125	0.125	0.125	0.064	0.064	0.125	0.064	0.064					
5	3102	0.008	0.004	0.002	0.004	0.004	0.008	0.004	0.008	0.008	0.004	0.016	0.008	0.008	0.004	0.008	0.008	0.004	0.004	≤0.032	0.016	0.008	0.004	>32	0.008	0.004	0.004	0.004	0.002	>32	2	0
6	3107	16	32	8	4	8	16	32	16	>32	>32	>32	>32	>32	16	>32	>32	8	>32	16	≥32	>1.0	8	8	>32	>32	16	>32	4	>32	6	6

NT – not tested, one laboratory could not retrieve one strain

**Upon investigation, the freeze-dried vials of 3098 and 3104 each contained both the 3098 and 3104 isolates, and subsequently 3098 and 3102 were not the duplicate set as anticipated. Therefore data from isolates 3098 and 3104 were not included in any of the concordance calculations. Isolate 3102 was deemed to be pure and was subsequently included as a single isolate.*

Table A1.14. Country coded MIC values (mg/L) – CEFTRIAXONE

Strain	Laboratory codes																										Modal MIC	Min MIC	Max MIC	2 MIC dilutions different	>2 MIC dilutions different
	582	874	90984	91431	92613	92621	92622	92623	92624	92625	92626	92627	92628	92629	92630	92631	92632	92634	92636	92784	92945	93994	93995	93996	93997	94603					
3098*	0.008	0.008	0.008	0.004	0.008	0.016	0.008	0.016	0.004	0.016	0.008	<0.016	<0.002	0.008	0.008	0.008	<0.002	0.016	0.004	0.016	0.064	0.016	<0.016	0.008	<0.016	<0.016					
3104*	0.008	0.016	0.008	0.004	0.008	0.016	0.016	0.016	0.004	0.016	0.016	<0.016	0.008	0.008	0.008	0.008	<0.002	0.016	0.004	0.008	0.032	0.016	<0.016	0.004	<0.016	<0.016					
3099	<0.002	0.002	<0.002	<0.002	0.002	0.002	<0.002	<0.002	0.002	<0.002	<0.002	<0.016	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	≤0.002	≤0.002	<0.016	<0.002	<0.016	0.002	<0.016	<0.016	<0.002	<0.002	0.002	0	0
3100	0.125	NT	0.016	0.004	0.032	0.5	0.25	0.125	0.125	0.125	0.125	0.032	0.064	0.25	0.125	0.064	0.032	0.25	0.032	0.125	>0.125	0.064	0.5	0.064	0.125	0.125					
3103	0.125	NT	0.016	0.016	0.032	0.5	0.25	0.125	0.125	1	0.125	<0.016	0.064	0.25	0.125	0.064	0.032	0.25	0.016	0.125	>0.125	0.064	0.25	0.064	0.125	0.125	0.125	0.004	1	16	10
3106	0.125	NT	0.032	0.016	0.032	0.5	0.25	0.125	0.125	0.125	0.25	<0.016	0.032	0.25	0.25	0.064	0.032	0.25	0.016	0.125	>0.125	0.064	0.5	0.032	0.125	0.064					
3101	0.004	0.008	0.008	0.008	0.004	0.016	0.008	0.008	0.004	0.016	0.008	<0.016	0.004	0.008	0.008	0.008	0.004	0.008	0.004	0.016	0.032	0.008	0.016	0.008	<0.016	<0.016	0.008	0.004	0.032	1	0
3105	0.008	0.008	0.008	0.008	0.008	0.016	0.008	0.008	0.004	0.008	0.016	<0.016	0.004	0.008	0.008	0.008	0.004	0.008	0.004	0.008	<0.016	0.008	<0.016	0.008	<0.016	<0.016					
3102	0.008	0.016	0.004	0.008	0.008	0.032	0.016	0.016	0.002	0.016	0.016	<0.016	0.004	0.016	0.008	0.008	0.002	0.016	0.004	0.004	0.032	0.008	<0.016	<0.016	<0.016	<0.016	0.016	0.002	0.032	4	2
3107	0.016	0.016	0.016	0.016	0.016	0.032	0.032	0.032	0.016	0.016	0.064	<0.016	0.016	0.032	0.064	0.016	0.008	0.016	0.016	0.032	0.125	0.032	0.016	<0.016	0.032	0.016	0.016	0.008	0.125	2	1

NT – not tested, one laboratory could not retrieve one strain
**Upon investigation, the freeze-dried vials of 3098 and 3104 each contained both the 3098 and 3104 isolates, and subsequently 3098 and 3102 were not the duplicate set as anticipated. Therefore data from isolates 3098 and 3104 were not included in any of the concordance calculations. Isolate 3102 was deemed to be pure and was subsequently included as a single isolate.*

Table A1.15. Country coded category of susceptibility concordance – SPECTINOMYCIN

	Strain	Laboratory codes																					Total	No. sensitive	No. inter-mediate	No. resistant	Consensus	% Concordance
		582	92621	92622	92623	92624	92625	92626	92627	92628	92630	92631	92632	92634	92636	92784	92945	93994	93995	93996	94603						
1	**3098***	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	40	40	0	0	S	
	3104*	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S						
2	**3099**	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	20	20	0	0	S	100
3	**3100**	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	59	59	0	0	S	100
	3103	S	S	S	S	S	S	S	N	S	S	S	S	S	S	S	S	S	S	S	S						
	3106	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S						
4	**3101**	S	S	S	S	S	S	S	S	S	S	S	N	S	S	S	S	S	S	S	S	39	39	0	0	S	100
	3105	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S						
5	**3102**	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	20	20	0	0	S	100
6	**3107**	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	20	20	0	0	S	100
																										Total	100

N – not retrieved or susceptibility category not supplied.

Table A1.16. Country coded MIC values (mg/L) – SPECTINOMYCIN

		Laboratory codes																							
	Strain	582	92621	92622	92623	92624	92625	92626	92627	92628	92630	92631	92632	92634	92636	92784	92945	93994	93995	93996	94603	Modal MIC	Min MIC	Max MIC	2 MIC dilutions different	>2 MIC dilutions different
1	**3098***	16	32	8	16	16	8	8	16	8	16	8	8	16	16	16	<16	16	2	8	16					
	3104*	16	16	8	16	16	16	8	32	8	16	8	8	16	16	32	<16	16	2	8	16					
2	**3099**	16	32	8	16	16	16	8	32	16	16	8	16	32	32	32	<16	32	4	8	16	16	4	32	1	0
3	**3100**	8	8	4	8	8	4	4	16	8	8	2	4	8	≤8	8	<16	4	1	4	4					
	3103	16	8	2	4	8	16	4	4	4	8	2	4	8	16	8	<16	8	2	4	8	8	1	16	6	1
	3106	16	8	4	8	8	8	4	4	4	8	2	4	8	≤8	8	<16	8	2	4	4					
4	**3101**	8	32	8	8	8	8	8	32	8	16	8	8	16	16	16	<16	16	2	8	16	8	2	32	5	0
	3105	8	16	8	16	16	8	8	8	8	16	8	8	16	16	32	<16	16	2	4	16					
5	**3102**	16	16	4	8	8	4	8	32	8	8	4	8	8	16	16	<16	16	2	8	8	8	2	32	2	0
6	**3107**	16	32	8	16	16	8	8	16	8	16	8	16	16	32	32	<16	16	4	8	16	16	4	32	1	0

Note: Laboratories 874, 90984, 91431, 92613, 92629 and 93997 did not submit spectinomycin data
**Upon investigation, the freeze-dried vials of 3098 and 3104 each contained both the 3098 and 3104 isolates, and subsequently 3098 and 3102 were not the duplicate set as anticipated. Therefore data from isolates 3098 and 3104 were not included in any of the concordance calculations. Isolate 3102 was deemed to be pure and was subsequently included as a single isolate.*

Table A1.17. Country coded MIC values (mg/L) – GENTAMICIN

		Laboratory codes																	
	Strain	582	91431	92622	92625	92626	92627	92630	92631	92632	92784	93994	93995	93996	93997	Modal MIC	Min MIC	Max MIC	2 MIC dilutions different	>2 MIC dilutions different
1	**3098***	4	2	4	4	4	16	8	8	2	4	4	2	4	8					
	3104*	8	2	4	4	4	16	8	8	4	4	4	2	4	8					
2	**3099**	4	2	4	4	4	8	8	4	2	4	4	2	4	4	4	2	8	0	0
3	**3100**	4	1	2	1	2	4	4	4	1	2	2	2	2	2					
	3103	4	1	1	2	2	2	4	4	1	2	1	1	2	2	2	1	4	0	0
	3106	4	1	2	1	2	4	4	4	1	2	1	1	2	2					
4	**3101**	4	1	4	2	4	8	8	4	2	4	4	2	4	2					
	3105	2	1	4	4	4	4	8	4	2	4	2	1	4	2	4	1	8	3	0
5	**3102**	4	2	4	2	4	16	4	4	2	4	2	0.25	4	4	4	0.25	16	1	1
6	**3107**	8	2	4	2	8	8	8	8	4	4	4	4	4	8	8	2	8	2	0

Note: Laboratories 874, 90984, 91431, 92613, 92621, 92623, 92624, 92628, 92629, 92634, 92636 and 92945 did not submit gentamicin data
**Upon investigation, the freeze-dried vials of 3098 and 3104 each contained both the 3098 and 3104 isolates, and subsequently 3098 and 3102 were not the duplicate set as anticipated. Therefore data from isolates 3098 and 3104 were not included in any of the concordance calculations. Isolate 3102 was deemed to be pure and was subsequently included as a single isolate.*