



**EUCAST**

EUROPEAN COMMITTEE  
ON ANTIMICROBIAL  
SUSCEPTIBILITY TESTING

European Society of Clinical Microbiology and Infectious Diseases

# **Defining problems in antimicrobial susceptibility testing: lessons from external quality assurance**

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# Participants in UKNEQAS for Microbiology (2008)

Austria	43	Netherlands	18
Belgium	4	Poland	1
Croatia	6	Portugal	52
Finland	23	Romania	2
Germany	1	Sweden	28
Greece	16	Switzerland	24
Ireland	45	United Kingdom	278
Italy	124	Other	82

# Breakpoint guidelines used by participants in UKNEQAS Nov 2008

<b>Guideline</b>	<b>Number (%) labs</b>
CLSI	389 (55)
BSAC (UK)	184 (26)
SRGA (Sweden)	34 (5)
NWGA (Norway)	6 (1)
CRG (Netherlands)	5 (1)
EUCAST	5 (1)
Other/not stated/combined	81 (11)
<b>TOTAL</b>	<b>704</b>

# Methods used by participants in UKNEQAS Nov 2008

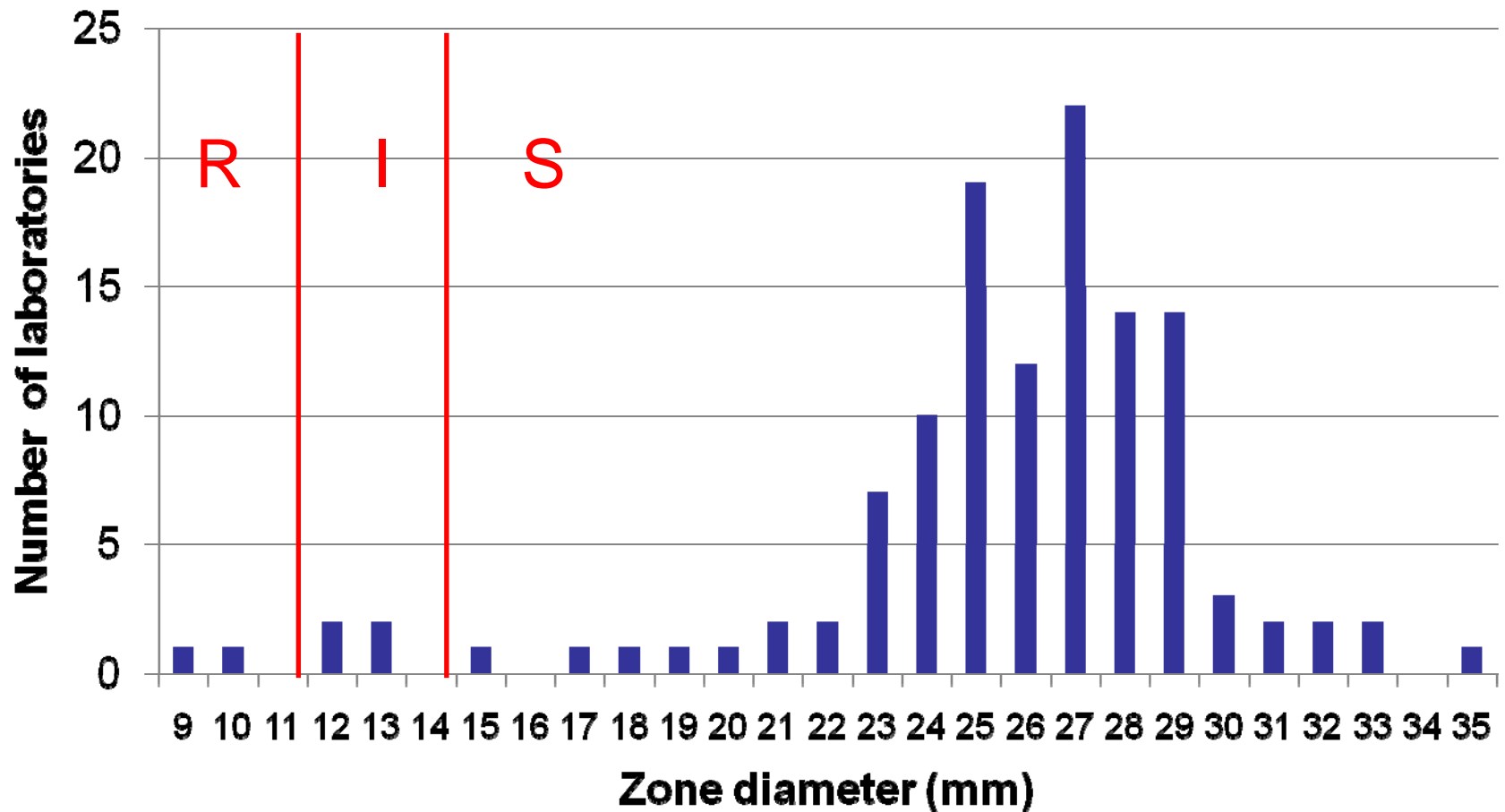
Method	Number (%) labs
Disk diffusion	310 (43)
Automated	257 (37)
MIC	27 (4)
Breakpoint	14 (2)
Other/not stated/combined	96 (14)
Total	704

# Methods related to guidelines used by participants in UKNEQAS Nov 2008

Method	CLSI n (%)	BSAC n (%)	SRGA n (%)
Disk diffusion	106 (27)	148 (80)	24 (71)
Automated	220 (57)	17 (9)	1 (3)
MIC	23 (6)	3 (2)	0 (0)
Breakpoint	8 (2)	4 (2)	1 (3)
Other/not stated	32 (8)	12 (6)	8 (23)

**Laboratories may perform  
poorly**

# Zone diameter for *K. pneumoniae* 9142 with co-amoxiclav (BSAC)



# Some susceptibility tests are more difficult, e.g.

- Some MRSA
- Some penicillin resistant *S. pneumoniae*
- Some glycopeptide resistant enterococci
- Glycopeptide susceptibility in staphylococci
- BLNAR *H. Influenzae*
- Borderline susceptibility in general

**Performance is affected by  
breakpoint guidelines**

# Susceptibility testing of *P. aeruginosa* specimen 8812 to piperacillin-tazobactam (MIC 32-64 mg/L) by UKNEQAS participants

Method	Breakpoints	Susceptible	Intermediate	Resistant
CLSI	S <sub>≤</sub> 64 R <sub>&gt;</sub> 64	223	37	57
BSAC	S <sub>≤</sub> 16 R <sub>&gt;</sub> 16	50	12	105
SRGA	S <sub>≤</sub> 16 R <sub>&gt;</sub> 16	2	9	18

# Susceptibility testing of *Neisseria gonorrhoeae* specimen 8482 to ciprofloxacin (MIC 0.5 mg/L) by UKNEQAS participants

Method	Breakpoints	Susceptible	Intermediate	Resistant
CLSI	S <sub>≤</sub> 0.06 R <sub>&gt;</sub> 0.5	73	117	93
BSAC	S <sub>≤</sub> 0.03 R <sub>&gt;</sub> 0.06	14	4	166
SRGA	S <sub>≤</sub> 0.03 R <sub>&gt;</sub> 0.06	2	0	28

# Changes in breakpoints may affect reporting

*S aureus* 7240, Ciprofloxacin MIC 0.5 mg/L

Method	Breakpoints	Susceptible	Intermediate	Resistant
CLSI	$S_{\leq 1}$ $R_{>2}$	434	5	4
BSAC	$S_{\leq 1}$ $R_{>1}$	167	0	1
SRGA	$S_{\leq 0.06}$ $R_{>2}$	3	19	0

*S aureus* 7876, Ciprofloxacin MIC 0.25 mg/L

Method	Breakpoints	Susceptible	Intermediate	Resistant
CLSI	$S_{\leq 1}$ $R_{>2}$	350	0	0
BSAC	$S_{\leq 1}$ $R_{>1}$	176	0	1
SRGA	$S_{\leq 1}$ $R_{>1}$	23	2	1

**Performance is affected by the  
method used**

# Detection of VanB glycopeptide resistance in enterococci by UKNEQAS participants

*E. faecium* 7826

Vancomycin MIC 8-16 mg/L, I/R

Method	Breakpoints	Susceptible	Intermediate	Resistant
CLSI	S <sub>≤</sub> 4 R>16	40 (11%)	52	288
BSAC	S <sub>≤</sub> 4 R>8	84 (43%)	8	108
SRGA	S <sub>≤</sub> 4 R>8	14 (38%)	0	23

# Methods used for detection of VanB glycopeptide resistance in enterococci

*E. faecium* 7826

Vancomycin MIC 8-16 mg/L, I/R

Method	Susceptible	Intermediate	Resistant
Disk	122 (37%)	37	173
Automated	8 (4%)	12	188
MIC	7 (13%)	9	38
Breakpoint	3 (13%)	2	19

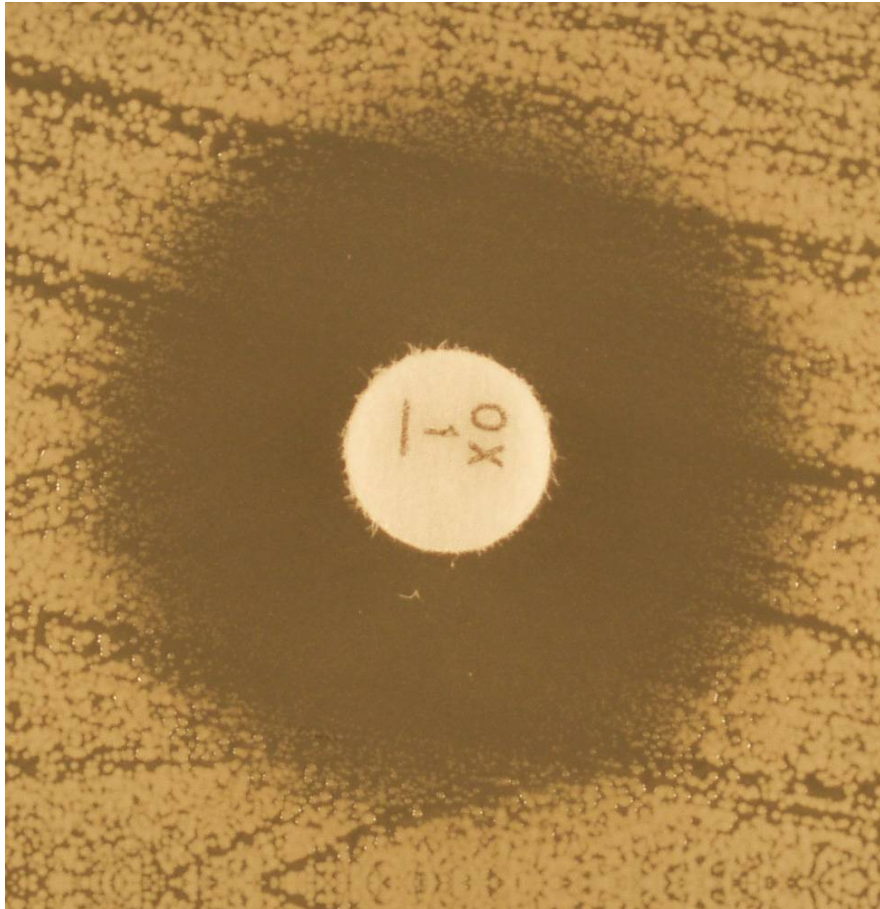
# Reporting *S. epidermidis* (specimen 7156) with reduced susceptibility to teicoplanin (MIC 8 BSAC, 16 mg/L CLSI)

Method	Breakpoints	Susceptible	Intermediate	Resistant
CLSI	S <sub>≤</sub> 8 R>16	105 (31%)	141	92
BSAC	S <sub>≤</sub> 4 R>4	84 (53%)	8	67
SRGA	S <sub>≤</sub> 4 R>4	11 (50%)	2	9

# Methods used for detection of reduced susceptibility to teicoplanin (MIC 8-16 mg/L) in *S. epidermidis* (specimen 7156)

Method	Susceptible	Intermediate	Resistant
Disk	148 (60%)	47	52
Automated	31 (19%)	70	62
MIC	9 (11%)	23	52
Breakpoint	2 (11%)	4	13

# Detection of methicillin (oxacillin) resistance in *S. aureus* with cefoxitin



# Detection of oxacillin/cefoxitin resistance in *mecA* positive *S aureus*

Organism	Oxacillin MIC (mg/L)	Oxacillin		Cefoxitin	
		n	%R	n	%R
7240	16->128	535	81	48	98
7538	≥128	614	99	77	99
7597	>128	590	96	77	99
7659	>128	647	99	85	100
7703	>128	626	99	106	96
8248	64->128	609	95	162	99
8452	≥128	569	99	405	97
8701	32-128	615	96	471	94
8858	>128	604	100	513	99
9141	16-32	600	93	518	95

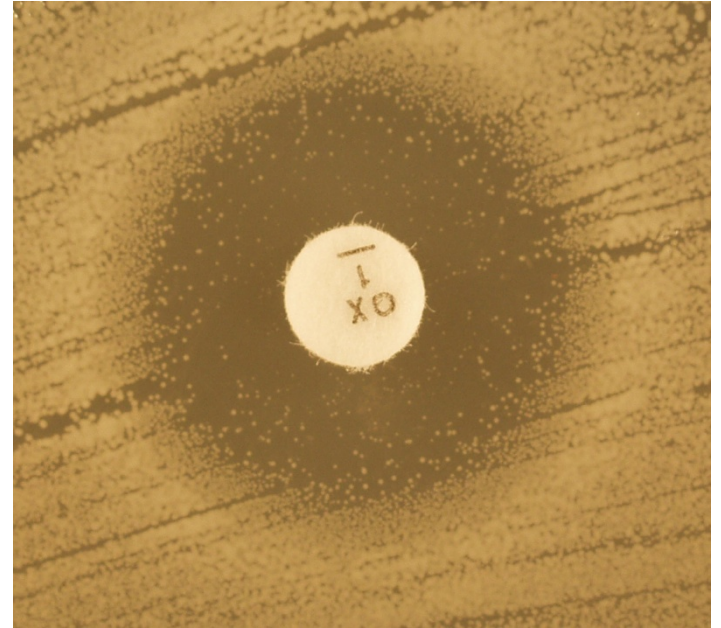
# Penicillinase-hyperproducing *S. aureus*

*S aureus* 7876

oxacillin susceptible

(MIC 0.5-1 mg/L)

*mecA*-ve )



Organism	Oxacillin		Cefoxitin	
	n	%S	n	%S
7876	619	88	120	100

**Routine methods may not be  
correctly calibrated to MIC  
breakpoints**

# Susceptibility testing of *S. aureus* specimen 8578 to ciprofloxacin (MIC 1 mg/L)

Method	Breakpoints	Susceptible	Intermediate	Resistant
CLSI	S <sub>≤</sub> 1 R>2	428	20	4
BSAC	S <sub>≤</sub> 1 R>1	97	3	83
SRGA	S <sub>≤</sub> 1 R>1	19	1	1

# Susceptibility testing of *S. haemolyticus* specimen 8702 to gentamicin (MIC 16 mg/L)

Method	Breakpoints	Susceptible	Intermediate	Resistant
CLSI	S <sub>≤</sub> 4 R <sub>&gt;</sub> 8	64 (18%)	58	224
BSAC	S <sub>≤</sub> 1 R <sub>&gt;</sub> 1	7 (4%)	2	162
SRGA	S <sub>≤</sub> 1 R <sub>&gt;</sub> 1	0 (0%)	0	30

# **Variable application of reporting guidelines**

# Detection and reporting of reduced susceptibility to penicillin in *S. pneumoniae* 8886 (penicillin MIC 0.5 mg/L)

Test/report	Participants results		
	S	I	R
Oxacillin screen	2	2	489
Penicillin report meningitis	12 (1.9%)	61 (9.8%)	549 (88.3%)
Penicillin report pneumonia	190 (30.4%)	152 (24.3%)	284 (45.3%)

**Variable application of expert  
rules affects reporting**

# Detection of resistance mediated by ESBL *E. coli* 8738 (CTX-M-15)

Participants reported ESBL positive 668, negative 8

Agent	MIC (mg/L)	Participants reporting		
		S	I	R
Cefotaxime	>128	6	0	603
Ceftazidime	32-64	7	22	661
Piperacillin-tazobactam	8-16	324 (49.3%)	55 (8.4%)	278 (42.3%)

# Reporting susceptibility of *Serratia marcescens* with inducible AmpC

## *S. marcescens* 8859

Agent	MIC (mg/L)	Participants reporting		
		S	I	R
Cefotaxime	0.12-0.5	534	3	50
Ceftazidime	0.25	629	5	51
Piperacillin-tazobactam	1-8	663	1	12

Participants reported ESBL positive 4, negative 499

# Detection of resistance mediated by plasmid-borne AmpC *E. coli* 9059 (Cit AmpC)

Agent	MIC (mg/L)	Participants reporting		
		S	I	R
Cefotaxime	16-32	16	98	504
Ceftazidime	32->128	2	7	681
Piperacillin-tazobactam	4	451 (68.5%)	50 (7.6%)	157 (23.9%)

Participants reported ESBL positive 138, negative 509

# Defining problems in antimicrobial susceptibility testing: lessons from external quality assurance

- Some errors are due to poor performance
- Some tests are inherently more difficult
- Breakpoint guidelines affect results
- Some methods are less reliable with some tests
- Routine methods may not be correctly calibrated to reference MIC tests
- Application of reporting guidelines is variable
- Application of expert rules is variable