

British Society for Antimicrobial Chemotherapy

BSAC to actively support the EUCAST Disc Diffusion Method for Antimicrobial Susceptibility Testing in preference to the current BSAC Disc Diffusion Method

From January 2016, the BSAC Standing Committee for Antimicrobial Susceptibility Testing, with the support of Council, will:

- Cease active support, maintenance and development of the BSAC disc diffusion method (queries from laboratories that continue to use the BSAC disc diffusion method will be supported during the transition period).
- Support UK laboratories in changing to the EUCAST (European Committee on Antimicrobial Susceptibility Testing) disc diffusion method should they wish to do this, through increased educational activities.
- Re-fashion the Residential Workshops to support a wider range of susceptibility testing and resistance detection methods and particularly support those using EUCAST methods.
- Re-fashion the current "User Days" to cover a wider range of issues in susceptibility testing.
- Support EUCAST in the further development and maintenance of the EUCAST susceptibility testing methods.
- Support UK laboratories implementing EUCAST methods and having queries about th

Background

Since it was first developed and published in 2001, the BSAC standardized disc diffusion method of antimicrobial susceptibility testing has been adopted by more than 175 laboratories across the UK. Annual updates have been published since the initial launch and Version 14 of the method was published on the BSAC website in January 2015.

However, over the last five years there have been a number of developments in the field of antimicrobial susceptibility testing which have rightly led to a re-evaluation of the position of the BSAC method.

The BSAC Standing Committee has been instrumental in supporting the development of EUCAST. It signed-up to the EUCAST process for harmonised MIC breakpoint setting and EUCAST breakpoints have been incorporated into the BSAC guidelines.

Although it was not part of the original EUCAST project, a standardised disc diffusion method (based on the Kirby-Bauer method using Mueller-Hinton agar) has been developed, resulting in a choice of two similar standardised disc diffusion methods (BSAC and EUCAST) that are calibrated against EUCAST breakpoints.

The decision to support the EUCAST disc diffusion method in preference to the BSAC disc diffusion method has been taken for a number of reasons:

- The EUCAST method is a robust and standardised method. It is correlated to MICs performed according to the international standard method for testing antimicrobial susceptibility (ISO20776-1:2006).
- Many laboratories in the UK have already changed to using the EUCAST disc diffusion method. This leads to confusion between laboratories, particularly when reviewing NEQAS performance as the BSAC and EUCAST methods may perform differently for some challenging organisms.
- The EUCAST disc diffusion method has been developed to cover more antimicrobial agent/organism combinations than the BSAC disc diffusion method. A few gaps remain (e.g. *Neisseria gonorrhoeae* testing), but these are being actively developed.
- The fact that both BSAC and EUCAST methods are now used across the UK raises issues for the Standing Committee in delivery of relevant day-to-day support and also educational meetings and workshops.
- The EUCAST disc diffusion method is now the standard method used in most European countries and increasingly outside Europe. This means that EUCAST can draw on a wider international pool of experts and laboratories (including those in the UK) for development and support
- Use of the EUCAST disc diffusion method would improve international standardisation and comparability and support resistance surveillance.
- EUCAST is recognised by the EMA for the setting of MIC breakpoints for new agents and is increasingly seen by drug developers as the standard-setting organisation for MIC breakpoints and disc diffusion testing.

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British Society for Antimicrobial Chemotherapy

Standing Committee on Susceptibility Testing

Version 14.0, 05-01-2015

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Pink indicates breakpoints have restricted use.

British Society for Antimicrobial Chemotherapy

Standing Committee on Susceptibility Testing

Version 14, January 2015	Changes	Changes (cells containing a change, a deletion or an addition) from version 12 are marked yellow
Enterobacteriaceae	Addition of MIC breakpoints:	Ceftaroline
	Addition of diameter breakpoints:	Ceftaroline
	Addition of comments	<ul style="list-style-type: none"> • Any ceftaroline resistant isolates should be confirmed using an MIC method. • Methicillin susceptible isolates can be reported susceptible to ceftaroline without further testing.
	Addition of a screening cut-off in general notes	<ul style="list-style-type: none"> • Carbapenemase producers
Staphylococcus spp.	Addition of MIC breakpoints:	Ceftaroline
	Addition of diameter breakpoints:	Ceftaroline
	Addition of comments	<ul style="list-style-type: none"> • Any ceftaroline resistant isolates should be confirmed using an MIC method. • Methicillin susceptible isolates can be reported susceptible to ceftaroline without further testing.
<i>H. influenzae</i>	Removal of MIC and zone diameter breakpoints	<ul style="list-style-type: none"> • Cefaclor

Suggestions for appropriate agents to include in routine antimicrobial susceptibility testing

These suggestions are intended to indicate minimum sets of agents to test routinely in a diagnostic laboratory in order to give an

For each organism group, suggestions are given of agents to test in systemic infection, or uncomplicated Urinary Tract Infection. In a few instances, the agents suggested do not allow all potentially relevant expert rules to be used, and these are listed in each section. EUCAST expert interpretive rules can be assessed at:

http://www.eucast.org/fileadmin/src/media/PDFs/EUCAST_files/EUCAST_SOPs/EUCAST-Expert-rules-v2-CMI.pdf

Organisms	Systemic infections	Uncomplicated UTI
Enterobacteriaceae	Ampicillin or Amoxicillin Ceftazidime plus cefotaxime or Ciprofloxacin * Gentamicin Imipenem or meropenem Ertapenem Piperacillin-tazobactam [Cefuroxime] [Cefpodoxime] (for ESBL screening)	Ampicillin or Amoxicillin Amoxicillin-clavulanate Cefpodoxime (for ESBL screening) Ciprofloxacin or norfloxacin Cephalexin Nitrofurantoin Trimethoprim

* It is recommended that an MIC is performed for invasive Salmonella isolates

Organisms	Systemic infections	Uncomplicated UTI
Acinetobacter	Ciprofloxacin Gentamicin Imipenem or meropenem Colistin * Amikacin ** [Piperacillin-tazobactam]	Treat as systemic as likely not uncomplicated

* MIC testing is required to establish colistin susceptibility

** EUCAST rule 12.7 "If intermediate or resistant to tobramycin and susceptible to gentamicin and amikacin, report amikacin as

Organisms	Systemic infections	Uncomplicated UTI
Pseudomonas spp	Amikacin Ceftazidime Ciprofloxacin Gentamicin Imipenem or meropenem Piperacillin-tazobactam Colistin * [Tobramycin]** [Amikacin]**	Treat as systemic as likely not uncomplicated

* MIC testing is required to establish colistin susceptibility

** May be appropriate according to local use

Suggestions for appropriate agents to include in routine antimicrobial susceptibility testing

Organisms	Systemic infections	Uncomplicated UTI
Staphylococci	Oxacillin or cefoxitin Erythromycin Fusidic acid or rifampicin Gentamicin Tetracycline Vancomycin * Mupirocin [Linezolid]** [Daptomycin]** [Penicillin]** [Teicoplanin]**	<i>S. saprophyticus</i> Ciprofloxacin or norfloxacin Gentamicin Oxacillin or cefoxitin Vancomycin * Nitrofurantoin Trimethoprim Treat as other species as systemic as likely not.
* MIC testing is required to establish vancomycin susceptibility		
** Recommended for testing in severe infection		
<i>S. pneumoniae</i>	Penicillin (oxacillin screen) Erythromycin Tetracycline Levofloxacin or moxifloxacin [Vancomycin]	
Enterococcus spp	Ampicillin or amoxicillin Gentamicin (high level screen) Vancomycin Linezolid Teicoplanin [additional not alternative to vancomycin]	Ampicillin or amoxicillin Vancomycin Nitrofurantoin Trimethoprim Ciprofloxacin or norfloxacin Teicoplanin [additional not alternative to vancomycin]
Beta-haemolytic streptococci	Erythromycin Penicillin Tetracycline	(Group B) Penicillin Nitrofurantoin Trimethoprim

Suggestions for appropriate agents to include in routine antimicrobial susceptibility testing

Organisms	Systemic infections
<i>M. catarrhalis</i>	Ampicillin or amoxicillin * Co-amoxiclav Erythromycin Tetracycline Ciprofloxacin [nalidixic acid to detect any quinolone resistance] [Chloramphenicol] [Cefotaxime]
<p>* Resistance to ampicillin by production of β-lactamase (BRO-1/2 β-lactamase) may be misidentified by disk diffusion technique and, because production is slow, may give weak results with <i>in-vitro</i> tests. Since >90% of <i>M. catarrhalis</i> strains produce β-lactamase, testing of penicillinase production is discouraged and isolates reported resistant to ampicillin and amoxicillin.</p>	
Organisms	Systemic infections
<i>N. gonorrhoeae</i>	Penicillin Ceftriaxone Cefixime Tetracycline Spectinomycin Ciprofloxacin [nalidixic acid to detect any quinolone resistance] Beta-lactamase [Cefuroxime as indicator of cephalosporin resistance]
Organisms	Systemic infections
<i>H. influenzae</i>	Ampicillin or amoxicillin Co-amoxiclav Cefuroxime Trimethoprim Tetracycline Ciprofloxacin [nalidixic acid to detect any quinolone resistance] Beta-lactamase [Chloramphenicol] [Cefotaxime]

Enterobacteriaceae (including Salmonella, Shigella spp. And Yersinia enterocolitica)

BSAC, Version 14, January 2015

The identification of Enterobacteriaceae to species level is essential before applying Expert Rules for the interpretation of susceptibility.

Disk diffusion method for Antimicrobial Susceptibility testing

Medium: Iso-Sensitest agar

Inoculum: McFarland 0.5, dilute 1:100

Incubation: Air, 36±1°C, 19±1h

Reading: Read zone edges as the point showing no growth viewed from the back of the plate against a dark background illuminated with reflected light.

Quality control: *Escherichia coli* NCTC 10418 or ATCC 25922

	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Amikacin	8	16	16	30	19	16-18	15		<i>Salmonella</i> spp should be reported resistant to these agents, irrespective of susceptibility testing result. Aminoglycosides are considered inactive against <i>Salmonella</i> spp <i>in-vivo</i> .
Gentamicin	2	4	4	10	20	17-19	16		
Gentamicin (Topical only)	2	-	2	10	20	-	19		
Tobramycin	2	4	4	10	21	18-20	17		

General notes: Individual aminoglycoside agents must be tested; susceptibility to other aminoglycosides cannot be inferred from the gentamicin result and *vice versa*.

Penicillins	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Amoxicillin	8	-	8	10	15	-	14		Species that have chromosomal penicillinases (<i>Klebsiella</i> spp.) or inducible AmpC enzymes (e.g. <i>Enterobacter</i> spp., <i>Citrobacter</i> spp. and <i>Serratia</i> spp.) are intrinsically resistant to ampicillin/amoxicillin.
Ampicillin	8	-	8	10	15	-	14		
Co-amoxiclav (Systemic)	8	-	8	20/10	21	-	20	MIC breakpoints are correlated to MICs performed using fixed concentration of 2mg/L clavulanate.	Species inducible AmpC enzymes (e.g. <i>Enterobacter</i> spp., <i>Citrobacter</i> spp. and <i>Serratia</i> spp.) are intrinsically resistant to Co-amoxiclav.
Co-amoxiclav (see UTI comments)	32	-	32	20/10	15	-	14		
Mecillinam (see UTI comments)	8	-	8	10	14	-	13	These interpretative criteria are for <i>P. mirabilis</i> & <i>E. coli</i> only.	Isolates of <i>E. coli</i> and <i>Klebsiella</i> spp. that produce ESBLs often appear susceptible to mecillinam <i>in vitro</i> but clinical efficacy against these organisms is unproven.
Piperacillin	8	16	16	75	23	21-22	20		
Piperacillin-tazobactam	8	16	16	75/10	23	21-22	20		
Temocillin	8	-	8	30	20	-	19	No EUCAST BP available, based on BSAC data. The distribution of zone diameters for ESBL and AmpC producers straddles the breakpoint. Organisms that appear resistant by disc diffusion should have resistance confirmed by MIC determination.	
Temocillin (see UTI comments)	32	-	32	30	12	-	11	No EUCAST BP available, based on BSAC data.	
Ticarcillin-clavulanate	8	16	16	75/10	23	-	22	The zone diameter breakpoint relates to an MIC of 8mg/L as no data for the intermediate category are currently available.	

Enterobacteriaceae (including Salmonella, Shigella spp. And Yersinia enterocolitica)					BSAC, Version 14, January 2015				
Cephalosporins	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Cefalexin (see UTI comments)	16	-	16	30	16	-	15	These interpretative criteria are for <i>E. coli</i> and <i>Klebsiella</i> spp. only.	Cefalexin results may be used to report susceptibility to cefadroxil and cefradine.
Cefalexin (see UTI comments)	16	-	16	30	18	-	17	These interpretative criteria are for <i>P. mirabilis</i> only.	
Cefepime	1	2-4	4	30	32	27-31	26		
Cefixime	1	-	1	5	20	-	19	MIC breakpoint for UTI only	
Cefotaxime	1	2	2	30	30	24-29	23		For Enterobacter spp., Citrobacter freundii, Serratia spp. & Morganella morganii: if susceptible in-vitro either suppress result or add comment discouraging use of cefotaxime as immunotherapy due to selection of resistance. (http://www.eucast.org/fileadmin/s)
Cefoxitin (AmpC screen)	-	-	-	30	23	-	-	This is an epidemiological "cut off" for AmpC detection which has high sensitivity but low specificity as susceptibility is also affected by permeability.	
Cefpodoxime (ESBL screen)	1	-	1	10	20	-	19	If screening for ESBLs is required for infection control or epidemiological purposes, Enterobacteriaceae isolates should be screened with cefpodoxime or both cefotaxime and ceftazidime. The presence of ESBLs should be confirmed with a specific test.	
Ceftaroline	0.5	-	0.5	5	23	-	22	Any resistant isolates should be confirmed using an MIC method	
Ceftazidime	1	2-4	4	30	27	23-26	22		For Enterobacter spp., Citrobacter freundii, Serratia spp. & Morganella morganii: if susceptible in-vitro either suppress result or add comment discouraging use of cefotaxime as monotherapy due to selection of resistance. (http://www.eucast.org/fileadmin/s)
Ceftriaxone	1	2	2	30	28	24-27	23		
Cefuroxime (atexil) (see UTI comments)	8	-	8	30	20	-	19		<i>Salmonella</i> spp. should be reported resistant to these agents, irrespective of susceptibility testing result.
Cefuroxime (parenteral)	8	-	8	30	20	-	19	Breakpoint relates to a dosage of 1.5g three time a day and to <i>E. coli</i> , <i>Klebsiella</i> spp. and <i>P. mirabilis</i> only.	
Carbapenems	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Doripenem	1	-	2	10	24	19-23	18	The doripenem MIC breakpoint has changed but a review of the data indicates that no adjustment of the zone diameter breakpoints is necessary.	
Ertapenem	0.5	1	1	10	28	16-27	15	Detection of carbapenem resistance is difficult. For epidemiological or cross infection purposes consideration should be given to testing isolates resistant to ceftazidime and a carbapenem for the presence of carbapenemases. Guidance on detection is given	<i>Proteus</i> spp. and <i>Morganella morganii</i> are considered poor targets for imipenem
Imipenem	2	4-8	8	10	21	17-20	16		
Meropenem	2	4-8	8	10	27	20-26	19		
General notes:	Screening for carbapenem producing Enterobacteriaceae can be performed using a cut-off of 32mm with meropenem 10ug disc.								

Enterobacteriaceae (including *Salmonella*, *Shigella* spp. And *Yersinia enterocolitica*)

BSAC, Version 14, January 2015

Other β -lactams	MIC breakpoint (mg/L)			Disk content (μ g)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S \leq	I	R >		S \geq	I	R \leq		
Aztreonam	1	2-4	4	30	28	23-27	22		
Quinolones	MIC breakpoint (mg/L)			Disk content (μ g)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S \leq	I	R >		S \geq	I	R \leq		
Ciprofloxacin	0.5	1	1	1	20	17-19	16		For ciprofloxacin there is clinical evidence to indicate a poor response in systemic infections caused by <i>Salmonella</i> spp., with reduced susceptibility to fluoroquinolones. Isolates with MICs greater than 0.06mg/L should be reported as resistant. It is recommended that the ciprofloxacin MIC be determined for all invasive salmonellae infections.
Levofloxacin	1	2	2	1	17	14-16	13		
Moxifloxacin	0.5	1	1	1	20	17-19	16		
Nalidixic acid (see UTI comments)	16	-	16	30	18	-	17		
Norfloxacin (systemic)	0.5	1	1	2	26	19-25	18		
Norfloxacin (see UTI comments)	4	-	4	2	16	-	15	No EUCAST breakpoint. BSAC data used.	
Ofloxacin	0.5	1	1	5	29	26-28	25		
Macrolides, lincosamides & streptogramins	MIC breakpoint (mg/L)			Disk content (μ g)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S \leq	I	R >		S \geq	I	R \leq		
Azithromycin	-	-	-	15	19	-	18	These interpretative criteria are for <i>S. typhi</i> only. Azithromycin has been used in the treatment of infections with <i>S. typhi</i> (MIC \leq 16mg/L for wild type isolates) and some enteric infections.	
Tetracyclines	MIC breakpoint (mg/L)			Disk content (μ g)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S \leq	I	R >		S \geq	I	R \leq		
Tetracycline	4	-	4	10	24	-	23	These interpretative criteria are for <i>Y. enterocolitica</i> only.	
Tigecycline	1	2	2	15	24	20-23	19	Disc diffusion for Enterobacteriaceae other than <i>E. coli</i> may not give reliable results; an MIC method is preferred if tigecycline is considered as therapy. Susceptibility of <i>E. coli</i> isolates appearing intermediate or resistant should be confirmed with an MIC method.	<i>Morganella morganii</i> , <i>Providencia</i> spp. & <i>Proteus</i> spp. are considered inherently non-susceptible to tigecycline.

Enterobacteriaceae (including Salmonella, Shigella spp. And Yersinia enterocolitica)					BSAC, Version 14, January 2015				
Miscellaneous antimicrobials	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Chloramphenicol	8	-	8	30	21	-	20		
Colistin	2	-	2	-	-	-	-	Disc diffusion susceptibility testing is unreliable. Colistin susceptibility should be determined with an MIC method.	
Co-trimoxazole	2	4	4	1.25/23.75	16	-	15	The MIC breakpoint is based on the trimethoprim concentration in a 1:19 combination with sulphamethoxazole.	Link to co-trimoxazole guidance
Fosfomycin (see UTI comments)	32	-	32	200/50	25	-	24	These interpretative criteria are for <i>E. coli</i> only.	MIC breakpoints refer to i.v. treatment for system infections and oral treatment for uncomplicated UTI therapy.
					37	-	36	These interpretative criteria are for <i>P. mirabilis</i> only.	
Nitrofurantoin (see UTI comments)	64	-	64	200	17	-	16	These interpretative criteria are for <i>E. coli</i> only.	
Trimethoprim (see UTI comments)	2	4	4	2.5	17	14-16	13		

Acinetobacter spp.

BSAC, Version 14, January 2015

Disk diffusion method for Antimicrobial Susceptibility testing

Medium: Iso-Sensitest agar

Inoculum: McFarland 0.5, dilute 1:100

Incubation: Air, 36±1°C, 19±1h

Reading: Read zone edges as the point showing no growth viewed from the back of the plate against a dark background illuminated with reflected light.

Quality control: *Escherichia coli* NCTC 10418 or ATCC 25922

Aminoglycosides	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Amikacin	8	16	16	30	21	19-20	18		
Gentamicin	4	-	4	10	20	-	19		
Penicillins	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Piperacillin-tazobactam	8	16	16	75/10	22	20-21	19	No EUCAST MIC BP available due to insufficient evidence. BSAC data used.	
Carbapenems	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Doripenem	1	-	2	10	22	15-21	14	The doripenem MIC breakpoint has changed but a review of the data indicates that no adjustment of the zone diameter breakpoints is necessary.	
Imipenem	2	4-8	8	10	25	14-24	13		
Meropenem	2	4-8	8	10	20	13-19	12		
Quinolones	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Ciprofloxacin	1	-	1	1	21	-	20		
Tetracyclines	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Tigecycline	-	-	-	-	-	-	-	No EUCAST MIC BP due to insufficient clinical evidence. For determining susceptibility an MIC method should be used and the EUCAST PKPD BPs of S=0.25mg/L, R=0.5mg/L applied to interpret.	
Miscellaneous antimicrobials	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Colistin	2	-	2	-	-	-	-	Disc diffusion susceptibility testing is unreliable. Colistin susceptibility should be determined with an MIC method.	

Pseudomonas

BSAC, Version 14, January 2015

These interpretative criteria are not for use with other non-fermenting organisms (including Burkholderia spp.)

Disk diffusion method for Antimicrobial Susceptibility testing

Medium: Iso-Sensitest agar

Inoculum: McFarland 0.5, dilute 1:100

Incubation: Air, 36±1°C, 19±2h

Reading: Read zone edges as the point showing no growth viewed from the back of the plate against a dark background illuminated with reflected light.

Quality control: *Pseudomonas aeruginosa* ATCC 27853 or NCTC 10662

Aminoglycosides	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Amikacin	8	16	16	30	22	16-21	15		
Gentamicin	4	-	4	10	18	-	17		
Netilmicin	4	-	4	10	14	-	13		
Tobramycin	4	-	4	10	20	-	19		
General notes:	Individual aminoglycoside agents must be tested; susceptibility to other aminoglycosides cannot be inferred from the gentamicin result and <i>vice versa</i> .								
Penicillins	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Piperacillin	16	-	16	75	25	-	24		
Piperacillin-tazobactam	16	-	16	75/10	25	-	24		
Ticarcillin	16	-	16	75	20	-	19		
Ticarcillin-clavulanate	16	-	16	75/10	20	-	19		
Cephalosporins	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Ceftazidime	8	-	8	30	24	-	23		
Carbapenems	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Doripenem	1	-	2	10	32	25-31	24	The doripenem MIC breakpoint has changed but a review of the data indicates that no adjustment of the zone diameter breakpoints is necessary.	
Imipenem	4	8	8	10	23	17-22	16	Detection of carbapenem resistance is difficult. Guidance on detection is given at:	
Meropenem	2	4-8	8	10	20	16-19	15	http://www.hpa.org.uk/webc/HPAwebFile/HPAweb_b_C/1317138520481 .	
Other β-lactams	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Aztreonam	1	2-16	16	30	36	20-35	19		Relates only to isolates from patients with cystic fibrosis given high dosage therapy to treat <i>P. aeruginosa</i> .

Pseudomonas					BSAC, Version 14, January 2015				
Quinolones	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Ciprofloxacin	0.5	1	1	1	23	13-22	12		
Ciprofloxacin	0.5	1	1	5	30	20-29	19		
Levofloxacin	1	2	2	5	22	17-21	16	No EUCAST MIC breakpoint due to insufficient clinical evidence. EUCAST PKPD breakpoint and BSAC data used.	
Miscellaneous antimicrobials	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Colistin	4	-	4	-	-	-	-	Disc diffusion susceptibility testing is unreliable. Colistin susceptibility should be determined with an MIC method.	

Stenotrophomonas

BSAC, Version 14, January 2015

Disk diffusion method for Antimicrobial Susceptibility testing

Medium: Iso-Sensitest agar

Inoculum: McFarland 0.5, dilute 1:100

Incubation: Air, 30°C, 19±1h

Reading: Read zone edges as the point showing no growth viewed from the back of the plate against a dark background illuminated with reflected light.

Quality control: *Pseudomonas aeruginosa* ATCC 27853 or NCTC 10662

Miscellaneous antimicrobials	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Co-trimoxazole	4	-	4	1.25/23.75	20	-	19	For <i>Stenotrophomonas maltophilia</i> , susceptibility testing is not recommended except for co-trimoxazole. See http://bsac.org.uk/wp-content/uploads/2012/02/steno.pdf .	

Staphylococci

BSAC, Version 14, January 2015

Disk diffusion method for Antimicrobial Susceptibility testing

Medium: Iso-Sensitest agar

Inoculum: McFarland 0.5, dilute 1:10

Incubation: Air, 36±1°C, 19±1h (* cefoxitin should be tested at 35±1°C)

Reading: Read zone edges as the point showing no growth viewed from the back of the plate against a dark background illuminated with reflected light.

Quality control: *Staphylococcus aureus* NCTC 6571 or ATCC 25923

Aminoglycosides	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Amikacin	8	16	16	30	19	16-18	15	These interpretative criteria are for <i>S. aureus</i> only.	
					25	22-24	21	These interpretative criteria are for coagulase negative staphylococci only.	
Gentamicin	1	-	1	10	20	-	19		
Tobramycin	1	-	1	10	21	-	20	These interpretative criteria are for <i>S. aureus</i> only.	
					30	-	29	These interpretative criteria are for coagulase negative staphylococci only.	
Neomycin	-	-	-	10	17	-	16	For topical use only. The zone diameter breakpoint distinguishes the "wild type" susceptible population from isolates with reduced susceptibility.	
General notes: Individual aminoglycoside agents must be tested; susceptibility to other aminoglycosides cannot be inferred from the gentamicin result and vice versa.									
β-lactams	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Ampicillin (UTI 1,2,4)	-	-	-	25	26	-	25	These interpretative criteria are for <i>S. saprophyticus</i> only.	Staphylococci exhibiting resistance to oxacillin/cefoxitin should be regarded as resistant to other penicillins, cephalosporins, carbapenems and combinations of β-lactam and β-lactamase inhibitors.
Cefoxitin* ^{see incubation temp above}	4	-	-	10	22	-	21	These interpretative criteria are for <i>S. aureus</i> only.	
Cefoxitin* ^{see incubation temp above}	-	-	-	10	20	-	19	These interpretative criteria are for <i>S. saprophyticus</i> only.	
Cefoxitin* ^{see incubation temp above}	4	-	-	10	27	22-26	21	These interpretative criteria are for coagulase negative staphylococci only.	
								For coagulase negative staphylococci (except <i>S. saprophyticus</i>) with cefoxitin zone diameters 22-26mm PCR for <i>mecA</i> is required to determine susceptibility for treatment of deep seated infection with any β-lactam.	
Ceftaroline	1	-	1	5	20	-	19	Any resistant isolates should be confirmed using an MIC method	
Oxacillin	2	-	-	1	15	-	14	For oxacillin tests on Mueller-Hinton or Columbia agar with 2% NaCl: some hyperproducers of β-lactamase give zones within range of 7-14mm and if possible, should be checked by a PCR method for <i>mecA</i> or a latex agglutination test for PBP2a. Increase in zone size in the presence of clavulanic acid is not a reliable test for hyper-producers of β-lactamase as zones of inhibition with some MRSA also increase in the presence of clavulanic acid. Rarely, hyper-producers of β-lactamase give no zone in this test and would therefore not be distinguishable from MRSA.	
Penicillin	0.12	-	0.12	1 unit	25	-	24	These interpretative criteria are for <i>S. aureus</i> and <i>S. lugdunensis</i> only. With penicillin, check for heaped zone edge which indicates β-lactamase mediated resistance.	
General notes: Most staphylococci are penicillinase producers. The benzylpenicillin will mostly, but not unequivocally, separate β-lactamase producers. Isolates positive for β-lactamase are resistant to benzylpenicillin, phenoxymethylpenicillin, amino- and ureido-penicillins. Isolates negative for β-lactamase and susceptible to cefoxitin can be reported susceptible to these drugs. Isolates positive for β-lactamase and susceptible to cefoxitin are susceptible to penicillin-β-lactamase inhibitor combinations and penicillinase-resistant penicillins (oxacillin, loxacillin, dicloxacillin and flucloxacillin). Isolates resistant to cefoxitin are methicillin resistant and resistant to β-lactam agents, including β-lactamase inhibitor combinations, except for cephalosporins with approved anti-MRSA activity and clinical breakpoints.									

Staphylococci

BSAC, Version 14, January 2015

Quinolones	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Ciprofloxacin	1	-	1	1	14	-	13		MIC breakpoints relate to high-dose therapy (750mg BD).
Ciprofloxacin (UTI ^{1,2,4})	1	-	1	1	18	-	17	These interpretative criteria are for <i>S. saprophyticus</i> only.	
Levofloxacin	1	2	2	5	23	-	-		
Moxifloxacin	0.5	1	1	1	20	16-19	15		
Ofloxacin	1	-	1	5	28	-	27		
Glycopeptides	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Teicoplanin	2	-	2	-	-	-	-	These interpretative criteria are for <i>S. aureus</i> only.	
Teicoplanin	4	-	4	-	-	-	-	These interpretative criteria are for coagulase negative staphylococci only.	
Vancomycin	2	-	2	-	-	-	-	These interpretative criteria are for <i>S. aureus</i> only.	http://bsac.org.uk/wp-content/uploads/2014/06/Glycopeptide-Susceptibility-Testing-with-S-aureus-final.pdf
Vancomycin	4	-	4	-	-	-	-	These interpretative criteria are for coagulase negative staphylococci only.	
General notes:	Disc diffusion for staphylococci does not give reliable results. An MIC method should be used to determine susceptibility, positive results requiring confirmation. Population analysis is the most reliable method for confirming resistance and for distinguishing susceptible, hetero-GISA and GISA isolates. If, on clinical grounds, resistance to vancomycin is suspected, it is recommended that the organism be sent to a specialist laboratory, such as Dept. of Microbiology, Lime Walk Building, Southmead Hospital, Westbury on Trym, Bristol BS10 5NB or the Specialist Antimicrobial Chemotherapy Unit, Public Health Wales, University Hospital of Wales, Heath Park, Cardiff, CF14 4XW.								
Macrolides, lincosamides & streptogramins	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Azithromycin	1	2	2	15	20	-	19	The zone diameter breakpoint relates to an MIC of 1mg/L as no data for the intermediate category are currently available.	
Clarithromycin	1	2	2	2	18	15-17	14		
Clindamycin	0.25	0.5	0.5	2	26	23-25	22	Organisms that appear resistant to erythromycin, but susceptible to clindamycin should be checked for the presence of inducible resistance (see http://bsac.org.uk/wp-content/uploads/2012/02/Testing-for-dissociated-resistance-in-staphylococci.pdf in index tab). Place the erythromycin and clindamycin discs 12-20 mm apart (edge to edge) and look for antagonism (the D phenomenon).	Inducible resistance can only be detected in the presence of a macrolide antibiotic. If positive, report as resistant to clindamycin or report as susceptible with a warning that clinical failure during treatment with clindamycin may occur by selection of constitutively resistant mutants and the use of clindamycin best avoided in severe infection.
Erythromycin	1	2	2	5	20	17-19	16	See clindamycin note above.	Erythromycin can be used to determine susceptibility to azithromycin, clarithromycin and roxithromycin.
Quinupristin-dalfopristin	1	2	2	15	22	19-21	18	The presence of blood has a marked effect on the activity of quinupristin-dalfopristin. On the rare occasions when blood needs to be added to enhance the growth of staphylococci, susceptible ≥15mm, resistant ≤14mm.	
Tetracyclines	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Doxycycline	1	2	2	30	31	-	30	The zone diameter breakpoint relates to an MIC of 1mg/L as no data for the intermediate category are currently available.	
Minocycline	0.5	1	1	30	28	-	27	The zone diameter breakpoint relates to an MIC of 0.5mg/L as no data for the intermediate category are currently available.	
Tetracycline	1	2	2	10	20	-	19	The zone diameter breakpoint relates to an MIC of 1mg/L as no data for the intermediate category are currently available.	Isolates susceptible to tetracycline are also susceptible to doxycycline and minocycline. Some isolates resistant to tetracycline may be susceptible to minocycline and/or doxycycline.
Tigecycline	0.5	-	0.5	15	26	-	25	Strains with MIC values above the susceptible breakpoint are not yet reported. The identification and susceptibility tests on any such isolate must be repeated and if the result is confirmed the isolate must be sent to a reference laboratory.	Until there is further evidence regarding clinical laboratory response for confirmed isolates with MIC above the current breakpoint they should be reported as resistant.

Staphylococci

BSAC, Version 14, January 2015

Miscellaneous antimicrobials	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Daptomycin	1	-	1	-	-	-	-	<p>Strains with MIC values above the susceptible breakpoint are very rare or not yet reported. The identification and susceptibility tests on any such isolate must be repeated and if the result is confirmed the isolate must be sent to a reference laboratory.</p> <p>Susceptibility testing by disc diffusion is not reliable. Susceptibility should be determined using a broth dilution method with Mueller-Hinton broth or by an MIC method on Mueller-Hinton agar. The test conditions must provide 50mg Ca++ to avoid false resistance being reported.</p>	Until there is evidence regarding clinical laboratory response for confirmed isolates with MIC above the current breakpoint they should be reported as resistant.
Chloramphenicol	8	-	8	10	15	-	14		
Co-trimoxazole	2	4	4	1.25/23.75	17	14-16	13	LINK to guidance	
Trimethoprim	1	-	1	5	20	-	19	Breakpoints are epidemiological "cut offs" based on distributions for the "wild type" population. However there is no clear evidence correlating these breakpoints with clinical efficacy.	
Trimethoprim (UTI 1,2,4)	2	4	4	2.5	15	13-14	12	<i>These interpretative criteria are for S. saprophyticus only.</i>	
Fosfomycin (IV)	32	-	32	200/50	34	-	33		
Fusidic acid	1	-	1	10	30	-	29		
Linezolid	4	-	4	10	20	-	19		
Mupirocin	1	2-256	256	20	27	7-26	6		In nasal decontamination, isolates with low-level resistance to mupirocin (MICs 2-256mg/L) may be initially cleared, but early recolonisation is common.
Nitrofurantoin (UTI 1,2,4)	64	-	64	200	20	-	19	<i>These interpretative criteria are for S. saprophyticus only.</i>	
Rifampicin	0.06	0.12-0.5	0.5	2	30	24-29	23		

Streptococcus pneumoniae

BSAC, Version 14, January 2015

Disk diffusion method for Antimicrobial Susceptibility testing

Medium: Iso-Sensitest agar supplemented with 5% defibrinated horse blood (ISA + %5 horse blood + 20mg/L NAD may also be used)

Inoculum: McFarland 0.5, dilute 1:10

Incubation: 4-6% CO₂, 36±1°C, 19±1h

Reading: Read zone edges as the point showing no growth viewed from the front of the plate, being careful not to read haemolysis.

Quality control: Streptococcus pneumoniae ATCC 49619 OR Staphylococcus aureus NCTC 6571

Penicillins	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Penicillin	0.06	0.12-2	2	Oxacillin 1	20	-	19	Reduced susceptibility to penicillin in <i>Streptococcus pneumoniae</i> is most reliably detected with an oxacillin 1µg disc; confirm resistance with a penicillin MIC determination.	Most MIC values for penicillin, ampicillin, amoxicillin and Piperacillin (with or without a β-lactamase inhibitor) differ by no more than one dilution step and isolates fully susceptible to benzylpenicillin (MIC≤0.06mg/L; susceptible by oxacillin disc screen) can be reported susceptible to β-lactam agents that have been given breakpoints.
									Infections with organisms with a penicillin MIC ≤2mg/L may be effectively treated if adequate doses are used except in infections of the central nervous system. In addition, cefotaxime or ceftriaxone MIC determination is advised for isolates from meningitis or other invasive infections.
Cephalosporins	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Cefaclor	0.03	0.06-0.5	0.5	-	-	-	-	Screen for β-lactam resistance with the oxacillin 1µg disc.	Isolates categorised as susceptible with the oxacillin 1µg disc can be reported susceptible to cefepime, cefotaxime, cefpodoxime, ceftriaxone, cefuroxime ± axetil and cefaclor.
Cefotaxime	0.5	1-2	2	-	-	-	-		
Cefpodoxime	0.25	0.5	0.5	-	-	-	-		
Ceftriaxone	0.5	1-2	2	-	-	-	-		
Cefuroxime	0.5	1	1	-	-	-	-		
General notes:	Isolates with MIC values above the S/I breakpoint are very rare. The identification and susceptibility tests on any such isolate must be repeated and if the result is confirmed the isolate must be sent to a reference laboratory. Until there is evidence regarding clinical response for confirmed isolates with MIC values above the current resistant breakpoint they should be reported resistant.								
Carbapenems	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Ertapenem	0.5	-	0.5	-	-	-	-	Screen for β-lactam resistance with the oxacillin 1µg disc.	Isolates categorised as susceptible with the oxacillin 1µg disc can be reported susceptible to imipenem, ertapenem, and meropenem.
Imipenem	2	-	2	-	-	-	-		
Meropenem (infections other than meningitis)	2	-	2	-	-	-	-		
Meropenem (meningitis)	0	0.5-1	1	-	-	-	-		
General notes:	Isolates with MIC values above the S/I breakpoint are very rare. The identification and susceptibility tests on any such isolate must be repeated and if the result is confirmed the isolate must be sent to a reference laboratory. Until there is evidence regarding clinical response for confirmed isolates with MIC values above the current resistant breakpoint they should be reported resistant.								

Streptococcus pneumoniae

BSAC, Version 14, January 2015

Quinolones	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Ciprofloxacin	0.12	0.25-2	2	1	25	10-24	9		For systemic infection the "wild type" isolates (MIC 0.25-2mg/L) are considered intermediate in susceptibility.
Ofloxacin	0.12	0.25-4	4	5	28	16-27	15		For systemic infection the "wild type" isolates (MIC 0.25-4mg/L) are considered intermediate in susceptibility.
Levofloxacin	2	-	2	1	10	-	9		
Moxifloxacin	0.5	-	0.5	1	18	-	17		
Glycopeptides	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Vancomycin	2	-	2	5	13	-	12		
General notes:									
Macrolides, lincosamides & streptogramins	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Azithromycin	0.25	0.5	0.5	15	22	20-21	19		
Clarithromycin	0.25	0.5	0.5	2	22	20-21	19		
Clindamycin	0.5	-	0.5	2	24	-	23	Organisms that appear resistant to erythromycin, but susceptible to clindamycin should be checked for the presence of inducible resistance. Place the erythromycin and clindamycin discs 12-16 mm apart (edge to edge) and look for antagonism (the D phenomenon)	Inducible resistance can only be detected in the presence of a macrolide antibiotic. If positive, report as resistant to clindamycin or report as susceptible with a warning that clinical failure during treatment with clindamycin may occur by selection of constitutively resistant mutants and the use of clindamycin best avoided in severe infection.
Erythromycin	0.25	0.5	0.5	5	22	20-21	19	See clindamycin note above.	Erythromycin can be used to determine susceptibility to azithromycin, clarithromycin and roxithromycin.
Telithromycin	0.25	0.5	0.5	15	29	-	28	No EUCAST breakpoint, BSAC data used. Insufficient data are available to distinguish the intermediate category.	
Tetracyclines	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Tetracycline	1	2	2	10	20	-	19	The zone diameter breakpoint relates to an MIC of 1mg/L as no data for the intermediate category are currently available.	Isolates susceptible to tetracycline are also susceptible to doxycycline, and minocycline. Some isolates resistant to tetracycline may be susceptible to minocycline and/or doxycycline.
Miscellaneous antimicrobials	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Chloramphenicol	8	-	8	10	18	-	17		
Co-trimoxazole	1	2	2	1.25/23.75	17	-	16	LINK to guidance	
Linezolid	2	4	4	10	20	-	19	The zone diameter breakpoint relates to an MIC of 2mg/L as no data for the intermediate category are currently available.	
Rifampicin	0.06	0.12-0.5	0.5	5	23	21-22	20		

Enterococci

BSAC, Version 14, January 2015

For isolates from endocarditis the MIC should be determined and interpreted according to the national endocarditis guidelines (Gould FK et al Guidelines for the diagnosis and antibiotic treatment of endocarditis in adults; report of the Working Party of the British Society for Antimicrobial Chemotherapy. J. Antimicrob. Chemother. 2012;67:269-89.

Disk diffusion method for Antimicrobial Susceptibility testing

Medium: Iso-Sensitest agar

Inoculum: McFarland 0.5, dilute 1:100

Incubation: Air, 36±1°C, 18±2h (glycopeptides require full 24h incubation time)

Reading: Read zone edges as the point showing no growth from the back of the plate against a dark background illuminated with reflected light.

Quality control: *Enterococcus faecalis* NCTC 12697 (ATCC 29213)

Aminoglycosides	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Gentamicin	128	-	128	200	15	-	14	High-level gentamicin resistant enterococci usually give no zone or only a trace of inhibition around a 200ug disc. Occasionally, however, the plasmid carrying the resistance may be unstable and the resistance is seen as a zone of inhibition with a few small colonies within the zone. Retesting of resistant colonies results in growth to the disc or increased numbers of colonies within the zone.	
								Zones should be carefully examined to avoid missing such resistant organisms. If in doubt, isolates may be sent to a reference laboratory for confirmation.	
Streptomycin	128	-	128	300	24	-	23	The EUCAST breakpoint is 512mg/L tested on Mueller-Hinton agar which correlates with the MIC breakpoint of 128mg/L on IsoSensitest agar and the zone criteria given.	
Penicillins	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Amoxicillin	4	8	8	10	20	-	19		
Ampicillin	4	8	8	10	20	-	19		Co-amoxiclav susceptibility can be inferred from the ampicillin result.
Carbapenems	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Imipenem	4	8	8	10	19	17-18	16	These interpretative criteria are for <i>E. faecalis</i> only.	
Glycopeptides	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Teicoplanin	2	-	2	30	20	-	19	To ensure that microcolonies indicating reduced susceptibility to the glycopeptides are detected, it is essential that plates are incubated for at least 24h before reporting a strain as susceptible to vancomycin or teicoplanin.	
Vancomycin	4	-	4	5	13	-	12		
Macrolides, lincosamides & streptogramins	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Quinupristin-dalfopristin	1	2-4	4	15	20	12-19	11	The presence of blood has a marked effect on the activity of quinupristin-dalfopristin. On the rare occasions when blood needs to be added to enhance the growth of enterococci, susceptible ≥15mm, resistant ≤14mm.	Generally, <i>E. faecalis</i> are intermediate or resistant and <i>E. faecium</i> are susceptible.

Enterococci					BSAC, Version 14, January 2015				
Tetracyclines	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Tigecycline	0.25	0.5	0.5	15	21	-	20	isolates with MIC values above the susceptible breakpoint are very rare or not yet reported, so there is no intermediate category for disc diffusion. The identification and susceptibility tests on any such isolate must be repeated and if the result is confirmed the isolate must be sent to a reference laboratory.	Until there is further evidence regarding clinical laboratory response for confirmed isolates with MIC above the current breakpoint they should be reported as resistant.
Miscellaneous antimicrobials	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Linezolid	4	-	4	10	20	-	19		
Nitrofurantoin (UTI 1,2,4)	64	-	64	200	20	-	19		
Trimethoprim (UTI 1,2,4)	0.03	0.06-1	1	2.5	>50	22-50	21		There is some doubt about the clinical relevance of testing the susceptibility of enterococci to trimethoprim. The breakpoints have been set to interpret all enterococci as intermediate.

Alpha haemolytic streptococci

BSAC, Version 14, January 2015

For isolates from endocarditis the MIC should be determined and interpreted according to the national endocarditis guidelines (Gould FK et al Guidelines for the diagnosis and antibiotic treatment of endocarditis in adults; report of the Working Party of the British Society for Antimicrobial Chemotherapy. J. Antimicrob. Chemother. 2012;67:269-89).

Disk diffusion method for Antimicrobial Susceptibility testing

Medium: Iso-Sensitest agar supplemented with 5% defibrinated horse blood + 20mg/L NAD

Inoculum: McFarland 0.5, dilute 1:10

Incubation: 4-6% CO₂, 36±1°C, 19±1h

Reading: Read zone edges as the point showing no growth viewed from the front of the plate.

Quality control: *Streptococcus pneumoniae* ATCC 49619 OR *Staphylococcus aureus* NCTC 6571

Penicillins	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Amoxicillin	0.5	1-2	2	2	24	15-23	14		
Penicillin	0.25	0.5-2	2	1 unit	17	11-16	10		
Cephalosporins	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Cefotaxime	0.5	-	0.5	5	23	-	22		
Glycopeptides	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Teicoplanin	2	-	2	30	16	-	15		
Vancomycin	2	-	2	5	14	-	13		
Macrolides, lincosamides & streptogramins	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Clindamycin	0.5	-	0.5	2	20	-	19	Organisms that appear resistant to erythromycin, but susceptible to clindamycin should be checked for the presence of inducible resistance (see http://bsac.org.uk/wp-content/uploads/2012/02/Testing-for-dissociated-resistance-in-staphylococci.pdf). Place the erythromycin and clindamycin discs 12-16 mm apart (edge to edge) and look for antagonism (the D phenomenon).	Inducible resistance can only be detected in the presence of a macrolide antibiotic. If positive, report as resistant to clindamycin or report as susceptible with a warning that clinical failure during treatment with clindamycin may occur by selection of constitutively resistant mutants and the use of clindamycin best avoided in severe infection.
Erythromycin	2	-	2	5	20	-	19		
Miscellaneous antimicrobials	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Linezolid	2	-	2	10	20	-	19	No EUCAST MIC breakpoint as there is insufficient evidence. BSAC data used.	

Beta haemolytic streptococci					BSAC, Version 14, January 2015				
<p>For isolates from endocarditis the MIC should be determined and interpreted according to the national endocarditis guidelines (Gould FK et al Guidelines for the diagnosis and antibiotic treatment of endocarditis in adults; report of the Working Party of the British Society for Antimicrobial Chemotherapy. J. Antimicrob. Chemother. 2012;67:269-89.</p> <p>Disk diffusion method for Antimicrobial Susceptibility testing</p> <p>Medium: Iso-Sensitest agar supplemented with 5% defibrinated horse blood (ISA + %5 horse blood + 20mg/L NAD may also be used)</p> <p>Inoculum: McFarland 0.5, dilute 1:100</p> <p>Incubation: O2, 36±1°C, 19±1h</p> <p>Reading: Read zone edges as the point showing no growth viewed from the front of the plate.</p> <p>Quality control: Streptococcus pneumoniae ATCC 49619 OR Staphylococcus aureus NCTC 6571</p>									
Penicillins	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Penicillin	0.25	-	0.25	1 unit	20	-	19		Susceptibility to other penicillins, carbapenems and cephalosporins can be inferred from the penicillin result.
Macrolides, lincosamides & streptogramins	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Azithromycin	0.25	0.5	0.5	15	22	20-21	19		
Clarithromycin	0.25	0.5	0.5	2	22	20-21	19		
Clindamycin	0.5	-	0.5	2	17	-	16	Organisms that appear resistant to erythromycin, but susceptible to clindamycin should be checked for the presence of inducible resistance (see http://bsac.org.uk/wp-content/uploads/2012/02/Testing-for-dissociated-resistance-in-staphylococci.pdf . Place the erythromycin and clindamycin discs 12-16 mm apart (edge to edge) and look for antagonism (the D phenomenon)	Inducible resistance can only be detected in the presence of a macrolide antibiotic. If positive, report as resistant to clindamycin or report as susceptible with a warning that clinical failure during treatment with clindamycin may occur by selection of constitutively resistant mutants and the use of clindamycin best avoided in severe infection.
Erythromycin	0.25	0.5	0.5	5	22	20-21	19		
Telithromycin	0.25	0.5	0.5	15	26	-	25	Zone diameter breakpoints relate to the "wild type" susceptible population as no data are available for the non-susceptible population.	
Tetracyclines	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Tetracycline	1	2	2	10	20	-	19		Isolates susceptible to tetracycline are also susceptible to doxycycline and minocycline
Tigecycline	0.25	0.5	0.5	15	25	20-24	19		Strains with MIC values above the susceptible breakpoint are very rare or not yet reported. The identification and antimicrobial susceptibility testing of any such isolate must be repeated and if the result is confirmed the isolate must be sent to a reference laboratory. Until there is evidence regarding clinical response for confirmed isolates with MIC above the current breakpoint they should be reported resistant.
Miscellaneous antimicrobials	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Co-trimoxazole	1	2	2	1.25/23.75	20	17-19	16		
Trimethoprim (UTI 1,2,4)	2	-	2	2.5	16	-	15	These interpretative criteria are for Group B streptococci only.	
Daptomycin	1	-	1	-	-	-	-	No zone diameter breakpoints are given because disc diffusion susceptibility testing is unreliable.	Strains with MIC values above the susceptible breakpoint are very rare or not yet reported. The identification and antimicrobial susceptibility testing of any such isolate must be repeated and if the result is confirmed the isolate must be sent to a reference laboratory. Until there is evidence regarding clinical response for confirmed isolates with MIC above the current breakpoint they should be reported resistant.
Linezolid	2	4	4	10	20	-	19	Zone diameter breakpoints relate to the MIC breakpoint of 0.12mg/L as no data for the intermediate category are currently available.	
Nitrofurantoin (UTI 1,2,4)	64	-	64	200	19	-	18		

Moraxella catarrhalis

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Disk diffusion method for Antimicrobial Susceptibility testing

Medium: Iso-Sensitest agar supplemented with 5% defibrinated horse blood (ISA + 5% horse blood + 20mg/L NAD may also be used)

Inoculum: McFarland 0.5, dilute 1:10

Incubation: Air, 36±1°C, 19±1h

Reading: Read zone edges as the point showing no growth viewed from the front of the plate.

Quality control: *Haemophilus influenzae* NCTC 11931 OR *Haemophilus influenzae* ATCC 49247

Penicillins	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Ampicillin	-	-	-	-	-	-	-	Resistance to ampicillin by production of β-lactamase (BRO-1/2 β-lactamase) may be misidentified by disc diffusion technique and, because β-lactamase production is slow, may give weak results with in vitro tests. Since 90% of <i>M. catarrhalis</i> strain produce β-lactamase, testing of penicillinase production is discouraged and isolates reported resistant to ampicillin and amoxicillin.	
Co-amoxiclav	1	-	1	2/1	19	-	18		
Cephalosporins	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Cephaclor	0.12	-	0.12	30	28	-	37	MIC breakpoints render all <i>M. catarrhalis</i> resistant to cefaclor.	
Cefuroxime	4	8	8	5	17	-	16	Zone diameter breakpoints relate to the MIC breakpoint of 4mg/L as no data for the intermediate category are currently available.	
Cefuroxime axetil	0.12	0.25-4	4	5	35	17-34	16		
General notes:									
Carbapenems	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Ertapenem	0.5	-	0.5	10	35	-	34		
Quinolones	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Ciprofloxacin	0.5	-	0.5	1	18	-	17	Quinolone resistance is most reliably detected with nalidixic acid.	
Levofloxacin	1	-	1	1	20	-	19		
Moxifloxacin	0.5	-	0.5	1	18	-	17		
Nalidixic acid (screen)	-	-	-	30	18	-	17		
Ofloxacin	0.5	-	0.5	5	35	-	34		
Macrolides, lincosamides & streptogramins	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Clarithromycin	0.25	0.5	0.5	2	22	20-21	19		
Erythromycin	0.25	0.5	0.5	5	28	-	27	Zone diameter breakpoints relate to the MIC breakpoint of 0.25mg/L as no data for the intermediate category are available.	
Telithromycin	0.25	0.5	0.5	15	30	-	29	Erythromycin can be used to determine susceptibility to azithromycin and clarithromycin.	

Moraxella catarrhalis

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Tetracyclines	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Tetracycline	1	2	2	10	22	-	21	No disc diffusion data to distinguish the intermediate category available at present.	Isolates susceptible to tetracycline are also susceptible to doxycycline and minocycline. Some isolates resistant to tetracycline may be susceptible to minocycline and/or doxycycline.
Miscellaneous antimicrobials	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Chloramphenicol	2	-	2	10	30	-	29	Breakpoints relate to topical use of chloramphenicol.	
Co-trimoxazole	0.5	1	1	1.25/23.75	12	-	11		

Neisseria gonorrhoeae

BSAC, Version 14, January 2015

Disk diffusion method for Antimicrobial Susceptibility testing

Medium: Iso-Sensitest agar supplemented with 5% defibrinated horse blood (ISA + %5 horse blood + 20mg/L NAD may also be used)

Inoculum: McFarland 0.5, no dilution

Incubation: CO₂, 36±1°C, 19±1h

Reading: Read zone edges as the point showing no growth viewed from the front of the plate.

Quality control: *Neisseria gonorrhoeae* ATCC 49226 OR *Staphylococcus aureus* NCTC 6571

For general susceptibility testing in *N. gonorrhoeae* please see: <http://bsac.org.uk/wp-content/uploads/2014/06/Neisseria-gonorrhoeae.pdf>

Penicillins	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Penicillin	0.06	0.12-1	1	1 unit	26	18-25	17	Always test for β-lactamase.	If positive for β-lactamase report resistant to penicillin.
Cephalosporins	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Cefixime	0.12	-	0.12	-	-	-	-	Although cefuroxime is not recommended for clinical use, it can be used as an indicator antibiotic to detect reduced susceptibility to other oxyamino cephalosporins. For organisms with reduced zones to cefuroxime an MIC determination is needed to confirm susceptibility to ceftriaxone, cefotaxime and cefixime.	
Cefotaxime	0.12	-	0.12	-	-	-	-		
Ceftriaxone	0.12	-	0.12	-	-	-	-		
Cefuroxime (Screen)	-	-	-	5	24	-	23		
General notes:									
Quinolones	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Ciprofloxacin	0.03	0.06	0.06	1	29	-	28	Zone diameter breakpoints relate to the MIC breakpoint of 0.03mg/L as no data for the intermediate category are currently available. Quinolone resistance is most reliably detected with nalidixic acid; however there are a few isolates that are resistant to ciprofloxacin yet susceptible to nalidixic acid in disc diffusion tests. The mechanism of resistance and prevalence of these isolates in the UK is still under investigation. Isolates with reduced susceptibility to fluoroquinolones normally have no zone of inhibition with a 30µg nalidixic acid disc. For organisms with nalidixic acid zone diameters 10-31mm a ciprofloxacin MIC should be determined if the patient is to be treated with this agent.	
Nalidixic acid (Screen)	-	-	-	30	32	10-31	9		
Macrolides, lincosamides & streptogramins	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Azithromycin	0.25	0.5	0.5	15	28	-	27	Zone diameter breakpoints relate to the MIC breakpoints of >0.5mg/L as disc diffusion will not reliably differentiate between the intermediate and susceptible populations.	
Tetracyclines	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Tetracycline	0.5	1	1	10	32	27-31	26	No disc diffusion data to distinguish the intermediate category available at present.	The tetracycline result may be used to infer susceptibility to doxycycline. Isolates susceptible to tetracycline are also susceptible to doxycycline and minocycline.
Miscellaneous antimicrobials	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Spectinomycin	64	-	64	25	14	-	13		

Neisseria meningitidis

BSAC, Version 14, January 2015

Disk diffusion method for Antimicrobial Susceptibility testing

Medium: Iso-Sensitest agar supplemented with 5% defibrinated horse blood (ISA + %5 horse blood + 20mg/L NAD may also be used)

Inoculum: McFarland 0.5, dilute 1:10

Incubation: CO₂, 36±1°C, 19±1h

Reading: Read zone edges as the point showing no growth viewed from the front of the plate.

Quality control: *Neisseria gonorrhoeae* ATCC 49226 OR *Staphylococcus aureus* NCTC 6571

Penicillins	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Ampicillin	-	-	-	2	32	-	31	EUCAST MIC breakpoints are ≤0.12mg/L, R>1mg/L. Currently there are no BSAC MIC breakpoints and zone diameter breakpoints relating to the presence of specific mutations in the <i>penA</i> gene.	Ampicillin and amoxicillin are used as indicator antibiotics to detect reduced susceptibility to penicillin. The recommendations given are for this purpose only; ampicillin and amoxicillin should not be used therapeutically.
Amoxicillin	-	-	-	2	30	-	29		
Penicillin	0.06	0.12-0.25	0.25	1 unit	29	15-28	14		
Cephalosporins	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Cefotaxime	0.12	-	0.12	5	40	-	39		
Ceftriaxone	0.12	-	0.12	5	40	-	39		
General notes:									
Quinolones	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Ciprofloxacin	0.03	0.06	0.06	1	32	-	31	Zone diameter breakpoints relate to the MIC breakpoint of 0.03mg/L as no data for the intermediate category are currently available.	
								Quinolone resistance is most reliably detected with nalidixic acid. Isolates with reduced susceptibility to fluoroquinolones normally have no zone of inhibition with a 30ug nalidixic acid disc.	
Miscellaneous antimicrobials	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Chloramphenicol	2	4	4	10	20	-	19	Zone diameter breakpoints relate to the MIC breakpoint of 2mg/L as insufficient data to distinguish the intermediate category are currently available.	
Rifampicin	0.25	-	0.25	2	30	-	29	Epidemiological breakpoint based on an MIC breakpoint of 0.25mg/L.	

Haemophilus influenzae

BSAC, Version 14, January 2015

Disk diffusion method for Antimicrobial Susceptibility testing

Medium: Iso-Sensitest agar supplemented with 5% defibrinated horse blood + 20mg/L NAD

Inoculum: McFarland 0.5, dilute 1:100

Incubation: CO₂, 36±1°C, 19±1h

Reading: Read zone edges as the point showing no growth viewed from the front of the plate.

Quality control: *Haemophilus influenzae* ATCC 49247 OR NCTC 11931

Penicillins	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Ampicillin	1	-	1	2	18	-	17	Strains may be resistant to penicillins, aminopenicillins and/or cephalosporins due to changes in PBPs (βLNAR β-lactamase negative ampicillin resistant) and a few strains have both resistance mechanisms (βLPACR, β-lactamase positive, co-amoxiclav resistant).	Isolates susceptible to ampicillin/amoxicillin are also susceptible to piperacillin and piperacillin/tazobactam. Susceptibility to amoxicillin can be inferred from ampicillin.
Amoxicillin	2	-	2	2	14	-	13		
Co-amoxiclav	2	-	2	2/1	14	-	13		
General notes: Always test for β-lactamase; β-lactamase positive isolates should always be reported resistant. Breakpoints refer to β-lactamase negative isolates only.									

Cephalosporins	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Cefotaxime	0.12	-	0.12	5	25	-	24	Zone diameter breakpoints relate to the MIC breakpoint of 1mg/L as no data for the intermediate category are currently available.	
Ceftriaxone	0.12	-	0.12	30	25	-	24		
Cefuroxime	1	2	2	5	17	-	16		

Carbapenems	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Ertapenem	0.5	-	0.5	10	33	-	32	Meropenem is the only agent used for meningitis.	
Imipenem	2	-	2	10	23	-	22		
Meropenem (infection other than meningitis)	2	-	2	10	23	-	22		
Meropenem (Meningitis)	1	0.5-1	0.25	-	-	-	-		

Quinolones	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Ciprofloxacin	0.5	-	0.5	1	28	-	27	Quinolone resistance is most reliably detected in tests with nalidixic acid. Strains with reduced susceptibility to fluoroquinolones give no zone of inhibition with a 30ug nalidixic acid disc.	
Levofloxacin	1	-	1	1	20	-	19		
Moxifloxacin	0.5	-	0.5	1	18	-	17		
Nalidixic acid	-	-	-	-	-	-	-		
Ofloxacin	0.5	-	0.5	5	37	-	26		

Haemophilus influenzae

BSAC, Version 14, January 2015

Macrolides, lincosamides & streptogramins	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Azithromycin	0.12	-	4	15	-	-	19	Correlation between macrolide MICs and clinical outcome is weak for <i>H. influenzae</i> . Therefore breakpoints for macrolides and related antibiotics have been set to categorise "wild type" <i>H. influenzae</i> as intermediate.	Erythromycin can be used to determine susceptibility to azithromycin and clarithromycin.
Clarithromycin	1	-	32	5	-	-	8		
Erythromycin	0.5	-	16	5	-	-	14		
Telithromycin	0.12	-	8	15	-	-	15		
Tetracyclines	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Tetracycline	1	2	2	10	22	18-21	17	Isolates susceptible to tetracycline are also susceptible to doxycycline and minocycline. Some isolates resistant to tetracycline may be susceptible to minocycline and/or doxycycline.	
Miscellaneous antimicrobials	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Chloramphenicol	2	-	2	10	25	-	24		
Co-trimoxazole	0.5	1	1	25	21	18-20	17	See link in index tab.	

Pasteurella multocida

BSAC, Version 14, January 2015

Disk diffusion method for Antimicrobial Susceptibility testing

Medium: Iso-Sensitest agar supplemented with 5% defibrinated horse blood + 20mg/L NAD

Inoculum: McFarland 0.5, dilute 1:100

Incubation: CO₂, 36±1°C, 19±1h

Reading: Read zone edges as the point showing no growth viewed from the front of the plate.

Quality control: *Pasteurella multocida* NCTC 8489

Penicillins	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Ampicillin	1	-	1	10	30	-	29		
Co-amoxiclav	1	-	1	-	-	-	-		
Penicillin	0.5	-	0.5	1 unit	22	-	21	Any resistant isolate should be confirmed by MIC method.	Resistant isolates are rare.
General notes:									
Cephalosporins	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Cefotaxime	0.03	-	0.03	-	-	-	-		
Quinolones	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Ciprofloxacin	0.06	-	0.06	-	-	-	-	Quinolone resistance is most reliably detected in tests with nalidixic acid discs.	
Nalidixic acid	-	-	-	30	28	-	27		
Tetracyclines	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Tetracycline	2	-	2	-	-	-	-		

Campylobacter species

BSAC, Version 14, January 2015

Disk diffusion method for Antimicrobial Susceptibility testing

Medium: Iso-Sensitest agar supplemented with 5% defibrinated horse blood (ISA + %5 horse blood + 20mg/L NAD may also be used)

Inoculum: McFarland 0.5, no dilution

Incubation: microaerophilic conditions, 42°C, 24h

Reading: Read zone edges as the point showing no growth viewed from the front of the plate.

Quality control: Staphylococcus aureus NCTC 6571 or ATCC 25923, **For target zone sizes see:** <http://bsac.org.uk/wp-content/uploads/2012/02/Acceptable-ranges1.pdf>

Quinolones	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Ciprofloxacin	0.5	-	0.5	1	26	-	25	Quinolone resistance is most reliably detected in tests with nalidixic acid discs.	
Nalidixic acid	-	-	-	30	20	-	19		
Macrolides, lincosamides & streptogramins	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Erythromycin	4	-	4	5	22	-	21		The susceptibility of clarithromycin can be inferred from the erythromycin result.

Corynebacterium spp (except *C.diphtheriae*)

BSAC, Version 14, January 2015

Disk diffusion method for Antimicrobial Susceptibility testing

Medium: Iso-Sensitest agar supplemented with 5% defibrinated horse blood + 20mg/L NAD

Inoculum: McFarland 0.5, dilute 1:10

Incubation: CO₂, 36±1°C, 19±1h

Reading: Read zone edges as the point showing no growth viewed from the back of the plate against a dark background illuminated with reflected light.

Quality control: *Staphylococcus aureus* NCTC 6571 or ATCC 25923

Aminoglycosides	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Gentamicin	1	-	1	-	-	-	-		
β-lactams	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Penicillin	0.12	-	0.12	1 unit	20	-	19		
Quinolones	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Ciprofloxacin	0.5	1	1	1	17	12-16	11	The zone diameter relates to an MIC breakpoint of 0.5mg/L as no data for the intermediate category are currently available.	
Moxifloxacin	0.5	-	0.5	-	-	-	-		
Glycopeptides	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Vancomycin	2	-	2	5	20	-	19		
Macrolides, lincosamides & streptogramins	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Clindamycin	0.5	-	0.5	-	-	-	-		
Tetracyclines	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Tetracycline	2	-	2	-	-	-	-		
Miscellaneous antimicrobials	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Linezolid	2	-	2	-	-	-	-		
Rifampicin	0.06	-	0.5	-	-	-	-		

Gram-negative anaerobes (incl. *Bacteroides* species)

BSAC, Version 14, January 2015

Disk diffusion method for Antimicrobial Susceptibility testing

Medium: Iso-Sensitest agar supplemented with 5% defibrinated horse blood + 20mg/L NAD

Inoculum: McFarland 0.5, dilute 1:100

Incubation: 10% CO₂ /10%H₂ /80% N₂, 36±1°C, 19±1h

Reading: Read zone edges as the point showing no growth viewed from the front of the plate.

Quality control: *Bacteroides fragilis* NCTC 9343

Penicillins	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Amoxicillin	0.5	1-2	2	-	-	-	-		
Ampicillin	0.5	1-2	2	-	-	-	-		
Co-amoxiclav	4	8	8	30	29	21-28	20	Zone diameter breakpoints are for <i>B. fragilis</i> only.	
Penicillin	0.25	-	0.5	-	-	-	-		Susceptibility to ampicillin, amoxicillin and piperacillin ± tazobactam can be inferred from susceptibility to penicillin. <i>B. fragilis</i> is inherently resistant to penicillin.
Piperacillin	16	-	16	-	-	-	-		
Piperacillin-tazobactam	8	16	16	75/10	27	-	26	Zone diameter breakpoints are for <i>B. fragilis</i> only. The zone diameter breakpoint relates to an MIC of 8mg/L as no data for the intermediate category are currently available.	The breakpoints are based on "wild type" susceptible population as there are few clinical data relating MIC to outcome. Organisms that appear resistant in disc diffusion tests should have resistance confirmed by MIC determination and resistant isolates be sent to the Anaerobe Reference Unit, Public Health Wales, Cardiff.
Ticarcillin	16	-	16	-	-	-	-		
Ticarcillin-clavulanate	8	16	16	-	-	-	-		
Carbapenems	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Doripenem	1	-	1	-	-	-	-		
Ertapenem	1	-	1	-	-	-	-		
Imipenem	2	4-8	8	-	-	-	-		
Meropenem	2	4-8	8	10	26	19-25	18	Zone diameter breakpoints are for <i>B. fragilis</i> and <i>B. thetaiotaomicron</i> only.	
Macrolides, lincosamides & streptogramins	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Clindamycin	4	-	4	2	10	-	9	Zone diameter breakpoints are for <i>B. fragilis</i> and <i>B. thetaiotaomicron</i> only.	The breakpoints are based on "wild type" susceptible population as there are few clinical data relating MIC to outcome. Organisms that appear resistant in disc diffusion tests should have resistance confirmed by MIC determination and resistant isolates be sent to the Anaerobe Reference Unit, Public Health Wales, Cardiff.

Gram-negative anaerobes (incl. *Bacteroides* species)

BSAC, Version 14, January 2015

Miscellaneous antimicrobials	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Chloramphenicol	8	-	8	-	-	-	-		
Metronidazole	4	-	4	5	18	-	17	Zone diameter breakpoints are for <i>B. fragilis</i> and <i>B. thetaiotaomicron</i> only.	

Clostridium difficile

BSAC, Version 14, January 2015

Disk diffusion method for Antimicrobial Susceptibility testing

Medium: Iso-Sensitest agar supplemented with 5% defibrinated horse blood + 20mg/L NAD

Inoculum: McFarland 0.5, dilute 1:100

Incubation: 10% CO₂ /10%H₂ /80% N₂, 36±1°C, 19±1h

Reading: Read zone edges as the point showing no growth viewed from the front of the plate.

Quality control: *Bacteroides fragilis* NCTC 9343

Antimicrobial	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Daptomycin	-	-	4	-	-	-	-	MIC breakpoint based on the ECOFF for the "wild type" population.	Not used clinically. May be tested for epidemiological purposes only.
Fusidic acid	-	-	2	-	-	-	-	MIC breakpoint based on the ECOFF for the "wild type" population.	Not used clinically. May be tested for epidemiological purposes only.
Metronidazole	2	-	2	-	-	-	-	Breakpoints are based on epidemiological "cut off" values (ECOFFs) which distinguish "wild type" isolates from those with reduced susceptibility.	
Moxifloxacin	-	-	4	-	-	-	-	MIC breakpoint based on the ECOFF for the "wild type" population.	Not used clinically. May be tested for epidemiological purposes only.
Tigecycline	0.25	-	-	-	-	-	-	MIC breakpoint based on the ECOFF for the "wild type" population.	Not used clinically. May be tested for epidemiological purposes only.
Rifampicin	0.004	-	-	-	-	-	-	MIC breakpoint based on the ECOFF for the "wild type" population.	Not used clinically. May be tested for epidemiological purposes only.
Vancomycin	2	-	2	-	-	-	-	Breakpoints are based on epidemiological "cut off" values (ECOFFs) which distinguish "wild type" isolates from those with reduced susceptibility.	

Gram positive anaerobes except *Clostridium difficile*

BSAC, Version 14, January 2015

Disk diffusion method for Antimicrobial Susceptibility testing

Medium: Iso-Sensitest agar supplemented with 5% defibrinated horse blood + 20mg/L NAD

Inoculum: McFarland 0.5, dilute 1:10

Incubation: 10% CO₂ /10%H₂ /80% N₂, 36±1°C, 19±1h

Reading: Read zone edges as the point showing no growth viewed from the front of the plate.

Quality control: *Clostridium perfringens* NCTC 8359

Penicillins	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Amoxicillin	4	8	8	-	-	-	-		
Ampicillin	4	8	8	-	-	-	-		
Co-amoxiclav	4	8	8	-	-	-	-		
Penicillin	0.25	0.5	0.5	1 unit	23	-	22	Zone diameter breakpoints are for <i>C. perfringens</i> only.	The breakpoints are based on "wild type" susceptible population as there are few clinical data relating MIC to outcome. Organisms that appear resistant in disc diffusion tests should have resistance confirmed by MIC determination and resistant isolates be sent to the Anaerobe Reference Unit, Public Health Wales, Cardiff.
								The zone diameter breakpoint relates to an MIC of 0.25mg/L as no data for the intermediate category are currently available.	Susceptibility to ampicillin, amoxicillin, co-amoxiclav and piperacillin ± tazobactam can be inferred from susceptibility to penicillin.
Piperacillin	8	16	16	-	-	-	-		
Piperacillin-tazobactam	8	16	16	-	-	-	-		The breakpoints are based on "wild type" susceptible population as there are few clinical data relating MIC to outcome. Organisms that appear resistant in disc diffusion tests should have resistance confirmed by MIC determination and resistant isolates be sent to the Anaerobe Reference Unit, Public Health Wales, Cardiff.
Ticarcillin	8	16	16	-	-	-	-		
Ticarcillin-clavulanate	8	16	16	-	-	-	-		
Carbapenems	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Doripenem	1	-	1	-	-	-	-		
Ertapenem	1	-	1	-	-	-	-		
Imipenem	2	4-8	8	-	-	-	-		
Meropenem	2	4-8	8	10	26	19-25	18	Zone diameter breakpoints are for <i>C. perfringens</i> only.	
Glycopeptides	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Vancomycin	2	-	2	-	-	-	-		

Gram positive anaerobes except *Clostridium difficile*

BSAC, Version 14, January 2015

Macrolides, lincosamides & streptogramins	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
	S ≤	I	R >		S ≥	I	R ≤		
Clindamycin	4	-	4	2	10	-	9	Zone diameter breakpoints are for <i>C. perfringens</i> only.	The breakpoints are based on "wild type" susceptible population as there are few clinical data relating MIC to outcome. Organisms that appear resistant in disc diffusion tests should have resistance confirmed by MIC determination and resistant isolates be sent to the Anaerobe Reference Unit, Public Health Wales, Cardiff.
Miscellaneous antimicrobials	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Agent specific notes:	Reporting guidance
S ≤	I	R >	S ≥		I	R ≤			
Chloramphenicol	8	-	8	-	-	-	-		
Metronidazole	4	-	4	5	18	-	17	Zone diameter breakpoints are for <i>C. perfringens</i> only.	

UTI related comments

1	UTI recommendations are for organisms associated with uncomplicated urinary infections only. For complicated UTI systemic recommendations should be used.
2	If an organism is isolated from multiple sites, for example from blood and urine, interpretation of susceptibility should be made with regard to the systemic site (e.g., if the blood isolate is resistant and the urine isolate susceptible, both should be reported resistant irrespective of the results obtained using interpretative criteria for urine isolates).
3	For agents not listed, criteria given for systemic isolates may be used for urinary tract isolates. Intermediate susceptibility infers that the infection may respond as the agent is concentrated at the site of infection.
4	Direct susceptibility tests on urine samples may be interpreted only if the inoculum gives semi-confluent growth.
5	In the absence of definitive organism identification, use the recommendations most appropriate for the presumptive identification, accepting that on some occasions the interpretation may be incorrect. A more cautious approach is to use the systemic recommendations.

Principals of reporting

1	Reporting is one of the most important parts of the service, as what a laboratory releases makes a difference to the prescribing of antimicrobial agents.
2	Ensure reporting is in line with local guidance on the use of antimicrobial agents.
3	Report all clinically-relevant resistances for significant pathogens.
4	Report results for relevant antimicrobial agent(s) that the requestor has stated are in use, unless clinically inappropriate.
5	Whenever possible, always include a susceptibility result for a non- β -lactam agent, so there is always a treatment option for those with penicillin allergy.
6	Whenever possible and appropriate include results for antimicrobial agents that can be given orally.
7	Take note of restrictions for special patient groups when reporting (e.g. tetracyclines not to be used in pregnancy or for children)
8	Reporting should aim to reduce antimicrobial resistance and <i>C. difficile</i> through reducing selective pressures and targeting the most appropriate treatment for each organism reported.
9	The order in which the laboratory reports susceptibility results is important, as prescribers will tend to choose the first listed.
10	Inform clinicians that susceptibility results for further antimicrobial agents may be available.