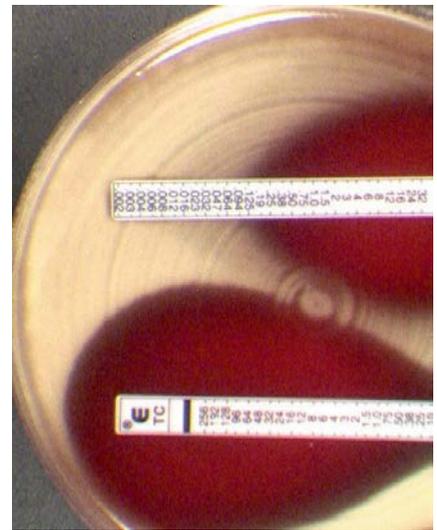
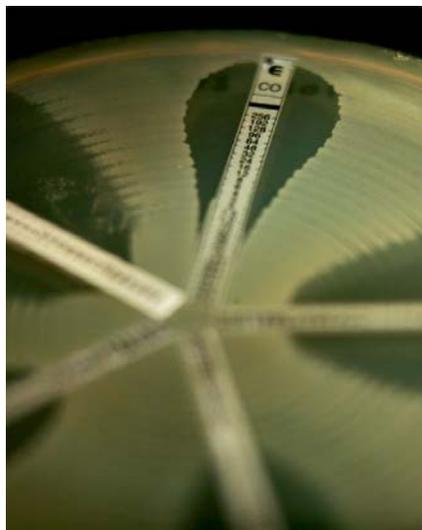
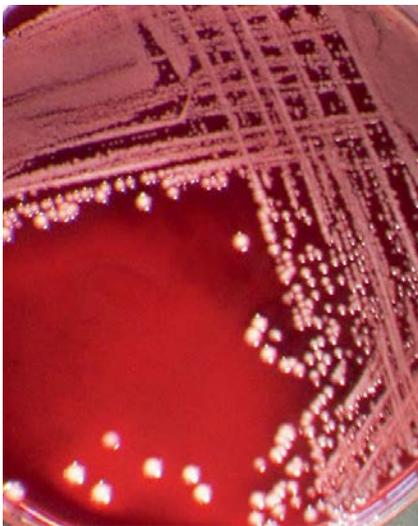


NCTC[®] Antimicrobial Resistance Reference Strains and Antimicrobial Susceptibility Testing Control Strains



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Section 1: Antimicrobial Resistance Reference Strains

Public Health England's National Collection of Type Cultures (NCTC), working in partnership with Public Health England's Antimicrobial Resistance and Healthcare Associated Infections (AMRHAI) Reference Unit, offers a range of reference strains with characterised resistance mechanisms. These include:

- a range of extended-spectrum β -lactamases (ESBLs), including examples of all major CTX-M groups
- a range of carbapenemases, including examples of all of the five major groups which dominate internationally, namely KPC and OXA-48 non-metallo-enzymes and IMP, NDM and VIM metallo-carbapenemases
- the first vancomycin-resistant enterococci isolated in the UK¹, the first methicillin-resistant *Staphylococcus aureus* to carry the *mecA* gene homologue *mecC*², the first reported *Neisseria gonorrhoeae* strain with high-level resistance to ceftriaxone³, and an *Escherichia coli* strain with the *mcr-1* gene conferring transferable colistin resistance⁴
- several fully-sequenced (and published) multi-drug resistance plasmids

With the exception of laboratory-derived strains containing fully sequenced plasmids, most of these strains are partially-characterised and, as such, are likely to have other resistance mechanisms in addition to those specified.

Strains are manufactured in accordance with the requirements of ISO 9001:2008 and undergo extensive quality control by NCTC and AMRHAI to confirm the characteristics of the strain as new batches are prepared, although plasmids and genes are not resequenced.

For more information, or to order online visit www.phe-culturecollections.org.uk

The significant increase in the incidence of antibiotic resistance in bacteria observed in recent years represents a major challenge to public health microbiology worldwide. Not least among these challenges are extended-spectrum β -lactamases (ESBLs) and carbapenemases among Enterobacteriaceae and other Gram-negative micro-organisms and vancomycin resistance among enterococci.

Public Health England's Antimicrobial Resistance and Healthcare Associated Infections (AMRHAI) Reference Unit is the national reference laboratory responsible for the detection and investigation of antibiotic resistance, especially in healthcare associated and sexually transmitted bacterial pathogens, and offers molecular detection of the genetic determinants of certain key resistances.

1. Penicillinase without Extended-Spectrum β -Lactamase (ESBL) Activity

Organism	NCTC® Strain Reference	Characteristics	Ref	Other collection number
<i>Escherichia coli</i>	NCTC 11560	TEM-1 β -lactamase producer. British Society of Antimicrobial Chemotherapy recommended control strain	5	-
<i>Escherichia coli</i>	NCTC 11954	(ATCC 35218) β -lactamase producing control strain	6	ATCC 35218
<i>Staphylococcus aureus</i>	NCTC 11561	β -lactamase producing strain		-

2. Extended-Spectrum β -Lactamases (ESBL)

2.1 TEM β -lactamases

Organism	NCTC® Strain Reference	Characteristics	Ref	Other collection number
<i>Escherichia coli</i>	NCTC 13351	TEM-3 ESBL – Transconjugant control strain isolated in Clermont Ferrand in 1985	5	-
<i>Escherichia coli</i>	NCTC 13352	TEM-10 ESBL – Transconjugant original control strain TEM-10 producer isolated in Chicago in 1988	6	-

2.2 SHV β -lactamases

Organism	NCTC® Strain Reference	Characteristics	Ref	Other collection number
<i>Klebsiella pneumoniae</i>	NCTC 13368	SHV-18 (ATCC 700603) control strain		ATCC 700603; CCUG 45421; LMG 20218

2.3 CTX-M β -lactamases

Organism	NCTC® Strain Reference	Characteristics	Ref	Other collection number
<i>Escherichia coli</i>	NCTC 13353	Strain EO 487. CTX-M-15 ESBL producer. Control strain for group 1 <i>bla</i> _{CTX-M} multiplex PCR assays	7	-
<i>Escherichia coli</i>	NCTC 13441	Strain EO 499. CTX-M-15 ESBL producer – Uropathogenic strain O25:H4 sequence type (ST) 131. Clinical isolate harbouring sequenced plasmid pEK499 (see NCTC 13400); Strain for group 1 <i>bla</i> _{CTX-M} multiplex PCR assays.	7	-
<i>Escherichia coli</i>	NCTC 13400	Strain Tr499 = DH5-a derivative. Source of pEK499 (fully sequenced plasmid GenBank Accession No EU935739) encoding CTX-M-15 enzyme. Fusion of type FII and FIA replicons, and harbours 10 antibiotic resistance genes (see catalogue entry for details)	8	-

2.3 CTX-M β -lactamases continued

Organism	NCTC® Strain Reference	Characteristics	Ref	Other collection number
<i>Escherichia coli</i>	NCTC 13451	Strain J499 = J53 derivative. Source of pEK499 (fully sequenced plasmid GenBank Accession No EU935739) encoding CTX-M-15 enzyme. Fusion of type FII and FIA replicons, and harbours 10 antibiotic resistance genes (see catalogue entry for details)	8	-
<i>Escherichia coli</i>	NCTC 13450	Strain Tr516 = DH5-a derivative. Source of pEK516 (fully sequenced plasmid GenBank Accession No EU935738), which encodes CTX-M-15 enzyme. Harbours 7 antibiotic resistance genes (see catalogue entry for details)	8	-
<i>Escherichia coli</i>	NCTC 13452	Strain J204 = J53 derivative. Source of pEK204 (fully sequenced plasmid GenBank Accession No EU935740), encoding CTX-M-3 enzyme. Plasmid pEK204 (93,732-bp) belongs to incompatibility group IncI1, and harbours two antibiotic resistance genes (see catalogue entry for details)	8	-
<i>Escherichia coli</i>	NCTC 13461	Strain harbours unsequenced <i>bla</i> _{CTX-M} group 1 gene	9	-
<i>Escherichia coli</i>	NCTC 13462	Strain harbours unsequenced <i>bla</i> _{CTX-M} group 2 gene	9	-
<i>Escherichia coli</i>	NCTC 13463	Strain harbours unsequenced <i>bla</i> _{CTX-M} group 8 gene	9	-
<i>Enterobacter cloacae</i>	NCTC 13464	Strain harbours unsequenced <i>bla</i> _{CTX-M} group 9 gene	9	-
<i>Klebsiella pneumoniae</i>	NCTC 13465	Strain harbours unsequenced <i>bla</i> _{CTX-M} group 25 gene	9	-

2.4 VEB β -lactamases

Organism	NCTC® Strain Reference	Characteristics	Ref	Other collection number
<i>Pseudomonas aeruginosa</i>	NCTC 13437	VIM-10 metallo-carbapenemase; VEB-1 ESBL	10	-

3. AmpC β -Lactamases

Organism	NCTC® Strain Reference	Characteristics	Ref	Other collection number
<i>Enterobacter cloacae</i>	NCTC13405	Strain 684. Inducible AmpC β -lactamase, wild type. Strain for AmpC detection tests.		-
<i>Enterobacter cloacae</i>	NCTC13406	Strain 684-con. AmpC β -lactamase depressed (i.e. constitutive hyper-producing) mutant of NCTC 13405. Strain for AmpC detection tests		-

4. Carbapenemases

4.1 Class A Carbapenemases

Organism	NCTC® Strain Reference	Characteristics	Ref	Other collection number
<i>Klebsiella pneumoniae</i>	NCTC 13438	Member of the international ST258 clone producing KPC-3 carbapenemase		-
<i>Escherichia coli</i>	NCTC 13919	Positive control for the detection of <i>bla</i> _{GES}		-
<i>Serratia marcescens</i>	NCTC 13920	Positive control for the detection of <i>bla</i> _{SME-4}		-
<i>Enterobacter cloacae</i> complex	NCTC 13922	Positive control for the detection of <i>bla</i> _{NMC-A}		-
<i>Enterobacter cloacae</i> complex	NCTC 13925	Positive control for the detection of <i>bla</i> _{IMI-2}		-

4.2 Class β Carbapenemases (Metallo-β-lactamases)

Organism	NCTC® Strain Reference	Characteristics	Ref	Other collection number
<i>Pseudomonas aeruginosa</i>	NCTC 13437	VIM-10 metallo-carbapenemase; VEB-1 ESBL	10	-
<i>Klebsiella pneumoniae</i>	NCTC 13439	VIM-1 metallo-carbapenemase; QnrS1 (outbreak strain)	12	-
<i>Klebsiella pneumoniae</i>	NCTC 13440	VIM-1 metallo-carbapenemase; QnrS1 (sporadic)	12	-
<i>Klebsiella pneumoniae</i>	NCTC 13443	New Delhi Metallo-carbapenemase (NDM-1)		CCUG 68728
<i>Escherichia coli</i>	NCTC 13476	IMP-type metallo-carbapenemase (unsequenced)		CCUG 68729
<i>Pseudomonas aeruginosa</i>	NCTC 13921	Positive control for the detection of <i>bla</i> _{SPM-1}	25	-

4.3 Class D Carbapenemases (OXA carbapenemases)

Organism	NCTC® Strain Reference	Characteristics	Ref	Other collection number
<i>Acinetobacter baumannii</i>	NCTC 13301	OXA-23 (also with OXA-51-like)	13	-
<i>Acinetobacter baumannii</i>	NCTC 13302	OXA-25 (OXA-24/40-like) (also with OXA-51-like)	13	-
<i>Acinetobacter baumannii</i>	NCTC 13303	OXA-26 (also with OXA-51-like)	13	-
<i>Acinetobacter baumannii</i>	NCTC 13304	OXA-27 (also with OXA-51-like)	13	-
<i>Acinetobacter baumannii</i>	NCTC 13305	(A 15) OXA-58 (also with OXA-51-like)	14	-
<i>Acinetobacter baumannii</i>	NCTC 13421	OXA-23 Clone 2 (also with OXA-51-like)	15,5 6	-
<i>Acinetobacter baumannii</i>	NCTC 13424	OXA-23 Clone 1 (also with OXA-51-like)	15,5 6	-
<i>Acinetobacter baumannii</i>	NCTC 13420	SE Clone OXA-51-like	15,5 6	-
<i>Acinetobacter baumannii</i>	NCTC 13422	NW Clone OXA-51-like	17, 18,5 9	-
<i>Acinetobacter baumannii</i>	NCTC 13423	T strain (UK3) OXA-51-like	17,5 8,19	-
<i>Klebsiella pneumoniae</i>	NCTC 13442	Sequence type 353 with OXA-48	20	CCUG 68727

5. Plasmid-mediated Fluoroquinolone Resistance

Organism	NCTC® Strain Reference	Characteristics	Ref	Other collection number
<i>Klebsiella pneumoniae</i>	NCTC 13439	VIM-1 metallo-carbapenemase; QnrS1 (outbreak strain)	12	-
<i>Klebsiella pneumoniae</i>	NCTC 13340	VIM-1 metallo-carbapenemase; QnrS1 (sporadic)	12	-
<i>Escherichia coli</i>	NCTC 13400	aac(6')-Ib-cr	24	-
<i>Escherichia coli</i>	NCTC 13441	aac(6')-Ib-cr	7	-
<i>Escherichia coli</i>	NCTC 13450	aac(6')-Ib-cr	24	-
<i>Escherichia coli</i>	NCTC 13451	aac(6')-Ib-cr	24	-

6. Vancomycin Resistant Enterococci

Organism	NCTC® Strain Reference	Characteristics	Ref	Other collection number
<i>Enterococcus faecalis</i>	NCTC 12201	VanA-type glycopeptide resistance	1	-
<i>Enterococcus faecium</i>	NCTC 12202	VanA-type glycopeptide resistance	1	-
<i>Enterococcus faecalis</i>	NCTC 12203	VanA-type glycopeptide resistance	1	-
<i>Enterococcus faecium</i>	NCTC 12204	VanA-type glycopeptide resistance	1	-
<i>Enterococcus faecalis</i>	NCTC 13379	VanB-type glycopeptide resistance		ATCC 51299; CIP104676; WDCM 00085; WDCM 00152

7. Multidrug Resistance Plasmids

Organism	NCTC® Strain Reference	Characteristics	Ref	Other collection number
<i>Escherichia coli</i>	NCTC 13400	Strain Tr499 = DH5-a derivative. Source of pEK499 (fully sequenced plasmid GenBank Accession No EU935739). Fusion of type FII and FIA replicons, and harbours 10 antibiotic resistance genes (see catalogue entry)	8	-
<i>Escherichia coli</i>	NCTC 13451	Strain J499 = J53 derivative. Source of pEK499 (fully sequenced plasmid GenBank Accession No EU935739). Fusion of type FII and FIA replicons, and harbours 10 antibiotic resistance genes (see catalogue entry)	8	-
<i>Escherichia coli</i>	NCTC 13450	Strain Tr516 = DH5-a derivative. Source of pEK516 (fully sequenced plasmid GenBank Accession No EU935738). Harbours 7 antibiotic resistance genes (see catalogue entry)	8	-

7. Multidrug Resistance Plasmids continued

Organism	NCTC® Strain Reference	Characteristics	Ref	Other collection number
<i>Escherichia coli</i>	NCTC 13452	Strain J204 = J53 derivative. Source of pEK204 (fully sequenced plasmid GenBank Accession No EU935740), encoding CTX-M-3 enzyme. Plasmid pEK204 (93,732-bp) belongs to incompatibility group IncI1, and harbours two antibiotic resistance genes (see catalogue entry for details)	8	-

8. Methicillin-Resistant *Staphylococcus aureus*(MRSA)

Organism	NCTC® Strain Reference	Characteristics	Ref	Other collection number
<i>Staphylococcus aureus</i>	NCTC 13142	EMRSA-15 type strain. Epidemic MRSA from UK. Strain for <i>mecA</i> detection tests	21	-
<i>Staphylococcus aureus</i>	NCTC 13552	Strain LGA251. Strain for the <i>mecA</i> homologue MecC detection tests. Isolated from bulk milk.	2	-
<i>Staphylococcus aureus</i>	NCTC 13656	PVL-negative CA-MRSA strain belonging to clonal complex 59, a clone that originated in East Asia	22	-
<i>Staphylococcus aureus</i>	NCTC 13435	PVL-positive CA-MRSA strain belonging to clonal complex 80, commonly known as the so-called European clone of CA-MRSA	23	-

9. Colistin resistance

Organism	NCTC® Strain Reference	Characteristics	Ref	Other collection number
<i>Escherichia coli</i>	NCTC 13846	Colistin resistant <i>mcr-1</i> positive	4	DSMZ 105182

10. Linezolid resistance

Organism	NCTC® Strain Reference	Characteristics	Ref	Other collection number
<i>Enterococcus faecium</i>	NCTC 13923	Positive control for the detection of <i>optrA</i> conferring resistance to linezolid	-	-
<i>Staphylococcus epidermidis</i>	NCTC 13924	Positive control for the detection of <i>cfr</i> or G2576T mutation both of which confer resistance to linezolid	26	-

Section 2: Antimicrobial Susceptibility Testing Control Strains

NCTC offers a wide range of strains that can be used as controls in antimicrobial susceptibility testing to:

- monitor test performance and quality of the materials used
- confirm that the in-use method will detect resistance

NCTC strains are verified by Public Health England's Antimicrobial Resistance and Healthcare Associated Infections (AMRHAI) Reference Unit and are used in diagnostic testing laboratories worldwide.

The strains listed are specifically recommended by one or more of the following:

- the European Committee on Antimicrobial Susceptibility Testing (EUCAST)
- Clinical and Laboratory Standards Institute (CLSI)
- United Kingdom Standards for Microbiology Investigations (formerly National Standard Methods) (UKSMI)
- British Society of Antimicrobial Chemotherapy (BSAC)

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1. The European Committee on Antimicrobial Susceptibility Testing (EUCAST)

1.1 Routine and extended internal quality control for MIC determination and/or disk diffusion as recommended by EUCAST. Version 7.1, 2017

Organism	NCTC® Strain Reference	Routine or extended internal QC	Characteristics	Other collection number
<i>Campylobacter jejuni</i>	NCTC 11351	Routine	-	ATCC 33560; CCUG 11284; CIP 702; DSM 4688
<i>Enterococcus faecalis</i>	NCTC 12697	Routine	-	ATCC 29212; WDCM 00087
<i>Enterococcus faecalis</i>	NCTC 13379	Extended	High-level gentamicin resistant (HLGR), vanB positive	ATCC 51299; CIP 10467; WDCM 00085; WDCM 00152
<i>Escherichia coli</i>	NCTC 12241	Routine	-	ATCC 25922; DSM 1103; NCIMB 12210; WDCM 00013
<i>Escherichia coli</i>	NCTC 11954	Routine	TEM-1 β -lactamase (Non-ESBL) producer	ATCC 35218
<i>Escherichia coli</i>	NCTC 13846	Routine	<i>mcr-1</i> Positive	DSMZ 105182
<i>Haemophilus influenzae</i>	NCTC 12975	Routine	-	ATCC 49766; CIP 103570
<i>Haemophilus influenzae</i>	NCTC 12699	Extended	-	ATCC 49247
<i>Klebsiella pneumoniae</i>	NCTC 13368	Routine and extended	SHV-18 ESBL producing	ATCC 700603; CCUG 45421; LMG 20218
<i>Pseudomonas aeruginosa</i>	NCTC 12903	Routine	-	ATCC 27853; WDCM 00025
<i>Staphylococcus aureus</i>	NCTC 12493	Extended	Methicillin resistant (MRSA), <i>mecA</i> positive	WDCM 00212
<i>Staphylococcus aureus</i>	NCTC 12973	Routine	Weak β -lactamase positive, <i>mecA</i> negative	ATCC 29213; CIP 103429; DSM 2569; JCM 2874; WDCM 00131
<i>Streptococcus pneumoniae</i>	NCTC 12977	Routine	Penicillin intermediate (altered penicillin binding protein)	ATCC 49619; CIP 104340

2. Clinical and Laboratory Standards Institute (CLSI)

2.1 Recommended performance standards for antimicrobial susceptibility testing (M100-S27)

® Strain

Organism	NCTC® Strain Reference	Characteristics	Other collection number
<i>Bacteroides fragilis</i>	NCTC 9343	β-lactamase positive	ATCC 25285; CN 6300; DSM 2151
<i>Bacteroides thetaiotaomicron</i>	NCTC 13706	β-lactamase positive	-
<i>Enterococcus faecalis</i>	NCTC 12697	-	ATCC 29212; WDCM 00087
<i>Enterococcus faecalis</i>	NCTC 13379	Resistant to vancomycin (VanB) and high-level aminoglycosides	ATCC 51299; CIP 10467; WDCM 00085; WDCM 00152
<i>Enterococcus faecalis</i>	NCTC 13705	-	WDCM 00210
<i>Enterococcus faecalis</i>	NCTC 13763	-	ATCC 33186
<i>Escherichia coli</i>	NCTC 12241	β-lactamase negative	ATCC 25922; DSM 1103; NCIMB 12210; WDCM 00013
<i>Escherichia coli</i>	NCTC 11954	Contains plasmid-encoded TEM-1 β-lactamase (Non-ESBL) producer	ATCC 35218
<i>Escherichia coli</i>	NCTC 13353	CTX-M-15 ESBL-producing strain	-
<i>Haemophilus influenzae</i>	NCTC 12699	BLNAR (β-lactamase negative, ampicillin resistant)	ATCC 49247
<i>Haemophilus influenzae</i>	NCTC 12975	Ampicillin susceptible	ATCC 49766; CIP 103570
<i>Haemophilus influenzae</i>	NCTC 13377	-	ATCC 10211; CIP 103708
<i>Klebsiella pneumoniae</i>	NCTC 13368	SHV-18 ESBL producing	ATCC 700603; CCUG 45421; LMG 20218
<i>Klebsiella pneumoniae</i>	NCTC 13809	KPC-producing strain, MHT positive	ATCC BAA-1705
<i>Klebsiella pneumoniae</i>	NCTC 13810	Resistant to carbapenems by mechanisms other than carbapenemase, MHT negative	ATCC BAA-1706

2.1 Recommended performance standards for antimicrobial susceptibility testing (M100-S27)

® Strain continued

Organism	NCTC® Strain Reference	Characteristics	Other collection number
<i>Neisseria gonorrhoeae</i>	NCTC 12700	CMRNG (Chromosome-mediated resistant <i>Neisseria gonorrhoeae</i>)	ATCC 49226
<i>Pseudomonas aeruginosa</i>	NCTC 12903	Contains inducible AmpC β -lactamase	ATCC 27853; WDCM 00025
<i>Staphylococcus aureus</i>	NCTC 12981	β -lactamase negative, <i>mecA</i> negative, little value in MIC testing due to its extreme susceptibility to most drugs	ATCC 25923; CIP 76.25; DSM 1104; JCM 2413; WDCM 00034
<i>Staphylococcus aureus</i>	NCTC 12973	Weak β -lactamase positive, <i>mecA</i> negative	ATCC 29213; CIP 103429; DSM 2569; JCM 2874; WDCM 00131
<i>Staphylococcus aureus</i>	NCTC 13373	Oxacillin resistant, <i>mecA</i> negative	ATCC 43300; WDCM 00211
<i>Staphylococcus aureus</i>	NCTC 13811	Contains inducible <i>erm(A)</i> -mediated resistance	ATCC BAA-977
<i>Staphylococcus aureus</i>	NCTC 13812	Contains <i>msr(A)</i> -mediated macrolide-only resistance	ATCC BAA-976
<i>Staphylococcus aureus</i>	NCTC 13813	High-level mupirocin resistance mediated by the <i>mupA</i> gene	ATCC BAA-1708
<i>Streptococcus pneumoniae</i>	NCTC 12977	Penicillin intermediate (altered penicillin binding protein)	ATCC 49619; CIP 104340

3. UK Standards for Microbiology Investigations (UKSMI)

3.1 Recommended in B59: Enterobacteriaceae producing Extended Spectrum β -lactamases

Organism	NCTC® Strain Reference	Characteristics	Other collection number
<i>Escherichia coli</i>	NCTC 13353	CTX-M-15 (cefotaxime)	-
<i>Escherichia coli</i>	NCTC 13351	TEM-3 (Broad Spectrum)	-
<i>Escherichia coli</i>	NCTC 13352	TEM-10 (ceftazidimase)	-
<i>Klebsiella pneumoniae</i>	NCTC 13368	SHV-18 ESBL producing	ATCC 700603; CCUG 45421; LMG 20218

Note: Either *E. coli* NCTC 10418 or ATCC 25922 should be used as a negative control in ESBL confirmation tests.

3.1 Recommended in B60: Detection of bacteria with carbapenem-hydrolysing β -lactamases (carbapenemases)

Organism	NCTC® Strain reference	Characteristics	Other collection number
Class A Carbapenemase			
<i>Klebsiella pneumoniae</i>	NCTC 13438	Member of the international ST258 clone producing KPC-3 carbapenemase	-
Class B Carbapenemases (Metallo-β-lactamases)			
<i>Escherichia coli</i>	NCTC 13476	IMP-type metallo-carbapenemase (unsequenced)	CCUG 68729
<i>Klebsiella pneumoniae</i>	NCTC 13439	VIM-1 metallo-carbapenemase; QnrS1 (outbreak strain)	-
<i>Klebsiella pneumoniae</i>	NCTC 13440	VIM-1 metallo-carbapenemase; QnrS1 (sporadic)	-
<i>Klebsiella pneumoniae</i>	NCTC 13443	New Delhi Metallo- β -lactamase (NDM-1)	CCUG 68728
<i>Pseudomonas aeruginosa</i>	NCTC 13437	VIM-10 metallo-carbapenemase; VEB-1 ESBL	-
Class D Carbapenemases (OXA carbapenemases)			
<i>Acinetobacter baumannii</i>	NCTC 13301	OXA-23 (also with OXA-51-like)	-
<i>Acinetobacter baumannii</i>	NCTC 13302	OXA-25 (OXA-24/40-like) (also with OXA-51-like)	-
<i>Acinetobacter baumannii</i>	NCTC 13303	OXA-26 (also with OXA-51-like)	-
<i>Acinetobacter baumannii</i>	NCTC 13304	OXA-27 (also with OXA-51-like)	-
<i>Acinetobacter baumannii</i>	NCTC 13305	(A 15) OXA-58 (also with OXA-51-like)	-
<i>Acinetobacter baumannii</i>	NCTC 13421	OXA-23 Clone 2 (also with OXA-51-like)	-
<i>Acinetobacter baumannii</i>	NCTC 13424	OXA-23 Clone 1 (also with OXA-51-like)	-
<i>Acinetobacter baumannii</i>	NCTC 13420	SE Clone OXA-51-like	-
<i>Acinetobacter baumannii</i>	NCTC 13422	NW Clone OXA-51-like	-
<i>Acinetobacter baumannii</i>	NCTC 13423	T strain (UK3) OXA-51-like	-
<i>Klebsiella pneumoniae</i>	NCTC 13442	Sequence type 353 with OXA-48	CCUG 68727

Note: Either *E. coli* NCTC 10418 or ATCC 25922 should be used as a negative control in confirmation tests

4. World Health Organisation (WHO) - *Neisseria gonorrhoeae* panel

As listed in Unemo *et al* The novel 2016 WHO *Neisseria gonorrhoeae* reference strains for global quality assurance of laboratory investigations: phenotypic, genetic and reference genome characterization. J Antimicrob Chemother. 2016 Nov;71(11):3096-3108

Organism	NCTC® Strain Reference	WHO Designation	Characteristics	Other collection number
<i>Neisseria gonorrhoeae</i>	NCTC 13477	WHO F	Fully susceptible isolate	CCUG 57595
<i>Neisseria gonorrhoeae</i>	NCTC 13478	WHO G	Resistant to; ciprofloxacin (Low-level), penicillin (intermediate) tetracycline (TRNG)	CCUG 57596
<i>Neisseria gonorrhoeae</i>	NCTC 13479	WHO K	Resistant to; cefixime (low-level), ciprofloxacin (high-level), penicillin G, tetracycline	CCUG 57597
<i>Neisseria gonorrhoeae</i>	NCTC 13480	WHO L	Resistant to; azithromycin (intermediate), penicillin G, ceftriaxone (low-level), ciprofloxacin (high-level), tetracycline	CCUG 57598
<i>Neisseria gonorrhoeae</i>	NCTC 13481	WHO M	Resistant to; ciprofloxacin, penicillin G (penicillinase-producing), tetracycline	CCUG 57599
<i>Neisseria gonorrhoeae</i>	NCTC 13482	WHO N	Resistant to; penicillin G (penicillinase-producing), ciprofloxacin, tetracycline (TRNG)	CCUG 57600
<i>Neisseria gonorrhoeae</i>	NCTC 13483	WHO O	Resistant to; penicillin G (penicillinase-producing), spectinomycin, tetracycline	CCUG 57601
<i>Neisseria gonorrhoeae</i>	NCTC 13484	WHO P	Resistant to; azithromycin, penicillin G (intermediate), tetracycline (intermediate)	CCUG 57602
<i>Neisseria gonorrhoeae</i>	NCTC 13817	WHO U	Resistant to; azithromycin, ciprofloxacin (high-level), penicillin G (intermediate), tetracycline (intermediate)	-
<i>Neisseria gonorrhoeae</i>	NCTC 13818	WHO V	Resistant to; azithromycin (high-level), ciprofloxacin (high-level), penicillin G (penicillinase-producing), tetracycline	-
<i>Neisseria gonorrhoeae</i>	NCTC 13819	WHO W	Resistant to; cefixime (low-level), ciprofloxacin (high-level), penicillin G, tetracycline	-
<i>Neisseria gonorrhoeae</i>	NCTC 13820	WHO X	Resistant to; azithromycin (intermediate), Cefixime (high-level), ceftriaxone (high-level), ciprofloxacin (high-level), penicillin G	-
<i>Neisseria gonorrhoeae</i>	NCTC 13821	WHO Y	Resistant to; azithromycin, cefixime (high-level), ceftriaxone (high-level) and ciprofloxacin (high-level), penicillin G (intermediate), tetracycline	-
<i>Neisseria gonorrhoeae</i>	NCTC 13822	WHO Z	Resistant to; azithromycin, ceftriaxone (low-level), cefixime (high-level) and ciprofloxacin (high-level), penicillin G, tetracycline	-

5. British Society for Antimicrobial Chemotherapy (BSAC)

Method for Antimicrobial Susceptibility Testing (Version 14 January 2015)

Control strains with a resistance mechanism

Organism	NCTC [®] Strain Reference	Characteristics	Other collection number
<i>Bacteroides fragilis</i>	NCTC 9343	Susceptible	ATCC 25285; CN 6300; DSM 2151
<i>Bacteroides thetaiotaomicron</i>	NCTC 13706	Susceptible	-
<i>Clostridium perfringens</i>	NCTC 8359	Susceptible	ATCC 12915; CN 3335
<i>Enterococcus faecalis</i>	NCTC 12697	Susceptible	ATCC 29212; WDCM 00087
<i>Escherichia coli</i>	NCTC 12241	Susceptible (β -lactamase negative)	ATCC 25922; DSM 1103; NCIMB 12210; WDCM 00013
	NCTC 10418	Susceptible	ATCC 10536; CN 6455; DSM 682; NCIB 8879;
<i>Escherichia coli</i>	NCTC 11560	TEM-1 β -lactamase producer	-
<i>Haemophilus influenzae</i>	NCTC 11931	Susceptible	-
<i>Haemophilus influenzae</i>	NCTC 12699	Resistant to β -lactams (β -lactamase-negative)	ATCC 49247
<i>Neisseria gonorrhoeae</i>	NCTC 12700	Low level chromosome mediated resistant to penicillin	ATCC 49226
<i>Pasteurella multocida</i>	NCTC 8489	Susceptible	-
<i>Pseudomonas aeruginosa</i>	NCTC 12903	Susceptible (contains inducible AmpC β -lactamase)	ATCC 27853; WDCM 00025
	NCTC 10662	Susceptible	ATCC 25668; CCUG 1423; DSM 46358; WDCM 00114
<i>Staphylococcus aureus</i>	NCTC 12981	Susceptible (β -lactamase negative)	ATCC 25923; CIP 76.25; DSM 1104; JCM 2413; WDCM 00034
	NCTC 6571	Susceptible	ATCC 9144; CN 6457; NCIB 6571; NRRL-B314; WDCM00035
<i>Staphylococcus aureus</i>	NCTC 12493	<i>MecA</i> positive, methicillin resistant	WDCM 00212
<i>Streptococcus pneumoniae</i>	NCTC 12977	Low level resistant to penicillin (altered penicillin binding protein)	ATCC 49619; CIP 104340

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| www.eucast.org | The European Committee on Antimicrobial Susceptibility Testing (EUCAST) |
| www.clsi.org | Clinical and Laboratory Standards Institute (CLSI) |
| www.gov.uk | UK Standards for Microbiological Investigations |
| www.bsac.org.uk | British Society for Antimicrobial Chemotherapy (BSAC) |

