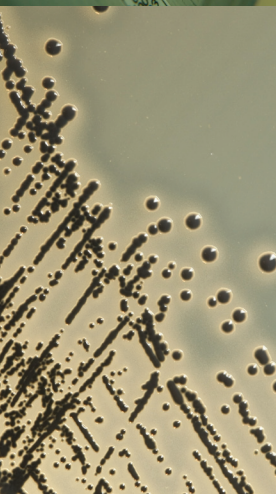
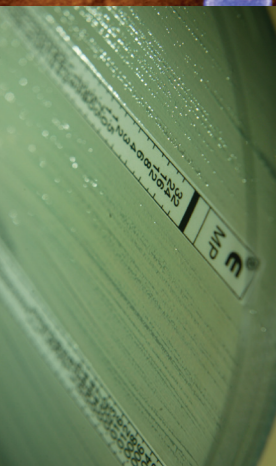
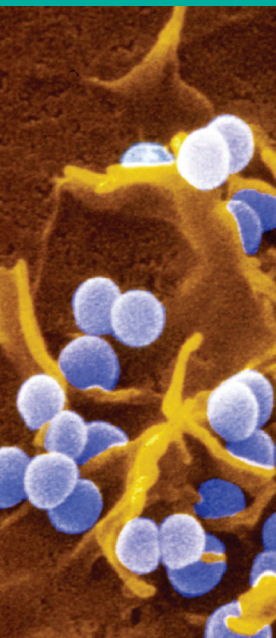
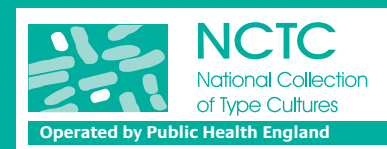


Antimicrobial Resistance Reference Strains Available from NCTC



Public Health England's National Collection of Type Cultures (NCTC), working in partnership with Public Health England's Antimicrobial Resistance and Healthcare Associated Infections Reference Unit (AMRHAI) 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 reported clinical isolates of vancomycin-resistant enterococci (VRE)¹⁶.
- Several fully-sequenced (and published) multi-drug resistance plasmids.
- Methicillin-resistant *Staphylococcus aureus* (MRSA) including the first reported (and whole genome sequenced) strain identified with the novel *mecA* homologue, *mecC*.

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 Reference Unit (AMRHAI) is the national reference laboratory responsible for the detection and investigation of antibiotic resistance, especially in healthcare associated 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
<i>Escherichia coli</i>	NCTC 11560	TEM-1 β -lactamase producer. British Society of Antimicrobial Chemotherapy recommended control strain	1
<i>Escherichia coli</i>	NCTC 11954	(ATCC 35218) β -lactamase producing control strain	2
<i>Staphylococcus aureus</i>	NCTC 11561	β -lactamase producing control strain	

2. Extended-Spectrum β -Lactamases (ESBL):

2.1 TEM β -lactamases

Organism	NCTC® Strain Reference	Characteristics	Ref
<i>Escherichia coli</i>	NCTC 13351	TEM-3 ESBL – Transconjugant of strain isolated in Clermont Ferrand in 1985	1
<i>Escherichia coli</i>	NCTC 13352	TEM-10 ESBL – Transconjugant of original TEM-10 producer isolated in Chicago in 1988	2

2.2 SHV β -lactamases

Organism	NCTC® Strain Reference	Characteristics	Ref
<i>Klebsiella pneumoniae</i>	NCTC 13368	SHV-18 (ATCC 700603)	

2.3 CTX-M β -lactamases

Organism	NCTC® Strain Reference	Characteristics	Ref
<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	3
<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); Control strain for group 1 <i>bla</i> _{CTX-M} multiplex PCR assays	3
<i>Escherichia coli</i>	NCTC 13400	Strain Tr499 = DH5- α 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)	4
<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)	4
<i>Escherichia coli</i>	NCTC 13450	Strain Tr516 = DH5- α 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)	4
<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)	4
<i>Escherichia coli</i>	NCTC 13461	Strain harbours unsequenced <i>bla</i> _{CTX-M} group 1 gene	5
<i>Escherichia coli</i>	NCTC 13462	Strain harbours unsequenced <i>bla</i> _{CTX-M} group 2 gene	5
<i>Escherichia coli</i>	NCTC 13463	Strain harbours unsequenced <i>bla</i> _{CTX-M} group 8 gene	5
<i>Enterobacter cloacae</i>	NCTC 13464	Strain harbours unsequenced <i>bla</i> _{CTX-M} group 9 gene	5
<i>Klebsiella pneumoniae</i>	NCTC 13465	Strain harbours unsequenced <i>bla</i> _{CTX-M} group 25 gene	5

2.4 VEB β -lactamases

Organism	NCTC® Strain Reference	Characteristics	Ref
<i>Pseudomonas aeruginosa</i>	NCTC 13437	VIM-10; VEB-1	6

3. AmpC β -Lactamases

Organism	NCTC* Strain Reference	Characteristics	Ref
<i>Enterobacter cloacae</i>	NCTC 13405	Strain 684. Inducible AmpC β -lactamase, wild type. Control for AmpC detection tests.	
<i>Enterobacter cloacae</i>	NCTC 13406	Strain 684-con. AmpC β -lactamase de-repressed (i.e. constitutive hyper-producing) mutant of NCTC 13405. Control for AmpC detection tests	

4. Carbapenemases

4.1 Class A Carbapenemase

Organism	NCTC* Strain Reference	Characteristics	Ref
<i>Klebsiella pneumoniae</i>	NCTC 13438	Member of the international ST258 clone producing KPC-3 carbapenemase	7

4.2 Class B Carbapenemases (Metallo- β -lactamases):

Organism	NCTC* Strain Reference	Characteristics	Ref
<i>Pseudomonas aeruginosa</i>	NCTC 13437	VIM-10; VEB-1	6
<i>Klebsiella pneumoniae</i>	NCTC 13439	VIM-1; QnrS1 (outbreak strain)	8
<i>Klebsiella pneumoniae</i>	NCTC 13440	VIM-1; QnrS1 (sporadic)	8
<i>Klebsiella pneumoniae</i>	NCTC 13443	New Delhi Metallo- β -lactamase (NDM-1)	
<i>Escherichia coli</i>	NCTC 13476	IMP-type (unsequenced)	

4.3 Class D Carbapenemases (OXA carbapenemases):

Organism	NCTC* Strain Reference	Characteristics	Ref
<i>Acinetobacter baumannii</i>	NCTC 13301	OXA-23 (also with OXA-51-like)	9
<i>Acinetobacter baumannii</i>	NCTC 13302	OXA-25 (OXA-24/40-like) (also with OXA-51-like)	9
<i>Acinetobacter baumannii</i>	NCTC 13303	OXA-26 (also with OXA-51-like)	9
<i>Acinetobacter baumannii</i>	NCTC 13304	OXA-27 (also with OXA-51-like)	9
<i>Acinetobacter baumannii</i>	NCTC 13305	(A 15) OXA-58 (also with OXA-51-like)	10
<i>Acinetobacter baumannii</i>	NCTC 13421	OXA-23 Clone 2 (also with OXA-51-like)	11,12
<i>Acinetobacter baumannii</i>	NCTC 13424	OXA-23 Clone 1 (also with OXA-51-like)	11,12
<i>Acinetobacter baumannii</i>	NCTC 13420	SE Clone OXA-51-like	11,12
<i>Acinetobacter baumannii</i>	NCTC 13422	NW Clone OXA-51-like	13, 14,15
<i>Acinetobacter baumannii</i>	NCTC 13423	T strain (UK3) OXA-51-like	13,14,15
<i>Klebsiella pneumoniae</i>	NCTC 13442	Sequence type 353 with OXA-48	17

5. Plasmid-mediated Fluoroquinolone Resistance (Qnr)

Organism	NCTC* Strain Reference	Characteristics	Ref
<i>Klebsiella pneumoniae</i>	NCTC 13439	VIM-1; QnrS1 (outbreak strain)	8
<i>Klebsiella pneumoniae</i>	NCTC 13440	VIM-1; QnrS1 (sporadic)	8

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6. Vancomycin Resistant Enterococci

Organism	NCTC® Strain Reference	Characteristics	Ref
<i>Enterococcus faecalis</i>	NCTC 12201	VanA-type glycopeptide resistance Erythromycin resistant	16
<i>Enterococcus faecium</i>	NCTC 12202	VanA-type glycopeptide resistance	16
<i>Enterococcus faecalis</i>	NCTC 12203	VanA-type glycopeptide resistance	16
<i>Enterococcus faecium</i>	NCTC 12204	VanA-type glycopeptide resistance	16

7. Multidrug Resistance Plasmids

Organism	NCTC® Strain Reference	Characteristics	Ref
<i>Escherichia coli</i>	NCTC 13400	Strain Tr499 = DH5- α 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 for details)	4
<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 for details)	4
<i>Escherichia coli</i>	NCTC 13450	Strain Tr516 = DH5- α derivative. Source of pEK516 (fully sequenced plasmid GenBank Accession No EU935738). Harbours 7 antibiotic resistance genes (see catalogue entry for details)	4
<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 Inc11, and harbours two antibiotic resistance genes (see catalogue entry for details)	4

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

Organism	NCTC® Strain Reference	Characteristics	Ref
<i>Staphylococcus aureus</i>	NCTC 13142	EMRSA-15 type strain. Epidemic MRSA from UK. Control for <i>mecA</i> detection tests.	18
<i>Staphylococcus aureus</i>	NCTC 13552	Strain LGA251. Control for <i>mecA</i> homologue (soon to be assigned <i>mecC</i>) detection tests. Isolated from bulk milk.	19

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