



Public Health
England

Protecting and improving the nation's health

National Infection Service Reference Laboratories Colindale

Bacteriology Reference Department User Manual

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About Public Health England

Public Health England exists to protect and improve the nation's health and wellbeing, and reduce health inequalities. We do this through world-leading science, knowledge and intelligence, advocacy, partnerships and the delivery of specialist public health services. We are an executive agency of the Department of Health, and are a distinct delivery organisation with operational autonomy to advise and support government, local authorities and the NHS in a professionally independent manner.

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Bacteriology reference department (BRD)

From April 2018, **Bacteriology Reference Department (BRD)** is part of the newly restructured National Infection Service (NIS) which is PHE's scientifically-led service to protect and reduce the burden of infectious disease to the UK public. BRD is a national and international reference department for a wide range of bacterial infections. We receive clinical samples and bacterial isolates from public health departments, National Health Service and commercial laboratories across the UK and internationally for specialist testing, bacterial characterisation and susceptibility testing.

The BRD department is made up of three units:

The Antimicrobial Resistance and Healthcare Associated Infections (AMRHAI) Reference Unit is the national reference laboratory for investigation of antibiotic resistance in, and characterization of, healthcare associated and sexually-transmitted bacterial pathogens. AMRHAI seeks to define outbreaks and identify transmission pathways using established and developmental phenotypic and genotypic methods to type isolates, to identify biomarkers associated with virulence, "fitness", host specificity and transmissibility. We determine susceptibility for most species of bacteria, with the notable exception of category 3 organisms, detect new and emerging resistances by interpretive analysis of MIC profiles and molecular investigation, and provide therapeutic guidance. AMRHAI undertakes laboratory-based surveillance, advises on outbreak investigations and investigation of unusual antibiotic resistance, and on any public health risk. The Unit also provides an identification service for difficult to identify bacteria and from culture-negative clinical samples; information and advice on infection control issues; investigation of healthcare- and community-associated infections, aspects of laboratory safety and other related matters.

AMRHAI is the designated *World Health Organization Collaborating Centre (WHO CC) for Reference and Research on Antimicrobial Resistance and Healthcare Associated Infections*.

The Gastrointestinal Bacteria Reference Unit (GBRU) works at local, regional, national and international levels to reduce the burden of gastrointestinal infection. Activities include national microbiological reference services for a range of gastrointestinal pathogens as well as the provision of specialist testing for the microbiological examination of clinical, food, water and environmental samples. The laboratory also undertakes research into the genetic diversity of pathogens and the development of improved detection and characterisation techniques for food, water and environmentally borne diseases. GBRU is able to offer expert advice, education and training on public health aspects of food microbiology and safety.

The Respiratory and Vaccine Preventable Bacteria Reference Unit (RVPBRU), provides national and international reference services for a number of bacteria causing respiratory, systemic and vaccine-preventable bacterial infections including *Streptococcus pneumoniae*, *Bordetella pertussis*, *Corynebacterium diphtheriae*, *Haemophilus influenzae*, *Legionella pneumophila*, *Leptospira* spp., *Mycoplasma* spp., *Ureaplasma* spp. and *Streptococcus* spp. RVPBRU receives bacterial isolates and

clinical samples which are analyzed by a wide range of methodologies in accordance with customer needs. RVPBRU also performs surveillance and advises on incident/outbreak investigation. The RVPBRU is a designated World Health Organization Collaborating Centre (WHO CC) for diphtheria and streptococcal infections and also a WHO CC for *Haemophilus influenzae* and *Streptococcus pneumoniae*.

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7	Jan 2017	Tests provided by STBRU now offered by AMRHAI and CSU (VRD). Remove STBRU and appendix 4 – see updated table. Update <i>Listeria</i> spp.	4, 13-28
8	Apr 2017	Add charging for requests for sharing data or isolates. Update test type and/or TAT for <i>Listeria</i> spp., <i>Staphylococcus</i> spp. (add whole genome sequencing (WGS) from Apr 2017) in table and Appendixes 1 and 2. Update transport medium for mycoplasmas. Update contact list.	10 23, 26, 45, 56 63 10
9	Apr 2018	Update BRD, key personnel list, Caldicott Guardian, Quality (UKAS ISO 15189 accredited) Update table: - replace resistance with susceptibility, update <i>Mycoplasma genitalium</i> , <i>Neisseria gonorrhoeae</i> and Resistance Mechanism Detection service, <i>Clostridium botulism</i> and <i>perfringens</i> , <i>Listeria</i> ssp, <i>Salmonella</i> ssp. services, pertussis oral fluid age to 2->17 yrs, remove non-culture of <i>L. monocytogenes</i> , add WGS for <i>S. pneumoniae</i> service, Update Appendix 1 (AMRHAI): Add additional charges, remove pseudomonas serodiagnosis service, update Antimicrobial Susceptibility Testing and Resistance Mechanisms Section. Appendix 2 (GBRU): Replace all Sections with GBRU, Update contact for <i>Clostridium botulism</i> service, <i>Listeria</i> and <i>Helicobacter</i> service. Update Appendix 3 (RVPBRU): Update <i>C. diphtheriae</i> service, <i>Haemophilus</i> service, add <i>Leptospira</i> culture MLST, add pertussis oral fluid.	7, 8, 13 -27, 31, 42, 50

Key personnel and contact details

Name	Designation	Telephone
Prof Neil Woodford	Deputy Director, NIS Labs	020 8327 6511
Dr Nandini Shetty	Interim Lead, BRD Consultant Medical Microbiologist	020 8327 6033
Steve Harbour	Interim Operations Lead, NIS Laboratories - Reference	020 8327 6432
Prof Neil Woodford	Unit Head AMRHA1	020 8327 6511
Dr Kathie Grant	Unit Head GBRU	020 8327 7117
Dr Vicki Chalker	Unit Head RVPBRU	020 8327 6636

Medical microbiologists at Colindale

Name	Clinical Secility
Dr Nandini Shetty	Antimicrobial resistance and Healthcare associated infections; clinical infection prevention and control
Dr Meera Chand	Respiratory and vaccine preventable infections
Dr Gauri Godbole	Gastrointestinal infections including clinical management of botulism and helicobacter
Dr Helen Fifer	Sexually transmitted bacterial infections
Dr Colin Brown	HIV infections, emerging and travel related infections, leptospirosis, invasive streptococcal infections and vaccine preventable infections

Consultant Medical Microbiologists are available to offer advice on diagnosis, clinical interpretation of results and management of infections. Their clinical service alignment and area of expertise is described in the table above. Additionally, we also have a system in place where a Medical Microbiologist is available every weekday during working hours for advice on medical management of cases, incidents or outbreaks. An on-call Public Health / Microbiology or Virology service is available through the Colindale switchboard. This service is not to access laboratory results.

If you need to contact a Medical Microbiologist please send an email to:

ColindaleMedMicro@phe.gov.uk or telephone 0208 327 6736

If you have any issues accessing the microbiologist please email jacinta.santos@phe.gov.uk.

BRD general office

Department addresses DX address: PHE Colindale Bacteriology DX 6530002	Postal address: Public Health England Bacteriology Reference Department 61 Colindale Avenue London NW9 5EQ View map
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Telephone: 020 8327 7887 (staffed 9am – 5.30pm Mon-Fri)

PHE MS Colindale switchboard: 020 8200 4400

How to obtain services

Hours of service

The Department is open from 9am to 5.30pm, Monday to Friday. Telephone enquiries should be directed to 020 8327 7887 from 9am to 5.30pm, Monday to Friday. No routine services are available outside these hours. The Department is closed on public holidays.

Services to the public

BRD does not offer diagnostic services to members of the public except via a registered medical practitioner. Results can only be issued to the requesting physician or medical unit and will not be given to patients directly under any circumstances. We reserve the right to check the authenticity of callers in order to protect the confidentiality of patients' personal data.

There are no clinical facilities at PHE Colindale and we are unable to see patients or give telephone medical advice directly to members of the public.

Specimen submission guidelines

Specimens

All clinical specimens must be labelled with at least two of the following unique identifiers:-

- surname/forename or other unique patient identifier and/or
- date of birth
- sender's sample number

All environmental specimens must be labelled with the following:
unique specimen identifier/sender's sample number.

Request forms

Request Forms must match and include the above information on the sample

Plus:

- name and contact information of requester (vital for urgent requests)
- tests required
- specimen type and site
- hazard group, if known, or suspected to be Category 3
- sender's sample number
- consultant or GP name (if applicable)

Request forms should also have:

- date of sample
- sex

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- relevant clinical information
- date of onset
- vaccination history (if relevant to test requested)
- NHS number

Please complete the forms in black or blue pens (not red or any other colour).

Requests for work on isolates that presumptively fall into ACDP Hazard Group 3 must be clearly marked to show the findings of the sending laboratory.

If an additional test is required, please discuss with the relevant Unit by telephone. The turnaround time in this instance will vary.

Please use the current versions of request forms where possible and complete all relevant sections. BRD specific request forms are available from the PHE website:

<https://www.gov.uk/government/collections/bacteriology-reference-department-brd>

<https://www.gov.uk/specialist-and-reference-microbiology-laboratory-tests-and-services>. Pre-addressed and bar-coded request forms to ensure reports are dispatched to the appropriate address are available on request.

Each request accepted by the laboratory for examination is considered to be an agreement under PHE terms and conditions of business.

Requests for sharing data or isolates.

Commonly requested strains are submitted to NCTC by PHE. BRD requires a material transfer agreement for shared data or strains. A charge will be levied unless prior collaborative PHE project is agreed and in place. Please contact relevant Unit.

Urgent specimens

If a reference service is required urgently, please contact a senior staff from the relevant Unit to discuss prior to dispatch. Always mark 'URGENT' clearly on the request form.

Medico-legal specimens

Medico-legal specimens, cultures from medico-legal cases, and forensic testing is performed under CPA/ISO 15189 and ISO 17025 (food, water and environmental samples). Should a sample be identified as a medico-legal case prior to referring specimens or cultures please ensure that a chain of evidence form accompanies all specimens. Due to the legal sensitivities of these types of specimen they will only be processed if the laboratory has been contacted in advance and if all paper work is correctly completed. Please contact relevant unit for further details.

Specimen transportation

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Arrangements must be made by referring laboratories to ensure that time and temperature requirements (detailed under “Key factors affecting tests”, below) for sample transportation are maintained. Failure to achieve this may compromise sample integrity and the validity of test results. Samples which do not meet the sample acceptance criteria may not be processed.

Samples which are dispatched at ambient temperature (10°C – 25°C) must have a transit time of no more than 72 hours. If the date of receipt is greater than 72 hours from the date of dispatch, the referring laboratory will be informed and the specimens may not be processed.

Specimens sent by post or by courier must be in a sealed container, surrounded by sufficient absorbent packing material to take up any leakage in the event of damage during transit, sealed in a plastic bag and placed in an approved outer container which meets current postal or other transport regulations.

Any organisation sending out cultures or diagnostic specimens has a legal duty to ensure that such items are sent in a safe manner. Infectious substances which break or leak in transit can result in a major incident, putting those handling them and those in receipt of them at risk of infection. It is therefore vital that the correct transport requirements are followed.

Contact the departmental safety manager (020 8327 6447) or the specimen reception manager (020 8327 6063) for further information.

Guidance on the transport of infectious substances (including links to current European agreements and information from the HSE) may be found on the following web page:

<http://www.dft.gov.uk/vca/dangerousgoods/useful-links.asp>

Specimen quarantine policy

Failure to comply with our specimen submission guidelines and the following quarantine policy may lead to specimen rejection and/or delay of reports.

Please complete request forms as fully as possible. Failure to do so may result in delays or rejection. Some specimens may be rejected if lack of information could expose staff to “high risk” pathogens at the incorrect containment level. Requests for work on isolates that presumptively fall into ACDP Hazard Group 3 must be clearly marked to show the findings of the sending laboratory. See specimen submission guidelines for more details. If a specimen is submitted to BRD for an investigation that we do not offer we will contact the customer and return, forward or archive the sample and issue a report to the sender explaining the reasons for the sample’s rejection. The sample will be returned if requested (within mainland UK) or discarded after 14 days.

The time taken to perform bacterial identification, typing and susceptibility testing is dependent on the receipt of pure cultures. Cultures that require purification or that cannot be

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retrieved because they are no longer viable may increase turnaround time significantly or require repeat submission.

Serology tests

For serological tests, separated serum is preferred. Samples which are highly haemolysed or hyperlipaemic should not be sent as lysed blood or heavily blood stained samples can interfere with serological testing.

Heat-inactivated samples may give rise to erroneous results in a number of assays and should not be sent – please contact the relevant Unit prior to sending the specimen if no other sample is available.

Services available

The Department undertakes tests as listed on the following pages. Key factors affecting individual tests are noted against the relevant test, including minimum sample volumes where relevant. Further information is available from the PHE website:

<https://www.gov.uk/health-protection/services>

<https://www.gov.uk/health-protection/infectious-diseases>

Turnaround times

Turnaround times (TAT) are from day of receipt to issue of reports in calendar days. The times shown are the typical TATs achieved by the laboratory, but may be longer or shorter depending on the availability of staff and the complexity of the investigation. BRD staff are committed to the fastest possible issue of reports, consistent with accuracy, on the specimens they examine. TATs may vary during seasonal outbreaks; testing may be conducted more frequently during epidemic seasons. We seek to process at least 80% of specimens received within the published TATs.

Requests for additional tests: time limits and specimen retention

If additional laboratory testing is required on a sample previously submitted to BRD, please contact the relevant Unit in the first instance. Original specimens are normally retained for at least one month (up to several years in the case of certain specimens) but further testing may not be possible due to sample volume constraints, specimen viability or other factors. The Unit will be able to advise on the feasibility of using the original specimen for analysis.

Services	Test type	Sample required	Target TAT*	Request form	Contact unit
<i>Abiotrophia</i> spp.	<i>Streptococcus</i> spp. and related genera identification	Pure culture on blood or chocolate agar slope	15 days	R1	RVPBRU
	Antimicrobial susceptibility only	Pure culture, Agar slope	15 days	H1, H2	AMRHAI
<i>Achromobacter</i> spp.	Species identification, molecular typing and antimicrobial susceptibility	Pure culture, Agar slope	15 days	H1, H2	AMRHAI
<i>Acinetobacter</i> spp.	Species identification, molecular typing and antimicrobial susceptibility	Pure culture, Agar slope	15 days	H1, H2	AMRHAI
Actinomycetes (aerobic only)	Antimicrobial susceptibility	Pure culture, Agar slope	15 days	H1, H2	AMRHAI
	Identification and confirmation	Pure culture, Agar slope	7 days	M1, H2	AMRHAI
<i>Aerococcus</i> spp.	<i>Streptococcus</i> spp. and related genera identification	Pure culture on blood or chocolate agar slope	15 days	R1	RVPBRU
	Antimicrobial susceptibility only	Pure culture, Agar slope	15 days	H1, H2	AMRHAI
<i>Alloiococcus</i> spp.	<i>Streptococcus</i> spp. and related genera identification	Pure culture on blood or chocolate agar slope	15 days	R1	RVPBRU
	Antimicrobial susceptibility only	Pure culture, Agar slope	15 days	H1, H2	AMRHAI
Antibiotic testing	The antibiotic susceptibility service includes interpretive analysis of MIC profiles and therapeutic guidance. The main examples are mentioned in this 'Services' table but most species other than the TB complex and anaerobes are covered. This is not routinely undertaken on rectal/faecal isolates submitted for	Pure culture, Agar slope	15 days (non-fastidious spp)	All requests for confirmation of possible carbapenemase-producing organisms should be submitted via the Electronic Reporting System	AMRHAI

Services	Test type	Sample required	Target TAT*	Request form	Contact unit
	carbapenemase detection. We use standard antibiotic panels based on EUCAST & CLSI recommendations.			(ERS);H1, H2	
Bacillus (other than B. anthracis)	Identification of <i>Bacillus</i> spp Molecular typing of <i>B.cereus</i> for outbreak investigations	Pure culture on agar slopes	10 days	L4	GBRU
	Detection of <i>B. cereus</i> emetic toxin gene by PCR	Pure culture on agar slope	9 days	L4	GBRU
	Antimicrobial susceptibility	Pure culture, Agar slope	15 days	H1, H2	AMRHAI
Bacterial Identification Service (BIDS): Isolate identification (unknown, atypical, fastidious, emerging bacteria)	Species identification	Pure culture on agar slope	7 days	H2, M1	AMRHAI
	Isolate identification (unknown, atypical, fastidious, emerging bacteria)	Pure culture on agar slope	7 days	H2, M1	AMRHAI
	Antimicrobial susceptibility	Pure culture, Agar slope	15 days	H1, H2	AMRHAI
BIDS: Clinical sample identification (culture-negative, unknown)	Bacterial detection and species identification for culture-negative clinical samples from normally sterile sites	Normally sterile site clinical sample: liquid – 200-500 µl, Tissue – 1 cm ³ , FFPE - up to 3 sections, each with a thickness of up to 10 µm and a surface area of up to 250 mm ²	7 days	M1	AMRHAI
Bartonella spp.	Serology is no longer offered by RVPBRU. AMRHAI can test by 16S rRNA gene PCR & sequencing	Normally sterile site clinical sample except blood/serum (see above BIDS for details)	7 days	M1	AMRHAI
Bordetella spp.	Confirmation of identification, serotyping of <i>B. pertussis</i>	Pure culture on a suitable agar slope or growth from a plate on	Varies	R3	RVPBRU

Services	Test type	Sample required	Target TAT*	Request form	Contact unit
		swab in charcoal transport medium			
	Antimicrobial susceptibility	Pure culture on agar slope	15 days	H1, H2	AMRHAI
<i>Bordetella pertussis</i>	Serology - anti-PT IgG antibodies NOT suitable for immune status	Not less than 400 µL serum in a sterile container (≥2 week history of cough)	10 days	R3	RVPBRU
	Oral fluid – anti-PT IgG antibodies NOT suitable for immune status	Oral fluid for notified cases 2->17 yrs - contact HPT for kit. (≥2 week history of cough)		Form distributed with kit	
	Further characterisation of <i>B. pertussis</i> qPCR positive clinical specimens for surveillance and epidemiological purposes	Aliquot of original specimen and/or DNA extract	Varies	R3	
<i>Burkholderia</i> spp.	Species identification, molecular typing and antimicrobial susceptibility	Pure culture, Agar slope	15 days	H1, H2	AMRHAI
<i>Burkholderia pseudomallei</i>	Identification and antimicrobial susceptibility	Pure culture, Agar slope	2-7 days	Contact Lab. H1, H2	AMRHAI
<i>Campylobacter</i> spp.	Identification and MLST by WGS. (Antimicrobial sensitivity by E-test only upon specific request).	Pure culture sent on Amies charcoal swab (preferably) or other suitable medium (eg blood or chocolate agar slope)	14 days	L4	GBRU
<i>Chlamydia</i> (respiratory)	Only available after discussion and prior agreement with RVPBRU senior staff. <i>C. pneumoniae</i> / <i>C. psittaci</i> / <i>C. abortus</i> - PCR assay	Minimum 200 µL of respiratory sample	Urgent phoned	Contact Lab before sending	RVPBRU

Services	Test type	Sample required	Target TAT*	Request form	Contact unit
<i>Chlamydia trachomatis</i>	<i>C. trachomatis</i> :/LGV multiplex - PCR				CSU (refer to VRD User Manual)
<i>Clostridium botulinum</i>	Detection and identification of <i>C. botulinum</i> from clinical, food or environmental samples by PCR and culture and molecular typing.	Faeces (10g) or rectal washout into anaerobic broth (universal). Faeces (10g) or rectal washout. Serum (≥ 5 mL) to be collected close to the onset of symptoms	9 days	Contact Lab. L4 (culture) L5 (specimen)	GBRU
	Detection of botulinum neurotoxins in clinical specimens or food associated with suspected cases.	(preferably < 3 days) and before antitoxin is given. Note: lysed or EDTA treated blood specimens are not suitable. Food/Drink samples (10g or 10 mL).	≥ 5 days (refer to Appendix 2)	Contact Lab. L5 (specimen) L7 (Food/Env)	GBRU
<i>Clostridium perfringens</i>	Identification of enterotoxigenic <i>C. perfringens</i> by PCR	Pure culture in anaerobic broth or transport swab	5 days	L4	GBRU
	Molecular typing for outbreak investigations	Pure culture in anaerobic broth or transport swab	10 days	L4	GBRU
	Detection of <i>C. perfringens</i> enterotoxin in faeces by ELISA	≥ 1 g or 1mL of faeces from cases of diarrhoea collected as close to the onset of symptoms as possible (preferably <3 days)	5 days	L5	GBRU
	<i>C. perfringens</i> Toxin (lethal toxins) typing by PCR	Pure cultures of <i>C. perfringens</i> in anaerobic broth or transport swab	5 days	L4	GBRU
<i>Clostridium tetani</i>	Detection and identification of <i>C. tetani</i> by PCR and culture	Pure cultures of <i>C. tetani</i> in anaerobic broth.	5 days	L5	GBRU

Services	Test type	Sample required	Target TAT*	Request form	Contact unit
		Tissue inoculated into anaerobic broth			
	Detection of <i>C. tetani</i> neurotoxin in serum (Note: serum will be first tested for tetanus antibody levels by RVPBRU)	Serum (≥ 2mL) to be collected close to the onset of symptoms (< 3 days) and before antitoxin is given. Note: lysed or EDTA treated blood specimens are not suitable	5 days (following antibody results)	L5	GBRU
	Tetanus immunity: serum antibodies	Not less than 200 µL serum in a sterile container	21 days unless urgent	As required R3	RVPBRU
<i>Corynebacterium</i> spp.	Molecular typing and antimicrobial susceptibility	Pure culture, Agar slope	15 days	Contact Lab. H1, H2	AMRHAI
<i>Corynebacterium diphtheriae/ ulcerans/ pseudotuberculosis</i>	<i>C. diphtheriae/ ulcerans/ pseudotuberculosis</i> (ie potentially toxigenic corynebacteria) Identification and Toxin testing by real-time PCR and Elek	Pure culture on blood or Loeffler slope (notify RVPBRU prior to submission)	Within 24 hours (PCR) (6 day service)	Contact Lab. R3	RVPBRU
	Diphtheria immunity: serum antibodies	Not less than 200 µL serum in a sterile container.	21 days unless urgent	R3	RVPBRU
<i>Corynebacterium jeikeium</i>	<i>C. jeikeium</i> Antimicrobial susceptibility	Pure culture	15 days	H1, H2	AMRHAI
<i>Cronobacter</i> spp.	<i>C. sakazakii</i> confirmation of identification, Molecular typing and antimicrobial susceptibility	Pure culture, Agar slope	15 days	Contact Lab. H1, H2	AMRHAI
Cystic Fibrosis (CF) Pathogens	Identification and molecular typing	Pure culture, Agar slope	18 days	H2	AMRHAI
	Antimicrobial susceptibility	Pure culture, Agar slope	15 days	H1, H2	AMRHAI
<i>Dolosicoccus</i> spp.	<i>Streptococcus</i> spp. and related genera identification	Pure culture on blood or chocolate agar slope	15 days	R1	RVPBRU

Services	Test type	Sample required	Target TAT*	Request form	Contact unit
	Antimicrobial susceptibility only	Pure culture, Agar slope	15 days	H1, H2	AMRHAI
<i>Dolosigranulum</i> spp.	<i>Streptococcus</i> spp. and related genera identification	Pure culture on blood or chocolate agar slope	15 days	R1	RVPBRU
	Antimicrobial susceptibility only	Pure culture, Agar slope	15 days	H1, H2	AMRHAI
<i>Elizabethkingia</i> spp.	Identification, molecular typing and antimicrobial susceptibility	Pure culture, Agar slope	15 days	H1, H2	AMRHAI
<i>Enterobacter</i> spp.	Molecular typing and antimicrobial susceptibility	Pure culture, Agar slope	15 days	Contact Lab. H1, H2	AMRHAI
<i>Enterococcus</i> spp.	Species identification, molecular typing and antimicrobial susceptibility	Pure culture, Agar slope	15 days	Contact Lab. H1, H2	AMRHAI
<i>Escherichia</i> spp.	<i>E. coli</i> (ACDP HG 2 only): Molecular typing and antimicrobial susceptibility	Pure culture, Agar slope	15 days	Contact Lab. H1, H2	AMRHAI
	Identification, serotyping, phage typing & molecular typing by whole genome sequencing. [We can offer fast identification of HG3 <i>E. coli</i> (VTEC) by PCR upon request]	Pure culture on Dorset's egg or nutrient agar slope	14 days	L4	GBRU
	<i>E.coli</i> O157: Serodiagnostic service	Sera aliquots of not less than 500µL	8 days	L5	GBRU
	PCR and Culture detection from faeces for non-O157 VTEC	Faecal sample in standard sealed container ≥1 gram	8 days	L5	GBRU
<i>Facklamia</i> spp.	<i>Streptococcus</i> spp. and related genera identification	Pure culture on blood or chocolate agar slope	15 days	R1	RVPBRU

Services	Test type	Sample required	Target TAT*	Request form	Contact unit
	Antimicrobial susceptibility only	Pure culture, Agar slope	15 days	H1, H2	AMRHAI
Gemella spp.	<i>Streptococcus</i> spp. and related genera identification	Pure culture on blood or chocolate agar slope	15 days	R1	RVPBRU
	Antimicrobial susceptibility only	Pure culture, Agar slope	15 days	H1, H2	AMRHAI
Globicatella spp.	<i>Streptococcus</i> spp. and related genera identification	Pure culture on blood or chocolate agar slope	15 days	R1	RVPBRU
	Antimicrobial susceptibility only	Pure culture, Agar slope	15 days	H1, H2	AMRHAI
Gram-negative bacteria non fermenter & fastidious organisms	Molecular typing and antimicrobial susceptibility	Pure culture, Agar slope	15 days	Contact Lab. H1, H2	AMRHAI
Gram-positive bacteria (except <i>C.diphtheriae</i>)	Molecular typing and antimicrobial susceptibility	Pure culture, Agar slope	15 days	Contact Lab. H1, H2	AMRHAI
Granulicatella spp.	<i>Streptococcus</i> spp. and related genera identification	Pure culture on blood or chocolate agar slope	15 days	R1	RVPBRU
	Antimicrobial susceptibility only	Pure culture, Agar slope	15 days	H1, H2	AMRHAI
Haemophilus spp.	<i>Haemophilus</i> spp. (excluding <i>H. ducreyi</i>) : Identification	Pure culture on chocolate agar slope with cap securely screwed down	12 days	R3	RVPBRU
	<i>H. influenzae</i> : Serotyping and capsular genotyping of <i>H. influenzae</i>	Pure culture on chocolate agar slope with cap securely screwed down	12 days	R3	RVPBRU
Haemophilus spp. & Aggregatibacter spp.	Anti microbial susceptibility	Pure culture, Agar slope	15 days	H1, H2	AMRHAI
Helcococcus spp.	<i>Streptococcus</i> spp. and related genera identification	Pure culture on blood or chocolate agar slope	15 days	R1	RVPBRU
	Antimicrobial susceptibility only	Pure culture, Agar slope	15 days	H1, H2	AMRHAI

Services	Test type	Sample required	Target TAT*	Request form	Contact unit
<i>Helicobacter</i> spp.	<i>H. pylori</i> isolation, identification and antibiotic susceptibility testing by E-test	Heavy suspension of isolate or Gastric biopsies in sterile saline or Dents transport medium	15 days	L4 (culture) L5 (specimen) Please avoid sending samples on Fridays	GBRU
<i>Ignavigranum</i> spp.	<i>Streptococcus</i> spp. and related genera identification	Pure culture on blood or chocolate agar slope	15 days	R1	RVPBRU
	Antimicrobial susceptibility only	Pure culture, Agar slope	15 days	H1, H2	AMRHAI
<i>Klebsiella</i> spp.	Molecular typing and antimicrobial susceptibility	Pure culture, Agar slope	15 days	H1, H2	AMRHAI
<i>Lactococcus</i> spp.	<i>Streptococcus</i> spp. and related genera identification	Pure culture on blood or chocolate agar slope	15 days	R1	RVPBRU
	Antimicrobial susceptibility only	Pure culture, Agar slope	15 days	H1, H2	AMRHAI
<i>Legionella</i> spp.	<i>L. pneumophila</i> : two commercial EIA assays (confirmation of sending lab testing results only)	Not less than 2mL urine sample (soon after onset), mid-stream, early morning with/without preservatives in a sterile container	8 days unless urgent	R1	RVPBRU
	<i>L. pneumophila</i> PCR (from urinary antigen positive patients only)	Lower respiratory tract samples (sputa, BAL, tracheal aspirate) and other clinical samples in a sterile container	Urgent samples should be notified by phone	R1	RVPBRU
	<i>L. longbeachae</i> enhanced surveillance culture & attempted molecular detection (from urinary antigen negative, intensive care,	Lower respiratory tract samples (sputa, BAL, tracheal aspirate) and other clinical samples in a sterile container	Urgent samples should be notified by phone	R1, clearly marked <i>Legionella longbeachae</i> surveillance	RVPBRU

Services	Test type	Sample required	Target TAT*	Request form	Contact unit
	contact with horticultural growth medium in 14 days prior to onset, pneumococci urine/routine respiratory pathogen screen negative patients only)				
	<i>Legionella spp.</i> severe respiratory failure centre enhanced surveillance culture & attempted molecular detection (from urine antigen negative patients admitted to a severe respiratory failure centre, pneumococci urine/routine respiratory pathogen screen negative patients only)	Lower respiratory tract samples (sputa, BAL, tracheal aspirate) and other clinical samples in a sterile container	Urgent samples should be notified by phone	<i>R1, clearly marked Legionella species severe respiratory failure centre (SRFC) surveillance</i>	RVPBRU
	Identification and epidemiological typing of clinical or outbreak associated isolates	Pure culture on either BCYE medium or a dense suspension in sterile distilled water or Page's saline	Varies	R1	RVPBRU
<i>Leptospira spp.</i>	BRD offers reference service for specimens that have been referred via Rare and Imported Pathogens Laboratory (RIPL), Public Health England (PHE), Porton Telephone 01980 612 348 only. All specimens should be sent to RIPL in the first instance. They will then be tested and referred to RVPBRU, BRD, PHE Colindale.				RIPL, PHE, Email ripl@phe.gov.uk
	Microscopic Agglutination Test (MAT)	1.5mL preferred (500 µL minimum volume), serum, plasma or clotted blood 7-10 day post onset and repeat	12 working days	DX 6930400 <i>P3</i>	MAT discussion RVPBRU

Services	Test type	Sample required	Target TAT*	Request form	Contact unit
		sample 7 days following first			
	<i>Leptospira</i> MLST Specimens from PCR positive patients will be referred to RVPBRU, BRD, PHE Colindale.	Cerebral spinal fluid (CSF): Minimum volume 0.5mL (0.25mL for MLST and 0.25mL for PCR). Serum taken within 7-10 days after the onset of symptoms. Urine taken as soon as possible. Post mortem tissue specimens not fixed, taken ASAP after death.	Varies	P3	MLST discussion RVPBRU
<i>Leuconostoc</i> spp.	<i>Streptococcus</i> spp. and related genera identification	Pure culture on blood or chocolate agar slope	15 days	R1	RVPBRU
	Antimicrobial susceptibility	Pure culture, Agar slope	15 days	H1, H2	AMRHAI
<i>Listeria</i> spp.	<i>Listeria</i> species identification, serotyping and typing of <i>L. monocytogenes</i> by whole genome sequencing and SNP analysis	Pure culture on agar slopes	14 days	L4	GBRU
	<i>Listeria</i> species identification and serotyping of <i>L. monocytogenes</i> by PCR (for urgent requiring rapid confirmation)	Pure culture on agar slopes	3 days	L4	GBRU
	Antimicrobial susceptibility	Pure culture, Agar slope	15 days	H1, H2	AMRHAI
<i>Mycoplasma</i> spp.	<i>M. hominis</i> and <i>Ureaplasma</i> spp.: PCR and/or culture	Minimum 200 µL of respiratory , CSF, joint and wound, aspirates in a sterile container	PCR - 5 days Culture – up to 42 days	R1	RVPBRU
	<i>Mycoplasma/Ureaplasma</i> :	Pure culture on mycoplasma	Varies	R1	RVPBRU

Services	Test type	Sample required	Target TAT*	Request form	Contact unit
	Biochemical characterisation and molecular methods	medium or chocolate/blood agar slope			
	<i>M. pneumoniae</i> : PCR & determination of mutations associated with macrolide resistance by PCR and sequencing.	Minimum 200 µL of respiratory sample (LRT or throat swab) in a sterile container CSF with paired respiratory samples or DNA extract of positive specimen	5 days	R1	RVPBRU
	<i>M. genitalium</i> : Molecular detection of the adhesion <i>MgPa</i> and <i>gap</i> genes and determination of mutations associated with macrolide resistance by PCR and sequencing on all clinical specimens found positive for <i>M. genitalium</i> .	Residual specimen from unprocessed NAAT swab transport medium (min volume =400 µL), fresh dry swab, urine (min 3 mL) or extracted DNA	8 days	B7	AMRHAI
	Other species: Culture, PCR and sequencing when relevant		PCR - 5 days Culture - up to 6 weeks	R1	RVPBRU
<i>Neisseria gonorrhoeae</i> (putative, for other <i>Neisseria spp.</i> please refer to the Bacterial Identification Section).	<i>N. gonorrhoeae</i> : Confirmation of identification by -MALDI-ToF. Further phenotypic and molecular methods will be used if necessary.	Pure culture on chocolate slope or VCM swab	7 days	B2	AMRHAI
	Susceptibility testing: ceftriaxone and azithromycin	Pure culture on chocolate slope or VCM swab	7 days	B2	AMRHAI

Services	Test type	Sample required	Target TAT*	Request form	Contact unit
	Programme: Gonococcal Resistance to Antimicrobials Surveillance Programme (GRASP)	Sample submission is based on a pre-agreement between the laboratory and AMRSTI	GRASP Annual Report	Contact Lab before sending samples.	AMRHAI
<i>Nocardia</i> spp.	Antimicrobial susceptibility	Pure culture, Agar slope	15 days	H1, H2	AMRHAI
	Identification and confirmation	Pure culture, Agar slope	7 days	M1, H2	AMRHAI
<i>Pandora</i> spp.	Molecular typing and antimicrobial susceptibility	Pure culture, Agar slope	15 days	H1, H2	AMRHAI
<i>Pediococcus</i> spp.	<i>Streptococcus</i> spp. and related genera identification	Pure culture on blood or chocolate agar slope	15 days	R1	RVPBRU
	Antimicrobial susceptibility only	Pure culture, Agar slope	15 days	H1, H2	AMRHAI
<i>Pseudomonas</i> spp.	<i>P. aeruginosa</i> antibodies (Serodiagnosis)	Serum (Not less than 200µL in 2 mL micro-tubes)	7-10 days	H3	AMRHAI
	Molecular typing and antimicrobial susceptibility	Pure culture, Agar slope	15 days	H1, H2	AMRHAI
Resistance Mechanism Detection	Molecular detection of acquired carbapenemase genes and transferable colistin resistance genes in Gram-negatives and characterisation of linezolid resistance mechanism(s) in staphylococci and enterococci (G2576T mutation, plus <i>cfr</i> and <i>optrA</i> genes)	Pure culture, Agar slope	14 days	All requests for confirmation of possible carbapenemase-producing organisms should be submitted via the Electronic Reporting System (ERS) ; H1, H2	AMRHAI
<i>Salmonella</i> spp.	Identification to genus and species	Pure culture on Dorset's egg or	17 days	L4	GBRU

Services	Test type	Sample required	Target TAT*	Request form	Contact unit
	level and determination of sequence types and serovar by whole genome sequencing	nutrient agar slope			
	Antimicrobial susceptibility testing	Pure culture on Dorset's egg or nutrient agar slope	By arrangement	L4	GBRU
	Analysis of whole genome sequence data to support outbreak investigations	Pure culture on Dorset's egg or nutrient agar slope	By arrangement	L4	GBRU
<i>Serratia</i> spp.	Molecular typing and antimicrobial susceptibility	Pure culture, Agar slope	15 days	Contact Lab. H1, H2	AMRHAI
<i>Shigella</i> spp.	Identification to genus and species level & molecular typing by whole genome sequencing	Pure culture on Dorset's egg or nutrient agar slope	14 days	L4	GBRU
<i>Staphylococcus</i> spp.	<i>S. aureus</i> (multiple isolates from suspected clusters): Molecular typing by <i>spa</i> typing ± PFGE	Pure culture, Agar slope	1-15 days	H1, H2	AMRHAI
	<i>S. aureus</i> (single isolates): Molecular typing derived from whole genome sequence data	Pure culture, Agar slope	14 days	H1, H2	AMRHAI
	<i>Staphylococcus</i> coagulase negative: Species identification & Molecular typing	Pure culture, Agar slope	1-15 days	H1, H2	AMRHAI
	Antimicrobial susceptibility	Pure culture, Agar slope	15 days	H1, H2	AMRHAI
	Resistance gene detection derived from whole genome sequence data	Pure culture, Agar slope	14 days	H1, H2	AMRHAI
	<i>S. aureus</i> : PVL testing only	Pure culture, Agar slope	1-6 days	H1, H2	AMRHAI

Services	Test type	Sample required	Target TAT*	Request form	Contact unit
	Virulence gene detection (14 genes, incl PVL) derived from whole genome sequence data	Pure culture, Agar slope	14 days	H1, H2	AMRHAI
	Enterotoxin gene detection (suspected staphylococcal food poisoning) derived from whole genome sequence data	Pure culture, Agar slope	14 days	H1, H2	AMRHAI
	Detection of staphylococcal enterotoxins A, B, C, D or E in foods or beverages.	Foods/beverages ≥10mL or 10g: keep refrigerated or frozen in a cooled or insulated container. Contact Shona Neal to send samples shona.neal@phe.gov.uk	9 days	Contact Lab.	GBRU
<i>Stenotrophomonas</i>	<i>S. maltophilia</i> : Molecular typing and antimicrobial susceptibility	Pure culture, Agar slope	15 days	Contact Lab. H1, H2	AMRHAI
<i>Streptococcus</i> spp. and related genera	<i>S. pyogenes</i> (Lancefield Group A) typing of invasive isolates (and outbreak/cluster associated non-invasive isolates)	Pure culture on blood or chocolate agar slope. Charcoal swabs are not suitable.	6 days	R1	RVPBRU
	<i>S. agalactiae</i> (Lancefield Group B) typing of invasive isolates (and outbreak/cluster associated non-invasive isolates)	Pure culture on blood or chocolate agar slope	6 days	R1	RVPBRU
	Streptococci Lancefield Group C & G typing of invasive isolates (and outbreak/cluster associated non-invasive isolates)	Pure culture on blood or chocolate agar slope	Contact laboratory	R1	RVPBRU

Services	Test type	Sample required	Target TAT*	Request form	Contact unit
	<i>S. pneumoniae</i> : species confirmation and capsule typing of invasive isolates (primary by whole genome sequencing since 01.10.2017 see PHE Briefing Note, serial no. 2017/039 05.09.2017).	Pure culture on blood or chocolate agar slope	14 days	R3	RVPBRU
	<i>Streptococcus</i> spp. and related genera identification	Pure culture on blood or chocolate agar slope	15 days	R1	RVPBRU
	Antimicrobial susceptibility	Pure culture, Agar slope	15 days	H1, H2	AMRHAI
<i>Tetragenococcus</i> spp.	<i>Streptococcus</i> spp. and related genera identification	Pure culture on blood or chocolate agar slope	15 days	R1	RVPBRU
	Antimicrobial susceptibility only	Pure culture, Agar slope	15 days	H1, H2	AMRHAI
<i>Treponema</i>	<i>T. pallidum</i> (syphilis): Serological				CSU (refer to VRD User Manual)
	<i>T. pallidum</i> / <i>Haemophilus ducreyi</i> /Herpes Simplex Virus (HSV) complex (Genital ulcer disease) – PCR				
<i>Ureaplasma</i>	Refer to <i>Mycoplasma</i>			R1	RVPBRU
<i>Vagococcus</i> spp.	<i>Streptococcus</i> spp. and related genera identification	Pure culture on blood or chocolate agar slope	15 days	R1	RVPBRU
	Antimicrobial susceptibility only	Pure culture, Agar slope	15 days	H1, H2	AMRHAI
<i>Vibrio</i> (including <i>Plesiomonas shigelloides</i>)	Identification to genus and species level and serotyping	Pure culture on Dorset's egg or nutrient agar slope	14 days	L4	GBRU
<i>Yersinia</i>	Identification and antibiotic susceptibility	Pure culture on Dorset's egg or nutrient agar slope	14 days	L4	GBRU

*TAT – Turnaround Times

Reports

Reports will be delivered electronically as PDF documents via E-lab, or will be printed and delivered by post if the referring laboratory is not registered to E-lab. Please contact Tony McNiff (tony.mcniff@phe.gov.uk) for details on how to register for E-lab and further information on the system. Reports will only be sent to the requestor named on the request form.

Policy on faxing and emailing reports containing patients' data

The following guidelines have been prepared having taken into account the Code of Practice on reporting patients' results by fax prepared by the Department of Health and Caldicott recommendations.

1. It is PHE Microbiology Services policy that reports containing patients' data should not be sent by fax or email.
2. Emails cannot be relied on to guarantee security of patients' data because they can be intercepted by a third party en route (except for those sent within the PHE network, within the NHS.Net network, or by encrypted e-mails)
3. In exceptional circumstances it may be necessary to send a result by fax but not by email. In this case, the following conditions must be adhered to after telephone discussion with the Laboratory. Refer also to "PHE Microbiology Services - recognition of Caldicott recommendations" on page 20 of this manual.
4. The report must be sent to a "safe-haven" fax machine. This means that, if the location is in general use, consideration must be given to ensuring that unauthorised personnel are unable to read reports, accidentally or otherwise. Also, the room housing the fax machine must be kept in a secure location which is locked if it is likely to be unattended at the time the fax is sent.
5. Assurance must be sought from the intended recipient of the faxed report, preferably in writing, that the receiving fax machine is a "safe-haven".
6. Measures must be taken to minimise the risk of mis-dialling, either by double-checking numbers or having frequently used numbers available on the fax machine's memory dial facility.
7. Confirmation must always be sought from the intended recipient that the fax is expected and has been received.
8. Confidential letter submission guidelines - Do not include confidential letters within the bio-bottle or the specimen box which are not related to the specimen. These should be sent separately and be clearly marked/addressed naming the recipient and indicating for the attention of the addressee only.

Quality assurance in BRD: participation in EQA and IQA schemes

BRD is UKAS ISO 15189 (No 8197) and ISO 17025 (No 1595) accredited. An overview of quality standards at microbiology services, Colindale, can be found on the following web page:

<https://www.gov.uk/government/publications/quality-standards-microbiology-services-colindale>

BRD participates in numerous EQA schemes with other reference laboratories, including the World Health Organisation (WHO) and Quality Control for Molecular Diagnostics (QCMD) and the UK National External Quality Assurance Scheme (NEQAS), Details of participation in specific schemes are available on request.

The quality of our systems is also checked by our IQA schemes, which require selection of referred samples for “blinded” testing at a later date. After processing, the results for IQA samples are unblinded and are assessed against the results originally reported to the sending laboratory. Any discrepancies are fully investigated as to their root cause before any remedial action is implemented. Results of our EQA and IQA performance are discussed at Management Review meetings, and also at Unit meetings, as appropriate.

Complaints procedure: If there is a problem, or you are not satisfied with the service you have received

In the first instance contact the appropriate Unit or Section Heads. Contact details are given in the summary list of contacts at the end of the user manual.

We endeavour to be responsive to the changing needs of all users of our services. We welcome comments on how we can improve the provision of these services. Please contact the Department if you have any queries.

PHE microbiology services - recognition of Caldicott recommendations

The recommendations of the Caldicott Report (1997) and the subsequent Information Governance Review (2013) have been adopted by Public Health England and by the National Health Service as a whole. These recommendations relate to the security of patient identifying data (PID) and the uses to which they are put. PHE Microbiology Services observes Caldicott guidance in handling PID and has appointed its own Caldicott Guardian. The Caldicott Guardian advises the Director of Reference Services and others on confidentiality issues and is responsible for monitoring the physical security of PID in all parts of the Colindale site. This also applies to the transfer of results of investigations to and from the site whether by mail services, telephone or fax. The value of 'safe haven' arrangements or other means of the sender and receiver of information identifying themselves to each other before data are transferred is emphasised (page 19 policy on faxing and e-mailing reports containing patients' data).

Customers are asked to draw to the Microbiology Services Caldicott Guardian's attention any instances where PID security has been threatened or has broken down. Uses that PID are put to outside clinical diagnostic services generally allow patient identifiers to have been removed beforehand, and when PID is used for research purposes the proposals are considered first by the PHE Research Ethics Committee. All enquiries about the security and use of PID at PHE

Microbiology Services Colindale should be addressed to PHE Caldicott Guardian, Prof. Anthony Kessel (Anthony.Kessel@phe.gov.uk).

Compliance with the Human Tissue Act: Submitting tissue samples from deceased people

PHE Microbiology Services Colindale is licensed by the Human Tissue Authority (licence number 12459) to store tissues from deceased people for scheduled purposes. Post mortem samples are submitted by coroners or pathologists for examination to help them determine the cause of death.

Obtaining consent to remove, store and use human tissues for a scheduled purpose is one of the underlying principles of the Human Tissue Act. Microbiology Services Colindale receives post-mortem samples from coroners' post-mortems or from NHS establishments across the UK and therefore we are performing the examination under the authority of the coroner. Unless consent has been obtained or the coroner has requested that samples are retained for further testing, samples are disposed of within three months of the initial test being performed.

When tissue samples from deceased people are received at Microbiology Services Colindale they are retained securely and confidentiality is maintained in compliance with Caldicott principles as are all samples received at this centre. It is normal practice for tissue samples from the deceased to be disposed of in the same way that all other clinical samples we receive are disposed of. However, we will adhere to any specific requirements regarding disposal or returning of tissue samples if requested by the sending coroner or pathologist.

Appendix 1: Antimicrobial resistance and healthcare associated infections reference unit (AMRHAI)

For key staff and contact refer to summary list of contacts

To ensure a pure strain is tested please ONLY send a slope of a single colony pick. Should a second strain/colony variant be identified – this could lead to a extra charge being incurred (contact lab for prices) or the sample being rejected. If you have identified two strains which require testing/comparison, please send them as two separate slopes of pure cultures.

Bacterial identification Service (BIDS)

BIDS provides specialist identification services for ‘unknowns’, which includes atypical, difficult to isolate or emerging bacterial pathogens detected in culture-negative clinical samples and from isolates with no national reference facility.

Isolate identification

All unknown isolates will first be tested by MALDI-ToF MS, and 16S rRNA gene analysis will only be used where reliable species identification is not achieved. Identification will be supplemented by phenotypic testing for certain groups of organisms where species identification is doubtful or requires additional confirmation.

Atypical and rarely isolated strains

Atypical isolates are those with phenotypic or physiological profiles deviating from the majority of strains belonging to the same genus or species (eg catalase test, oxidase or sugar fermentation), which affects the ability of the laboratory where it has been isolated to confirm its identity accurately. Laboratories may also seek confirmatory testing since the tests currently in use target groups of known clinically-significant organisms and may not confirm the identity of emerging and unusual infectious agents.

Bacterial taxa that are difficult to identify to the species level

Such species may have high genetic similarity or paucity in differentiating phenotypic tests resulting in mis-identification or may not be well represented in MALDI-ToF MS databases, giving low scores or unreliable identification.

Aerobic actinomycetes

Organisms collectively grouped under the broad category “aerobic, Gram-positive with/without branching filaments” form a very diverse collection of ill-defined genera and species. Often referred to as the ‘non-TB mycobacteria complex’, ‘*Nocardia* complex’, ‘*Rhodococcus* –

Gordonia – *Tsukamurella* – *Corynebacterium* complex' etc., they may be seen in pathology specimens and are often highlighted by the presence of sulphur granules. The taxonomy of this group has been actively investigated over the last 20 years, but is still in a state of flux. Their poor phenotypic identification is often compounded by their slow and poor growth.

NOTE: Some *Mycobacterium* spp. isolates are similar in morphology to aerobic actinomycetes. **If the isolate or a clinical sample is suspected to be a member of the *Mycobacterium* TB-complex based on preliminary tests or clinical assessment, then it is not accepted for this service and should be referred to the PHE National Mycobacterium Reference Service in the first instance.**

Clinical sample identification

BIDS provides a specialist service for the detection and identification of bacteria in clinical samples from normally sterile samples. Detection is performed by real-time 16S rDNA PCR, which has been shown to improve sensitivity of detection. Suitable sample types include tissue (eg native heart valves), paraffin-embedded tissue, non-pipettable liquids (eg pus) and liquids/fluids (eg blood, CSF, blood culture fluid). Unsuitable samples from non-sterile sites include samples in direct contact with skin or mucous membranes and samples in direct connection to the intestine.

Samples should be transported in a sterile container (eg 1.5 ml microfuge tube or universal) without adding any additional water, buffers or preservatives. Sterile water or PBS might be contaminated with DNA from pseudomonas and pseudomonas-like bacteria.

The amount of material must be adequate to maintain maximum sensitivity. In general we recommend 200 µl or more for liquid material (no more than 1 ml to be supplied) and a “finger nail” size piece of tissue for solid samples ~ 1.0 cm³, selecting the most necrotic diseased area for testing. Please do not submit excess sample material, as this may result in your sample being quarantined or rejected. For blood culture medium, remove 200 µl to 1,000 µl of fluid using aseptic technique to a sterile container. Please ensure the source is clearly indicated by ticking blood culture fluid box on the request form, this helps us to differentiate from other blood samples and for correct protocols to be used for processing. For paraffin embedded tissues supply 3-5 mm of solid block or 4-10 shavings in a sterile container.

Outcome of identification tests:

- identifying atypical isolates or novel pathogens that fail identification by conventional methods
- confirmation of identification of aerobic actinomycetes
- identification of bacteria detected in samples from normally sterile sites

Key factors affecting our ability to provide a timely service:

- inappropriate or incorrectly completed request forms
- safety question on request form not completed
- slow growing fastidious organisms
- mixed cultures submitted
- insufficient clinical sample submitted

- non-sterile site clinical samples submitted

Opportunistic Pathogens Section

Identification

Identification by MALDI-ToF MS and sequence-based methods is offered for pathogens from patients with cystic fibrosis and for other opportunistic pathogens, especially *Acinetobacter*, *Burkholderia*, *Enterobacter*, *Enterococcus*, *Klebsiella*, *Achromobacter*, *Pandoraea* and *Ralstonia* species, *Stenotrophomonas maltophilia*, *Burkholderia pseudomallei*, *Cronobacter sakazakii* and medically-important pseudomonads.

Please note: AMRHAI will not perform identification tests on *Pseudomonas* spp. sent from CF patients (non *Pseudomonas aeruginosa* strains).

Key factors affecting our ability to offer a timely and clinically relevant service:

- lack of clinical information

Requests for work on presumptive isolates must include:

- full details of sending laboratory's results
- an indication of whether the isolate(s) may be a hazard group 3 organism. Failure to provide necessary information on the form can result in an isolate being handled at Containment Level 2 instead of Containment Level 3, putting staff at risk. In these instances, a report of the incident will be sent to the Health and Safety Executive.
- full clinical details, including clinical and contact history. Failure to provide necessary clinical information on the form can also result in an isolate being tested using inappropriate methods which will delay reporting
- an indication of any recent travel abroad
- reason for typing investigations, ie; details of the comparisons sought and of the underlying question posed; we regret that 'ongoing surveillance' and 'vancomycin-resistant enterococcus' will not be considered sufficient

Molecular (DNA-based) typing

For inter-strain comparative purposes, a molecular typing service is available for all the organisms listed above, plus any other species involved in suspected outbreaks of healthcare-associated infection. Techniques used are pulsed-field gel electrophoresis (PFGE) or variable number tandem repeat (VNTR) analysis (*Pseudomonas aeruginosa*, *Klebsiella pneumoniae*, *Mycobacterium abscessus* complex). In addition, the following are offered:

Further characterisation of isolates of *Acinetobacter baumannii* by detection of *bla*_{OXA} carbapenemase genes, identification of isolates belonging to the major clonal lineages (international clones I, II and III), and determination of repeat numbers at VNTR loci with small repeat units, that can provide discrimination within a PFGE type.

PCR identification of capsular types K1, K2, K5, K54, and K57 of *Klebsiella* spp., associated with invasive disease, and of three putative virulence factors (*rmpA*, *rmpA2* and *wcaG*).

Key factors affecting the performance of the test:

- poor growers
- isolates where DNA degrades
- autolytic enzymes
- single isolate with no indication of what it should be compared with

Staphylococcus Reference Section

spa typing

This technique is available for the characterisation of multiple isolates of *Staphylococcus aureus* (MSSA or MRSA) referred from suspected clusters and involves DNA sequence-based typing of part of the protein A gene. The *spa* repeat succession can often be used to infer which MLST clonal complex an isolate belongs to.

Key factors affecting the performance of the test:

- some isolates may appear to be non-typable by *spa*; these are rare and can generally be typed using alternative PCR primers
- some isolates may include repeat units of a “non-standard” length (eg 25-28bp as opposed to 24bp). These can still be typed but will include a “??” notation in the repeat succession

Fine strain typing

PFGE-based analyses are available for inter-strain comparative purposes, including suspected outbreaks of MSSA, MRSA or coagulase negative staphylococci (CoNS) in healthcare or community settings.

Key factors affecting the performance of the test:

- poor growers
- isolates where DNA degrades
- autolytic enzymes

Whole-Genome Sequencing*

Whole-Genome Sequencing (WGS) is available for the characterisation of single isolates of MSSA or MRSA referred for testing. These include isolates referred for a number of reasons such as (i) surveillance (eg MRSA or MSSA from cases of bacteraemia), (ii) typing, antimicrobial resistance gene and/or toxin gene profiling, (iii) the identification of suspected Hospital- vs Community- vs Livestock-Associated MRSA etc.

Depending on the nature of the reason for referral, the following will be derived and reported from WGS data:

1. The lineage (Multi-Locus Sequence Type; MLST)
2. The detection of resistance genes including:
 - *mecA* and its homologue *mecC*, which confer resistance to oxacillin (Charged)
 - *mupA* and *mupB* which confer high-level resistance to mupirocin (Charged)
3. Toxin gene profiling (Charged), providing insights into strain virulence, including:

- 9 enterotoxin genes (*sea-see* and *seg-sei*)
- 3 exfoliative toxin genes *eta*, *etb* and *etd*
- Toxic shock syndrome toxin gene 1 (*tst*)
- Panton-Valentine Leukocidin toxin gene (*luk-PV*)

Non-enteric disease

When requesting *S. aureus* toxin gene testing, select either PVL-testing only or extended toxin gene profiling (the latter includes all 14 toxin genes listed above). Where the toxin request is NOT diagnostic we will not charge but the free text field MUST contain the relevant previous referral details of related isolates eg MS - Colindale Laboratory reference numbers or details of the outbreak/diagnostic isolates sent previously. If this is not included, we will assume it relates to primary diagnosis and will charge accordingly (please refer to latest price lists).

Enteric disease

Isolates of *S. aureus* from foods and/or cases of suspected food poisoning are screened for nine enterotoxin genes (A-E and G-J). Where detection of staphylococcal enterotoxins in samples of food or beverages is required, please contact the Gastrointestinal Bacteria Reference unit (GBRU).

* The analysis of WGS data to support outbreak investigations is not currently available; we anticipate this service will be launched in 2018.

PVL testing

Screening of isolates for the presence of the Panton-Valentine Leukocidin toxin genes (*luk-PV*) by real-time PCR is available as a “stand alone” test (Charged).

Identification of coagulase-negative staphylococci (CoNS)

Isolates are identified by MALDI-ToF MS (Charged). Where reliable species identification is not achieved, isolates are analysed by 16S rRNA gene analysis.

Key factors affecting the performance of these tests:

- slow growers
- organisms with specific growth requirements

***Staphylococcus aureus* ‘phages**

A ‘phage typing service for *S. aureus* is no longer available. The International Set of *S. aureus* ‘phages, together with their propagating strains, are available from NCTC.

Antimicrobial Resistance in Sexually Transmitted Infections (AMRSTI) Section

The main activities of the AMRSTI section are: (i) antibiotic susceptibility testing of *N. gonorrhoeae* for national and international surveillance of resistance; (ii) detection and confirmation of alert resistances and investigation of the underlying mechanisms; (iii) characterization of circulating strain types, including to inform and aid outbreak investigations

and suspected treatment failures; and (iv) evaluation of new phenotypic and genotypic methods for investigating AMR in gonorrhoea and other STIs.

Referral of putative *N. gonorrhoeae* cultures

AMRSTI will accept viable cultures on a chocolate slope or on a VCM swab.

Reference service is available for isolates that require:

- confirmation of identification because local results were anomalous - all isolates will first be tested by MALDI-ToF MS. Identification will be supplemented by phenotypic testing and where necessary an *N. gonorrhoeae* specific PCR when reliable species identification is not achieved by MALDI-ToF MS.
- antimicrobial susceptibility testing of confirmed isolates of *N. gonorrhoeae* with suspected resistance to ceftriaxone and/or azithromycin (first line antimicrobial therapy).
N.B. We do **not** seek to confirm *N. gonorrhoeae* with *intermediate* resistance to azithromycin (MICs 0.5 mg/L).
- antimicrobial susceptibility testing of confirmed isolates of *N. gonorrhoeae* that have been related to clinical treatment failure
- confirmation of identification for medico-legal purposes (please contact lab **before** sending isolates) – refer to **Specimen Submission Guidelines**

Mycoplasma

Molecular detection of *M. genitalium* *MgPa* adhesion and *gap* genes, and determination of mutations associated with macrolide resistance by PCR and sequencing. This AMR detection will be undertaken automatically on all clinical specimens found positive for *M. genitalium*; there is no opt-out.

Specimens accepted by AMRSTI:

- AMRSTI will accept specimens and DNA extracts for *M. genitalium* detection from symptomatic patients, known contact cases or for test of cure.

Specimens accepted include

- extracted DNA
- rectal and genital swabs
- urine

Please note, charges will be levied for this service.

AMRSTI also performs surveillance of antimicrobial resistance and investigates molecular epidemiology of bacterial STIs through various programmes and projects.

The Gonococcal Resistance to Antimicrobials Surveillance Programme (GRASP)

GRASP is a sentinel surveillance scheme monitoring antimicrobial resistance in *N. gonorrhoeae* across England and Wales, annually. Participating laboratories refer all gonococcal isolates identified over a three-month period (July – September) to AMRSTI for susceptibility testing. Isolates can be referred frozen on Microbank beads (storage in the referring laboratory must be at -80°C). Frozen batches will be collected by courier by arrangement.)

Antimicrobial Susceptibility Testing Section and Resistance Mechanisms Section

Confirmation of unusual resistances

AMRHAI investigates isolates found by diagnostic laboratories to have unusual resistances, aiming to identify (i) treatment options (ii) emerging resistance of public health importance (iii) underlying resistance mechanisms (iv) clonal spread of resistant strains. We have the capacity to determine the activity of most antibiotics available in the UK against most species (excluding obligate anaerobes, category 3, *Mycobacteria* spp. and enteric pathogens). Please state your requirements clearly on the request form.

While AMRHAI is willing to examine a wide range of resistance phenotypes for customers, we view the following combinations of organism and antibiotic resistance as exceptional and we advise referral of the following isolates:

***Acinetobacter* spp.**

Resistance to colistin (See also '*Carbapenem-resistant bacteria*')

Carbapenem-resistant bacteria*

All Enterobacteriaceae suspected to produce a carbapenemase. #.

Do NOT send isolates of *Enterobacter* that have borderline resistance to ertapenem, but remain fully susceptible to other carbapenems.

Do NOT send isolates of *Serratia*, *Morganella* or *Proteus* spp. that are borderline resistant to imipenem, but susceptible to other carbapenems.

All *Pseudomonas* spp. suspected to produce a carbapenemase, ie isolates resistant to carbapenems, ceftazidime, ceftolozane/tazobactam and piperacillin-tazobactam THAT ALSO HAVE strong imipenem-EDTA synergy (irrespective of susceptibility or resistance to aztreonam).

Do NOT send isolates of *Pseudomonas* spp. resistant only to carbapenems with good susceptibility to other β -lactams, in particular ceftolozane/tazobactam.

Do NOT send isolates of *Pseudomonas* spp. that are resistant to ertapenem, but susceptible to other carbapenems. Ertapenem resistance is inherent in the genus.

All *Acinetobacter* spp. suspected to produce a metallo-carbapenemase, ie with strong imipenem-EDTA synergy.

Do NOT send isolates of *Acinetobacter* that are resistant to ertapenem, but susceptible to other carbapenems. Ertapenem resistance is inherent in the genus.

Despite all of the above, microbiology laboratories are encouraged to have a high index of suspicion, at least for Enterobacteriaceae, and we accept that we won't find a carbapenemase in all referred carbapenem-resistant isolates. There is no penalty charge when we don't (unless isolates turn out to be fully susceptible or of a wild type).

Do NOT send isolates of *Stenotrophomonas maltophilia*, *Aeromonas* spp. , *Myroides* spp., *Elizabethkingia* spp. and 'chryseobacteria' for investigation of carbapenem resistance (though note final criterion below), because metallo-carbapenemase production is an intrinsic characteristic of these bacteria.

In addition, we seek representatives of any carbapenem-resistant strains (irrespective of suspected mechanism, and including species with intrinsic carbapenem resistance) that are associated with clusters or outbreaks of infection or colonization.

<p>Coagulase-negative staphylococci Any :resistance to vancomycin but not to teicoplanin alone, ceftaroline, ceftobiprole, linezolid/tedizolid, quinupristin/dalfopristin, daptomycin, televancin, dalbavancin, or tigecycline</p>
<p><i>Corynebacterium jeikeium</i>. Any resistance to vancomycin, teicoplanin, linezolid, quinupristin/dalfopristin</p>
<p>Enterobacteriaceae, including members of the genera Enterobacter, Escherichia, Citrobacter, Serratia, Proteus, Providencia, Klebsiella, Morganella, Salmonella #, Shigella # Resistance to colistin (except <i>Serratia</i> spp., <i>Proteus</i> spp., <i>Morganella</i> spp.). See also ‘Carbapenem-resistant bacteria’.</p>
<p>Enterococci Any resistance to: linezolid or tedizolid, daptomycin (<i>E. faecium</i> MICs >4 mg/L; <i>E. faecalis</i> MICs >2 mg/L), tigecycline. Also any isolates resistant to teicoplanin, but not vancomycin (do NOT send suspected VRE for confirmation of glycopeptide resistance – these can be detected by disc or automated methods and do not require reference confirmation).</p>
<p><i>H. influenzae</i> Any resistance to fluoroquinolones, third-generation cephalosporins, or carbapenems</p>
<p><i>M. catarrhalis</i> Resistance to ciprofloxacin or any third-generation cephalosporin</p>
<p><i>S. aureus</i> Any resistance to: MICs of oxacillin between 2 and 8mg/L or a discrepancy between oxacillin and ceftoxitin, vancomycin or teicoplanin with resistance to vancomycin, linezolid or tedizolid, quinupristin/dalfopristin, clindamycin-R when erythromycin-S, daptomycin, tigecycline, ceftaroline, ceftibiprole</p>
<p><i>S. pneumoniae</i> Any resistance to: meropenem, vancomycin, teicoplanin, linezolid, quinupristin/dalfopristin, tigecycline, penicillin (MICs >4 mg/L), cefotaxime (MICs >2 mg/L), moxifloxacin</p>
<p>Streptococci - Group A, B, C, G, β-haemolytic Any resistance to: penicillin, vancomycin, teicoplanin, linezolid, quinupristin/dalfopristin, quinolones, Tigecycline</p>
<p><i>Pseudomonas aeruginosa</i> Resistance to colistin or ceftolozane/tazobactam (See also ‘Carbapenem-resistant bacteria’)</p>

Salmonella and *Shigella* will be processed in the Gastrointestinal Bacteria Reference Unit.

*We are regularly asked to define criteria for referring carbapenem-resistant bacteria to us for investigation. They are subjective and under constant review.

We are happy to examine other unusual combinations of resistance(s) and organism(s) and cases where the sender has obtained conflicting results by different methods (eg where an automated system identifies an isolate as having a particular resistance but this cannot be confirmed by classical methodology).

We do **not** seek the routine submission of (i) penicillin-resistant pneumococci unless penicillin MICs are =>4 mg/L; (ii) enterococci resistant to teicoplanin and vancomycin; (iii) teicoplanin-resistant, but vancomycin-susceptible coagulase-negative staphylococci; (iv) ESBL or AmpC

producers for confirmation of resistance; (v) *Neisseria gonorrhoeae* with intermediate resistance to azithromycin (MICs 0.5 mg/L).

Determination of minimum inhibitory concentrations (MICs) for referred or survey isolates is undertaken by agar dilution and occasionally by E-test. Interpretative reading of these antibiograms allows assessment of the likely dominant underlying resistance mechanisms.

The antibiotics we report MICs on are those found in EUCAST or CLSI guidelines as appropriate to the species. A charge is applied if an MIC of an antibiotic outside of these guidelines is requested.

For the correct interpretation of susceptibilities, use of appropriate breakpoints and interpretation of mechanisms, isolates must be correctly identified to species level. You will be charged if unidentified 'coliform/gram-negative rod' isolates are submitted, unless also formally sent for reference identification. There are also charges for sending mixed cultures and the testing of sensitive isolates and wild types.

NHS laboratories will be charged for MIC determination where the confirmed antibiogram is found to be unexceptional (please see above).

Please note we will no longer determine MICs for confirmed carbapenemase-producing Enterobacteriaceae (CPE) from rectal/faecal screens (ie gut colonisation), or for those isolated from environmental samples. Should a patient go on to develop an infection, we will be happy to perform susceptibility testing on the clinically-relevant isolate. We will also continue to determine MICs for CPE from other sample types (if required), and for all isolates sent in for carbapenemase testing that are found PCR-negative.

For an up-to-date list of other charges please contact lab for the PHE Price List.

If an isolate is submitted for 'confirmation of results', please be aware that we can only comment if the results requiring confirmation are stated!

If you have a query about a report, please telephone the validator, using the contact details listed on our reports.

Key factors affecting the performance of the test:

- slow growers
- organisms with specific growth requirements
- organisms which have not been identified

Therapeutic guidance

By determining MICs of appropriate antibiotics for submitted isolates, AMRHAI aims to elucidate the most suitable options for treatment. To evaluate susceptibility, we use published clinical breakpoints or, in their absence, advise on the best evidence for any potential antibiotic treatment on a pharmacological basis and/or published evidence. Please note our advice on

MIC reports, which states: **For treatment purposes and reporting to clinicians, the MIC of any given agent may need further evaluation with respect to the dose and expected level at the infective site(s).**

Where multiply-resistant isolates are submitted for therapeutic guidance, susceptibilities already established by the sender should be recorded on the submission form, along with appropriate clinical details. Any significant resistance mechanisms relevant to treatment will be interpreted from MIC profiles and reported. Resistances may be further investigated by molecular investigations, which may lead to revisions in data and/or advice. We can undertake susceptibility testing on isolates within the species range advised (please see above) where the interpretation of in-vitro data has not been possible in the hospital laboratory or where there is difficulty in testing. In addition, we also undertake interpretation of hospital laboratory data on the telephone when there is an urgency. For urgent referrals, please see below.

Endocarditis

AMRHAI determines MICs for endocarditis isolates to provide therapeutic guidance, as some laboratories choose not to maintain MIC testing capacity. For enterococci, we automatically report MICs of streptomycin and daptomycin. Since this work does not entail investigating exceptional resistance, it is charged. To maximise the speed of our response, submission forms must be clearly marked 'ENDOCARDITIS' and the appropriate telephone number for reporting the results must be given. Users are advised to sign-up to receive reports electronically (as PDFs) via the eLab system, which allows access to results shortly after validation in AMRHAI.

Molecular investigation of resistance

Genes and mutations sought are those that confer resistance to agents of last resort, including carbapenems, colistin and linezolid. Molecular investigation of colistin and linezolid resistance are uncharged reference services to NHS laboratories, whilst some CPE confirmation is chargeable as there are now many commercial diagnostic tests available to undertake this work.

Services currently offered include detection of:

- 23S rRNA mutations and plasmid-mediated genes responsible for linezolid resistance in enterococci, staphylococci or streptococci
- genes encoding acquired carbapenemases in *Acinetobacter*, Enterobacteriaceae or *Pseudomonas* spp.
- plasmid-mediated genes responsible for colistin resistance in Enterobacteriaceae, *Acinetobacter* or *Pseudomonas* spp.

New antibiotics

AMRHAI liaises with pharmaceutical companies to test new antibiotics against representative or unusually resistant referred isolates, possibly revealing new treatment options. This is undertaken as contracted research.

New diagnostics

AMRHAI liaises with diagnostics companies to test new kits and platforms against representative or unusually resistant referred isolates. This is undertaken as contracted research.

Surveys of resistance

Point prevalence surveys of antibiotic resistance are undertaken, giving measures of the extent and nature of critical resistance problems.

Other useful Information relevant to susceptibility testing services

BSAC site (www.bsac.org.uk)

BSAC survey site (www.bsacsurv.org.uk)

Infection Prevention and Control Advice Section

Information and advice is available on infection control issues; education and training; research and audit; disinfection and sterilisation; investigation of healthcare- and community-associated infection, aspects of laboratory safety and other related matters.

Appendix 2: Gastrointestinal bacteria reference unit (GBRU)

For key staff and contact refer to summary list of contacts

GBRU FAX: 0208 327 7112

The Gastrointestinal bacteria reference unit (GBRU) provides a national reference facility for bacteria causing gastrointestinal infections. The range of services offered includes: identification to the genus and species level, phenotypic and molecular typing, whole genome sequencing, antimicrobial susceptibility testing and epidemiological typing.

GBRU offers a serodiagnostic service for *E. coli* O157 and other selected serogroups of Vero cytotoxin-producing *E. coli*. A primary diagnostic service for the detection of VTEC in faeces from clinically appropriate cases is also provided.

GBRU provides the national reference facility for the epidemiological typing and toxin testing for a range of Gram-positive bacteria associated with foodborne infection and intoxication. On identification of a presumptive potential pathogen or high level of toxin, GBRU is required to notify the appropriate Environmental Health Officer, Consultant in Communicable Disease Control and all other relevant people. Notification will be through a designated, competent senior member of staff.

***Bacillus* species**

Identification of *Bacillus* species, other than *B. anthracis*, and molecular typing of *Bacillus* isolates associated with foodborne outbreaks and other healthcare associated incidents.

What samples or specimens to send

Pure cultures of *Bacillus* on agar slopes isolated from:

- vomitus, faeces or foods suspected to be or linked with cases of food poisoning
- isolates from blood cultures, or from sites that are normally sterile, or other sites where invasive or other diseases are confirmed or suspected
- clinical and environmental sources where cross-infection is suspected
- foods or beverages with levels of *Bacillus* species including *B. cereus* of $\geq 10^4$ cfu per g or mL

As foods may be contaminated simultaneously with several species of *Bacillus*, a selection of different colonial types should be sent.

Please fill in the correct request form as completely as possible including your address and telephone number; your specimen/sample reference number; specimen/sample details; your presumptive identification of the isolate together with the testing you require. Brief clinical and

epidemiological information including patient details should be included with cultures from cases of infection.

Clostridium botulinum

Diagnostic service for botulism includes the detection of botulinum neurotoxin and PCR detection and isolation of *Clostridium botulinum* from clinical specimens, food and environmental samples associated with suspected cases of botulism.

Tests on food and referred isolates are UKAS ISO 17025 accredited (UKAS testing laboratory No. 1595).

What specimens and samples to send

There are five routes by which botulism can arise in humans: foodborne, intestinal colonisation, wound, accidental or deliberate. Details on clinical presentation, diagnosis and laboratory tests for *C. botulinum* are available on the PHE website. Antitoxin for treatment is available on request through the Colindale Duty Doctor System (24 hours telephone: 020 8200 4400) for treatment of foodborne and wound botulism. Advice on treatment and prevention of infant botulism can also be obtained through the Duty Doctor System or from the Infant Botulism Treatment and Prevention Programme, California Department of Health (<http://www.infantbotulism.org/>).

Suspected cases of all forms of botulism should be discussed with the Botulism service at Colindale (Dr Gauri Godbole 0782 6859642 and the Colindale Duty Doctor out of hours (0208 200 4400). The service will also discuss and ensure that the most appropriate samples are taken and sent under optimal conditions. Specimens should be sent immediately to the reference laboratory and GBRU notified of their arrival so that necessary preparations for testing can be made.

Specimens to samples to send:

- 10g or 10mL of suspected food and drink samples, refrigerated
- serum: At least 5mL to be collected as close to the onset of symptoms as possible. Serum specimens must be collected before antitoxin is given. Lysed or EDTA treated blood specimens are not suitable
- faeces: 10g faeces or rectal wash out for toxin detection and a pea sized portion inoculated into cooked meat broth or other anaerobic media for rapid PCR detection and isolation of *C. botulinum*
- vomitus, gastric washings or gut content: At least 10g in a sterile container
- pus or debrided tissue: To be placed as soon as possible into Cooked Meat Broth or other anaerobic culture medium.
- post mortem specimens: Heart blood, if not haemolysed. Specimens of faeces, gut contents or infected wounds may be useful
- all pure cultures suspected of being *C. botulinum* should be sent in a cooked meat medium using as category A transport

What information to send on the request form:

Please complete the correct request form in full including your address and telephone number, patient (specimen) details or food (sample) details including your reference number, major patient symptoms, recent travel history, your identification of the isolate and what testing you require. Brief clinical and epidemiological information should be included. If botulism is suspected, by any route, it is essential that the local CCDC is notified immediately. Please also notify the Microbiology Services Colindale, Duty Doctor (020 8200 4400).

Emergency situations

During working hours contact a senior member of staff for appropriate urgent attention. Outside working hours, contact the Colindale Duty Doctor (020 8200 4400). Urgent transport of samples to GBRU by taxi or courier should be considered if a clinical diagnosis of food botulism is suspected.

Turnaround times are shown in calendar days and reflect the proportion of tests requiring prolonged observation in order to establish a negative result. They are dependent upon receipt of sample and request as described above and may vary dependent upon the clinical or public health urgency. If neurotoxin is detected, a turnaround time of >5 days may be required to establish the toxin type. Rapid PCR detection of *C. botulinum* can be performed within 3 hours of the appropriate sample being received into the laboratory during the working day.

Positive results will be reported immediately.

For further information or for tests requiring urgent attention, please contact the appropriate member of staff.

Clostridium perfringens

Identification of *C. perfringens* toxin genes in cultures, typing of enterotoxigenic *C. perfringens*, and the detection of *C. perfringens* enterotoxin in faeces.

Specimens or samples to send:

Pure cultures of *C. perfringens* in anaerobic broth isolated from:

- faeces from cases of diarrhoea obtained after alcohol shock treatment or on direct isolation
- faeces, gut contents or gut biopsy in cases of suspected necrotising enterocolitis
- foods
- faeces and food may be contaminated with several types of *C. perfringens*; it is recommended at least three ↓ colony picks in separate CMB should be sent from faeces and food

Faeces for enterotoxin detection in cases of diarrhoea:

- minimum sample at least 1g or at least 1mL collected within 3 days from onset of symptoms.
- in cases of suspected necrotising enterocolitis : faeces or gut contents

What information to send

Please complete the correct request form including your address and telephone number, patient (specimen) details including your reference number, major patient symptoms, your identification

of the isolate and what testing you require. Brief clinical and epidemiological information should be included from cases of *C. perfringens* diarrhoea in particular the date of onset of symptoms. Please indicate if a relationship with other cases by common source is suspected and if the cases are suspected to be food-borne or as a result of person to person spread.

Clostridium tetani

Diagnostic of tetanus in humans by the detection of *C. tetani* neurotoxin in serum or/and by the isolation and identification of toxigenic *C. tetani* (toxin gene detection) from tissues/wound/pus.

Samples or specimens to send:

- pure cultures suspected to be *C. tetani* in an anaerobic broth
- tissue to be placed into an anaerobic broth
- serum at least 2ml collected as close to the onset of symptoms as possible; serum specimen must be collected before antitoxin is given and will be tested for the presence of tetanus antibodies before toxin detection is performed

What information to send

Please complete the correct request form including your address and telephone number, patient (specimen) details including your reference number, major patient symptoms, your identification of the isolate and what testing you require. Brief clinical and epidemiological information should be included with cultures/specimens from cases of infection.

Listeria

Identification of *Listeria* species and typing of *L. monocytogenes* isolates

What samples or specimens to send:

- pure cultures on agar slopes; isolates from all cases of human listeriosis should be sent for sub-typing; all reports are incorporated into a database for national surveillance of listeriosis
- Ideally all Isolates of *L. monocytogenes* from foods and the environment should be sent for sub-typing including in the following circumstances: if the isolates form part of a co-ordinated survey or follow up investigation;
- if there is a particular concern with a specific food product;
- if there is an association with a case of listeriosis.

GBRU offers a service for the identification of *Listeria* species and this may be helpful when laboratories are experiencing difficulties in this area. Isolates of *Listeria* species other than *L. monocytogenes* where these are present at high numbers in food should also be sent.

Foods may be contaminated simultaneously by several species of *Listeria*, or several strains of *L. monocytogenes*, multiple (ideally three to five) subcultures should therefore be examined for each sample.

What information to send

Please complete the correct request form including your address and telephone number, patient (specimen) details including your reference number, major patient symptoms, your identification of the isolate and what testing you require. Brief clinical and epidemiological information should be included with cultures from cases of human listeriosis. A more detailed surveillance questionnaire for completion will be sent for each case.

Molecular sub-typing by WGS is performed on all isolates of *L. monocytogenes* submitted to the GBRU for surveillance purposes and to assist in outbreak investigations. Subtyping results are not reported routinely but are available on request.

Staphylococcal enterotoxin detection

The Foodborne Pathogen Reference Service offers a referred service for the detection of Staphylococcal enterotoxins A, B, C, D or E in samples of food or beverages.

What samples or specimens to send:

- foods where *S. aureus* was recovered at $\geq 10^4$ cfu per g
- food or beverages where staphylococcal food poisoning was suspected
- minimum sample size ≥ 10 mL or 10g

Food samples should be kept refrigerated and sent in a cooled or insulated container to arrive refrigerated.

What information to send

Please email or phone the relevant contacts (from Table) and provide your address and telephone number, details of the sample, your reference number and any epidemiological information.

Campylobacter

What specimens or samples to send:

- pure culture sent on Amies charcoal swab (preferably) or other suitable media (ie blood or chocolate agar slope)

It is advisable to pick *Campylobacter* isolates from a non-selective medium to minimize overgrowth by contaminants. If an overnight delay before posting is anticipated then the isolate should be stored at 4°C.

What information to send:

Please complete the correct request form including your address and telephone number, patient (specimen) details including your reference number, major patient symptoms, recent travel history, your identification of the isolate and what testing you require.

Please note we do not provide a serodiagnostic service for *Campylobacter*.

Preston Microbiology Services offer *Campylobacter* serology testing (telephone 01772 522100). GBRU will impose a handling charge for dealing with such requests.

***Helicobacter pylori* (charged service)**

What specimens or samples to send:

- ***H. pylori* cultures:** should be harvested from a 48 to 72 hour culture. A heavy suspension (visibly cloudy) should be prepared in Dent's transport medium* or any rich broth (eg Brain Heart Infusion). Alternatively Amies charcoal swabs may be used. Isolates should be transported as soon as possible after harvesting
- **gastric biopsies** for culture of *H. pylori* should be sent without delay, preferably within 24 hours. Ideally biopsies should be sent in Dent's transport medium*. Additional details below.

Instructions to optimise the growth of *Helicobacter* spp from gastric biopsy material:

1. Perform multiple gastric biopsies (5-6), at least 2 from the antrum and 2 from the anterior and posterior corpus respectively.
2. Do not pool biopsies as the organism is lost if one biopsy cross contaminates others, (there is a fixed charge regardless of number of specimens from one specific patient episode)
3. Larger volumes increase the yield.
4. All microbiology specimens should be taken with sterile forceps before the histology specimens are taken to reduce risk of contamination.
5. Gastric biopsies for culture of *H. pylori* should be sent without delay, preferably within 24 hours of collection. Ideally biopsies should be sent in Dent's transport medium*. The medium needs to be maintained at 4°C. Alternatively biopsies can be sent in sterile saline. If a biopsy is not posted / couriered on the day of receipt in your laboratory then please store at 4°C (drying and exposure at air/oxygen kills *Helicobacter* spp easily).
6. Endoscopic biopsies should be performed in the middle of the week (avoid Fridays) and sent via courier or Dx within 24 hours to the Gastrointestinal Bacteria Reference Unit Colindale.
7. Have treatment free interval before biopsy, at least 2 weeks off PPI and 4 weeks off antibiotics.

What information to send:

Please complete the correct request form including your address and telephone number, patient (specimen) details including your reference number, major patient symptoms, recent travel history, your identification of the isolate and what testing you require.

* Dent's transport medium can be arranged by emailing GBRU@phe.gov.uk

We do not provide a serodiagnostic service for *Helicobacter*. GBRU will impose a handling charge for dealing with such requests.

Escherichia coli

Services offered:

- species identification of the genus *Escherichia*
- *E. coli* serotyping
- *E. coli* Vero cytotoxin-producing (VTEC) O157 phage typing
- typing of VTEC O157 by whole genome sequencing
- detection of Verocytotoxin (VT) genes by PCR

- identification by PCR of virulence genes in VTEC and in strains that may belong to other groups of *E. coli* associated with diarrhoeal illness. These enterovirulent *E. coli* include: enteropathogenic (EPEC), enteroaggregative (EAaggEC), enterotoxigenic (ETEC), enteroinvasive (EIEC).
- testing of faecal samples for VTEC and, by arrangement, other enterovirulent *E. coli*

What specimens or samples to send:

- pure culture on Dorset's Egg or Nutrient agar slopes
- faecal sample in standard sealed container ≥ 1 gram

When submitting a culture to GBRU please pick from a non-selective medium or check the purity before sending. Submitting a pure culture significantly reduces sample processing time.

What information to send

Please complete the correct request form including your address and telephone number, patient (specimen) details including your reference number, major patient symptoms, recent travel history, your identification of the isolate and what testing you require. If you have any reason to suspect that the agent being submitted is an ACDP HG3, please indicate this clearly on form.

Shigella, Vibrio and Yersinia species

Services offered:

- species identification of the genus *Shigella*
- serotyping of *Sh. dysenteriae*, *Sh. flexneri* and *Sh. boydii*
- molecular typing of *Sh. Sonnei*, *Sh. dysenteriae*, *Sh. flexneri* and *Sh. boydii*
- species identification of the genus *Yersinia* (including *Yersinia pestis*)
- species identification of the genus *Vibrio* (including *Plesiomonas shigelloides*)
- *V. cholerae* serotyping

What specimens or samples to send:

- pure culture on Dorset's Egg or Nutrient agar slopes.

When submitting a culture to GBRU please pick from a non-selective medium or check the purity before sending. Submitting a pure culture significantly reduces sample processing time.

What information to send:

Please complete the correct request form including your address and telephone number, patient (specimen) details including your reference number, major patient symptoms, recent travel history, your identification of the isolate and what testing you require.

Serodiagnosis

A serodiagnostic reference service is offered for the following bacteria:

- *Escherichia coli* O157

Please note that if a patient has undergone renal dialysis or received a blood transfusion as part of their current therapy, this can adversely affect tests for detecting antibodies to *E. coli* O157. Please provide information on request form if any of these treatments have been performed.

What information to send:

Please complete the correct request form including your address and telephone number, patient (specimen) details including your reference number, major patient symptoms, recent travel history, your identification of the isolate and what testing you require.

Salmonella

Services offered:

- whole genome sequencing of all *Salmonella* species providing sequence type and inferred serovar
- monitoring of resistance to antimicrobial drugs of therapeutic and epidemiological relevance
- analysis of whole genome sequencing data to support outbreak investigations
- investigation of the genetic basis of antibiotic resistance in enteric bacteria

What samples to send:

- **suspect *Salmonella* cultures:** should be submitted on nutrient agar or Dorsets' egg slopes in screw-capped containers
- **urgent submissions:** Advise the relevant contacts (from Table) by telephone of any urgent specimen that is being dispatched to GBRU.

What information to send

Please complete the correct request form including your address and telephone number, patient (specimen) details including your reference number, major patient symptoms, recent travel history, and your identification of the isolate including the hazard group and what testing you require.

Appendix 3: Respiratory and vaccine preventable bacteria reference unit (RVPBRU)

For key staff and contact refer to summary list of contacts

The laboratory is happy to discuss and advise upon particular clinical or epidemiological problems and outbreak investigations, ask for above Unit/Section Heads in the first instance.

Specimen submissions regarded by the sending laboratory as especially important or urgent should be notified to the Unit by telephone to ensure that the appropriate level of priority is accorded to these specimens immediately upon receipt.

Turnaround times will vary depending on the nature of the enquiry and the complexity of the investigation required. Priority will always be given to outbreak associated isolates.

Where services are offered as reference services (ie free of charge) for customers in England and Wales, they are offered on the assumption that the primary diagnostic work has been undertaken already. Evidence of such primary testing should be noted on the specimen request forms or a charge will be levied.

Respiratory and systemic bacteria section (RSBS)

Lancefield Group A Streptococci (GAS), *Streptococcus pyogenes*

Genotypic classification and epidemiological typing of Group A streptococci (GAS), *Streptococcus pyogenes*.

Typing of GAS is useful in the investigation of both community and hospital outbreaks of GAS infection.

The laboratory requests submission of ALL GAS isolated from blood culture or other normally sterile sites as part of the national surveillance of invasive disease due to GAS.

- RVPBRU offers a reference service for typing of *S. pyogenes* strains from non-invasive infections if linked to a cluster of infection under investigation. Non-invasive isolates of *S. pyogenes* (ie isolates from throat swabs) will be charged.
- Please indicate details on the referral form regarding cases under investigation for cross-infection/cluster investigation.
- If seeking MICs only from non-invasive *S. pyogenes* isolates please refer directly to AMRHAI.

What specimens or samples to send

Pure culture on blood or chocolate agar slope. Charcoal swabs not suitable.

Other information:

- typing of GAS is based upon determination of the M-protein which is inferred by sequencing the *emm* gene.
- *emm* genotyping (genotypic detection of the *emm* gene, which encodes M protein) is performed by sequencing the 5'-hypervariable region of the *emm* gene. More than 130 *emm* sequence types, ST(s) have been identified. Results are reported as an *emm* sequence type, which usually correlates with the M protein type, for example: *emm* ST12 = M type 12.

Lancefield Group B Streptococci (GBS), *Streptococcus agalactiae*

Serological classification and epidemiological typing of Lancefield group B streptococci (GBS).

GBS are a relatively common cause of puerperal and neonatal infections, which may be nosocomially acquired. Epidemiological typing may assist in the investigation of apparent clusters or outbreaks of GBS sepsis in all age groups.

The laboratory requests submission of ALL group B streptococci isolated from blood culture or other normally sterile sites of neonates as part of the national surveillance of invasive disease due to GBS in this age group (0-90 days).

GBS may also cause systemic infection in adults (non-pregnancy related). We are pleased to receive blood culture or other "sterile site" isolates for typing and surveillance purposes.

- RVPBRU does not offer a reference service for typing of *S. agalactiae* strains from non-invasive infections unless linked to a cluster of infection under investigation. Non-invasive isolates of *S. agalactiae* (ie isolates from ear/rectal swabs) will not normally be tested and an admin charge may be applied in these cases. If testing is required please contact RVPBRU and a charge will be levied.
- Where typing of non-invasive *S. agalactiae* may be helpful in the investigation of clusters/instances of suspected cross-infection in hospitals/other please indicate details on the referral form.
- If seeking MICs only from non-invasive *S. agalactiae* isolates please refer directly to AMRHAI.

Other information:

- the serological classification of GBS is based upon the identification of polysaccharide and protein antigens. There are currently ten polysaccharide antigens designated, Ia, Ib, II, III, IV, V, VI, VII, VIII, IX
- the most common polysaccharide antigens are serotypes Ia, Ib, II or III. Serotype III is most commonly associated with neonatal infections
- molecular typing of GBS is available upon written request and discussion with the unit

Lancefield Group C and Group G Streptococci

For urgent public health investigations and in other relevant clinical circumstances, after discussion and agreement with Unit/Section Heads similar typing to GAS can be undertaken. Group C and G streptococci may cause both nosocomial (eg: burns unit cross-infection episodes) or institutional outbreaks.

Group C and G streptococci may also cause systemic infections in adults and in particular the taxonomy of group C streptococci may have clinical implications, as (with the exception of the human species *S. dysgalactiae* subsp *equisimilis*) they are all primarily animal species.

Group C streptococci of animal origin eg: *S. equi* subsp *zooepideicus* may cause severe systemic infections in humans. Such infections may occur in clusters and have been associated with the consumption of raw milk.

The current typing methodology for these streptococci is based upon the detection and sequence of the *emm* gene, which encodes the major virulence factor, the M protein. The human group C and group G streptococci carry M protein antigens that are both serologically and genotypically distinct from those carried by the Lancefield group A streptococcus and are useful epidemiological markers.

emm sequencing is based upon the heterogeneity of the 5' terminus of the *emm* gene which gives rise to the different sequence types. More than 40 *emm* types of group C and group G have been identified and information on these types can be found at:

http://www.cdc.gov/ncidod/biotech/strep/M-ProteinGene_typing.htm.

- RVPBRU does not offer a reference service for typing of Group C and G streptococcal strains from non-invasive infections unless linked to a cluster of infection under investigation. Non-invasive Group C and G streptococcal isolates (ie isolates from ear/rectal swabs) will not normally be tested and an admin charge may be applied in these cases. If testing is required please contact RVPBRU and a charge will be levied.
- Where typing of non-invasive Group C and G streptococcal isolates may be helpful in the investigation of clusters/instances of suspected cross-infection in hospitals/other please indicate details on the referral form.
- If seeking MICs only from non-invasive *S. agalactiae* isolates please refer directly to AMRHAI.

Identification of streptococci and related genera

Referred (charged for) taxonomic identification service for streptococci and other related Gram-positive, catalase negative genera from systemic and other significant infections.

However, a free-of-charge reference service will continue to be available for urgent public health investigations, outbreaks and incident management, either nosocomial or community based.

This should be discussed and agreed with the section head.

Isolates that needs MIC/MBC and that are not streptococci and may be an enterococcus or a Gram-positive rod will be referred to the AMRHAI Unit. The turnaround time in this instance will vary.

Other information:

- an identification scheme incorporating updated taxonomic methodologies is used.
- updated nomenclature based upon both the UK and USA classification schemes is used to subdivide streptococci into many species eg the 'sanguinis group' is subdivided into *S.sanguinis*, *S.parasanguinis*, *S.gordonii* and *S.cristatus*; *S.australis*; the 'anginosus group' is subdivided into *S.anginosus*, *S.constellatus* subsp *constellatus*, *S.intermedius* and *S.constellatus* subsp. *pharyngis*.

Legionella

A range of reference and confirmatory tests useful in the investigation of individual cases and outbreaks of legionella infection.

The laboratory works very closely with the colleagues responsible for national surveillance and reports all clinically relevant results to them. National surveillance of Legionnaires' disease is undertaken by Dr Gavin Dabrera (tel: 020 8327 7689).

If samples are submitted as part of an outbreak or incident investigation please ensure this is made clear on the request form and the relevant Health Protection Team is identified.

Legionella pneumophila sgp 1 urinary antigen detection

The laboratory encourages and requests the submission of all urine specimens for reference and confirmatory testing which have been found to be positive, equivocal or unexpectedly negative using commercially available *L. pneumophila* urinary antigen kits.

RVPBRU will perform two commercial EIA assays to enable the confirmation of the submitting laboratory's findings.

Please supply details of the assay used and results obtained from primary testing otherwise you will be charged for these tests

Legionella genome detection and culture from clinical material

These services are provided to assist in the investigation of outbreaks of legionella infection and other incidents of potential Public Health significance. Submission of any lower respiratory tract samples from all *L. pneumophila* urinary antigen positive, PCR positive or culture positive patients is particularly encouraged as such samples are likely to yield useful epidemiological typing data. Lower respiratory tract specimens from urine antigen test positive patients taken within 2 days of admission are more likely to be positive by isolation molecular detection and yield typing data.

Respiratory specimens will be tested by qPCR and culture, however these services are not offered for primary diagnosis unless part of an HPT led investigation. In exceptional circumstances *L. pneumophila* PCR and culture may be requested as a referred (charged) service after discussion and agreement with the laboratory.

The most commonly referred specimens are sputum and bronchoalveolar lavage (BAL), though the laboratory is pleased to receive other clinical specimens for examination from patients with **other evidence of legionella infection.**

Please supply details of the assay used and results obtained from primary testing.

Enhanced surveillance of *Legionella longbeachae*

RVPBRU offers *L longbeachae* enhanced surveillance culture & attempted molecular detection (from urinary antigen negative, intensive care, contact with horticultural growth medium in 14 days prior to onset, pneumococci urine/routine respiratory pathogen screen negative patients only). Please contact RVPBRU directly prior to sending specimens.

Identification and epidemiological typing of legionella isolates

The laboratory encourages submission of ALL legionellae isolated from clinical material for confirmation and national surveillance purposes. We are also happy to receive any putative legionella isolate from clinical and other sources which is of public health significance.

Identification is made by nutritional characteristics and genotypic methods.

Specialised typing methodologies including monoclonal antibody subgrouping and DNA-sequence based typing are available as part of epidemiological investigations or, when appropriate, **after discussion** with the laboratory.

Please supply details of the assay used and results obtained from primary testing.

Leptospira

All specimens tested at PHE Colindale are received and referred via RIPL PHE Porton following positive polymerase chain reaction (PCR) result and/ or positive Leptospiral ELISA IgM testing. RVPBRU offers isolation and confirmatory testing, including the serological diagnosis of human leptospirosis by the microscopic agglutination test (MAT) and Multi-Locus Sequence Type (MLST) of *Leptospira* from clinical material.

The Unit offers a referred (charged for) service for the confirmation of *Leptospira*. Costs are included in initial specimen processing charges to RIPL, PHE Porton and additional charges will not be made for specimens received via RIPL, PHE Porton.

Leptospira serology

The microscopic agglutination test (MAT) is the gold standard test with high specificity, allowing for the detection of agglutinating antibodies. Antibodies to *Leptospira* can be detected 5 to 10 days post onset of disease. To determine alterations in titre and give an indication of the presumptive infecting serovar in acute Leptospiral infection it is necessary to examine more than one specimen, with a second specimen requested 7-14 days after the initial specimen.

Leptospira MLST

MLST is performed based on a scheme targeting seven loci (*glmU*, *pntA*, *sucA*, *tpiA*, *pfkB*, *mreA*, *caiB*) of seven pathogenic *Leptospira* species (*L. alexanderi*, *L. borgpetersenii*, *L. interrogans*,

L. kirschneri, *L. noguchii*, *L. santarosai*, *L. weilii*). MLST is performed on clinical samples that have tested PCR positive. It is possible to determine *Leptospira* species directly from urine, serum, cerebral spinal fluid and tissue (biopsies and post mortem).

Mycoplasma

The Unit offers confirmatory and referred services useful in the investigation of individual cases and outbreaks of mycoplasma and ureaplasma infection. These are genome detection and/or culture from clinical material and identification of referred isolates.

QUICK VIEW TABLE (further details below)

Target	Test	Turnaround time	Preferred specimen	Minimum specimen Volume
<i>M. pneumoniae</i>	PCR & determination of point mutations associated with macrolide resistance	5 days	Respiratory sample (LRT or throat swab) Positive DNA extract	0.2mL 0.1mL
Neonate screen: <i>M. hominis</i> / <i>Ureaplasma spp.</i>	PCR with culture on PCR positives	5 days	ETS, NPA	0.2mL
Other species	Culture, PCR and sequencing when relevant	Species dependant (see below)	Case dependant (eg respiratory, CSF, joint and wound, aspirates)	0.2mL
Isolates	Culture, PCR and sequencing when relevant	Species dependant (see below)	Culture on blood agar or in transport medium*	N/A

*Please use transport medium for *Chlamydia*, *mycoplasmas* and *ureaplasmas* (eg VCM) and not viral transport medium (eg VTM) as not suitable for culture.

The detection of *Mycoplasma pneumoniae* DNA in clinical samples

This referred (charged) service is available where *M. pneumoniae* infection is of increased likelihood or would be of major clinical significance.

The presence of *M. pneumoniae* DNA in clinical material taken from an acutely ill patient is determined by using a PCR directed against the P1 adhesin gene. Any respiratory specimen is suitable for this test, preferably a lower respiratory tract specimen or throat swab. DNA extracts from known positives can also be referred for determination of point mutations associated with macrolide resistance.

CSF samples are rarely, if ever, positive for *M. pneumoniae* and are therefore not routinely tested for *M. pneumoniae* DNA.

The detection of mycoplasma / ureaplasma from clinical material

Detection and culture of mycoplasma is laborious and expensive. This referred (charged) service is not intended for the routine investigation of respiratory illness, but is available where mycoplasma infection is of increased likelihood or would be of major clinical significance.

Neonate screen

U. urealyticum, *U. parvum* and *M. hominis*, may be involved in respiratory infection or rarely meningitis/septicemia in neonates, especially low birth weight infants. The presence of *U. urealyticum*, *U. parvum* and *M. hominis* DNA in clinical material is determined using PCR amplifying the urease gene in ureaplasmas with species-specific probes (Yi *et al.*, 2005) and the glyceraldehyde-3-phosphate dehydrogenase (*gap*) gene in *M. hominis* (adaption of Baczynska *et al.*, 2004 with an house probe design). Culture will be attempted on all PCR positive specimens.

Other specimens

Mycoplasma and ureaplasmas may cause respiratory and other infections in the immunocompromised. Respiratory specimens from such patients are suitable for investigation. Mycoplasmas have occasionally been isolated from other extra-pulmonary sites including CSF, blood cultures, wound and joint aspirates. The presence of mycoplasmas will be determined using PCR, sequencing and culture when relevant for all human and zoonotic mollicute species except haemoplasmas.

Relevant PCR, sequencing and culture results will be available dependant on the organism in question. Culture results will be available ASAP following successful isolation. Some species such as *M. hominis* take only a few days while others such as *M. pirum* may take as long as 6 weeks to isolate.

Detection in genital specimens of *U. urealyticum*, *U. parvum* and *M. hominis* is not undertaken.

The identification of putative isolates of mycoplasmas and ureaplasmas

This reference service is undertaken by biochemical characterisation, growth inhibition studies, and molecular methods including 16S rDNA sequencing.

The laboratory is pleased to receive any putative isolates from clinical material. The most frequently referred species include *M. hominis*, *U. urealyticum*, *U. parvum* and *M. pneumoniae*. Priority will always be given to isolates of current clinical relevance.

Respiratory chlamydiae

The Unit can provide a reference service for chlamydia DNA detection by PCR, which may be useful in the investigation of potential outbreaks of respiratory chlamydia infections. This service is only offered where there is a clear Public Health need to establish the diagnosis. Please contact the laboratory to discuss before sending any samples.

This is not a routine service and turnaround times will therefore vary depending on the nature of the enquiry and the complexity of the investigation required.

Vaccine Preventable Bacteria Section (VPBS)

Bordetella pertussis* and other *Bordetella

The VPBS offers a range of reference, enhanced surveillance, and referred tests useful in the investigation of individual cases and outbreaks of pertussis infection. These are serology, identification and, where appropriate, phenotypic and genotypic characterisation of isolates, including other *Bordetella* spp. and further characterisation of *B. pertussis* PCR positive specimens.

The laboratory works very closely with the Immunisation Service, NIS and reports all clinically relevant results to them. National surveillance of pertussis is undertaken by Drs Gayatri Amirthalingam and Ms Helen Campbell, who can be contacted on 020 8327 6407.

***Bordetella pertussis* serology**

The Unit offers a referred (charged for) serological service for the diagnosis of pertussis. Anti-pertussis toxin (PT) IgG antibody levels are determined using an in-house EIA. This service is offered where the following criteria are met: single samples taken >2 weeks after onset of cough for any individuals with a history of prolonged cough.

Please note: This service is **NOT** suitable for assessment of immune status.

Further characterisation of *Bordetella pertussis* PCR positive specimens

The laboratory requests referral of clinical specimens and/or DNA extracts from specimens found to be *B. pertussis* PCR positive for surveillance purposes and further characterisation.

***Bordetella pertussis* oral fluid antibody testing**

The Unit offers a service testing for anti-pertussis toxin (PT) IgG antibody levels in oral fluid samples using an in-house EIA, for the diagnosis of pertussis and for national surveillance, as an alternative to serology testing.

This service is offered where the following criteria are met: patients must be aged between 2 and <17 years of age and their local Health Protection Team must be notified of the clinical suspicion of pertussis by their GP in order for the patient to be sent an oral fluid testing kit. The patient takes their own oral fluid sample (≥ 2 weeks after onset of cough) and posts it (in a prepaid envelope) directly to the Unit.

Further characterisation of *Bordetella pertussis* PCR positive specimens

The laboratory encourages submission of all *Bordetella pertussis* isolates for confirmation and national surveillance purposes.

Identification and characterisation of *Bordetella* species

The Unit is pleased to receive putative isolates of *Bordetella* spp. from any human source. These will be fully characterised by a range of phenotypic and genotypic methods.

Other information

In conjunction with the Immunisation Service, NIS, VPBS will provide laboratory support for any investigations into pertussis outbreaks. Contact the laboratory before sending any samples.

Streptococcus pneumoniae identification and capsular typing of pneumococci

RVPBRU requests submission of ALL *S. pneumoniae* isolates from blood, CSF and other normally "sterile site" from episodes of invasive disease for confirmation of identity and capsule serotyping as part of the national surveillance function of our laboratory. Results of pneumococcal capsule typing are shared with the Immunisation, Hepatitis and Blood Safety Department, Colindale and contribute to National Surveillance. Presently available and likely future pneumococcal vaccines contain specific, generally common, capsular polysaccharide antigens. For this reason it is important to monitor the capsular type distribution of isolates from invasive disease in both adults and children. Capsular typing of pneumococci may also be helpful in the investigation of instances of suspected cross-infection in hospitals, other residential institutions and day care centres (or similar) for children.

From October 2017, most *Streptococcus pneumoniae* isolates from invasive disease sent to PHE Colindale for confirmation of identity and capsular typing will undergo routine whole genome sequencing (WGS). Identification and capsular type will be derived from WGS, but will be reported in the same format as previously. Identification and capsular typing will still be carried out using phenotypic methods in a small number of cases when required.

The Unit liaise closely with the AMRHAI in studies of antibiotic resistant pneumococci.

Other information

- There are currently at least 92 distinct pneumococcal capsular polysaccharide serotypes defined by the Danish classification scheme (SSI Diagnostica). Some of the 92+ serogroups/serotypes may be divided into specific serotypes or subtypes ie; types carrying the same number, but different letters, eg 6A, 6B, 9A, 9L, 9V. Subtyping is undertaken on all isolates from normally sterile sites, in particular for any episode of systemic infection associated with possible vaccine failure.
- RVPBRU, together with the Immunisation, Hepatitis and Blood Safety Department, Colindale, are actively following up all cases of invasive pneumococcal disease in the childhood age groups targeted for vaccination in order to ascertain immunisation history and determine vaccine effectiveness. This applies to anyone born after 4th September 2004.
- Typing of isolates to assist in the management of clusters of pneumococcal disease, including non-sterile site isolates can be undertaken. Such requests should be made via the local Health Protection Team or contact RVPBRU.

- RVPBRU does not offer a reference service for typing of *Streptococcus pneumoniae* strains from non-invasive infections. Unless part of an investigation as described above, non-invasive isolates of *S. pneumoniae* (ie isolates from eye swabs, sputum, will not normally be tested) or can be tested as a charged test.
- Where capsular typing of non-invasive pneumococci may be helpful in the investigation of instances of suspected cross-infection in hospitals, other residential institutions and day care centres (or similar) for children please contact the Health Protection Team and discuss with Senior RVPBRU staff prior to sending isolates.
- If seeking MICs from non-invasive pneumococcal isolates please refer directly to AMRHAI.
- RVPBRU does NOT carry out tests for *S. pneumoniae* antibodies. *S. pneumoniae* serology is performed by Professor Ray Borrow, PHE Vaccine Evaluation Unit, Manchester Medical Microbiology Partnership, Clinical Sciences Building 2, Manchester Royal Infirmary, Oxford Road, Manchester, M139WL Please contact Professor Ray Borrow (0161 276 6793).

Identification and toxigenicity testing of *Corynebacterium diphtheriae* and other potentially toxigenic corynebacteria (*C. ulcerans* and *C. pseudotuberculosis*)

Identification/confirmation and toxigenicity testing of potentially toxigenic Corynebacteria is performed initially by real-time PCR (qPCR) on the submitted isolate. Isolates which are qPCR positive for the toxin gene (*tox*) will also be tested by the Elek test for toxin expression. Although *C. diphtheriae*, *C. ulcerans*, and *C. pseudotuberculosis* toxin gene PCR positive results will be confirmed by the Elek test, a toxin gene PCR positive result should be acted upon without waiting for the Elek result. A toxin gene PCR result of 'not detected' (ie PCR negative) is final and no further toxigenicity testing will be reported on these isolates.

Other information:

Infections with toxigenic *C. diphtheriae* is very uncommon within the UK and is almost always imported. A travel and immunisation history should always be obtained from suspected cases of diphtheria and, if feasible, their close contacts.

Some strains of *C. ulcerans* (and very rarely *C. pseudotuberculosis*) may produce diphtheria toxin and the illness caused may present as clinical diphtheria. Such infections should be treated as diphtheria with the important proviso that person-to-person transmission is extremely rare. Infection is usually acquired from raw milk and/or contact with farms and farm animals and also perhaps close contact with companion animals.

UK microbiological laboratories are encouraged to submit all isolates of *C. diphtheriae*, *C. ulcerans*, and *C. pseudotuberculosis* to RVPBRU for toxigenicity testing and surveillance purposes. The Unit is a designated WHO Collaborating Centre for reference and research on diphtheria.

Urgent isolates received by 12 noon will be processed on the same day (Monday to Saturday). Under normal circumstances, a final written report is issued within 5 days of receipt and all interim results are given by telephone, usually within 24 hours.

Notify RVPBRU (telephone 0208 327 7887) before sending an isolate for toxigenicity testing within working hours on a weekday. Outside these hours, please notify the Colindale duty doctor on 0208 200 4400. If possible always use the RVPBRU Request Form (R3) and always ensure full contact telephone numbers are provided on the form.

Advice on immunisation against diphtheria and provision of diphtheria antitoxin for therapeutic use is available from the Immunisation Service, NIS Colindale on 020 8200 6868 (Dr M. Ramsay, 020 8200 7085 or Dr Gayatri Amirthalingam 020 8327 6407) during normal hours. Out of hours via Colindale Duty Doctors on 020 8200 4400.

References

Please refer to: Public health control and management of diphtheria (in England and Wales) 2015 Guidelines - Diphtheria Guidelines Working Group for further details

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/416108/Diphtheria_Guidelines_Final.pdf

Haemophilus influenzae

RVPBRU requests submission of ALL *H. influenzae* isolates from invasive disease (ie blood, CSF and other normally sterile sites) for confirmation of their identification, serological serotyping and capsular genotyping.

Conjugate *H influenzae* type b vaccine is routinely offered to all infants in the UK. Typing of strains of *H. influenzae* is invaluable in determining whether the strain is *H. influenzae* type b that is a vaccine preventable serotype, a non-type b serotype or non-capsulated strain.

The Unit requests submission of ALL *H. influenzae* isolated from blood culture or other normally sterile sites in patients of ALL ages as part of the surveillance of invasive disease due to *H. influenzae* and for detecting Hib vaccine failures in children. This surveillance is being conducted in collaboration with the Immunisation Service, NIS Colindale.

The laboratory is happy to discuss and advise upon particular clinical or epidemiological problems.

Other information:

- identification of *H. influenzae* is based upon X and V factor requirement and a species-specific PCR directed at the *ompP2* gene.
- there are 6 capsular serotypes of *H. influenzae* (a-f) based on the capsular polysaccharide of the organisms. Before the introduction of a conjugate vaccine against serotype b (Hib), this serotype caused the majority of serious human infections in the UK.
- other capsular serotypes, notably types e and f, and non-capsulated strains can also cause serious infections

- the Unit will refer requests for antimicrobial susceptibility testing to AMRHAI.
- the Unit does not offer a routine service for typing or susceptibility testing *H.influenzae* strains from non-invasive infections. Non-invasive isolates of *H. influenzae* (ie isolates from eye swabs, sputum) will only be examined if there are sound clinical or epidemiological reasons for the investigations. The laboratory is happy to discuss any clinical problem that may warrant further investigation.
- RVPBRU does NOT carry out tests for Hib antibodies. Hib serology is performed by Professor Ray Borrow, PHE Vaccine Evaluation Unit, Manchester Medical Microbiology Partnership, Clinical Sciences Building 2, Manchester Royal Infirmary, Oxford Road, Manchester, M139WL. Please contact Professor Ray Borrow (0161 276 6793).

Identification of *Haemophilus* species (excluding *Haemophilus ducreyi*)

RVPBRU will confirm the identity of strains of other *Haemophilus* species isolated from cases of invasive disease. For isolates not confirmed as *Haemophilus* spp a preliminary report will be issued and the isolate forwarded to AMRHAI for full identification, who will issue a report in due course.

Diphtheria immunity/vaccination studies

A referred (charged for) service for the determination of serum antibodies to diphtheria toxin.

Diphtheria immunity status is determined by a tissue culture toxin neutralisation assay of serum antibodies specific for diphtheria toxin. Test plates are incubated for up to six days before a final report is issued. This assay is more reliable than ELISA, particularly for detecting susceptible individuals.

Results are reported in International Units/mL and classified as:

- individual is susceptible: <0.016 IU/mL
- levels conferring some protection: 0.016 – 0.09 IU/mL
- protective levels: 0.1 – 0.9 IU/mL
- levels conferring long-term protection: >1.0 IU/mL

Tests are batched every three weeks, unless a sample is deemed to be urgent. Please supply details of vaccination history (if known) with all requests plus relevant clinical details.

Tetanus immunity

A referred (charged for) service for the determination of serum antibodies to tetanus toxin. Tetanus immunity status is determined by an ELISA for serum antibodies specific for tetanus toxin.

Provided serum is collected prior to therapeutic administration of antitoxin, determination of tetanus immunity status can be useful in supporting a clinical diagnosis of tetanus. Absence of detectable antibody or levels below or close to the minimum protective level lends support to the clinical diagnosis while higher levels do not.

Results are reported in International Units/mL. Minimum protective level is presently defined as 0.1 IU/mL.

According to demand tests are normally batched every three weeks. If a sample is deemed to be urgent, please contact RVPBRU before sending to discuss.

Please supply details of vaccination history (if known) with all requests plus relevant clinical details.

Summary list of contacts

Antimicrobial Resistance and Healthcare Associated Infections Reference Unit (AMRHAI)			
Professor Neil Woodford	Unit Head	neil.woodford@phe.gov.uk	020 8327 6511
Susceptibility testing, interpreting antibiograms			
Dr Katie Hopkins	Section Head	katie.hopkins@phe.gov.uk	020 8327 7061
Infection prevention and control, site visits			
Mr Peter Hoffman	Section Head	peter.hoffman@phe.gov.uk	020 8327 7274
Resistance mechanisms, inferring mechanism from antibiograms, commercial opportunities			
Dr Katie Hopkins	Section Head	katie.hopkins@phe.gov.uk	020 8327 7061
Staphylococci ID & typing, PVL / other toxins			
Professor Angela Kearns	Section Head	angela.kearns@phe.gov.uk	020 8327 7227
Opportunistic pathogens typing			
Dr Jane Turton	Section Head	jane.turton@phe.gov.uk	020 8327 7224
Bacterial identification, culture negative clinical specimens (16S rDNA sequencing)			
Dr Julie Logan	Section Head	julie.logan@phe.gov.uk	020 8327 6059
Antibiotic resistance in sexually transmitted bacteria			
Dr Michelle Cole	Section Head	michelle.cole@phe.gov.uk	020 8327 6465
Gastrointestinal Bacteria Reference Unit (GBRU)			
Dr Kathie Grant	Unit Head	kathie.grant@phe.gov.uk	020 8327 7117
<i>E.coli</i> , Shigella, Vibrio, Yersinia, serodiagnosis			
Dr Claire Jenkins	Pathogen Lead	claire.jenkins@phe.gov.uk	020 8327 6035
Salmonella			
Dr Marie Chattaway	Pathogen Lead	marie.chattaway@phe.gov.uk	020 8327 6171
<i>Bacillus</i> , <i>Clostridia</i> (<i>C. perfringens</i> , <i>C. botulinum</i> , <i>C. tetani</i>), <i>Listeria</i>			
Dr Corinne Amar	Pathogen Lead	corinne.amar@phe.gov.uk	020 8327 7341
Campylobacter, Helicobacter			
Dr Craig Swift	Pathogen Lead	craig.swift@phe.gov.uk	020 8327 6597
Respiratory and Vaccine Preventable Bacteria Reference Unit (RVPBRU)			
Dr Vicki Chalker	Unit Head	vicki.chalker@phe.gov.uk	020 8327 6636
Bordetella, Diphtheria, Haemophilus, Pneumococci			
Dr Norman Fry	Section Head	norman.fry@phe.gov.uk	020 8327 6776
Streptococcus, Legionella, Mycoplasma/Ureaplasmas, Leptospira			
Dr Derren Ready	Section Head	derren.ready@phe.gov.uk	020 8327 6146
Medical Microbiologists			
Dr Nandini Shetty		nandini.shetty@phe.gov.uk	020 8327 6033
Dr Meera Chand		meera.chand@phe.gov.uk	020 8327 6989
Dr Gauri Godbole		gauri.godbole@phe.gov.uk	020 8327 7142
Dr Helen Fifer		helen.fifer@phe.gov.uk	020 8327 6745
Dr Colin Brown		Colin.brown@phe.gov.uk	020 8327 7623