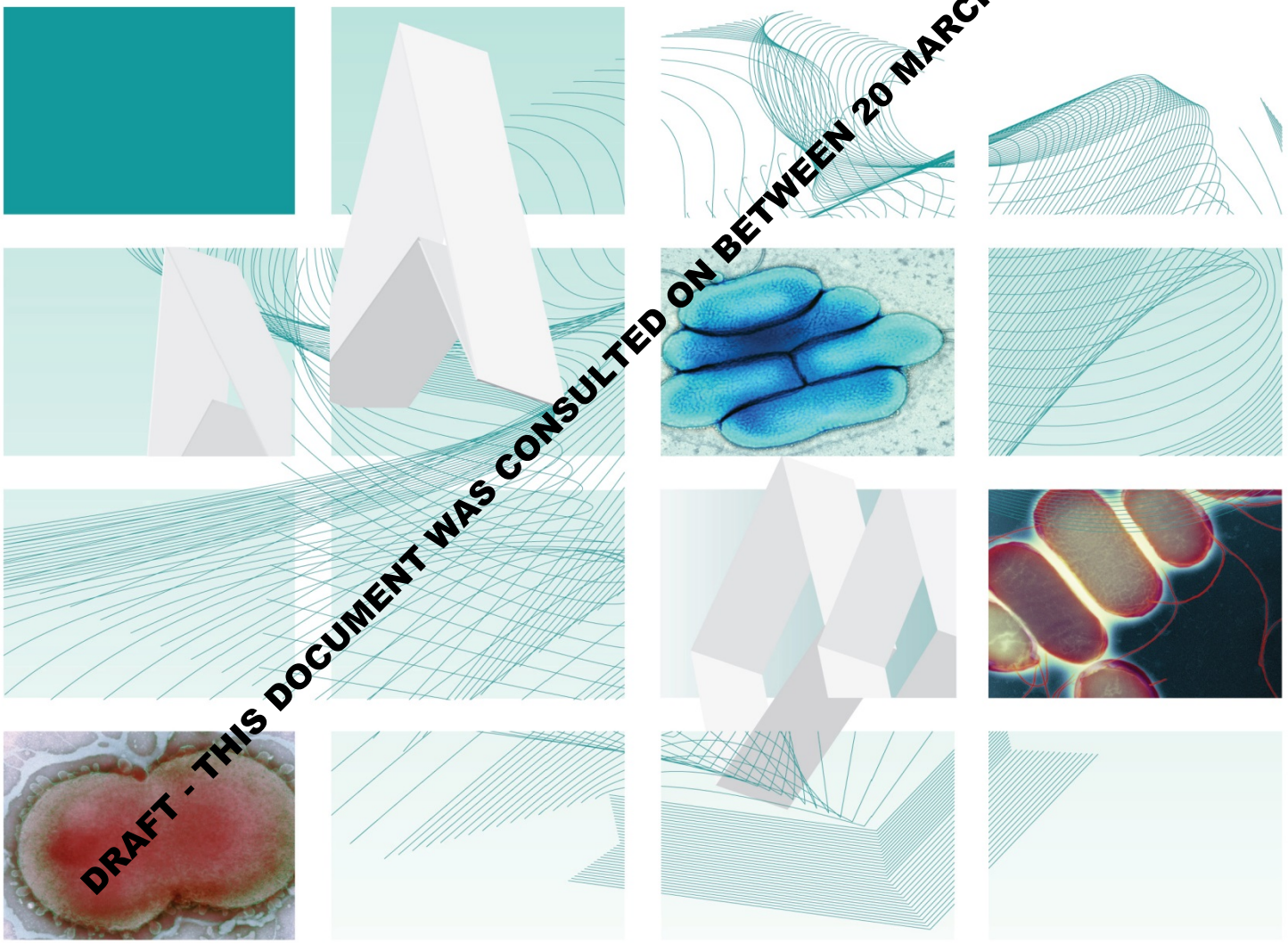
Public Health England

NHS

# UK Standards for Microbiology Investigations

## Example reference strains for UK Standards for Microbiology Investigations test procedures





NICE accredited
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"NICE has renewed accreditation of the process used by **Public Health England (PHE)** to produce **UK Standards for Microbiology Investigations**. The renewed accreditation is valid until **30 June 2021** and applies to guidance produced using the processes described in **UK standards for microbiology investigations (UKSMIs) Development process, S9365', 2016**. The original accreditation term began in **July 2011.**"

Issued by the Standards Unit, National Infection Service, PHE

# Acknowledgments

UK Standards for Microbiology Investigations (UK SMIs) are developed under the auspices of Public Health England (PHE) working in partnership with the National Health Service (NHS), Public Health Wales and with the professional organisations whose logos are displayed below and listed on the website https://www.gov.uk/uk-standards-for-microbiology-investigations-smi-quality-and-consistency-in-clinical-laboratories. UK SMIs are developed, reviewed and revised by various working groups which are overseen by a steering committee (see https://www.gov.uk/government/groups/standards-for-microbiology-investigations-steering-committee).

The contributions of many individuals in clinical, specialist and reference laboratories who have provided information and comments during the development of this document are acknowledged. We are grateful to the medical editors for editing the medical content.

For further information please contact us at:

Standards Unit
National Infection Service
Public Health England
61 Colindale Avenue
London NW9 5EQ

E-mail: standards@phe.gov.uk

Website: https://www.gov.uk/uk-standards-for-microbiology-investigations-smi-quality-and-consistency-in-clinical-laboratories

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Logos correct at time of publishing.

# Contents

# Amendment table

Each UK SMI method has an individual record of amendments. The current amendments are listed on this page. The amendment history is available from standards@phe.gov.uk.

New or revised documents should be controlled within the laboratory in accordance with the local quality management system.

| Amendment number/date | |
|---|---|
| Issue number discarded | 2 |
| Insert issue number | 3 |
| Anticipated next review date* | |
| **Section(s) involved** | **Amendment** |
| Whole document. | Document updated.<br>Technical limitations updated with subheadings. |
| Quality Control Organisms. | The NCTC 8540 strain for the X factor test only has been validated by NCTC. |

*Reviews can be extended up to five years subject to resources available.

# UK SMI[#]: scope and purpose

## Users of UK SMIs

Primarily, UK SMIs are intended as a general resource for practising professionals operating in the field of laboratory medicine and infection specialties in the UK. UK SMIs also provide clinicians with information about the available test repertoire and the standard of laboratory services they should expect for the investigation of infection in their patients, as well as providing information that aids the electronic ordering of appropriate tests. The documents also provide commissioners of healthcare services with the appropriateness and standard of microbiology investigations they should be seeking as part of the clinical and public health care package for their population.

## Background to UK SMIs

UK SMIs comprise a collection of recommended algorithms and procedures covering all stages of the investigative process in microbiology from the pre-analytical (clinical syndrome) stage to the analytical (laboratory testing) and post analytical (result interpretation and reporting) stages. Syndromic algorithms are supported by more detailed documents containing advice on the investigation of specific diseases and infections. Quality guidance notes describe laboratory processes which underpin quality, for example assay validation.

Standardisation of the diagnostic process through the application of UK SMIs helps to assure the equivalence of investigation strategies in different laboratories across the UK and is essential for public health surveillance, research and development activities.

## Equal partnership working

UK SMIs are developed in equal partnership with PHE, NHS, Royal College of Pathologists and professional societies. The list of participating societies may be found at https://www.gov.uk/uk-standards-for-microbiology-investigations-smi-quality-and-consistency-in-clinical-laboratories. Inclusion of a logo in an UK SMI indicates participation of the society in equal partnership and support for the objectives and process of preparing UK SMIs. Nominees of professional societies are members of the Steering Committee and working groups which develop UK SMIs. The views of nominees cannot be rigorously representative of the members of their nominating organisations nor the corporate views of their organisations. Nominees act as a conduit for two-way reporting and dialogue. Representative views are sought through the consultation process. UK SMIs are developed, reviewed and updated through a wide consultation process.

## Quality assurance

NICE has accredited the process used by the UK SMI working groups to produce UK SMIs. The accreditation is applicable to all guidance produced since October 2009. The process for the development of UK SMIs is certified to ISO 9001:2008. UK SMIs represent a good standard of practice to which all clinical and public health microbiology laboratories in the UK are expected to work. UK SMIs are NICE accredited and represent neither minimum standards of practice nor the highest level



[#] Microbiology is used as a generic term to include the two GMC-recognised specialties of Medical Microbiology (which includes Bacteriology, Mycology and Parasitology) and Medical Virology.

of complex laboratory investigation possible. In using UK SMIs, laboratories should take account of local requirements and undertake additional investigations where appropriate. UK SMIs help laboratories to meet accreditation requirements by promoting high quality practices which are auditable. UK SMIs also provide a reference point for method development. The performance of UK SMIs depends on competent staff and appropriate quality reagents and equipment. Laboratories should ensure that all commercial and in-house tests have been validated and shown to be fit for purpose. Laboratories should participate in external quality assessment schemes and undertake relevant internal quality control procedures.

## Patient and public involvement

The UK SMI working groups are committed to patient and public involvement in the development of UK SMIs. By involving the public, health professionals, scientists and voluntary organisations the resulting UK SMI will be robust and meet the needs of the user. An opportunity is given to members of the public to contribute to consultations through our open access website.

## Information governance and equality

PHE is a Caldicott compliant organisation. It seeks to take every possible precaution to prevent unauthorised disclosure of patient details and to ensure that patient-related records are kept under secure conditions. The development of UK SMIs is subject to PHE Equality objectives https://www.gov.uk/government/organisations/public-health-england/about/equality-and-diversity.

The UK SMI working groups are committed to achieving the equality objectives by effective consultation with members of the public, partners, stakeholders and specialist interest groups.

## Legal statement

While every care has been taken in the preparation of UK SMIs, PHE and the partner organisations, shall, to the greatest extent possible under any applicable law, exclude liability for all losses, costs, claims, damages or expenses arising out of or connected with the use of an UK SMI or any information contained therein. If alterations are made by an end user to an UK SMI for local use, it must be made clear where in the document the alterations have been made and by whom such alterations have been made and also acknowledged that PHE and the partner organisations shall bear no liability for such alterations. For the further avoidance of doubt, as UK SMIs have been developed for application within the UK, any application outside the UK shall be at the user's risk.

The evidence base and microbial taxonomy for the UK SMI is as complete as possible at the date of issue. Any omissions and new material will be considered at the next review. These standards can only be superseded by revisions of the standard, legislative action, or by NICE accredited guidance.

UK SMIs are Crown copyright which should be acknowledged where appropriate.

## Suggested citation for this document

Public Health England. (YYYY <tab+enter>). Example Reference Strains For UK Standards for Microbiology Investigations Test Procedures. UK Standards for

# Scope of document

This UK Standards for Microbiology Investigations is designed as a stand-alone document giving information on example reference material that can be used as control strains for the range of test procedures covered in the UK SMI Test Procedures. This document contains information on the reference material and does not include information on how to carry out the test procedure which can be found in the individual Test Procedures available through the UK Standards for Microbiology Investigations. In all cases the reference material should be an authenticated reference culture from a recognised national culture collection.

**Note:** the organisms are not all necessarily type strains.

Reference materials can be provided by the Public Health England Culture Collections, National Collection of Type Cultures (NCTC) (http://www.phe-culturecollections.org.uk/) or from equivalent organisations including the American Type Culture Collection. The reference strains listed in this document are commonly used and have been validated by NCTC for the tests shown otherwise where indicated.

This UK SMI should be used in conjunction with other UK SMIs.



# Introduction

Use of appropriate reference material alongside the test procedure is crucial to ensure reliability of results. Appropriate controls are needed to ensure that the test is working within defined limits. If the reference material fails to give a positive or negative result (as appropriate) for the test it is used in and it is the appropriate control then the validity of the results is questionable. If this is the case the reason for failure should be fully investigated and where necessary the test should be repeated and a review of the process performed. The use of controls is recognised as good laboratory practice and a recognised part of any accreditation process.

# Technical information/limitations

### Viability of organisms

Cryovials™ should be returned to -80°C as quickly as possible as excessive changes in temperature reduce the viability of the organisms.

### Quality control

It is good practice to record all subcultures on a record sheet. If any contamination is evident on the working cultures before the normal replacement time, fresh ones should be prepared from the reference bead stock.

It is important to check and ensure that the control organisms give the correct results before routine use. Any inconsistent results need investigation.

# 1 Safety considerations[1-18]

Refer to current guidance on the safe handling of all organisms and reagents documented in this UK SMI.

All work likely to generate aerosols must be performed in a microbiological safety cabinet.

It is recommended that all ampoules/vials are to be opened in a microbiological safety cabinet to avoid inhalation of aerosols/dust from the ampoule.

The above guidance should be supplemented with local COSHH and risk assessments.

Compliance with postal and transport regulations is essential.

# 2 Reagents and equipment

Different agar media or broths dependent on the test performed.

Incubator - both oxygen and carbon dioxide.

Anaerobic jars.

Diamond cutter/pen or Glass file

# 3 Quality control organisms

## 3.1 Table of example reference NCTC strains

| UK SMI | Example reference strain | | |
|---|---|---|---|
| TP 2 – Aesculin Hydrolysis Test | **Positive control** | *Enterococcus faecalis* | NCTC 12697 |
| | **Negative control** | *Streptococcus agalactiae* | NCTC 8181 |
| TP 3 – Agglutination Test | **Positive control**<br>**Negative control** | N/A | |
| TP 5 – Bile Solubility Test | **Positive control** | *Streptococcus pneumoniae* | NCTC 12977 |
| | **Negative control** | *Streptococcus mitis* | NCTC 10712 |
| TP 8 – Catalase Test | **Positive control** | *Staphylococcus aureus* | NCTC 6571 |
| | **Negative control** | *Streptococcus mitis* | NCTC 10712 |
| TP 10 – Coagulase Test | **Positive control** | *Staphylococcus aureus* | NCTC 6571 |
| | **Negative control** | *Staphylococcus haemolyticus* | NCTC 11042 |
| TP 12 – Deoxyribonuclease Test | **Positive control** | *Staphylococcus aureus* | NCTC 6571 |
| | **Negative control** | *Staphylococcus haemolyticus* | NCTC 11042 |
| TP 19 – Indole Test | **Positive control** | *Escherichia coli* | NCTC 10418 |
| | **Negative control** | *Proteus mirabilis* | NCTC 10975 |

| | | | |
|---|---|---|---|
| TP 21 – Motility Test | **Positive control** | *Proteus mirabilis* | NCTC 10975 |
| | **Negative control** | *Acinetobacter lwoffii* | NCTC 5866 |
| TP 22 – Nagler Test | **Positive control** | *Clostridium perfringens* | NCTC 8359* |
| | **Negative control** | *Clostridium difficile* | NCTC 11204* |
| TP 24 - ONPG (ß-Galactosidase) Test (for Enterobacteriaceae) | **Positive control** | *Escherichia coli* | NCTC 10418 |
| | **Negative control** | *Proteus mirabilis* | NCTC 10975 |
| TP 24 - ONPG (ß-Galactosidase) Test (for *Neisseria* species | **Positive control** | *Neisseria lactamica* | NCTC 10617 |
| | **Negative control** | *Neisseria gonorrhoeae* | NCTC 8375 |
| TP 25 – Optochin Test | **Positive control** | *Streptococcus pneumoniae* | NCTC 12977 |
| | **Negative control** | *Streptococcus mitis* | NCTC 10712 |
| TP 26 – Oxidase Test | **Positive control** | *Pseudomonas aeruginosa* | NCTC 10662 |
| | **Negative control** | *Escherichia coli* | NCTC 10418 |
| TP 27 – Oxidation/Fermentation of Glucose Test (Gram negative rods) | **Oxidation:** **Positive control** | *Pseudomonas aeruginosa* | NCTC 10662 |
| | **Negative control** | *Acinetobacter lwoffii* | NCTC 5866 |
| | **Fermentation:** **Positive control** | *Escherichia coli* | NCTC 10418 |
| | **Negative control** | *Acinetobacter lwoffii* | NCTC 5866 |
| TP 27 – Oxidation/Fermentation of Glucose Test (Gram positive cocci) | **Oxidation:** **Positive control** | *Micrococcus luteus* | NCTC 2665 |
| | **Negative control** | OF basal medium without carbohydrate | |
| | **Fermentation:** **Positive control** | *Staphylococcus aureus* | NCTC 6571 |
| | **Negative control** | OF basal medium without carbohydrate | |
| TP 29 – Porphyrin synthesis (ALA) Test | **Positive control** | *Haemophilus parainfluenzae* | NCTC 10665 |
| | **Negative control** | *Haemophilus influenzae* | NCTC 11931 |
| TP 30 - Potassium Hydroxide Test | **Positive control** | *Escherichia coli* | NCTC 10418 |
| | **Negative control** | *Staphylococcus aureus* | NCTC 6571 |
| TP 32 - Changing the Phase in *Salmonella* | **Positive control** | N/A | |
| | **Negative control** | | |
| TP 34 – Thermonuclease Test | **Positive control** | *Staphylococcus aureus* | NCTC 6571 |
| | **Negative control** | *Staphylococcus haemolyticus* | NCTC 11042 |
| TP 36 – Urease Test | **Positive control** | *Proteus mirabilis* | NCTC 10975 |
| | **Negative control** | *Escherichia coli* | NCTC 10418 |

| | | |
|---|---|---|
| TP 38 – X and V factor Test | **X and V factor** | *Haemophilus influenzae* NCTC 11931 |
| | **V factor only** | *Haemophilus parainfluenzae* NCTC 10665 |
| | **X factor only** | *Haemophilus haemoglobinophilus* NCTC 8540 |
| *The reference strains have not been validated by NCTC for the tests shown.<br>There is validation data for all the strains tested. | | |

# 4 Procedure and results

The reference material on receipt must be rehydrated in accordance with any NCTC (or equivalent) recommendations. The reference material should be sub-cultured to appropriate non-selective media and incubated using the correct atmosphere and temperature. If the culture is to be stored for future use, this should be done in such a way as to ensure optimum recovery. It is suggested that micro Cryovials™, which contain a cryopreservative, are used. These should be inoculated with young colonial growth (18-24hr old) from the subculture to approximately a 3-4 McFarland standard. The vial should be closed tightly and inverted 4-5 times to emulsify the organisms. Do not vortex. The organisms are then bound to the porous beads. The excess cryopreservative should be aspirated with a sterile pasette leaving the beads as free of liquid as possible. Re-close the vial finger tight. Label the vial with the corresponding storage number, NCTC (or equivalent) number, name and date. These beads constitute the reference bead stock and are stored at -80°C. A second set of beads should be made which constitutes the working stock culture.

One bead from each working stock should be sub-cultured to an appropriate non-selective medium monthly, to prepare plate cultures. Under aseptic conditions, open the Cryovial™ and with a sterile needle or forceps, remove one bead. The inoculated bead may be directly streaked onto the appropriate plate culture medium. The plates must be clearly labelled with name of organism, date of subculture and NCTC number (or equivalent). The plate cultures may be sub-cultured weekly to fresh plates, and every 4$^{th}$ week plates should be made from the Cryovial™ stock as above.

See relevant Test Procedures from UK Standards for Microbiology Investigations.

# References

### Modified GRADE table used by UK SMIs when assessing references

Grading of Recommendations, Assessment, Development, and Evaluation (GRADE) is a systematic approach to assessing references. A modified GRADE method is used in UK SMIs for appraising references for inclusion. Each reference is assessed and allocated a grade for strength of recommendation (A-D) and quality of the underlying evidence (I-VI). A summary table which defines the grade is listed below and should be used in conjunction with the reference list.

| Strength of recommendation | | Quality of evidence | |
|---|---|---|---|
| A | Strongly recommended | I | Evidence from randomised controlled trials, meta-analysis and systematic reviews |
| B | Recommended but other alternatives may be acceptable | II | Evidence from non-randomised studies |
| C | Weakly recommended: seek alternatives | III | Non-analytical studies, for example, case reports, reviews, case series |
| D | Never recommended | IV | Expert opinion and wide acceptance as good practice but with no study evidence |
| | | V | Required by legislation, code of practice or national standard |
| | | VI | Letter or other |




1. European Parliament. UK Standards for Microbiology Investigations (UK SMIs) use the term "CE marked leak proof container" to describe containers bearing the CE marking used for the collection and transport of clinical specimens. The requirements for specimen containers are given in the European in vitro Diagnostic Medical Devices Directive (98/79/EC Annex 1 B 2.1) which states: "The design must allow easy handling and, where necessary, reduce as far as possible contamination of, and leakage from, the device during use and, in the case of specimen receptacles, the risk of contamination of the specimen. The manufacturing processes must be appropriate for these purposes". 1998. **A, V**

2. Official Journal of the European Communities. Directive 98/79/EC of the European Parliament and of the Council of 27 October 1998 on *in vitro* diagnostic medical devices 1998. 1-37. **A, V**

3. Health and Safety Executive. Safe use of pneumatic air tube transport systems for pathology specimens. 2009. **A, V**

4. Department for Transport. Transport of Infectious Substances, 2011 Revision 5. 2011. **A, V**

5. World Health Organization. Guidance on regulations for the Transport of Infectious Substances 2017-2018. 2017. **A, V**

6. Home Office. Anti-terrorism, Crime and Security Act. 2001. **A, V**

7. Advisory Committee on Dangerous Pathogens. The Approved List of Biological Agents. Health and Safety Executive 2013. 1-35. **A, V**

8. Advisory Committee on Dangerous Pathogens. Infections at work: Controlling the risks. Her Majesty's Stationery Office 2003. **A, V**

9. Advisory Committee on Dangerous Pathogens. Biological agents: Managing the risks in laboratories and healthcare premises. Health and Safety Executive 2005. **A, V**

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11. Centers for Disease Control and Prevention. Guidelines for Safe Work Practices in Human and Animal Medical Diagnostic Laboratories. MMWR Surveill Summ 2012;61:1-102. **B, IV**

12. Health and Safety Executive. Control of Substances Hazardous to Health Regulations. The Control of Substances Hazardous to Health Regulations 2002 (as amended). HSE Books,. 2013. **A, V**

13. Health and Safety Executive. Five Steps to Risk Assessment: A Step by Step Guide to a Safer and Healthier Workplace. HSE Books,. 2002. **A, V**

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15. Health Services Advisory Committee. Safe Working and the Prevention of Infection in Clinical Laboratories and Similar Facilities. HSE Books 2003. **A, V**

16. British Standards Institution (BSI). BS EN12469 - Biotechnology - performance criteria for microbiological safety cabinets 2000. **A, V**

17. British Standards Institution (BSI). BS 5726:2005 - Microbiological safety cabinets. Information to be supplied by the purchaser and to the vendor and to the installer, and siting and use of cabinets. Recommendations and guidance. 2005. 1-14. **A, V**

18. Department of Health. Transport of Infectious Substances. Best Practice Guidance for Microbiology Laboratories. Department of Health. 1-13. 2007. **A, V**