



# UK Standards for Microbiology Investigations

## Motility Test



## Acknowledgments

UK Standards for Microbiology Investigations (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 <http://www.hpa.org.uk/SMI/Partnerships>. SMIs are developed, reviewed and revised by various working groups which are overseen by a steering committee (see <http://www.hpa.org.uk/SMI/WorkingGroups>).

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.

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UK Standards for Microbiology Investigations are produced in association with:



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NICE has accredited the process used by Public Health England to produce Standards for Microbiology Investigations. Accreditation is valid for 5 years from July 2011. More information on accreditation can be viewed at [www.nice.org.uk/accreditation](http://www.nice.org.uk/accreditation).

For full details on our accreditation visit: [www.nice.org.uk/accreditation](http://www.nice.org.uk/accreditation).

## Amendment Table

Each 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](mailto:standards@phe.gov.uk).

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

Amendment No/Date.	5/14.03.14
Issue no. discarded.	2.2
Insert Issue no.	2.3
<b>Section(s) involved</b>	<b>Amendment</b>
Whole document.	<p>Document has been transferred to a new template to reflect the Health Protection Agency's transition to Public Health England.</p> <p>Front page has been redesigned.</p> <p>Status page has been renamed as Scope and Purpose and updated as appropriate.</p> <p>Professional body logos have been reviewed and updated.</p> <p>Standard safety and notification references have been reviewed and updated.</p> <p>Scientific content remains unchanged.</p>

Amendment No/Date.	4/21.10.11
Issue no. discarded.	2.1
Insert Issue no.	2.2
<b>Section(s) involved</b>	<b>Amendment</b>
Whole document.	Document presented in a new format.
References.	Some references updated.

# UK Standards for Microbiology Investigations<sup>#</sup>: Scope and Purpose

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## Users of SMIs

- SMIs are primarily intended as a general resource for practising professionals operating in the field of laboratory medicine and infection specialties in the UK.
- SMIs 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.
- SMIs 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 SMIs

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. Guidance notes cover the clinical background, differential diagnosis, and appropriate investigation of particular clinical conditions. Quality guidance notes describe laboratory processes which underpin quality, for example assay validation.

Standardisation of the diagnostic process through the application of 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

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 <http://www.hpa.org.uk/SMI/Partnerships>. Inclusion of a logo in an SMI indicates participation of the society in equal partnership and support for the objectives and process of preparing SMIs. Nominees of professional societies are members of the Steering Committee and Working Groups which develop 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.

SMIs are developed, reviewed and updated through a wide consultation process.

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<sup>#</sup>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.

## Quality Assurance

NICE has accredited the process used by the SMI Working Groups to produce SMIs. The accreditation is applicable to all guidance produced since October 2009. The process for the development of SMIs is certified to ISO 9001:2008.

SMIs represent a good standard of practice to which all clinical and public health microbiology laboratories in the UK are expected to work. SMIs are NICE accredited and represent neither minimum standards of practice nor the highest level of complex laboratory investigation possible. In using SMIs, laboratories should take account of local requirements and undertake additional investigations where appropriate. SMIs help laboratories to meet accreditation requirements by promoting high quality practices which are auditable. SMIs also provide a reference point for method development.

The performance of 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 SMI Working Groups are committed to patient and public involvement in the development of SMIs. By involving the public, health professionals, scientists and voluntary organisations the resulting 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 SMIs are subject to PHE Equality objectives [http://www.hpa.org.uk/web/HPAwebFile/HPAweb\\_C/1317133470313](http://www.hpa.org.uk/web/HPAwebFile/HPAweb_C/1317133470313). The 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

Whilst every care has been taken in the preparation of SMIs, PHE and any supporting organisation, 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 SMI or any information contained therein. If alterations are made to an SMI, it must be made clear where and by whom such changes have been made.

The evidence base and microbial taxonomy for the SMI is as complete as possible at the time 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.

SMIs are Crown copyright which should be acknowledged where appropriate.

### Suggested Citation for this Document

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UNDER REVIEW

## Scope of Document

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This test is used to determine if an organism is motile or non-motile. Motile organisms are generally bacilli although a few motile cocci do exist.

This SMI should be used in conjunction with other SMIs.

## Introduction

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This test is used to determine if organisms are motile by means of flagella. The location of the flagella is determined by the bacterial species. Non-motile bacteria do not possess flagella. The production of flagella is also subject to culture conditions; for example, some bacteria are motile at different temperatures from those at which they are normally incubated, eg, *Yersinia enterocolitica* is motile at 20–25°C but not at 30°C<sup>1</sup>. Some bacteria such as *Capnocytophaga* species exhibit gliding motility.

Occasionally bacteria such as *Campylobacter* species produce non-motile variants; these rarely revert to motile forms.

## Technical Information/Limitations

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Bacterial motility must be distinguished from Brownian motion. Weakly motile bacteria may require prolonged observation of individual cells.

Some bacteria on first isolation from blood cultures do not appear to be motile.

Motility results are difficult to determine for anaerobic bacteria. Only a positive result is significant.

Some bacteria are motile at one temperature and non-motile when incubated at another.

Some bacteria become less motile in old cultures. Repeat motility testing on a fresh subculture.

## 1 Safety Considerations<sup>2-18</sup>

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

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

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

Compliance with postal and transport regulations is essential.

## 2 Reagents and Equipment

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### Hanging drop method<sup>19</sup>

Liquid bacterial culture (incubation times and temperatures may vary depending on the species). Refer to the appropriate identification SMI.

Microscope slide with a central depression (or a ring of petroleum jelly or plasticine may be made on an ordinary microscope slide).

Coverslip.

### Semi-solid agar method (Craigie)<sup>20</sup>

Bacteriological straight wire/loop (preferably nichrome) or disposable alternative.

### Three coverslip method

Normal microscope slide without central depression.

Coverslips.

## 3 Quality Control Organisms<sup>21</sup>

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### Positive Control

*Proteus mirabilis* NCTC 10975

### Negative Control

*Acinetobacter lwoffii* NCTC 5866

## 4 Procedure and Results

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### 4.1 Hanging Drop Method

- Place a small drop of liquid bacterial culture in the centre of a coverslip
- Place a small drop of water at each corner of the coverslip
- Invert a slide with a central depression over the coverslip
- The coverslip will stick to the slide, and when the slide is inverted the drop of bacterial culture will be suspended in the well

- Examine microscopically (x400) for motile organisms

**Note:** If well slides are not available, a ring of Vaseline or plasticine may instead be made on an ordinary microscope slide.

### Positive Result

A darting, zigzag, tumbling or other organised movement.

### Negative Result

No movement or Brownian motion only.

## 4.2 Semi Solid Agar (Craigie)

- Inoculate the test organism - the central glass tube
- Incubate at the relevant temperature for 18-24hr
- Subculture from the outer section of the medium

### Positive Result

Organism can be recovered from the outer section of the medium.

### Negative Result

Organism remains in the inner tube.

## 4.3 Three Coverslip Method

- Set microscope slide according to Figure 1 (below)

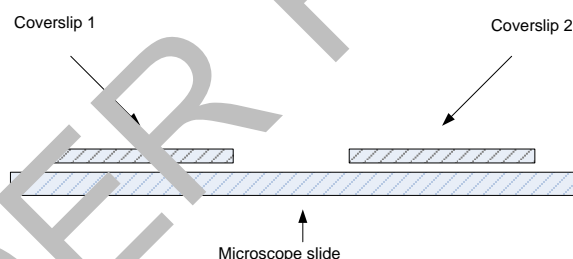


Fig.1

- Place a small drop of bacterial culture in centre of third coverslip
- Place a small drop of water at each corner of the coverslip
- Cover the prepared microscope slide over the third coverslip
- The coverslip should stick to the other coverslips on the slide and when inverted the drop of bacterial culture should be suspended in the gap between the microscope slide and third coverslip
- Examine microscopically (x400) for motile organism

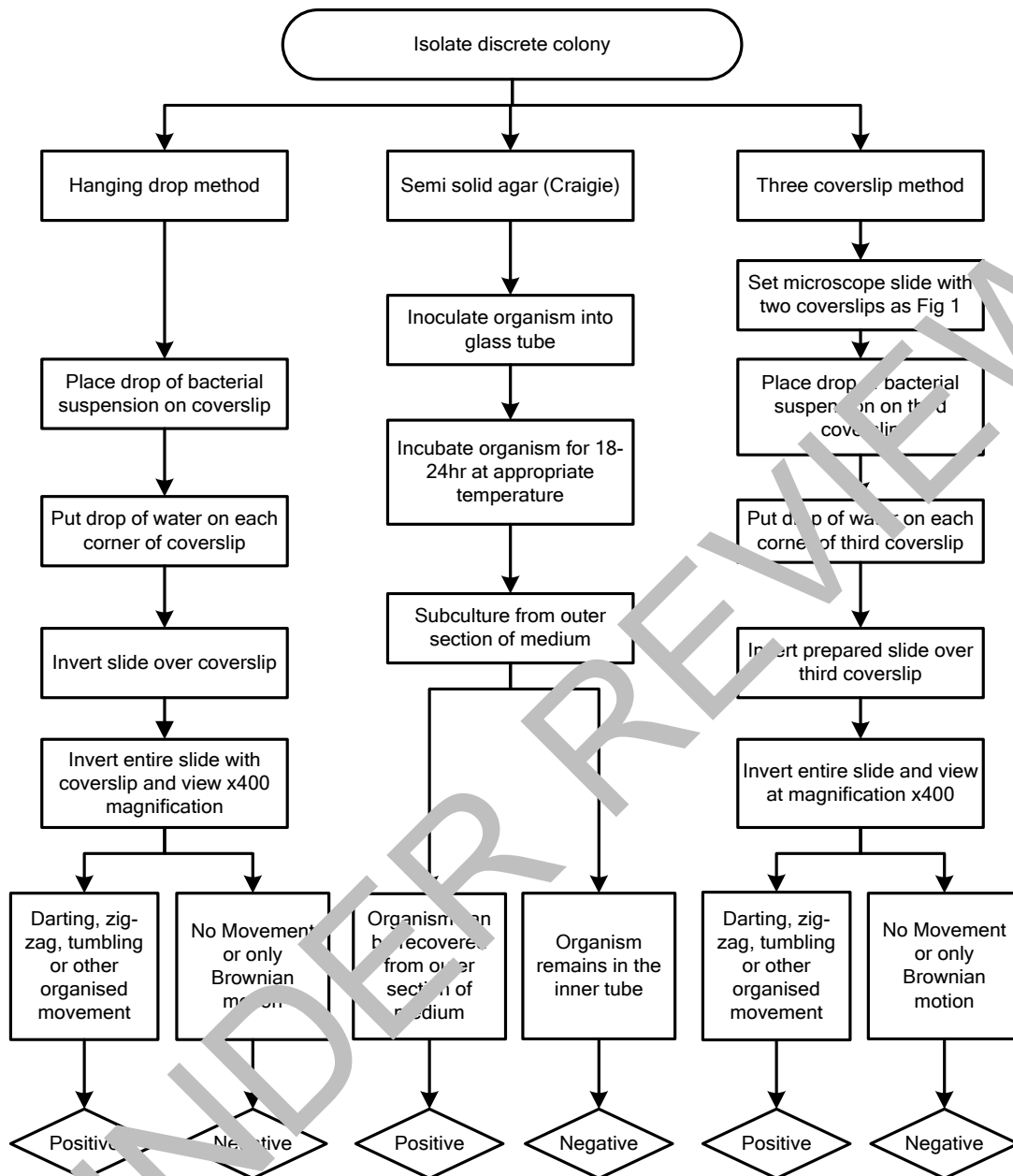
### Positive Result

A darting, zigzag, tumbling or other organised movement.

### Negative Result

No movement or only Brownian motion.

## Appendix: Motility Test



Note:

Positive control: *Proteus mirabilis* NCTC 10975

Negative control: *Acinetobacter lwoffii* NCTC 5866

The flowchart is for guidance only.

## References

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1. Bottone EJ. *Yersinia enterocolitica* infections. In: Gorbach SL, Bartlett JG, Blacklow NR, editors. *Infectious Diseases*. 2nd ed. Philadelphia: WB Saunders Company; 1998. p. 733-8.
2. European Parliament. UK Standards for Microbiology Investigations (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 EU *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".
3. 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. 7/12-1998. p. 1-37.
4. Health and Safety Executive. Safe use of pneumatic air tube transport systems for pathology specimens. 9/99.
5. Department for transport. Transport of Infectious Substances, 2011 (revision 5). 2011.
6. World Health Organization. Guidance on regulations for the Transport of Infectious Substances 2013-2014. 2012.
7. Home Office. Anti-terrorism, Crime and Security Act 2001 (as amended).
8. Advisory Committee on Dangerous Pathogens. The Approved List of Biological Agents. Health and Safety Executive. 2013. p. 1-32
9. Advisory Committee on Dangerous Pathogens. Infections at work: Controlling the risks. Her Majesty's Stationery Office. 2007.
10. Advisory Committee on Dangerous Pathogens. Biological agents: Managing the risks in laboratories and healthcare premises. Health and Safety Executive. 2005.
11. Advisory Committee on Dangerous Pathogens. Biological Agents: Managing the Risks in Laboratories and Healthcare Premises. Appendix 1.2 Transport of Infectious Substances - Revision. Health and Safety Executive. 2008.
12. 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.
13. Health and Safety Executive. Control of Substances Hazardous to Health Regulations. The Control of Substances Hazardous to Health Regulations 2002. 5th ed. HSE Books; 2002.
14. Health and Safety Executive. Five Steps to Risk Assessment: A Step by Step Guide to a Safer and Healthier Workplace. HSE Books. 2002.
15. Health and Safety Executive. A Guide to Risk Assessment Requirements: Common Provisions in Health and Safety Law. HSE Books. 2002.
16. Health Services Advisory Committee. Safe Working and the Prevention of Infection in Clinical Laboratories and Similar Facilities. HSE Books. 2003.
17. British Standards Institution (BSI). BS EN12469 - Biotechnology - performance criteria for microbiological safety cabinets. 2000.

18. 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. 24-3-2005. p. 1-14
19. Identification Methods. In: Collins CH, Lyne PM, Grange JM, editors. Collin and Lyne's Microbiological Methods. 7th ed. London: 2004. p. 102-20.
20. Craigie J. Studies on the serological reactions of the flagella of *B. typhosus*. *J Immunol* 1931;21:417-511.
21. Snell JJS, Brown DFJ, Roberts C, editors. Quality Assurance Principles and Practice in the Microbiology Laboratory. London: Public Health Laboratory Service; 1999. p. 147-8

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