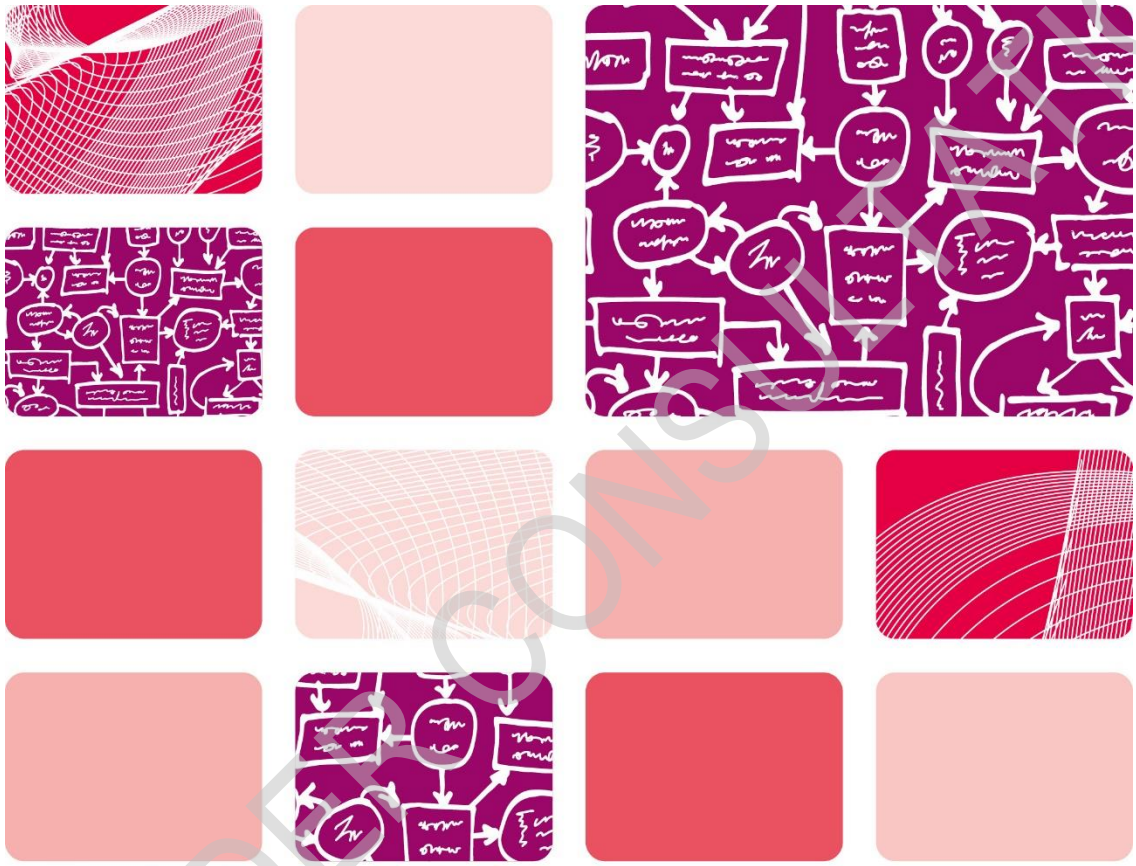
UK Health Security Agency

UK Standards for Microbiology Investigations

Painful and/or discharging ear



National Institute for Health and Care Excellence (NICE) has renewed accreditation of the process used by the **UK Health Security Agency** to produce **UK Standards for Microbiology Investigations (UK SMIs)**. The renewed accreditation is valid until **30 June 2026** and applies to guidance produced using the processes described in '**UK Standards for Microbiology Investigations Development Process' (2021)**. The original accreditation term began on 1 July 2011.

Acknowledgments

UK Standards for Microbiology Investigations (UK SMIs) are developed under the auspices of UKHSA working in partnership with the partner organisations whose logos are displayed below and listed on the UK SMI website. UK SMIs are developed, reviewed and revised by various working groups which are overseen by a steering committee (see the Steering Committee section on the UK SMI website).

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.

UK SMIs are produced in association with:

Displayed logos correct as of December 2023

Contents

Amendment table

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

Any alterations to this document should be controlled in accordance with the local document control process.

Amendment number/date	x/dd.mm.yy
Issue number discarded	
Insert issue number	
Anticipated next review date*	dd.mm.yy
Section(s) involved	**Amendment**
Whole document	This new syndromic document is based on *UK SMI B01: Investigation of ear infections and associated specimens*. The content and scope have expanded, and the document is presented in a new template with the relevant titles and headings.

*Reviews can be extended up to 5 years where appropriate

1 General information

View general information related to UK SMIs.

2 Scientific information

View scientific information related to UK SMIs.

3 Scope of document

This document provides a comprehensive overview of infections related to painful and/or discharging ear, caused by bacteria, viruses, or fungi. It outlines relevant investigations, utilising molecular, culture, and serological techniques to identify common pathogens.

The scope of this document includes infections affecting the outer, middle, and, to a lesser extent, inner parts of the ear. Inner ear infections are briefly covered due to their significantly distinct clinical presentation.

The document will also cover infections associated with medical devices such as hearing aids, ventilation tube, tympanostomy tubes and post-surgical infections.

This standard primarily targets laboratory professionals involved in diagnosing ear infections in secondary care settings, with some elements useful for primary care. The information presented here is also valuable for General Practitioners (GPs) when sample collection becomes necessary, such as in cases of otitis externa unresponsive to standard treatment.

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

4 Background

Table 01: below is a summary of the information found on the NHS website: differences between inner, middle and outer ear infections.

Outer ear infection (otitis externa)	Middle ear infection (otitis media)	Inner ear infection
Usually affects adults	Usually affects children	Affect both children and adults
Caused by something irritating the ear canal, such as eczema, water or wearing earplugs	Caused by viruses with secondary bacterial infection of the middle ear after initial upper	Caused by viral or bacterial infections

	respiratory tract infection. Can also be caused by fungi, usually related to more tropical climates.	
Affects the ear canal (the tube between the outer ear and the eardrum)	Associated with the eustachian tube disfunction, which connects the middle ear (area behind the eardrum) to the back of the nose	Affects parts of the inner ear like the labyrinth and vestibular system, and can lead to labyrinthitis

4.1 Outer ear infections – Otitis Externa

History and physical examination is essential in diagnosing the type of otitis externa and to initiate effective targeted treatment. In general, infection of the external auditory canal resembles infection of skin and soft tissue elsewhere. However, there are some notable differences. The canal is narrow making it susceptible to the entrapment of foreign materials, build-up of epithelial debris and fluids, leading to irritation and superficial tissue maceration. Otitis externa manifests in various forms, each with distinct characteristics; acute localised, acute diffuse, chronic, and necrotising otitis externa (also called skull base osteomyelitis and previously called ‘malignant otitis externa’) (1).

Herpes zoster oticus is mentioned briefly under this section and is highlighted for consideration in individuals with a history of chickenpox. It is not covered in the flowcharts as accurate diagnosis is done through polymerase chain reaction (PCR).

4.1.1 Acute localised otitis externa

Acute localised otitis externa, often resulting in a furuncle or pustule of a hair follicle, is primarily caused by *Staphylococcus aureus*. Erysipelas, associated with Group A Streptococcus, may be present in the concha and canal.

4.1.2 Acute diffuse otitis externa

Acute diffuse otitis externa, commonly known as "swimmer's ear," is prevalent among adults, particularly in hot and humid conditions. It is caused by variety of bacteria, the most common being *Pseudomonas aeruginosa* and *S. aureus* and occasionally anaerobes. Fungal pathogens, particularly *Aspergillus* and *Candida* species, contribute to approximately 10% of cases. Individuals with dermatological conditions such as eczema are more susceptible to developing acute diffuse otitis externa. Additionally, factors like trauma, diabetes, ENT surgery, high humidity/temperature, and ear drum perforation can predispose individuals to fungal otitis externa (2,3).

4.1.3 Chronic otitis externa

Chronic otitis externa is inflammation lasting longer than 3 months. It is the result of recurrent otitis externa with bacterial or fungal infections, and may be associated with underlying skin conditions. Fungal pathogens including *Aspergillus* species or *Candida*

albicans are common causes. Skin disease such as atopic dermatitis, erysipelas, psoriasis and discoid lupus erythematosus involving the ear canal are predisposing factors (2). These conditions present similarly but can also become secondarily infected with bacteria and fungi.

4.1.4 Necrotising otitis externa

It is very important to identify necrotising otitis externa (also called skull base osteomyelitis and previously called 'malignant otitis externa'). This is a severe necrotising infection that spreads from the squamous epithelium of the ear canal into surrounding soft tissues, cartilage and bone. Primarily affecting elderly, diabetic, or immunocompromised individuals, and those who underwent radiotherapy. It is potentially a life-threatening condition with risk of neurological involvement including facial nerve paralysis. Early diagnosis and treatment is essential and *Pseudomonas aeruginosa* is a common causative agent. Necrotising otitis externa can also be caused by fungal pathogens such as Mucorales, and *Scedosporium spp* which can be very difficult to treat. In many cases the initiating infection in the ear canal may settle with topical treatment, but the skull base osteomyelitis may persist. In such cases ear swabs from the ear canal are inadequate in guiding the treatment. Biopsy of the granulation tissue is recommended for microbiological and histopathological examination to exclude other causes, such as malignancy or cholesteatoma (2,4).

Refer to the diagnostic and management algorithm provided by ENT UK on necrotising otitis externa.

4.1.5 Herpes zoster oticus

Herpes zoster oticus, also known as Ramsay Hunt Syndrome, results from the reactivation of the dormant varicella-zoster virus (VZV) in individuals with a history of chickenpox. It presents with facial nerve paralysis, severe ear pain with vesicular rash in the ear and vertigo. The incidence and severity increase with age and in immunocompromised patients. Early diagnosis and management is recommended. Diagnosis is primarily based on clinical evaluation, with confirmation through polymerase chain reaction (PCR) (5,6).

4.2 Middle ear infections – Otitis Media

Otitis media covers a spectrum of diseases, including acute otitis media, acute mastoiditis, chronic otitis media and otitis media with effusion. While less common in adults, the causative organisms and treatment parallel those in children. The more widespread uptake of the pneumococcal vaccination may impact the spectrum of the causative organisms for this condition (7).

An external ear swab is generally not useful in the investigation of otitis media unless eardrum perforation with purulent discharge into the ear canal occurs, and standard treatment is ineffective. Tympanocentesis is rarely necessary for sampling middle ear effusion.

It is essential to differentiate acute otitis media from otitis media with effusion ("glue ear") to prevent unnecessary antibiotics prescriptions. An alternative approach involves antimicrobial prophylaxis through myringotomy and tympanostomy tubes placement (8).

A very common presentation in young children is turbid effusion in the ear, with chronic bacterial infection characterised by recurrent episodes of ear pain and ear or nasal discharge. In these young children without fully developed paranasal sinuses the nasal discharge often reflects the bacterial flora in the middle ear.

For immunosuppressed patients with a history of otitis externa and evidence of necrosis or eardrum perforation, consider the presence of fungal infection.

4.2.1 Acute otitis media

Acute otitis media is defined by middle ear inflammation lasting less than 3 months and is characterised by the presence of purulent fluid in the middle ear usually with signs and symptoms of acute illness, such as fever and earache. It occurs when nasopharyngeal organisms ascend the eustachian tube and are not eliminated by the defence mechanisms of the middle ear, and may occur following a viral upper respiratory tract infection. The most common bacteria that cause this type of infection are *Streptococcus pneumoniae*, *Haemophilus influenzae* and *Moraxella catarrhalis.* Viral pathogens include respiratory syncytial virus (RSV), rhinovirus, adenovirus, influenza virus, and parainfluenza virus (7,9). Diagnosis of acute otitis media can be based on the symptoms as the disease develops and through pneumatic otoscopic examination, with most cases of children resolving without treatment (10).

Consider otitis media as a common complication of measles in high-risk individuals such as infants, children aged <5 years and immunocompromised (11).

4.2.2 Acute mastoiditis

Acute mastoiditis is the most common complication of acute otitis media. It is an acute infection and inflammation in the mastoid, primarily affecting children. *Streptococcus pneumoniae* is the predominant pathogen, followed by *Staphylococcus aureus*, *Streptococcus pyogenes*, and *Haemophilus influenzae. Pseudomonas aeruginosa* is more common in patients with recent recurrent acute otitis media or recent antibiotic use. Surgical intervention is often necessary, providing an opportunity to collect samples for culture sensitivity testing (12,13).

4.2.3 Chronic otitis media

Chronic otitis media is inflammation of the middle ear lasting over 3 months, exists in mucosal and squamous forms. Chronic mucosal otitis media results from ear drum perforation. Chronic squamous otitis media results from retraction of the ear drum into the middle ear with trapped squamous epithelium (often termed cholesteatoma). Chronic otitis media can be further subdivided into active and inactive according to the presence and absence of infection. Repeated infection can be destructive and, if longstanding, can be associated with complications such as hearing loss, facial palsy and intracranial infection. The most common bacterial pathogen is *Pseudomonas aeruginosa* but may rarely result from meticillin resistant *Staphylococcus aureus* (MRSA) with anaerobic bacteria found in 25% of patients (14).

4.2.4 Otitis media with effusion

Otitis media with effusion also known as ‘glue ear’ is characterised by the collection of non-infected fluid in the middle ear space without signs or symptoms of acute ear infection. In most instances, the fluid clears spontaneously and the hearing recovers. It may be asymptomatic but it is the leading cause of childhood hearing impairment,

often affecting children between 6 months and 4 years. Children with Down syndrome or cranio-facial malformation (including cleft palate) are at increased risk of developing otitis media with effusion. Although organisms may be cultured, it is not considered an active infection requiring culture or antimicrobial treatment (15,16).

In adults with significant lymphadenopathy enlargement, consider chronic viral infections, including human immunodeficiency virus (HIV).

4.3 Inner ear infections – labyrinthitis and vestibular neuritis

4.3.1 Labyrinthitis

Labyrinthitis is inflammation of the membranous labyrinth, and can be caused by viruses, bacteria, or systemic diseases. It presents with vertigo, nausea, vomiting, tinnitus, and/or hearing loss. In most cases, labyrinthitis is caused by a viral infection such as varicella zoster virus, cytomegalovirus, herpes, measles, mumps and rubella. Bacterial labyrinthitis is a complication of otitis media or bacterial meningitis. Diagnosis is supported by history, physical examination, and audiometry (17,18). Suppurative labyrinthitis is a severe form, requires management similar to meningitis.

4.3.2 Vestibular neuritis

Vestibular neuritis is inflammation of the vestibular nerve, often following a viral infection or secondary to ischaemia of the anterior vestibular artery. Viruses causing upper respiratory tract infections, such as influenza virus, adenovirus, herpes simplex virus, cytomegalovirus, Epstein-Barr virus, and parainfluenza virus are linked to vestibular neuritis. Herpes simplex virus type I is the most common cause of viral infection of the vestibular. Vestibular neuritis is characterised by acute spontaneous vertigo without hearing loss. Other symptoms include nausea, vomiting, and unsteadiness (19,20).

Hearing loss is a feature of labyrinthitis, but hearing is not affected in vestibular neuronitis.

4.4 Infections associated with medical devices

4.4.1 Hearing aid

The use of a hearing aid can alter the ear canal flora, increasing the risk of fungal and bacterial otitis externa. Symptoms include debris/wax accumulation and irritation, itching and ear discharge. It is recommended to use appropriate hygiene routine to clean and disinfect hearing aids and ear moulds regularly (21). Early sampling/swabbing is advised for patients with secondary ear canal complications related to hearing aid usage, this also applies to the use of ear pods for prolonged period of time.

4.4.2 Tympanostomy tube (grommet)

Tympanostomy tube insertion is a common procedure to improve hearing and reduce middle ear infections. The most common complication of tube insertion is otorrhea (22).

In addition, water precautions are advised to prevent tympanostomy tube related complication.

4.4.3 Cochlear implant

The use of cochlear implants is common in patients with sensorineural hearing loss, particularly in children younger than 3 years. Surgical site infection and acute otitis media leading to bacterial meningitis are rare but severe complication of cochlear implant. It is recommended to have regular check-ups and look for possible signs and symptoms of meningitis and ear infection. In addition, ensure that patient is up to date with their vaccination before having a cochlear implant (23). Early sampling may be useful in case of suspected infections.

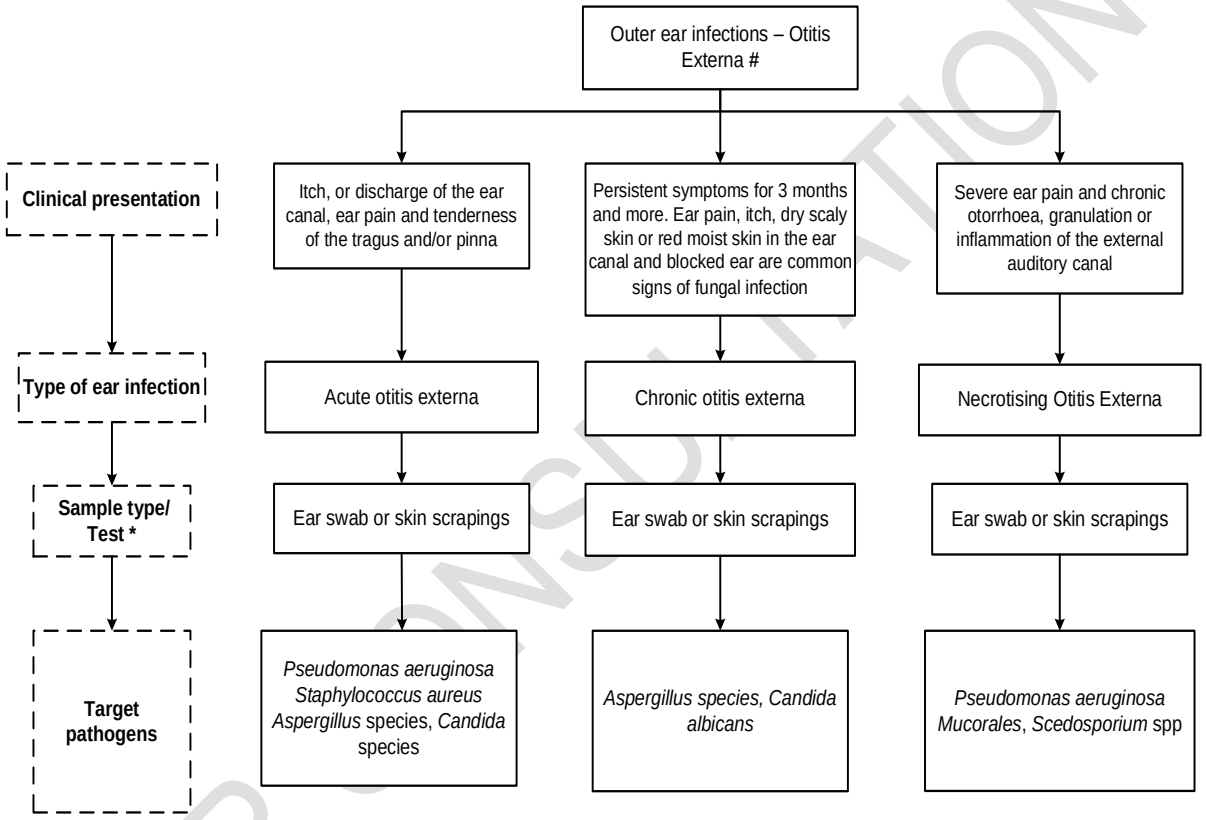
4.5 Treatment based on clinical judgment

In a primary care setting, the management of otitis externa and otitis media is typically guided by clinical presentation, history and otoscopic examination. For otitis externa a topical steroid containing antimicrobial spray is used. For otitis media antibiotics are used for children under 2 years with bilateral acute otitis media or any age with otorrhoea (10). Ear discharge (otorrhoea) is a relative contraindication to antibiotic treatment as the ear is spontaneously draining unless the patient is systemically unwell or immunocompromised.

Patients not responding to treatment or showing symptoms or signs of a more serious illness or condition may benefit from microbiological analysis of samples from the ear. Referral to secondary care may be considered in such cases.

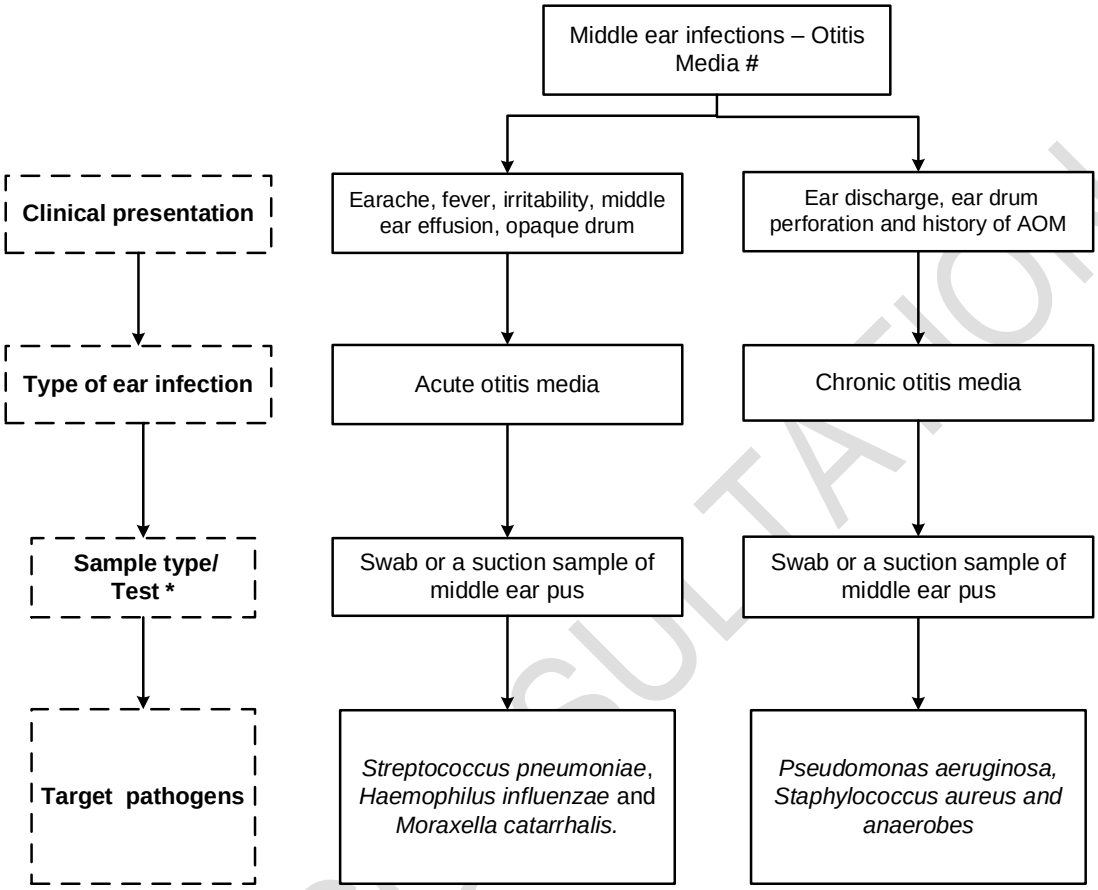
5 Clinical presentations of painful and/or discharging ear

5.1 Outer ear infections – Otitis Externa



1. * Microbiological testing should be pursued if clinically indicated
2. # Some infections can also be caused by upper respiratory viral infections, refer to section 4 for more information

5.2 Middle ear infections – Otitis Media



1. * Microbiological testing should be pursued if clinically indicated
2. # Some infections can also be caused by upper respiratiory viral infections, refer to section 4 for more information

Note: Otitis media with effusion: no microbiological testing required

6 Pre-laboratory processes (pre-analytical stage)

6.1 Specimen type

Main indications for microbiological diagnosis are; severe or unusual presentation, post-surgical and device associated infections, poor response to standard treatment and infection in immunocompromised patient.

The type of specimens include (if clinically indicated):

- Otitis Externa:
  - Ear swab
  - Skin scrapings from pinna for fungal diagnostics
  - Herpes zoster oticus: swab from skin lesions are preferred sample for detecting VZV from the external ear (24).

    Notes:

    Swabs taken from the nasopharynx for diagnosis of ear infections are inappropriate and should be discarded according to local protocols.

    Send a swab sample from the affected ear for culture and sensitivity.

    If seborrheic dermatitis of auricle is suspected skin scrapings may be required. Please refer to UK SMI B 39 – investigation of dermatological specimens for superficial mycoses.

    In the case of skull base osteomyelitis, early sampling particularly in vulnerable patients is recommended.

- Otitis Media:
  - Swab or a suction sample of middle ear pus.
  - Under specialist guidance by the ENT: a nasal swab may be useful for a young child suffering from recurrent episodes of painful ear with nasal discharge.
  - For investigation of complex fungal infection, scrapings of material from the ear canal are preferred as they allow direct microscopy although swabs can also be used if direct microscopy is not required.

- Device associated infections:
  - Swab

Under specialist guidance: for hearing aid and cochlear implant users early sampling/swabbing of the affected area may be useful

6.2 Specimen collection and handling (25)

- Collect specimens as soon as possible after onset of symptoms.

- Collect all specimens before antimicrobial or antifungal therapy where possible
- Swabs should be slim enough to comfortably fit in the ear canal.
- When collecting samples from the ear to aid in diagnosis, the tip of the microbiology swab should only touch the site of infected debris to minimise risk of contamination with normal commensal bacteria. When using a swab to collect middle ear pus the outer ear canal should be first cleaned for the same reason. It is not necessary to wear sterile gloves or prepare the surrounding skin.
- For investigation of fungal infection, the same swabbing technique should be applied as for bacterial infections.
- Care should be taken with wooden swabs, which can be contaminated with fungi, in particular *Aspergillus* species.
- For intact ear drum, clean ear canal to remove any scabbing and superficial debris and collect fluid via syringe aspiration technique
- For ruptured ear drum, collect fluid on flexible shaft swab via auditory speculum
- For outer ear use a moistened swab to remove any debris or crust from the ear canal. Obtain a sample by firmly rotating swab in the outer canal (26).

Refer to current guidance on the safe handling of all organisms documented in the UK SMI general safety document.

6.3 Specimen transport and storage

This section covers specimen transport and storage consideration related to this UK SMI, and should be read in conjunction with the scientific information on the UK SMI website

- Unless otherwise stated, swabs for bacterial and fungal culture should be placed in appropriate transport medium.
- Pus samples other than swabs should be collected in CE marked leak-proof containers and placed in sealed plastic bags.

All specimens should be transported and processed as soon as possible. If processing is delayed, refrigeration is preferable to storage at ambient temperature.
For safety considerations refer to Section 6.5.

6.4 Relevant clinical history details needed on patient request forms when referring samples to the laboratory

Full clinical details and information on patient history should be provided with clinical requests.

These details should include:

- specimen date and time of collection

- where the sample has been taken from, such as the outer ear and middle ear
- type of infection suspected
- type of swab/sample sent to the laboratory
- immune status
- other relevant information (travel history, occupation, trauma, ENT surgery, presence of grommets, hearing aid wearer, water exposure)

6.5 Safety considerations

The section covers specific safety considerations (25,27-47) related to this UK SMI, and should be read in conjunction with the general safety considerations on the UK SMI website.

Containment Level 2.

Containment level 3 organisms are extremely rare causes of painful and or discharging ear.

Collect specimens in appropriate CE marked leak proof containers and transport in sealed plastic bags.

Collect swabs into appropriate transport medium.

Compliance with postal, transport and storage regulations is essential.

Laboratory procedures that give rise to infectious aerosols must be conducted in a microbiological safety cabinet.

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

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

7 Laboratory processes (analytical stage)

7.1 Microscopy

7.1.1 Specimen processing:

- Swab: microscopy is not recommended for external ear swabs
- Pus: middle ear pus should be assessed by microscopy
- Skin Scrapings: should be assessed by microscopy

If skin scrapings from the ear canal are sent specifically for fungal investigation a fungal stain (potassium hydroxide – calcofluor white (KOH-CFW) preparation) should be performed. Refer to TP 39 – Staining procedures for detailed protocols for bacterial and fungal staining.

For safety considerations refer to Section 6.5.

7.2 Culture

7.2.1 Specimen processing:

- Swab: Inoculate each agar plate directly by rolling the swab on a part of the plate (refer to Q 5 - Inoculation of Culture Media for Bacteriology). Swabs taken from the nasopharynx for diagnosis of ear infections are inappropriate and should be discarded according to local protocols
- Pus: Using a sterile pipette inoculate each agar plate with the specimen (refer to UK SMI B14 – Investigation of pus and exudates)
- Skin Scrapings: If scrapings of material from the ear canal are sent for investigation use a sterile loop to inoculate the material onto agar

For the isolation of individual colonies, spread inoculum with a sterile loop.

For safety considerations refer to Section 6.5.

Table 2: Investigation

Clinical details/ conditions	Specimen	Standard media	Incubation			Cultures read	Target Organisms
			Temperature °C	Atmosphere	Time		
External Ear Infection: Acute localised otitis externa Necrotising otitis externa Acute diffuse otitis externa Chronic otitis externa	All swabs / Pus / Tissues	Chocolate agar with or without bacitracin[a]	35 to 37	5 to 10 % CO_2	40 to 48hr	daily	**Top Pathogens:** *H. influenzae* *M. catarrhalis* *S. pneumoniae* *Lancefield group A streptococcus* Other organisms in pure growth may be significant. Consider *Neisseria meningitidis* when bacterial meningitis suspected
Internal Ear Infection: Acute otitis media Acute mastoiditis Chronic otitis media	All swabs/ Pus / Tissues	Blood agar[a] And / Or Staph/strep selective agar	35 to 37 35 to 37	5 to 10 % CO_2 Air	40 to 48hr 40 to 48hr	daily daily	*M. catarrhalis* *S. pneumoniae* *S. aureus* Lancefield Groups A,C,G and F Streptococcus anginosus group Other organisms in pure growth may be significant

Internal Ear Infection: Acute mastoiditis Recurrent acute otitis media Chronic otitis media	All swabs	CLED or MacConkey agar	35 to 37	Air	16 to 24hr	greater than 16hr	**Top Pathogen:** *Pseudomonas aeruginosa*
External Ear Infection: Acute diffuse otitis externa Chronic otitis externa Necrotising otitis externa	Swabs Tissues / Pus	Neomycin fastidious anaerobe agar with metronidazole 5µg disc	35 to 37	Anaerobic	48hr – 7d*	greater than 40hr	Anaerobes Polymicrobial infections possible, extended incubation recommended for osteomyelitis
Internal Ear Infection: Recurrent acute otitis media Chronic otitis media Acute mastoiditis	Swabs Tissues / Pus	CLED or MacConkey agar	35 to 37	Air	16 to 24hr	greater than 16hr	**Top Pathogen:** *Pseudomonas aeruginosa* Clinical circumstances determines the significance of the following isolates, consider reporting for pus /tissue samples or when necrotising infection present Pseudomonads Enterobacterales Other nonfermenting Gram negative bacilli

External Ear Infection: Acute diffuse otitis externa Chronic otitis externa Necrotising otitis externa	Tissues / Pus / Swabs / Skin scrapings	Sabouraud dextrose agar **c**	30 to 37	air	40-48h**b**	daily	Fungi Yeasts
All immunocompromised patients with necrotic infections **External Ear Infection:** Necrotising otitis externa	Tissues / Pus / Swabs / Skin scrapings	Sabouraud dextrose agar **c**	28 to 30	air	14d	weekly	Fungi Moulds

a may include either a bacitracin 10 unit disc or bacitracin incorporated in the agar. When bacitracin is incorporated into the plate a separate blood agar plate incubated in 5 to 10% CO2 will need to be put up to detect *M. catarrhalis* and *S. pneumoniae.*

b in cases where extended incubation is clinically indicated then incubation may be extended to 7 days for isolation of moulds. In such cases plates should be read at greater than 40hr for early sign of growth and then left in the incubator/cabinet until day 7. Certain opportunistic pathogens will require extended incubation.

For fungal culture, one SABC plate should be used per sample and streaked as per routine and standard bacteriology practice. It is highly recommended that SABS plates be sealed with gas-permeable tape or alternatively placed inside a sealable plastic bag during incubation to avoid cross contamination. Incubation of SABC plates in 'automated incubation and imaging' modules may lead to fungal contamination of modules and other cultures. No fungal isolate should be dismissed as a 'contaminant' without full identification.

c Supplemented with chloramphenicol or gentamicin

In patients coming from endemic regions tuberculous granuloma of the middle ear should be considered and appropriate cultures set up see B 40 – Investigation of Specimens for *Mycobacterium* species.

7.3 Identification

Refer to individual UK SMIs for organism identification.

All clinically significant isolates should be identified to species level.

Note: Any organism considered to be a contaminant may not require identification to species level. Organisms may be identified further if clinically or epidemiologically indicated.

7.4 Molecular testing

Investigation of varicella-zoster virus (VZV):

- NAAT testing is the most sensitive method for confirming a diagnosis of varicella to detect VZV in skin lesions (24).
- Deep sterile site samples may benefit 16S and or panfungal PCR

8 Post-laboratory processes (post analytical stage)

8.1 Microscopy

8.1.1 Reporting microscopy

Report microscopy results as:

Gram's stain

1. Report presence of WBC's
2. Report if organisms detected.

Fungal stain

1. Report presence or absence of fungal elements
2. Differentiate between yeasts and filamentous hyphae (moulds).
3. Where possible provide a description of the filamentous hyphae observed.

Notes:
The presence of broad, aseptate or pauci-septate hyphae with wide-angle branching is consistent with Mucorales. The presence of regularly septate hyphae with 45°C branching is consistent with *Aspergillus spp* but could represent other hyaline fungi such as *Scedosporium spp*.

Reports simply stating fungal elements seen, with no differentiation are of limited clinical utility and should be avoided.

8.1.2 Microscopy reporting time

Interim or preliminary results should be issued on detection of clinically significant results as soon as growth is detected, unless specific alternative arrangements have been made with the requestors.

In immunocompromised patients or when fungal investigation is specifically requested, microscopy positive fungal results indicating presence of filamentous hyphae indicative of mucoraceous mould (members of Mucorales) or *Aspergillus species* should be immediately communicated to the consultant looking after the patient or an infection consultant liaising with the clinical teams.

Urgent results should be telephoned or transmitted electronically in accordance with local policies.

Final written or computer generated reports should follow preliminary and verbal reports as soon as possible.

8.2 Culture

8.2.1 Reporting Culture

Bacterial culture

- Clinically significant organisms with antimicrobial susceptibility results
- No growth of clinically significant organisms*
- No growth

* Identification should not be reported for organisms of no clinical significance.

Fungal culture

- Yeasts should be reported along with an indication of growth quantity of scantly/light, moderate or heavy to allow for interpretation of significance.
- Any isolation of filamentous fungi should be reported
- No fungal growth

Note:

The presence of fungi should be documented even when a fungal culture is overgrown by chloramphenicol-resistant Gram-negative bacterial (e.g., Pseudomonas spp.). This should be noted in the result and not reported as ‘fungi not isolated’.

All clinically significant isolates should be identified to species level (for yeast species level identification is essential in recurrent or recalcitrant infections).

8.2.2 Culture reporting time

Interim or preliminary results should be issued promptly upon detection of clinically significant isolates as soon as growth is detected, unless specific alternative arrangements have been made with the requestors.

Urgent results should be conveyed through telephone or transmitted electronically in accordance with local policies.

Final written or computer-generated reports should follow preliminary and verbal reports as soon as possible.

8.3 Reporting other tests including molecular testing

As newer and more novel methods are becoming available, their validation and reporting would be as per local laboratory testing protocol.

9 Antimicrobial susceptibility testing

Laboratories should test and interpret antimicrobial susceptibility using the criteria in The European Committee on Antimicrobial Susceptibility Testing (EUCAST), refer to EUCAST guidelines for breakpoint information.

Alternatively, isolates can be sent to an appropriate specialist or reference laboratory.

9.1 Reporting of antimicrobial susceptibility testing

Report susceptibilities as clinically indicated. Prudent use of antimicrobials according to local and national protocols is recommended.

References

An explanation of the reference assessment used is available in the scientific information section on the UK SMI website.

1. Thaw MH. Otitis Externa. Global ENT 2023.**++**

2. Wiegand S and others. Otitis Externa. Dtsch Arztebl Int 2019: volume 116, issue 13, pages 224-34.**1+** 10.3238/arztebl.2019.0224

3. Rosenfeld RM and others. Clinical practice guideline: acute otitis externa. Otolaryngol Head Neck Surg 2014: volume 150, issue 1 Suppl, pages S1-s24.**2+** 10.1177/0194599813517083

4. Barry V and others. Otitis externa. BMJ 2021: volume 372, pages n714. 10.1136/bmj.n714

5. Sweeney CJ, Gilden DH. Ramsay Hunt syndrome. J Neurol Neurosurg Psychiatry 2001: volume 71, issue 2, pages 149-54.**2+** 10.1136/jnnp.71.2.149

6. NICE. Shingles. 2023.**++** https://cks.nice.org.uk/topics/shingles/

7. Schilder AG and others. Otitis media. Nat Rev Dis Primers 2016: volume 2, issue 1, pages 16063.**2+** 10.1038/nrdp.2016.63

8. Jonathan Cohen WGP, Steven M. Opal Infectious Diseases E-Book: Expert Consult Premium Edition: Enhanced Online Features and Print; 2016. **+**

9. Atkinson H and others. Acute otitis media. Postgraduate Medicine 2015: volume 127, issue 4, pages 386-90.**2+** 10.1080/00325481.2015.1028872

10. NICE. Otitis media (acute): antimicrobial prescribing [NG91]. 2018.**++**

11. National Center for Immunization and Respiratory Diseases DoVD. 'Measles (Rubeola)'.'last updated' 2020 '(viewed on' https://www.cdc.gov/measles/hcp/index.html **+**

12. E.Warner GM, L.Collin, K.Seymour, M. Wareing, P.Monksfield. Acute mastoiditis guideline. British Society of Otology 2020.

13. Mather M and others. Acute mastoiditis in children: contemporary opportunities and challenges. J Laryngol Otol 2020: volume 134, issue 5, pages 434-9.**2+** 10.1017/s0022215120000833

14. Cunningham M and others. Otitis media. Future Microbiol 2012: volume 7, issue 6, pages 733-53. 10.2217/fmb.12.38

15. Rosenfeld RM and others. Clinical Practice Guideline: Otitis Media with Effusion (Update). Otolaryngol Head Neck Surg 2016: volume 154, issue 1 Suppl, pages S1-s41.**1+** 10.1177/0194599815623467

16. Blanc F and others. Management of otitis media with effusion in children. Société française d'ORL et de chirurgie cervico-faciale clinical practice guidelines. Eur Ann Otorhinolaryngol Head Neck Dis 2018: volume 135, issue 4, pages 269-73.**+** 10.1016/j.anorl.2018.04.008

17. Taxak P, Ram C. Labyrinthitis and Labyrinthitis Ossificans - A case report and review of the literature. J Radiol Case Rep 2020: volume 14, issue 5, pages 1-6. 10.3941/jrcr.v14i5.3706

18. Isaacson B MB, Joni K D, Iain S. Labyrinthitis. BMJ Best Practice 2021.**2++**

19. NICE. 'Vestibular neuronitis'.'last updated' 2023 '(viewed on' 2023) https://cks.nice.org.uk/topics/vestibular-neuronitis/

20. Bae CH and others. Current diagnosis and treatment of vestibular neuritis: a narrative review. J Yeungnam Med Sci 2022: volume 39, issue 2, pages 81-8.**2+** 10.12701/yujm.2021.01228

21. Karaca ÇT and others. External auditory canal microbiology and hearing aid use. American Journal of Otolaryngology 2013: volume 34, issue 4, pages 278-81.**2+** https://doi.org/10.1016/j.amjoto.2012.12.002

22. Schmelzle J and others. Acute otitis media in children with tympanostomy tubes. Can Fam Physician 2008: volume 54, issue 8, pages 1123-7.**1+**

23. Rubin LG, Papsin B. Cochlear implants in children: surgical site infections and prevention and treatment of acute otitis media and meningitis. Pediatrics 2010: volume 126, issue 2, pages 381-91.**1+** 10.1542/peds.2010-1427

24. National Center for Immunization and Respiratory Diseases DoVD. 'Chapter 17: Varicella'.'last updated' 2018 '(viewed on' https://www.cdc.gov/vaccines/pubs/surv-manual/chpt17-varicella.html#laboratory **2++**

25. 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. pages 1-37. **++**

26. Karen C. Carroll MAP Manual of Clinical Microbiology; 2019. **+**

27. British Standards Institution (BSI). BS EN12469 - Biotechnology - performance criteria for microbiological safety cabinets 2000. **++**

28. Home Office. Public Health Act (Northern Ireland) 1967 Chapter 36. 1967. **++**

29. The Royal College of Pathologists. The retention and storage of pathological records and specimens (5th edition). pages 1-59. 2015. **++**

30. The Welsh Assembly Government. Health Protection Legislation (Wales) Guidance. 2010. **++**

31. Scottish Government. Public Health (Scotland) Act. 2008. **++**

32. Department of Health. Health Protection Legislation (England) Guidance. pages 1-112. 2010. **++**

33. Home Office. Anti-terrorism, Crime and Security Act. 2001. **++**

34. Department for Transport and others. Transport of infectious substances UN2814, UN2900 and UN3373 Guidance note number 17/2012 (revision 7). 2013. **++**

35. Advisory Committee on Dangerous Pathogens. The Approved List of Biological Agents. Health and Safety Executive 2021. pages 1-39. **++**

36. Health and Safety Executive. Risk assessment: A brief guide to controlling risks in the workplace. HSE. 2014. **++**

37. Centers for Disease Control and Prevention. Guidelines for Safe Work Practices in Human and Animal Medical Diagnostic Laboratories. MMWR Surveill Summ 2012: volume 61, pages 1-102.**+**

38. Gizzie N, Adukwu E. Evaluation of Liquid-Based Swab Transport Systems against the New Approved CLSI M40-A2 Standard. J Clin Microbiol 2016: volume 54, issue 4, pages 1152-6.**2+** 10.1128/JCM.03337-15

39. Tyrrell KL and others. Comparison of the Copan eSwab System with an Agar Swab Transport System for Maintenance of Fastidious Anaerobic Bacterium Viability. J Clin Microbiol 2016: volume 54, issue 5, pages 1364-7.**2+** 10.1128/JCM.03246-15

40. World Health Organization. Guidance on regulations for the transport of infectious substances 2019-2020. WHO. 2019. **++**

41. Health and Safety Executive. Safe use of pneumatic air tube transport systems for pathology specimens. 2009. **++**

42. 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. pages 1-14. **++**

43. Health and Safety Executive. Blood-borne viruses in the workplace. Guidance for employers and employees. HSE. 2001. **++**

44. Health and Safety Executive. Control of Substances Hazardous to Health Regulations. The Control of Substances Hazardous to Health Regulations 2002 (as amended). Approved Code of Practice and guidance L5 (sixth edition). HSE Books. 2013. **++**

45. Health and Safety Executive, Advisory Committee on Dangerous Pathogens. Management and operation of microbiological containment laboratories. HSE. 2019. **++**

46. Health Services Advisory Committee. Safe working and the prevention of infection in clinical laboratories and similar facilities. Books. H 2003. **++**

47. Agency UHS. Laboratory reporting to UKHSA: a guide for diagnostic laboratories. UKHSA 2023. pages 1-31. **++**