Consensus of microbiology reporting of ear swab results to primary care clinicians in patients with otitis externa

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ABSTRACT

Otitis externa is a ubiquitous inflammatory disease; although it arises most commonly from an infection, there is no consensus in the UK for the reporting of ear swab culture results. This study aims to review current microbiology laboratory reporting of ear swab specimens to primary care and reach an evidence-based consensus for a reporting policy. Fifty consecutive ear swab reports were reviewed from each of 12 laboratories in the South West region to determine and discuss reporting practice. The Health Protection Agency (HPA) GP Microbiology Laboratory Use Group reviewed the underlying evidence and worked towards a consensus of expert microbiology opinion for laboratory reporting of ear swab results using a modified version of the Delphi technique. A total of 487 reports from primary care were reviewed (54% female; 46% male). Cultures most commonly yielded *Pseudomonas* species (36%), *Staphylococcus* species (21%), *Streptococcus* species (15%) and fungi (11%). Five reporting policies were agreed: Policy 1: Common pathogens such as group A β-haemolytic streptococci, *Streptococcus pneumoniae*, *Staphylococcus aureus* – Always reported by name with antibiotic susceptibilities. Policy 2: *Pseudomonas* species – Always reported, but antibiotic susceptibilities only reported in severe disease. Policy 3: *Aspergillus*, *Candida*, coliforms and *Proteus* species, as well as non-group A streptococci and anaerobes – Only reported if moderate numbers of colonies and it is the predominant organism present; if appropriate report antibiotic susceptibilities. Policy 4: Coagulase-negative staphylococci, diphtheroids and enterococci – Not reported by name; generic terms used and antibiotic susceptibilities not reported. Policy 5: When antibiotic susceptibilities reported these must include susceptibility to a topical antibiotic. It is suggested that laboratories should consider adopting this evidence-based reporting consensus for ear swab culture results from primary care patients with otitis externa.

Key Words: Ear swabs.
Primary care.
Otitis externa.
Delphi consensus

Introduction

Otitis externa (OE) is one of the most common conditions seen in general medical practice, affecting about 1.2–1.3% per annum and presents with otalgia and otorrhoea.[1,2] It is an inflammatory disease which can be acute or chronic. The acute form is frequently caused by bacterial or fungal infection,[3] commonly precipitated by moisture, trauma and conditions such as psoriasis and eczema.

Complications include canal oedema and occlusion, abscess formation, cellulitis of the pinna and face, perichondritis and parotitis. Fibrosis can lead to permanent canal stenosis and conductive deafness. The tympanic membrane may become inflamed (myringitis) and perforate. Skull base osteomyelitis, often referred to as malignant otitis externa, is a rare, potentially life-threatening infection usually seen in diabetics.[4]

Appropriate management of OE depends not only on familiarity with the clinical presentation, anatomy and physiology of the external auditory canal, but also on an understanding of potential pathogens.[5] General practitioners usually manage OE with empiric topical drops containing antiseptics or antibiotics, with or without steroids.[6] Ear swabs may be taken for culture and susceptibility testing either before initiation of therapy or, more commonly, in cases not responding to routine treatment and those in which complications develop. Identifying the causal organism and its antibiotic susceptibility profile in these cases may assist further management.

Despite the frequency of OE, there is no consensus on reporting of ear swab culture results by microbiology laboratories in the UK. Although Health Protection Agency (HPA) Standard Operating Procedures (SOPs)[7] are used for processing ear swabs in UK microbiology laboratories, neither consensus nor guidance exist on how culture and antibiotic susceptibility results should be

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reported. An agreed policy of standardised reporting is important as it will promote appropriate antibiotic usage[8,9] and minimise potential side effects of ototopical and oral medication.[10]

This study aims to i) determine how microbiology laboratories currently report ear swab culture results to primary care, and ii) develop consensus on evidence-based best-practice reporting. It is hoped that this work will prompt microbiology laboratories to review their primary care laboratory reporting protocols.

Materials and methods

The HPA General Practice Microbiology Laboratory Use Group, which comprises microbiologists and a general practitioner (GP), conducted a reporting audit of 16 microbiology laboratories' ear swab results for primary care in the south and south-west of England. Each laboratory collected 50 consecutive ear swab reports commencing 1 June 2006. Data on ear swab submissions were descriptively analysed to determine patient demographics, organisms

Table 1. Organisms and antimicrobial susceptibilities listed on ear swab reports to primary care from laboratories and comparison to other studies.

		This study			Normal ear studies		Otitis externa studies		
Organism (group, genus or species) as reported		**Organisms reported**		**Susceptibility reported**	**Stroman *n*=164**	**Dibb *n*=77**	**Ninkovic *n*=116**	**Arshad *n*=124**	**Roland *n*=2039**
		n	**%**	**%**	**%**	**%**	**%**	**%**	**%**
Anaerobes	Anaerobes	12	3	100			6.3		
	Mixed anaerobes	35	7	77					
Coliforms	Coliforms	30	6	41				Yes	~2
	Escherichia coli	1	<0.5	0				Yes	
	Enterobacter cloacae	1	<0.5	0					
	Proteus spp.	6	1	67				Yes	
Gram negative					5.1	4			
Coryneforms					22				
Fungi	Fungi	NA	NA		10	Variety			~2.2
	Yeasts unidentified	22	4	0					
	Candida spp.	19	4	0			9.7		
	Candida albicans	1	<0.5	0					
	Aspergillus spp.	1	<0.5	0			4.2		
	Aspergillus niger	8	2	0					
	Aspergillus fumigatus	2	<0.5	0					
	Aspergillus flavus	1	<0.5	0					
	Scedosporium sp.	1	<0.5	0					
H. influenza		20	4	100					
M. catarrhalis		3	1	100					
No significant growth	No significant growth	49	10	0	11.2	5		13	
	Skin flora	53	11	0					
	Diphtheroids	23	5	0		32			
	Mixed growth	33	7	0					
Pseudomonads	*Pseudomonas* spp.	85	18	79	5.1				
	P. aeruginosa	91	19	70	1.3		45	38	38
Streptococci	*S. pneumoniae*	22	5	100	7		0.7		
	Group A (*pyogenes*)	29	6	100			1.4		
	Group B (*agalactiae*)	10	2	80					
	Group C	2	<0.5	100					
	Group D (*enterococcus/bovis*)	1	<0.5	0				'yes'	1.9
	Group G	10	2	100			3		
S. aureus	*S. aureus*	102	21	98		7	9	38	7.8
	MRSA	7	1	100			0.7		
Other staphylococci	Coagulase-negative	16	3	0	63	83			7.3
	S. epidermidis	15	3	0		Majority			9.1

cultured, susceptibilities reported and comments appended. The number of ear swabs submitted by GPs throughout 2006 in seven laboratories was used to calculate the annual rate of submission.

Consensus on a reporting policy was gained using a modified version of the Delphi technique, through five rounds of deliberation, via email and three face-to-face meetings. The results of the laboratory report survey were discussed within the HPA GP Microbiology Laboratory Use Group and a preliminary reporting policy was drafted. By email, group members anonymously rated their agreement for each organism's reporting category on a four-point Likert scale. Extensive literature searches to underpin the rationale for the guidance were undertaken using Medline, AMED, BNI, CINAHL, Embase, Health Business Elite, HMIC, PsycoINFO and Guidelines Clearing House. The policies and evidence were then debated by the HPA GP Microbiology Laboratory Use Group and, subsequently, by the larger South West Microbiologists Group, comprising 40 clinical microbiologists, biomedical scientists and infectious disease clinicians. Experts in mycology, anaerobes and otolaryngology were also consulted. The guidelines were recirculated for final agreement in 2008.

Results

Review of current microbiology laboratory reporting

Twelve of 16 (75%) south-west laboratories returned a total of 587 ear swab reports, with 487 reports originating from general practice. One report was excluded due to an error in the antibiotic susceptibilities. The mean rate of GP ear swab submissions to laboratories was 348 per 100,000 population per year (range: 69–589 per 100,000 population per year). Ear

Table 2. Draft reporting Policies 1–5 formulated at the first face-to-face meeting of microbiologists, and agreement on a Likert Scale with the draft policy ascertained by emailed questionnaire.

Organism	Number of participants who agreed or disagreed with the assignment of organism to each reporting policy							
	Strongly agree		Agree		Disagree		Strongly disagree	
	No.	%	No.	%	No.	%	No.	%
Policy 1: Always report organism by name and antibiotic susceptibilities should be included.								
Group A streptococci	14	87.5	2	12.5				
Streptococcus pneumoniae	14	87.5	2	12.5				
Haemophilus influenzae	13	81.3	3	18.8				
Staphylococcus aureus	12	75.0	4	25.0				
Moraxella catarrhalis	5	33.3	7	46.7	3	20.0		
Policy 2: Always report organism by name but antibiotic susceptibilities should only be reported under specific circumstances.								
Pseudomonas species: Susceptibilities included if cellulitis or malignant otitis externa	6	40.0	5	33.3	2	13.3	2	13.3
Policy 3: Organism should only be reported if isolated in pure and heavy growth. If appropriate, antibiotic susceptibilities should be given.								
Aspergillus species	4	25.0	4	25.0	5	31.3	3	18.8
Candida species	4	25.0	5	31.3	6	37.5	1	6.3
Coliform species	3	21.4	5	35.7	4	28.6	2	14.3
Proteus species (report as coliform species)	3	20.0	6	40.0	5	33.3	1	6.7
Other streptococci (non-group A) species	3	20.0	7	46.7	2	13.3	3	20.0
Policy 4: Organism should not be reported by name. Generic terms should instead be used. For example, skin flora, mixed growth or no pathogen isolated. Antibiotic susceptibilities should not be reported.								
Anaerobic species	5	33.3	2	13.3	7	46.7	1	6.7
Staphylococcus epidermidis	11	73.3	3	20.0	1	6.7		
Other coagulase-negative staphylococci	12	75.0	3	18.8	1	6.3		
Diphtheroids	11	68.8	3	18.8	1	6.3	1	6.3
Enterococci	8	53.3	5	33.3	2	13.3		
Policy 5: When antibiotic susceptibilities are reported, these must include susceptibility to a topical antibiotic.								
All organisms for which antibiotic susceptibilities are reported	6	37.5	5	31.3	4	25.0	1	6.3

swabs were submitted from 262 females (54%) and 224 males (46%). The mean age of patients was 37.1 years; 24% of swabs were from patients aged less than 10 years (Fig. 1).

Clinical details

The most common clinical information recorded was discharge (132; 27%), otitis externa (101; 20%) and otitis media (17; 3.5%). Malignant OE was not recorded for any clinical specimen. Current or previous antibiotic treatment was stated for 78 patients (16%), but intended treatment was only given in 14 (3%). No clinical details were completed for 170 patients (35%). Children under 10 years had discharge/otorrhoea recorded more frequently (39%) and otitis externa (5.1%) less frequently than in other age groups.

Organisms and antibiotic susceptibilities reported

Although all laboratories in the review reported well-recognised pathogens by name, together with antibiotic susceptibilities, there was a wide range of reporting policies for the other organisms and the antibiotic susceptibilities listed varied widely. Clinical details were not given in a third of requests, making interpretation of cultures more difficult for the microbiologists. The organisms most frequently reported were *Pseudomonas* spp. (36%), *Staphylococcus aureus* (22%), *Streptococcus* spp. (15%), of which 6% were group A, and fungi (11%). Anaerobic bacteria (10%) and *Haemophilus influenzae* (4%) were less commonly reported. All laboratories reported antimicrobial susceptibilities for *Streptococcus pneumoniae*, *H. influenzae*, *Streptococcus* groups A, G and C, *Moraxella catarrhalis* and methicillin-resistant *Staphylococcus aureus* (MRSA); 98% reported susceptibilities for *S. aureus* isolates and 70% for *Pseudomonas aeruginosa*. No antimicrobial susceptibilities were reported for coagulase-negative staphylococci (including those listed as *Staphylococcus epidermidis*), fungi (including *Aspergillus* species) or skin flora/diphtheroids (Table 1).

Range of antibiotic susceptibilities reported

For *S. aureus*, many different antimicrobials were reported, most commonly erythromycin (99%), flucloxacillin (97%) and gentamicin (54%). For *P. aeruginosa*, antibiotic susceptibilities most frequently reported were gentamicin (84%), colistin (63%) and ciprofloxacin (52%); for group A streptococci, erythromycin (93%) and penicillin (79%) were reported; and for anaerobes or mixed anaerobes, only metronidazole susceptibility was reported.

Consensus on guideline for standardised reporting policies

The reporting strategy with four categories of organisms was drafted at the first face-to-face meeting when the reporting audit results were discussed, and the results of the anonymous opinion survey on this draft strategy are shown in Table 2.

Policy 1: Microbiology experts unanimously agreed that group A streptococci, *Streptococcus pneumoniae*, *H. influenzae* and *Staphylococcus aureus* should be reported to species level and antibiotic susceptibilities always stated; 80% also supported this policy for *M. catarrhalis*.

Policy 2: Eleven microbiologists (73%) agreed that *P. aeruginosa* and other *Pseudomonas* spp should be reported, but only with antibiotic susceptibilities under specific

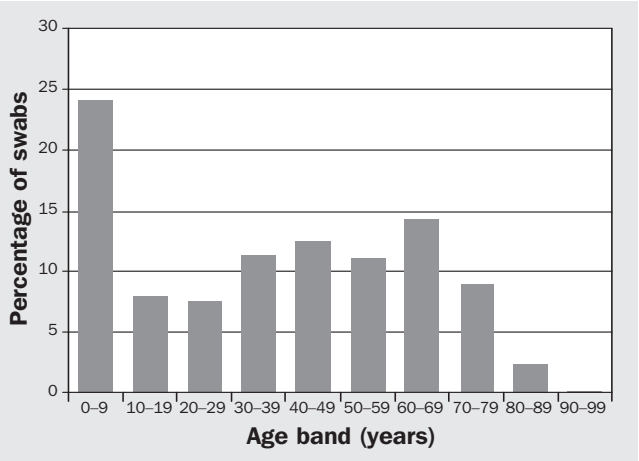

Fig. 1. Submission of ear swabs by age band.

circumstances. Two laboratories surveyed considered that antibiotic susceptibilities for *Pseudomonas* species should always be reported.

Policy 3: Five or more experts disagreed with the wording of this proposed reporting policy for: *Aspergillus*, *Candida*, coliforms, *Proteus* spp., non-group A streptococci and anaerobes. Policy 3 was, therefore, reworded to read: "Organism should only be reported if moderate numbers of colonies, and it is the predominant organism present".

Policy 4: Thirteen (87%) microbiologists agreed that susceptibilities should not be given for *Staphylococcus epidermidis*, other coagulase-negative staphylococci, diphtheroids and enterococci, and should only be reported in generic terms and not by name.

A fifth reporting policy on reporting of topical antimicrobials was proposed: Eleven (69%) microbiologists agreed that reporting of susceptibility to topical antimicrobials should be standard practice whenever systemic susceptibilities are listed. Concern was raised about making general all-encompassing statements regarding organisms and susceptibilities, as clinical details accompanying such specimens are important in determining the isolate's significance. It was agreed that, in addition to these recommendations, the treatment recommendations for each patient had to be tailored to their particular clinical scenario. Therefore, many microbiologists suggested including comments with reports, but this was impossible with some computer systems.

The final consensus reporting guidelines reached after due consideration after two further face-to-face meetings and one further email circulation are presented in Table 2 with the evidence discussed below (Box).

Discussion

It is important to recognise commensal flora of the external ear canal skin and cerumen before discussing the significance of culture results and reporting of potential pathogens. Two studies (Table 1)[11,12] identified that normal flora of the healthy outer ear canal comprises mainly coagulase-negative staphylococci (63–83%), especially

BOX. Agreed reporting policies for organisms isolated from ear swabs submitted to the microbiology laboratory from primary care derived from consensus of expert opinion and search of evidence

Policy	Organism	Organism Reporting	Antibiotic Susceptibility Reporting
1	Group A streptococci *Streptococcus pneumoniae* *Haemophilus influenzae* *Staphylococcus aureus* *Moraxella catarrhalis*	Always report organism by name	Always report
2	*Pseudomonas* species	Always report organism by name	Report only severe disease
3	*Aspergillus* species – rarely commensal	Organism should only be reported if moderate numbers and it is the predominant growth	No resistance present so no need to perform susceptibility. Advise treatment without repeat
	Group C, G & F streptococci Anaerobes		Suppress susceptibility as topical treatment first line
	Candida species, coliforms, *Proteus* species – can be commensals		Report if refractory infection
4	*Staphylococcus epidermidis* Other coagulase-negative staphylococci Diphtheroids Enterococci	Organism should not be reported by name. Generic terms should instead be used. For example skin flora, mixed growth or no pathogen isolated	None
5	When antibiotic susceptibilities are reported, these should include susceptibility to a topical aural antibiotic		To include topical antibiotic available to UK GPs: neomycin/gentamicin/framycetin or chloramphenicol or clotrimazole

Staphylococcus epidermidis. Diphtheroids are also common (22–32%) and a variety of yeast species are recognised fairly frequently (10%). *Staphylococcus aureus* is a much less common finding (<7%). Gram-negative bacteria are rare (<5%). No anaerobes were cultured in these studies (Table 1). In contrast, the most common organisms isolated in studies of OE presenting to secondary care are *Pseudomonas aeruginosa* (38–45%), *S. aureus* (8–38%) and moulds and yeasts (2–14%).[13–15] Coagulase-negative staphylococci (7%), anaerobes (6%), β-haemolytic streptococci (3%), coliforms (2%) and MRSA (<1%) are reported much less frequently. These figures are comparable with findings from the laboratory audit of reporting to primary care and indicate that the reporting experience of the microbiologists involved in developing this guidance is similar to that found in formal prevalence studies (Table 1).

Policy recommendations

The final evidence-based consensus policy recommendations encourage standardised, reproducible reporting by laboratories of microorganisms and their antibiotic susceptibilities to primary care. This will support clinicians to determine the relevance of identified organism(s) and encourage appropriate antimicrobial usage.

The group of organisms in Policy 1 (Box) are included as they are an uncommon constituent of the normal flora of the ear and when present may cause severe ear disease and systemic complications. *S. aureus* is commonly cultured in OE,[13–16] and frequently found in combination with group A β-haemolytic streptococci (*Streptococcus pyogenes*);[17] both of which cause significant illness. *Streptococcus pneumoniae* is a leading pathogen in otitis media, pneumonia and meningitis.

Staphylococcus aureus is one of the most common organisms cultured in OE.[13–16] It is often identified in combination with group A β-haemolytic streptococci (*Streptococcus pyogenes*), another frequent pathogen of OE.[17] Both organisms may cause significant deep-seated infection. *Streptococcus pneumoniae* is a leading bacterial cause of otitis media, pneumonia and meningitis. *H. influenzae* can cause serious invasive disease such as bacteraemia, meningitis, cellulitis, epiglottitis, septic arthritis and pneumonia, especially in young children.[18] *M. catarrhalis* is a frequent cause of otitis media in infants and children, causing 15–20% of acute otitis media episodes.[19]

Pseudomonas is included in Policy 2 (Box) as, although it frequently causes OE,[12] primary care patients usually present with a mild infection amenable to aural toilet and topical antiseptics.[20] Antibiotic resistance of *Pseudomonas* has increased over the past decade,[21] and, to prevent oral antibiotic overuse, the policy recommends not routinely reporting susceptibilities. In contrast, *Pseudomonas* skull-base osteomyelitis, known as malignant otitis externa, is potentially a life-threatening infection requiring urgent referral and parenteral antimicrobials.[22,23] However, the initial diagnosis remains largely clinical and relies on clinicians to communicate with the laboratory that susceptibility tests are required on the rare occasions that this is suspected.

The organisms included in Policy 3 (Box) are uncommon constituents of the normal flora of the ear,[11,12] but do, rarely, cause severe ear disease, so insignificant numbers may be important; furthermore, systemic antimicrobials are often not needed as they can usually be managed with aural toilet and appropriate topical antiseptics or antifungals.

Aspergillus can be an environmental laboratory contaminant, which is why it should be isolated in at least moderate numbers to be indicative of significant infection. However, as *Aspergillus* is rarely found as a commensal and

is found in approximately 4% of OE,[14] when isolated in moderate numbers the clinician should treat the infection without a repeat swab. In confirmed fungal OE, 64% of cases are caused by *Aspergillus* spp.,[24] of which *Aspergillus flavus* (26%) and *Aspergillus niger* (21%) are the most common. Infrequent reports exist of *Aspergillus* causing skull-base osteomyelitis.[25] Invasive *Aspergillus* ear infection in immunocompromised patients necessitates systemic antifungal therapy. Non-invasive infection of lesser severity in immunocompetent patients can be managed with aural toilet and topical treatment.[26]

Candida albicans causes 27% of cases of fungal OE, occurring in 2–14% of all ear infections. *Candida* is selected out by antibiotic use and is significant only if grown as the predominant organism in moderate or heavy growth. Antibiotic susceptibility testing is unnecessary as resistance is very rare,[26,27] and most infections are mild and can be treated with an agent such as 2% acetic acid. Established disease requires topical antifungals such as clotrimazole or clioquinol.[3]

The upper airways harbour large numbers of commensal non-haemolytic streptococci and anaerobic bacteria, and these appear to have limited invasive properties unless associated disease states permit their egress to deeper structures (e.g., the inner ear) that are normally sterile. Anaerobes are an unusual finding in acute upper airways infections (e.g., acute sinusitis and acute otitis media) but are often found if these become chronic.[28] For example, in chronic otitis media they are found in 43% of cases.[29] Major pathogens in anaerobic infections of the head and neck, in terms of frequency of isolation and pathogenic potential, are *Fusobacterium nucleatum*, *Prevotella melaninogenica* and other anaerobic bacteria. As the recovery of these anaerobic bacteria depends on adequate collection, prompt transportation in suitable culture medium, and prolonged incubation, they may be an under-diagnosed cause of chronic ear disease in general practice. Thus, it is suggested that anaerobes be reported if present in moderate numbers. As in the treatment of other causes of OE, topical antiseptics and aural toilet should be used before oral antibiotics are considered, and antibiotic susceptibilities should not be reported routinely.

Coliforms and *Proteus* spp. are an unusual cause of OE and are not part of normal ear or respiratory tract flora. Antibiotic susceptibilities should only be reported if infection is clinically severe or refractory.

The rationale for Policy 4 (Box) is that these organisms including *Staphylococcus epidermidis*, other coagulase-negative staphylococci, diphtheroids and enterococci are normal flora commonly cultured from the ear (Table 1).[11,12] Surveys of clinicians' interpretation of reports have found that reporting an organism by name gives the impression that the organism is significant and may lead to inappropriate antimicrobial treatment.[9]

The rationale for including topical antimicrobial agents in the susceptibility testing (Policy 5) and report is that it will encourage their use over systemic agents. It is suggested that this should include the most common constituents of eardrops, which at least include one of the aminoglycosides (e.g., neomycin, gentamicin or framycetin), chloramphenicol and clotrimazole for fungi.

Otitis externa is among the top 10 indications for antimicrobial prescribing by UK GPs.[30] Unfortunately, inappropriate antimicrobial prescribing occurs frequently.[8,20] Topical ear preparations and analgesia are the recommended first-line treatment for the majority of uncomplicated cases of diffuse OE. Topical agents have several advantages over systemic treatment. First, potential systemic side effects are minimised. Second, being placed in direct contact with bacteria attains far greater concentrations than systemic administration. This may explain the low rate of antimicrobial resistance to topical aural agents,[31] in contrast to the increasing incidence of bacterial resistance to oral agents.[32–35]

A wide range of topical agents is available, broadly classified into astringents, antibiotics, antifungals, combined corticosteroid/antibiotics or combined corticosteroid and antibiotic/antifungal agents. Antibiotic constituents are either aminoglycosides (e.g., neomycin, gentamicin or framycetin) or chloramphenicol; the antifungal is often clotrimazole. Meta-analysis has confirmed that topical ear drops containing antiseptic or antibacterial agents with steroids have similar efficacy in OE.[4,36] A large UK study of the General Practice Research Database demonstrated that the majority (85%) of GPs prescribed eardrops as first-line treatment for OE.[1] A perforated tympanic membrane and tympanostomy tubes are a theoretical contraindication to topical aminoglycosides, due to possible cochlear ototoxicity.[37] Clinicians should weigh the risk of hearing loss secondary to ototoxic drops against the risk of hearing loss arising from the infection, and discuss the treatment options with patients accordingly. Quinolones (e.g., ofloxacin) are commonly prescribed in the USA and the UK, but are currently not licensed for use as ototopical agents in the UK. Adding a steroid to ear drops may decrease inflammation and oedema of the canal and resolve symptoms more quickly;[38,39] thus, prednisolone- and betamethasone-containing drops are used commonly by GPs for the treatment of OE. However, other studies do not show a benefit and even suggest steroids can act as a topical sensitiser.[40]

Implications

Microbiology laboratories should review their reporting policies for ear swabs submitted from primary care. Microbiologists should consider using the agreed evidence-based reporting policies and suggest topical agents as first-line treatment in any comments made on the reports. Clinicians should be encouraged to give more clinical details on request forms. An audit of laboratory results and clinicians' interpretation of results is needed to determine the clinical impact of ear swabs in the management of ear disease. □

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