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What you need to know about microbiology referrals

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Abstract

Microbiologists are frequently consulted for guidance on the investigation and management of infection, including antimicrobial prescribing in hospital settings. There is a rising demand for timely microbiology advice in the context of increasing global travel and antibiotic resistance, which give rise to complex cases. However, junior doctors are seldom trained in making effective referrals. Improving confidence in this key skill saves time for both the referring clinician and the specialist, and results in more accurate advice being given. This benefits patients who are more likely to receive appropriate treatment. This article presents guidance, developed in consultation with specialists, to improve the quality of referrals to microbiologists. This includes the information required for a high-quality referral, and signposts referring clinicians to existing resources which are suitable for simpler cases not requiring specialist input.

Key words: Antibiotic; Framework; Hospital; Junior doctor; Microbiology; Referral

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The role of junior doctors in antimicrobial prescribing and stewardship

Antimicrobial prescribing and stewardship are important responsibilities for all NHS clinicians. Recognising infections and initiating appropriate antibiotics in a timely fashion is essential, particularly in the context of immunosuppression and in patients with bacterial sepsis (Liu et al, 2017). However, around 40% of in-hospital antibiotic prescriptions are not concordant with local or national evidence-based guidelines (Zarb et al, 2011). Doctors in training (registrar level and below) are responsible for the bulk of antibiotic prescribing for hospitalised patients, often during consultant-led ward rounds and independently with indirect supervision during on-call shifts. Junior doctors are commonly targeted for initiatives to improve the quality of antimicrobial prescribing (Md Rezal et al, 2015) and efforts are ongoing to embed antibiotic prescribing and stewardship teaching into medical school curricula (Health Education England, 2016). Despite these interventions, many final year medical students in Europe report feeling underprepared for independent antimicrobial prescribing (Dyar et al, 2018). Furthermore, the high turnover of junior doctors rotating between different specialties and hospitals makes long-term departmental postgraduate training challenging.

Junior doctors in UK hospitals are encouraged to follow a 'start smart then focus' approach. Empirical broad-spectrum antibiotics, initiated early for presumed bacterial infections, are later rationalised according to clinical response and the results of preliminary investigations (Ashiru-Oredope et al, 2012). Therefore, antibiotic prescriptions should be regularly reviewed and adjusted to optimise their effect for specific patients. However, in reality antibiotic prescribing is a complex, error-prone process (Kajamaa et al, 2019). Many prescriptions are written without careful clinical assessment to identify likely sources of infection. In addition, they frequently reflect personal preferences rather than local guidelines, and are not promptly reviewed as new investigation results come to light. Consequently, patients receive inappropriate and prolonged broad-spectrum therapy, which may be detrimental to their health and drive antimicrobial resistance. Conversely, trainee doctors who lack confidence in routine antimicrobial prescribing often reflexively contact local microbiology teams for advice rather than prescribing independently. In the authors' experience, this contributes to a vicious cycle whereby microbiologists become frustrated by responding to routine queries, which discourages junior doctors from seeking specialist advice when it is appropriate to do so.

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The role of microbiology

Medical microbiologists work to support the prevention, diagnosis and treatment of illness caused by microorganisms. This requires cooperation with staff across multiple departments, including public health specialists, laboratory scientists and clinicians. Microbiologists work closely with infectious diseases clinicians, intensivists, acute medical, surgical and specialty clinicians and primary care teams to provide diagnostic guidance and help clinical teams select appropriate antibiotics. They take into account numerous factors, including the clinical picture, allergies and results of investigations, and may carry out ward rounds to facilitate this. A study across six NHS trusts showed that regular 'infection team' reviews (comprising a microbiologist or infectious diseases doctor and an antibiotic pharmacist) reduced lengths of hospital stays, facilitated earlier switching to oral preparations, and reduced the overall use of antibiotics (Dryden et al, 2012). As effective microbiology reviews improve patient care, it is important that junior doctors feel able to seek advice from their microbiology teams on a regular basis and have access to a clear framework for referrals.

Medical microbiologists provide a 24-hour service to support antimicrobial prescribing in general medical and surgical patients and special patient groups, including children, pregnant women and immunosuppressed patients. Most telephone consultations are initiated by frontline clinicians, although microbiologists may directly inform clinical teams of salient results, such as positive blood cultures. An audit revealed that around 80% of telephone consultations from clinical colleagues at an NHS hospital concerned antimicrobial treatments (Seale et al, 2014). Out-of-hours advice may be provided by a consultant or middle-grade (ST3+ or equivalent) doctor, who fields large numbers of queries offsite without access to clinical notes. Over an 11-year period at a Dublin teaching hospital, 13% of consultations occurred between 2300 and 0700 (Humphreys, 2020). However, where local antimicrobial guidelines exist, most specialist queries can be addressed within normal working hours, where microbiologists have access to historical clinical records and detailed investigation results. The authors urge clinicians to carefully consider the added value of microbiology advice before seeking it out-of-hours.

Finally, the authors commend the addition of specialist forums for discussing microbiology within UK hospitals. Examples include dedicated intensive care unit microbiology ward rounds and weekly microbiology multidisciplinary team meetings within both medical and surgical departments. These provide a more appropriate opportunity for discussion of non-urgent matters, with input from multiple clinical teams. Junior doctors must familiarise themselves with the existence of these services, and their referral criteria. A member of the clinical team should be made available to discuss the case at the allocated time.

A framework for referrals

The authors have worked with junior doctors and microbiologists to create a framework for referrals to microbiology for advice on antimicrobial treatments for hospitalised patients (Table 1). This guidance can be readily modified to assist with other inquiries, such as advice on diagnostic tests.

Before contacting the microbiology team, it is essential that the doctor familiarises themself with the patient. The microbiologist on the end of the phone has probably never met the patient or heard of the case. To ensure that good-quality advice is provided there are some essential pieces of information they will need. Before picking up the phone, the steps outlined in Table 1 should be carried out.

As with all referrals, an ISBAR (introduction, situation, background, assessment, recommendation) approach is an effective way to relay information and ask a focussed question (Table 2).

Special cases

Some cases require more thought and discussion within the team before speaking to microbiology. This is another reason that it is vital that the doctor understand the patient's history and specific vulnerabilities before asking for advice. For example, patients who have undergone recent intra-abdominal surgery are likely to require additional anaerobic cover (hence the frequent

Table 1. Recommended steps before consulting local microbiology team for advice on antimicrobial prescribing

Know your patient	This may sound obvious, but it can be overlooked, particularly if you have been handed over a patient or called by the lab regarding new investigation results. It is important to know basic details about the symptoms that have led to a microbiology consult (eg dysuria, cough or diarrhoea) and salient examination findings. Review the notes and perform a focused A–E assessment with an emphasis on potential sources of infection (eg chest, urine, skin, lines and drains)
Review lab results and imaging	What are the patient's latest white cell count, C-reactive protein and/or procalcitonin levels? Is there a trend? Are there any previous positive microbiology results and what are the sensitivities? These are all things the microbiologist will want to know so you should have this information to hand
Review antimicrobial history	Is your patient already prescribed antibiotics? If so, which antibiotic(s), which route, and for how long? Were they taking anything before that, either in hospital or in the community? You should be clear on what your patient has already taken and the duration of each agent
Clarify allergies	Ask your patient about any documented allergies and the type of reactions they have had. A recent exposure associated with facial swelling and a hospital admission is more concerning than a historic childhood exposure resulting in a delayed onset maculopapular rash. Avoidance of beta lactam antibiotics in patients is associated with an increased risk of adverse outcomes (MacFadden et al, 2016) and it may be possible to 'de-label' patients without a true allergy as an inpatient or after a hospital stay
Consult local antibiotic guidelines	Early initiation of antibiotics is associated with improved patient outcomes. If in doubt, start an empirical antibiotic and tailor your choices as further investigation results become available. Your hospital will have specific guidance on first-line antibiotics for common infections. Remember that in certain circumstances, empirical antibiotics may be inappropriate, notably in patients who have previously been colonised with cephalosporin-resistant organisms
Consult a senior	If you are unsure which antibiotic to prescribe, you should first discuss the case with a senior colleague within your own team. Even if they cannot answer your question, it may still be helpful in clarifying the clinical questions. Remember that it is important not to delay patient care, especially when there are potential adverse outcomes. If senior doctors are busy and you cannot get timely advice, you should consult microbiology if you have any concerns

addition of metronidazole). Immunosuppressed patients (eg as a result of haematological malignancy or during chemotherapy) are more likely to require broad-spectrum regimens including piperacillin-tazobactam and/or aminoglycoside antibiotics to cover *Pseudomonas aeruginosa*. Certain classes of antibiotic (such as tetracyclines) are contraindicated during pregnancy and the post-partum period as a result of risks of harm to the fetus or neonate. Junior doctors should refer to trustworthy resources, such as the Best Use of Medicines in Pregnancy (BUMPS) website (https://www.medicinesinpregnancy.org/), to identify safe treatments and provide reassurance to expectant mothers requiring antibiotic therapy.

Future work

Numerous NHS-wide initiatives have been developed to improve antimicrobial prescribing among junior doctors from medical school up to registrar level-training. The most widely known have been discussed here, such as the use of ISBAR frameworks and the 'start smart then focus' ethos of antibiotic prescribing.

Further examples of communication aids and systems to improve antibiotic prescribing include local educational programmes, intelligent prescribing systems and emerging artificial intelligence support. A 2016 study (Gharbi et al, 2016) used qualitative methods to explore knowledge, attitudes and behaviours around antibiotic prescribing among NHS junior doctors in west London. Low self-confidence, poor knowledge and difficulty accessing support were identified as the key barriers to good prescribing. As a result the authors have designed a continuing professional development short course designed to focus on five key areas around antibiotic prescribing.

At University College London Hospital, the EPIC electronic patient record provides useful prompts and prescribing alerts to promote careful consideration around antibiotic prescribing in certain patient groups. In addition, development of an antibiotic surveillance system (samurAI) aims to improve the identification of patients who can stop, change or switch antibiotics and prompt doctors to refer for specialist advice where appropriate. The

Table 2. An example of an ISBAR (introduction, situation, background, assessment, recommendation) approach to making a microbiology referral

Introduction	Name, role, location	'My name is Dr Smith, I am one of the senior house officers calling from the acute medical ward at University College London Hospital'
Situation	What is the question?	'I would like some advice on the best antibiotic for my patient. She is a 63-year-old woman from Bangladesh who has presented with an upper urinary tract infection'
Background	Who is your patient?	'She has a history of type 2 diabetes mellitus and hypertension. There are no previous microbiology results available on our patient records, or on any regional healthcare platforms. She does not speak English but her son tells me she has no allergies. She arrived in the UK 2 weeks ago from Bangladesh to visit family'
Assessment	What have you done?	'She has been with us for 2 days so far. She is currently haemodynamically stable (heart rate 78 beats/minute, blood pressure 137/68 mmHg). Her most recent C-reactive protein level is 178 mg/litre from 123 mg/litre with a white cell count of $22x10^9$/litre (neutrophils $18x10^9$/litre). She has spiked two temperatures of 38.5°C this morning. On examination she is flushed with left renal flank tenderness. Urine and blood cultures have been sent but we have no results yet. We are planning to get an ultrasound of her kidneys, ureters and bladder later today'
Recommendation	What is your impression?	'She does not seem to be improving despite 48 hours of intravenous cefuroxime as per microguide. Given her recent travel history, I am concerned about her risk of extended spectrum beta-lactamase-producing bacteria. What do you think about switching to amikacin for now? We would also like an escalation plan, do you think meropenem would be appropriate if she deteriorates further?'

research is being conducted at University College London Hospital and the aim is to have samurAI in use in three pilot hospitals by 2024 (Shallcross and Brown, 2020).

Conclusions

This guidance, when followed by junior doctors, will increase confidence in antibiotic prescribing and improve the quality of referrals to microbiologists. The incorporation of artificial intelligence into novel prescribing systems may identify further areas for improvement in the future.

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Key points

- Given the frequency of antimicrobial prescriptions among junior doctors, microbiologists provide an essential resource for advice and support. Junior doctors should feel confident that they can contact microbiology for specialist advice as needed in the best interests of their patient.
- It is important that junior doctors are well informed about their patient's specific case before they call microbiology. Informed referrals will result in better quality advice and more patient-centred care, particularly in more vulnerable patient groups (eg postoperatively, pregnancy, immunocompromised).
- Using the classic ISBAR framework when referring provides a standardised approach that is well known to most junior doctors.

Curriculum checklist

This article addresses the following requirements from the general internal medicine curriculum:

- Providing continuity of care to medical inpatients
- Managing medical problems in patients in other specialties and special cases

Conflicts of interest

The authors declare that they have no conflicts of interest.

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