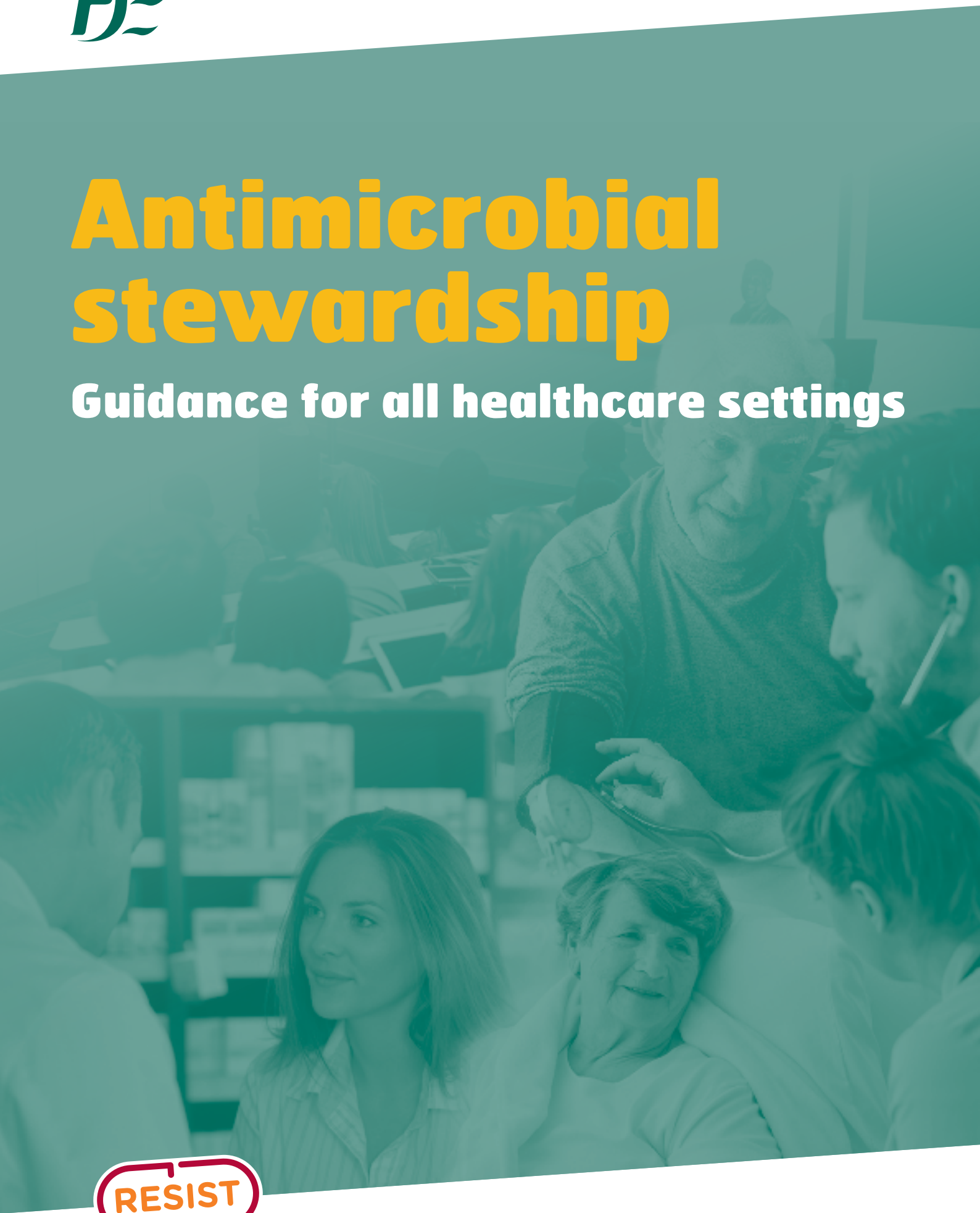
# Antimicrobial stewardship

## Guidance for all healthcare settings



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| Term | Definition |
|---|---|
| **Antibiogram** | An antibiogram is a cumulative summary of in vitro antimicrobial susceptibility test results obtained with bacteria and/or fungi recovered from patients with infection over a defined period of time in a given healthcare setting. |
| **Antibiotic** | The term can be used to refer to an antimicrobial agent produced by another microorganism (e.g. penicillin is produced by fungi). The term is commonly used to refer to any antimicrobial agent, naturally occurring or synthetic, used to prevent or treat bacterial infection. It is in this wider sense that the term is used in this document. |
| **Antimicrobial** | An antimicrobial is a medicine used to prevent and treat infections in humans, animals, and plants. Antimicrobials include antibacterials, antivirals, antifungals, and antiparasitics. In this document, antimicrobial primarily refers to antibacterial agents, although the principles of stewardship apply equally to antivirals, antifungals and antiparasitics. |
| **Diagnostic stewardship** | Coordinated guidance and interventions to improve appropriate use of microbiological diagnostics to guide therapeutic decisions. It should promote appropriate and timely diagnostic testing, including specimen collection, and pathogen identification and accurate timely reporting of results to guide service user treatment. |
| **Green/Red agents** | In community settings in Ireland, a simple categorisation is promoted to identify preferred antimicrobials ('Green') versus non-preferred antimicrobials ('Red'). This is commonly referred to as 'Green/Red classification' of antimicrobials and is made available in the form of mouse mats or posters to primary care and residential care facilities. For more information, visit www.antibioticprescribing.ie. |
| **Outpatient parenteral antibiotic therapy (OPAT)** | The administration of parenteral (usually intravenous) antimicrobial treatment outside of an acute care hospital, such as in the home, a designated infusion clinic, or day service, for example, day ward or dialysis unit. Parenteral antimicrobials can be administered by the service user, relative or caregiver, or by a healthcare worker. |
| **Pharmacokinetic** | The study of drug absorption, distribution, metabolism and excretion. |
| **Pharmacodynamic** | Pharmacodynamics correlates the concentration of the drug with its pharmacological or clinical effects. For an antimicrobial, this correlation refers to the ability of the drug to kill or inhibit the growth of microorganisms. |
| **Service user** | Any recipient of healthcare services. For the purposes of this guidance, this term includes 'patients' 'residents', 'clients' and 'consumers'. |

# Acronyms

| Term | Definition |
|---|---|
| **ACSQHC** | Australian Commission on Safety and Quality in Health Care |
| **AI** | Artificial intelligence |
| **AMR** | Antimicrobial resistance |
| **AMRIC** | Antimicrobial resistance and infection control |
| **AMS** | Antimicrobial stewardship |
| **ATC** | Anatomic, therapeutic, chemical |
| **AWaRe** | Access, Watch and Reserve |
| **BSAC** | British Society for Antimicrobial Chemotherapy |
| **CDC** | Centers for Disease Control and Prevention |
| **CDSS** | Clinical decision support system |
| **CHOs** | Community healthcare organisations |
| **COVID-19** | Infection caused by SARS-CoV-2 virus |
| **CPE** | Carbapenemase producing Enterobacterales |
| **DAFM** | Department of Agriculture, Food and the Marine |
| **DDD** | Defined daily dose |
| **DOH** | Department of Health |
| **DOT** | Days of therapy |
| **DTC** | Drug and therapeutics committee |
| **ECDC** | European Centre for Disease Prevention and Control |
| **EHR** | Electronic healthcare record |
| **ESCMID** | European Society of Clinical Microbiology and Infectious Diseases |
| **GMS** | General Medical Services |
| **GP** | General practitioner |
| **HALT** | Healthcare associated infections in long-term care facilities |
| **HCAI** | Healthcare associated infection |
| **HCWs** | Healthcare workers |
| **HEI** | Higher education institutions |
| **HIQA** | Health Information and Quality Authority |
| **HMR** | Health Market Research |
| **HPSC** | Health Protection Surveillance Centre |
| **HSE** | Health Service Executive |
| **ICT** | Information and communication technology |
| **iNAP** | Irish National Action Plan for Antimicrobial Resistance |

| | |
|---|---|
| **IPC** | Infection prevention and control |
| **IPHA** | Irish Pharmaceutical Healthcare Association |
| **ISO** | International Organization for Standardization |
| **MALDI-TOF** | Matrix-assisted laser desorption/ionisation time of flight |
| **MRSA** | Methicillin-resistant *Staphylococcus aureus* |
| **OPAT** | Outpatient parenteral antimicrobial therapy |
| **PCR** | Polymerase chain reaction |
| **PCRS** | Primary Care Reimbursement Service |
| **POCI** | Point of care intervention |
| **PPPG** | Policy, Procedure, Protocol, Guideline |
| **PPS** | Point prevalence study |
| **QI** | Quality improvement |
| **RCF** | Residential care facility |
| **RCPI** | Royal College of Physicians of Ireland |
| **RCSI** | Royal College of Surgeons in Ireland |
| **SARI** | Strategy for Control of Antimicrobial Resistance in Ireland |
| **VRE** | Vancomycin resistant enterococci |
| **WTE** | Whole-time equivalent |
| **WHO** | World Health Organization |

# Foreword

Antimicrobials have made a huge difference to the lives of millions of people since they became widely available in the middle of the 20th century. We frequently take it for granted that there will always be an antimicrobial for us when we need one. We may need them when we have a bacterial infection and we depend on them to help us through major surgery or chemotherapy.

Over the last 20 to 30 years, we have seen many of those antimicrobials become less effective or useless for treatment of some bacterial infections. This is because of antimicrobial resistance. This pushes us to use different antimicrobials that may be more toxic and more difficult to use. They may cause more disturbance to our normal bacteria that we depend on to stay healthy. For a long time, many people expected that we would always be able to stay one step ahead of changes in bacteria. We know now that we cannot depend on that. Bacteria adapt too quickly and new classes of antimicrobials that are as safe and effective as the penicillins have proved very hard to find. Even common bacterial infections like cystitis and pneumonia have already become harder to treat safely and effectively.

We need to stop this situation from getting worse and then attempt to gradually roll back the tide. We have a very good scientific understanding of why this is happening. We know what we need to do to make it better. We need to use less antimicrobials in every sector and use them better when required to use them. The process of using antimicrobials wisely is referred to as antimicrobial stewardship.

We need to stop antimicrobial resistant bacteria and antimicrobial resistance genes spreading from person to person, animal to animal, and between people and animals. We also need to stop widespread dissemination of antimicrobial resistant bacteria through environmental pollution with human and animal faeces.

These guidelines are about rising to the challenge of translating knowledge and understanding into change. We need, as healthcare workers, to feel empowered to play our part by learning how to incorporate antimicrobial stewardship in our day-to-day practice. Antimicrobial stewardship teams should be aware of the evidence that supports antimicrobial stewardship. They need to work with the governance and accountability structures to support change using the suite of interventions available. Also, higher education institutions and professional groups need to further develop the provision of education and training on antimicrobial stewardship.

This guidance reflects the HSE's commitment to working with and supporting everyone who works in healthcare, uses healthcare services, or supports education of healthcare students to deliver that change. This is how we safeguard the benefits of antimicrobials for us, for our children, and for our grandchildren both now and in the future.

*Prof. Martin Cormican*
**Clinical Lead, AMRIC 2017 - April 2022**

# **Part A:** Guidance for antimicrobial stewardship in Ireland

## Introduction

Antimicrobial resistance (AMR) has been recognised as one of the greatest potential threats to human and animal health over the last decade. AMR is the ability of a microorganism to survive and resist exposure to antimicrobial drugs, threatening the effectiveness of successful treatment of infection. A One Health response at global and local level is essential in order to address the challenge of AMR. The One Health approach recognises that the health and wellbeing of people is connected to the health and welfare of animals, biodiversity, and the environment. The United Nations has recognised AMR as a threat to the attainment of the Sustainable Development Goals, and indeed the global public health threats of AMR and climate change are interdependent. Reducing AMR can have a positive impact on sustainability. Like climate change, a collaborative, intersectoral, and internationally coordinated approach is needed to tackle AMR, as drug resistant bacteria do not respect national borders.

Since 2020, the implications of an infection for which we do not have an effective treatment on human health have been clearly demonstrated during the COVID-19 global pandemic. Antimicrobials are key to the practice of modern medicine and enable sophisticated medical interventions and treatments, including chemotherapy and organ transplants. High levels of antimicrobial use and inappropriate use of antimicrobials cause increasing AMR and other service user harms. Antimicrobial stewardship (AMS) is vital in limiting and potentially reversing the development of AMR.

As an integral component of patient safety, AMS promotes maximising the benefit of antimicrobials and causing the least harm for the individual service user. AMS programmes are delivered by a multidisciplinary team using a suite of strategies and interventions and operate within the governance structure of a healthcare facility.

The concept of antimicrobial stewardship was first introduced in Ireland in 2001 by the Strategy for Control of Antimicrobial Resistance in Ireland (SARI). Prior to, and since then, healthcare workers have been incorporating aspects of AMS into their day-to-day practice, such as using more narrow-spectrum antimicrobials in preference to a broader-spectrum agent, using recommended durations of antimicrobial therapy and promoting vaccination for vaccine preventable diseases. Nationally coordinated examples of AMS efforts include the Green/Red antimicrobial quality improvement initiative, the repository of antimicrobial prescribing guidelines available on www.antibioticprescribing.ie, and the annual national antimicrobial point prevalence study in acute hospitals. The Health Protection Surveillance Centre (HPSC), previous clinical leads, as well as individuals, professional societies, higher education institutions, and professional colleges have worked to progress and develop AMS.

In 2009, a pivotal document was published by SARI entitled Guidelines for Antimicrobial Stewardship in Hospitals in Ireland. These guidelines informed and supported the creation, development, and continuance of AMS programmes in acute hospitals in Ireland.

Since 2017, greater resources supported by the Department of Health and a stronger Antimicrobial Resistance and Infection Control (AMRIC) governance structure within the HSE has resulted in a greater emphasis on development and extension of AMS programmes in the community and hospital. Underpinning this work was Ireland's first and now current second National Action Plan for Antimicrobial Resistance (iNAP 1 and 2) and the HSE AMRIC Action Plan 2022–2025.

The requirement for AMS in both acute hospitals and the community is detailed in the Health Information and Quality Authority (HIQA) National Standards for the prevention and control of healthcare associated infections in acute healthcare services (2017) and the HIQA National Standards for infection prevention and control in community services (2018), respectively.

The extension of formal AMS programmes to all healthcare settings, maturation of existing AMS programmes in acute hospitals, and the requirements of the currently available strategy documents and standards have created a requirement for an update to the 2009 AMS guidelines. The aim of this document is to provide support and guidance to AMS teams, healthcare facility managers, and the individual healthcare workers by providing the evidence, expert guidance, and tools they need to initiate and sustain AMS programmes.

The work of higher education institutions, professional colleges, and groups is central to the creation and delivery of AMS education. This creates a strong AMS foundation for healthcare professionals from their undergraduate education and training and that they can further develop this knowledge through postgraduate education. This document will provide guidance to the development of curricula, educational courses, and training programmes.

## Key references

The following key AMS reference sources have been referred to extensively in producing this guidance. Note that any additional references referred to within individual chapters are listed at the end of each chapter and those mentioned here are not replicated.


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## Executive summary

Antimicrobial stewardship (AMS) is an integral component of any patient safety programme. It promotes maximising the benefit of antimicrobials and causing the least harm for the individual service user. AMS programmes are delivered by a multidisciplinary team using a suite of strategies and interventions; they operate within the governance and accountability processes of the healthcare facility or service.
The guidance is structured around six chapters. Chapter 1 introduces the role of the various healthcare workers in AMS, which include (i) prescribers encompassing doctors, dentists, and nurse/midwife prescribers; (ii) pharmacists; and (iii) nurses and midwives. Chapter 2 details the governance and structures required to deliver AMS. The next three chapters delve further into AMS interventions, with a detailed focus on the supports of education and information and communication technology. The final chapter includes advice and guidance on the tools to measure and monitor AMS programmes.

The following summarises the key points from each chapter.

### Chapter 1: Roles and responsibilities of healthcare workers in antimicrobial stewardship

- All healthcare workers are antimicrobial stewards.
- In all healthcare settings, successful implementation of AMS programmes requires collaboration between all members of the healthcare team, managers, and service users.
- Knowledge, awareness, and participation of all involved in the care of service users, in all care settings, is key to creating a culture that understands antimicrobials and generates behaviours that improve their use.
- All healthcare workers have a central role in supporting service users to gain a better understanding of appropriate antimicrobial use, the impact that it can have on their care, and of antimicrobial resistance (AMR).
- Healthcare workers should adhere to the eight principles of good AMS:
  1. Recognise clinical evidence of infection
  2. Avoid unnecessary antimicrobial use
  3. Choose an antimicrobial that will have the most benefit and cause the least harm
  4. Optimise the dosing regimen and route
  5. Minimise the duration
  6. Assess response to treatment
  7. Communicate effectively about antimicrobials
  8. Prevent infection (including vaccination).

### Chapter 2: Antimicrobial stewardship governance, structures and supports

- The Antimicrobial Resistance and Infection Control (AMRIC) Implementation Team leads a key patient safety programme under the direction of the Chief Clinical Officer of the HSE. The programme is supported by a governance structure led by the AMRIC Oversight Group, which guides the management of infection prevention and control (IPC) and AMS within acute and community services.
- The AMRIC Implementation Team, which reports to the Oversight Group, supports implementation and maintenance of a comprehensive AMS service in accordance with the AMRIC Action Plan and the second Irish National Action Plan for Antimicrobial Resistance (iNAP2).
- The AMRIC Implementation Team is supported by an AMS Advisory Group.
- The AMRIC implementation work programme is driven by the national HSE AMRIC Team (reports to the Office of the Chief Clinical Officer), the Acute Operations AMRIC Team (reports to National Director, Acute Operations), and the Community Operations AMRIC Team (reports to National Director, Community Operations).
- Hospital Group and CHO IPC and AMS (AMRIC) committees and teams implement IPC and AMS at those levels.

- Hospital and service managers are responsible for ensuring that appropriate governance structures and processes for management of AMS are in place at the hospital/service level.
- A multidisciplinary AMS oversight committee should oversee and support the work of the AMS team in the effective implementation of Hospital Group and CHO AMS plans in conjunction with relevant IPC committees. An AMS and IPC (AMRIC) Committee that addresses both IPC and AMS is a good model that reflects the structures at national level. AMS activities must also be coordinated with drugs and therapeutics committees.
- AMS teams are responsible for designing, implementing, and reporting on the effectiveness of the AMS programme within an organisation. They play a central role in leading and sustaining improvement in the use of antimicrobials in an organisation.
- The core AMS team should include a clinical microbiologist or an infectious disease physician (or both), and an antimicrobial pharmacist. Nursing support for the AMS team from IPC, intravenous catheter care team, or other nursing staff with a particular interest should be included whenever possible. Members of the AMS team should have protected time dedicated to AMS activities.
- Competencies and skills in the areas of quality improvement, behavioural changes, and measurement and data analysis can enhance the impact of AMS professionals within an organisation.
- All healthcare organisations should have an AMS policy and an annual AMS plan relevant to the local context.
- The approach to AMS should support integrated measures and objectives between community and acute services.

### Chapter 3: Strategies and tools for antimicrobial stewardship programmes

- Key strategies for AMS programmes include:
  - » Restricted use of certain antimicrobials and pre-authorisation
  - » Clinical review with point of care interventions and direct prescriber feedback
  - » Prescribing guidelines, clinical pathways, and prescriber aids
  - » Antimicrobial prescribing surveillance, audit, quality improvement, and feedback
  - » Learning from patient safety incidents
  - » Diagnostic stewardship
  - » Education and training.
- Implementation of different strategies and tools is dependent on resources available and the type of care setting.
- A formulary for antimicrobials, with restrictions on use, and an approval system for antimicrobials are effective in changing prescribing practices.
- The AMS team should have a system for timely identification of particular cohorts of service users who are likely to benefit from AMS review.
- Point of care interventions, such as dose optimisation, intravenous-to-oral conversion, or therapeutic drug monitoring, can improve service user management and outcomes. They also provide excellent opportunities to educate colleagues on optimal prescribing.
- The use of evidence based guidelines, developed through multidisciplinary collaboration, has been shown to be effective in improving prescribing practice. All acute hospitals and community settings should have access to local, regional, or national antimicrobial prescribing guidelines that take account of relevant AMR data where possible.
- Diagnostic stewardship can optimise the ordering and collection, processing, and reporting of diagnostic tests to improve appropriate antimicrobial use. Restrictive and interpretative laboratory reporting can guide appropriate prescribing.

### Chapter 4: Information and communication technology to support antimicrobial stewardship

- Information and communication technology (ICT) can support AMS through enhancement of data collection and reporting and provision of decision support to prescribers.

- Electronic clinical decision support systems (CDSS) complement the clinical, pharmacy, and other members of the AMS team.
- ICT supports achievable within the AMS programme in an individual healthcare setting include the use of mobile applications, dashboard software, electronic approval systems, and automated dispensing cabinets.
- Progression of larger-scale ICT projects, such as e-prescribing, electronic healthcare records (EHRs), and infection prevention surveillance systems subject to appropriate resourcing are expected to improve AMS.
- AMS professionals can make valued input into the development of ICT systems at an early stage to confirm that the processes work to facilitate AMS.

### Chapter 5: Antimicrobial stewardship education

- Education and training is a core element of AMS and should be tailored to the audience and the setting. It should be an ongoing part of continuing education and professional development for all healthcare workers.
- Education on AMR, IPC and AMS, including the vaccination of preventable diseases, should be part of core curriculum training and examination for all healthcare students at undergraduate and postgraduate level.
- Every healthcare worker involved in prescribing, dispensing, or administering antimicrobials should receive AMS education on induction and updates appropriate to their professional role.
- Ongoing education and training of the AMS team, who coordinates and operationally manages the AMS programme, and in turn provide formal and informal education to the wider staff involved in the antimicrobial usage process, is of key importance.
- Multidisciplinary groups in conjunction with healthcare education providers should advise the planning, developing, and delivering of local and national AMS education programmes.
- A wide range of national and international resources are available to assist with AMS education and training, as detailed in Appendix 2 and Appendix 3 of Part A.

### Chapter 6: Measuring performance of antimicrobial stewardship programmes and use of data for quality improvement

- Data are required to inform annual plans, measure performance, and evaluate effectiveness of an AMS programme.
- Data can be quantitative (consumption reporting) or qualitative (audit of appropriateness of prescribing, e.g. point prevalence studies).
- Key quality indicators for AMS programmes can encompass structure, process, outcome, and balancing measures.
- Structure measures for AMS can support organisations to determine whether the appropriate governance, workforce, and processes, such as formularies and guidelines, are in place.
- When measured as regular audits and reported back to prescribers, process measures can be useful to measure, maintain, and improve AMS performance. These measures include the quantity and quality of antimicrobial use.
- The main categories of outcomes for AMS programmes include improved service users outcomes, improved patient safety, reduced antimicrobial consumption, reduced AMR, and reduced costs.
- Measurement of balancing measures, such as rate of adverse events or higher rate of infection related readmission, allows AMS teams to be alert to potential unintended consequences of AMS interventions.
- Actionable feedback from the results of any audit or point prevalence study conducted should be made available to prescribers as well as to the executive, divisions or directorates, and specific clinical units.

# **Chapter 1:** Roles and responsibilities of healthcare workers in antimicrobial stewardship

## Key points

- All healthcare workers are antimicrobial stewards.
- In all healthcare settings, successful implementation of AMS programmes requires collaboration between all members of the healthcare team, managers, and service users.
- Knowledge, awareness, and participation of all involved in the care of service users, in all care settings, is key to creating a culture that understands antimicrobials and generates behaviours that improve their use.
- All healthcare workers have a central role in supporting service users to gain a better understanding of appropriate antimicrobial use, the impact that it can have on their care and of AMR.
- Healthcare workers should adhere to the eight principles of good AMS:
    1. Recognise clinical evidence of infection
    2. Avoid unnecessary antimicrobial use
    3. Choose an antimicrobial that will have the most benefit and cause the least harm
    4. Optimise the dosing regimen and route
    5. Minimise the duration
    6. Assess response to treatment
    7. Communicate effectively about antimicrobials
    8. Prevent infection (including vaccination).

## 1.1 All healthcare workers are antimicrobial stewards

In all healthcare settings, the successful implementation of AMS programmes requires collaboration between all members of the healthcare team, managers, and service users. It extends beyond prescribing. It encompasses antimicrobial clinical review, supply and dispensing, preparation and administration, service user monitoring and review, service user and carer education, and infection prevention and control (IPC), including vaccination. Stewardship can encompass any action that promotes responsible use of antimicrobials. AMS is a key component of safe effective care.

Many health and social care workers may not perceive a role for their discipline in preventing the emergence and spread of AMR. However, knowledge, awareness and participation of all those involved in the care of service users, in all care settings, is key to creating a culture that understands antimicrobials and generates new behaviours around their use. Healthcare workers also influence public and service user understanding and expectations through their societal contacts. Table 1.1 gives examples of actions that can be taken by different members of the healthcare team to promote responsible use of antimicrobials.

### Table 1.1: How each member of the healthcare team can be a good antimicrobial steward

| I am a | I maximise benefit of antimicrobials and reduce harm by doing the following |
|---|---|
| **Community prescriber** | • Prescribe antimicrobials for treatment only where there is good reason to expect they will do more good than harm.<br>• Use best-practice treatment guidelines on www.antibioticprescribing.ie, using a Green antimicrobial in preference to a Red antimicrobial where an antimicrobial is needed.<br>• Use interventions such as incision and drainage, wound management, and removal of infected devices when required.<br>• Recommend symptom relief for self-limiting infections, with safety netting advice, and direct service users and carers to www.undertheweather.ie.<br>• Document indication, duration, and review dates for all antimicrobial prescriptions, including antimicrobial prophylaxis.<br>• Review my antimicrobial prescribing using audit tools, e.g. AMRIC urinary tract infection prophylaxis audit tool.<br>• Discuss the issue of AMR with service users.<br>• Where appropriate, seek specialist advice from clinical microbiology, infectious diseases, or antimicrobial pharmacist. |
| **Community pharmacist** | • Check, where possible, if antimicrobial prescriptions align with antimicrobial prescribing guidelines on www.antibioticprescribing.ie.<br>• Promote optimal dosing regimens and durations for antimicrobials and explain it to the service user.<br>• Provide advice when a service user presents with a self-limiting or viral infection and direct them to www.undertheweather.ie.<br>• Manage the expectation of an antimicrobial for a likely viral illness or self-limiting infection, even if the service user may need to see the doctor if unwell.<br>• Remind service users that any unused antimicrobials should be returned to the pharmacy for safe disposal.<br>• Where appropriate, seek specialist advice from clinical microbiology, infectious diseases, or antimicrobial pharmacist. |
| **Nurse in residential care facility** | • Check immunisation status of residents and encourage them to take all recommended vaccinations.<br>• Help prevent unnecessary antimicrobial prescribing caused by inappropriate use of dipstick urinalysis in accordance with AMRIC position statements.<br>• Take appropriate microbiological samples before antimicrobial administration when required.<br>• Be aware of antimicrobial prescribing guidelines on www.antibioticprescribing.ie.<br>• Highlight when an antimicrobial may be due for stop or review. |
| **Medical laboratory scientist, epidemiologist or surveillance scientist** | • Support rapid diagnosis of infection and detection and the reporting of AMR.<br>• Communicate increasing trends in AMR within pathogens or hospital areas to relevant healthcare workers.<br>• Be aware of national, European and global trends in emerging AMR problems. |

| I am a | I maximise benefit of antimicrobials and reduce harm by doing the following |
|---|---|
| **Nurse or midwife in acute hospital** | • If a nurse prescriber, follow antimicrobial prescribing guidelines.<br>• Take appropriate microbiological samples when appropriate prior to antimicrobial administration.<br>• Recognise signs of sepsis or failure to respond to therapy and take appropriate action.<br>• Administer prescribed antimicrobial therapy promptly in sepsis.<br>• Administer antimicrobials at evenly spaced intervals throughout the day.<br>• Highlight to the prescriber or pharmacist any antimicrobial prescription which has continued beyond 7 days without a specified duration.<br>• Encourage use of the optimal route of administration and highlight when the oral route is feasible to the prescriber or pharmacist.<br>• Talk to service users about their treatment plan.<br>• Support service users understanding and expectation of role of antimicrobials in their infection. www.hse.ie/antibiotics<br>• Be aware of local antimicrobial prescribing guidelines. |
| **Dentist** | • Perform drainage for dental infections before issuing antimicrobials when appropriate.<br>• Prescribe antimicrobials for treatment only when they are more likely to do good than harm.<br>• Use www.antibioticprescribing.ie, choosing a Green antimicrobial in preference to a Red antimicrobial when indicated and safe to do so.<br>• Discuss the issue of AMR with service users. www.hse.ie/antibiotics<br>• Talk to service users about their treatment plan.<br>• Where appropriate, seek specialist advice from clinical microbiology, infectious diseases, or antimicrobial pharmacist. |
| **Physiotherapist** | • Refer service users with suspected infections appropriately and manage the expectation that an antimicrobial will only be prescribed if clinically indicated.<br>• Promote self-care of service users with self-limiting infections. www.undertheweather.ie |
| **Care assistant** | • Follow principles of good infection prevention and control.<br>• Keep up-to-date with infection prevention and control training by completing e-learning on www.hseland.ie, e.g. AMRIC Introduction to Infection Prevention and Control and Antimicrobial Resistance.<br>• Be aware of AMR and the importance of safe antimicrobial use. |
| **Manager of any facility** | • Ask for and review high-level reports on antimicrobial use in the facility.<br>• Promote activities for Antibiotic Awareness Day within the organisation.<br>• Promote staff education on AMS.<br>• Provide resources for AMS, including support for ICT modernisation, which can support AMS.<br>• Promote the display of materials, such as posters and service user information leaflets, to reduce the demand for unnecessary antimicrobials.<br>• Ensure that relevant staff are aware that, where required, specialist advice is available from clinical microbiology, infectious diseases, or antimicrobial pharmacist, and that they know who to contact locally. |

» *Note that these lists are not exhaustive.*

### 1.1.1 Healthcare workers engaging the service user in AMS

All healthcare workers have a central role in supporting service users to gain a better understanding of appropriate antimicrobial use, AMR, and the impact that it can have on their care. Involving people who use healthcare services in their care is the essence of patient-centred care. Many service users are aware that AMR is a problem, but their understanding of the nature of the problem, its societal implications, and the role that service users can play may be limited. The terms antimicrobial resistance and antimicrobial stewardship may not be easily understood by the wider public. Public awareness campaigns and interactions with healthcare workers are two major influencers of service user knowledge and understanding of antimicrobials.

Where possible, service users should have an active role in their treatment plan. Shared decision making occurs when a prescriber and a service user jointly decide about healthcare. Shared decision making within a consultation guides a two-way information exchange. Service users should be encouraged to ask questions and discuss their treatment plan. Service users, or their legal guardians/carers, should be informed of the rationale for prescribing or not prescribing antimicrobials, and informed of any associated risks or adverse effects, including the development of AMR.

Tools and resources to support service user engagement, education, and awareness of antimicrobial use and AMR are available at www.undertheweather.ie, www.hse.ie, www.hse.ie/antibiotics, www.antibioticprescribing.ie and www.healthpromotion.ie. Information may need to be provided in different languages, formats and styles, and tailored to the needs and preferences of the service user. Diagrams, videos, and other graphics may aid in the explanation of key concepts. Service users concerns, preferences, and expectations about antimicrobial use and AMR should be discussed openly (see Table 1.2).

RESIST is the identity for a number of communications and awareness initiatives that the AMRIC programme has introduced. The language of this brand is built around forming a movement to resist an oppressive enemy - superbugs. So fight, resist, join, help, are words we use as they are simple, direct and energising. They make it clear to our staff the action we want them to take.

A key part of the RESIST programme includes providing guidelines and information materials for patients and staff to promote AMS and hand hygiene awareness. There are 12 patient information leaflets available to order. All of the patient information leaflets have been awarded the Plain English mark from the National Adult Literacy Association (NALA). Two of the patient leaflets, how to Take Your Antibiotics and Being Infection Aware, have useful messages relating to AMS for patients. Leaflets can be ordered via hcai.amrteam@hse.ie other resources are accessible on www.hse.ie/infectioncontrol Patient information videos on antibiotics, infections and superbugs are also available from hcai.amrteam@hse.ie.

Service users can play a role on AMS committees to provide a service users perspective, contribute experiences, and advocate for their interests. Service users should also be involved in the design and delivery of education and research about antimicrobials and AMR.

**Table 1.2: How all healthcare workers can engage service users in antimicrobial stewardship**

| How all healthcare workers can engage service users in AMS |
|---|
| • Explain that for certain infections, most commonly caused by viruses, such as coughs, colds and sore throats, that antimicrobials may do more harm than good.<br>• Advise them to take antimicrobial courses as recommended by the prescriber/pharmacist.<br>• Advise them not to store or use leftover antimicrobials.<br>• Advise them not to share antimicrobials with others.<br>• Encourage the disposal of unused antimicrobials by bringing them to the local pharmacy for disposal to prevent them getting into the environment.<br>• Encourage them to keep vaccinations up to date.<br>• Educate on the importance of proper hand hygiene, especially before eating and food preparation, to prevent the spread of infections. www.hse.ie/handhygiene.<br>• Signpost to www.undertheweather.ie and www.hse.ie to learn more about how to get well without antimicrobials, antimicrobial treatments, and AMR. |

## 1.2 Role of the prescriber in antimicrobial stewardship

In Ireland, a prescriber of antimicrobials can be a doctor, dentist, nurse or midwife. Prescribers can support AMS in the following ways.

- Adhere to good prescribing and AMS principles, as outlined in Table 1.3. The **Start Smart, Then Focus** antibiotic care bundle is example of how the principles have been adapted in the format of a national antimicrobial care bundle for hospitals.
- Utilise feedback on individual antimicrobial prescribing to improve prescribing practice. Feedback may compare use to guidelines, indicators or peers.
- Engage in regular education relating to AMS, such as local induction/update sessions, events to mark the annual European Antibiotic Awareness Day on 18 November, and postgraduate education. HSeLanD (www.hseland.ie) provides the following e-learning modules for those who prescribe, dispense, and administer antimicrobials:
  - » Antimicrobial stewardship
  - » Prevention and management of urinary tract infections
  - » *Clostridioides difficile* infection: IPC and AMS principles, prevention and management.
- Participate in local or national quality improvement audits for antimicrobial prescribing. Examples of national work include surgical antibiotic prophylaxis duration, review of urinary tract infection prophylaxis, and review of azithromycin prophylaxis. Tools to assist are available on www.antibioticprescribing.ie.
- Follow local and national policies when interacting with representatives from pharmaceutical companies, as outlined in Chapter 3 (section 3.4.4.3).
- Keep abreast of local and national antimicrobial prescribing guidelines, policies, and position statements that inform antimicrobial prescribing in their setting. For example:
  - » If you prescribe surgical antibiotic prophylaxis, you should be aware of the HSE position statement regarding surgical antibiotic prophylaxis duration and resources to support quality improvement work. These are available at www.bit.ly/3eGoCKw, while the surgical antibiotic prophylaxis e-learning module is available on www.hseland.ie.

### Table 1.3: Prescribers – practices that support the principles of good antimicrobial stewardship

| | |
|---|---|
| **1. Recognise clinical evidence of infection** | |
| • Prescribe antimicrobials promptly for infections that are likely to benefit from antimicrobial treatment.<br>• Consider the balance of benefit and harm before prescribing an antimicrobial. | |
| **2. Avoid unnecessary antimicrobial use** | |
| • Consider if the infection may be self-limiting and not require the use of an antimicrobial.<br>• Direct service users to www.undertheweather.ie for self-care advice.<br>• Use source control to manage the infection, e.g. drainage of pus, removal of infected device.<br>• Do not prescribe antimicrobials solely based on a culture result on a microbiological sample. Consider the evidence of infection or if the result reflects colonisation or contamination. | |
| **3. Choose an antimicrobial that will have the most benefit and cause the least harm** | |
| **Microbiological sampling** | • Obtain a relevant microbiological sample before starting the antimicrobial, when appropriate.<br>• Take appropriate samples using correct technique.<br>• Wait for results before starting therapy if safe to do so.<br>• Direct therapy based on microbiological sample results. |
| **Use of guidelines** | Use local hospital guidelines or visit www.antibioticprescribing.ie to choose the optimal agent, dosing, and duration for the site and type of infection. |
| **Individual service user considerations** | Consider service user factors such as interactions, allergies, renal/hepatic impairment, other conditions, age, recent antimicrobial use, or known infection or colonisation with AMR organisms, as they may influence the choice of agent. |
| **Seek expert advice** | Know when to consult senior colleagues or infection specialists, e.g. when managing very severe infection or infection not responding to treatment. |
| **Choose narrow-spectrum agents** | Use narrow-spectrum (Green) antimicrobials in preference to broad-spectrum (Red) agents when the narrow-spectrum antimicrobial is likely to be effective, as they cause less adverse effects and less AMR. |
| **Reserve antimicrobials** | Adhere to the HSE policy on restricted antimicrobials and local policy. |
| **4. Optimise the dosing regimen** | |
| **Right dose and frequency** | Consult guidelines for recommended dose and frequency. Incorrect dose or incorrect frequency of dosing of an antimicrobial can result in underexposure, causing treatment failure and increased risk of AMR. It can also result in overexposure, with increased risk of adverse effects. |
| **Right route** | • Use the oral route for antimicrobials where appropriate.<br>• Review the indication for intravenous antimicrobials daily. |
| **Right rate** | Administer intravenous antimicrobials at specified rates to minimise harm and infusion-related reactions, e.g. vancomycin and clarithromycin. |
| **Right time** | Establish correct timing of antimicrobial administration and even spacing of daily dosing to ensure a consistent level of antimicrobial reaches the site of infection over the course of the day and night.<br>Administer antimicrobials (of particular importance in sepsis/surgical prophylaxis) in a timely manner. |

**5. Minimise the duration**

- Avoid unnecessary prolonged courses of antimicrobials, as they are associated with increased harm.
- Document a stop date or review date on all antimicrobial prescriptions.
- Confirm prescription durations are in keeping with current guidance.

**6. Assess response to treatment**

It may take one or two days to see an improvement in signs and symptoms.

- Review clinical, haematological and biochemical parameters at appropriate intervals.
- Refer to any available microbiological sample results to guide treatment.

**7. Communication**

A treatment has the best chance of success, and the least risk of harm, if the service user understands and agrees to their treatment plan.

- Involve the service user in discussion about treatment. With their agreement you may involve others who support them. Discuss relevant aspects of treatment, including recognising the signs and symptoms of (worsening) infection, site of infection, microbiological sample results, treatment rationale, any changes to treatment if required, and how and when to take the treatment course.
- Document treatment decisions, rationale, and management plan.

**8. Prevent infection**

The prevention of infection results in less risk of harm to the service user and also reduces the likelihood of inappropriate antimicrobial prescription.

- Arrange vaccination (e.g. influenza, pneumococcal, meningococcal, and COVID-19) for at risk service users.
- Always use IPC standard precautions with all service users and transmission-based precautions during interactions when there is a suspected or confirmed case of communicable infection or colonisation with specific antimicrobial-resistant organisms.
- Review indwelling devices daily and their removal as soon as possible.

## 1.3 Role of the pharmacist in antimicrobial stewardship

Pharmacists play a key role in AMS across many care settings, including acute hospitals, residential care facilities, primary care, and other community settings. Pharmacists, providing both clinical and dispensary services to service users, are medication experts and provide integral support to optimise the use of antimicrobials and AMS in their organisations. Pharmacists can support AMS in the following ways:

- Adhere to AMS principles, as outlined in Table 1.4.
- Engage in regular education relating to AMS, such as local update sessions, events to mark the annual European Antibiotic Awareness Day on 18 November, postgraduate education, and AMS e-learning (www.hseland.ie and www.iiop.ie). Share learning and experiences about antimicrobial resistance and stewardship.
- Participate in local or national quality improvement audits for antimicrobial use. Examples of national work include surgical antibiotic prophylaxis duration, review of urinary tract infection prophylaxis, review of azithromycin prophylaxis. Tools to assist are available on www.antibioticprescribing.ie. Locally, monitor antimicrobial use in facilities (such as a residential care facility) and provide feedback and reporting.
- Act as liaison between the AMS team or antimicrobial pharmacist and prescriber to advise on optimising the use of antimicrobials.
- Keep abreast of local and national antimicrobial prescribing guidelines, policies, and position statements that inform antimicrobial prescribing in their setting.
- Participate in relevant committees (e.g. drug and therapeutics committee) and advise on the use of antimicrobials at the facility.
- Contribute to the development of antimicrobial prescribing guidelines, both locally and nationally.
- Follow local and national policies when interacting with representatives from pharmaceutical companies, as outlined in Chapter 3 (section 3.4.4.3).

### Table 1.4: Pharmacists – practices that support the principles of good antimicrobial stewardship

| | |
|---|---|
| **1. Recognise clinical evidence of infection** | |
| • Recognise self-limiting infections, including many common viral infections.<br>• Refer to a clinician for further assessment when clinically necessary and manage the expectation that antimicrobials will subsequently be prescribed. | |
| **2. Avoid unnecessary antimicrobial use** | |
| • Advise on symptomatic treatment (e.g. hydration, rest, analgesia in addition to non-antimicrobial over-the-counter preparations) for self-limiting infections that do not require antimicrobial therapy.<br>• Direct service users to www.undertheweather.ie when appropriate.<br>• Advise on the use of source control to manage the infection, e.g. wound care. | |
| **3. Choose an antimicrobial that will have the most benefit and cause the least harm** | |
| **Microbiological sampling** | Direct therapy based on microbiological sample results when appropriate and available.* |
| **Use of guidelines** | Recognise when antimicrobial agent, dose, and duration are not in line with local or national guidelines and highlight this to the prescriber. |
| **Individual service user considerations** | Determine/verify service user factors such as interactions, adverse reactions, including allergies, erroneous accounts of allergy limiting treatment, renal/hepatic impairment, age, recent antimicrobial use, or known infection or colonisation with AMR organisms. These factors may influence the choice of agent and promote optimal therapy. |
| **Seek expert advice** | Know when to consult senior colleagues or infection specialists. For example: a very severe infection or if not responding to the chosen treatment, or if an infection caused by a resistant organism is suspected or confirmed. |
| **Choose narrow-spectrum agents** | • Promote the use of narrow-spectrum (Green) antimicrobials in preference to broad-spectrum (Red) agents when the narrow-spectrum antimicrobial is likely to be effective, as they cause less adverse effects and less AMR.<br>• Promote review and timely de-escalation of broad-spectrum antimicrobials.* |
| **Reserve antimicrobials** | Promote adherence to the HSE policy on restricted antimicrobials and local policy.* |
| **4. Optimise dosing regimen** | |
| **Right dose and frequency** | • Consult guidelines for recommended dose and frequency, as incorrect dose or incorrect frequency of an antimicrobial can result in underexposure (can cause treatment failure and increased risk of AMR) or overexposure (unnecessary antimicrobial exposure and increased risk of adverse effects) to the antimicrobial.<br>• Support pharmacokinetic/pharmacodynamic optimisation based on service user-specific factors.* |
| **Right route** | Evaluate the route of administration and promote early intravenous-to-oral switch where possible.* |
| **Right rate** | Support the correct preparation and administration of intravenous antimicrobials at the correct rate to minimise harm and infusion-related reactions, e.g. vancomycin, clarithromycin, intramuscular ceftriaxone.* |

| | |
|---|---|
| **Right time** | • Advise on correct timing of antimicrobial administration and even spacing of daily dosing to ensure a consistent level of antimicrobial reaches the site of infection over the course of the day.<br>• Advise on timely administration of antimicrobials (of particular importance in sepsis/surgical prophylaxis).* |
| **5. Minimise the duration** | |
| • Advocate for appropriate duration of antimicrobial therapy, as longer courses than are necessary are associated with increased harm and shorter courses may be associated with relapse.<br>• Promote documentation of stop/review dates for all antimicrobial prescriptions.<br>• Promote prescription durations in keeping with current guidance. | |
| **6. Assess response to treatment** | |
| It may take one or two days to see improvement in signs and symptoms.<br>• Refer back to clinician when a service user is not responding to treatment.<br>• Review the microbiological sample and sensitivity results to guide treatment and minimise harm.* | |
| **7. Communication** | |
| A treatment has the best chance of success, and the least risk of harm, if the service user understands their treatment plan.<br>• Counsel service users about responsible antimicrobial use. Discuss expectations, attitudes, and benefits versus harms regarding antimicrobials.<br>• Provide advice to service users regarding prescribed antimicrobial therapy (e.g. how and when to take it correctly, potential adverse effects, expected time to improvement, and when to seek further medical advice). www.hse.ie/antibiotics<br>• Do not raise the expectation of antimicrobial prescribing when referring service users. | |
| **8. Prevent infection** | |
| The prevention of infection results in less risk of harm to the service user and also reduces the likelihood of inappropriate antimicrobial prescription.<br>• Arrange vaccination (e.g. influenza, pneumococcal, meningococcal, and COVID-19) for at-risk service user.<br>• Always use IPC standard precautions with all service users and transmission-based precautions when caring for service users with communicable infectious disease, or colonisation with specific antimicrobial-resistant organisms.<br>• Encourage review of indwelling devices daily and their removal as soon as possible. | |

**These interventions are more likely to be carried out by a pharmacist in a hospital setting.*

## 1.4 Role of the nurse and midwife in antimicrobial stewardship

Nurses and midwives are one of the largest group of healthcare workers across all care settings. They make an important contribution to AMS in their role as prescriber, in administering treatment, and in advocating for optimal antimicrobial use. Valuing the role of nurses and midwives in AMS can significantly influence antimicrobial prescribing across the healthcare system.

Nurses and midwives, working in settings such as the acute hospital, residential care facilities, general practitioner (GP) practices, public health, mental health, and other facilities, are regularly the healthcare worker with the most time spent in a service user facing role. They are key members of the multidisciplinary team and central to coordination of patient care. They are often best placed to monitor and review the service user during the course of treatment of an infection. They document this information to guide their own prescribing or to support engagement with prescribers. They are frequently the healthcare worker requesting and submitting microbiological samples and preparing and administering antimicrobials. Nurses and midwives support timely therapeutic drug monitoring in line with guidelines when required for specific antimicrobials.

Nurses and midwives can support AMS in the following ways:

- Prescribe according to guidelines
- Adhere to good AMS principles, as outlined in Table 1.5
- Engage in regular education relating to AMS, such as local update sessions, events to mark the annual European Antibiotic Awareness Day on 18 November, postgraduate education, and AMS e-learning (www.hseland.ie). Share learning and experiences about antimicrobial resistance and stewardship
- Participate in local or national quality improvement audits for antimicrobial prescribing. Examples of national work include surgical antibiotic prophylaxis duration and review of urinary tract infection prophylaxis. Tools to assist are available on www.antibioticprescribing.ie
- Follow local and national policies when interacting with representatives from pharmaceutical companies, as outlined in Chapter 3 (section 3.4.4.3)
- Keep abreast of local and national antimicrobial prescribing guidelines, policies, and position statements that inform antimicrobial prescribing in their setting, such as position statements for the use of dipstick urinalysis for assessing evidence of urinary tract infection on www.antibioticprescribing.ie
- Influence service user understanding and expectations about their infection and the role of antimicrobials. www.hse.ie/antibiotics

IPC nurse or midwife practitioners should be members of the AMS team, as they complement other specialist pharmacy and medical expertise on the team. They also support collaboration between the IPC programme and the AMS programme to achieve improved service user outcomes. Efforts to stop the development of AMR (by AMS) and the spread of AMR (by IPC) are two key strategies of Ireland's National Action Plans on Antimicrobial Resistance (iNAP). IPC nurse and midwife practitioners can contribute to the development of AMS policies, quality improvement initiatives and education, and encourage wider nurse and midwife participation in AMS. Nurses and midwives on intravenous catheter care teams can play an important role in encouraging the switch from intravenous-to-oral antimicrobial when appropriate.

**Table 1.5: Nurse/midwife – practices that support the principles of good antimicrobial stewardship**

| | |
|---|---|
| **1. Recognise clinical evidence of infection** | |
| • Recognise signs and symptoms of infection through service user assessment and monitoring.<br>• Identify service users with signs of deterioration/serious infection and initiate an appropriate response. | |
| **2. Avoid unnecessary antimicrobial use** | |
| • Do not prescribe antimicrobial if not required.<br>• Consider if the infection may be self-limiting and not requiring the use of an antimicrobial.<br>• Promptly remove invasive devices (e.g. intravascular devices, indwelling urinary catheters, etc.) when no longer required to prevent infection and thus the need for antimicrobials.<br>• Provide supportive measures such as hydration, analgesia or source control (e.g. removal of infected device or wound care) to maximise the benefit of antimicrobials.<br>• Support the appropriate use of dipstick urinalysis in accordance with AMRIC position statements on use to help prevent misdiagnosis and unnecessary antimicrobial prescribing. | |
| **3. Choose an antimicrobial that will have the most benefit and cause the least harm** | |
| **Microbiological sampling** | • Obtain a relevant microbiological sample before starting an antimicrobial, when appropriate.<br>• Take appropriate samples using correct technique.<br>• Arrange timely transfer of microbiological samples to the laboratory.<br>• Prescribe or advocate for prescribing based on microbiological sample results when appropriate. |

| | |
|---|---|
| **Use of guidelines** | Recognise when the antimicrobial agent, dose, and duration are not in line with local or national guidelines and highlight this to the prescriber. |
| **Individual service user considerations** | Determine/verify service user factors such as interactions, allergies, mistaken accounts of allergy, renal/hepatic impairment, other conditions, age, recent antimicrobial use, or known infection or colonisation with antimicrobial-resistant organisms. These may influence the choice of antimicrobial and therapy is tailored accordingly. |
| **Seek expert advice** | Know when to consult colleagues or infection specialists. For example: a very severe infection or if not responding to the chosen treatment, or if an infection caused by a resistant organism is suspected or confirmed. |
| **Choose narrow-spectrum agents** | • Promote the use of narrow-spectrum (Green) antimicrobials in preference to broad-spectrum (Red) agents when the narrow-spectrum antimicrobial is likely to be effective, as they cause less adverse effects and less AMR.<br>• Promote review and timely de-escalation of broad-spectrum antimicrobials. |
| **Reserve antimicrobials** | Support adherence to the HSE policy on restricted antimicrobials and local policy. |
| **4. Optimise the dosing regimen** | |
| **Right dose and frequency** | • Consult guidelines for recommended dose and frequency, as the incorrect dose or incorrect frequency of an antimicrobial can result in underexposure (can cause treatment failure and increased risk of AMR) or overexposure (unnecessary antimicrobial exposure and increased risk of adverse effects) to the antimicrobial.<br>• Support therapeutic drug monitoring for those antimicrobials requiring same (e.g. gentamicin, amikacin, vancomycin) and promote review and action on subtherapeutic or supratherapeutic levels. |
| **Right route** | Evaluate the route of administration and promote early intravenous-to-oral switch where possible. |
| **Right rate** | Ensure intravenous antimicrobials are prepared correctly and administrated at the correct rate to minimise harm and infusion-related reactions, e.g. vancomycin, clarithromycin, intramuscular ceftriaxone. |
| **Right time** | • Administer antimicrobials at the correct time and space doses evenly to ensure a consistent level of antimicrobial reaches the site of infection over the course of the day.<br>• Administer antimicrobials (of particular importance in sepsis/surgical prophylaxis) in a timely manner. |
| **5. Minimise the duration** | |
| • Advocate for appropriate duration of antimicrobial therapy, as prolonged courses are associated with increased harm.<br>• Adhere to the use of stop/reviews dates if prescribing and promote documentation of stop/review dates for all antimicrobial prescriptions. Do not administer the antimicrobial after that date without checking with the prescriber.<br>• Promote prescription durations in keeping with current best evidence. | |

### 6. Assess response to treatment

It may take one or two days to see improvement in signs and symptoms.

- Monitor the service user's clinical condition and response to treatment.
- Monitor for toxicity to allow prompt adjustment of agent/dose.
- Consider microbiological sample results in own or others prescribing decisions.

### 7. Communication

A treatment has the best chance of success, and the least risk of harm, if the service user understands and agrees to their treatment plan.

- Involve and discuss treatment with the service user and, subject to their consent, with others associated with their care. Discuss all aspects of treatment, including recognising the signs and symptoms of (worsening) infection, site of infection, microbiological sample results, treatment rationale, any changes to treatment if required, and how and when to take the treatment course.
- Share consistent messages about antimicrobial use. www.hse.ie/antibiotics.
- Document clearly and handover IPC and antimicrobial therapy information at the discharge or transfer of care.

### 8. Prevent infection

The prevention of infection results in less risk of harm to the service user and also reduces the likelihood of inappropriate antimicrobial prescription.

- Arrange vaccination (e.g. influenza, pneumococcal, meningococcal, and COVID-19) for at-risk service users.
- Always use IPC standard precautions with all service users and transmission-based precautions during interactions when there is a suspected or confirmed case of infection.
- Review indwelling devices daily and their removal as soon as possible.

## References

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Dyar OJ, Huttner B, Schouten J Pulcini C, ESGAP (ESCMID Study Group for Antimicrobial stewardship) (2017) What is antimicrobial stewardship? *Clin Microbiol Infect*, 23(11): 793–798.

# Chapter 2: Antimicrobial stewardship governance, structures and supports

## Key points

- The AMRIC team leads a key patient safety programme under the direction of the Chief Clinical Officer of the HSE. The programme is supported by a governance structure led by the AMRIC Oversight Group, which guides the management of IPC and AMS within acute and community services. The AMRIC team is a multidisciplinary team working full time on AMS and IPC.
- The AMRIC Implementation Team, which reports to the Oversight Group, supports implementation and maintenance of a comprehensive AMS service in accordance the AMRIC Action Plan and second Irish National Action Plan for Antimicrobial Resistance (iNAP2). The AMRIC implementation work programme is driven by the national HSE AMRIC Team (reports to the Office of the Chief Clinical Officer), the Acute Operations AMRIC Team (reports to National Director, Acute Operations), and the Community Operations AMRIC Team (reports to National Director, Community Operations).
- The AMRIC Implementation Team is supported by an AMS Advisory Group. The membership of this group is detailed in Appendix 4.
- Hospital Group and Community Health Organisation (CHO) IPC and AMS (AMRIC) committees and teams implement IPC and AMS at those levels.
- Hospital and service managers are responsible for ensuring that appropriate governance structures and processes for management of AMS are in place at the hospital/service level.
- A multidisciplinary AMS oversight committee should oversee and support the work of AMS team in the effective implementation of Hospital Group and CHO AMS plans in conjunction with relevant IPC committees. An AMS and IPC (AMRIC) Committee that addresses both IPC and AMS is a good model that reflects the structures at national level. AMS activities must also be coordinated with drugs and therapeutics committees.
- AMS teams are responsible for designing, implementing, and reporting on the effectiveness of the AMS programme within an organisation. They play a central role in leading and sustaining improvement in the use of antimicrobials in an organisation.
- The core AMS team should include a clinical microbiologist or an infectious disease physician (or both), and an antimicrobial pharmacist. Nursing support for the AMS team from IPC, intravenous catheter care team, or other nursing staff with a particular interest should be included whenever possible. Members of the AMS team should have protected time dedicated to AMS activities.
- Competencies and skills in the areas of quality improvement, behavioural changes, and measurement and data analysis can enhance the impact of AMS professionals within an organisation.
- All healthcare organisations should have an AMS policy and an annual AMS plan relevant to the local context.
- The approach to AMS should support integrated measures and objectives between with community and acute services.

## 2.1 Structure and governance of antimicrobial stewardship

### 2.1.1 National AMRIC Oversight Group

The AMRIC team leads a key patient safety programme under the direction of the Chief Clinical Officer of the HSE. The programme is supported by a governance structure led by the AMRIC Oversight Group (see Figure 2.1). This group is chaired by the Chief Clinical Officer and includes the National Directors for Acute and Community Operations among other HSE senior leaders. The AMRIC Oversight Group provides the HSE AMRIC Implementation Team with a clear mandate for its work.

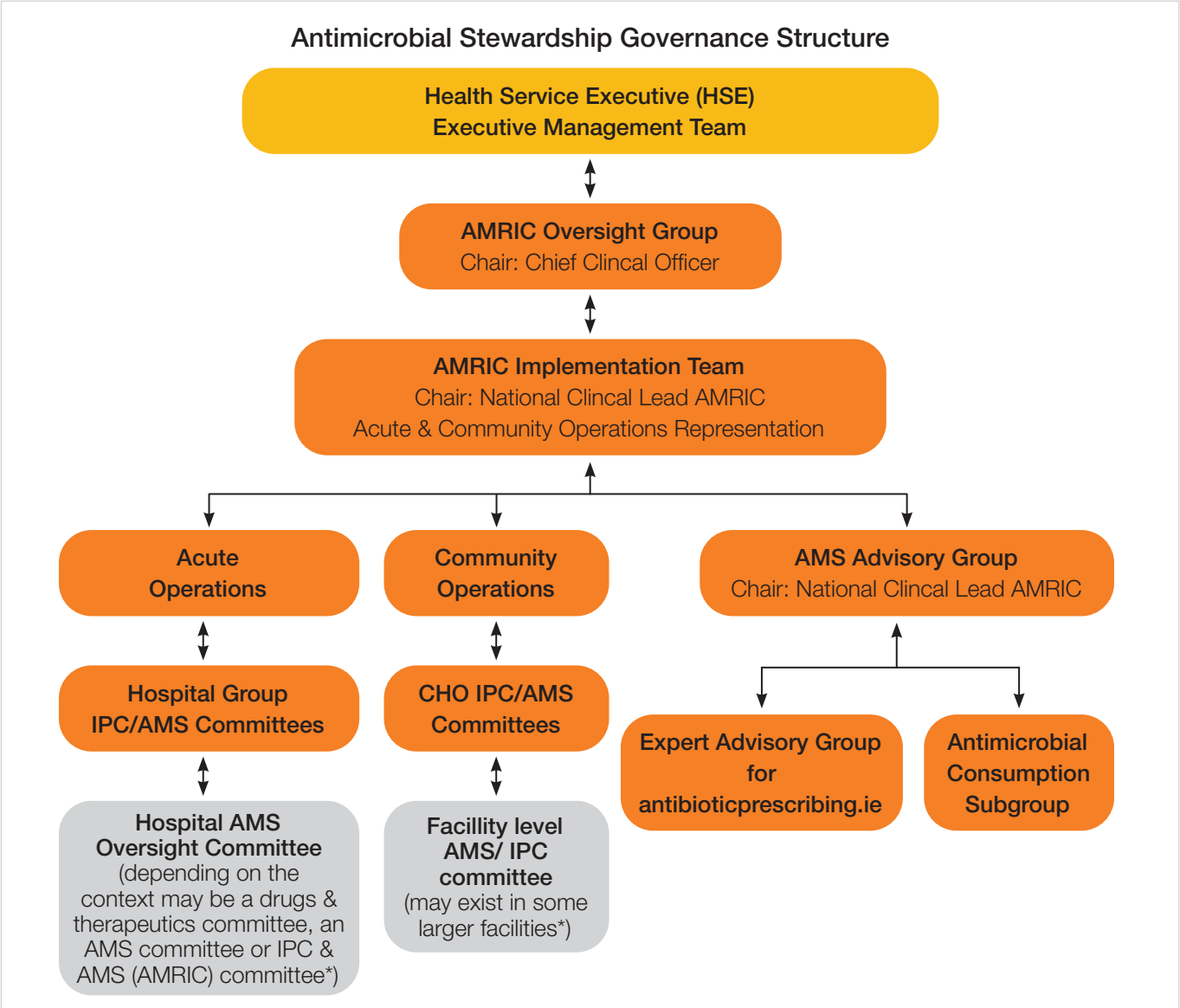
### 2.1.2 National AMRIC Implementation Team

The AMRIC Implementation Team is chaired by the HSE clinical lead for AMRIC and includes AMRIC managers from Acute and Community Operations as part of multidisciplinary team. The AMRIC Implementation Team supports the delivery of operational requirements and improvements necessary to fulfil the mandate provided by AMRIC Oversight to improve performance on IPC and AMS within the acute and community settings.

### 2.1.3 National Antimicrobial Stewardship Advisory Group

The National AMS Advisory Group is a multidisciplinary expert advisory group with representatives from clinical specialties. It advises the national AMRIC Implementation Team. The role of the group is to provide advice, strategies, and guidance to support the successful implementation and maintenance of a comprehensive AMS service encompassing all acute and community services with cognisance of the AMRIC Action Plan and iNAP2.

**Figure 2.1: National AMRIC governance structure**




** In smaller units/practices, this may be managed within general structures for quality improvement, patient safety or medication safety, or similar.*
*Note that the AMRIC core team inputs into work streams of all orange colour-coded boxes above.*
*AMRIC: antimicrobial resistance and infection control; AMS: antimicrobial stewardship; CHO: Community Healthcare Organisation; HSE: Health Service Executive; IPC: infection prevention and control.*

## 2.1.4 Operational governance structure

### 2.1.4.1 Hospital Group IPC and AMS committees

The Hospital Group IPC and AMS (AMRIC) committee is an advisory body. Governance in relation to IPC and AMS is through the Chief Executive Officer. The purpose of the Hospital Group IPC and AMS (AMRIC) committee is to support the Chief Executive Officer in ensuring the development of IPC and AMS services and structures in the Hospital Group and to advise on prioritisation of the use of these resources in line with national strategic objectives for healthcare associated infection/AMR. This group will receive and review periodic reports from hospitals regarding their AMS activities, promote and advance the importance of AMS within the organisation, support the implementation of an annual plan for AMS, and review and assist in implementing recommendations from audit reports.

### 2.1.4.2 Community Healthcare Organisation IPC and AMS committees

The CHO IPC and AMS (AMRIC) committee is an advisory body. Governance in relation to IPC and AMS is through the Chief Officer in the CHO. The purpose of the CHO IPC and AMS (AMRIC) committee is to support the Chief Officer in ensuring the development of IPC and AMS services and structures in the community and to advise on prioritisation of the use of these resources in line with national strategic objectives for healthcare associated infection/AMR. This group will receive and review periodic reports from CHO service divisions regarding their AMS activities, promote and advance the importance of AMS within the organisation, support the implementation of an annual plan for AMS, and review and assist in implementing recommendations from audit reports.

## 2.1.5 Institutional/service governance structures for community and acute services

### 2.1.5.1 Hospital or service managers

Hospital or service managers should confirm that appropriate structures and processes are in place to support AMS within the service area that they are responsible for. It is recommended that each hospital or service have an advisory group (e.g. a hospital AMRIC committee) and team, where appropriate, to the scale of the service area. The manager will ensure the following in a manner that is appropriate to the scale of the service:

- AMS is identified as a strategic quality and safety initiative.
- AMS operates in a planned and structured fashion. The extent to which this is formalised will vary with the scale of the service.
- There are appropriate governance structures for oversight of AMS in place. In hospitals, a drugs and therapeutics committee and/or an AMS committee or IPC and AMS (AMRIC) committee should provide oversight for the AMS programme. In smaller units/practices, this may be managed within general structures for quality improvement, patient safety or medication safety, or similar.
- For larger services, such as hospitals, oversight of the AMS programme includes approval of an annual report and annual plan. In smaller services where this is not practical, a brief process of planning and review is still important.
- The service area will endeavour to provide appropriate resources such as human, financial, and information and communication technology (ICT) for AMS.
- Ongoing AMS education and training, including information on optimal antimicrobial use and AMR, is available for all healthcare workers involved in prescribing, dispensing, and administering antimicrobials and those who influence any aspect of the process.
- A senior clinician is engaged to support and champion the AMS programme. In some facilities, this may be the AMS programme lead.

#### 2.1.5.2 Antimicrobial stewardship oversight committee

- The oversight of the AMS programme should be through a committee that can be one of the following: an IPC and AMS (AMRIC) committee; a drugs and therapeutics committee; a designated antimicrobial advisory committee; a quality improvement committee, or a patient/medication safety committee. In small services, this may require a less formal structure but some process for review and planning is appropriate for all services.
- The role of the committee is to oversee and support the effective implementation and ongoing function of the AMS programme. Examples of work include:
  - Approval of prescribing guidelines
  - Authorisation of the introduction of new antimicrobials within the facility
  - Approval of an antimicrobial restriction policy
  - Approval of an annual report and annual plan as appropriate to the scale of the service
  - This committee should meet at least quarterly for services at the scale of a hospital or CHO
  - This committee should have multidisciplinary representation reflecting the range of disciplines involved in the service.
- Membership will vary depending on the setting and available resources. Off-site specialists may be asked to provide expert advice to meetings by teleconference.
- Smaller organisations may link with regional committees for support and guidance but are responsible for implementation within their service area.
- The approach to AMS should support integrated measures and objectives between community and acute services; that is, hospital AMS oversight committees should include community representation, while community AMS oversight committees should include hospital representation. As Regional Health Areas develop, regional committees will support this integration.
- Suggested members include:
  - The AMS programme lead
  - A representative of the service manager or Executive Management Team
  - Clinical microbiologist
  - Infectious disease physician
  - Antimicrobial pharmacist
  - Clinicians from varying disciplines appropriate to the size, complexities, and specialities of the service (e.g. medicine, surgery, emergency medicine, intensive care, transplant unit, general practice or medical officers, dentist)
  - Non-consultant hospital doctors (relevant to acute and community settings)
  - Chief pharmacist
  - Infection prevention and control practitioners
  - Nursing administrator
  - Nurses and midwives (in particular prescribers)
  - Representative for the outpatient parenteral antimicrobial therapy (OPAT) service
  - Representatives from network or district facilities
  - Representatives of the sepsis committee if available
  - ICT staff
  - Surveillance scientist/epidemiologist
  - Quality improvement or behavioural science experts
  - Additional members co-opted, depending on the healthcare setting and the antimicrobial issue being considered.

#### 2.1.5.3 Antimicrobial stewardship team

The AMS team (or AMS lead in smaller services) is the face and clinical leader of AMS within the organisation. It is the operational team responsible for the design, implementation, and reporting on the effectiveness of the AMS programme. The overarching aim of the team is to achieve optimal use of antimicrobials by developing systems and structures to support safe and effective antimicrobial use within an organisation. Development and implementation of these interventions must be adapted to the specific context and consider local facilitators and barriers.

The members of the AMS team can vary from organisation to organisation and depend on local resources (see Table 2.1). A team with a clinical microbiologist, an infectious disease physician, and an antimicrobial pharmacist as main team members is optimal for a hospital, CHO or similar scale of operation. The clinical lead will usually be the consultant clinical microbiologist or infectious disease physician. Within the team itself, the roles and responsibilities can be distributed differently depending on the setting. It is integral that these roles and responsibilities are discussed and clearly defined at the local level. If a clinical microbiologist or infectious disease physician is not available, the AMS work may be led by the antimicrobial pharmacist, or doctor or nurse with a specific interest or expertise in the area. For smaller facilities, having formalised regional arrangements with a service lead in place will support sustainable AMS.

### Table 2.1: Membership of the antimicrobial stewardship team at hospital or Community Healthcare Organisation level

| Members of antimicrobial stewardship team | |
|---|---|
| **Key members** | **Additional team members** |
| • Consultant clinical microbiologist<br>• Consultant infectious disease physician<br>• Antimicrobial pharmacist<br>• Surveillance scientist/epidemiologist | • Non-consultant hospital doctors<br>• Clinical pharmacists<br>• IPC practitioners<br>• Prescribing clinicians from key departments<br>• Nurses and midwives (including prescribers)<br>• Representative from the OPAT service<br>• Community: GP, dentist, community pharmacist |

The role of the AMS team in an organisation is to design, implement, and report on the effectiveness of the AMS programme. This may include:

- Develop an annual AMS work plan and annual report
- Monitor antimicrobial consumption, AMR trends, and antimicrobial related patient safety incidents
- Disseminate reports, including consumption data, audit recommendations, and patient safety incidents
- Formulate or review antimicrobial guidelines in light of local AMR data
- Develop pathways in the diagnosis and management of common infections
- Conduct timely audit and feedback with clinical teams
- Provide education on optimal antimicrobial use to those who prescribe, dispense, and administer antimicrobials
- Pre-authorise restricted antimicrobials
- Review patients on intravenous antimicrobials for potential switch to oral therapy
- Review patients on oral antimicrobials who may require intravenous treatment
- Review patients receiving antimicrobials with duplicate spectra, or other potentially inappropriate drug combinations to include under-treatment
- Review patients on selected broad-spectrum or restricted antimicrobials
- Review patients with documented sterile site infections (e.g. bloodstream infection, meningitis) or other specific infections (e.g. *C. difficile*) to ensure appropriate antimicrobial therapy is in place
- Review patients receiving antimicrobials for a duration that exceeds recommendations in the prescribing guidelines
- Participate in the IPC programme.

See Chapter 3 for further detail on strategies and tools for AMS interventions.

The AMS team should work closely with the facility's IPC team to support the integration of prevention and control of healthcare associated infection and AMR with the AMS programme. In many facilities, the AMS team and IPC team will share common membership and may be led by the same individual.

A clinical pharmacy service within a facility, if available, is central to the effective implementation of AMS. It functions as a two-way mechanism to improving antimicrobial use by highlighting to the AMS team when review is required and, as part of the routine clinical pharmacy review, promoting adherence to prescribing guidelines and other AMS strategies.

AMS professionals are encouraged to seek further training in quality improvement and change management processes as required. It is important to consider involving others who can contribute this expertise from quality improvement or patient/medication safety teams. Key knowledge, skills, and competencies required of AMS professionals to enhance their impact within the organisation are summarised below:

- Principles of AMS
- Approaches to AMS interventions
- Antimicrobials and mechanisms of AMR
- Diagnosis and management of infections and infectious diseases
- Microbiology and laboratory diagnostics
- Management of sepsis
- Informatics/ICT
- Leadership and strategic planning
- Infection prevention and control
- Measurement and data analysis
- Quality improvement, including behavioural change
- Education.

### Leadership

The AMS team provides the vision, inspiration, and momentum to sustain and continuously improve the use of antimicrobials within an organisation. The leadership of the AMS team is essential to the success of the AMS programme in order to optimise individual care and protect public health generally through control of infection and control of AMR. The AMS team leads by communicating a clear vision and motivates staff by focusing on the shared purpose of improving service user care. An organisational approach is required to achieve AMS goals and the team should aim to influence at the organisation level through strategic input and integration with governance structures. Making AMS a core part of governance and patient safety within the healthcare organisation is key to changing culture and behaviours.

The team should actively engage with organisational and clinical leaders within the organisation to gain support for AMS interventions, such as new guidelines, clinical pathways, and treatment algorithms. In organisations with the available resources, the clinical microbiologist and/or infectious disease physician is the AMS lead. Clinicians caring for critically ill patients are more likely to follow an antimicrobial policy supported by their microbiologist or infectious disease colleagues, while the infection specialists can gain prescriber acceptance of antimicrobial interventions by ensuring that there is no perceived loss of autonomy in clinical decision-making. Similarly, antimicrobial pharmacists can harness the knowledge and motivation of the clinical pharmacy team to prioritise AMS across all specialities.

### Expert advice

The expertise provided by the AMS team in the management of infections and infectious diseases and support for AMS activities is considered essential to the success of the AMS programme. Expert advice of the team can influence service user care at the individual level right up to local, regional, and national level.

Participation of AMS team members in prescription review with point-of-care intervention and feedback on AMS ward rounds is a valuable tool in the provision of specialised advice to prescribers and other healthcare workers on the ongoing management of service users' antimicrobial therapy. The AMS team can provide expert support to high-risk units, such as intensive care, transplantation, cystic fibrosis, haematology, and oncology, where typically high antimicrobial use exerts selection pressure for AMR. The

AMS team can support the management of patients on these units through review of antimicrobial use, changes in cumulative antibiograms, and reports on multidrug resistant organisms.

The AMS team keeps abreast of the current literature, advances, and guidelines in the area of AMS and infectious diseases. In addition, advice is provided to the AMS committee on new interventions and guideline revisions as appropriate.

### Monitoring antimicrobial use and evaluating interventions

The AMS team has an important role in establishing and evaluating systems for monitoring the overall volume and quality of antimicrobial use in their organisation as well as the collection and use of data for quality improvement. The key performance measures and feedback strategies central to this activity are outlined further in Chapter 6.

The AMS team plays an essential role in surveillance at local level (i.e. to aid the development of local resistance profiles and to guide the choice of empiric therapy) and also contributes to regional, national, and international surveillance data. The team leads the interpretation of the data collected, including interpretation of antibiograms and trends in AMR, and the implementation of this within an organisation with actionable planning.

### Education

One of the primary roles of the AMS professional is that of educator. The AMS team makes a considerable contribution to the development and delivery of education to the staff through formal and informal education platforms, which are further detailed in Chapter 5. Some of the educational activities that AMS team members may engage in include but are not limited to:

- Providing prescriber feedback and education at forums, such as grand rounds, or as part of an AMS intervention
- Educating clinical staff and students on the principles of appropriate antimicrobial use, prescribing guidelines, and policies
- Educating staff about clinical indications for testing, correct specimen collection, available laboratory testing procedures, optimal use of these procedures, and providing updates when collection or testing methods change
- Educating clinicians about the interpretation of, clinical significance of, and appropriate responses to, significant microbiological sample results
- Presenting results of clinical audits and providing feedback to clinicians and hospital executives
- Educating service users, carers and the public about antimicrobials and contributing to the development of service user information resources.

### Communication and collaboration

Cross-speciality engagement and collaboration is essential to achieve the goals of the AMS team. The AMS team should collaborate and facilitate interaction with other departments and committees within the organisation (e.g. clinical directorates, pharmacy, drug and therapeutics committee, IPC, immunology, ICT, management) in order to embed AMS policy into the governance and safety structures.

A strong working relationship between the AMS team and laboratory services optimises both service user specific diagnostic testing and system-wide diagnostic stewardship. Continuous collaborative working with the laboratory is key to achieving many AMS interventions. The consultant microbiologist, due to their roles in both the laboratory and the AMS team, has a central part in the integration of test reporting with the AMS programme; timely adoption of new laboratory processes to reduce uncertainty and improve clinical care; and system approaches to optimise interpretation of clinical results and communication directly via the AMS team when appropriate.

The AMS team liaises with peer AMS experts through professional organisations and other bodies nationally and internationally to keep abreast of development and innovation in the field of AMS.

### AMS human resources

International recommendations and practices with regard to human resourcing of AMS teams vary considerably (see Table 2.2). It should be noted that comparability of international estimates is limited because of the different methods used to estimate bed capacity, varying primary activities for AMS teams, and the way in which services are delivered in the different healthcare systems. Currently, the literature only details such models for the acute hospital setting. AMS programmes in community settings in many countries are at an early stage and as such guidance regarding resourcing does not yet exist. Considering that the majority of antimicrobial use (80–90%) is in the community (inclusive of residential care facilities for older persons; mental health and intellectual disability; out-of-hours services; primary care; dentistry), community AMS teams are important and have recently been developed in Ireland.

The HSE has identified a baseline requirement for a component of the time of a consultant microbiologist or infectious disease physician and for a whole-time antimicrobial pharmacist (i.e. two antimicrobial pharmacists for a Model 4 hospital and one for a Model 3 or specialist hospital) to support hospital-based AMS. Medical leadership for the AMS programme requires protected time for AMS work and regular on-site commitment from a consultant microbiologist or infectious disease physician. Hospitals may require more resources than this based on caseload and services delivered.

Hospitals should enable:

- Prescribers to have appropriate access to clinical microbiology or infectious disease expertise on a 24-hour basis. Contact between a senior member of the service user's team and clinical microbiology or infectious diseases should be encouraged for all complicated infections
- All acute hospitals to have access to a laboratory-based surveillance scientist. This service is usually based in the laboratory that provides services to that hospital

The HSE has identified a baseline requirement for a component of the time of a consultant microbiologist or infectious disease physician and for one whole-time antimicrobial pharmacist for each CHO to support community-based AMS. Medical leadership for the AMS programme requires protected time for AMS work and consistent engagement with the CHO from a consultant microbiologist or infectious disease physician. CHOs may require more resources than this, however. This may take account of the population served and their health needs, including the number and variety of residential care facilities in the area, the number of prescribers, the population of the area, and the geographical spread. Table 2.2 sets out some international guidance on resources for AMS requirements.

**Table 2.2: International staffing recommendations available for antimicrobial stewardship in hospitals**

| Country/Region | How standards were defined (Source) | Staffing standards |
|---|---|---|
| **Europe**[1] | European Centre for Disease Prevention and Control (ECDC) technical report, guidance based on expert consensus | 2–6 WTE workforce members per 1000 acute care beds, as salary support and dedicated time for AMS activities |
| **Australia**[2] | Australian Commission on Safety and Quality in Health Care guideline, *Antimicrobial Stewardship in Australian Health Care 2018* | 4 WTE workforce members per 1000 acute care beds (ideally comprising physicians, pharmacists, and microbiologists) |
| **Canada**[3] | Based on an environmental scan, survey of the medical literature, and expert opinion of the Antimicrobial Stewardship and Resistance Committee | Core team members (minimum recommended): total of 4.9 WTE/1000 acute care beds:<br>• Physician: 1.0 WTE per 1000 acute care beds<br>• Pharmacist: 3.0 WTE per 1000 acute care beds<br>• Project/Programme administrative and coordination support: 0.5 WTE per 1000 acute care beds<br>• Data analyst: 0.4 WTE per 1000 acute care beds |
| **Austria and Germany**[3] | Guideline by the German Society for Infectious Diseases (DGI), based on the literature and expert advice | Antimicrobial stewardship team: minimum of 2 WTE per 1000 bed consisting of:<br>• An infectious diseases physician (or clinician with infectious disease training)<br>• An experienced clinical pharmacist/ hospital pharmacist<br>• A specialist in microbiology |
| **France**[3] | Nationwide survey in 65 hospitals, conducted in 2015 by a taskforce on antimicrobial resistance coordinated by the Ministry of Health | Optimal standards for the whole antimicrobial stewardship team: 6.7 WTE per 1000 acute care beds:<br>• 3.6 WTE per 1000 acute care beds for infection specialists (medical doctors, ideally infectious disease specialists)<br>• 2.5 WTE per 1000 acute care beds for pharmacists<br>• 0.6 WTE per 1000 acute care beds for microbiologists |

| | | |
|---|---|---|
| **The Netherlands**[3] | National consensus procedure | Standards for the whole AMS team:<br>*Start-up phase: optimal standards*<br>• Hospital <300 beds: 100 hours one time + 0.87 WTE per year<br>• Hospital 300–750 beds: 100 hours one time + 1.2 WTE per year<br>• Hospital >750 beds: 100 hours one time + 1.53 WTE per year<br>*Consolidation phase: minimum standards*<br>• Hospital <300 beds: 1.25 WTE per year<br>• Hospital 300–750 beds: 2.14 WTE per year<br>• Hospital >750 beds: 3.0 WTE per year |
| **United Kingdom**[4] | British Society for Antimicrobial Chemotherapy (BSAC) e-book, *Antimicrobial Stewardship: From Principles to Practice* | • Uncertainty about ideal ratio of AMS professionals to patients<br>• Recommended minimum: 2.0 WTE pharmacists per 1000 acute care beds<br>• May be insufficient if level of patient complexity is high<br>• Other human resources should also be assured, including physicians, microbiologists and IT specialists |
| **United States**[5] | Infectious Diseases Society of America (IDSA), Society for Healthcare Epidemiology of America (SHEA) and the Pediatric Infectious Diseases Society (PIDS) 2018[6] | Consensus recommendation for a minimum WTE-to-bed ratio to staff an AMS programme in the acute care setting:<br>• 100–300 beds: 1.4 WTE (1.0 pharmacist, 0.4 physician)<br>• 301–500 beds: 1.6 WTE (1.2 pharmacist, 0.4 physician)<br>• 501–1000 beds: 2.6 WTE (2.0 pharmacists, 0.6 physician)<br>• >1000 beds: 4.0 WTE (3.0 pharmacists, 1.0 physician) |
| | Antimicrobial Stewardship Task Force, Veterans Health Administration, 2017[7] | Recommendations in order to implement and manage a robust AMS programme:<br>• Pharmacist: 1.0 WTE/100 beds<br>• Physician: 0.25 WTE/ 100 beds |

» ***Source:*** *Adapted from Pulcini et al. (2017)*

***1*** *ECDC (2017);* ***2*** *ACSQHC (2018);* ***3*** *Pulcini et al. (2017);* ***4*** *BSAC (2018);* ***5*** *Greene et al. (2020);* ***6*** *Doernberg et al. (2018);* ***7*** *Echevarria et al. (2017)*

*AMS: antimicrobial stewardship; WTE: whole-time equivalent*

#### 2.1.5.4 Importance of microbiology laboratory

The microbiology laboratory works to aid in the diagnosis of infection and as a result aids in optimising antimicrobial use. It also works closely with the AMS team to promote best diagnostic stewardship is embedded in the organisation. The joint role of the consultant microbiologist in AMS and direction of laboratory services is referred to in section 2.1.5.3 above. Formalised procedures should encompass areas such as appropriate clinical specimen collection and testing; ensuring accuracy and quality of diagnostic testing; use of selective reporting of susceptibility testing; timely reporting with comments that assist in interpretation; and timely reporting of significant results. The microbiology laboratory is central to the surveillance of AMR and susceptibility patterns, which informs the development of local guidelines and initiatives and feeds into the national and international collection and analysis of data.

## 2.2 Antimicrobial stewardship programme

Two core components of an AMS programme, in addition to established governance structures and human resources, are the AMS policy and the AMS annual plan. The recommended interventions and measurement and monitoring are covered in more detail in Chapters 3–6.

### 2.2.1 Antimicrobial stewardship policy

An AMS policy establishes antimicrobial stewardship as a safety and quality priority, outlines the functions and accountability, gives authority to the AMS team, and defines relationships with management and clinical leadership within the service in relation to the key concepts of AMS. All large healthcare organisations (e.g. hospitals, CHOs, large residential care centres) should have a written AMS policy. Smaller services (e.g. GP practice) should at a minimum have a brief statement of guiding AMS principles agreed by prescribers. An AMS policy should be:

- Developed by the AMS team and AMS committee and include a review date
- Approved by the drug and therapeutics or medication safety committee or equivalent
- Endorsed by the executive management team of the health service organisation
- Regularly reviewed and audited for compliance
- Readily available to all who prescribe, dispense, or administer antimicrobials
- Used as the basis for AMS education programmes
- Used, at a minimum, to nominate a person and their position within the organisation who has executive responsibility for the policy's content, and a named AMS lead for implementing and monitoring it, and who will be involved in and provide direction for future AMS activities
- Provide information on how to access expert advice
- Incorporate the principles of AMS, including the need for prescribers to prescribe antimicrobials guided by the latest version of antimicrobial prescribing guidelines
- Include the documentation required by a prescriber for all antimicrobial prescriptions, such as indication, duration, and if applicable reason for variance with the available guidelines
- Include an approach for management regarding approval of restricted antimicrobials. Further detail in relation to a restricted list and operational details should be included in the antimicrobial prescribing guidelines
- Include details of the process and mechanism for review and approval of new antimicrobials (see section 3.4.4.2 for more detail)
- Refer to the health service organisation's policy on liaising with the pharmaceutical industry and be cognisant of national guidance outlined in Chapter 3 (section 3.4.4.3)
- Outline how compliance with the policy will be audited and fed back to prescribers and the AMS committee or governance bodies
- A brief statement of agreed AMS principles may refer to a commitment to prescription according to relevant guidelines, periodic peer group review of prescribing practice, and engagement with services available to support AMS.

### 2.2.2 Antimicrobial stewardship programme annual plan

All hospitals, Hospital Groups, and CHO AMS programmes will develop an annual plan that is approved by the relevant IPC and AMS (AMRIC) oversight committee and service manager (if not part of the oversight group). The plan should include the following core elements: governance; measurement and monitoring; guidelines and guideline review; audit; communication and education; and quality improvement, as outlined in Table 2.3.

**Table 2.3: Core elements of antimicrobial stewardship programme annual plan**

| 1. Governance |
|---|
| Assessment of the organisational readiness to implement an AMS programme:<br>• Define the structures and processes required<br>• Define the resources required to support the programme<br>• Understand the context in which the AMS programme is being implemented, including the organisational culture, safety culture, and local influences on prescribing behaviour<br>• See examples of useful self-assessment tools: New South Wales (NSW) Clinical Excellence Commission **Antimicrobial Stewardship Progress and Planning Tool**; Centers for Disease Control and Prevention (CDC) **Checklist for Core Elements of Hospital Antibiotic Stewardship Programs**; and Royal College of General Practitioners (RCGP) **TARGET Antibiotic Toolkit Self-Assessment Checklist** |
| Identification of effective interventions:<br>• See Chapter 3 for more detail<br>• Use a driver diagram, as it is a beneficial approach to determine which interventions to include in the AMS programme. The Institute for Healthcare Improvement (IHI) and CDC developed a **driver diagram** for AMS<br>• Align AMS programmes to medication safety programmes in organisations. Aligning to medication safety programmes, since antimicrobials are categorised as high-risk medications by the World Health Organization (WHO) (that are more likely to cause harm in the instance of a medication error), the **Hierarchy of Effectiveness** developed by the Institute for Safe Medication Practices (ISMP) Canada is a useful resource to determine effective interventions for the safe use of antimicrobials. |
| **2. Measurement and monitoring** |
| • Review and monitor local data on epidemiology, antimicrobial resistance, and outbreak reports.<br>• Review and monitor antimicrobial use, such as consumption reports, point prevalence study data and recommendations, audit recommendations, and inspection findings.<br>• Review patient safety incidents related to antimicrobial use, such as *Clostridioides difficile* infections or adverse drug reactions.<br>• Define measurable indicators, goals, and outcomes of an AMS programme:<br>» Use SMART (specific, measurable, achievable, realistic, timely) aims.<br>» Use a balanced set of measures, as discussed in Chapter 6, on measuring performance and evaluating AMS programmes.<br>• See Chapter 6 for more detail on measurement and monitoring. |
| **3. Guidelines and guideline review** |
| Create guidance and review existing antimicrobial policies and guidelines (more detail in Chapter 3). |
| **4. Audit** |
| Develop an audit plan for the year with consideration of point prevalence study, participation in regional, national or European audit, or specific audits for assessing adherence to guidelines/policy, quality assurance, or to garner information and identify targets for improvement aligned to national AMRIC goals (more detail in Chapter 6). |

**5. Communication and education**

- Note that robust communication is critical to raise awareness of the AMS programme and initiatives, engage stakeholders, and disseminate results.
- Consider the following in the communication plan: raising awareness and promoting the AMS programme, issuing AMS programme updates, and providing feedback on programme outcomes. The annual European Antibiotic Awareness Day on 18 November is a good time to communicate about the programme.
- Disseminate and communicate antimicrobial consumption reports, resistance data audit findings, and recommendations to relevant staff as part of the annual work plan.
- Include an education programme in all AMS plans, as education is an essential component of any AMS plan. Education on its own has limited effectiveness and should be used as part of a multimodal approach to AMS.
- See Chapter 5 for more detail on communication and education.

**6. Quality improvement (QI)**

Determination of priority areas for AMS activities and driving improvement:

- Review the core elements above to help inform priorities for improvement, including the identification of programme elements that are missing
- Use tools such as a QI audit sequence of plan–do–study–act cycles when implementing new strategies. Other useful resources can be found in in the **HSE Quality Improvement Toolkit**
- See Chapter 6 for more detail
- Evolve and develop the plan in line with emerging evidence and learning.

### 2.2.3 Sustaining an antimicrobial stewardship programme

- An AMS programme will evolve over time depending on outcome data, evaluation, resources, changes in service provision, and the availability of new tools/systems.
- Maintaining an AMS programme can be challenging, but continuous planning and evaluation with feedback to prescribers will support sustained improvements.
- Ongoing education and increasing awareness is critical to maintain the engagement of stakeholders in AMS initiatives.
- Programmes need to communicate successes with the use of process and outcome data and be ready to respond to changing circumstances.
- It is likely that programmes will need to change as new challenges are identified and as goals and achievements are realised.
- Using a quality improvement framework will support sustainability. Once a practice has become established or behavioural/cultural change has occurred, attention needs to be refocused on consolidating and providing quality assurances of improved prescribing practices and behaviours. Several measurement cycles might be needed to identify whether changes to clinical practice have been embedded in the organisation or not. If it becomes evident that practice change has not been sustained, strategies may need to be refined or retested.

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# Chapter 3: Strategies and tools for antimicrobial stewardship programmes

## Key points

- Key strategies for AMS programmes include:
  - » Restricted use of certain antimicrobials and pre-authorisation
  - » Clinical review with point-of-care interventions and direct prescriber feedback
  - » Prescribing guidelines, clinical pathways, and prescriber aids
  - » Antimicrobial prescribing surveillance, audit, quality improvement, and feedback
  - » Learning from patient safety incidents
  - » Diagnostic stewardship
  - » Education and training.
- Implementation of different strategies and tools is dependent on resources available and the type of care setting.
- A formulary for antimicrobials, with restrictions on use, and an approval system for antimicrobials are effective in changing prescribing practices.
- The AMS team should have a system for timely identification of particular cohorts of service users who are likely to benefit from AMS review.
- Point-of-care interventions, such as dose optimisation, intravenous-to-oral conversion, or therapeutic drug monitoring, can improve service user management and service user outcomes. They also provide excellent opportunities to educate colleagues on optimal prescribing.
- The use of evidence based guidelines, developed through multidisciplinary collaboration, has been shown to be effective in improving prescribing practice. All acute hospitals and community settings should have access to local, regional, or national antimicrobial prescribing guidelines that take account of relevant AMR data where possible.
- Diagnostic stewardship can optimise the ordering and collection, processing, and reporting of diagnostic tests to improve appropriate antimicrobial use. Restrictive and interpretative laboratory reporting can also guide appropriate prescribing.

## 3.1 Introduction to strategies and tools for antimicrobial stewardship programmes

This chapter outlines best-practice strategies and tools that have been demonstrated as effective for AMS programmes. It covers strategies of:

- Restricted use of antimicrobials and pre-authorisation
- Clinical review with point-of-care interventions and direct prescriber feedback
- Prescribing guidelines, clinical pathways, and prescriber aids
- Antimicrobial prescribing surveillance, audit, quality improvement, and feedback
- Learning from patient safety incidents
- Diagnostic stewardship.

Education and training is another key strategy, which is covered separately in Chapter 5. Implementation of different strategies and tools is dependent on resources available and the type of care setting. In many cases, specific advice has been suggested for different care settings.

## 3.2 Restricted use of antimicrobials and pre-authorisation

- Restriction of antimicrobials is a component of many AMS programmes worldwide.
- Processes for restricted use must be designed so they do not delay prompt access to essential antimicrobial treatment for service users who need it. If this requirement places limits on options for restriction of use, those limits must be accepted.
- Antimicrobial prescribing guidelines should include a list that stipulates which antimicrobials are restricted (approval of an infection specialist is required) or limited for use in specific circumstances (for treatment of specific conditions or by specific specialties).
- Criteria for restricting antimicrobials include potential toxicity, potential to select for AMR, spectrum of activity, potential for inappropriate use, and cost.
- Options for the classification of antimicrobial restriction include a locally agreed traffic-light approach, and/or the International World Health Organization (WHO) Essential Medicines Group **(AWaRe – Access, Watch, Reserve) listing**. Traffic-light approaches categorise antimicrobials as Green (unrestricted), Orange (restricted) or Red (highly restricted). The **AWaRe listing** divides antimicrobials into three groups:
  - » Access – medicines that should be readily accessible to treat common infections
  - » Watch – medicines that should be conserved for situations in which use is clearly justifiable and not freely available to all
  - » Reserve – last-line agents that should be reserved for use only when other agents cannot be expected to be effective, and generally only used with some degree of expert supervision.
- The list of restricted antimicrobials should be reviewed on a regular basis, in light of the local antimicrobial usage and AMR data. Restrictions may have to be reinforced, or applied to additional antimicrobial agents, in the setting of outbreaks caused by antimicrobial-resistant pathogens (e.g. *C. difficile*, VRE, MRSA).

### 3.2.1 Specific to hospitals

In the hospital setting and OPAT, the HSE policy on restricted antimicrobials applies. Restricted antimicrobials should be available from the hospital pharmacy and not generally included in ward drug stocks. However, hospitals must have a mechanism for accessing restricted agents in a timely manner, when required, including outside of normal working hours. In some cases, a ward stock of a restricted agent may be appropriate for specific wards or service areas.

- Pre-authorisation approval processes – 'no approval, no drug':
  - » Each hospital should have a process in place to allow pre-authorisation for the use of restricted antimicrobials by a member of the AMS team. Pre-authorisation may not be possible 24/7 where resources to support this are not available
  - » Authorisation may be given by several mechanisms, including paper-based order forms, telephone-based systems, or electronic systems, and tailored to staffing and resources in the setting.
- Post-prescription authorisation – 'no approval, dispensing stops':
  - » Where pre-authorisation is not possible on a 24/7 basis, there should be a system for identifying when restricted antimicrobials have been prescribed and early review (within 48–72 hours) of such prescriptions by a member of the AMS team.

### 3.3.2 Specific to community

In community settings in Ireland, a simple categorisation is promoted to identify preferred antimicrobials (Green) versus non-preferred antimicrobials (Red). This is commonly referred to as **'Green/Red classification'** of antimicrobials and is made available in the form of mouse mats or posters to primary care and residential care facilities. Feedback is provided on Green/Red usage on a quarterly basis to GPs reimbursed by the Primary Care Reimbursement Service (PCRS) to inform local practice and quality improvement. Prescribers are encouraged to periodically review use of Red agents in their practice with colleagues or with an antimicrobial pharmacist. To date this project has been very successful in reducing the use of non-preferred (red) antimicrobials in the community settings.

# In many cases the Preferred Antibiotic is No Antibiotic

## ☑ Preferred Antibiotics in Community

See www.antibioticprescribing.ie If antibiotic therapy is indicated the preferred first line choices below are effective, have fewer side effects, and are less likely to lead to resistant infections.

| Respiratory Infections (upper and lower) | Urinary Tract Infections | Soft tissue infections - cellulitis, acne |
|---|---|---|
| Penicillin V (phenoxymethylpenicillin) | Nitrofurantoin* | Flucloxacillin |
| Amoxicillin | Cefalexin | Cefalexin |
| Doxycycline* | Trimethoprim* | Doxycycline* |
| | Fosfomycin* | Lymecycline* |

## ☒ Antibiotics to be avoided first line in community

**Co-amoxiclav** — **Risks: C.diff**

Unless as first line for:
animal or human bite; facial cellulitis; post partum endometritis; caesarean wound infections; perineal wound infection

**Other cephalosporins** — **Risks: C.diff**

- Cefaclor
- Cefixime
- Cefuroxime

**Clindamycin*** — **Risks: C.diff**

**Quinolones** — **Risks: C.diff Drug Intx, Tendon/Nerve, AA+D, QT, Seizure**

- Levofloxacin* – unless consultant advice or known resistance to preferred AB in COPD acute exacerbation
- Ciprofloxacin* only in proven resistant UTI or acute prostatitis/epididymo-orchitis
- Ofloxacin* – only on consultant advice or if treating genital infxn
- Moxifloxacin* – AVOID risk of severe liver toxicity

**Macrolides** — **Risks: C.diff, Drug Intx, QT**

Unless TRUE PENICILLIN ALLERGY or specific indication e.g. mycoplasma, helicobacter eradication

- Clarithromycin*
- Azithromycin* – only on advice of consultant or if treating STI
- Erythromycin* – best avoided as other macrolides better tolerated

AA+D – risk of aortic aneurysm and dissection, Seizure – lowers seizure threshold, QT – prolongation of QT interval.
Antibiotics marked * may be safely used in patients with true penicillin allergy (immediate hypersensitivity).

**See www.antibioticprescribing.ie for details**

RESIST

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## 3.3 Clinical review with point-of-care intervention and direct prescriber feedback

- Members of the AMS team should have a high clinical profile in hospitals or community settings, including regular clinical review of service users and regular interaction with prescribers.
- Regular clinical review provides teaching opportunities for members of the healthcare team on the principles of prudent antimicrobial use, can improve patient safety, and can help to increase awareness of AMS within health service organisations.
- Post-prescription reviews provide a valuable opportunity to optimise the original prescription by using information that was not available at the time the antimicrobials were prescribed (e.g. from radiological and microbiological results). Assessment of the individual service user's clinical situation and many important service user specific factors should be assessed as clinical guidelines cannot encompass all situations. Optimisation may require escalation, de-escalation, or discontinuation. The dose may need to be increased or decreased or the route of administration changed.
- A range of point-of-care interventions can be used to provide direct and timely feedback to the prescriber at the time of prescription review or laboratory diagnosis.
- Advice provided to prescribers, arising from such a clinical review, should be seen as an expert recommendation to be considered by the primary team.
- AMS teams should keep records of their interventions to help them identify existing or emerging prescribing issues. This may also help to inform future communication, education campaigns, or quality improvement initiatives. The team may create summaries of information and provide feedback to the wards/units/healthcare workers involved to trigger opportunities for discussion.

### 3.3.1 Post-prescription reviews in hospitals

- Regular ward rounds for post-prescription antimicrobial review, often called AMS ward rounds, have been adopted in many Irish hospitals. These may be undertaken by a single healthcare worker – for example, a microbiology or an infectious disease physician or an antimicrobial pharmacist – or by a multidisciplinary team with two or more members. Both the individual approach and the team approach improve antimicrobial prescribing.
- The decision on which service users require bedside antimicrobial review may be based on:
  - » Formal requests for consultation
  - » Laboratory results (in particular, positive microbiological samples from normally sterile sites)
  - » Regular ward rounds in high-risk areas (e.g. intensive care units) accompanied by liaison with the medical or nursing team to identify appropriate service users
  - » High antimicrobial consumption areas
  - » Lists of service users receiving restricted antimicrobials, prolonged duration, unusual combinations of antimicrobials, or those requiring therapeutic drug monitoring.
- The AMS team should have a system for timely identification of service users who are receiving, or are likely to require, antimicrobial therapy, and who are likely to benefit from an AMS intervention. Potential sources of service user review list can include:
  - » Daily antimicrobial reports from ward-based pharmacists
  - » Reports from electronic prescribing systems
  - » Reports from automated dispensing cabinets
  - » Laboratory reports
  - » Daily admission lists from emergency departments
  - » Handover and clinical case review meetings
  - » IPC ward liaison reports
  - » Formal requests for consultation
  - » Opportunistic liaison with medical or nursing team.
- The frequency of AMS ward rounds depends on the size and resources of the hospital and the casemix of patients. Generally, an AMS team should aim to do ward rounds at least twice per week in areas of greatest need to capture cases in a timely manner.
- Where available, appropriately trained clinical pharmacists can highlight antimicrobial prescribing that requires prescriber review. They can also refer cases to the nominated AMS professional or team

as needed. Establishing systems that support referral to the AMS team by other members of the clinical workforce will enable workforce members to feel that concerns about antimicrobials will be addressed promptly.

- The AMS professional(s)/team should provide advice or feedback on optimal antimicrobial therapy to the prescriber/team responsible for the service user's care. This advice or feedback may be communicated via:
  - » Direct conversation with the prescriber/team. This feedback should be included in the service user's healthcare record. When advice is provided remotely (e.g. by telephone) and access to the service user's record is not available, a record should made, for example, on the laboratory information system or in another form
  - » Written record in the service user's healthcare record. If the advice is not urgent and simply provides confirmation that antimicrobial use is appropriate or assistance for planning ahead, it can be communicated solely via the healthcare record; otherwise, it can be accompanied by a phone call if any clarification is needed
  - » Written advice on a standardised advice form. This may be designed as prepopulated text on an electronic prescribing system, a two-part carbonless form (with one copy placed in the medical/prescribing record and one retained by the AMS team), or a sticker that can be directly affixed to the service user's medical record.
- Prescription review in facilities (including residential care settings) with limited resources should target areas in which AMS interventions will achieve the highest service user benefit. This could include conditions that account for the majority of the antimicrobial prescriptions and those with the most inappropriate antimicrobial prescriptions. Audits, such as point prevalence study, can help to identify these conditions, as well as the units, services, and prescribers responsible for significant proportions of antimicrobial use.
- Nurses, midwives, IPC practitioners, or doctors other than microbiologists, infectious disease physicians or pharmacists, can assist with post-prescription review when infection specialists are not available. They may do this by identifying high-risk service users or service users from a predetermined list of key indications or antimicrobials. Actions regarding these service users might include:
  - » Holding regular teleconferences with off-site antimicrobial pharmacists, clinical microbiologists, or infectious disease physicians to review service users' prescriptions and discuss cases
  - » Using telehealth to include off-site infection/AMS experts in ward rounds.

### 3.3.2 Post-prescription review at transitions of care

- Specific prescription review should occur at transitions of care (when service users are admitted to or discharged from a facility, or transferred within the facility).
- This is a critical time to verify all antimicrobials are optimised as it is a time point highly associated with medication errors.
- Indication for antimicrobial therapy (including prophylactic prescriptions), current and intended duration, dosing, and recent antimicrobial therapy should be clearly communicated across care settings.

### 3.3.3 Post-prescription reviews in community

- Individual prescription review may be prompted by a particular laboratory investigation result. Many laboratories will initiate contact with prescribers to discuss antimicrobial therapy when an unusual susceptibility profile or potentially clinically significant isolate is identified.
- Prescribers may also want to discuss antimicrobial prescriptions with infection experts based on clinical concerns. Pathways for prescribers in community settings to access such specialist advice should be clearly identified. This may occur through links with microbiology/infectious diseases/pharmacy services in hospitals, with clinical microbiologists at private laboratory service providers, or CHO-based IPC and AMS teams.

#### 3.3.3.1 Specific to primary care

- Post-prescription review of antimicrobials in primary care is an endorsed practice in some international guidelines. The ability to implement this depends on capacity. Where this can be performed, a focus could be on Red antibiotics. Developing community-based AMS services can support this review process, but review with a peer can also be very valuable.
- Clinical review of service users who are not prescribed antimicrobials (e.g. in the setting of a self-limiting viral infection) is also useful to reassure both the service user and the clinician as well as to identify any deterioration and act promptly.

#### 3.3.3.2 Specific to residential care facilities

Local policies should require clinical review of residents by a clinician familiar with the resident's care, if the resident was prescribed antimicrobials over the phone out-of-hours by someone who is not from the practice that normally supports their care. This review should be on the next working day and is particularly important for service users prescribed Red antibiotics.

### 3.3.4 Point-of-care interventions

Point-of-care interventions (POCIs) are one of the most effective aspects of AMS programmes. They can improve service user management and service user outcomes and can provide excellent opportunities to educate the clinical workforce on optimal prescribing. Recommendations from post-prescription review are likely to include one or more POCIs. Which interventions are selected, how they are delivered, and by whom will be determined by local resources and the expertise available. POCIs can be delivered by a clinical pharmacist, by an AMS team, or during a microbiology or an infectious disease consultation.

Examples of POCIs include advice or actions on:

- Discontinuation of therapy
- Dose optimisation
- Therapeutic drug monitoring
- Minimisation of therapy duration
- Intravenous-to-oral conversion or oral-to-intravenous conversion
- De-escalation/escalation based on microbiological sampling results
- Escalation to formal expert clinical review
- OPAT referral.

#### 3.3.4.1 Dose optimisation

AMS teams, with the support of clinical pharmacists where available, should optimise antimicrobial therapy in relation to dose, frequency, and duration, and consider individual service user characteristics (e.g. age, weight, renal function, liver function, pregnancy, allergy, obesity, comorbidities, drug interactions), likely causative organism, site of infection, and pharmacokinetic and pharmacodynamic characteristics of the antimicrobial agent(s). This may also involve guiding antimicrobial selection towards the most appropriate agents (e.g. agents with higher cerebrospinal fluid penetration if required). Dose optimisation is needed to ensure antimicrobial therapy is effective, particularly in service user populations where pharmacokinetic/pharmacodynamic parameters may be significantly altered (e.g. dialysis, burns, critical illness, pregnancy, neonates, obesity), while minimising the possibility of adverse effects.

When reviewing medication orders and dispensing prescriptions, pharmacists play an important role in identifying variation from recommended dosing schedules and recommending optimal dosing regimens.

#### 3.3.4.2 Therapeutic drug monitoring

AMS teams, with the support of clinical pharmacists where available, should support the team directly responsible for care in requesting that serum levels of antimicrobials requiring therapeutic drug monitoring (e.g. aminoglycosides, glycopeptides) are measured appropriately, and the results acted upon in a timely manner to maximise efficacy and minimise toxicity.

Use of clinical pathways/algorithms to guide initial dosing, timing of levels, advice on actions to take based on level results, dosing calculators can be helpful in doing this. A dedicated section for these agents in the medication record to document levels and dose adjustments has been demonstrated to improve management of these agents in Irish hospitals. Examples of clinical algorithms for management of gentamicin dosing can be found in the **HSE/RCPI gentamicin guidelines for once daily usage in adult and paediatric settings**.

#### 3.3.4.3 Duration of therapy as long as is needed and no longer

- Almost all infections have standard treatment durations. However, the duration of therapy may need to be tailored to the individual service user's condition and responses to treatment.
- It is important to promote and sustain a prescribing culture that includes regular review and setting a maximum duration of treatment, unless there is a clear indication for an individual service user, documented in the healthcare record, that therapy should be continued.
- The use of review and/or stop dates are recommended for all antimicrobial prescriptions and should be clearly documented in the service user's healthcare record and on their medication chart/prescription.
- AMS programmes are recommended to implement strategies and guidelines to reduce antimicrobial therapy to the shortest effective duration. Suitable approaches include developing written guidelines with specific recommendations for duration, including duration of therapy recommendations, as part of the pre-authorisation or during post-prescription review, or specifying duration at the time of antimicrobial ordering.
- Incorrect duration of antimicrobial therapy is commonly noted and prolonged duration of antimicrobials increases the risk of harm in terms of adverse effects and development of AMR; prolonged durations of antimicrobials for surgical prophylaxis is a common example.

In the 2020 Point Prevalence Study of Acute Hospitals in Ireland, the proportion of surgical prophylaxis prescriptions extending for more than 24 hours was 28%. Hospitals should have policies for the duration of surgical antibiotic prophylaxis in accordance with the 2021 AMRIC/National Clinical Programme for Surgery position statement. A number of resources are available to support surgical antibiotic prophylaxis in Irish hospitals on www.antibioticprescribing.ie

A Point Prevalence Study of Antimicrobial Use in HSE Older Persons Residential Care Facilities 2020/2021 found that 57% of prophylactic prescriptions had been prescribed for a duration in excess of 12 months, which is longer than recommended. It is recommended that urinary tract infection prophylaxis should not exceed 6 months, while azithromycin prophylaxis for chronic obstructive pulmonary disease/acute bronchiectasis/asthma should be reviewed every 6–12 months. There is now a suite of resources, including audit tools, available on www.antibioticprescribing.ie to support examination of prophylactic prescriptions for these indications and de-prescribing.

#### 3.3.4.4 Intravenous-to-oral conversion

Antimicrobial prescribing guidelines should include clinical criteria and guidelines for converting intravenous antimicrobial therapy to oral therapy, once the service user's condition allows. Criteria for switching from intravenous to oral therapy should be readily available to prescribers. Good AMS also involves recognising situations when oral antimicrobial therapy needs to be escalated to intravenous antimicrobial therapy.

Oral prescribing should be used wherever possible. The benefits of oral prescribing are:

- Reduced risk of infection from intravenous catheters
- Higher service user satisfaction, comfort, and mobility
- Reduced nursing time spent in preparing and administering intravenous doses
- Reduced length of stay
- Less use of consumables and subsequent waste generation (e.g. syringes, infusion bags, giving sets, etc.)
- Decreased total cost of therapy.

There is now evidence that oral therapy can be considered for part or all of the course of treatment for some infections traditionally managed with intravenous treatment for the entire duration of therapy. Examples include endocarditis, osteomyelitis, bacteraemia, intra-abdominal infection, and complicated urinary tract infection.

It is reasonable to consider oral therapy for osteomyelitis, bacteraemia, and endocarditis when **all** of the following criteria are met:

- The service user is clinically and haemodynamically stable
- Surgical or procedural source control has been achieved, if possible, with no persistent bacteraemia
- The service user is likely to be able to tolerate and absorb oral medications
- A published regimen is available with clinical outcomes data for targeted pathogens
- There are no psychosocial or logistical reasons to prefer intravenous therapy.

Certain antimicrobials – fluoroquinolones, clindamycin, linezolid, fluconazole, and voriconazole – have near complete bioavailability when given by mouth in people with normal gastrointestinal function (see Table 3.1). Service users receiving these therapies can often receive oral therapy from the outset (with the difference only the time to onset of action for the first dose), or they are often excellent candidates for early intravenous-to-oral switching. Additionally, service user specific factors are also important determinants in the decision to switch from intravenous to oral therapy.

**Table 3.1: Examples of antimicrobial agents with excellent oral bioavailability**

| | | |
|---|---|---|
| Ciprofloxacin | Clindamycin | Linezolid |
| Levofloxacin | Metronidazole | Fusidic Acid |
| Fluconazole | Rifampicin | Co-trimoxazole |
| Voriconazole | | |

The HSE/RCPI **Start Smart, Then Focus** antibiotic care bundle for acute hospitals recommends that intravenous antimicrobials be reviewed at 24–48 hours to determine whether the antimicrobial needs to be continued, rationalised and, if appropriate, switched to oral therapy. AMS teams should have a system in place for identifying service users whose antimicrobial therapy may be suitable for intravenous to oral conversion.

### 3.3.4.5 Optimisation of antimicrobial therapy based on microbiological sampling results

- Empiric antimicrobial therapy should be streamlined on the basis of ongoing clinical review, laboratory results, and diagnostic imaging, as soon as possible.
- When available, results of microbiological sampling, including identification and susceptibility, should be used to optimise therapy. In most cases, this optimisation will involve a de-escalation but on occasion it can require an escalation of antimicrobial therapy.
- Typical interventions in this category are:
  - » Changing the antimicrobial agent (e.g. changing from a broad-spectrum agent to one with a narrower spectrum that targets the infecting organism)
  - » Ceasing additional antimicrobials that will not improve outcomes (e.g. stopping dual anaerobic antibacterial therapy)
  - » Ceasing antibiotic therapy if the diagnosis is a non-bacterial infection (e.g. a viral infection) or non-infective condition (e.g. cardiac failure rather than pneumonia).

It is important to note that stopping an antimicrobial on review, in the light of information available at that time, does not imply that the prescription was inappropriate at time of prescribing.

- The need for microbiological sampling where appropriate should be incorporated into empiric treatment guidelines.
- All empiric antimicrobial therapy in hospitals should be reviewed on a daily basis by a doctor responsible for the service user's care.
- AMS teams should have a mechanism in place (e.g. liaising with the prescriber and clinical pharmacist, where possible) to identify antimicrobial regimens that are likely to require streamlining, such as:
  - » Antimicrobial combinations with overlapping spectrum of activity
  - » Prolonged use of broad-spectrum antimicrobials
  - » Unauthorised use of restricted agents outside of guidelines
  - » Antimicrobial agents, or combinations of agents, not in accordance with prescribing guidelines.
- For a small number of conditions, the choice of therapy can be optimised using microbiology test results that are available minutes or hours after specimen collection (rapid diagnostics); see section 3.7.6.

### 3.3.4.6 Escalation to formal expert clinical review

- Post-prescription review services often identify service users who have complex problems and are likely to benefit from early clinical review by clinical microbiologists or infectious disease physicians. Hospital governance systems should explicitly authorise this process of AMS team-initiated review as a patient safety requirement without a requirement for consult from the lead team. Escalation to review by microbiologists or infectious disease physicians has been reported to account for 5–10% of reviews in international literature. It is likely that many of these service users would eventually have been referred, but the post-prescription AMS review often facilitates earlier identification.

- This can enable critically important clinical problems to be identified and addressed by AMS teams in a timely fashion. For some infections, a microbiologist or infectious disease consultation has been demonstrated to reduce mortality through diagnostic precision and the optimisation of antimicrobial management.
- It is important that all services have access to advice from clinical microbiologists or infectious disease physicians or antimicrobial pharmacists in order to provide support when needed.
- Options for accessing expert advice when unavailable on-site may include:
  - » Using clinical microbiology networks from laboratories that provide diagnostic services
  - » Contacting an AMS pharmacist or physician in a CHO, regional, or hospital role
  - » Using telehealth networks to support formalised networks with specialists
  - » Contracting infectious disease and clinical microbiology services.

#### 3.3.4.7 Outpatient parenteral antimicrobial therapy (OPAT)

- AMS teams should promote the use of OPAT, where available, input into local OPAT guidance and policies, and ideally review these service users' antimicrobial prescriptions prior to OPAT referral and subsequent discharge.
- Further details relating to OPAT are available at https://portal.opat.ie/OPAT/Pathways.aspx
- Some considerations for appropriate service user selection for the OPAT programme are shown in Table 3.2.

**Table 3.2: Considerations for appropriate service user selection for OPAT programme**

| Considerations for service user selection for OPAT programme |
|---|
| 1. Is parenteral antimicrobial therapy needed? Have potential oral options been considered? |
| 2. Has the difference between the antimicrobial selection for OPAT and for therapy in the hospital been considered? Has the frequency of administration and potential for adverse effects of the agent been considered from an OPAT perspective? |
| 3. Is the home or outpatient environment safe and adequate to support care? |
| 4. Are the service user and/or caregiver willing to participate and able to safely, effectively, and reliably deliver parenteral antimicrobial therapy? |
| 5. Is there at least a once-weekly review schedule by the hospital consultant in place, as additional arrangements may be required if specific monitoring is required? |
| 6. What support is in place if the service user or caregiver experiences difficulties with administration, line access, etc.? |
| 7. Has the service user or caregiver been informed of what to do if there is a worsening of their infection? |
| 8. Are mechanisms for rapid and reliable communications about problems and for monitoring of therapy in place between members of the OPAT team? |
| 9. Do the service user and caregiver understand the benefits, risks, and economic considerations involved in OPAT? |
| 10. Is a model of self-administered OPAT (S-OPAT) or healthcare professional OPAT (H-OPAT) most appropriate for the service? |

## 3.4 Prescribing guidelines, clinical pathways, and prescriber aids

### 3.4.1 Prescribing guidelines

Appropriate antimicrobial use is more likely to occur when antimicrobials are prescribed according to evidence based guidelines, with choice, dose, and duration specified to optimise clinical outcomes and minimise adverse consequences. Prescribing guidelines are an essential requirement for AMS programmes.

- All services should have access to local, regional, or national antimicrobial prescribing guidelines that take account of relevant AMR data where practical to do so.
- Guidelines should be evidence based and developed by multidisciplinary collaboration. The involvement of prescribers can improve antimicrobial prescribing behaviour and thereby influence service user outcomes.
- Guidelines should be updated at least every two years and as required in response to major changes in protocols or information about emerging AMR. Guidelines should be distributed to all prescribers and those involved in dispensing and administering antimicrobials and, where possible, made available in electronic format.
- Antimicrobial prescribing guideline development needs to be accompanied by an implementation process that includes a programme of audit and feedback. To inform implementation planning and promote uptake, it is essential to understand the existing culture and prescribing practices, the drivers affecting them, and any barriers to change. Each of these needs to be considered as part of a local guideline implementation plan.
- Ideally, prescribing guidelines should be implemented within a quality improvement framework. The guidelines serve as the starting point for a quality improvement cycle that leads to ongoing refinement of the guidelines, continual guideline implementation, and ongoing improvement in service user outcomes.
- Audits of antimicrobial prescribing should include the proportion of antimicrobial use in accordance with guidelines and should be conducted at least annually. Evaluating the use of prescribing guidelines can help to identify whether implementation strategies are effective and whether alternative approaches are needed, and can enable unintended consequences to be identified and addressed.
- User surveys can also be conducted to check that guidelines are acceptable, being used consistently, and meeting the requirements of prescribers and those involved in dispensing and administering antimicrobials.

#### 3.4.1.1 Specific to community

The website www.antibioticprescribing.ie provides treatment recommendations for common infections. These guidelines are developed using a rigorous process of consultation with experts from multiple relevant disciplines. If local prescribing guidelines are necessary, they should reflect the nationally agreed practice described on www.antibioticprescribing.ie. This also applies to antimicrobial treatment recommendations in clinical guidelines, local care pathways, and algorithms. If local guidelines are already in place, they should be reviewed against www.antibioticprescribing.ie. Where differences are warranted – for example, in response to local AMR patterns or an outbreak of a new resistant bacterial strain – an evidence-based rationale should be provided for any variation in practice.

#### 3.4.1.2 Specific to hospital

The vision of HSE AMRIC is to work towards agreed national antimicrobial prescribing and infection management guidance for both acute and community healthcare available to all on www.antibioticprescribing.ie. This website was created initially for antimicrobial prescribing guidelines for treatment of community infections and is a key reference source for GPs, dentists, and community pharmacists. The website should also be used to guide prescriptions for community acquired infections in many acute hospital settings. There is now a hospital related guideline page on the website. It is

increasingly used to provide guidance also for hospital based practitioners. The goal is to provide a comprehensive suite of guidance for hospital based prescribers on this site.

### 3.4.2 Clinical pathways, prescriber aids, and decision support

- All services should consider the introduction of educational aids to guide prescribers at the point of care. Resources such as telephone apps, desktop-based supports, posters, checklists, clinical pathways, reminders, newsletters, visual prompts, and aids can promote guideline uptake. These may include clinical algorithms for the diagnosis of infection or methods to standardise documentation of treatment decisions, such as infection stamps; the use of brightly coloured stickers to be included in the clinical notes or medication record; or reminders of the principles of good antimicrobial prescribing. Examples are provided below:
  - » HSE/RCPI **Start Smart, Then Focus** antibiotic care bundle for acute hospitals
  - » HSE **Clinical pathway for management of community-acquired lower respiratory tract infection** in hospital
  - » HSE **resources** such as posters, PowerPoint presentation for local delivery, HSeLanD e-learning module, and patient information leaflet to support the implementation of the HSE/RCSI position statement on surgical antibiotic prophylaxis duration
  - » HSE Antibiotic Prescribing Bulletin highlighting updates and developments on www.antibioticprescribing.ie.
- Examples of clinical algorithms for management of gentamicin dosing can be found in the **HSE/RCPI gentamicin guidelines for once daily usage in adult and paediatric settings**. Other tools – such as laminated cards, booklets, and smart-device apps – may simplify guidelines and make recommendations easily available for users.
- Consideration should be given to providing laminated cards to prescribers, summarising prescribing guidelines for common infections. Such cards should be pocket-sized or designed to be attached to staff identification badges, include the date created, and reference the current edition of the antimicrobial guidelines.
- Smartphone/tablet apps are now commonplace and can be useful for providing prescribing guidelines at the point of care. There is also an opportunity to include educational messages or specialist prescribing information, such as safety of antimicrobials in pregnancy and breastfeeding.
- Dose calculators are recommended for antimicrobials with a narrow therapeutic index.
- Where possible, information technology support for prudent antimicrobial use should be introduced. This includes electronic service users' records, electronic access to laboratory results, electronic prescribing, and clinical decision support software, which are discussed in detail in Chapter 4.
- All acute hospitals and residential care facilities that do not have electronic prescribing should consider introducing antimicrobial order forms, or designate a section of the prescription chart for antimicrobial prescribing. This could include a requirement for clinical indication and a required duration before order renewal. Order forms should distinguish between antimicrobials used for prophylaxis and those used for active therapy. Consideration should be given to having separate order forms/section within order forms for surgical antibiotic prophylaxis.
  - » A template of an antimicrobial section for a medication chart for acute hospitals facilitating review/stop date, indication and automatic stop dates is available at https://www.hse.ie/eng/about/who/nqpsd/patient-safety-programme/medication-safety/medication-record.html.

### 3.4.3 Allergy assessment and delabelling

Many service users who report an allergy to antimicrobials or who are documented as allergic to antimicrobials, in particular to penicillins, are not allergic to these agents. This is important because the report/documentation may limit their access to optimal therapy.

In service users with a reported history of beta-lactam allergy, AMS programmes should promote an assessment on the basis of the reported/documented allergy and use of testing for penicillin allergy when appropriate. Allergy assessments and penicillin skin testing can enhance the use of first-line agents, but it

is largely unstudied as a primary AMS intervention. In facilities with appropriate resources for skin testing, the AMS programme should actively work to develop testing and treatment strategies with immunologists where this service is available.

### 3.4.4 Hospital formularies, new antimicrobials, and pharmaceutical promotion

#### 3.4.4.1 Hospital formularies

- A formulary (i.e. a list of medicines, including antimicrobial agents that have been approved for use) promotes consistency of prescribing in hospitals and means that prescribers have clear, common expectations about the availability of antimicrobials. A formulary that includes a list of restricted antimicrobials is an essential component of a hospital AMS programme.
- The antimicrobial formulary should be appropriate to the needs of the hospital and should consider the range of antimicrobials required, the clinical orientation of the hospital, and local AMR.
- Responsibility for creating and maintaining a formulary usually is delegated to the hospital's drug and therapeutics committee (DTC). The DTC evaluates the evidence regarding the efficacy, safety, and cost of new agents before deciding whether to endorse their use in the hospital and list them on the formulary. The DTC may have an AMS committee to advise or request the AMS team to evaluate requests for new antimicrobial agents or new indications for use, and to make recommendations for formulary listing.
- Antimicrobial formulary decisions are informed by local microbiological data. For example, if resistance to one antimicrobial class has been emerging locally, the DTC may respond by directing prescribing towards alternative agents or making alternatives available. This may require a change in criteria for approval to use the alternative agents. It is therefore important for microbiologists and infectious disease physicians to provide continuous expert advice to DTCs (through membership of the committee or liaison with the AMS team).

#### 3.4.4.2 New antimicrobials

- Organisations should have systems in place to manage the introduction of new antimicrobials.
- All medicines in use in the HSE, other than in exceptional situations, should be of the status 'approved for use in the HSE.'
- Introduction of new antimicrobials in a healthcare setting should be considered by an existing decision-making group (e.g. a drug and therapeutics committee).
- When evaluating a new antimicrobial for local use and for inclusion in the local formulary, the decision-making group should take into account:
  - The need for the new antimicrobial
  - Its clinical effectiveness
  - The population in which it will be used
  - The specific organisms or conditions for which it will be used
  - Dose, frequency, formulation, and route of administration
  - Likely tolerability and adherence
  - Any drug interactions, contraindications, or cautions
  - Local rates and trends of resistance
  - Whether use should be restricted and, if so, how use will be monitored
  - Any additional monitoring required
  - Any urgent clinical need for the new antimicrobial
  - Any plans for introducing the new antimicrobial, including education and specific guidance
  - Any national AMRIC advice regarding the agent
  - Cost and outcome of any National Centre for Pharmacoeconomics (NCPE) rapid review or pharmacoeconomic evaluation.

- Once a new antimicrobial has been approved for local use, organisations should consider ongoing monitoring by:
  - » Conducting an antimicrobial use review (reviewing whether prescribing is appropriate and in line with the diagnosis and local (where available) and/or national guidelines)
  - » Costing the use of the new antimicrobial
  - » Reviewing non-formulary antimicrobial consumption
  - » Evaluating local prescribing and resistance patterns
  - » Reviewing clinical outcomes such as response to treatment, treatment rates, emerging safety issues, tolerability, and length of hospital stay.

#### 3.4.4.3 Pharmaceutical promotion

The literature indicates that interactions with the pharmaceutical industry can influence prescribing practices, leading to increased medicine costs, prescribing not compliant with guidelines, a preference for new medicines, and decreased prescribing of generic medicines. Prescribers should consider if engagement with representatives, in particular industry representative attendance at or sponsorship of workplace education and training events, contributes to improved patient care.

- If commercial promotion of antimicrobials is carried out, it should be done so in an ethical manner, in line with the Irish Pharmaceutical Healthcare Association's (IPHA) Code of Practice for the Pharmaceutical Industry (available from www.ipha.ie).
- An antimicrobial should not be promoted for use outside the relevant national or institutional guidance.
- An antimicrobial agent that is classified as a restricted agent (in hospitals this may be defined locally or nationally, while in community it refers to listed Red agents) should only be discussed with infection specialists (such as microbiologists, infectious disease physicians, antimicrobial pharmacists).
- An antimicrobial agent not approved for use in the HSE should not be promoted/detailed.
- The IPHA should be informed if a pharmaceutical company is found to be carrying out promotional activities in breach of the IPHA Code of Practice for the Pharmaceutical Industry.
- The Irish Medical Council's Guide to Professional Conduct and Ethics (2009) states that 'you should not rely solely on promotional literature distributed by pharmaceutical companies for information about particular drugs or medical devices. Instead, you should source independent, evidence-based information on the benefits and risks of all medication and medical devices before you prescribe them'.

## 3.5 Antimicrobial prescribing surveillance, audit, quality improvement, and feedback

AMS programmes should have a system of regular surveillance and audit of antimicrobial use. This information will help inform quality improvement. This is a key strategy utilised by effective antimicrobial stewardship programmes and is discussed in more detail in Chapter 6. In summary:

- Quantitative measurement of antimicrobial use should be monitored and reported to management and prescribers on a quarterly basis. Where possible, the data should be broken down to the level of individual wards/units/teams or prescribers
- Qualitative measurement of antimicrobial use in the form of regular (quarterly, six monthly or annual) assessment of key performance indicators or point prevalence studies of antimicrobial use should be undertaken and further in-depth audit performed if necessary
- At a national level, the AMRIC Action Plan sets clear targets for outcome measures in relation to AMR and IPC over the period 2022–2025
- In-depth audit and feedback of data collected on antimicrobial prescribing can be targeted at wards or areas of practice where antimicrobial prescribing is known to be high or particularly challenging, for example, intensive care units, haematology and oncology, surgical antibiotic prophylaxis, emergency department prescribing for outpatients, or urinary tract infection/respiratory tract prophylaxis
- The results of antimicrobial use audits should be fed back to prescribers and those involved in dispensing and administering antimicrobials on a regular basis
- Members of the AMS team should discuss the results of targeted audits in face-to-face meetings with relevant staff
- An action plan should be formulated based on key audit findings.

## 3.6 Learning from patient safety incidents

- AMS programmes should consider developing systems and processes for providing regular updates (e.g. annually) on patient safety incidents related to antimicrobial use, including hospital admissions for potentially avoidable life-threatening infections, infections with *C. difficile*, adverse drug reactions such as anaphylaxis, or medication errors.
- Antimicrobials are high-risk medications, according to the WHO, that are more likely to result in harm as a result of an error; therefore, collation of patient safety incidents, garnering and reporting of learning, and development of risk minimisation strategies should align and be integrated into wider medication safety programmes.
- Educational strategies employed by the HSE national medication safety programme and local medication safety programmes such as use of alerts, newsletters, and 'medication safety minutes' (as created by the medication safety programme in St James's Hospital, Dublin) may be utilised successfully within organisations to share learning from antimicrobial-related patient safety incidents.

## 3.7 Diagnostic stewardship

Diagnostic stewardship aims to optimise the ordering and collection (pre-analytic interventions), processing (analytic intervention), and reporting (post-analytic intervention) of diagnostic tests to improve service user management and reduce overuse and misuse of antimicrobials. Diagnostic stewardship should aim to guide appropriate clinical behaviour to reduce unnecessary testing and false-positive results and to promptly identify pathogens and target therapy.

### 3.7.1 Access to high quality laboratory service

Accredited quality management systems (e.g. ISO 15189) are important to ensure quality of results; therefore, microbiological specimens should be referred to accredited laboratories when available. All acute hospitals should have 24-hour access to a microbiology laboratory. These laboratories should:

- Use validated methods for laboratory testing.
- Have a quality assurance process in place; this should normally conform to accreditation requirements, designed to assess compliance with the ISO 15189 standard.
- Liaise with users to tailor the service to meet the demands of the clinical service via user surveys and feedback.
- Provide access to established methods with acceptable turnaround time required to support AMS (e.g. mass spectrometry (MALDI-TOF), automated antimicrobial susceptibility testing).
- Provide access to additional specialised testing when required to support AMS.

### 3.7.2 Provision of laboratory user manual

Each laboratory should provide an up to date user manual that outlines:

- Services provided
- Sample requirements for each investigation
- Expected turnaround times.

### 3.7.3 Provision of clinical liaison

- The clinical microbiologist who directs the microbiology service is responsible for timely reporting of results and for clinical liaison regarding critical results in order to improve clinical outcomes for service users and reduce inappropriate antimicrobial use.
- Prescribers should have access to specialist advice regarding the investigation of possible infection, empiric and directed therapy, and monitoring of treatment where necessary.

### 3.7.4 Provision of antimicrobial resistance surveillance data

- The laboratory should conduct surveillance of AMR, with feedback of standardised data to local prescribers.
- Annual antibiograms for common pathogens or conditions (e.g. antimicrobial susceptibilities for organisms causing urinary tract infection), or stratified antibiograms for specific units or service user groups (e.g. intensive care unit), should be reviewed according to local requirements.
- The susceptibility data included in the annual antibiogram should be based on the first clinical isolate of a given pathogen per service user.
- Surveillance data aid the development of local resistance profiles to guide the choice of empiric therapy and also feeds into regional, national, and international surveillance.

### 3.7.5 Laboratory reporting

#### 3.7.5.1 Interpretative comments

- The range of laboratory investigations available is expected to continue to increase, including access to rapid diagnostics; therefore, processes must be developed to assist prescribers in interpreting and responding appropriately to results.
- Laboratories should include interpretative comments on reports, when required, to guide prescribers in deciding whether or not antimicrobial therapy is required and, if so, what drug to prescribe.
- Laboratory results should be reported in a way that encourages prescribers to discuss the results with a clinical microbiologist, or other member of the AMS team where necessary, before deciding to prescribe an antimicrobial agent. Contact details or methods of communication should be made available.

#### 3.7.5.2 Restrictive and interpretative laboratory reporting

- Laboratories should report antimicrobial susceptibilities where this is appropriate in the context of the details available and these should be restricted to agents that are likely to be appropriate for use.
- Where susceptibility results are reported, these should guide towards the narrower-spectrum agents to which the organism is susceptible and which are likely to be suitable based on available information. Susceptibility results for broad-spectrum agents should be limited, but must be made available to prescribers following appropriate clinical liaison.
- Where electronic prescribing systems are available, prescribers may be reminded to review antimicrobial therapy at 48–72 hours by an alert regarding mismatches between microbiological sample results and ongoing antimicrobial therapy.

### 3.7.6 Rapid diagnostics and inflammatory markers

- Laboratories should aim to develop or provide access to rapid diagnostic methods that can confirm the presence of a pathogen (e.g. polymerase chain reaction (PCR) identification of *Neisseria meningitidis* in blood or cerebrospinal fluid) or help to determine if a bacterial infection is less likely (PCR identification of respiratory viruses in children with lower respiratory tract infection).
- Laboratories should provide rapid testing as appropriate for inflammatory markers that may aid in confirming or ruling out serious infections, monitor response to therapy, and guide the duration of antimicrobial therapy (e.g. C-reactive protein, procalcitonin, Interleukin-8). Laboratories should promote awareness of the limitations of these tests and the need to limit the frequency of repeat testing.
- Use of these markers should be restricted to those populations in whom their use has been shown to be or is likely to be beneficial.
- Integration of point-of-care testing (e.g. respiratory virus testing) into clinical assessment pathways in certain setting may identify service users with viral infections, thereby discouraging antimicrobial prescription.

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https://www.bradspellberg.com/oral-antibiotics


HEART RATE
91 bpm
PATIENT ID
1067 5093 6918
NEUROLOGY
HISTOLOGY
GENETICS
CYTOLOGY
TOXICOLOGY
IMMUNOLOGY
MEDICAL
FMRI

# Chapter 4: Information and communication technology to support antimicrobial stewardship

## Key points

- Information and communication technology (ICT) can support AMS through enhancement of data collection and reporting and provision of decision support to prescribers.
- Electronic clinical decision support systems (CDSS) complement the clinical, pharmacy, and other members of the AMS team.
- ICT supports achievable within the AMS programme in an individual healthcare setting include the use of mobile applications, dashboard software, electronic approval systems, and automated dispensing cabinets.
- Progression of larger scale ICT projects, such as e-prescribing, electronic healthcare records (EHRs), and infection prevention surveillance systems subject to appropriate resourcing are expected to improve AMS.
- AMS professionals can make valued input into the development of ICT systems at an early stage to confirm that the processes work to facilitate AMS.

## 4.1 Introduction to ICT to support antimicrobial stewardship

Antimicrobial stewardship is complex and many aspects of both prescribing and stewardship of antimicrobials can be supported and improved by the use of ICT.

ICT can streamline and support AMS in two main capacities:

- **Enhanced data collection and reporting:** this can include identifying service users for AMS review and facilitating informational workflow; organisational or facility level auditing and reporting; monitoring antimicrobial consumption; prescribing; and surveillance at local, regional, and national level.
- **Provision of decision support to prescriber to optimise antimicrobial prescribing:** this can include providing information or prompting the prescriber to consider factors such as diagnostic factors, availability of microbiology results and susceptibility data, availability of antimicrobials, guidelines, and service user factors.

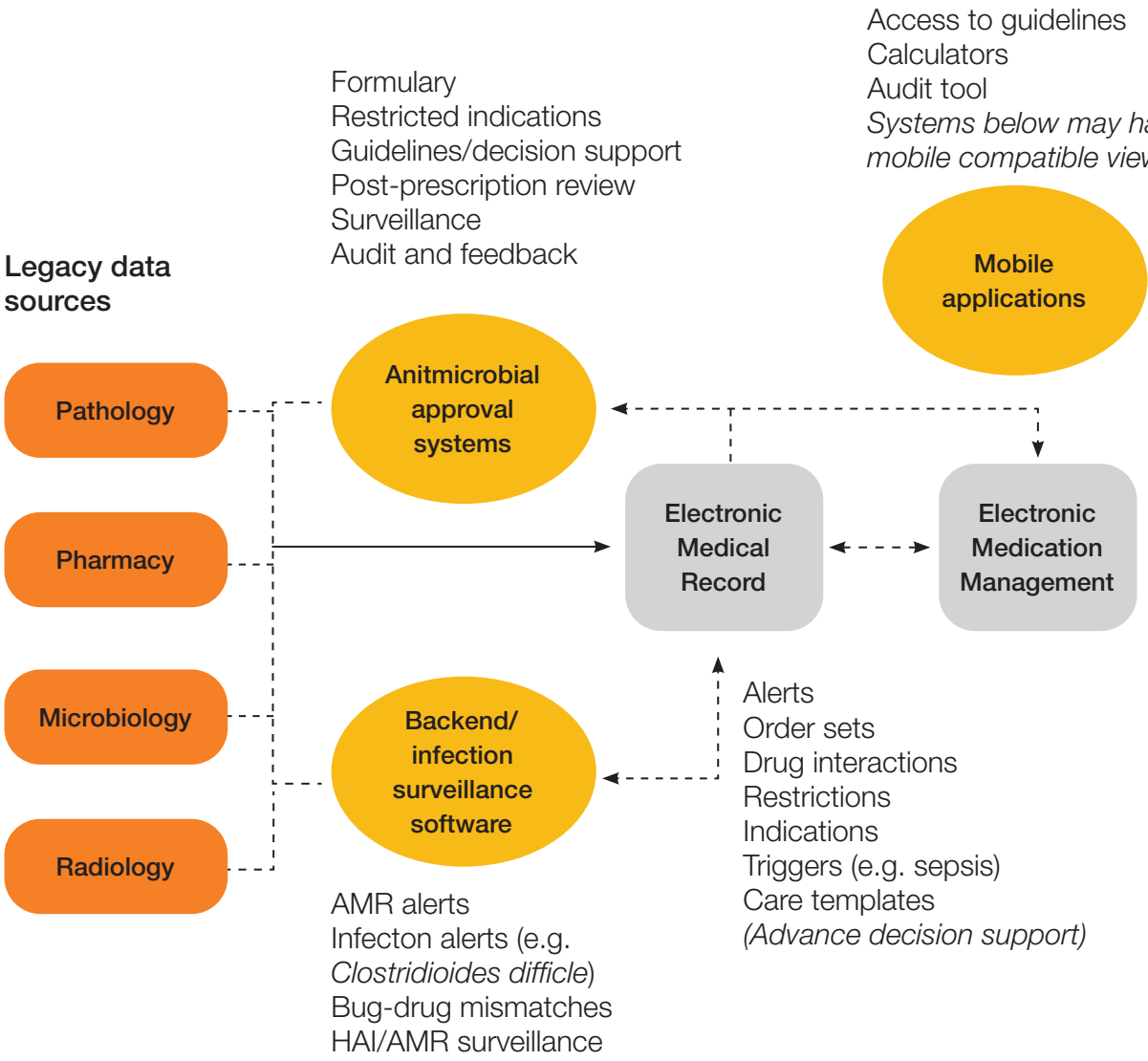
ICT can support AMS through a wide variety of different systems. It can range from simply accessing local or national antimicrobial prescribing guidance on a mobile device by a prescriber at the service user bedside, right through to the use of more complex tools, such as a clinical decision support system (CDSS). An electronic CDSS provides access to information that is stored electronically to enable prescribers to make decisions about healthcare. CDSSs can support the AMS team through the provision of restrictions, alerts, and rules as well as data aggregation from multiple sources. Such systems can support antimicrobial decision-making at the bedside by allowing clinicians to access real-time microbiology and other laboratory results for the service user and to integrate these data with local or national antimicrobial prescribing guidance to produce a tailored choice of antimicrobial agent, dose, and route of administration.

Electronic prescribing or e-prescribing systems allow clinicians to generate electronic medication prescriptions. Electronic medicines management systems are information systems that manage each phase of the medication management process, including:

- Computerised entry of physician orders (e-prescribing)
- Medication review
- Medication reconciliation
- Dispensing
- Recording medication administration
- Decision support (optional).

The interaction of ICT and AMS is illustrated in Figure 4.1.

**Figure 4.1: Multiple options for introducing decision support for antimicrobial programmes**




» *Source: British Society for Antimicrobial Chemotherapy (reproduced with permission)*

» *HAI: healthcare associated infection; AMR: antimicrobial resistance*

## 4.2 Key findings of previous reports and guidelines

Previous reports and guidelines have made recommendations regarding the need to develop appropriate ICT to support AMS in the Irish healthcare system.

- The SARI 2009 guidelines for AMS in hospitals recommended that the HSE should prioritise the provision of pharmacy information technology systems, which are capable of providing AMS audit and surveillance requirements as part of the national IT strategy. It also called for ICT support for prudent antimicrobial use to be introduced, including electronic health records (EHR), e-prescribing, and CDSS.
- The HIQA 2016 report of the review of AMS in public acute hospitals found that most hospital ICT systems dealing with infection operated independently of each other. It was found that there was a greater potential for ICT to further support antimicrobial stewardship and infection prevention and control. This report also highlighted the need for further development of ICT to support rapid monitoring of antimicrobial consumption patterns and generation of reports to allow for quality assurance and improvement efforts. It was found that Ireland remained significantly behind many other healthcare systems in introducing e-prescribing systems. Although a small number of hospitals were found to have e-prescribing systems in individual units within their institution, these were found to operate independently of one another and were not integrated. It was noted that as e-prescribing in primary care and acute services develops further, there is a need for a national standardised approach and integration across the healthcare system.

iNAP2 and the HSE AMRIC Action Plan 2022–2025 identify progressing the implementation of e-prescribing throughout healthcare systems, in order to support AMS and audit, as a key objective. This is also aligned with the key objectives of the *Sláintecare Report* and *Sláintecare Implementation Strategy and Action Plan 2021–2023*; the *eHealth Strategy for Ireland*; and **HSE Digital Transformation** mission. The limitations of digital information systems in Ireland are recognised as a significant challenge to enable coordination on AMR and IPC and access core data to support analysis. A programme of investment in national or regional ICT infrastructure is required to support the integration of the multiple ICT systems currently in use across Irish healthcare settings. Coordinated integrated systems, encompassing laboratory data, prescribing, dispensing, clinical notes, IPC, and audit, is required to achieve AMS goals.

## 4.3 ICT support for antimicrobial stewardship

In this guidance, it is recognised that implementation of certain ICT supports are beyond the reach of local AMS programmes. As such, ICT supports for antimicrobial stewardship achievable within AMS programmes in all healthcare settings (see Table 4.1) and ICT supports that require a national or regional approach are referred to separately (see Table 4.2).

Standalone ICT solutions, such as online access to guidelines and electronic approval systems, can lead to improvement in antimicrobial prescribing and increase efficiency, even in the absence of complex decision support or e-prescribing (see Table 4.1). For instance, initiatives such as implementation of electronic audit software and use of electronic pop-up messaging in the out-of-hours GP service have been found to improve the quality of antimicrobial prescribing. Advancement of ICT has also allowed for increasingly efficient collection and refinement of antimicrobial consumption (dispensed) data in the community pharmacy setting in Ireland in recent years. Creating more meaningful datasets and reports (local, regional, and national) allows quality improvement initiatives to be targeted more effectively.

### Table 4.1: Suggested ICT supports for local antimicrobial stewardship programmes

| Intervention opportunities | Benefits | Considerations during implementation |
|---|---|---|
| **Mobile applications** | | |
| » Guideline applications | | |
| • Dissemination of disease-based or medication-based guidelines (as an add-on to web-based applications)<br>• Dosing calculators<br>• Passive support | • Allow rapid dissemination<br>• Useful for healthcare facilities with poor ICT infrastructure<br>• Ready access to passive decision support available at the point of care<br>• Easy to update remotely without having to issue new physical copies | • May be unable to be integrated with healthcare facility system<br>• Need to have a system for version control and a process for timely update of revisions<br>• May not influence prescribing of senior clinicians<br>• User may need to initiate updates on their own device<br>• Prescribers may not feel comfortable using an app in front of service users.<br>• Third-party apps may require local customisation<br>• Compliance with existing and emerging standards and regulations<br>• Apps that directly affect clinical decisions or use service user data may fall under 'software as a medical device' category |
| » Audit tool applications | | |
| • Real-time auditing platform<br>• Allow concise collection<br>• Automatic feedback of data to data providers/ prescribers<br>• Report of all nationally recommended key performance indicators | • Can be used across hospital settings, community, and residential care facilities<br>• Streamline work flow<br>• Produce data comparable between institutions<br>• Instant reports | • Systems must be used in conformance with GDPR requirements |
| **Dashboard software for reporting key performance indicators** | | |
| • Use of an online platform to provide AMS performance feedback | • Can be ward based/ service or team based/ individualised to prescriber<br>• Engaging and up-to-date presentation of information | |

| Approval systems (standalone or integrated with e-prescribing systems) | | |
|---|---|---|
| • Enforcing a formulary<br>• May be pre-prescription or post-prescription<br>• Enforcing approved indications by medicine<br>• Educational opportunity for the prescriber<br>• Can include clinical decision support<br>• Reports and feedback | • Can work well in the absence of EHR or e-prescribing<br>• Support an organisational approach to AMS<br>• Should trigger post-prescription review<br>• Best combined with an AMS team to review service users 24–48 hours after approval<br>• Can improve the quality of prescribing by helping direct attention of AMS professionals to prescriptions requiring review<br>• Can facilitate audit and feedback to individual prescribers | • Appropriate human resources to perform post-prescription review<br>• Locally relevant criteria for the generation of alerts and customise approval process<br>• Any system that requires an indication can lead to erroneous or deliberate selection to provide access<br>• Any patient safety risks associated with an approval system |
| **Automated dispensing cabinet system** | | |
| • Provides computer-controlled storage, dispensing, and tracking of medication<br>• Provides audit data and reports | • Can be useful for tracking use of restricted agents and limiting ward stock, particularly for out-of-hours pharmacy service<br>• Provides accessibility and inventory control<br>• Enhances first dose availability, facilitating timely administration (e.g. in emergency department or intensive care unit) | • Requires robust protocols and processes to optimise patient safety |

In Table 4.2, larger-scale ICT projects that can support AMS and which require national or regional coordination and investment are outlined. It is recognised that some individual hospitals have progressed such ICT systems as have certain segments in the community setting. For instance, the HSE National Dental Record and Information System provides fully digitised dental treatment records for all service users in HSE Dental Services, with capacity for electronic antimicrobial audit and prescriber feedback. Another example of a national ICT project supporting AMS is the development of PCRS software. This has enabled dissemination of quarterly prescriber-level feedback of Green/Red prescribing and antimicrobial prescribing rate to GPs reimbursed by the PCRS to inform local practice and quality improvement. For the majority of healthcare settings, development of these ICT supports is dependent on delivery either regionally or nationally. These projects are outside the scope of an individual AMS team. However, AMS professionals can make valued input to these systems at an early stage of development to confirm that the processes work to facilitate AMS.

### Table 4.2: Larger-scale ICT projects that can support antimicrobial stewardship programmes

| Intervention opportunities | Benefits | Considerations during implementation |
|---|---|---|
| **Computerised physician order entry (e-prescribing)** | | |
| • Alerts<br>• Drug–drug interactions<br>• Dosing<br>• Restriction prompts<br>• Automated stop orders (e.g. surgical prophylaxis)<br>• Order sets (community-acquired pneumonia, sepsis)<br>• AMS review care protocols (templates or phases order sets)<br>• 'Front end' system<br>• Allows remote review by specialists (e.g. clinical pharmacy, microbiologist, infectious disease physician) with improved efficiency<br>• Generates antimicrobial consumption reports (based on service users' prescriptions), and prescriber-level feedback | • Reduces transcription errors, but not incorrect choice or indication (unless combined with decision support)<br>• Best combined with decision support<br>• Allows immediate retrieval of data<br>• Enables remote review of prescriptions by specialists, particularly in areas of limited access currently/low resource and in outbreak/pandemic situations<br>• Prescriber-level feedback<br>• Monitoring antimicrobial consumption based on actual prescriptions<br>• Offers possibility of expanding hospital AMS services to the outpatient setting through implementation of processes, such as a discharge queue, by the AMS team to verify antimicrobials prescribed at discharge | • Requires more resources to develop customised AMS reports<br>• Often delivered as part of an EHR<br>• Alert fatigue is common<br>• Significant time required by healthcare facility ICT and investment to create the tools<br>• National guidelines/policies beneficial to apply within systems; but where local variation exists, individual modifications to system settings would be required |
| **Clinical surveillance infection control system** | | |
| • Real-time access to burden of AMR within an organisation, regional or national<br>• Pharmacy ± laboratory integration<br>• Surveillance and real-time alerts<br>• Generates antimicrobial consumption reports (using dispensed data) | • Can help identify service users at risk of developing healthcare associated infections, monitor antimicrobial resistance, and assist with routine surveillance activities<br>• Supports an organisational approach<br>• Can be integrated with an EHR<br>• Monitors antimicrobial consumption trends and interprets alongside surveillance trends | • Requires substantial resources to review reports and determine clinically relevant alerts that need action<br>• Interoperability can be an issue |

| Electronic healthcare records, including those that include a medication record | | |
|---|---|---|
| • Error alerts, such as allergy, dosing, drug–drug interactions<br>• Chart abstraction tools to screen and identify service users at risk for sepsis, or collate information for AMS (medicines, results)<br>• Pre-prescription restriction rules<br>• Record AMS recommendations and interventions<br>• Support order sets for syndromes (e.g. community-acquired pneumonia)<br>• Alerts and triggers identify service users suitable for intravenous-to-oral switching or AMS review<br>• Care protocols (templates or phased order sets)<br>• Chart abstraction tools to screen and identify service users at risk for sepsis, or collate information for AMS<br>• Record AMS recommendations and interventions | • Eliminate the cost of external vendor<br>• Allow real-time interventions and alerts<br>• Allow retrieval of data for research | • Require substantial institutional investment up front<br>• Require considerable healthcare facility ICT time to create the tools<br>• Templates must be incorporated into EHRs at each site<br>• Local adaptation still required for each build<br>• Less responsive to change |

Progression of e-prescribing and eHealth in Ireland is crucial to delivering current and future AMS goals both nationally and locally. Implementation of new ICT supports represents a unique opportunity to engage with healthcare workers to promote safe, effective, and appropriate antimicrobial use and reinforce the AMS message through a new platform. Studies have demonstrated evidence for the benefits of AMS functionality within e-prescribing systems. Positive impacts on prescribing and service user outcomes include increased guideline adherence and effective initial therapy or reductions in antimicrobial prescribing, antimicrobial resistance, dosing errors, length of hospital or intensive care unit stay, and mortality. E-prescribing can support a bundled approach to AMS, including antimicrobial restriction, dosing recommendations, rule-based alerts, and order sets for disease conditions. E-prescribing features that can facilitate AMS are considered in Table 4.3.

Currently, the HSE is introducing an electronic National Clinical Infection Control System. The Office of the Chief Information Officer and the AMRIC Programme are working to deliver this project in collaboration with acute and community services. In its first phase of development, this focuses on surveillance of incidence and clustering of microorganisms of interest to support IPC within regions, as arranged by Hospital Group, and will additionally support AMS within those areas. Subsequent functionality may include provision of antibiograms, alert organisms for preoperative patients, and bacteraemia with resistant organisms. Future developments may include an additional AMS module that could include extra surveillance of antimicrobial use if e-prescribing is implemented. For further information, visit ehealthireland.ie.

### Table 4.3: Design considerations for e-prescribing software to facilitate antimicrobial stewardship

| Design considerations for e-prescribing software to facilitate AMS | |
|---|---|
| **Prescribing alerts or prompts** | • Allergy checker/precise nature of drug allergy<br>• Indication prompt<br>• Treatment protocols, e.g. duration of surgical prophylaxis<br>• Drug interaction checker<br>• Dose checker (adult/children)<br>• Restricted antimicrobial block<br>• Therapeutic drug monitoring alert |
| **Active prescription surveillance** | • Drug-indication mismatch<br>• Prolonged intravenous/oral course<br>• Daily report of newly prescribed restricted antimicrobials<br>• Ongoing prescription of restricted drug<br>• Missed antimicrobial doses<br>• Aminoglycoside<br>• New prescription for diagnosis of interest<br>• New prescription for sepsis of unknown origin<br>• Daily report of any newly prescribed antimicrobials |
| **Microbiology laboratory system interface** | • Susceptibility testing–prescribed antimicrobial conflict<br>• Previous microbiology includes antimicrobial-resistant organisms |
| **Antimicrobial prescribing/ consumption monitoring** | • Trends in point prevalence, missed doses, delayed stat doses, total days of therapy, average length of therapy<br>• Monitoring of consumption based on antimicrobial administration (as opposed to antimicrobial dispensing)<br>• Technical aspects:<br>» Activity denominator (patient days/admissions)<br>» Report-time intervals<br>» Directive reporting, prescriber-level feedback<br>» Drug groupings/antimicrobial classification system |
| **Reporting function** | • Flexibility of reporting and capacity to customise<br>• Ability to alter background classifications in accordance with international recommendations<br>• Reporting to national standard<br>• Defined daily doses in addition to days of therapy |
| **Clinical information system interface** | • Link to guidelines<br>• Disease severity scoring systems<br>• Drug information |
| **Restriction systems** | • Authorisation codes<br>• Authorisation by named specialist<br>• System access restricted to trained prescribers<br>• Compulsory recording of indication |
| **Additional narrative fields** | • Infection specialist advice<br>• Justification for off-guideline prescribing<br>• Reasons for missed doses<br>• Facility to use ‘auto-saved notes’ for AMS interventions that can be adjusted for the individual service user |

| | |
|---|---|
| **Soft stops/review dates functionality** | • Block administration until review<br>• Patient safety of automatic prescription stop |
| **Dosing support** | • Dosing by age<br>• Weight and renal function |
| **Drug history** | • Primary care and previous hospital admissions |
| **Stat doses** | • Automatic associated stat dose and appropriately spaced maintenance dose<br>• Stat dose remains visible if delayed |

» *Source: Adapted from Hand et al. (2017)*

## 4.4 Overarching considerations when implementing ICT supports for antimicrobial stewardship

- Implementing ICT supports requires careful planning and prior assessment of the organisation's needs and capacity.
- The ICT infrastructure, literacy, expertise, and training requirements for users in the organisation should be considered.
- Implementation requires coordination between staff users, laboratory and pathology clinicians, technical staff, and epidemiology/surveillance/data experts.
- Cultural factors, such as organisational dynamics, capacity for collaboration, and support for interventions and initiatives, can play a critical role in determining the success of ICT support implementation.
- No single system is likely to meet all requirements and a combination system may be required.
- Substantial customisation is often required to integrate new systems with existing infrastructure and align with organisational workflow. There is benefit to national standardisation, where possible, to reduce the variations between practices and guidelines in different healthcare settings and to reduce the amount of local customisation required as a result. Disparate private software systems that exist in practice, for instance across GP practice in Ireland, may be a barrier to achieving national standardisation.
- Healthcare workers involvement in all stages of the development process, monitoring, and user feedback are key to ensuring effective integration of ICT supports into the clinical workflow.
- Risks associated with the introduction of ICT supports should always be given due consideration alongside the potential positive impact on patient safety and workflow efficiency.
- Implementation should consider the time available to the end user and aim to integrate with the prescribing workflow.
- A judicious, balanced approach to the use of educational prompts should be taken to promote sustained healthcare worker engagement and reduce the risk of 'alert fatigue'.
- Poorly implemented e-prescribing, for instance with an excessively large number of medicines and dosing combinations or dangerous autocomplete directions, may be associated with a negative effect on antimicrobial prescribing.
- GDPR requirements should be fully considered.

ICT supports are not effective in isolation. They complement the clinical, pharmacy, and technical members of the AMS team but cannot replace their expertise. The success of any ICT support or system is reliant on the ongoing input and support of AMS professionals. For instance, antimicrobial approval systems and infection prevention surveillance systems require processes and a clinical workforce to monitor and act on alerts and to generate reports and feedback. Customisation and modification of ICT systems also requires considerable time investment in terms of both ICT and content expertise. Studies have shown that increased information flow needs to be supported by human resourcing, which if not addressed can be a barrier to the success of these initiatives.

## 4.5 Future considerations

In the future, advanced decision support systems which use complex logic, mathematical modelling, and case based probabilities may provide service user specific recommendations. Artificial intelligence (AI) may allow the use of vast amounts of data provided by EHRs to create predictive models to optimise the accuracy and consistency of empiric antimicrobial prescribing. EHRs provide rich information (e.g. history of past infections, antimicrobial susceptibility data, service user symptoms, past medical history, laboratory results, and imaging) that has the potential to be utilised by AI models. Using the right tools, AI models may be able to rapidly sift through data and predict the answers to specific patient-oriented questions. For instance, it may be possible for AI models to estimate probabilities of infection with drug resistant bacteria for specific service users. The output could be in real time and available at the point of patient care.

These systems are complex and usually bespoke. Advanced CDSSs are in the early phase of adoption and the ability to be translated to other sites is unclear. Early studies indicate that AI has the potential to improve safety. However, AI requires robust ICT and advances in exchanging data across diverse health systems in order to realise its full potential. Furthermore, the high acquisition cost of emerging technologies may only make it cost effective in very limited cases or environments, particularly when considering the cost/risk of changing clinical workflows/pathways surrounding the system.

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# Chapter 5: Antimicrobial stewardship education

## Key points

- Education and training is a core element of AMS and should be tailored to the audience and the setting. It should be an ongoing part of continuing education and professional development for all healthcare workers.
- Education on AMR, IPC, and AMS, including education on the vaccination of preventable diseases, should be part of core curriculum training and examination for all healthcare students at undergraduate and postgraduate level.
- Every healthcare worker involved in prescribing, dispensing, or administering antimicrobials should receive AMS education on induction and updates appropriate to their professional role.
- Ongoing education and training of the AMS team, who coordinates and operationally manages the AMS programme, and in turn provides formal and informal education to the wider staff involved in the antimicrobial usage process, is of key importance.
- Multidisciplinary groups in conjunction with healthcare education providers should advise the planning, developing, and delivering of local and national AMS education programmes.
- A wide range of national and international resources are available to assist with AMS education and training, as detailed in Appendix 2 and Appendix 3 of Part A.

## 5.1 Introduction to antimicrobial stewardship education

Education is a core element of an effective AMS programme. The second Irish National Action Plan on Antimicrobial Resistance (iNAP2) promotes a One Health approach to AMS education for all those involved in the fields of human health, animal health, agriculture, and environment. This chapter focuses on the education of healthcare workers and is relevant to all those working in all health service organisations across both the private and public areas of the community and acute services. It should be noted that this chapter does not cover communication strategies and education for the general public.

iNAP2 and the HSE AMRIC Action Plan 2022–2025 have identified AMS education and training as a key focus to enable all staff integrate best practice into the delivery of day-to-day care. Unlike certain other medications where prescribing, dispensing, and administration may be restricted to specialists (e.g. cytotoxic agents), antimicrobials are widely prescribed, dispensed, and administered by healthcare workers at all stages of their career, and workforce rotations are common in many settings.

Education is an enabling intervention that increases means and reduces barriers to achieving AMS goals. Education about AMR and AMS should be an ongoing part of continuing education and professional development for all healthcare workers. In addition to focused undergraduate training, every healthcare worker involved in prescribing, dispensing or administering antimicrobials should receive AMS education on induction and updates appropriate to their professional role. The purpose of AMS education is to influence and change antimicrobial prescribing practices.

- An open and transparent culture should be encouraged that allows healthcare workers to openly discuss and raise questions of antimicrobial prescribing practices of colleagues when these are not in line with local (where available) or national guidelines and no reason is documented.
- Training in effective communication is essential to equip healthcare workers with the skills required to educate service users, engage in health promotion, manage service user expectations, and improve the way in which staff raise concerns with one another regarding antimicrobial prescriptions.
- Education strategies that incorporate behaviour change principles such as audit and feedback, along with more active strategies, including academic detailing and educational workshops, are more effective in changing behaviour than the passive dissemination of information alone.

See Table 5.1 for more details of educational techniques.

**Table 5.1: Antimicrobial stewardship educational techniques**

| Teaching technique | Examples | Effectiveness |
|---|---|---|
| **Passive** | • eLearning modules<br>• Lectures<br>• Distribution of printed learning material | Alone has little effect on antimicrobial use; can increase effectiveness of other interventions |
| **Active** | • Audit and individualised real-time feedback on appropriateness of antimicrobial prescribing in comparison to peers within a given healthcare setting<br>• Interactive small-group workshops/webinars<br>• Simulation teaching | More effective; has greater and more lasting effects on prescribing than passive techniques, but resource intensive |
| **Combined and multifaceted** | • Clinical education combined with audit and feedback<br>• Education combined with clinical reminder and decision support systems<br>• Education module linked to clinical audit project | More effective in reducing antimicrobial prescribing; multifaceted interventions that combine healthcare worker and service user education in different venues and formats is the most successful approach to reducing inappropriate prescribing |

Education should be tailored to the audience and the setting. Integration of education into practice has been shown to enhance learning and dissemination of education material, and is most effective in the context of a focused stewardship goal.

Good governance requires organisations to monitor both the type and frequency of education provided, and the extent of participation, to confirm that all healthcare workers are provided with education and training that will enable them to deliver safe care. The effectiveness of education activities should be evaluated (e.g. survey of participants, monitoring guideline website/app hits, audit).

Multidisciplinary groups (including clinical microbiologists, infectious disease physicians, antimicrobial pharmacists, other specialists, dentists, nurses, midwives, infection control practitioners, and medical scientist/surveillance scientists) in conjunction with healthcare education providers should advise the planning, developing, and delivering of local and national AMS education programmes. It is important that healthcare workers have confidence in the advice provided.

## 5.2 Higher education and research

Higher education institutions and professional bodies have a role in the provision of a firm educational foundation in AMS to all who are involved in prescribing, dispensing, and administration of antimicrobials. During undergraduate education and early career, the knowledge, attitudes, and behaviours of healthcare workers are shaped. HEIs should support students to complete foundation learning in AMR and AMS before their first clinical placement. Education on AMR and AMS should be part of core curriculum training and examination for all healthcare students at undergraduate and postgraduate levels. There is a need for this to be implemented in a consistent manner across all programmes. Vertical integration of AMS into undergraduate education is important so that students are exposed to AMS concepts throughout their educational journey, thus consolidating knowledge over time. Failure to integrate AMS fully into undergraduate

education has been cited as a factor that can limit subsequent engagement in AMS implementation. The **European Society of Clinical Microbiology and Infectious Diseases (ESCMID) generic competencies in AMS and prescribing** are intended to be relevant for all independent prescribers in Europe and can be adapted to the needs of specific professional groups. Competencies are listed in three key domains:

- Core concepts in microbiology, pathogenesis, and diagnosing infections, including understanding the common microbiological causes of infection, differences between colonisation and infection, and knowing how to diagnose common infections and use supporting investigations
- Antimicrobial prescribing, including antimicrobial-related benefits and harms, understanding when not to prescribe antimicrobials, how to initiate and review antimicrobial therapy, the clinically relevant spectrum for commonly prescribed antimicrobials, and documenting antimicrobial treatment plans
- Antimicrobial stewardship, including understanding the need to use antimicrobials safely (for the service user and for the future), engaging with local stewardship policies and quality measures, and how to communicate about antimicrobial treatment decisions with service users, their carers, and other healthcare professionals.

These competencies can be used by regulators and professional bodies to inform standards; by undergraduate and postgraduate educators to derive curricula learning outcomes; by healthcare organisations to inform intern and clinical training programme requirements; and by individuals to assess their own competency. Consideration should be given to adapting these competencies for all those who dispense and administer antimicrobials.

Implementation of a core competency framework requires those involved in the development of healthcare undergraduate education to map AMS specific learning outcomes to core competencies. Gaps in the content taught can then be identified and the content adjusted accordingly. Furthermore, healthcare organisations are encouraged to review their education for staff on AMS and adapt resources to allow competency descriptors to be met. One example of an approach to mapping AMS competencies in undergraduate healthcare education is the project undertaken jointly by Cardiff University and the University of Birmingham, which can be found at:
https://www.nice.org.uk/sharedlearning/consensus-based-national-antimicrobial-stewardship-competencies-for-uk-undergraduate-healthcare-professional-education

The national antimicrobial prescribing guidelines and resources available on www.antibioticprescribing.ie and HSeLanD AMRIC modules are an essential reference to inform the education of healthcare workers. The use of prescribing skills workshops and/or certificates on prescribing would aid in consolidating this learning.

There is value in offering students and postgraduates of different healthcare disciplines the opportunity to come together for problem-based and shared AMS learning. This provides the additional benefit of students developing the skills to practise collaboratively, enabling a shared understanding of antimicrobial treatment plans, decisions, and outcomes, and may have a positive influence on interprofessional learning and working. The social as well as the biomedical dimensions of AMR should be addressed. Emphasis should be placed on the development of communication skills and strategies in order to convey AMS messages to service users, their families, and the wider public as well as to improve communication with other healthcare workers to optimise antimicrobial use. HEIs should strive to provide AMS education that is engaging and practical for students.

HEIs are in a unique position to foster a culture of research and education focused on AMS and promote collaborative service user participation in this research. Building education, awareness, and understanding of AMR for future generations of health and social care staff, both clinical and non-clinical, is integral. Interdisciplinary research and collaboration between social and non-social disciplines using a cross-sectoral One Health approach may be useful to stimulate creativity in AMS. Undergraduate and postgraduate students across healthcare, agriculture, animal health, and other disciplines can make a significant contribution to AMS.

## 5.3 Education and continued professional development for all healthcare workers

A key component of an AMS programme involves the effective education and training of non AMS specialised staff to optimise antimicrobial use. This includes provision of continuing education about antimicrobial use and AMS strategies for all healthcare workers. All hospitals and community facilities and services should have a programme of ongoing AMS education for healthcare workers.

AMS education should be specifically targeted at healthcare workers in their early career in order to build a solid knowledge base for future practice. Key information on AMR, IPC, and AMS should be included in all induction material for incoming staff and a process in place to confirm completion/assessment. Involving students and early career professionals in team-based quality improvement projects for AMS can improve clinical care and build the capability and capacity of the workforce in both quality improvement and AMS. It can also help people understand the complexity of health systems and appreciate the roles of different healthcare workers and teams in service user care. Attitudes and behaviours can change over time, as can the evidence base; therefore, it is important that educational messages are regularly reviewed and updated. The messages should be repeated to promote consolidation of the knowledge with further training throughout the career of the healthcare worker.

AMS is well suited to being taught within a multidisciplinary learning environment because it relies on the expertise and engagement of all team members. All non AMS specialists should be aware of the availability of AMS team members and processes for obtaining expert advice, whether on-site or remotely.

Local education should be provided specifically to all healthcare workers in the area of diagnostic stewardship. It is crucial that prescribers understand the indications for and limitations of diagnostic investigations and are guided to perform appropriate investigations and interpret the results of such tests appropriately in the clinical context. Diagnostic stewardship is discussed in further detail in Chapter 3 (section 3.7). Educational support materials should be provided to those ordering investigations to verify:

- Key practical application and limitations of the test are understood.
- Timing and method of collection, sample type, and volume required as well as transportation requirements are considered.

Health and social care workers across all care settings should be educated and encouraged to work together to support AMS by:

- Communicating and sharing consistent messages about antimicrobial use
- Sharing learning and experiences about antimicrobial resistance and stewardship
- Referring appropriately between services without raising expectations that antimicrobials will subsequently be prescribed.

Development of local AMS networks across all care settings should be considered to communicate information and share learning on antimicrobial prescribing, AMR, and patient safety incidents. Professional colleges and associations can take a proactive role in supporting AMS – for example, by updating their members about changes to guidelines, providing continuing education or discussion forums, and inclusion of an AMS educational requirement as part of specialist training. This is especially important for groups that are responsible for prescribing antimicrobials as one specific part of a role that may focus primarily on other skills (e.g. surgeons, anaesthetists, dentists).

## 5.4 Education and continued professional development for AMS specialists

Key to the success of any AMS programme is the ongoing education and training of a group of specialised staff – the AMS team – who coordinate and operationally manage the AMS programme, and in turn provide formal and informal education to the wider staff involved in the antimicrobial usage process. Support for education and training of AMS professionals by providing resources, including allocated time or funding, is integral. Leading an AMS programme requires a range of skills and knowledge beyond infectious diseases and microbiology, and healthcare workers interested in leading AMS programmes should be encouraged to develop these skills. Knowledge of behavioural change, quality improvement techniques, and measuring the success of a programme are key. Core knowledge and skills required for AMS professionals engaged with building, leading, and evaluating AMS programmes are summarised in Chapter 2 (section 2.1.5.3).

The HIQA review of AMS in public acute hospitals found that there was a limited number of training programmes available for staff wishing to specialise in AMS. A number of online education programmes and external training courses are available for AMS professionals. AMS professional groups, such as AMS InSight, the Irish Antimicrobial Pharmacists' Group, the Irish Society of Clinical Microbiologists, the Infectious Diseases Society of Ireland, and the postgraduate medical and surgical colleges have an important role in the provision of a network for sharing knowledge and experience across settings.

AMS specialists should consider the extent to which they rely on pharmaceutical industry organised and sponsored educational events and should ensure that unbiased and independent educational sources provide the great majority of their information. For further guidance on interacting with the pharmaceutical industry, see Chapter 3 (section 3.4.4.3).

## 5.5 Education resources

A range of Irish and international resources are available to assist with AMS education. Prescribers should be educated and facilitated where possible to use credible and up-to-date references and resources. Local AMS committees may provide links to appropriate endorsed websites and apps.

### 5.5.1 Educational techniques and tools

The type of education and training that prevails may depend on the setting and the available resources (e.g. access to and availability of AMS professionals) and should be adapted to meet staff needs. Some of the more commonly used AMS educational interventions are listed below:

- Lectures, tutorials, workshops (using case studies, interactive problem-based learning, or local data to illustrate areas for improvement where possible)
- Presentations by members of the AMS team at induction, clinical staff educational meetings or team/departmental journal club meetings, grand rounds
- Feedback to staff in the clinical environment, for example, intervention and feedback during AMS ward rounds or planned bedside training of junior staff, during the approval process for a restricted antimicrobial, during the provision of microbiological sampling results
- Audit and feedback to clinical staff, management, and committees with focused educational messaging for improvement, for example, point prevalence studies and quality improvement projects
- One-to-one or small group educational sessions between a healthcare worker and an AMS professional, for example, within a GP practice or a single speciality medical team or focus group
- eLearning modules, ideally with an interactive component and questions during and on completion to allow reflection and measurement of learning, especially where resources are limited
- Supplementary activities with electronic messages, posters, leaflets, social media activity, and online resources
- Microlearning through smartphone applications, podcast discussions, email or social media platforms to provide quick learning and reinforce key messaging, for example, Bugs and Drugs quizzes

- Technology-enhanced methods and integration of AMS learning into all teaching activities, for example, HEI's using objective structured clinical examination and patient-centred labs to assess learning outcomes.

Combining education with other AMS activities enhances efficacy, for example, focusing on educational activities for healthcare workers during European Antibiotic Awareness Day, World Antibiotic Awareness Week, or World Sepsis Day. General education can be coupled with local feedback and information to increase its impact. Topics addressed could include local antimicrobial prescribing patterns (with benchmarking where available), local AMR patterns for common pathogens, local patterns of infection, and, where possible, service user outcomes including learning from patient safety incidents. National research findings in relation to AMR and its current trends can also be incorporated into education.

### 5.5.2 Evidence based clinical guidelines

Local, regional, and national antimicrobial prescribing guidelines can form the basis for educating healthcare workers on accepted practice for antimicrobial prescribing in an organisation. Guideline implementation and adherence can be facilitated through educational tools and interventions.

The website www.antibioticprescribing.ie provides treatment recommendations for common infections. This website also hosts a range of useful educational resources, national position statements, audit tools, and other AMS resources to support implementation of guidelines.

### 5.5.3 Online learning

eLearning offers access to learning materials developed by experts that may not otherwise be readily accessible to all healthcare workers, especially those working in smaller, rural or remote settings. A number of e-learning modules are available on HSeLanD that can support AMS education. Of particular relevance are the following modules:

- Antimicrobial Stewardship in Practice:
  - » This module is designed for all healthcare professionals involved in prescribing, dispensing, or administering antimicrobials
  - » The course covers the principles of good AMS and application to practice. It outlines the benefits and harm related to antimicrobial use, how to identify the factors that optimise antimicrobial use and reduce harm, and how to identify tools and resources to support best practice.
- Prevention and Management of Urinary Tract Infection:
  - » This module is aimed at all healthcare workers who play a role in the prevention of urinary tract infection and who care for these service users.. It is suitable for undergraduates and postgraduates
  - » The course covers how to reduce antimicrobial-related harm and reduce the incidence of healthcare associated urinary tract infection and how to manage urinary tract infections.
- Surgical Antibiotic Prophylaxis:
  - » This module has been designed for surgeons and anaesthetists, nurses, midwives, pharmacists, and undergraduate students of these disciplines
  - » The resource aims to support optimised provision of surgical antibiotic prophylaxis: the right agent, the right dose, at the right time for the right duration.
- *Clostridioides difficile* Infection: IPC and AMS Principles, Prevention and Management:
  - » This module is designed for all healthcare workers in all settings where healthcare is delivered
  - » The course covers how to prevent, recognise, and manage *C. difficile* infection as the learner implements IPC and AMS best practices in their own setting.
- Introduction to Sepsis Management for Adults including maternity:
  - » This module is aimed at nurses, midwives, doctors, health and social care professionals, and undergraduate healthcare students working in acute care settings. It may also be beneficial to other healthcare workers involved in patient care, including healthcare assistants
  - » The objective of the programme is for the learner to understand that sepsis is a time-dependent

medical emergency that requires early recognition and treatment to give the service user the best chance of survival. It outlines how to identify those at higher risk of sepsis, how to recognise the signs and symptoms of sepsis, how and when to screen for sepsis, and escalate for a timely medical review. It also outlines how to treat the service user with the one-hour treatment bundle, ongoing management, and review.

Specifically for community pharmacists, there is an AMS e-learning programme hosted by the Irish Institute of Pharmacy. Specifically for physicians, the Royal College of Physicians of Ireland (RCPI) provides an e-learning module, **Principles of Antibiotic Use for General Internal Medicine**, which was developed as part of the national healthcare associated infection/AMR programme.

A range of resources is also available internationally and these resources are outlined in Appendix 2 and Appendix 3 of Part A. It should be noted that international practice and guidelines may vary from the Irish context and therefore the source and relevance of the resource should always be given due consideration.

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# Chapter 6: Measuring performance of antimicrobial stewardship programmes and use of data for quality improvement

## Key points

- Data are required to inform annual plans, measure performance, and evaluate effectiveness of an AMS programme.
- Data can be quantitative (consumption reporting) or qualitative (audit of appropriateness of prescribing, e.g. point prevalence studies).
- Key quality indicators for AMS programmes can encompass structure, process, outcome, and balancing measures.
- Structure measures for AMS can support organisations to determine whether the appropriate governance, workforce, and processes, such as formularies and guidelines, are in place.
- When measured as regular audits and reported back to prescribers, process measures can be useful to measure, maintain, and improve AMS performance. These measures include the quantity and quality of antimicrobial use.
- The main categories of outcomes for AMS programmes include improved service user outcomes, improved patient safety, reduced antimicrobial consumption, reduced AMR, and reduced costs.
- Measurement of balancing measures, such as rate of adverse events or higher rate of infection-related readmission, allows AMS teams to be alert to potential unintended consequences of AMS interventions.
- Actionable feedback from the results of any audit or point prevalence study conducted should be made available to prescribers as well as to the executive, divisions or directorates, and specific clinical units.

## 6.1 Key quality indicators for antimicrobial stewardship programmes

The use of data is recommended to measure performance and evaluate the effectiveness of an AMS programme. Data are also key to inform and evaluate quality improvement initiatives and efforts. Data can be quantitative (consumption reporting) or qualitative (audit of appropriateness of prescribing, e.g. point prevalence studies).

There are a number of ways to assess the effectiveness or performance of an AMS programme by collection and monitoring of data for quality indicators. These indicators can encompass structure, process, outcome, and balancing measures. Examples of these indicators are provided in Table 6.1 and detailed below. Quality indicators should be defined as part of an organisation's AMS programme strategy. The choice and frequency of quality indicators will depend on the programme of work, needs, and setting of the facility.

Some of the key principles of sustainable measurement are as follows:

- » Seek usefulness, not perfection, in the measurement
- » Keep measurements simple
- » Be clear about definitions of the measures
- » Measure small, representative samples
- » Try to build measurement into daily work.

At a national level, the HSE AMRIC Action Plan sets clear targets for outcome measures in relation to AMR and IPC over the period 2022–2025 in Ireland. Targeted metrics are provided in the action plan for outcomes in the key areas of healthcare associated infection, antimicrobial consumption (i.e. community consumption, acute hospital consumption, surgical antibiotic prophylaxis duration, and general practice prescription of antibiotics), and public awareness and understanding. Some of these outcome measures are linked to key performance indicators in the annual HSE National Service Plan. These measures are set out in detail in the **HSE AMRIC Action Plan 2022–2025**.

**Table 6.1: Examples of quality indicators used for antimicrobial stewardship programmes**

| Type of measure | Questions answered by the measures | Examples |
|---|---|---|
| **Structure** | • Are the right elements in place?<br>• Are the resources, lines of reporting, and policies available? | • Self-assessment of the programme using a structured tool |
| **Process** | • Are our systems performing as planned?<br>• Are they effective? | • Quarterly measure of overall quantity of antimicrobial use, or quantity of selected agents, or quantitative and proportion use of access, watch, and reserve antimicrobials<br>• Compliance with prescribing guidelines<br>• Compliance with antimicrobial restriction conditions<br>• Proportion of service users on intravenous antimicrobials who are suitable for oral shift<br>• Proportion of single dose surgical antimicrobial prophylaxis or assessment of surgical prophylaxis given for more than 24 hours<br>• Proportion of service users receiving aminoglycoside therapy with toxic or subtherapeutic serum levels with review/ adjustment before next dose<br>• Assessment of adequacy of documentation of indication for antimicrobial therapy<br>• Assessment of adequacy of prescription details (e.g. dosing regimen, duration, documentation of stop date/review date) for antimicrobial therapy<br>• Proportion of service users with community-acquired pneumonia assessed using a validated measure of severity<br>• Proportion of service users with community acquired pneumonia who have received antimicrobial therapy in concordance with prescribing guidelines<br>• Rates of general practice visits, emergency visits or admissions for specific conditions |
| **Outcome** | What is the result? | • Service user outcomes (e.g. infection-related mortality such as with *C. difficile* infection, length of stay, time to respond to treatment, time to first dose in sepsis)<br>• Surveillance of antimicrobial resistance (e.g. using cumulative antibiogram)<br>• Changes in cost, length of stay, antimicrobial acquisition costs, cost-effective use of laboratory services |
| **Balancing** | Are the changes causing new problems? | • Incidence of adverse drug events (e.g. cardiac toxicity, renal impairment)<br>• Incidence of allergic reactions<br>• Infection related mortality<br>• Infection related readmission in 28 days<br>• Rates of surgical site infection |

## 6.2 Structure measures

### 6.2.1 Hospitals

Structure measures for AMS can support organisations to determine whether the appropriate governance, workforce, and processes, such as formularies and guidelines, are in place. Further information on AMS governance, structures, and supports is provided in Chapter 2. The Transatlantic Taskforce on Antimicrobial Resistance (CDC/ECDC) published a set of **core and supplementary structure and process indicators for hospital AMS programmes**, which could be adopted and used by health service organisations to assess whether they have the infrastructure and activities to support AMS. Other resources internationally include the South Australia (SA) Health **Antimicrobial Stewardship Program Self-evaluation Toolkit**, or the **CDC Checklist for Core Elements of Hospital Antimicrobial Stewardship Programs**.

### 6.2.2 Community

#### 6.2.2.1 Residential care facilities

The CDC **Core Elements of Antibiotic Stewardship for Nursing Homes** is a useful checklist of requirements for AMS in residential care settings, which could be adopted to the Irish setting.

#### 6.2.2.2 Primary care

The CDC **Core Elements of Outpatient Antibiotic Stewardship** includes a useful prescriber checklist of requirements for AMS in primary care, which could be adopted to the Irish setting.

## 6.3 Process measures

When measured as regular audits and reported back to prescribers, process measures can be useful to measure, maintain, and improve AMS performance to an appropriately high level. These measures include the quantity and quality of antimicrobial use.

Process measures may be used regularly as part of AMS programme monitoring (e.g. quarterly assessment or annual assessment), as part of a quality improvement cycle, or on an intermittent basis as part of the evaluation of an AMS intervention. Reporting and feedback on process measures should be in a format that can be readily interpreted and used by those who prescribe, dispense or administer antimicrobials, or influence antimicrobial use for quality improvement.

### 6.3.1 Measuring quantity of antimicrobial use (antimicrobial consumption)

Reductions in the volume of prescribing may be the most immediate effect of an AMS programme. Conversely, there are situations in which an increase in the use of specific antimicrobials may indicate an improvement in the appropriateness of prescribing and may be linked to improved service user outcomes. Ongoing monitoring of antimicrobial use across a hospital, facility, practice, group or nationally provide AMS teams with data to identify issues and effect changes in prescribing. Surveillance needs to be carried out consistently, using standard definitions and data-gathering methods, and ideally analysed in a statistically valid manner to ensure integrity of the results and their interpretation. Any significant change can act as a trigger to investigate the cause. The primary value of the data is to compare trends over time in a given facility or service, assess the impact of interventions, and identify targets for future interventions. This is more important than comparing results between facilities and services, which is challenging because of variations in service and population served.

Antimicrobial consumption is generally reported using the anatomic, therapeutic, chemical (ATC) classification and expressed as defined daily doses (DDD) per 100 bed-days used for acute hospitals, or per 1000 population for community settings. A denominator is needed to enable the measurement

of use over time and between geographical regions such as hospitals, regions or countries to become meaningful. The ATC/DDD system was devised by the WHO as a standardised method of measuring antimicrobial consumption. In simple terms, the DDD is the amount of that antimicrobial that a typical adult service user will receive each day for treatment of an infection.

An alternative to DDDs is the days of therapy (DOT). One DOT represents the administration of a single antimicrobial on a given day regardless of the number of doses administered or dosage strength; for example, administration of cefuroxime as a single 1.5 g dose or as three 750-mg doses 8 hours apart would both represent 1.0 DOT. Although this requires patient-level information, it may be a more practical measure at a local level where full prescription or dispensing volumes cannot be accessed for conversion to DDDs, such as a residential care facility or GP practice. Use of a denominator would still be advised to allow benchmarking, such as DOTs per 1000 patient/resident days.

#### 6.3.1.1 For hospitals

Hospital pharmacies currently report data quarterly on antimicrobial consumption to the HPSC. Data on inpatient use are generally obtained from the volume of ward stock issued, and in the absence of electronic prescribing systems, these data have limitations in terms of reflecting actual patient use and facilitating prescriber-level feedback. With the increasing use of EHRs and electronic prescribing systems, antimicrobial dispensing or administration data can be linked to prescribers, and more precise surveillance and feedback are possible.

Participation in HPSC antimicrobial surveillance for acute hospitals provides national data and hospitals with information on antimicrobials prescribed and changes in use over time with comparison to other hospitals of a similar type. Contributing hospitals receive biannual reports of their antimicrobial use and comparisons. Direct comparison between hospitals should be undertaken with caution due to differences in casemix and limitations of the ATC/DDD system; for example, hospitals with specialist units such as intensive care units may have higher use of antimicrobials than a local non-specialised hospital. Since DDDs are based on adult dosing, these measures are not ideal for determining antimicrobial use in paediatric hospitals.

Local analysis of consumption (e.g. quarterly), ideally with conversion to DDDs/100 bed-days, is recommended to provide timely access to local trends in antimicrobial use. Data can be reported for the whole hospital or broken down into individual ward or directorate information. Data can also be reported by total antimicrobial consumption or by specific antimicrobials or antimicrobial classes. The current feedback is quite detailed. HSE-AMRIC and the HPSC are currently working to develop a more high level feedback format intended for managers and clinical leaders in non AMS specific roles.

#### 6.3.1.2 For community

Current antimicrobial use in the community is assessed using wholesale (supply) data to community pharmacies and then converted to DDDs/1000 inhabitants and reported biannually by the HPSC. Participation by community pharmacies in Health Market Research (HMR) allows dispensed antimicrobial use, in numbers of antimicrobial packs per 1000 inhabitants, to be examined monthly, which is another valid measure used in community settings. Dispensed data are preferred to wholesale and are more representative of actual use as they are influenced by stockholding in pharmacies. Antimicrobial use data collected locally can be used to monitor use at a local level.

In Ireland, a strategy of quarterly feedback to GPs was initiated in 2019 for General Medical Services (GMS) service users, facilitated by the PCRS, in which doctors are made aware of their prescribing for service users on their GMS list. Data are presented as proportions of Green/Red agents relative to that of their peers (i.e. for general practitioners with over 100 GMS service users).

### 6.3.2 Measuring quality of antimicrobial use

Auditing the quality of prescribing can provide assurances that the most effective therapy is being given and that the risk of poor outcomes (including antimicrobial related adverse events) is being reduced. A qualitative approach is required to provide information on which service users are being given which antimicrobials; their indication; which antimicrobials are being used to treat particular infections; and whether the antimicrobials prescribed are in accordance with local prescribing guidelines.

#### 6.3.2.1 Point prevalence studies

The use of point prevalence study (PPS) enables assessment of the quality of antimicrobial use, identification of targets for quality improvement, and assessment of the effectiveness of interventions through repeated studies. Point prevalence or 'snapshot' studies have the advantage of being resource efficient. However, they can only provide feedback on limited elements of prescribing in the health service organisation and may not consistently reflect practice within a unit or hospital. A PPS is usually carried out at a single site on a single day. Electronic prescribing and routine data linkage are not available in most healthcare settings and so PPS have become a key approach to planning and assessing the impact of AMS interventions. Local PPS are recommended, ideally as part of a coordinated PPS across a care setting, and as a tool to assess quality of antimicrobial use. Serial point prevalence studies conducted at regular intervals are a practical method for studying antimicrobial use in the absence of electronic prescribing. They provide organisations with baseline information on current antimicrobial use, from which specific targets for intervention can be identified and evaluated in subsequent audits. Results of PPS should be shared with the executive team and disseminated to specialities who are responsible for developing action plans within their area.

Rationale of PPS

- Identify and monitor prevalence of antimicrobial prescribing.
- Identify differences between prescribing rates between specific departments, hospitals, residential facilities, regions, and countries.
- Determine variation in antimicrobials, dose, and indication across different locations.

Depending on how the PPS is set up and the data collected, there can be wealth of information gathered, such as:

- Have broad or narrow-spectrum antimicrobials been used?
- What are the indications for antimicrobials – community- or hospital-acquired infections, medical or surgical prophylaxis?
- Which antimicrobials are being used for particular infections?
- Are they prescribed in line with local guidelines?
- What is the duration of antimicrobials for surgical prophylaxis?
- Has a clear duration of treatment or stop/review date been recorded?
- Has the treatment been changed in light of microbiology results?
- Has intravenous therapy been switched to oral therapy where appropriate?
- What is the audit time to first dose of antimicrobial in sepsis?

Examples of PPS conducted in Irish healthcare settings include:

- PPS of healthcare associated infections and antimicrobial use in European acute care hospitals. More information including the current protocol can be found on the **ECDC website**
- National annual antimicrobial PPS study in acute hospitals. The results of studies for 2020 and earlier are available on the **HPSC website**. The results and protocols from 2021 onwards will be available at www.antibioticprescribing.ie
- PPS of healthcare associated infection and antimicrobial use in long-term care facilities (HALT). More information including protocols and survey reports can be found on the **ECDC website**
- PPS of antimicrobial use in HSE older persons residential care facilities are also conducted by CHO-based antimicrobial pharmacists. More information, including reports of the findings, can be found on www.antibioticprescribing.ie.

#### 6.3.2.2 Clinical audit and feedback

Use of clinical audit with feedback can be an effective tool to improve the quality of antimicrobial prescribing. The dataset should be kept to a minimum, to facilitate completion of the audit, and only include data that are likely to be acted upon.

Clinical audit allows problem areas to be targeted and enables more intensive examination, leading to further interventions to improve prescribing. Clinical audit should focus on high-risk areas (e.g. intensive care units or emergency department prescribing for outpatients), or on aspects of antimicrobial use, such as global antimicrobial use by selected speciality or service; antimicrobial use for selected conditions (e.g. community-acquired pneumonia or ventilator-associated pneumonia); restricted antimicrobial use; intravenous-to-oral switch; and adherence with therapeutic drug monitoring guidelines.

Clinical audits are also useful for measuring the effects of interventions and driving quality improvement. Measurement for improvement is not focused on judging whether data meet a compliance threshold or target, but as a means to determine whether the changes made to improve practice are effective and to what degree. A quality improvement audit collects data on a small number of subjects, focusing on key measures of quality of prescribing. These audits are usually designed to be simple so that they are easy to repeat periodically in order to document improvement in practices over time and feed into the plan–do–study–act model of quality improvement. Data for improvement measured regularly can be visually displayed with the use of run charts, which can be a useful aid when providing feedback to staff.

Some organisations use clinical audits as the basis of regular antimicrobial rounds, where the AMS team or individuals review either all service users prescribed antimicrobials or, more commonly, service users prescribed restricted agents. A variety of measurements, taken from regular prevalence studies or clinical audits, can act as process indicators for the success of AMS programmes.

##### For hospitals

An example of quarterly assessment of process measures (quality indicators) for a hospital is available on the **HSE website**.

##### For residential care facilities

An example of monthly assessment of process measures (quality indicators) for a residential care facility is included in Appendix 1 of Part A.

##### For primary care

On www.antibioticprescribing.ie, there are examples of audit activities that can be undertaken by primary care practitioners, such as the Preferred Antibiotics Audit Tool. This involves a self-audit of 10 antimicrobial prescriptions and encourages GPs to reflect on their prescribing behaviour relative to current best-practice guidelines.

#### 6.3.2.3 Qualitative and other related measures of programme activity

A qualitative evaluation of the AMS programme can be used to inform the AMS team about how well the programme is operating and to identify further areas for improvement. User acceptance can be measured directly through surveys or questionnaires for healthcare workers; questions might cover awareness of the programme, effectiveness of the interface with the AMS team, and the degree to which the AMS team's advice was considered useful.

Surveys and questionnaires can also provide opportunities for the AMS team to get feedback that can be used to improve the programme. This feedback can also be helpful to assess the perceptions and attitudes of prescribers to AMR in order to assess changes in local culture potentially influenced by the AMS programme.

In conjunction with this feedback, activity of the AMS programme can also be reviewed by assessing the number of guidelines written or reviewed, the number of education sessions delivered, the number of service users reviewed by the AMS team, the rate of acceptance of advice within 24 hours, and the number of audits conducted under the AMS programme each year.

## 6.4 Outcome measures

Although reduction in antimicrobial use and improvement in the quality of antimicrobial use are usually the most easily measured outcomes, by themselves they may not indicate improvements in service user outcomes. Indeed, a range of outcome measures may also need to be monitored. The main categories of outcomes for AMS programmes are as follows.

### 6.4.1 Improved service user outcomes

Indicators of clinical success associated with AMS programmes include reduced infection related mortality, reduced length of stay and improved time to respond to treatment. Given that there are a number of factors that can contribute to service user outcomes, it is not possible to ascribe changes in these parameters solely to AMS programmes. However, process measures that can reliably be related to improvements in outcomes may be more readily measured by health service organisations (e.g. surgical antibiotic prophylaxis duration) and may be used as surrogates for outcome measures.

### 6.4.2 Improved patient safety

Improvements in safety can be measured by surveillance of adverse events associated with antimicrobial use. For example, a reduction in *C. difficile* infection has been a notable outcome of some AMS programmes in hospitals, as this infection is directly related to overall antimicrobial use and the use of certain broad spectrum agents. *C. difficile* infection rates can also be reduced by implementing stricter infection control strategies; a number of studies have demonstrated that a combination of improving infection control precautions and reducing overall antimicrobial use can reduce the incidence of nosocomial *C. difficile* infections. Qualitative analysis of individual cases of *C. difficile* can be used for feedback to prescribers on antimicrobial prescribing that may have contributed to the development of these infections. Other indicators of improved patient safety are lower mortality associated with appropriate administration of empiric antimicrobial therapy and fewer antimicrobial adverse events. An example of the latter may be fewer cases of vancomycin-induced nephrotoxicity if appropriate dosing and therapeutic drug monitoring are used within an AMS programme. Similarly, fewer episodes of hypersensitivity reactions to penicillin, given to service users with documented penicillin allergies, may be expected if the workforce is appropriately educated to recognise those antimicrobials that are classified as penicillins. Likewise, there may be less unnecessary use of broad spectrum or toxic antimicrobials if reported penicillin allergy is critically assessed rather that accepted at face value.

### 6.4.3 Reduced antimicrobial resistance

AMS programmes aim to address the increase in AMR in healthcare. Reductions in resistance have been difficult to measure and ascribe directly to an AMS programme because the causes of resistance are complex and often outside the control of hospital or community programmes. However, there is increasing evidence indicating that AMS activities can contribute to a decrease in AMR. Monitoring changes in resistance through an annual cumulative antibiogram is a useful mechanism for this.

### 6.4.4 Reduced costs

Economic outcomes are an important aspect to consider; however, they should not be the main stimulus for establishing such a programme. A baseline measurement at the outset of a new programme will allow changes to be monitored over time. If reduced system costs can be demonstrated following the introduction of an AMS programme, managers are able to see the tangible benefits of investment and may be prepared to resource further improvements. AMS programmes are ultimately cost saving for an organisation. Early in the programme, cost savings can be clearly demonstrable from direct antimicrobial agent savings. However, as a programme matures, these direct savings stabilise and the savings are made by preventing *C. difficile* infection; stability or improvements in rates of AMR; better cure rates for service users with infections; and fewer infections due to more appropriate surgical prophylactic antimicrobial use. Demonstrating the ongoing cost effectiveness of an AMS programme at this stage can be challenging; however, experience indicates that when AMS is not consistently supported prescribing practice tends to revert to practices associated with poorer outcomes and higher costs. Savings may be demonstrated through measures such as early intravenous-to-oral switching, reduced length of stay, and reduced adverse events.

A HIQA report (2021) estimated the economic burden of AMR on acute hospital settings through a broad range of methodologies. It highlighted that the financial cost of treating resistant infections places a significant burden on society, as service users infected with drug-resistant microorganisms are more likely to remain in hospital for a longer period of time, to have poorer outcomes, and to be unable to work. The societal costs of AMR are particularly challenging to estimate, but are likely to be substantial in the future as the rate of AMR grows globally.

## 6.5 Balancing measures

As well as measuring improvements in patient safety, AMS teams should be alert to the potential unintended consequences of AMS interventions. Changes in prescribing guidelines can have unexpected outcomes. For example, Bell *et al*. (2014) described an increase in the rate of acute kidney injury following a change in prophylactic guidelines from cephalosporins to gentamicin in orthopaedic surgery. Additionally, changes in prescribing as a result of an AMS intervention may create new selective pressures on microbial flora, causing potentially new clinical problems, such as the emergence of new multidrug resistant strains or the re-emergence of infections previously uncommon. When one antimicrobial is restricted and replaced with another, the reduction in resistance to the first class of antimicrobial may be ‘balanced out’ by increasing resistance to the second class (known as the ‘squeezing the balloon’ effect).

Therefore, it is important to consider that AMS interventions do not cause unintended consequences, such as increased mortality and morbidity – for example, higher complication rates, adverse drug events, and higher rates of infection-related readmission. These can be monitored by collecting data on balancing measures such as those listed in Table 6.1.

## 6.6 Frequency, reporting, and feedback of measures

It is critical that the results of any audit or PPS are fed back to the prescribers. Prescribers need ward level or unit level feedback on their performance, ideally relative to other units and wards within the organisation, or relative to other organisations. Feedback should be actionable. Auditors need to identify the two or three key messages to feed back to prescribers that would improve prescribing and include those messages in their report. Presenting locally derived, meaningful data to small groups of prescribers (e.g. at departmental meetings) is likely to be more successful than emailing formal reports. The use of dashboards and control charts to display information can be useful; however, several strategies are likely to be necessary to disseminate and communicate the data. The findings of the audits should prompt discussion and follow-up actions as soon after the audit as possible.

Key antimicrobial use data at the organisation level, or broken into ward or division information, should be reported at least quarterly to the executive, divisions or directorates, and specific clinical units (e.g. intensive care, transplant, oncology, haematology). The data, along with results of prevalence studies and quality improvement audits, should also be tabled for discussion at meetings of the drug and therapeutics committee, the IPC committee, and the AMS committee. These data, along with information on practice improvement initiatives, should be summarised and published in the form of an AMS annual report. Antimicrobial prescribing data, infection control data, and AMR data should be interpreted together to identify and prioritise areas for improvement; to establish a work plan for the following year, promoting a culture of continuous monitoring, audit, and improvement; and to measure the success of AMS interventions and IPC strategies.

## References

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# 7.0 Appendices

## Appendix 1: Example of monthly assessment of process measures (quality indicators) for a residential care facility: HCAI/AMR and antimicrobial consumption minimum dataset

| Monthly HCAI/AMR minimum dataset | | |
|---|---|---|
| 1 | Name of ward/unit | |
| 2 | Month of data collection | |
| 3 | Number of residents in the ward/unit today | |
| 4 | Number of residents in the ward/unit today that are long -term residents (30 days or more ) | |
| 5 | Number of residents who have urinary catheters today | |
| 6 | Overall number of residents on antibiotics by mouth or by injection in the past 24 hours | |
| 7 | Of the residents on antibiotics by mouth or injection, state the number of prophylactic antibiotics | |
| 8 | Number of residents on antibiotics by creams/drops/ointment in the past 24 hours | |
| 9 | Number of residents newly diagnosed with *Clostridioides difficile* infection* in this reporting period | |
| 10 | Number of residents colonised or infected with Carbapenemase Producing Enterobacterales* (CPE) who were resident for any period of a day or more during this reporting period | |
| 11 | Number of outbreaks* that occurred during this reporting period | |
| 12 | Type of outbreak (if applicable): | |
| | ☐ Acute infectious gastroenteritis (unspecified)<br>☐ Acute respiratory infection (unspecified<br>☐ Campylobacter<br>☐ CPE infection or colonisation<br>☐ *C. diff* infection<br>☐ COVID-19<br>☐ Influenza | ☐ Multi-drug resistant organism other than CPE. Please specify.<br>☐ Norovirus<br>☐ Rotavirus<br>☐ Salmonella<br>☐ Scabies<br>☐ Other outbreak. Please specify. |

AMR: antimicrobial resistance; CPE: Carbapenemase-Producing Enterobacterales; HCAI: healthcare associated infection

* All suspected/confirmed outbreaks of infection and cases of infectious disease must be notified as usual to the local Department of Public Health (Infectious Disease Regulations 1981 and subsequent amendments) and to HIQA (as specified in the Health Act 2007 for designated centres for older people).

# **Appendix 2:** AMS education resources and tools

| Online education | |
|---|---|
| **Ireland's One Health National Action Plan on Antimicrobial Resistance 2021–2025** (known as iNAP2) | Access to current iNAP2 online and in print where required by healthcare workers. |
| **HSE AMRIC Action Plan 2022–2025** | Access to AMRIC action plan online and in print where required by healthcare workers. |
| **HSeLanD**<br>The HSE's online learning and development portal (available across all healthcare settings, HSE and non-HSE) | A number of AMRIC e-learning modules on HSeLanD can support AMS education. Of particular relevance are the following modules:<br>• Antimicrobial Stewardship in Practice<br>• Prevention and Management of Urinary Tract Infection<br>• Surgical Antibiotic Prophylaxis<br>• *Clostridioides difficile* Infection: IPC and AMS Principles, Prevention and Management<br>Other e-learning modules which support AMS:<br>• Introduction to Sepsis Management for Adults including Maternity |
| **Scottish Antimicrobial Prescribing Group (SAPG) with NHS Education for Scotland** | It provides resources and supports for continuous professional development in hospital and community. |
| **FutureLearn** | It offers a broad range of courses in areas including AMS in hospital and primary care and utilising social science and behaviour change in AMS programmes. |
| **NPS MedicineWise**<br>An Australian website promoting safe and wise use of all medicines including antimicrobials | Antimicrobial resources available include online learning modules, case studies, clinical e-audits, and medicines use reviews. |
| **WHO Essential Medicines List Antibiotic Book** | This publication provides guidance on choice of antimicrobial, dose, route of administration, and duration of treatment for common infectious syndromes in alignment with the recommendations for antimicrobials included on the WHO Model List of Essential Medicines, the WHO Model List of Essential Medicines for Children, and the WHO AWaRe (Access-Watch-Reserve) classification of antibiotics (note in draft format at time of publication). |
| **Royal College of Physicians of Ireland** offers courses relating to clinical practice | Two courses supporting AMS containing overview, interactive presentation, and a number of clinical cases:<br>• Principles of Antibiotic Use for General Internal Medicine<br>• Principles of Antibiotic Use for Obstetrics and Gynaecology |

| AMS curricula and competencies | |
|---|---|
| **ESCMID Generic Competencies in Antimicrobial Stewardship and Prescribing** | It contains a set of generic competencies in antimicrobial prescribing and stewardship, which is the result of a structured consensus procedure including a multidisciplinary expert panel from 24 European countries; intended to be relevant for all independent prescribers in Europe |
| **Healthcare Workers' Education and Training on Antimicrobial Resistance:** Curricula Guide | This is an evidence-based learning framework for AMR education and training developed by the WHO, in collaboration with Public Health England; a curricula guide for educators of health professionals and other allied health-related disciplines |
| **UK Department of Health and Public Health England Antimicrobial Prescribing and Stewardship Competencies** | It contains five key antimicrobial prescribing and stewardship competencies that can be used by any independent prescriber to help develop their prescribing practice at any point in their professional development |

AMR: antimicrobial resistance; AMRIC: antimicrobial resistance and infection control; AMS: antimicrobial stewardship; ESCMID: European Society of Clinical Microbiology and Infectious Diseases; HSE: Health Service Executive; IPC: infection prevention and control; NPS: National Prescribing Service; UK: United Kingdom; WHO: World Health Organization

# **Appendix 3:** Antimicrobial stewardship specialist education resources and tools

| | |
|---|---|
| **ACSQHC**<br>Antimicrobial Stewardship in Australian Health Care 2018 | Antimicrobial Stewardship in Australian Health Care was initially published in 2018 and continues to be updated to provide evidence and information to inform AMS strategies and interventions and their implementation across a range of settings. |
| **IDSA/SHEA**<br>Implementing an Antibiotic Stewardship Program: Guidelines by the Infectious Diseases Society of America and the Society for Healthcare Epidemiology of America | These evidence based guidelines for implementation and measurement of antimicrobial stewardship interventions in inpatient populations, including long-term care, were prepared by a multidisciplinary expert panel of the Infectious Diseases Society of America and the Society for Healthcare Epidemiology of America. |
| **National Institute for Health and Care Excellence (NICE)**<br>Antimicrobial stewardship: systems and processes for effective antimicrobial medicine use | This guideline provides good practice recommendations on systems and processes for effective use of antimicrobials. |
| **British Society for Antimicrobial Chemotherapy (BSAC)** | Many educational resources are available, including the e-book: Antimicrobial Stewardship: From Principles to Practice. |
| **European Society of Clinical Microbiology and Infectious Diseases (ESCMID)**<br>Developing core elements and checklist items for global hospital antimicrobial stewardship programmes: a consensus approach | This is an ESCMID position paper on consensus core elements for hospital AMS programmes. |
| **Cochrane Library**<br>Interventions to improve antibiotic prescribing practices for hospital inpatients | This Cochrane review estimated the effectiveness and safety of interventions to improve antimicrobial prescribing to hospital inpatients and investigated the effect of two intervention functions: restriction and enablement. |
| **CDC/ECDC**<br>Transatlantic Taskforce on Antimicrobial Resistance set of core and supplementary structure and process indicators for hospital AMS programmes | This is a set of core and supplementary structure and process indicators for hospital AMS programmes, which could be adopted and used by health service organisations to assess whether they have the infrastructure and activities to support AMS. |
| **CDC**<br>Core Elements of Antibiotic Stewardship | CDC's Core Elements of Antibiotic Stewardship offer providers and facilities a set of key principles to guide efforts to improve antimicrobial use and therefore advance patient safety and improve outcomes. Resources include:<br>• Core elements of hospital AMS programmes<br>• Core elements of outpatient antibiotic stewardship<br>• Core elements of antibiotic stewardship for nursing homes<br>• Checklists and AMS programme assessment tools |

| | |
|---|---|
| **South Australia (SA) Health**<br>AMS Self-Evaluation Toolkit | This self-assessment tool enables health facilities to monitor improvements in effectiveness of their AMS programme. The tool can be modified by the user to suit small or large hospitals. |
| **Society of Infectious Diseases (SIDP)**<br>AMS Certificate Programs | The SIDP offers a number of programmes that provide education on the pharmacist's role in the appropriate use of antimicrobial agents. Of particular relevance are the following certificates:<br>• SIDP Antimicrobial Stewardship Certificate Program for Acute Care<br>• SIDP Long-Term Care (LTC) Antimicrobial Stewardship Certificate Program |
| **European Society of Clinical Microbiology and Infectious Diseases (ESCMID) AMS Certificate** | ESCMID provides a European level competency in AMS through a two-year training programme addressing basic and advanced aspects of AMS. |

ACSQHC: Australian Commission on Safety and Quality in Health Care; AMS: antimicrobial stewardship; CDC: Centers for Disease Control and Prevention; ECDC: European Centre for Disease Prevention and Control; ESCMID: European Society of Clinical Microbiology and Infectious Diseases; IDSA: Infectious Diseases Society of America; SHEA: Society for Healthcare Epidemiology of America; SIDP: Society of Infectious Diseases

# **Appendix 4:** Guidance development and approval process

Members of the Antimicrobial Stewardship Guidance Working Group completed literature searches and drafted all guidance content. The members of this working group do not have any conflicts of interest to declare in the development of this guidance development.

Members of the HSE Antimicrobial Stewardship Advisory Group provided extensive input, review and feedback of each chapter as it was finalised by the working group. This guidance was approved for use in the HSE by the AMRIC Oversight group. Memberships of these groups are detailed in the tables below.

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# Antimicrobial Stewardship Guideline for All Healthcare Settings

**Is this document a:**

**Policy** [ ] **Procedure** [ ] **Protocol** [ ] **Guideline** [x]

*Insert Service Name(s), Directorate and applicable Location(s):*

| | |
|---|---|
| **Title of PPPG Development Group:** | Antimicrobial Resistance and Infection Control (AMRIC) Implementation Team |
| **Approved by:** | AMRIC Oversight |
| **Reference number:** | 2022-01 |
| **Version number:** | Version 1 |
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| **Electronic location:** | www.antiboticprescribing.ie |

| Version | Date approved | List section numbers changed | Author |
|---|---|---|---|
| 1 | April 2022 | | AMRIC |
| | | | |
| | | | |
| | | | |

# Part B: Outline of PPPG Steps

## 1.0 Initiation

### 1.1 Purpose

The purpose of antimicrobial stewardship is:

- To support delivery of the right antimicrobial, at the right time, dose, and duration to meet service users' needs
- To protect service users from avoidable harm related to inappropriate antimicrobial use
- To safeguard antimicrobials for the future.

The purpose of this guidance is to provide support to healthcare facility managers, AMS teams, and individual healthcare workers to achieve that wider purpose and to engage the participation of service users and the public. The guidance does this by providing the evidence, expert guidance, and tools needed to initiate and sustain AMS programmes and work.

### 1.2 Scope

#### Target users

This guidance is intended for use by all healthcare workers, members of AMS teams, and healthcare facility management in the Irish healthcare system.

#### Populations to whom it applies

This guidance applies to the whole population receiving healthcare in acute and community settings, including adults, babies, and children. The guidance does not specifically address antiviral stewardship; however, the principles of stewardship that apply in general also apply to antiviral agents.

### 1.3 Objectives

The objectives are to achieve the best possible service user outcomes by optimising the use of antimicrobials in the Irish healthcare system and to limit the emergence and spread of antimicrobial resistance.

### 1.4 Outcomes

- Provided guidance for a coordinated system-wide approach for antimicrobial stewardship in human health.
- Reduced healthcare associated infection and of harm related to healthcare associated infection as a result of suboptimal antimicrobial use (National Service Plan key performance indicator).
- Reduced antimicrobial consumption towards the lowest level required to meet service user needs (community and acute consumption in line with AMRIC Action Plan outcome measure).
- Increased compliance with surgical antibiotic prophylaxis duration position statement (in line with AMRIC Action Plan outcome measure).
- Increased awareness and understanding of AMR (in line with AMRIC Action Plan outcome measure).

## 1.5 PPPG Development Group

**Antimicrobial Resistance and Infection Control Oversight Group**

A stakeholder engagement and consultation process was undertaken to inform this guidance document.

See Part A, Appendix 4 for Membership of the Guidance Development Group.

See Part B Appendix I for stakeholder engagements and consultations that were undertaken.

## 1.6 PPPG Governance Group

See Part A, Appendix 4 for Membership of the Approval Governance Group.

## 1.7 Supporting evidence

This guidance will replace the Guidelines for Antimicrobial Stewardship in Hospitals in Ireland (2009).

The requirement for antimicrobial stewardship in both acute hospitals and the community is detailed in the HIQA National Standards for the prevention and control of healthcare- associated infections in acute healthcare services (2017) and the HIQA National Standards for infection prevention and control in community services (2018), respectively.

The following key AMS reference sources have been referred to extensively in producing this guidance:

Australian Commission on Safety and Quality in Health Care (ACSQHC) (2018) *Antimicrobial stewardship in Australian health care 2018*. Sydney: ACSQHC.
https://www.safetyandquality.gov.au/sites/default/files/migrated/AMSAH-Book-WEB-COMPLETE.pdf

Barlam TF, Cosgrove SE, Abbo LM, MacDougall C, Schuetz AN, Septimus EJ, *et al*. (2016) Implementing an antibiotic stewardship program: guidelines by the Infectious Diseases Society of America and the Society for Healthcare Epidemiology of America. *Clin Infect Dis*, 62(10): e51–77.

British Society for Antimicrobial Chemotherapy (BSAC) (2018) *Antimicrobial stewardship: from principles to practice [e-book]*. Birmingham: BSAC.
https://bsac.org.uk/antimicrobial-stewardship-from-principles-to-practice-e-book/

Centers for Disease Control and Prevention (CDC) (2021) Core elements of antibiotic stewardship [published in different settings][Online]. Atlanta, GA: CDC.
https://www.cdc.gov/antibiotic-use/core-elements/index.html

Davey P, Marwick CA, Scott CL, Charani E, McNeil K, Brown E, *et al*. (2017) Interventions to improve antibiotic prescribing practices for hospital inpatients. *Cochrane Database Syst Rev, 2*(2): CD003543.

Department of Health (DOH) and Department of Agriculture, Food and the Marine (DAFM) (2021) *Ireland's Second One Health National Action Plan on Antimicrobial Resistance 2021–2025* [known as iNAP2]. Dublin: Government of Ireland.
https://www.gov.ie/en/publication/d72f1-joint-action-on-antimicrobial-resistance/

Health Information and Quality Authority (HIQA) (2016) *Report of the review of antimicrobial stewardship in public acute hospitals*. Dublin: HIQA.
https://www.hiqa.ie/sites/default/files/2017-01/Antimicrobial-Stewardship-Review.pdf.

Health Service Executive (HSE) (2021) HSE *Antimicrobial Resistance Infection Control (AMRIC) action plan 2022–2025*. Dublin: HIQA.
https://bit.ly/3nWROS7

National Institute for Health and Care Excellence (NICE) (2015) *Antimicrobial stewardship: systems and processes for effective antimicrobial medicine use*. London: NICE.
www.nice.org.uk/guidance/ng15

Pulcini C, Binda F, Lamkang AS, Trett A, Charani E, Goff DA, *et al*. (2019) Developing core elements and checklist items for global hospital antimicrobial stewardship programmes: a consensus approach. *Clin Microbiol Infect*, 25(1): 20–25.

SARI Hospital Antimicrobial Stewardship Working Group (2009) *Guidelines for antimicrobial stewardship in hospitals in Ireland*. Dublin: Health Protection Surveillance Centre.
https://www.hpsc.ie/a-z/microbiologyantimicrobialresistance/infectioncontrolandhai/guidelines/File,4116,en.pdf

World Health Organization (WHO) (2021) *Antimicrobial stewardship interventions: a practical guide*. Copenhagen: WHO Regional Office for Europe.
https://apps.who.int/iris/bitstream/handle/10665/340709/9789289054980-eng.pdf

## 2.0 Development of PPPG

Since the previous AMS guidelines were issued in 2009, a much greater appreciation has developed of the value of formal AMS programmes to all healthcare settings. The Department of Health (DOH) published Ireland's National Action Plan for Antimicrobial Resistance (iNAP) in 2017 and the second iNAP in 2021. The Department has also supported the HSE in providing additional capacity for AMS in community and acute healthcare settings. In the context of these changes and learning in Ireland and elsewhere in the past decade, there was a requirement for an update to the 2009 guidelines.

The National Project Team undertook an extensive literature review. The objective of the literature review was to establish current evidence and best practice and to seek new and emerging evidence in relation to AMS.

## 3.0 Governance and approval

AMRIC Implementation Team

AMRIC Oversight Group
See Part A, Appendix 4 for Membership of the Approval Governance Group.

## 4.0 Communication and dissemination

This guidance is circulated through HSE Acute and Community Operations to all hospital chief executive officers, chief officers, head of services, general managers, consultant microbiologists, consultants in infection diseases, chief pharmacists, and antimicrobial pharmacists for dissemination to relevant healthcare staff.

The guidance has been made available to higher educational institutes and relevant professional groups.

The guidance is also available using the following link: www.antibioticprescribing.ie

## 5.0 Implementation

Implementation of this guidance is a shared responsibility to which every healthcare worker should contribute, in particular those who prescribe, dispense, or administer antimicrobials. The leaders in implementation of the guidance are the Hospital Group chief executive officers, hospital managers and chief clinical directors, community operations chief officers, heads of services, general managers, consultant microbiologists, consultants in infectious diseases, GP practice principals, chief pharmacists, and antimicrobial pharmacists.

The recommendations included in this guidance are designed for all healthcare settings in Ireland and should be implemented in parallel with national IPC guidance and local infection and control programmes. Implementation should be aligned to medication safety programmes.

This guidance outlines core elements of AMS programmes which are effective, and which are relevant across all settings. These elements may be applied quite differently in acute settings compared with community settings. Their application may also vary, depending on local resources available. It may not be possible to implement every AMS intervention in every healthcare setting. Indeed, not every intervention may be appropriate to every setting. AMS teams are encouraged to consider each core element and how it could be applied in their setting. They should seek to implement as many of the recommendations included as possible and as are relevant to their setting.

Resources and supports will be continually developed subsequent to this guidance to support its implementation and will be made available on www.antibioticprescribing.ie

## 6.0 Monitoring, audit and evaluation

See Chapter 6 on measuring performance of AMS and use of data for quality improvement.

## 7.0 Revision/update

**AMRIC Implementation Team**

Date for revision: 2025

## 8.0 References

See Part A for key references. Specific references are provided at the end of each chapter.

# 9.0 Appendices

## Appendix I: Stakeholder engagements and consultations that were undertaken

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|---|
| Antimicrobial Resistance and Infection Control Oversight Group |
| Antimicrobial Resistance and Infection Control Implementation Team |
| Antimicrobial Stewardship Advisory Group |
| ePharmacy Group of the Office of the Chief Information Officer |
| Higher Education Institutions |
| HSE Acute Operations |
| HSE Community Operations |
| Irish College of General Practitioners |
| Irish Dental Association (IDA) |
| Irish Institute of Pharmacy |
| Nursing and Midwifery Board of Ireland |
| Nursing and Midwifery Planning and Development Unit |
| Office of the Nursing and Midwifery Services Director |
| Royal College of Physicians of Ireland |
| Royal College of Surgeons of Ireland |

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