

Antimicrobial Stewardship Adherence and Resistant Pathogens in a High Dependency Unit

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Abstract

Aims

To evaluate antimicrobial prescribing adherence to local guidelines, implementation of microbiology recommendations, and documentation and execution of escalation plans in a tertiary hospital High Dependency Unit (HDU).

Methods

A concurrent audit was conducted on a random sample of 50 adult HDU patients who received antimicrobial therapy, excluding those stepped down from Intensive Care. The HDU functions as an open unit, with antimicrobial suggestions made by both the core HDU multidisciplinary team (MDT) and prescriptions by visiting specialty teams. Data collected included patient demographics, antimicrobial prescriptions, adherence to local guidelines, microbiology multidisciplinary team (MDT) input and implementation, and escalation plan documentation.

Results

Of the 50 patients included, 28 (56%) were medical, 15 (30%) surgical, and 7 (14%) had mixed admissions. Antimicrobial prescriptions were fully guideline-adherent in 15 cases (30%), partially adherent in 15 (30%), and non-adherent in 11 (22%). In 9 cases (18%), no local guidelines were identified, and prescribing was based on microbiology advice. A total of 33 patients (66%) received input from the Microbiology multidisciplinary team, generating 50 recommendations. Of this subgroup of 33 patients, 28 (56%) were fully implemented, 4 (8%) partially implemented, and 1 (2%) not implemented. A history of infection or colonisation with resistant organisms were isolated in 7 patients (14%), including 2 cases each of carbapenemase-producing Enterobacterales (CPE), extended-spectrum β -lactamase producers (ESBL), methicillin-resistant *Staphylococcus aureus*

(MRSA), and 4 cases of vancomycin-resistant *Enterococcus* (VRE). Of the 10 microbiology-issued escalation plans, 6 (60%) were enforced during clinical deterioration.

Discussion

Antimicrobial guideline adherence in the HDU was suboptimal, but microbiology recommendations were largely accepted. Regular microbiology rounds, prescriber education, and targeted surveillance would enhance antimicrobial stewardship and patient safety in critical care.

Introduction

Antimicrobial resistance (AMR) is recognised as one of the most serious global public health threats in the world today. In 2021, an estimated 4.71 million deaths were associated with bacterial AMR, including 1.14 million deaths attributable to bacterial AMR¹. In particular, resistance in key pathogens such as *Escherichia coli*, *Klebsiella pneumoniae*, *Staphylococcus aureus*, and *Pseudomonas aeruginosa*, pathogens commonly encountered in critical care, accounts for a substantial proportion of this burden². Such data underscore the importance of optimising antimicrobial use, especially in high-risk hospital areas where AMR can spread rapidly and cause significant mortality.

This study was conducted in a tertiary hospital serving the Mid-West region of Ireland, with 535 inpatient beds. The adult High Dependency Unit (HDU) comprises 16 beds, providing level 2 critical care units for patients with either single-organ failure or with a requirement for invasive and/or regular clinical monitoring that exceeds the scope of level 1 units, according to the National Standards for Adult Critical Care Services published by the Joint Faculty of Intensive Care Medicine of Ireland³. Patients requiring invasive mechanical ventilation or other level 3 critical care interventions are transferred to the ICU for ongoing care. Unlike ICU patients where prescribing is intensivist led, in our HDU patients remain under the care of primary medical or surgical teams, supported by microbiology and critical care input. This dynamic creates opportunities for variability in antimicrobial prescribing and stewardship adherence.

According to the “Antimicrobial Stewardship” (AMS) document published by the Health Service Executive (HSE) Ireland, it is recommended that AMS team advice and microbiology input be treated as expert guidance to be integrated into patient care⁴. This includes regular ward rounds in high-risk areas (e.g. ICU and HDU) and a multi-disciplinary prescription review with point-of-care intervention and feedback on AMS ward rounds. These inputs are a valuable tool in the provision of specialised advice to prescribers and other healthcare workers on the ongoing management of service users’ antimicrobial therapy. Additionally, the recommendations extend to include in-depth audit and feedback of data collected on

antimicrobial prescribing, which 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.

To date, there is limited published data on adherence to AMS guidelines or microbiology advice in HDUs in Ireland, whereby there is a significant gap, particularly in light of the rising AMR burden across Europe. This study addresses that gap by focusing specifically on HDUs, a critical care setting that is often overlooked in AMS research.

This audit aimed to assess three key areas of clinical practice within the HDU. Firstly, it evaluated whether antimicrobial prescriptions adhered to local hospital antimicrobial guidelines. Secondly, it examined whether microbiology recommendations were implemented by the primary clinical teams. Finally, it assessed whether escalation plans for clinical deterioration were both documented and appropriately followed.

Methods

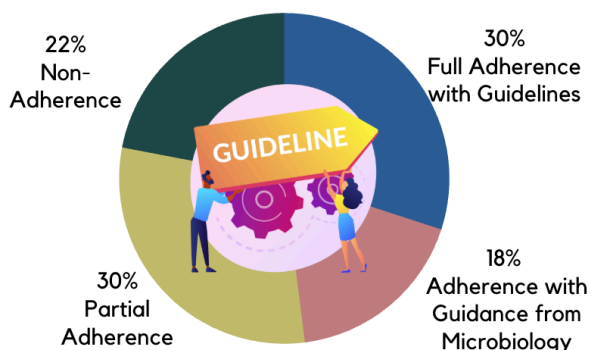
A concurrent audit was conducted on a random sample of 50 adult patients admitted to the HDU who received antimicrobial therapy for suspected or confirmed infection. Patients who had been stepped down from the ICU were excluded, as their antimicrobial prescribing is primarily intensivist-led and does not reflect the prescribing practices of the primary medical or surgical teams, which were the focus of this audit. Patients prescribed antimicrobial prophylaxis only were also excluded. The HDU functions as an open unit, with antimicrobial prescriptions made by both the core HDU multidisciplinary team (MDT) and visiting specialty teams. Microbiology MDT recommendations were communicated to the primary clinical teams through written documentation in patients' clinical notes immediately following daily MDT meetings. Data were captured from a combination of paper medical records, prescribing kardexes, and electronic microbiology information systems. Data collected included basic patient demographics, antimicrobials prescribed during the HDU stay, the infective diagnosis (where known), and whether prescribing adhered to local antimicrobial guidelines based on the suspected or confirmed infection. In addition, MDT recommendations were reviewed, along with documentation of whether these recommendations were implemented by the primary team. The audit also assessed whether escalation plans for clinical deterioration were documented, whether they were implemented when needed, and whether non-escalation decisions were clearly recorded. Data on resistant organisms were obtained from prior microbiology records, reflecting historical colonisation or infection status rather than new acquisitions during the HDU admission.

Results

Table 1: Patient Demographics and Characteristics

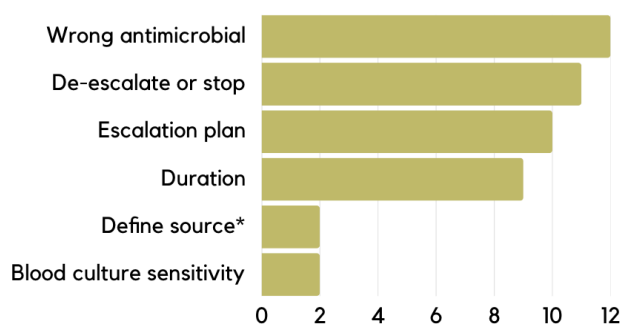
Category	Details	
Number of patients	50	
Average HDU stay	4.4 days	
Age range	19 – 90 years	
Patient type	56% medical 30% surgical 14% mixed	
Admission source	58% Emergency Department 24% Post-operative 18% Ward transfers	
Resistant organism	2	Carbapenemase-producing Enterobacterales (CPE)
	2	Extended-Spectrum Beta-Lactamase (ESBL)
	2	Methicillin-Resistant Staphylococcus Aureus (MRSA)
	4	Vancomycin-Resistant Enterococcus (VRE)
Site of infection	28	Respiratory (community acquired)
	2	Respiratory (hospital acquired)
	2	Respiratory (aspiration)
	2	Urinary tract
	13	Intra-abdominal
	2	Skin (cellulitis)
	2	Neurological

Figure 1: Adherence to Guidelines



Of the 50 patients, antimicrobial prescriptions fully adhered to local guidelines in 30% of cases. A further 30% demonstrated partial adherence, most commonly involving correct antimicrobial choice but incorrect duration. In 18% of cases, there were no applicable local guidelines, and prescribing followed recommendations provided by the microbiology team. The remaining 22% of prescriptions were classified as non-adherent to either local guidelines or microbiology advice.

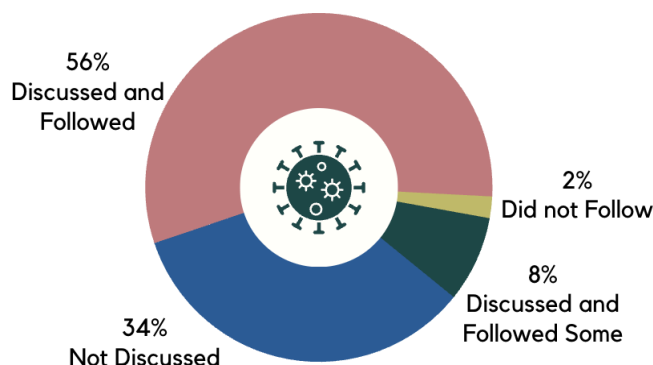
Figure 2: Microbiology MDT Advice



Microbiology MDT involvement was documented for 33 patients. Across these cases, a total of 50 recommendations were issued. These included twelve changes to inappropriate antimicrobial agents, most commonly due to lack of activity against the identified pathogen or deviation from guideline-recommended first-line therapy. Furthermore, nine modifications to treatment duration, to shorten the planned duration of therapy where the course exceeded the clinical indication. Two recommendations for targeted source control, and two suggestions for targeted antimicrobial therapy based on culture results.

Additionally, ten escalation plans were provided for use in the event of clinical deterioration, and eleven recommendations advised either de-escalation or discontinuation of antimicrobials.

Figure 3: Implementation of Microbiology Advice



Of the 33 patients (66%) that received input from the Microbiology multidisciplinary team, generating 50 recommendations, this subgroup had 28 recommendations (56%) fully implemented, 4 (8%) partially implemented, and 1 (2%) not implemented. The remaining 34% of this subgroup patients had no microbiology input, typically because the initial antimicrobial prescribing was already guideline-adherent. Of the ten patients for whom microbiology provided specific escalation plans for clinical deterioration, six had those plans appropriately enacted when deterioration occurred.

These findings indicate discrepancies between initial antimicrobial prescribing and hospital guidelines in the HDU setting in our centre. Over half of initial prescriptions (52%) were not fully adherent to local protocols prior to microbiology advice, although a further half of that subgroup demonstrated partial adherence, most commonly involving correct antimicrobial choice but incorrect duration. This highlights the need for continuous AMS input. Importantly, most expert recommendations and escalation plans were accepted by the primary teams. This underscores the value of a multidisciplinary approach between AMS, microbiology, critical care, and primary clinical teams, particularly in a complex environment like the HDU.

In terms of site of infection, a majority of 32 of 51 were respiratory infections (63%), predominantly community-acquired. Two of these cases were treated for hospital-acquired pneumonia and a further two were aspiration pneumonia. This was followed by intra-abdominal infections (13/50, 26%), urinary tract infections (2/50, 4%), skin and soft-tissue infections (2/50, 4%), and neurological infections (2/50, 4%). This distribution illustrates the

typical HDU caseload. Of note, one patient had concurrent respiratory and urinary tract infections, bringing the total number of infection sites to 51 across 50 patients.

Discussion

This audit highlights significant opportunities to optimise antimicrobial prescribing in the HDU. Only 30% of prescriptions were fully guideline-adherent, with a further 30% partially adherent, and 22% non-adherent. Despite this, the audit observed a fairly high uptake of microbiology recommendations – 56% fully accepted and 8% partially accepted. This reflects international evidence that collaborative AMS processes improve prescribing and patient outcomes⁵. However, duration of therapy errors and suboptimal implementation of escalation plans remain priority areas for improvement.

Notably, the European AMR burden study showed that AMR is driving a significant mortality burden across Europe, with 195,000 deaths associated with AMR bloodstream infections alone in 2019⁵. This stresses the need for targeted local action to complement regional efforts.

With regards to resistant organisms, 14% (7/50) of HDU patients had a documented history of infection or colonization with resistant organisms, identified from previous microbiology results. Of these, two patients had two resistant organisms detected. These data reflect the baseline AMR risk profile of HDU admissions rather than new acquisitions during the audit period, emphasising the vulnerability of HDU patients and the risk of AMR transmission in such settings. These are priority pathogens identified by the WHO and EU due to their high resistance potential and role in hospital-acquired infections^{6,7}.

Four out of these six pathogens were observed in this audit. This identification is especially important given alarming European Union (EU) trends: CPE bloodstream infections increased by 57.5% between 2019 and 2023⁸. VRE also showed a significantly increasing trend in Europe. This reinforces the need for stringent AMS in the HDU.

Compared with studies in ICU settings, where prescribing tends to be more protocol-driven and intensivist-led, our findings reflect the unique challenges of the HDU environment. The responsibility for antimicrobial prescribing lies with primary teams who may have variable levels of experience or familiarity with AMS principles. This distinction reinforces the need for structured AMS support within mixed or open HDUs, including regular microbiology rounds, feedback loops, and enhanced education for prescribers.

A strength of this audit is its real-time concurrent data collection, which likely improved the accuracy of prescribing documentation and implementation tracking. Another strength is the exclusion of prophylaxis-only cases, which ensured that all antimicrobial prescriptions

evaluated reflected therapeutic use for suspected or confirmed infection. However, several limitations must be acknowledged. The sample size was relatively small, and drawn from a single institution, which may limit generalisability. Additionally, the classification of guideline adherence and implementation may have been subject to interpretation, despite efforts to use objective criteria. Resistance data were derived from prior microbiology records, which may not represent active infection during the HDU admission but rather previous infection or colonisation status. Furthermore, detailed data on device association were not systematically collected, which limits stratified interpretation of infection-related prescribing patterns.

Overall, this audit identifies key opportunities for improving antimicrobial prescribing in the HDU through enhanced AMS collaboration, improved documentation of escalation plans, and continued education of prescribing teams. Given the growing threat of antimicrobial resistance and the vulnerable nature of HDU patients, these findings support the implementation of more robust stewardship processes in intermediate critical care settings.

Based on these findings, several recommendations can be made to improve antimicrobial stewardship within the HDU setting. Better documentation and timely implementation of escalation plans for clinical deterioration should be encouraged, especially in a high-risk population. On the other hand, they may not fully address the underlying reasons for suboptimal guideline adherence observed in this audit. In an open HDU model, prescribing decisions are dispersed across multiple clinical teams, creating variability in stewardship standards. Transitioning toward a more closed model might improve consistency but require additional staffing and governance support. Furthermore, interventions that address human factors such as cognitive bias, professional autonomy, and limited accountability for antimicrobial decisions may be necessary. Educational initiatives combined with feedback and peer review could help bridge this behavioural gap.

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Declarations of Conflicts of Interest:

None declared.

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