Barriers and facilitators to the use of diagnostic tests in antimicrobial prescribing among medical interns in public hospitals in Uganda.

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Abstract

Antimicrobial resistance is a growing public health threat globally with a disproportionate burden in low and middle-income countries, including Uganda. Inappropriate antimicrobial prescribing, particularly empirical treatment without confirmatory diagnostic testing, contributes significantly to resistance. Medical interns constitute a substantial proportion of frontline prescribers in public hospitals, yet evidence regarding factors influencing their use of diagnostic tests remains scarce. This study synthesized evidence on barriers and facilitators to the use of diagnostic tests in antimicrobial prescribing among medical interns in public hospitals in Uganda. A systematic review was conducted using PubMed to identify relevant studies published between 2016 and 2026. Eligibility was determined using the PEO (Population, Exposure, Outcome) framework. Studies examining barriers and/or facilitators to diagnostic test utilization in antimicrobial prescribing among health professionals in public hospitals in Uganda and comparable low and middle-income countries were included. Qualitative, quantitative and mixed methods studies were considered. Data were extracted using a standardized excel form, and methodological quality was appraised with the Mixed Methods Appraisal Tool (MMAT). Findings were synthesized narratively and thematically, of 430 records identified, 15 primary empirical studies were included. None focused exclusively on medical interns. Barriers were categorized as individual, institutional and health system level. Facilitators included structured training and supervision, awareness of AMR, improved availability of RDTs, integrated fever management programs, adherence monitoring and strengthened TB and HIV diagnostic programs. Diagnostic test use remains suboptimal, with barriers at multiple levels. Strengthening diagnostic stewardship within internship programs may enhance rational antimicrobial use and mitigate AMR in Uganda.

INTRODUCTION

Antimicrobial resistance (AMR) is a critical and growing global public health threat that undermines the effectiveness of modern nursing and medicine [1,2]. The misuse and overuse of antimicrobials in humans, animals and plants are the primary drivers of resistant

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pathogens, while poverty, inequality and fragile healthcare systems exacerbate their impact, particularly in low and middle-income countries [3,4]. As a result, infections that were once easily treatable have become harder and more expensive to manage, leading to prolonged illness and higher mortality. Resistant pathogens such as Escherichia coli, Klebsiella pneumoniae and Mycobacterium tuberculosis have emerged as major threats, causing longer hospital stays, the need for last-resort and often more toxic drugs like Carbapenems, and increased treatment costs [4,5,6,7,8]. The situation is even more concerning in developing countries, where overuse and misuse of antimicrobials are widespread, leaving physicians with limited treatment options and driving up healthcare costs for patients, families, and health systems. Beyond health, antimicrobial resistance poses a significant socioeconomic burden by reducing productivity, straining health budgets, and jeopardising medical advances such as safe surgeries, chemotherapy, and organ transplantation [4,5,6,7,8]. Globally, AMR was directly responsible for 1.14 million deaths and contributed to an estimated 4.71 million deaths worldwide, with the burden being disproportionately higher in low and middle-income countries where surveillance, infection control and access to quality healthcare remain inadequate [4,6,9,10,11]. In Sub-Saharan Africa alone, AMR was associated with more than one million deaths in 2019, with Klebsiella pneumoniae, Escherichia coli and Staphylococcus aureus among the leading causes [8,12]. In Uganda, increasing AMR has been reported against multidrug-resistant Mycobacterium tuberculosis, Klebsiella pneumoniae and Streptococcus pneumoniae resistant to drugs such as Penicillins, Cotrimoxazole and third-generation Cephalosporins [13,14,15]. This growing resistance has contributed to a significant health burden, where of the 26,800 deaths that were associated with AMR, 5,620 of them were directly attributed to it [13]. To combat this threat, the World Health Organisation (WHO) launched the Global Action Plan on Antimicrobial Resistance in 2015, which emphasises improving awareness and education, strengthening surveillance systems, promoting rational use of antibiotics and investing in research for new treatments [4]. Uganda has implemented its own National Action plan on Antimicrobial Resistance, focusing on improving laboratory capacity, antimicrobial stewardship programs in health facilities, public awareness campaigns and tighter regulation of over-the-counter antibiotics sales. These efforts, while promising, face challenges including limited funding, inadequate enforcement of regulations and gaps in training of frontline health workers [16]. Previous studies in various countries have shown that although health workers generally recognise the importance of diagnostic testing before prescribing antibiotics, reliance on empirical treatment remains widespread due to limited diagnostic capacity, high patient load and infrastructural gaps [17,18,19,20]. In Uganda, studies as well indicate suboptimal use of diagnostic tests in routine care where drugs are prescribed without confirmatory tests, underscoring persistent gaps in diagnostic stewardship and the continued dependence on syndromic management [21,22,23,24,25]. Diagnostic tests, including microbiological cultures, rapid diagnostic tests, microscopy and radiological imaging, are essential for guiding rational prescribing; however, their use remains low in many Ugandan health facilities [20,26,27]. Health workers, including medical interns, often rely on empiric treatment due to systematic constraints, patient expectations and lack of support systems. As frontline prescribers, medical interns significantly influence antimicrobial use patterns, yet few studies have explored their experiences with diagnostic tests. Despite extensive documentation of inappropriate antimicrobial prescribing in Uganda, there is limited research specifically examining the use of diagnostic tests by medical interns and the factors that influence their prescribing practices. Identifying these barriers and facilitators is crucial to guiding antimicrobial stewardship programs, strengthening

diagnostic capacity, informing policy and improving clinical decision making at the point of care. This systematic review aimed to summarise existing evidence on the barriers and facilitators to the use of diagnostic tests in antimicrobial prescribing among medical interns in public hospitals in Uganda. Problem statement Globally, AMR continues to place a significant strain on the healthcare systems despite efforts to combat it [1,28]. Many low and middle-income countries are disproportionately affected due to limited diagnostic capacity and irrational antimicrobial use, with Uganda not being an exception [3,4]. In Uganda, AMR has emerged as an escalating public health challenge, threatening the effectiveness of essential treatments and increasing the risk of preventable deaths [14,15,29]. In response, the government of Uganda developed a multifaceted National Action plan on Antimicrobial Resistance to strengthen antimicrobial stewardship in healthcare facilities, enhance surveillance systems for resistant pathogens and promote public awareness on rational antibiotic use [29]. Despite these initiatives, irrational use of antimicrobials remains widespread among both healthcare providers and the public. Studies in Uganda have shown that many health professionals still prescribe medications without confirmatory diagnostic tests [21,22,23]. This contributes to the growing burden of AMR in the country and undermines national efforts to contain it. A synthesis of existing data on barriers and facilitators to the use of diagnostic tests in antimicrobial prescribing among medical interns is crucial to guiding antimicrobial stewardship programs, strengthening diagnostic capacity, informing policy and improving clinical decision making at the point of care, as they constitute a substantial portion of Uganda's healthcare force. However, evidence on the same topic among medical interns in Uganda is limited. This systematic review, therefore, aimed to summarise existing evidence on barriers and facilitators to the use of diagnostic tests in antimicrobial prescribing among medical interns to inform targeted interventions to promote rational antimicrobial use and reduce the burden of AMR in Uganda's healthcare system. Justification The inappropriate use of antimicrobials in Uganda continues to drive the rise of AMR, undermining the effectiveness of treatments for common infections and increasing healthcare costs. Medical interns, as frontline prescribers across public hospitals, play a critical role in antimicrobial use, yet their reliance on empirical treatment and limited diagnostic tests may contribute to irrational prescribing. Understanding the barriers and facilitators to diagnostic test use among interns is therefore crucial to inform targeted interventions, strengthen antimicrobial stewardship programs and promote rational prescribing practices that can help curb AMR and improve patient outcomes in Uganda. Objectives 1. To identify barriers faced by medical interns in using diagnostic tests when prescribing antimicrobials in public hospitals in Uganda. 2. To report facilitators that promote the use of diagnostic tests in antimicrobial prescribing among medical interns in public hospitals in Uganda. 3. To summarise recommendations from existing studies to improve diagnostic stewardship among medical interns in public hospitals in Uganda.

METHODOLOGY

This systematic review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.

Eligibility criteria

The eligibility of studies was determined using the PEO (Population, Exposure and Outcome) framework. Studies were included if they focused on health professionals, including intern doctors, intern nurses and midwives, intern pharmacists and dental interns and examined the use of diagnostic tests in antimicrobial prescribing. Eligible studies were required to

report barriers and/ or facilitators influencing diagnostic test utilisation and be conducted in public hospital settings in Uganda. Due to the anticipated limited availability of Uganda-specific literature, studies from comparable low and middle-income country settings were also considered where relevant and clearly indicated. Qualitative, quantitative and mixed methods study designs will be included to capture a broad range of evidence. Editorials, abstracts without full texts and studies not available in English were excluded.

Search strategy

A comprehensive literature search was done using PubMed, a freely accessible biomedical database. PubMed was selected due to its extensive coverage of peer-reviewed literature in health-related research. However, this may have limited the retrieval of studies indexed in other databases. The search included all eligible studies published from 2016 to 2026. A structured search strategy was developed using Medical Subject Headings (MeSH) and free text terms related to antimicrobial stewardship, diagnostic testing, prescribing and medical interns. Boolean operators (AND, OR) and truncation symbols were used to combine search terms. The search strategy was conducted in PubMed and limited to studies published between January 2016 and January 2026. The full search strategy is provided below: (antimicrobial* OR antimicrobials* OR antibiotic OR antibioticophila OR antibiotics OR antibioticum OR antibioticus OR antifungal OR antiviral OR antiviralis OR antivirals OR antiparasitic OR antiparasitics) AND (”Diagnostic Tests, Routine”[MeSH] OR ”Microbiological Techniques”[MeSH] OR ”Point-of-Care Testing”[MeSH] OR diagnos* test* OR culture* OR microscopy OR imaging OR ”rapid diagnostic test”) AND (”Drug Prescriptions”[MeSH] OR prescribing OR ”antimicrobial stewardship”) AND (Internship*[MeSH] OR intern* OR trainee* OR ”medical intern*” OR ”junior doctor*” OR ”nursing intern*” OR ”midwifery intern*” OR ”pharmacy intern*” OR ”pharmacist intern*” OR ”dental intern*” OR ”health professional intern*” OR ”healthcare intern*”) AND (Uganda).

Study selection

All retrieved records were exported into a reference management system, and duplicates were removed. Titles and abstracts were screened for eligibility, followed by full-text screening of potentially relevant articles. Study selection was guided by the inclusion and exclusion criteria.

Data extraction

A standardised data extraction form developed in MS Excel was used to collect relevant information from the included studies. Extracted data will include: authors, year of publication, setting, study design and objectives, study population, types of diagnostic tests assessed, reported barriers and facilitators to diagnostic test use, key findings and recommendations.

Quality Assessment

The quality of the included studies was assessed using the Mixed Methods Appraisal Tool (MMAT). This tool allows for the appraisal of qualitative, quantitative and mixed methods studies within a single framework. Each study was assessed against relevant MMAT criteria and was rated as Yes, No or Can’t tell. In line with MMAT guidance, no overall quality score was calculated.

Data synthesis

Findings from the included studies were synthesised manually using narrative and thematic synthesis. Reported barriers and facilitators were coded and grouped into individual-level, institutional-level and health-level factors. Patterns and similarities across studies were identified and described narratively.

Where appropriate, tables were used to summarise key findings.

Ethical Considerations

Ethical approval was not required for this study as it involves the synthesis of data from published literature. However, ethical principles of transparency, accurate reporting and appropriate citation of sources were adhered to throughout the review. This study faced some limitations, including publication bias, limited availability of Uganda-specific studies and heterogeneity in study designs and outcome measures. Additionally, most included studies did not focus specifically on medical interns, which limited the ability to generate intern-specific conclusions despite the review's focus on this group.

RESULTS

A total of 433 studies were identified through database searching on PubMed. After removal of duplicates and screening of titles and abstracts, 26 full-text articles were assessed for eligibility. Of these, 11 articles were excluded because they were systematic reviews, policy analyses, consensus statements or modelling studies and did not meet the inclusion criteria for primary empirical research. Therefore, 15 primary studies were included in the final synthesis (Supplementary Table 1). Characteristics of the included studies The included studies were conducted across Uganda, Nigeria, Burkina Faso, Malawi, Zambia and multi country Sub Saharan African settings. Study designs included cross-sectional surveys, mixed methods studies, qualitative interviews, observational implementation research and facility-based analyses. Although few studies focused exclusively on medical interns, most examined frontline prescribers, including junior doctors, nurses and community health workers in public healthcare settings. Notably, none of the included studies examined medical interns as a distinct and isolated prescribing group, limiting the ability to draw intern-specific conclusions. Diagnostic tests assessed included malaria rapid diagnostic tests (RDTs), microscopy, tuberculosis diagnostics and antimicrobial susceptibility testing (Supplementary Table 2). Synthesis of barriers to diagnostic test use Barriers were categorised into individual, institutional and health system level factors (Supplementary Table 3). A. Individual-level barriers Several studies reported continued reliance on syndromic management and empirical prescribing despite the availability of diagnostic tools. In Uganda, febrile children under five were often treated with antibiotics without confirmatory testing [30,31]. Similar patterns were observed in Malawi and Zambia, where antibiotic overuse persisted despite integrated fever management strategies [32,33]. Non-adherence to negative malaria RDT results was also documented in many African settings where clinicians prescribed antimalarials or antibiotics despite negative findings [34,35,36]. This indicates limited trust in diagnostic accuracy and diagnostic override behaviour. Gaps in diagnostic interpretation and prescribing confidence were reported among frontline providers managing tuberculosis and pneumonia [37,38]. Uncertainty in interpreting laboratory results contributed to the use of antibiotics with too many precautions. B. Institutional level barriers Many studies reported inconsistent supply of malaria RDTs and essential diagnostic commodities [36,39,40]. Limited access to functional laboratory services reduced diagnostic uptake, especially in rural facilities. Studies in Malawi and Uganda reported weak laboratory capacity that includes shortages of trained personnel and equipment [31,32]. Poor infrastructure limited confirmatory testing for tuberculosis and other infections [41]. Some studies highlighted that where diagnostics were available, delays in obtaining results discouraged use in high-volume outpatient settings [38,42]. C. Health system level barriers Resource limitations affecting diagnostic implementation were reported across Burkina Faso, Nigeria and Uganda [36,39,40]. Insufficient

funding for laboratory systems undermined policy intentions. Although national guidelines promoted test-before-treat practices, implementation gaps persisted, weakening diagnostic stewardship efforts [30,31]. Studies from Zambia and Uganda found that caregiver expectations influenced antibiotic prescribing even when diagnostics suggested otherwise [30,33]. Facilitators to diagnostic test use. Supplementary Table 4 shows facilitators influencing diagnostic test use in antimicrobial prescribing A. Individual-level facilitators Improved adherence to malaria RDT results was associated with structured capacity building training and supervision of frontline health providers that strengthened confidence in diagnostic-guided prescribing [34,36]. Recognition of AMR risks encouraged more cautious prescribing in some settings [37,42]. B. Institutional level facilitators Community-based access to malaria diagnostic tests improved appropriate treatment decisions [39,40]. Integrated pediatric fever management reduced unnecessary antibiotic use in Malawi [32]. Monitoring compliance with RDT use improved prescribing alignment with test results [36]. C. Health system level facilitators Targeted investments in TB and HIV diagnostics improved early treatment decisions [37,41]. Community health worker involvement enhanced diagnostic uptake and rational treatment practices [39,40].

Discussion

This review synthesised primary evidence from Sub-Saharan Africa relevant to Uganda to examine barriers and facilitators influencing diagnostic test use in antimicrobial prescribing. Individual-level barriers Consistent with the results, reliance on empirical treatment emerged as a dominant barrier across different settings. In Uganda, febrile children under five were frequently treated with antibiotics without confirmatory testing [30,31]. Similar trends were reported in Malawi and Zambia, where antibiotic overuse persisted despite integrated fever management strategies [32,33]. These findings suggest that diagnostic availability does not necessarily translate into diagnostic utilisation, instead, prescribing behaviour appears to be shaped by syndromic management practices. The implication for Uganda is that expanding access to rapid diagnostic tests (RDTs) alone will be insufficient unless accompanied by targeted behavioural change interventions, particularly within internship programs where prescribing habits are developed [23]. Poor adherence to negative test results further reinforces this concern. Multiple studies documented clinicians prescribing antimalarials or antibiotics despite negative malaria RDT findings [34,35,36]. This diagnostic override behaviour indicates limited trust in test accuracy and fear of adverse patient outcomes, the persistence of this pattern across multiple countries suggests a broader regional challenge in translating diagnostic evidence into prescribing restraint [43,44]. For Uganda, strengthening confidence in diagnostic interpretation through mentorship and antimicrobial stewardship training may reduce precautionary prescribing [45]. Knowledge and confidence gaps were also reported, particularly in managing tuberculosis and pneumonia [37,38]. Uncertainty in interpreting laboratory findings contributed to cautious antibiotic use even when not clinically indicated [37,38]. These findings imply that diagnostic stewardship requires not only access to tools but also strengthened competency in result interpretation, embedding structured diagnostic interpretation modules into an internship program could therefore directly address this barrier [46]. Institutional-level barriers At the institutional level, stockouts and limited availability of diagnostic tools were consistently reported, especially in rural facilities [36,39,40]. This unreliability reinforces empirical prescribing by reducing clinician trust in diagnostic systems. Ensuring an uninterrupted diagnostic supply is a prerequisite for effective antimicrobial stewardship in Uganda. Inadequate laboratory in-

frastructure further constrained diagnostic use. Studies from Malawi and Uganda highlighted shortages of trained laboratory personnel and equipment, while limited confirmatory testing capacity for tuberculosis and other infections was reported elsewhere [31,32,41]. Weak laboratory systems reduce the feasibility of confirmatory diagnosis and perpetuate syndromic treatment practices [31,32,41]. Investment in laboratory workforce development and infrastructure strengthening is therefore essential for translating policy into practice. Delays in turnaround time were also identified as barriers. In high-volume outpatient settings, clinicians were unlikely to wait for results before initiating treatment [38,42]. This operational inefficiency discourages diagnostic use even where tests are available [38,42]. Improving point-of-care testing and laboratory workflow efficiency would therefore enhance real-time decision making and reduce empirical prescribing pressures [47]. Health system level barriers Resource constraints were reported across Burkina Faso, Nigeria and Uganda, where insufficient funding limited diagnostic implementation [36,39,40]. These systematic limitations undermine national antimicrobial resistance strategies by restricting operational capacity [36,39,40]. The findings suggest that policy commitments must be matched by sustainable financing for laboratory systems. Policy practice gaps further weakened diagnostic stewardship. Although national guidelines promoted test-and-treat approaches, implementation remained inconsistent [30,31]. This highlights governance and accountability challenges; hence, incorporating diagnostic adherence indicators into hospital performance monitoring frameworks may strengthen implementation fidelity in Uganda. Patient and caregiver expectations also influenced prescribing decisions. Studies in Zambia and Uganda found that clinicians sometimes prescribed antibiotics to meet perceived caregiver demands despite contrary diagnostic findings [30,33]. This indicates that antimicrobial stewardship must extend beyond clinicians to include community-level education addressing expectations for antibiotics. Facilitators to diagnostic test use Encouragingly, several facilitators were identified across individual, institutional and health system levels. At the individual level, structured training and supervision improved adherence to malaria RDT results [34,36]. These findings demonstrate that capacity-building interventions can positively influence prescribing behaviour. In Uganda, integrating continuous professional development and mentorship within internship programs could enhance diagnostic confidence and adherence. Awareness of antimicrobial resistance risks was also associated with more cautious prescribing [37,42]. Increasing AMR awareness during medical internship may strengthen motivation to adhere to diagnostic evidence. At the institutional level, improved availability of RDTs, particularly through community-based access enhance appropriate treatment decisions [39,40]. Integrated fever management programs in Malawi were associated with reductions in unnecessary antibiotic use, demonstrating the value of structured clinical algorithms [32]. Additionally, monitoring compliance with RDT use improved alignment between test results and prescribing, suggesting that audit and feedback mechanisms can reinforce stewardship practices [36]. At the health system level, targeted investments in tuberculosis and HIV diagnostic programs strengthened early and appropriate treatment decisions [37,41]. Engagement of community health workers further enhanced diagnostic uptake and rational treatment practices [39,40]. These findings indicate that coordinated systems can produce measurable improvements in diagnostic stewardship. Conclusion This review identified persistent reliance on empirical prescribing and limited adherence to diagnostic results across Sub-Saharan African public health care settings relevant to Uganda. Barriers were evident at individual, institutional and health system levels while training, supervision, diagnostic availability and structured programs improved adherence. However, the limited focus on medical interns highlights a significant re-

search gap. Strengthening diagnostic stewardship during the internship period is essential in promoting rational antimicrobial use and addressing antimicrobial resistance in Uganda.

Conflict of Interest

The authors declare that they have no competing interests.

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