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REVIEW

Pharmacist-led antimicrobial stewardship: A systematic review of implementation barriers, facilitators, and policy-to-practice gaps in Bangladesh

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ABSTRACT

Background: Antimicrobial resistance disproportionately affects low- and middle-income countries. Bangladesh has adopted a National Action Plan (2023–2028) yet exemplifies the persistent gap between pharmaceutical policy frameworks and frontline antimicrobial stewardship (AMS) practice. No prior systematic review has synthesized barriers, facilitators, and AMS strategies across all Bangladesh health care settings, or positioned findings within a pharmaceutical-policy and pharmacy-practice frame.

Objectives: To synthesize the documented barriers, facilitators, and core and supplemental antimicrobial stewardship strategies reported across all Bangladesh healthcare settings, and to position the findings within a pharmaceutical-policy and pharmacy-practice frame to inform operationalization of the National Action Plan.

Methods: A systematic review was conducted per PRISMA 2020. Five databases (MEDLINE/PubMed, CINAHL, Scopus, Cochrane Library, Google Scholar) were searched on 22 August 2024 combining terms for AMS, implementation, and Bangladesh. Eligibility followed the Population–Exposure–Outcome framework. Records were screened by the primary reviewer and verified by the supervising author. Quality was appraised using the Critical Appraisal Skills Programme checklists (2022). Narrative synthesis combined frequency tabulation with inductive thematic analysis; meta-analysis was not appropriate given heterogeneity.

Results: Fourteen studies (2014–2025) were included: 10 empirical studies contributing primary data and 4 narrative reviews or study protocols, which contributed no participants and were included for their analysis of policy and implementation context. The empirical evidence base comprised 8489 individuals (7930 patients or children and 559 health care professionals), 25,107 clinical specimens, and 643 bacterial isolates; these denominators represent distinct units of observation and are not aggregated. Principal barriers were absent or weakly enforced AMS policies ($n = 6$), entrenched empirical prescribing ($n = 5$), limited diagnostic capacity ($n = 4$), and absent AMS teams ($n = 3$). Key facilitators were surveillance infrastructure ($n = 6$), training and education ($n = 5$), leadership commitment ($n = 3$), and international collaboration ($n = 2$). Only 31% of prescriptions were culture-guided. No included study reported an AMS program meeting all 5 criteria of the *a priori* operational definition of a functioning institutionalized program, and findings were unchanged in a sensitivity analysis restricted to the 10 studies published from 2020 onward.

Conclusion: AMS implementation in Bangladesh remains fragmented, reflecting a structural disjuncture between pharmaceutical-policy ambition and operational delivery. Education-led initiatives cannot sustain change without parallel investment in diagnostic infrastructure, multidisciplinary AMS teams including clinical pharmacists, and enforcement of community-pharmacy dispensing regulation. Strengthening pharmacy-led AMS is an underutilized entry point for operationalizing the National Action Plan.

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Key Points

What was already known:

- Antimicrobial resistance disproportionately burdens low- and middle-income countries, and Bangladesh has adopted a National Action Plan (2023–2028), yet national policy ambition has repeatedly outpaced frontline antimicrobial stewardship implementation.
- International evidence shows that structural stewardship strategies and pharmacist-led prescription review reduce inappropriate antibiotic use, but their uptake across South Asian health systems remains limited and poorly characterized.

What this study adds:

- This first systematic review across all Bangladesh health care settings found that no included study reported a functioning, institutionalized stewardship program against an a priori operational definition, and only 31% of antibiotic prescriptions were guided by microbiological culture.
- Core stewardship strategies remained recommended rather than implemented, while education and surveillance dominated practice, revealing a structural disjuncture between pharmaceutical-policy design and operational delivery.
- Pharmacy-led stewardship and enforcement of community-pharmacy dispensing regulation are underused levers for operationalizing the National Action Plan, with transferable lessons for comparable low- and middle-income countries.

Background

Antimicrobial resistance (AMR) represents one of the most urgent threats to global public health. Bacterial AMR directly caused an estimated 1.27 million deaths worldwide in 2019 and contributed to approximately 4.95 million additional deaths, with projections indicating that annual direct mortality could reach 1.91 million by 2050 and that 39 million AMR-related deaths may occur cumulatively between 2025 and 2050.^{1,2} The World Health Organization (WHO) has consistently ranked AMR among the top 10 global public health threats, and the burden is disproportionately concentrated in low- and middle-income countries (LMICs), where approximately 4.3 million AMR-associated deaths occur annually and nearly all AMR-related child deaths occur.^{3,4}

Antimicrobial stewardship (AMS) is defined as a coordinated set of strategies to promote the appropriate use of antimicrobials, preserve their effectiveness, and reduce AMR. The concept was formally described in the 1990s and has since been codified within international frameworks, including the WHO Global Action Plan and national programs such as England's *Start Smart Then Focus* toolkit.^{5–7} High-income countries such as the United Kingdom have demonstrated the value of systemic AMS investment: the English Surveillance Programme for Antimicrobial Utilisation and

Resistance enables routine national monitoring, and the UK's 2024–2029 National Action Plan targets a 5% reduction in total antibiotic use alongside an increase in narrow-spectrum prescribing.⁸ Pharmacists have been central to these gains, providing prescription review, audit and feedback, formulary management, and patient counselling within multidisciplinary stewardship teams.⁹

Bangladesh, a lower-middle-income country of approximately 170 million people, exemplifies the paradox confronting many LMICs: robust national policy commitments coexist with severe implementation gaps. In 2019, 26,200 deaths were directly attributable to AMR, and 98,800 deaths were AMR-associated.¹⁰ Bangladesh ranked 75th globally for age-standardized AMR mortality per 100,000 population according to the WHO Tracking AMR Country Self-Assessment Survey,¹¹ though this ranking is confounded by limited surveillance coverage: only 11 hospitals contribute data to the WHO Global Antimicrobial Resistance and Use Surveillance System (GLASS).¹² Despite the introduction of a comprehensive National Action Plan for AMR Containment (2023–2028) that adopts a One Health approach,¹³ hospital assessments reveal no formal AMS programs across tertiary facilities, and fewer than half of physicians demonstrate AMS awareness.¹⁴ Community pharmacies, frequently the first point of contact for febrile illness, dispense antibiotics without prescription in an estimated 56.6% of transactions,¹⁵ placing pharmaceutical regulation and pharmacy-practice reform at the center of any sustainable AMS strategy.

Objectives

While several narrative reviews and individual empirical studies have examined antimicrobial prescribing in Bangladesh, no prior systematic review has synthesized the full scope of barriers, facilitators, and AMS strategies across all healthcare setting types in the country, nor positioned the findings explicitly within a pharmaceutical policy and pharmacy-practice frame. This evidence gap hampers the design of targeted, scalable stewardship interventions and limits the operational translation of the National Action Plan. The present systematic review, therefore, addresses three a priori review questions: (i) What are the documented barriers to AMS implementation across health care settings in Bangladesh? (ii) What are the facilitators of AMS implementation? (iii) Which core and supplemental AMS strategies are reported or recommended in the published evidence? The review covers all human health care settings in Bangladesh in which antimicrobial use occurs, tertiary hospitals (including intensive care, pediatric and neonatal units), secondary hospitals, primary and rural care, and community pharmacies, and analyses barriers, facilitators and strategies separately by setting as well as in aggregate. Across the 14 included studies, the review finds that no study reported a functioning institutionalized AMS program, that only 31% of prescriptions were culture-guided, and that core stewardship strategies were recommended rather than implemented while education and surveillance dominated observed practice. The synthesis is intended to generate setting-specific, evidence-based recommendations for sustainable stewardship improvement, with explicit attention to the role of pharmaceutical policy

and pharmacy practice in operationalizing the National Action Plan, and to inform comparable LMIC contexts.

Methods

This systematic review was conducted and reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) statement;¹⁶ the completed PRISMA 2020 checklist is provided as [supplementary material](#). The review protocol was registered on PROSPERO on 10 May 2026 (registration number CRD420251176903) and is available at <https://www.crd.york.ac.uk/PROSPERO/view/CRD420251176903>. The protocol, comprising eligibility criteria, search strategy, screening procedure, extraction template, and quality appraisal approach, was prepared and approved by the supervising author before commencement of searches.

Eligibility criteria

Eligibility criteria were structured using the Population–Exposure–Outcome framework ([Table 1](#)), which is appropriate for systematic reviews of non-interventional, descriptive evidence on health care practice. Studies were eligible if they examined AMS implementation, antimicrobial prescribing practices, or barriers and facilitators to stewardship within any Bangladesh healthcare context. Eligible study designs included systematic reviews, literature reviews, meta-analyses, cross-sectional studies, cohort studies, case–control studies, qualitative studies, case studies, and conference abstracts. Studies were restricted to those published in English between 2010 and 2025 and reporting on human health settings. Studies exclusively addressing veterinary or environmental antimicrobial use were excluded, as were studies without accessible full text.

Information sources and search strategy

Electronic searches were conducted on 22 August 2024 across 5 databases: MEDLINE (via PubMed), CINAHL, Scopus, the Cochrane Library, and Google Scholar (the first 60 records, sorted by relevance). The search strategy combined 3 concept blocks using Boolean operators (AND between blocks, OR within): (i) AMS concept (“antimicrobial stewardship” OR “antibiotic stewardship” OR “AMS” OR “antibiotic use” OR “antibiotic management”); (ii) implementation concept (“implementation” OR “strategy” OR “barrier” OR “facilitator” OR “challenge”); and (iii) setting concept (“Bangladesh” OR “hospital” OR “primary care” OR “secondary care” OR “community pharmacy.”) Database-specific filters limited results to English-language records published between January 2010 and the search date. Retrieved records were exported to Zotero and managed in Microsoft Excel for deduplication and screening; backward citation tracking of all included studies was additionally performed. Infection prevention and control (IPC) terms were not included as primary search terms; this scope decision is acknowledged as a limitation.

Study selection

Screening was undertaken by the primary reviewer with independent verification by the supervising author, rather than by fully duplicate independent screening of all records by 2 reviewers in parallel. The primary reviewer screened all 4271 de-duplicated titles and abstracts against the a priori eligibility criteria. Full-text reports were retrieved for all records that could not be excluded at title and abstract, and every full-text report ($n = 102$) was assessed independently against the prespecified inclusion and exclusion criteria by both the primary reviewer and the supervising author. Disagreements at either stage were resolved by discussion between the 2 reviewers, and consensus was reached in every instance; a third reviewer had been designated a priori to adjudicate any unresolved disagreement but was not required. Reasons for full-text exclusion were recorded prospectively and are reported in [Figure 1](#). The greater potential for selection bias inherent in this approach, relative to fully duplicate independent screening at the title-and-abstract stage, is acknowledged in the Limitations. The PRISMA 2020 flow diagram ([Figure 1](#)) outlines the study selection process.

Quality assessment

The methodological quality of included studies was assessed using the Critical Appraisal Skills Programme (CASP) checklists, version 2022.¹⁷ Appropriate checklist versions were applied according to study design (Qualitative Studies, Cross-Sectional Studies, Cohort Study). Each criterion was scored as met/partially met/not met/not applicable. An overall rating was assigned a priori based on the proportion of applicable criteria satisfied: high ($\geq 80\%$), moderate (50% to 79%), or low ($< 50\%$). Quality assessments were performed by the primary reviewer with verification by the supervising author; discrepancies were resolved by discussion. Quality ratings were not used to exclude studies but were used to weight the analytical confidence placed on each finding in the synthesis, with greater interpretive weight given to barriers and facilitators consistently identified in high-quality studies.

Data extraction

Data were extracted by the primary reviewer into a standardized extraction form capturing: author, year, healthcare setting, study design, population, sample size, barriers to AMS, facilitators of AMS, core AMS strategies, supplemental AMS strategies, AMS outcomes, knowledge and attitudes, and regulatory or policy context.

Data synthesis

Given the heterogeneity of included study designs, insufficient information about standardized AMS metrics, and the lack of trials across the included evidence, a meta-analysis was unsuitable. A narrative synthesis was therefore undertaken, combining quantitative descriptive analysis (frequency tabulation of barriers, facilitators, and AMS strategies across studies) with inductive qualitative thematic analysis. Codes were developed iteratively in Microsoft Excel by the primary reviewer and reviewed by the supervising author; codes were

Table 1
Eligibility criteria using the Population–Exposure–Outcome (PEO) framework

PEO element	Inclusion criteria	Exclusion criteria
Population	Health care professionals, patients, or professional bodies responsible for AMS in Bangladesh health care settings	Studies focused exclusively on antibiotic use in animals, veterinary, or environmental settings
Exposure	Studies examining AMS implementation, interventions, challenges, or antibiotic use practices within Bangladesh	Studies that do not describe or evaluate antimicrobial stewardship in any form
Outcome	Studies reporting barriers, facilitators, attitudes, behaviors, motivations, or capacity relating to AMS implementation	Studies with outcomes unrelated to AMS implementation or antimicrobial prescribing practices
Study design	Systematic reviews, literature reviews, meta-analyses, cross-sectional, cohort, case–control, qualitative, case studies, and conference abstracts	Non-English language publications; studies without accessible full text

then grouped into candidate themes, refined through discussion, and finalized when no new themes emerged. Categorization of AMS strategies as core (audit and feedback, multidisciplinary AMS committee, formulary restriction, microbiology-guided prescribing) or supplemental (training, education, awareness campaigns, and guideline development) followed established stewardship frameworks.^{18,19}

Operational definition of a functioning institutionalized AMS program

For the purposes of this synthesis, a functioning institutionalized AMS programme was defined a priori as one meeting all 5 of the following criteria, adapted from the CDC Core Elements of Hospital Antibiotic Stewardship Programs,²⁰ the Infectious Disease Society of America/Society of Healthcare Epidemiology of America (IDSA/SHEA) implementation guidelines,¹⁸ and the WHO practical toolkit for AMS programs in health-care facilities in low- and middle-income countries:²¹ (i) documented senior leadership commitment with allocated financial or staffing resource; (ii) a named clinical lead and a named pharmacy lead with a defined stewardship remit; (iii) at least one core stewardship intervention delivered routinely as part of usual care rather than as a time-limited study, prospective audit and feedback, formulary restriction with pre-authorization, or a mandated antibiotic review at 48–72 h; (iv) facility-level monitoring of antibiotic use and of stewardship process measures; and (v) regular reporting of use and resistance data back to prescribers, combined with prescriber education. Programs meeting some but not all criteria were classified as partial and are described as such.

Patient and public involvement

Patient and public involvement reinforced and extended the synthesized findings. Contributors with lived experience of health care in Bangladesh confirmed that purchasing antibiotics from community pharmacies without prior medical consultation is widely practiced and culturally normalized, and that local pharmacists are frequently regarded as accessible and trusted sources of advice for everyday illness. This experiential account reinforces the centrality of community-pharmacy regulation and the integration of pharmacists into formal AMS roles. Public input also highlighted determinants of antibiotic use that are not always foregrounded in the included evidence base, including pharmaceutical-industry marketing practices, the quality of dispensed medicines, antibiotic use in the agricultural sector, the activities of

informal healthcare providers, and patient and caregiver demand. Importantly, the consultation drew attention to the need for any tightening of community-pharmacy regulation to be accompanied by safeguards against widening inequities in access to care, since stricter dispensing controls combined with rising consultation fees or medicine prices could inadvertently exclude lower-income households from timely treatment. These perspectives are consistent with the wider empirical literature on antibiotic use in LMICs and reinforce the recommendation that reform of community-pharmacy regulation should be coupled with affordability protections, One Health-informed action on agricultural antimicrobial use, and engagement with informal health care providers, rather than implemented as a stand-alone enforcement measure.

Ethical approval

Ethical approval was not required, as no primary data collection involving human participants were undertaken.

Results

Study selection and characteristics

The electronic search identified 9410 records: PubMed (n = 4971), Scopus (n = 2654), Cochrane Library (n = 910), CINAHL (n = 815), and Google Scholar (n = 60). After removal of 5139 duplicates, 4271 records were screened at the title and abstract stage, yielding 102 reports for full-text assessment. After applying the eligibility criteria, 14 studies published between 2014 and 2025 were included in the final synthesis (Figure 1).

Ten of the 14 included studies were empirical studies contributing primary data; the remaining 4 were narrative reviews or study protocols, which contain no participants and were included for their analysis of policy and implementation context only. Across the 10 empirical studies the evidence base comprised 8489 individuals (7930 patients or children and 559 health care professionals), 25,107 clinical specimens, and 643 bacterial isolates. These denominators are reported separately and are not aggregated into a single total, since individuals, specimens and isolates are distinct units of observation. Study designs were heterogeneous: point-prevalence surveys and cross-sectional prescribing audits (n = 3), retrospective and prospective laboratory or genomic surveillance (n = 3), prospective cohort analyses (n = 2), cross-sectional surveys of healthcare professionals (n = 1), secondary care population surveys (n = 1), and narrative

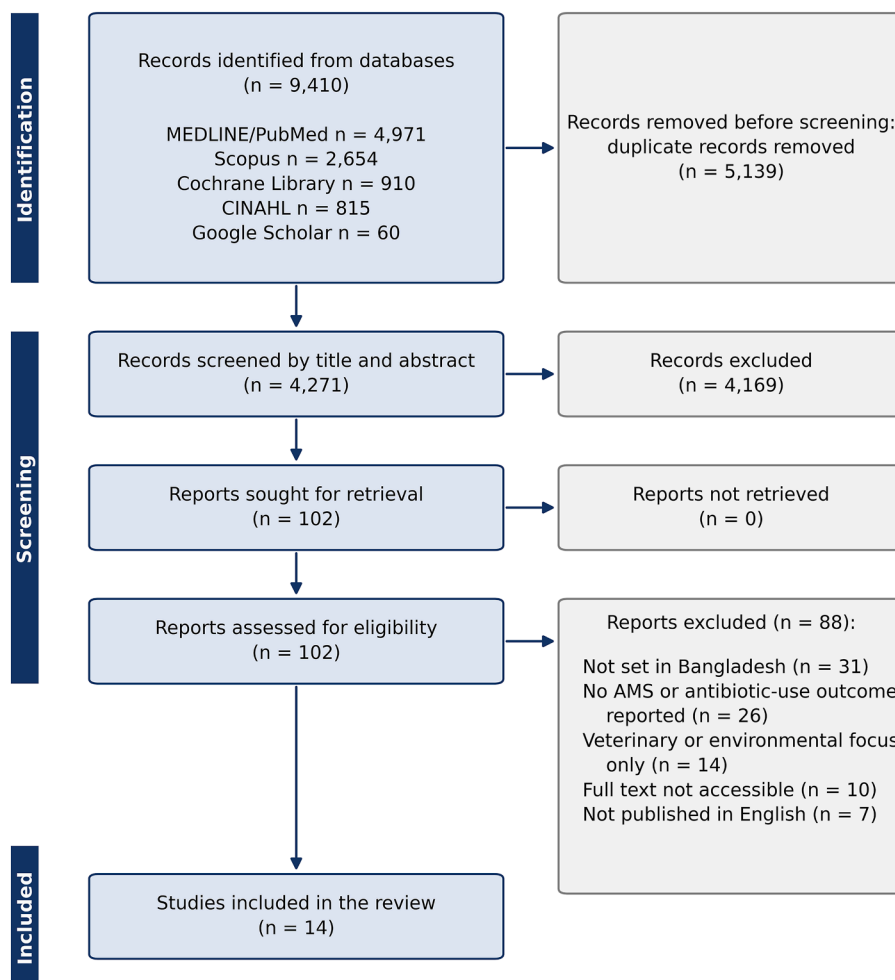


Figure 1. PRISMA 2020 flow diagram of study identification, screening, and selection. Alt text: PRISMA 2020 flow diagram showing 4 sequential boxes: identification (9410 records retrieved), screening (4271 records after removing 5139 duplicates), eligibility (102 full-text reports assessed; 88 excluded), and inclusion (14 studies included in synthesis).

reviews or study protocols ($n = 4$). The majority were conducted in tertiary hospital settings (64%; $n = 9$ studies), with mixed secondary and tertiary settings (29%; $n = 4$) and secondary-only settings (7%; $n = 1$). The full data extraction is presented in [Table 2](#).

Methodological quality

Of the 14 included studies, 7 (50%) were rated high quality ($\geq 80\%$ of CASP criteria satisfied), 5 (36%) moderate quality (50% to 79%), and 2 (14%) low quality ($< 50\%$). Common methodological strengths were clear research aims, appropriate study design, and adequate reporting of population characteristics. Common weaknesses included incomplete reporting of recruitment procedures, limited consideration of confounding factors (particularly in cross-sectional and cohort designs), and the absence of standardized AMS outcome metrics. Per-study quality ratings are reported in [Table 2](#).

Temporal sensitivity analysis

Ten of the 14 included studies (71%) were published in 2020 or later. All 4 studies published before 2020 addressed resistance patterns, prescribing prevalence, or over-the-counter access rather than the structure of stewardship programs. Restricting the synthesis to the 10 studies published from 2020 onward did not alter any principal finding: absent or unenforced institutional AMS policies, entrenched empirical prescribing, limited diagnostic capacity, and the absence of stewardship teams remained the 4 leading barriers in the same rank order; no post-2020 study reported a functioning institutionalized AMS programme; and no post-2020 study reported a standardized AMS consumption metric. The pre-2020 studies are therefore used for contextual description of resistance and access patterns rather than for inference about the current structure of stewardship provision.

AMS metrics and measurement

None of the 14 included studies reported standardized AMS consumption or outcome metrics, including the defined

Table 2
Summary data extraction for the 14 included studies

Study	Setting	Design	N	Key barriers	Key facilitators	Quality
Sumon et al. ¹⁴	Tertiary	Cross-sectional survey	559 HCPs	No AMS guidelines; limited training; high workload	Clinician interest in AMS; recognition of misuse	High
Harun et al. ²²	Tertiary	Study protocol	N/A	Staffing and governance gaps	IPC–AMS integration; alignment with NAP	Moderate
Sumon et al. ²³	Tertiary	Point prevalence survey	1063 patients	Empirical prescribing; no microbiology; no guidelines	Staff willingness; PPS feasibility	High
Rashid et al. ²⁴	Mixed (2°/3°)	Point prevalence survey	1099 patients	Overuse of Watch antibiotics; weak stewardship	WHO AWaRe framework applicable	High
Mia et al. ²⁵	Tertiary ICU	Cross-sectional microbiology	1670 patients	High resistance; empirical treatment; weak enforcement	Pilot stewardship feasible in ICU	Moderate
Rubel et al. ²⁶	Mixed (BD/UK)	Protocol/comparative	N/A	Lower guideline adherence versus. UK	International benchmarking as leverage	Low
Haque and Godman ²⁷	Mixed	Narrative review	N/A	OTC sales; weak regulation; resource shortfalls	International experience; policy frameworks	Moderate
Rashid et al. ²⁸	Tertiary paediatric	Cross-sectional	80 children	Nonadherence to WHO guidelines; empirical use	Pneumonia guidelines available	Moderate
Boone et al. ²⁹	Tertiary neonatal	Prospective cohort	448 admissions	Diagnostic uncertainty; empirical prescribing; no AMS	Cohort methodology feasible	High
Ahmed et al. ³⁰	Secondary (rural)	Survey	3570 children	OTC access; caregiver demand; weak enforcement	Strong surveillance capacity (icddr,b)	High
Afroz et al. ³¹	Tertiary	Retrospective study	3584 specimens	Delayed diagnostics; absent stewardship	Laboratory diagnostic capacity	Moderate
Zujbe et al. ¹⁰	Mixed	Narrative review	N/A	Poor IPC infrastructure; weak surveillance	Policy-level interest; NAP highlighted	Low
Roy et al. ³²	Tertiary	Laboratory surveillance	21,523 specimens	MDR prevalence; absent AMS committee	Longitudinal surveillance capacity	High
Farzana et al. ³³	Tertiary	Genomic surveillance	643 isolates	CRE spread; limited genomic capacity	International collaboration; genomic tracking	High

Abbreviations used: AMS, antimicrobial stewardship; CRE, carbapenem-resistant Enterobacterales; HCPs, health care professionals; icddr,b, International Centre for Diarrhoeal Disease Research, Bangladesh; IPC, infection prevention and control; MDR, multidrug-resistant; N/A, not applicable; NAP, National Action Plan; OTC, over-the-counter; PPS, point prevalence survey.

daily dose (DDD), days of therapy (DOT), length of stay (LOS), or direct antibiotic cost, despite these being specified as core process and outcome measures in the IDSA/SHEA implementation guidelines,¹⁸ the CDC Core Elements of Hospital Antibiotic Stewardship Programs,²⁰ the WHO practical toolkit for AMS programs in health-care facilities in low- and middle-income countries,²¹ and the WHO methodology for point prevalence surveys of antibiotic use in hospitals.³⁴ This represents a critical evidence gap that limits benchmarking, the health-economic justification for AMS investment, and the evaluation of pharmacy-led interventions in Bangladesh. Studies instead used nonstandardized measures, including antibiotic prescribing prevalence ($n = 7$), culture-guided prescribing rates ($n = 3$), WHO AWaRe distribution ($n = 2$), multidrug-resistance prevalence ($n = 4$), and the proportion of patients receiving broad-spectrum agents.

Four plausible causes underlie this measurement gap. First, DDD and DOT calculation requires patient-level dispensing or administration data linked to occupied bed-days; most Bangladeshi facilities retain paper-based prescribing records without electronic pharmacy dispensing systems, so the required denominator is unavailable. Second, no included institution had a stewardship team or a clinical pharmacist with a defined remit for antimicrobial consumption reporting, so no organizational owner of these metrics existed. Third, national reporting requirements under the National Action Plan emphasize resistance surveillance rather than consumption surveillance,¹³ so institutions face no external reporting incentive to compute consumption denominators. Fourth, most included studies were

investigator-initiated prevalence or laboratory studies designed to characterize resistance rather than to evaluate stewardship interventions, and such designs do not require longitudinal consumption metrics. The consequence is that stewardship in Bangladesh cannot currently be benchmarked nationally or regionally, cannot be justified health economically, and cannot demonstrate the return on investment that would support funding a clinical pharmacist stewardship workforce.

Barriers to AMS implementation

Systematic coding of the included studies identified 4 principal categories of barrier (Figure 2). The most frequently identified barrier was the absence or weak enforcement of hospital AMS policies or guidelines, reported across 6 studies, including 4 high-quality studies^{14,23,24,30} and studies of moderate or lower quality,^{10,25,27} giving high analytical confidence to this finding. Entrenched empirical prescribing culture, characterized by widespread broad-spectrum antibiotic use without microbiological guidance, was documented in 5 studies, 3 of high quality^{23,24,29}; Sumon et al.²³ reported that 73.5% of hospitalised patients were receiving antibiotics, with cephalosporins accounting for 54% of defined daily doses. Limited diagnostic and laboratory capacity was identified in 4 studies,^{23,25,31,33} with only 31% of prescriptions informed by microbiological culture results.²³ Lack of dedicated AMS staffing and multidisciplinary stewardship teams, including absent or under-utilised pharmacist roles, was highlighted in 3 studies.^{14,22,27} Caregiver demand and

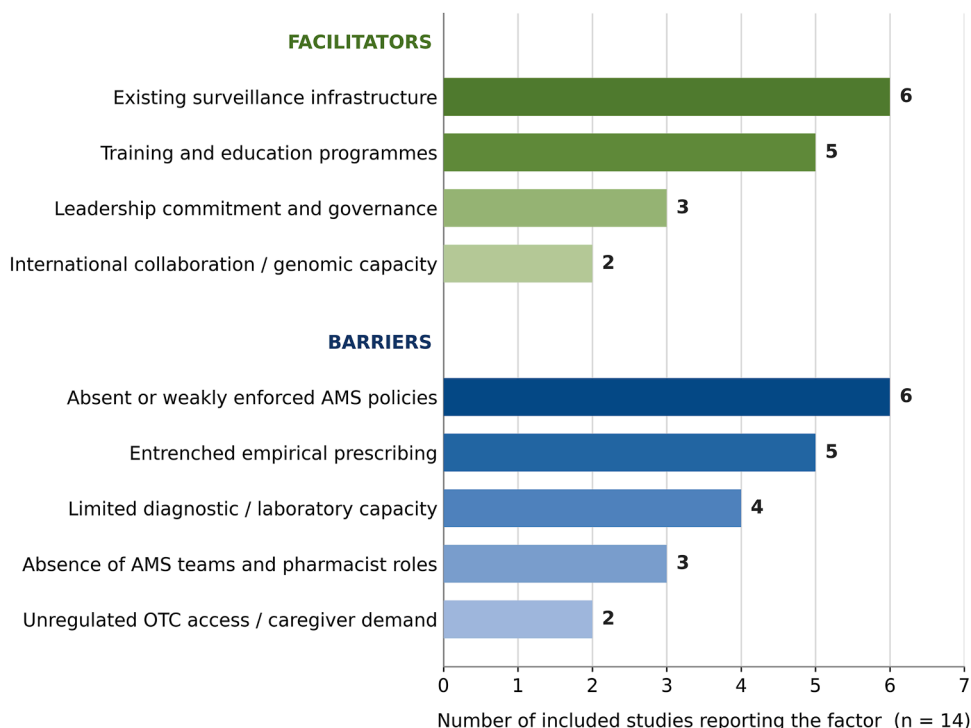


Figure 2. Barriers and facilitators to antimicrobial stewardship implementation identified across the included studies (n = 14). Green bars = facilitators; blue bars = barriers. Bar length represents the number of studies (n) in which each factor was identified. Alt text: Horizontal bar chart comparing the frequency of barriers (blue) and facilitators (green) across 14 included studies. Most frequent barriers are absent AMS policies (6 studies), empirical prescribing (5 studies), limited diagnostic capacity (4 studies), and absence of AMS teams (3 studies). Most frequent facilitators are surveillance infrastructure (6 studies), training and education (5 studies), leadership commitment (3 studies), and international collaboration (2 studies). AMS, antimicrobial stewardship.

unregulated over-the-counter (OTC) antibiotic access, identified by both high- and moderate-quality studies,^{28,30} were additionally identified as community-level barriers and underscore the central role of community-pharmacy regulation in any sustainable AMS strategy (Figure 2).

Facilitators of AMS implementation

Despite pervasive implementation barriers, several enabling factors were identified (Figure 2). Existing antimicrobial surveillance capacity was the most frequently cited facilitator, appearing in 6 studies including 5 of high quality.^{10,23,24,31-33} Training and education programs targeting healthcare professionals were identified as pragmatic facilitators in 5 studies,^{14,25-27,30} with high clinician receptivity to AMS engagement documented in the highest-quality healthcare-professional survey to date.¹⁴ Leadership commitment and institutional governance were highlighted in 3 studies.^{10,14,27} International collaboration and expanding genomic and resistance-characterization capacity were identified as additional facilitators in 2 high-quality studies.^{22,33}

AMS strategies

Critically, no included study reported an AMS program meeting all 5 criteria of the a priori operational definition of a functioning institutionalized program set out in the Methods; in particular, no study reported a named clinical and pharmacy stewardship lead, a routinely delivered core

intervention, or facility-level monitoring of stewardship process measures. Core AMS strategies were recommended rather than implemented in 64% of studies (n = 9), and supplemental strategies were reported or recommended in 50% (n = 7), but uptake remained inconsistent (Supplementary Table 1 and Figure 3).

Among core strategies, antibiotic prescribing audit and surveillance was reported in 3 studies,^{23,29,32} microbiology-based or genomic guidance was applied in 4 studies,^{14,25,31,33} point prevalence surveys were conducted in 2 studies,^{23,24} and WHO AWaRe benchmarking was utilized in 1 study.²⁴ Formal AMS committee or team formation was recommended, but not operationalized, in 2 studies.^{22,27} Among supplemental strategies, training and education were recommended in 5 studies,^{14,25,28,30,32} awareness campaigns in 3,^{14,27,30} and guideline development, international collaboration, and public engagement each in 2 studies. Notably, no study described a structured pharmacist-led prescription review or formulary management activity, despite international evidence of pharmacist effectiveness in such roles.⁹

Variation by health care setting and study design

Barriers were not distributed uniformly across settings (Table 3, Figure 4). Diagnostic and laboratory capacity constraints were concentrated in tertiary and intensive care settings, where microbiological services exist but are too slow or too limited to inform initial therapy. Absent or unenforced AMS policies were reported in every setting type and were the only factor identified at all levels of care. Entrenched

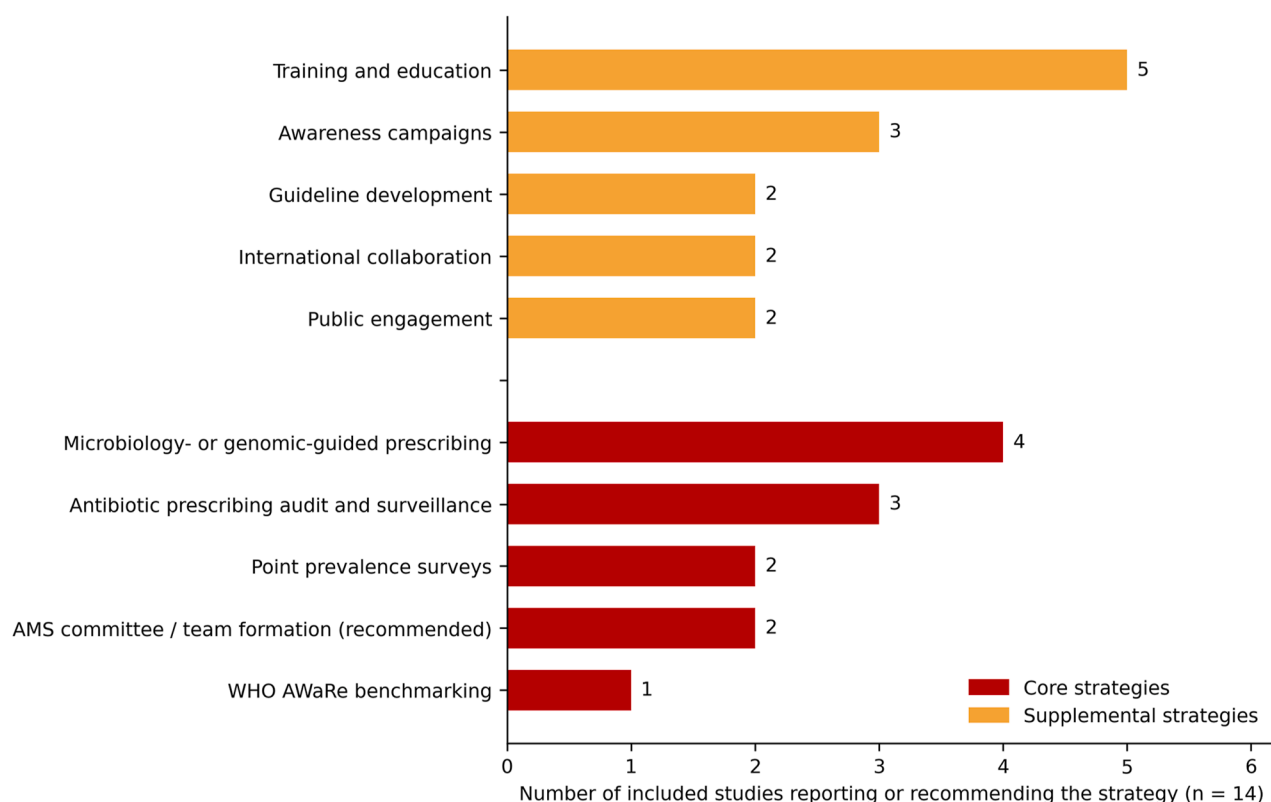


Figure 3. Core and supplemental antimicrobial stewardship strategies reported or recommended across included studies (n = 14). Red bars = core AMS strategies; amber bars = supplemental strategies. Bar length represents the number of studies (n) in which each strategy was reported or recommended. Alt text: Horizontal bar chart showing core AMS strategies in red (microbiology-guided prescribing in 4 studies, audit and surveillance in 3 studies, point prevalence surveys in 2 studies, AMS committee formation in 2 studies, AWaRe benchmarking in 1 study) and supplemental strategies in amber (training and education in 5 studies, awareness campaigns in 3 studies, guideline development in 2 studies, international collaboration in 2 studies, public engagement in 2 studies). AMS, antimicrobial stewardship.

empirical prescribing predominated in tertiary inpatient and pediatric or neonatal settings. Unregulated over-the-counter dispensing and caregiver demand were identified exclusively in community and rural studies and in no tertiary hospital study, a distribution that reflects where each study was conducted as much as where the problem lies, since no included study examined community-pharmacy practice and hospital prescribing within a single design.

Barrier identification also varied systematically by study design. Cross-sectional surveys of health care professionals identified attitudinal and workload barriers; point prevalence surveys and prescribing audits identified guideline-adherence and diagnostic barriers; laboratory and genomic surveillance studies identified infrastructural and governance barriers; and narrative reviews and protocols identified regulatory and policy barriers. No single design captured barriers across more than 2 of these domains. The apparent frequency of a barrier therefore partly reflects the distribution of study designs in the available literature rather than its true prevalence, and frequency counts throughout this review should be read as an indication of the extent of documentation rather than of magnitude.

Qualitative thematic analysis

Inductive thematic analysis identified 4 overarching themes.

Theme 1: Systemic resource and infrastructure deficits. Infrastructural constraints, including limited laboratory diagnostics, insufficient stewardship staffing, inadequate data systems, and scarce financing, emerged as foundational drivers of high empirical prescribing and the primary barriers to operationalizing core AMS strategies. Only 31% of prescriptions were culture-guided,²³ directly reflecting the diagnostic gap. Four studies explicitly identified laboratory capacity constraints^{23,25,31,33} and 3 highlighted stewardship staffing gaps.^{14,22,27} Fragmented surveillance and data feedback infrastructure were documented in 4 studies.^{23,24,32,33} The absence of structured pharmacist roles in stewardship infrastructure was a recurrent, though under-discussed, sub-theme.

Theme 2: Practice–policy implementation gap. Formal policies and national frameworks, including the WHO AWaRe classification and Bangladesh's National Action Plan, existed or were being adopted, yet adherence at the point of care was consistently poor. Four studies reported substantial discordance between guideline availability and actual prescribing practice,^{23,24,26,28} and 5 studies documented an entrenched culture of empirical broad-spectrum prescribing.^{23–25,29,32}

Theme 3: Health care setting-specific challenges. Implementation barriers differed meaningfully by clinical setting. In intensive care units, high multidrug-resistance burdens coexisted with minimal stewardship infrastructure.^{25,33} In pediatric settings, 3 studies demonstrated high antibiotic exposure and systematic non-adherence to WHO pediatric

Table 3

Barriers and facilitators to AMS implementation, stratified by health care setting and by study design

Setting	Dominant barriers	Dominant facilitators	Predominant study designs
Tertiary inpatient	Absent institutional AMS policy; empirical broad-spectrum prescribing; no AMS team or pharmacist role; limited culture-guided prescribing	Surveillance capacity; clinician receptivity to training; hospital leadership commitment	Point prevalence surveys; cross-sectional surveys; laboratory surveillance
Critical care	High MDR burden with minimal stewardship infrastructure; empirical broad-spectrum use; weak enforcement	Existing microbiology services; feasibility of pilot stewardship; international collaboration	Cross-sectional microbiology; genomic surveillance
Paediatric/neonatal	Non-adherence to WHO pediatric guidelines; diagnostic uncertainty; high empirical exposure	Availability of pediatric guidelines; feasible cohort methodology	Prospective cohort; cross-sectional audit
Secondary/rural	Weak regulatory enforcement; over-the-counter access; caregiver demand	Strong population surveillance capacity (icddr,b)	Population survey
Community pharmacy	Dispensing without prescription; absent pharmacist stewardship remit; no dispensing audit	Accessibility and public trust in pharmacists; policy-level interest	Narrative review; contextual evidence

Abbreviations used: AMS, antimicrobial stewardship; icddr,b, International Centre for Diarrhoeal Disease Research, Bangladesh; MDR, multidrug-resistant; WHO, World Health Organization.

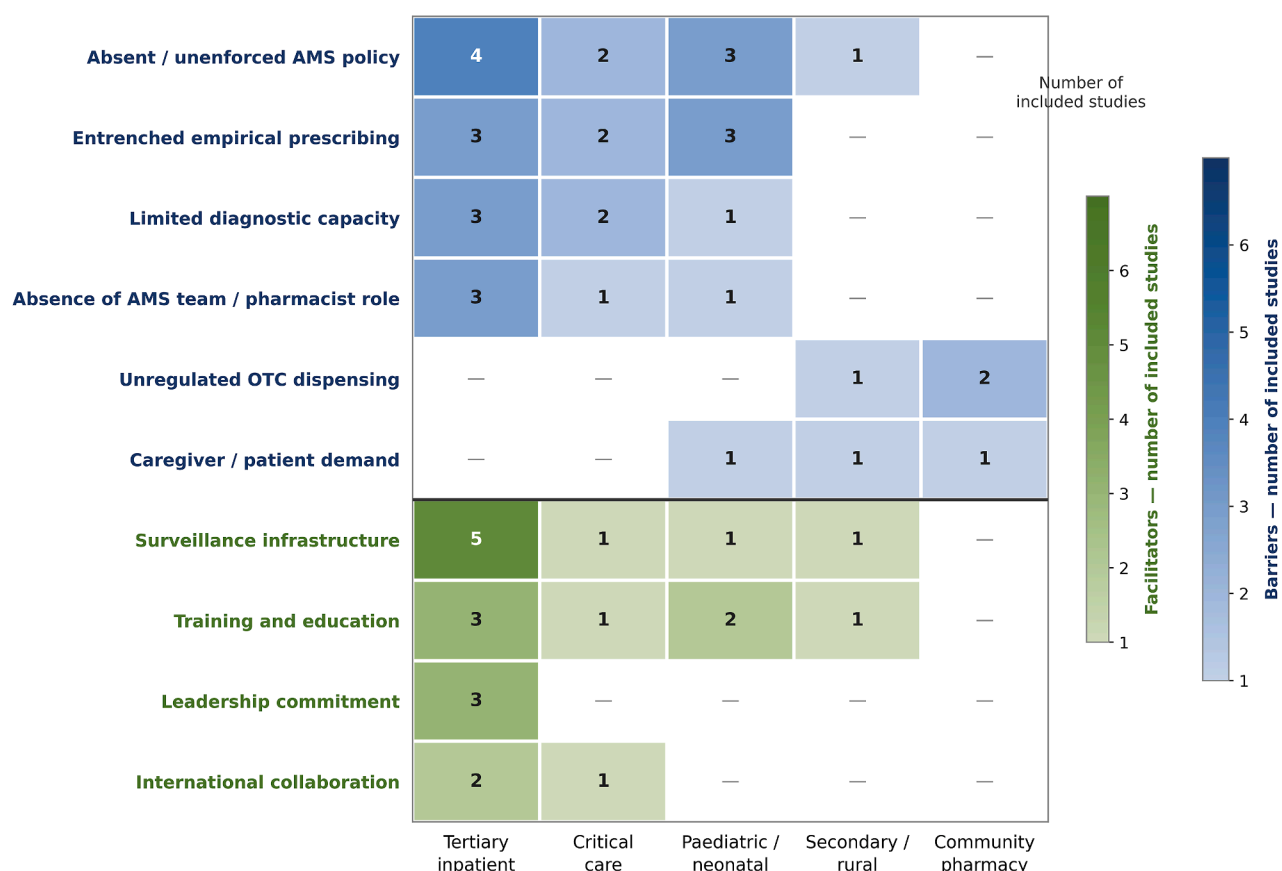


Figure 4. Setting-stratified heat map of barriers and facilitators across the included studies. Heat map with health care settings (tertiary inpatient, critical care, paediatric/neonatal, secondary/rural, community pharmacy) as columns and 10 barrier and facilitator factors as rows; cell shading and values indicate the number of included studies identifying each factor in each setting, showing that policy and infrastructure barriers concentrate in hospital settings while dispensing and demand barriers appear only in community and rural settings.

prescribing guidelines.²⁸⁻³⁰ At the community level, unregulated OTC access driven by caregiver demand represented a distinct barrier and reflects the broader pharmaceutical regulatory environment in which community pharmacies operate.^{15,30}

Theme 4: Enabling factors for AMS implementation. Clinician receptivity to training and structured stewardship support was high,¹⁴ and surveillance capacity, although fragmented, provided a foundation for expanded monitoring.^{24,32} Leadership commitment at hospital and policy levels,^{10,14,27} combined with

international collaboration and genomic surveillance capacity,³³ represented additional leverage points for systemic change.

Discussion

This systematic review provides the first comprehensive synthesis of barriers, facilitators, and strategies relating to AMS implementation across all healthcare setting types in Bangladesh, drawing on 14 studies and 34,097 participants and positioning the findings explicitly within a pharmaceutical policy and pharmacy-practice frame. Three principal findings emerge. First, documented antibiotic prescribing rates exceeded 70% among hospitalized patients and were dominated by empirical broad-spectrum therapy, broadly consistent with patterns observed across LMIC healthcare systems.³⁵ Second, what distinguishes Bangladesh's situation is the explicit coexistence of a sophisticated national policy framework with an almost complete absence of operational AMS structures at institutional level: no included study reported a functioning AMS committee, routine audit-and-feedback cycle, or prescribing formulary with active restriction mechanisms. This represents a structural failure of translation between pharmaceutical policy design and clinical implementation, rather than resource scarcity alone. Third, the most frequently reported AMS-related activities were training, education, and surveillance — supplemental strategies — whereas core strategies, including pharmacist-led activities such as prescription review and formulary management, remained recommended rather than implemented.

South Asian regional context

Placing the Bangladesh findings within a South Asian regional frame strengthens their interpretation and clarifies which determinants are country-specific and which are system-level. Studies from neighboring South Asian LMICs document strikingly similar patterns: India reports broad-spectrum empirical prescribing rates of 60% to 75% across tertiary settings and limited functional AMS committees outside research centers; Pakistan documents high OTC dispensing and antibiotic prescribing without diagnostic confirmation in community settings;^{36,37} and Sri Lanka and Nepal report comparable diagnostic-laboratory deficits and entrenched empirical prescribing cultures. The convergence across these settings indicates that the principal drivers identified in Bangladesh—diagnostic capacity, absent AMS teams, weak regulation of community dispensing, and limited pharmacist integration—are South Asian regional implementation determinants, not Bangladesh-specific anomalies. By contrast, Bangladesh's relative strength in surveillance infrastructure (WHO GLASS-reporting hospitals) is a country-specific asset that could be leveraged to lead regional efforts in AMS data systems. This regional comparison reinforces the idea that durable AMS gains in Bangladesh will require structural and pharmaceutical policy interventions of a kind that have proven effective elsewhere in South Asia, rather than education-led approaches alone.

The apparent tension between weak AMS policy as the most frequently reported barrier and leadership commitment as a facilitator resolves once the level of the health system is

specified. Leadership commitment was documented at national and ministerial level, adoption of the National Action Plan (2023–2028),¹³ participation in WHO GLASS,¹² and explicit endorsement of stewardship in national policy statements. Weak policy was documented at the institutional level: the absence of local antibiotic guidelines, formulary restriction mechanisms, AMS committees, and any enforcement or accountability structure within individual hospitals. National commitment has therefore not been transmitted into institutional mandate. This is precisely the policy-to-practice gap the review identifies: stewardship in Bangladesh has political sponsorship without operational infrastructure, which is a different problem from an absence of political will and requires a different remedy. It implies that the binding constraint lies in the implementation layer, designated institutional accountability, a funded stewardship workforce including clinical pharmacists, and mandatory reporting, rather than in further national policy development.

Core AMS strategies, including prospective audit and feedback, multidisciplinary committees, formulary restriction, and microbiology-guided prescribing, represent the structural backbone of effective stewardship and are associated with the most robust evidence for sustained prescribing improvement.^{18,19} In Bangladesh, these strategies existed only as policy recommendations. Supplemental strategies, such as training, education, and awareness campaigns, were more frequently cited and are undoubtedly valuable, given the documented receptivity of clinicians to AMS engagement.¹⁴

However, global evidence consistently demonstrates that education alone cannot produce durable changes in prescribing behavior without the concurrent institutionalization of structural governance mechanisms.^{38,39} The risk in Bangladesh is that supplemental interventions come to substitute for, rather than complement, the core infrastructure that sustains stewardship, a pattern observed in other LMIC settings facing comparable policy–practice disjunctures.⁴⁰

Pharmaceutical Policy, Pharmacy Practice, and Community Stewardship

The documented availability of antibiotics without prescription, affecting an estimated 56.6% of antibiotic dispensing transactions in community pharmacies,¹⁵ represents a dimension of AMS that hospital-focused stewardship programs cannot address in isolation. Bangladesh's pharmaceutical regulatory environment, characterised by limited enforcement of dispensing controls and an under-utilized community-pharmacist workforce, sits at the center of the country's AMS challenge. International evidence shows that pharmacist-led AMS interventions, prescription review, dose optimization, intravenous-to-oral switching, and patient counselling, produce measurable reductions in inappropriate antibiotic use in both hospital and primary-care settings.⁹ No included study in this review reported an operational pharmacist-led AMS activity, despite Bangladesh having a substantial community-pharmacy workforce. This represents an underutilized lever for policy reform.

Sustainable AMS in Bangladesh therefore requires 4 pharmaceutical-policy and pharmacy-practice reforms operating in parallel: (i) regulatory enforcement of prescription-only dispensing in community pharmacies; (ii) integration

of community pharmacists into formal AMS roles, with appropriate training, remuneration, and accountability mechanisms; (iii) inclusion of clinical pharmacists in hospital multidisciplinary AMS committees, modelled on the WHO LMIC stewardship guidance²¹ and the IDSA/SHEA framework¹⁸; and (iv) incorporation of AMS competencies into undergraduate and continuing pharmacy education. These reforms collectively translate the One Health framework outlined in the National Action Plan¹³ from a policy document into operational practice.

One Health drivers and the limits of health care-sector stewardship

Antimicrobial use in Bangladesh's health care sector accounts for only part of the national selection pressure. Bangladesh has a large and rapidly intensifying poultry and aquaculture sector in which antimicrobials, including agents classified by WHO as highest-priority critically important for human medicine, such as colistin and fluoroquinolones, have been used for growth promotion and prophylaxis, and resistant organisms and resistance determinants have been recovered from poultry, farmed fish, and the effluent and surface waters surrounding production sites and pharmaceutical manufacturing facilities.^{41,42} Environmental loading is spatially concentrated: resistance burdens attributable to industrial and agricultural effluent are highest in localized catchments around production and manufacturing sites, whereas the aggregate national burden is driven by the far larger dispersed volumes of agricultural and human consumption. Precise attribution fractions are not available for Bangladesh and are not estimated here; the relevant point for pharmacy practice is directional rather than numerical.

Two implications follow for stewardship in the health care sector. First, nonclinical selection pressure sets a ceiling on what clinical stewardship alone can deliver: even complete optimization of hospital prescribing would leave a substantial share of community-acquired resistance unaddressed. This is a further reason that stewardship programs in Bangladesh should be evaluated against prescribing-appropriateness process measures rather than against facility resistance rates, over which they exert limited control. Second, it strengthens rather than weakens the case for pharmacist-led stewardship, because the pharmacy workforce spans both sides of the One Health boundary. Community pharmacies and drug outlets in Bangladesh supply antimicrobials to smallholder livestock and aquaculture producers as well as to patients, and pharmacists are therefore positioned to act at a point in the supply chain that hospital stewardship programs cannot reach. Enforcement of prescription-only dispensing, restriction of critically important agents in veterinary supply, and inclusion of One Health content in pharmacy curricula and continuing education would extend the National Action Plan's One Health commitment¹³ into the pharmacy sector, where at present, it has no operational expression.

Diagnostic, surveillance, and IPC integration

The finding that only 31% of prescriptions were informed by microbiological culture is a stark indicator of the diagnostic-prescribing gap.²³ Without reliable, timely culture and susceptibility results, prescribers cannot de-escalate

therapy, prescribing audits cannot identify targets for intervention, and AWARe benchmarking cannot be acted upon meaningfully. Strengthening diagnostic laboratory capacity is therefore a prerequisite for any stewardship program, not merely a technical upgrade. Similarly, the fragmentation of antimicrobial surveillance across fewer than a dozen GLASS-reporting hospitals limits the national evidence base¹² and constrains both the health-economic justification of AMS investment and the identification of resistance trends with policy relevance.

Although IPC was outside the primary search scope of this review, it must be acknowledged that AMS and IPC are inseparable in operational practice: IPC failures generate the antibiotic-resistant infections that AMS programs then attempt to manage. Bangladesh's National Action Plan explicitly identifies IPC as a core pillar,¹³ and the only included study explicitly linking IPC to AMS framed them as integrated, not parallel, activities.²² Future Bangladeshi stewardship programs should be designed around joint AMS–IPC governance, shared data systems, and integrated training for clinical and pharmacy staff.

Strengths and limitations

This review provides the most comprehensive synthesis of AMS implementation evidence specific to Bangladesh to date, spanning empirical hospital-based studies, laboratory and genomic surveillance, health care-professional surveys, and narrative policy analyses. The dual quantitative–qualitative synthesis enabled both descriptive characterization of prescribing metrics and deeper interpretive analysis of implementation processes. Quality ratings were used analytically to weight confidence in findings, and the synthesis is positioned within a South Asian regional comparative frame and a pharmaceutical-policy lens.

Several limitations must be acknowledged. First, the absence of standardized AMS metrics (DDD, DOT, LOS, cost) across the included evidence limits comparability and precludes meta-analysis or formal economic evaluation. Second, most included studies were conducted in tertiary urban hospitals, with limited representation from primary care and rural settings, which may underestimate inappropriate antibiotic use in community settings where most of the population receives care. Third, restricting the search to English-language publications may have excluded relevant grey literature or studies published in Bangla. Fourth, IPC terms were not included as primary search terms; while AMS and IPC are inseparable in operational practice, a dedicated future review of integrated AMS–IPC implementation in Bangladesh would extend the present synthesis. Fifth, title-and-abstract screening was conducted by the primary reviewer with independent verification by the supervising author at full-text stage, rather than by fully duplicate independent screening by 2 reviewers in parallel at every stage; this carries a greater risk of selection bias and is acknowledged as a methodological limitation, partially mitigated by the use of explicit *a priori* eligibility criteria, independent duplicate full-text assessment, consensus discussion, and protocol approval prior to commencement of searches. Sixth, the barriers and facilitators identified are constrained by the designs available in the literature: no included study surveyed pharmacists in any

Table 4
Setting-specific implementation priorities, pharmacist role, responsible actor, and feasibility horizon

Setting	Priority action	Pharmacist role	Responsible actor	Horizon
Tertiary hospital	Establish a multidisciplinary AMS committee with a named clinical and pharmacy lead; introduce 48–72 h antibiotic review	Named pharmacy stewardship lead; prospective audit and feedback	Hospital director; DGHS	Immediate; low cost
Tertiary hospital	Adopt DDD and DOT reporting using pharmacy dispensing data	Pharmacy-led consumption data collection and reporting	Hospital pharmacy; DGHS	Medium term
Critical care	Locally adapted empirical therapy guideline linked to unit antibiogram	Formulary restriction and pre-authorization	Hospital AMS committee	Medium term
Paediatric/neonatal	Audit adherence to WHO pediatric prescribing guidelines	Prescription review and dose optimization	Unit clinical lead; pharmacist	Immediate
All hospital settings	Invest in diagnostic microbiology capacity to raise culture-guided prescribing above 31%	Liaison between laboratory and prescribers	Ministry of health; development partners	Requires investment
Secondary/rural	Extend surveillance and stewardship training beyond tertiary centres	Dispensing audit and training delivery	DGHS; professional bodies	Medium term
Community pharmacy	Enforce prescription-only dispensing with affordability safeguards; register and audit dispensing outlets	Accredited dispenser role with defined stewardship and referral remit	DGDA; Pharmacy Council of Bangladesh	Requires regulatory action
Education	Embed AMS and one health competencies in undergraduate and continuing pharmacy education	Curriculum and CPD delivery	Pharmacy Council; universities	Medium term

Abbreviations used: AMS, antimicrobial stewardship; CPD, continuing professional development; DDD, defined daily dose; DGDA, Directorate General of Drug Administration; DGHS, Directorate General of Health Services; DOT, days of therapy; WHO, World Health Organization.

setting, none examined community-pharmacy practice and hospital prescribing within a single design, and frequency counts therefore reflect the extent of documentation rather than prevalence. Seventh, four included studies were published before 2020; their findings are used contextually, and a sensitivity analysis restricted to studies published from 2020 onwards left all principal findings unchanged.

Future directions and recommendations

Based on the synthesized evidence, this review makes 6 pharmaceutical-policy and pharmacy-practice recommendations, set out below and mapped to specific practice settings, responsible actors and feasibility horizons in Table 4:

- *Establish functioning multidisciplinary AMS committees* in all tertiary and secondary hospitals, comprising infectious disease physicians, clinical pharmacists, microbiologists, and infection prevention practitioners.^{18,35}
- *Implement routine prospective audit and feedback programs*, linked to locally adapted antibiotic formularies informed by resistance surveillance data, with clinical pharmacists positioned as operational leads.¹⁹
- *Prioritize investment in diagnostic microbiology laboratory capacity* to increase the proportion of culture-guided prescribing from the current 31% toward international benchmarks.
- *Enforce regulatory frameworks for community-pharmacy antibiotic dispensing* and integrate pharmacist-led AMS into primary care, with appropriate training and remuneration mechanisms.^{9,15}
- *Adopt standardized AMS outcome metrics* (DDD, DOT, LOS, cost per episode) to enable national benchmarking and health-economic evaluation, with pharmacy-led data collection systems where feasible.

- *Leverage international collaborations and South Asian regional networks* to adapt successful stewardship and pharmacy-practice models to Bangladesh's healthcare infrastructure, and to position Bangladesh's surveillance assets (icddr, GLASS) as regional leadership opportunities.

The review also identifies the primary research that the current evidence base cannot supply. Three studies are indicated as immediate priorities: a national cross-sectional survey of hospital and community pharmacists' stewardship roles, training and perceived barriers, since no included study surveyed pharmacists in any setting; a multisite point prevalence survey using standardized WHO methodology³⁴ reporting DDD and DOT, to establish the national consumption baseline that this review found to be entirely absent; and a mixed-methods evaluation of pharmacist-led prescription review in one or more tertiary facilities, using implementation-science frameworks to characterize the conditions under which such models can be adapted and scaled within Bangladesh's health system. Future research should also evaluate stewardship interventions across primary, secondary and rural settings using standardized outcome metrics.

Conclusion

AMS implementation in Bangladesh remains at an early and fragmented stage, characterized by a structural disjuncture between national pharmaceutical-policy ambition and institutional operational practice. Core stewardship strategies — audit and feedback, multidisciplinary AMS committees including pharmacists, culture-guided prescribing, and formulary controls — are absent from frontline settings despite their proven effectiveness. Training and education offer pragmatic entry points, and clinician receptivity is high, but

supplemental strategies alone cannot change prescribing norms sustainably. Sustained progress will require coordinated structural reforms across diagnostic capacity, pharmacy practice, and community-pharmacy regulation, alongside standardized national surveillance metrics, to translate Bangladesh's policy commitments into measurable changes in antimicrobial use and resistance.

Data availability

All data analyzed in this systematic review were derived from previously published studies, fully cited in the reference list. No new primary data were generated. The completed PRISMA 2020 checklist and the supplementary AMS-strategies extraction table are provided as [Supplementary Material](#).

CRedit author statement

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Disclosure

The authors declare no relevant conflicts of interest or financial relationships.

Supplementary data

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