FEASIBILITY OF IMPLEMENTING ANTIBIOTIC STEWARDSHIP GUIDELINES AMONG RURAL HEALTHCARE PROVIDERS IN WEST BENGAL

OASIS

One Health Antibiotic Stewardship in Society

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Project Partners

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1.Executive Summary

Antimicrobial resistance (AMR) is recognised as one of the greatest threats to global healthcare systems, and sustainable development. India bears one of the world's highest burdens of antibiotic consumption, with inappropriate antibiotic use occurring across both formal and informal healthcare sectors (Laxminarayan et al., 2013; World Health Organization WHO, 2015). In rural India, rural healthcare providers (RHPs) frequently serve as the first point of contact for healthcare, placing them at the centre of community-level antibiotic use and antimicrobial stewardship efforts (Bloom et al., 2011; Gautham et al., 2014).

The UKRI funded One Health Antibiotic Stewardship in Society[1] or OASIS project (later on changed to the One Health Antibiotic Stewardship for Informal Health Systems) was initiated in 2019 with the goal of co-designing an antibiotic stewardship intervention for RHPs as well as Para veterinarians (paravets) in rural West Bengal in India. One of the key recommendations of the stakeholder consultations and dialogues conducted during the project was the development of context-specific antibiotic stewardship guidelines covering six common infectious syndromes in human health and nine in animal health, encountered at the primary care level. The guidelines were designed to support symptom-based diagnosis, assessment of illness severity, evidence-informed treatment decisions, timely referral, and optimisation of antibiotic use. Four priority syndromes in human health and an equal number in animal health were piloted through first conducting three structured orientation and capacity-building sessions followed by field interviews and observations to assess the usability, acceptability, and feasibility of implementing the guidelines and to obtain feedback from the providers.

This feasibility assessment focused on human health RHPs and examined the acceptability, usability, operational feasibility, technical feasibility, social feasibility, economic implications, legal awareness, and market feasibility associated with implementing the guideline among rural healthcare providers for human health[2] in rural West Bengal.

Overall, the findings indicate high implementation feasibility and considerable potential for wider scale-up. Participants reported improvements in clinical assessment, symptom recognition, treatment decision-making, and referral practices. Most providers expressed willingness to reduce unnecessary antibiotic prescribing and adopt supportive management strategies, including oral rehydration solution (ORS), paracetamol, rehydration counselling, and watchful waiting before initiating antibiotic therapy. The assessment also identified important implementation challenges. Persistent patient demand for antibiotics, reinforced by competition among healthcare providers, remained a major barrier to rational prescribing. Participants demonstrated varying levels of understanding regarding antibiotic classification, appropriate dosage selection, and treatment escalation. Concerns regarding

[1] Gautham, M., et al., *A multi-stakeholder approach towards operationalising antibiotic stewardship in India's pluralistic rural health system. https://gtr.ukri.org/projects?ref=MR%2FS013598%2F1#/tabOverview.* 2019.

[2] A combined analysis for both human and animal healthcare providers was done by an M.Sc student at LSHTM. The report is available at: Msc-One-Health-research-project-Z1488.pdf

potential reductions in medicine-related income and limited awareness of antibiotic regulations and stewardship policies were also identified.

Despite these challenges, the intervention demonstrated promise. The findings suggest that antibiotic stewardship interventions targeting rural healthcare providers can improve prescribing behaviour when guidelines are designed to address practical clinical decision-making rather than focusing exclusively on antimicrobial resistance. Sustainable implementation, however, will require continued training, supportive supervision, community engagement, digital clinical decision-support tools, and collaboration with pharmaceutical suppliers, professional associations, and health system stakeholders.

Summary of Feasibility Assessment Across the Eight Dimensions of Implementation

Feasibility Domain	Key Facilitators	Key Barriers	Implications for Scale-up
Acceptability and usability	High provider willingness to adopt guidelines; perceived credibility of the guidelines; improved diagnostic confidence; simple language and symptom-based algorithms	Patient expectations for antibiotics; incomplete understanding of some treatment protocols; reluctance to completely stop antibiotic prescribing	Continue orientation programmes, refresher training, and practical mentoring to improve adherence and reinforce appropriate prescribing.
Technical Feasibility	User-friendly design; Bengali language; colour-coded severity classification; improved symptom recognition and referral decisions	Knowledge gaps regarding antibiotic classes, generic versus brand names, dosage calculations, and disease-specific algorithms	Develop digital decision-support tools and provide continuous technical support through refresher training and supervision.
Operational Feasibility	Easy integration into routine practice; flexible placement of guidelines; medicines generally available; improved workflow and clinical decision-making	Limited consultation time; difficulty consulting printed guidelines during practice; space constraints in clinics; reliance on memorisation	Introduce mobile application/PDF versions, phased introduction of new guidelines, and regular reinforcement through supportive supervision.
Social Feasibility	Strong provider–patient trust; increasing patient acceptance following successful treatment; improved patient counselling; growing awareness of rational antibiotic use	Persistent patient demand for antibiotics and injections; competition among providers; misconceptions regarding rapid recovery	Combine provider training with community awareness campaigns, patient education, and engagement of all rural providers within the locality.
Economic Feasibility	Reduced patient out-of-pocket expenditure; improved provider reputation; anticipated increase in long-term patient load; enhanced trust	Short-term reduction in medicine sales; dependence on dispensing income; existing medicine stock; competition affecting patient retention	Consider incentive mechanisms, strengthen patient awareness regarding economic benefits, and promote service-based rather than medicine-based practice models.
Market Feasibility	Availability of recommended medicines; adaptable pharmaceutical supply chains; distributor support; increased use of supportive medicines	Occasional unavailability of recommended medicines; substitution with alternative products; commercial preference for higher-margin medicines	Engage pharmaceutical distributors and pharmacies to ensure uninterrupted availability of guideline-recommended medicines and reduce inappropriate antibiotic promotion.
Legal Feasibility	Positive attitude towards rational antibiotic use; willingness to receive training; recognition of the	Limited awareness of antibiotic regulations; poor understanding of national AMR policies; widespread	Integrate regulatory education into stewardship training, strengthen monitoring of irrational drug use, continued advocacy for limited use

	importance of appropriate prescribing	over-the-counter antibiotic availability	of ACCESS antibiotics under guidance and engage provider associations to improve compliance.
Schedule Feasibility	Providers willing to invest time in learning; gradual incorporation into routine practice; repeated use improved confidence and recall	Limited time during consultations; difficulty memorising multiple guidelines; need for ongoing reinforcement	Adopt phased implementation with periodic refresher training, mentorship, digital learning tools, and continuous supportive supervision to sustain behaviour change.

2 . Background

Antimicrobial resistance (AMR) has emerged as one of the defining public health challenges of the twenty-first century, threatening the effectiveness of modern medicine and undermining decades of progress in the prevention and treatment of infectious diseases. The World Health Organization (WHO) has identified AMR as one of the top global health threats, warning that continued increases in antimicrobial resistance could result in millions of preventable deaths annually and impose substantial social and economic costs if effective action is not taken (O'Neill, 2016; WHO, 2015). The inappropriate use of antibiotics in human health, animal health, and agriculture continues to accelerate the emergence and spread of resistant microorganisms, particularly in low- and middle-income countries (LMICs), where access to antibiotics is often poorly regulated (Laxminarayan et al., 2013).

India represents one of the largest consumers of antibiotics globally and faces a particularly complex AMR landscape. The rapid expansion of antibiotic consumption, widespread availability of antibiotics without prescription, inappropriate prescribing practices, self-medication, weak regulatory enforcement, and limited public awareness have collectively contributed to increasing antimicrobial resistance across both community and healthcare settings (Laxminarayan et al., 2013; WHO, 2015). Although India has developed a National Action Plan on Antimicrobial Resistance, translating national policy into effective stewardship practices at the community level remains a considerable challenge (Government of India, 2017; WHO, 2015).

These challenges are particularly evident in rural areas, where shortages of formally trained healthcare professionals, limited accessibility of public health facilities, and financial constraints often restrict access to timely healthcare services. Within these contexts, rural healthcare providers (RHPs) play a pivotal role in delivering primary healthcare and frequently represent the first point of contact for individuals seeking treatment for common illnesses (Bloom et al., 2011; Gautham et al., 2014; Peters & Bloom, 2012). Despite operating outside formal regulatory systems, these providers have become deeply embedded within rural health systems because they are geographically accessible, financially affordable, culturally acceptable, and available beyond conventional healthcare facility operating hours (Sudhinaraset et al., 2013).

Numerous studies have shown that rural healthcare providers manage a substantial proportion of common infectious illnesses, respiratory tract infections, diarrhoeal diseases, skin and soft tissue infections, urinary tract infections, and other uncomplicated community-acquired conditions (Gautham et al., 2014; Sudhinaraset et al., 2013). Their extensive engagement with communities places them in a unique position to influence antibiotic use at the population level. Consequently, improving prescribing practices among rural healthcare providers has been identified as an important opportunity for strengthening antimicrobial stewardship in settings where formal health services remain insufficient to meet community needs (Gautham et al., 2021).

However, previous research has consistently demonstrated that inappropriate antibiotic prescribing is common among rural healthcare providers. Antibiotics are frequently prescribed empirically in the absence of adequate clinical assessment or diagnostic confirmation and are often influenced by diagnostic uncertainty, patient expectations, commercial competition, pharmaceutical marketing, and relationships with medicine distributors (Gautham et al., 2021; Kotwani et al., 2010). Similar prescribing patterns have been reported across several LMICs, where providers often prescribe antibiotics to satisfy patient expectations, minimise perceived clinical risk, or maintain patient loyalty within highly competitive healthcare markets (Ayukekbong et al., 2017; Holloway et al., 2013).

Although antimicrobial stewardship programmes have traditionally focused on hospitals and formally trained healthcare professionals, there is growing recognition that effective stewardship strategies must also engage community-based providers, particularly those practising within rural healthcare systems (Charani & Holmes, 2019; WHO, 2019).

However, stewardship interventions designed for physicians working in tertiary healthcare facilities are often unsuitable for rural providers because they assume levels of diagnostic capacity, clinical training, and resource availability that are not present in many rural settings (Charani & Holmes, 2019; Gautham et al., 2021; WHO, 2019). Implementation of clinical guidelines alone, however, does not guarantee changes in clinical practice. Successful implementation depends on multiple interacting factors, including provider acceptability, usability, technical design, operational integration, social context, economic considerations, market dynamics, legal and regulatory environments, and implementation processes (Damschroder et al., 2009; Proctor et al., 2011; Sekhon et al., 2017).

Addressing this evidence gap is essential for designing scalable antimicrobial stewardship programmes that are responsive to the realities of community-based healthcare delivery in India and other low- and middle-income countries. Against this background, the present study aimed to evaluate the feasibility of implementing antibiotic stewardship guidelines among rural healthcare providers in rural West Bengal. Specifically, the study explored providers' experiences of using the guideline, the facilitators and barriers to implementation, perceived changes in clinical practice, and contextual factors influencing adoption across operational, technical, social, economic, market, legal domains. The findings are intended to inform future implementation strategies for community-based antimicrobial stewardship programmes targeting rural healthcare providers in India and other LMIC settings.

3. Methods

3.1 Study design

An expert committee was established to identify the clinical syndromes with the highest prevalence at the primary care level. Six priority syndromes were selected: acute undifferentiated fever, upper respiratory tract infection (URTI), lower respiratory tract infection (LRTI), urinary tract infection (UTI), acute watery diarrhoea, and skin and soft tissue infection (SSTI). The antibiotic stewardship guidelines were developed to assist rural healthcare providers in identifying key clinical symptoms and red-flag signs, determining when referral to a higher-level health facility was required, and optimising the appropriate use of antibiotics in primary care settings.

Orientation of guidelines with RHPs

Three orientation sessions on the antibiotic stewardship guidelines were conducted at Sreenagar Primary Health Centre (PHC), Chakdah Block, Nadia District, to train rural healthcare providers (RHPs) in the use of the guidelines and to obtain their feedback on the content, usability, and applicability of the recommendations, after use for 2-3 weeks. The pilot implementation focused on four clinical syndromes: acute undifferentiated fever, upper respiratory tract infection, lower respiratory tract infection and acute watery diarrhoea.

This study employed a qualitative descriptive design to evaluate the feasibility of implementing evidence-informed antibiotic stewardship guidelines among rural healthcare providers (RHPs) practising in rural West Bengal, India. A qualitative descriptive approach was considered appropriate because it facilitates a comprehensive understanding of participants' experiences, perceptions, behavioural changes, and contextual factors influencing implementation (Sandelowski, 2000). The study was informed by principles of implementation science and sought to examine multiple dimensions of implementation feasibility, including acceptability, technical feasibility, operational feasibility, social feasibility, economic feasibility, market feasibility, legal feasibility, and schedule feasibility. In-depth interviews (IDIs) were undertaken to explore providers' experiences of integrating the guidelines into routine clinical practice, identify facilitators and barriers to implementation, and generate recommendations for future scale-up and sustainability.

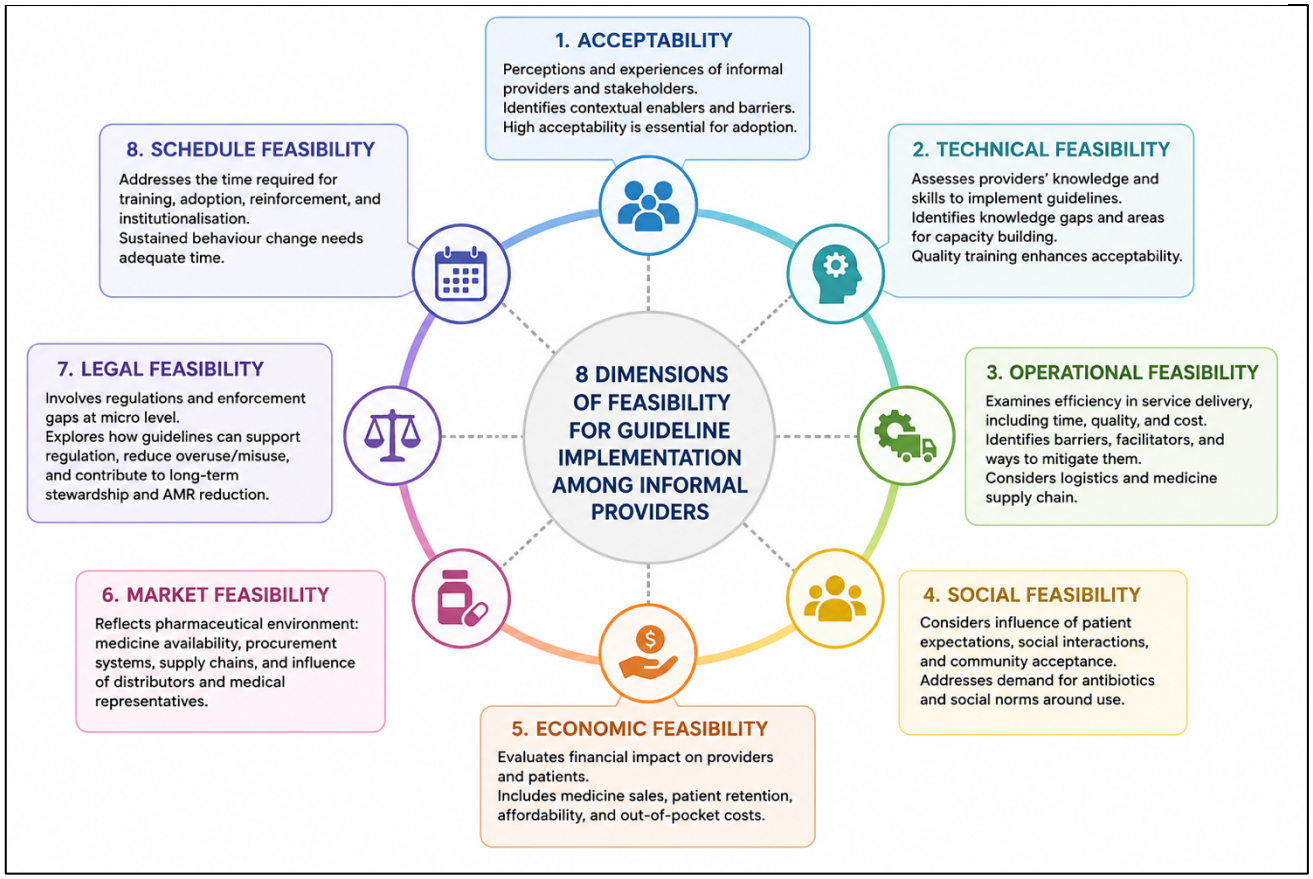
The study is reported in accordance with the Consolidated Criteria for Reporting Qualitative Research (COREQ) checklist to enhance transparency and rigour in qualitative reporting (Tong et al., 2007).

3.2 Conceptual framework

Implementation of antibiotic stewardship interventions is a complex process influenced by multiple interacting behavioural, organisational, social, and health system factors. To guide the study design, data collection, and interpretation of findings, a conceptual framework was developed drawing on established implementation science theories, including the Consolidated Framework for Implementation Research (CFIR), Proctor's Implementation Outcomes Framework, and the Theoretical Framework of Acceptability (TFA) (Damschroder et al., 2009; Proctor et al., 2011; Sekhon et al., 2017). The framework was subsequently adapted to reflect the realities of rural healthcare practice in rural India and informed by findings from the study-specific feasibility assessment.

As illustrated in Figure 1, implementation feasibility was conceptualised as a multidimensional construct comprising eight interrelated domains: acceptability, technical feasibility, operational feasibility, social feasibility, economic feasibility, market feasibility, legal feasibility, and schedule feasibility. Rather than functioning independently, these domains interact dynamically to influence the adoption, integration, sustainability, and potential scale-up of antibiotic stewardship guidelines within routine community healthcare practice.

Figure 1: Framework for assessing feasibility of antibiotic stewardship guideline



At the centre of the framework is Implementation Feasibility of Antibiotic Stewardship Guidelines**,** representing the overall capacity of the intervention to be adopted, integrated into routine clinical practice, and sustained over time. Each feasibility domain contributes directly to this central construct while simultaneously influencing other domains through reciprocal relationships.

- Acceptability reflects of guidelines. It considers the perceptions and experiences of rural providers and stakeholders and helps to know the contextual drivers acting as enablers or barriers in implementing the intervention component (Liu et al., 2022; Gautham et al., 2021).High levels of acceptability are considered essential because providers are unlikely to adopt interventions perceived as impractical or inconsistent with patient expectations.
- Technical feasibility explores and estimates rural provider's knowledge level in implementing the intervention component – guidelines; the extent of gap in knowledge and the areas to build the capacity in order to remove the barrier to implement. Quality of capacity building influences acceptability of intervention components (Rahman et al., 2022).
- Operational – Implementation of the component explore the impact on efficiency in service delivery, predicting barriers and facilitators to reach time, quality and cost efficiency and the ways to mitigate the challenges. Nature of mediating and moderating factors (if any) is also to be explored. The intervention needs to be beneficial in terms of supply chain and logistics – stock of medicine (Gautham et al., 2021; Liu et al., 2022).
- Social feasibility captures the influence of patient expectations as prescribing behaviour is often shaped by social interactions, community acceptance is fundamental to successful stewardship interventions. Studies show that patient's perception and knowledge about antibiotics are important drivers of demand for antibiotics and IPs prescribe them in fear of patient retention (King et al., 2022; Gautham et al.., 2021). Another study has shown that antibiotic use is common as prophylactic measure within communities where antibiotics are available without prescription (Bandyopadhyay & Samanta, 2020).
- Economic feasibility considers the financial implications of guideline implementation for providers and patients, including perceived effects on medicine sales, patient retention, affordability of treatment, and out-of-pocket healthcare expenditure (Gautham et al., 2021).
- Market feasibility reflects the broader pharmaceutical environment, including medicine availability, procurement systems, pharmaceutical supply chains, and interactions with distributors and medical representatives that may influence prescribing behaviour (Gautham et al., 2021).
- Legal feasibility encompasses top-down regulations and prescribing of antibiotics at micro level is evident with interpretation and enforcement gaps. It is also difficult to create strict regulations against IPs given the lack of availability of qualified providers in rural areas (Gautham et al., 2021). The legal feasibility aspect needs to explore how the use of these guidelines can ease the process of regulating antibiotic use, stop the overuse or misuse and reduce AMR in the long-run through effective antibiotic stewardship.

- Schedule feasibility represents the temporal dimension of implementation and recognises that sustained behavioural change requires adequate time for training, adoption, reinforcement, and institutionalisation within routine practice (Maghareh et al., 2011).

A distinguishing feature of this framework is the recognition that these eight dimensions are mutually reinforcing rather than hierarchical. Improvements in one domain may strengthen implementation across several others, whereas weaknesses in any single domain may constrain successful implementation despite favourable conditions elsewhere.

3.3 Study setting

The study was conducted among rural healthcare providers (RHPs) practising in Srinagar village, Chakdah Block, Nadia District, West Bengal, India**.** The study area is predominantly rural, with dispersed populations and limited accessibility to formal healthcare services. Consequently, rural healthcare providers constitute an important source of first-contact primary healthcare because of their geographical accessibility, affordability, flexible consultation hours, and longstanding relationships with local communities.

Rural healthcare providers in the study area routinely manage common infectious illnesses, including respiratory tract infections, diarrhoeal diseases, skin and soft tissue infections, and urinary tract infections. Their central role in community healthcare delivery makes them key stakeholders in efforts to improve rational antibiotic use and antimicrobial stewardship.

The implementation programme introduced simplified antibiotic stewardship guidelines specifically developed for rural healthcare providers managing common community-acquired infections. Before implementation, participating providers attended structured orientation and training sessions that introduced the principles of antimicrobial stewardship, symptom-based diagnosis, severity assessment, appropriate antibiotic use, supportive treatment, and referral practices. Following several months of routine use, qualitative interviews were conducted to explore participants' experiences of guideline implementation and its influence on prescribing behaviour, patient management, and clinical decision-making.

3.4 Participant recruitment

Participants were recruited from the cohort of rural healthcare providers who had participated in the implementation of the antibiotic stewardship intervention. Eligible participants were providers who were actively practising within the study area, had completed the orientation programme, had routinely used the antibiotic stewardship guideline for an adequate period to provide informed reflections on implementation, and were willing to participate in an audio-recorded interview.

Potential participants were approached by trained qualitative researchers who had established rapport with providers during the implementation phase of the study. The objectives and procedures of the qualitative study were explained in Bengali, and written informed consent was obtained from all participants before commencement of the

interviews. Participants were assured that participation was entirely voluntary, that confidentiality would be maintained throughout the study, and that declining participation would not affect their involvement in any future programme activities. Interviews were scheduled at times convenient to participants to minimise disruption to routine clinical practice.

3.5 Sampling strategy

A purposive sampling strategy was employed to capture a broad range of implementation experiences among rural healthcare providers. Participants were selected to ensure variation in age, years of independent practice, patient volume, previous healthcare experience, and practice characteristics. This maximum variation sampling approach enabled exploration of diverse perspectives regarding implementation across different provider profiles and practice settings.

Sampling continued until saturation was achieved, whereby additional interviews no longer generated substantially new insights relevant to the study objectives (Malterud et al., 2016). Rather than aiming for statistical representation, sampling sought to obtain rich, information-dense data capable of providing a comprehensive understanding of implementation feasibility within the study context.

3.6 Development of the interview guide

A semi-structured interview guide was developed to explore the multidimensional feasibility of implementing antibiotic stewardship guidelines among rural healthcare providers. The guide was informed by implementation science literature, antimicrobial stewardship principles, the conceptual framework underpinning the study, and the specific objectives of the feasibility assessment. It was designed to encourage participants to describe their experiences in their own words while allowing interviewers sufficient flexibility to probe emerging issues and contextual factors.

The interview guide explored seven broad domains as per the framework. Open-ended questions encouraged participants to provide detailed examples from routine clinical practice, while follow-up probes explored the underlying reasons, contextual influences, behavioural changes, and implementation challenges associated with adopting the antibiotic stewardship guidelines. The interview guide was reviewed by members of the multidisciplinary research team to ensure content validity and contextual relevance before field implementation (Annexure-I) .

3.7 Data collection procedures

Conducting In-depth interview with RHPs

Data were collected through face-to-face in-depth interviews (IDIs**)** conducted by experienced qualitative researchers who had received formal training in qualitative interviewing techniques and were familiar with the local healthcare context. Conducting interviews in person enabled researchers to establish rapport with participants, explore implementation experiences in depth, and capture contextual information that may not have been apparent through structured questionnaires alone.

All interviews were conducted in Bengali, the participants' preferred language, to facilitate open discussion and ensure that participants could express their experiences comfortably and accurately. Interviews were undertaken in participants' clinics or other mutually agreed private locations that minimised interruptions and protected participant confidentiality.

Each interview followed the semi-structured interview guide while allowing flexibility to explore issues that emerged during the discussion. Researchers used open-ended questions and probing techniques to clarify responses, explore underlying reasons for participants' decisions, and obtain detailed examples from routine clinical practice. Discussions focused on participants' experiences of implementing the antibiotic stewardship guideline, changes in clinical assessment and prescribing behaviour, patient interactions, referral practices, perceived facilitators and barriers to implementation, and recommendations for improving future implementation strategies.

With participants' written consent, all interviews were digitally audio-recorded and supplemented by detailed field notes documenting contextual observations, non-verbal communication, interviewer reflections. Interview duration varied according to participants' experiences and the depth of discussion. At the conclusion of each interview, participants were invited to share any additional comments or recommendations that had not been covered during the interview.

3.8 Data management and analysis

Audio recordings were transcribed verbatim in Bengali and subsequently translated into English by trained bilingual researchers familiar with the study context. To enhance translation accuracy, selected transcripts were independently compared with the original audio recordings, and discrepancies were resolved through discussion among members of

the research team. All transcripts were anonymised before analysis by removing names, clinic identifiers, and other potentially identifying information. Electronic files, transcripts, and audio recordings were stored on password-protected computers accessible only to authorised members of the research team.

Data were analysed using reflexive thematic analysis, following the six-phase analytical approach described by Braun and Clarke (2006, 2022). Analysis commenced with repeated reading of all transcripts to achieve familiarity with the data and develop an overall understanding of participants' implementation experiences. During this phase, researchers documented preliminary observations and analytical memos to capture emerging concepts and potential relationships among codes.

Meaningful text segments were then coded systematically using a deductive–inductive analytical approach. Deductive codes were informed by the conceptual framework, study objectives, and interview guide, whereas inductive codes emerged directly from participants' narratives. This approach enabled the analysis to remain theoretically informed while allowing unexpected findings and contextual influences to emerge naturally from the data.

Following initial coding, related codes were grouped into broader descriptive categories and subsequently refined into higher-order themes through an iterative process involving constant comparison across interviews. The final analysis explored providers' experiences across multiple dimensions of implementation feasibility, including acceptability, technical feasibility, operational feasibility, social feasibility, economic feasibility, market feasibility, legal feasibility, and implementation sustainability. Particular attention was given to identifying interactions among these domains and understanding how contextual factors influenced implementation within routine community healthcare practice.

3.9 Development of the coding framework

A hierarchical coding framework was developed to organise and synthesise qualitative findings systematically. The framework combined deductive coding, informed by the conceptual framework and interview guide, with inductive coding derived from participants' lived experiences during implementation. This approach ensured that analysis remained closely aligned with the study objectives while retaining sufficient flexibility to capture emerging implementation issues not anticipated during study design.

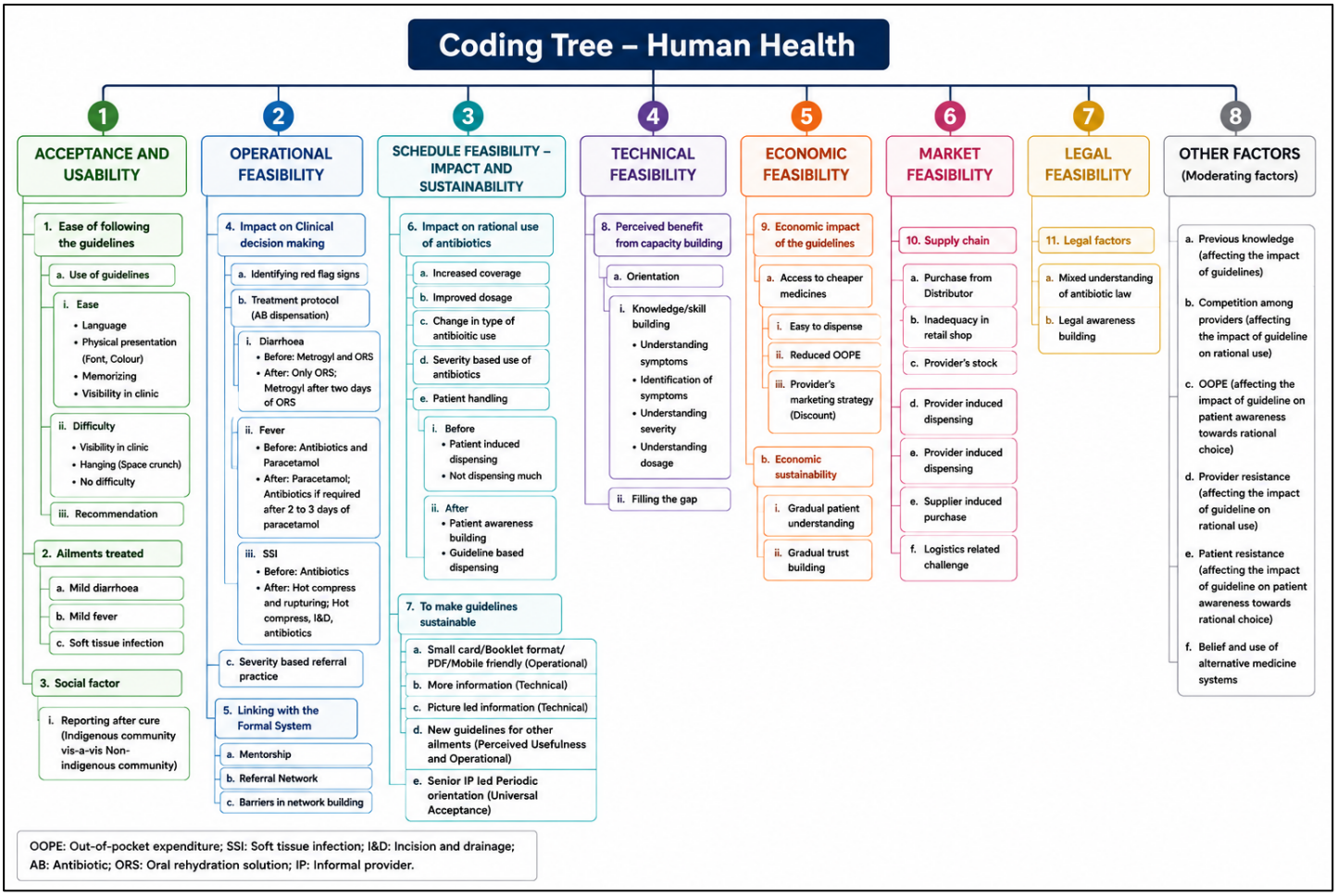
Initial coding focused on participants' descriptions of guideline implementation, prescribing practices, facilitators and barriers to adoption, behavioural changes, and recommendations for programme improvement. Similar codes were progressively grouped into broader categories through continuous comparison across interviews, allowing refinement of both descriptive and interpretive themes.

The final coding framework was organised around the eight predefined feasibility domains underpinning the study (Figure 2). Within each domain, hierarchical coding captured progressively finer levels of interpretation, facilitating both descriptive and explanatory analysis of implementation experiences. Several contextual factors—including patient

expectations for antibiotics, previous clinical experience, provider competition, financial constraints, and community healthcare-seeking behaviours—were identified as cross-cutting influences operating across multiple feasibility domains. Rather than functioning as independent themes, these factors were interpreted as implementation moderators that shaped providers' experiences and influenced adoption of the antibiotic stewardship guideline.

The coding tree (Figure 2) provides a transparent visual representation of the analytical process by illustrating how lower-order codes were progressively synthesised into broader subthemes and overarching implementation themes.

Figure 2. Coding Tree



3.10 Ethics

Ethical approval was obtained through the LSHTM's Research Ethics Committee (reference code: 30367). and from Indian Ethics Committees: Public Health Foundation of India Institutional Review Board (reference code: TRC-IEC 448/20, extension approval reference code: TRC-IEC 448.1/20) and West Bengal University of Animal and Fishery Sciences (reference code: IAEC/190(XVII)/B).

4. Result

4.1 Participant characteristics

A total of 9 rural healthcare providers (RHPs) participated in the qualitative study. Participants represented multiple rural practice locations within Srinagar village, Chakdah Block, Nadia district, West Bengal, and reflected considerable diversity in age, years of clinical practice, patient volume, and previous healthcare experience. This variation enabled exploration of a wide range of perspectives regarding the implementation of the antibiotic stewardship guidelines.

The participants had a median of 10 years of independent clinical practice (range: 1–43 years) and had been working in their current clinics for a median of 8 years (range: 9 months–20 years). All participants operated clinic-based practices and reported using allopathic medicines as part of routine patient care, while a few also reported using Ayurvedic or homeopathic medicines. Although none possessed formal medical, nursing, pharmacy, or paramedical qualifications, several had certificates from rural medical practitioner (RMP) associations or other alternative medicine training programmes.

All participants owned a smartphone and had access to the internet, indicating a favourable environment for implementing digital or mobile-based antibiotic stewardship interventions. The providers routinely managed common community-acquired infectious illnesses and had all participated in the antibiotic stewardship orientation programme before the interviews. Their varied levels of clinical experience and practice settings provided rich insights into the acceptability and feasibility of implementing the stewardship guidelines in routine practice.

Table 1. Characteristics of study participants (N = 9)

Characteristic	Value
Number of participants	9
Study area	Srinagar village, Chakdah Block, Nadia district, West Bengal
Years of independent practice (median)	10.5
Years in current clinic (median)	8
Clinic-based practice (%)	100
Smartphone ownership (%)	100
Internet access (%)	100
Previous experience as compounder/assistant (%)	100
Dispenses antibiotics from clinic (%)	77.8

Previous healthcare-related certification	Mainly Rural Medical Practitioner (RMP) or alternative medicine certificates; no formal medical or nursing qualifications
Exposure to intervention	Received antibiotic stewardship guideline orientation
Conditions commonly managed	Fever, diarrhoeal illness, respiratory infections, urinary tract infections, skin and soft tissue infections, and other common community-acquired illnesses

4.2 Acceptability and Usability

Overall, the antibiotic stewardship guidelines were highly acceptable to the participating rural healthcare providers (RHPs). Eight of the nine interviewed providers expressed a clear willingness to modify their antibiotic prescribing practices in accordance with the recommendations outlined in the guidelines. Participants consistently described the guidelines as a credible and trustworthy source of clinical information that provided more structured and evidence-informed treatment recommendations than the approaches they had previously followed. Many reported that the guidelines increased their confidence in identifying symptoms, assessing disease severity, making treatment and referral decisions, and selecting appropriate management strategies.

One participant described the value of the guidelines as follows:

“How to identify the illness is the best functionality of these guidelines…” (FS_IDI_1_IP_01).

Another participant stated:

“I couldn’t understand symptoms before receiving guidelines...but after receiving guidelines I ask patients and following that I give medicines according to what is written in the guideline...Guidelines are very helpful...” (FS_IDI_1_IP_07).

Although participants demonstrated a strong willingness to adopt the guidelines, their decisions regarding adherence were influenced by several contextual factors. These included the nature and severity of the patient's illness, patient expectations regarding antibiotics, and the need to maintain good relationships with patients in a competitive healthcare environment. While providers generally accepted the principle of rational antibiotic use, discussions also suggested some hesitation in changing long-established prescribing practices, particularly with respect to the selection of antibiotics. This appeared to reflect incomplete understanding of antibiotic classifications, generic and brand names, and the concept of appropriate dosing rather than reluctance to engage with the intervention itself.

Participants reported that the guidelines had already influenced their routine prescribing behaviour. One of the most notable changes was a reduction in the immediate use of antibiotics during the first patient consultation. Several providers explained that they now preferred to observe patients initially and provide supportive treatment before considering

antibiotic therapy. Although the guidelines recommend referral to a formally qualified practitioner rather than antibiotic prescribing by rural providers when symptoms persist or worsen, interviews indicated that some participants still prescribed antibiotics after an initial period of observation. Nevertheless, compared with their previous practice, this represented a positive shift towards more cautious and rational prescribing.

As one participant explained:

Previously, I was using more antibiotics than now… I used to give antibiotics to patients who had fever for 5 or 6 hours… but it was not a strong dose… amoxicillin 500…but now I am not doing it..." (FS_IDI_2_IP_03).

Another participant reflected:

"Now I first give paracetamol or ORS and explain to the patient why antibiotics are not always necessary. Many patients recover without antibiotics." (FS_IDI_2_IP_07)

Providers gave numerous examples of new assessment techniques that they had incorporated into routine practice. For patients with diarrhoea, they reported assessing dehydration using clinical signs such as skin turgor, loss of skin elasticity, sunken eyes, fatigue, and restlessness. For patients presenting with fever or respiratory symptoms, they described paying greater attention to cough, chest pain, ear pain, runny nose, body aches, and other associated symptoms before making treatment decisions. Participants explained that these structured assessments helped them determine whether additional investigations were required and when referral to a higher-level facility was appropriate.

Participants also highlighted the importance of the colour-coded severity classification used throughout the guideline. The progressive change in background colour from green to yellow and red enabled providers to recognise increasing disease severity quickly and to follow the corresponding management recommendations. Many considered this visual presentation particularly useful during busy consultations because it reduced uncertainty and facilitated rapid decision-making.

One participant described the usefulness of the colour coding:

"We could not divide the stages before. Now the green, yellow and red colours make it much easier to understand whether the condition is mild or severe." (FS_IDI_1_IP_04)

Another participant added:

“Like red indicates the danger and I have to refer to the patient and can't hold the patient…” (FS_IDI_2_IP_08).

Though the guidelines are very helpful in their practice IPs also discussed about some barriers in uninterrupted use of the guidelines. Among those factors most of them talked about highly competitive market for rural providers. Due to higher concentration of many rural practitioners in a small locality increases patients bargaining power and they force them to prescribe certain antibiotics of certain dose.

"Patients ask for one or two doses of medicines and mention the names – Calpol 500/650, Metrogyl 400…I give according to their demand…" (FS_IDI_1_IP_07).

The second challenge is ensuring dosage compliance. One of them shared that among total number of patients, less than half of them reports back and half of them completes full dosage.

"It is a challenge for me...what I do is that I repeatedly tell them that if today they are taking it at 10 AM then tomorrow they have to take it again exactly at 10 AM...if they are not taking the full dose, they will be in danger...the medicine will stop working on them...but some of them forget…" (FS_IDI_2_IP_07).

Nevertheless, participants consistently regarded the guidelines reliable and trustworthy. To increase the usability of the guidelines, IPs recommend to add more explanation about antibiotics with pictures to explain symptoms, arrange monthly orientation sessions, setting up of one telephonic medium with medically trained doctors for on-call guidance, and adding new sections on different varieties of medicines by stages of severity.

"I think more options of different medicines at different stages of treatment and based on how serious it is - will be very helpful along with how possible side effects can be avoided…" (FS_IDI_2_IP_06).

According to them repeated training sessions including all the IPs in a locality will break the resistance among IPs who do not want to use the guidelines. They also mentioned that if all the IPs in a locality are considered it will be easier to convince the patients with reduced competition and increased collaboration between IPs, thereby increasing the acceptability and usability of the guidelines further. One of them mentioned to connect this antibiotic stewardship initiative with the RMP association in the district to ease the process. Overall, it seems that building adherence to antibiotic policies require more efforts starting with revision sessions to correct the misinterpretation of the guidelines.

4.3 Operational feasibility

Operational feasibility emerged as one of the strongest domains of implementation, reflecting the extent to which the antibiotic stewardship guidelines could be integrated into the routine workflow of rural healthcare providers (RHPs). Participants consistently described the guidelines as practical and useful in supporting day-to-day clinical decision-making. However, their experiences also highlighted several operational considerations relating to placement of the guidelines, methods of use, medicine availability, clinic infrastructure, and time constraints that influenced routine implementation.

Participants adopted different strategies for keeping and using the guidelines depending on their clinic environment and working practices. Some preferred to keep the guidelines at home, where they could read them carefully during the evening and memorise the recommendations before applying them during clinical practice. They explained that consulting the guidelines during patient consultations was often impractical because of heavy patient load and limited consultation time.

As one participant explained:

"I have kept that in my house… I read that after returning home… I follow it… I am following it at night… Because it is impossible to follow it here…" (FS_IDI_1_IP_01).

Another participant similarly stated:

"I read it in my house. These are really big; therefore, I cannot keep them on the table here…" (FS_IDI_2_IP_01).

In contrast, several providers preferred to keep the guidelines within their clinics so that they could consult them whenever required. Participants explained that repeated exposure to the guidelines during routine consultations helped reinforce their learning and gradually improved recall of treatment recommendations.

RHPs consulting the guidelines

One participant commented:

"I keep them here...since I am applying them continuously in my work, these are in my memory, I can memorize easily. I go through them before patients visit and also after their visit..." (FS_IDI_2_IP_04).

Participants also discussed preferences regarding the size and placement of the printed guidelines. Smaller laminated versions were considered easier to hang within clinics and more practical for everyday use, whereas larger posters were appreciated because they could be read from a distance and were perceived to increase patient awareness regarding appropriate treatment practices.

Participants described different approaches to incorporating the guidelines into routine clinical practice. Several providers preferred to study the guidelines at home and memorise the recommendations before applying them during patient consultations. Others reviewed the guidelines during quieter periods at the clinic or referred to them when managing patients presenting with symptoms covered by the intervention.

One participant explained:

"I always keep them with me and check when needed. For example, now I am reading in details about the different types of UTI…" (FS_IDI_1_IP_04, FS_IDI_2_IP_05).

Another participant described how the guidelines had become part of routine practice:

*"After receiving these guidelines, I started to understand them thoroughly in my clinic. I also hang them on the wall of my clinic as you can see…" (*FS_IDI_2_IP_07).

Despite the high operational feasibility of the intervention, participants identified several practical challenges affecting routine implementation. The most frequently reported barrier was the limited physical space available within clinics to display the larger printed guidelines. Heavy patient workload and limited consultation time also reduced opportunities to consult the guidelines during patient encounters, leading many providers to rely on memorisation.

One participant explained:

"I cannot follow it here…if I want to follow it here, I will see those patients or follow it? That cannot be done…" (FS_IDI_1_IP_01).

Participants also expressed concern that introducing too many guidelines simultaneously could reduce their ability to remember and correctly apply the recommendations. Several participants explained that attending the orientation sessions carefully made it easier to remember the treatment recommendations. Others suggested that periodic refresher training would help reinforce learning, particularly if additional disease-specific guidelines were introduced in future.

"I think these two topic related guidelines given to us … one is loose motion and another is for fever… I think these are enough. If you give more information than that then it might not be in our knowledge…" (FS_IDI_1_IP_01).

Another participant highlighted the constraints imposed by clinic infrastructure:

"The larger ones take so much place given the limited place in my clinic it becomes difficult to hang on the walls…" (FS_IDI_2_IP_06).

Participants generally reported that the medicines recommended in the guidelines were readily available through local pharmacies and medicine suppliers, suggesting that medicine availability was not a major barrier to implementation. Commonly recommended medicines, including antibiotics and supportive treatments, were usually accessible within local markets.

One participant confirmed medicine availability:

"Interviewer: Are the medicines mentioned in the guidelines available in your shop? Interviewee: Yes…doxycycline…cefixime??Check…Azithromycin…These are available here…" (FS_IDI_2_IP_01).

When recommended medicines were unavailable, participants adopted different approaches depending on the clinical situation. Some preferred referring patients to another practitioner rather than delaying treatment.

One participant explained:

"Interviewer: Suppose, there is a medicine written in the guideline and you did not have that medicine then what do you do?
Interviewee: Then I tell the patient to go to another doctor… I do not hold the patient here… it is not good for the patient…" (FS_IDI_1_IP_03).

Others reported substituting medicines that they considered clinically appropriate based on symptom presentation.

"If not available...still we have to give antibiotic...for example, Clavum is written...but I do not have that...I am then checking which symptoms are written correspondingly...if I find that Azithral will also work, then I will give that…" (FS_IDI_1_IP_05_06).

Several participants also described actively managing medicine supply through established distributor networks.

"if I need any medicine, I talk to the distributor and tell them what medicines are needed and they supply based on the list given by me… When these people do not deliver, we have to go to Bonga or there is Parul pharmacy… from these places I collect the medicines…." (FS_IDI_2_IP_03).

To address these operational barriers, participants recommended providing the guidelines in digital formats such as mobile applications or downloadable PDF versions, introducing periodic refresher training sessions, and developing additional disease-specific guidelines gradually rather than simultaneously. These suggestions indicate that relatively simple implementation modifications could substantially improve integration of the guidelines into routine clinical practice while maintaining their high level of operational acceptability.

4.4 Technical Feasibility

Patient consultation by RHPs *(display of guidelines in wall)*

Technical feasibility was consistently rated as high and emerged as one of the principal facilitators of guideline adoption. Participants described the antibiotic stewardship guidelines as simple, practical, and closely aligned with their routine clinical practice. The use of the Bengali language, colour-coded treatment pathways, symptom-based diagnostic algorithms, and disease-specific management recommendations substantially improved readability, comprehension, and confidence in applying the guidelines during patient consultations.

Majority of them mentioned that the guidelines are easy to understand. One of them added that the information are organised properly and terminologies are easy to recognize. Use of

Bengali language to describe the components made it easier and one of them suggested including English terminologies in English fonts along with Bengali meaning to increase clarity. They mentioned that guidelines explained very lucidly the clinical diagnosis techniques, names and dosage of medicines by symptoms and when to prescribe at which amount. They feel the structure and contents are okay, however, the preference of smaller and bigger size varies.

"I have no difficulty...previously it was difficult for me to understand what should be the dose for an ailment, who needs how much...I couldn't understand symptoms before receiving guidelines...but after receiving guidelines I ask patients and following that I give medicines according to what is written in the guideline...Guidelines are very helpful…" (FS_IDI_1_IP_07).

"...as per our education level, understanding these is creating barriers for us… if these guidelines would be more detailed and also if more time would be taken for the explanation… then it will be more helpful for us, especially for me...there is … the name of the antibiotics… there are multiple names of antibiotics suggested in those guidelines… it's difficult to understand…" (FS_IDI_2_IP_08)

Different suggestions came out from the IP interviews related to the technical improvements of the guidelines. Some of them recommended adding more notes, more explanation on detailed medicine specific dosage, step by step explanation of symptoms, treatment protocol, medicines will be useful to enhance knowledge further. Three of them suggested adding more pictures describing the symptoms followed by explanation will be more helpful. Most of them want the guidelines in PDF or book format.

"I will like more pictures of different examples...say different symptoms of diseases and related pictures explaining each symptom in more detail...with those extra pictures…" (FS_IDI_2_IP_05).

"I can tell you that whatever is presented in the guideline is okay for me. Plus, the explanation is also good…the step-by-step representation is okay… the colour used is good; like red indicates the danger and I have to refer to the patient and can't hold the patient…" (FS_IDI_2_IP_08).

They also suggested creating WhatsApp group as a common platform with medically trained doctors for doubt clearing and need based discussions as the guidelines cover only a limited number of diseases. Demand for revision classes on monthly basis is evident. Furthermore, one of them suggested adding the types of laboratory test required by disease will be very helpful in their practice.

"...because it is not possible to give guidelines for everything… Therefore, 1 telephonic medium is required so we can call the doctor and take advice… or an immediate WhatsApp response from a doctor who will guide what to do in that condition…" (FS_IDI_2_IP_02).

"...say, the guideline of fever...more or less it is okay...now related to the diagnostic part, after how long do I need to conduct blood test?...what I know is that if I give antibiotic first

and then go for test then I will not get the accurate result...it will not reflect because the bacteria already have started dying...for example, Typhoid... or I don't know what will happen in case of Malaria or Dengue. So I need more information on when to do a blood test and for whom which test is to be done…" (FS_IDI_2_IP_07).

Participants repeatedly identified symptom recognition and structured clinical assessment as the most valuable components of the guidelines. Before receiving the orientation, many providers acknowledged relying primarily on patients' self-reported complaints, such as "fever" or "infection", without systematically assessing danger signs or differentiating disease severity. The stepwise algorithms encouraged a more comprehensive clinical assessment, enabling providers to identify warning signs, classify illness severity, and make more appropriate treatment and referral decisions.

One participant described this change as follows:

"How to identify the illness is the best functionality of these guidelines." (FS_IDI_1_IP_01)

Another participant explained:

"I couldn't understand the symptoms before receiving the guidelines, but after receiving them I ask patients about the symptoms and give medicines according to what is written in the guideline. The guidelines are very helpful." (FS_IDI_1_IP_07)

Several providers reported that detailed descriptions of symptoms, including dehydration, loss of skin elasticity, sunken eyes, chest pain, cough, ear pain, and respiratory distress, improved their ability to distinguish between mild and severe illness. This represented a significant departure from previous practice, where treatment decisions were often guided by patient complaints or clinical intuition rather than structured assessment.

The colour-coded severity classification was consistently highlighted as one of the most useful design features. Participants reported that the graduated use of green, yellow, and red backgrounds enabled rapid interpretation of illness severity and reduced uncertainty during consultations. In particular, the red colour acted as an immediate visual reminder that the patient required urgent referral rather than continued treatment within the clinic.

As one participant explained:

"We couldn't divide these stages before. Now the yellow, green and red colours make it much easier to understand the severity." (FS_IDI_1_IP_04)

Another provider stated:

"These colours indicate mild and severe conditions. The red colour indicates a very critical condition." (FS_IDI_1_IP_07)

Participants also appreciated the step-by-step layout of the guideline, reporting that it reduced cognitive burden during consultations and enabled them to navigate treatment decisions more systematically. Many considered the Bengali language, colour coding, and

structured presentation more user-friendly than conventional clinical guidelines developed for formally trained clinicians.

One participant commented:

"Whatever is presented in the guideline is good. The step-by-step explanation is very easy to understand, and the colour coding helps me decide what I should do." (FS_IDI_2_IP_08)

Despite these positive experiences, several technical challenges remained. Although participants generally understood the importance of reducing unnecessary antibiotic use, some demonstrated incomplete understanding of antibiotic classification, generic versus brand names, dose calculations, and substitution of medicines when recommended products were unavailable. A few providers appeared to combine recommendations from different disease-specific guidelines, suggesting that although knowledge had improved, mastery of the complete treatment algorithms remained incomplete.

One participant explained:

"Some antibiotic names are difficult to remember because we usually know medicines by their brand names." (FS_IDI_2_IP_05)

Another participant requested greater detail within the guideline:

"These guidelines are very helpful, but if they contained more names of antibiotics, especially the local brands and their dosages, it would be even more useful." (FS_IDI_2_IP_05)

4.5 Social Feasibility

Social feasibility reflected the complex interaction between guideline recommendations, patient expectations, community perceptions of healthcare quality, and the competitive environment in which rural healthcare providers practise. Although participants overwhelmingly supported the principles of rational antibiotic use, they recognised that sustained implementation depended not only on their own behaviour but also on the willingness of patients and communities to accept treatment approaches that differed from long-established prescribing practices.

Importantly, participants described a noticeable shift from patient-induced antibiotic prescribing towards knowledge-informed clinical decision-making. Prior to implementation of the guidelines, prescribing decisions were often influenced by patients' expectations for antibiotics or injections. Following training, participants reported increasing confidence in recommending treatment based on clinical assessment and guideline recommendations rather than patient demand. Although complete behavioural change had not yet been achieved, participants believed that the guidelines had strengthened their ability to negotiate treatment decisions with patients.

One participant explained how patients had begun to recognise the benefits of the new prescribing approach:

"*…They mention that "doctor you used to give antibiotics before, but we are now getting cured without antibiotics". It is taking time, but they are feeling better, and they are also realizing that. The person who you saw visited now, everyone had fever in his house a couple of days ago. I have given only paracetamol to all of them and asked for saline gargle (kuli kora). They are now cured…"* (FS_IDI_2_IP_05).

Another participant described how patient feedback influenced his confidence in implementing the guidelines:

"...after meeting you people I collect feedback from my patients...some of them report that they are cured...some of them report that they are cured to some extent...I also consult with the doctor reporting about which medicines I have given and share what patients are reporting...this is how I am following…patients do not just accept the medicine I offer…they see what I am giving first, judge it and then take it…" (FS_IDI_1_IP_07).

Participants acknowledged, however, that changing patient expectations remained challenging. Many of patients still request antibiotics because they believed these medicines provided faster relief. Some providers also experienced dissatisfaction among patients who perceived that recovery took longer when antibiotics were withheld. Nevertheless, participants explained that they actively engaged in discussions with patients to justify treatment decisions and gradually build acceptance of the guideline recommendations.

"…When someone tells us to give antibiotics, we tell them that using antibiotics can affect them in the long run… I try to give them examples from real life… I tell them that if you keep using antibiotics then there will be a time when using antibiotics will not affect your body anymore…" (FS_IDI_2_IP_03)

One participant explained how economic considerations were used to encourage acceptance of the recommended treatment:

"...but who understands my words...listen to me...I tell them that if they buy antibiotic, they have to spend more...if they recover with a little treatment that is better for them. Some of them understand..." (FS_IDI_2_IP_07).

Similarly, another participant explained how patients requesting intravenous fluids were counselled regarding appropriate treatment:

"*…but I am telling them that using saline without purpose is not necessary…saline can only be taken when the patient is dehydrated, if the patient does not have dehydration what is the need of using saline… I am telling them to drink sugar and salt saline water at home… If necessary, use electral or ORS… then it will be okay… when I say all these things to them, patients usually listen to me…"* (FS_IDI_1_IP_01).

Participants perceived that these educational discussions gradually improved patient understanding and increased acceptance of supportive treatment approaches such as ORS and paracetamol in place of antibiotics. Although success varied between providers, most believed that awareness was increasing and that patients were beginning to appreciate the long-term benefits of rational antibiotic use.

Patient trust emerged as one of the strongest facilitators of social feasibility. Participants explained that successful treatment without antibiotics reinforced patients' confidence in the providers' clinical judgement and strengthened acceptance of guideline-based care. Many anticipated that positive patient experiences would generate spillover effects through word-of-mouth recommendations, leading to increased patient attendance in the future.

One participant described this process:

"I will continue to make them aware about this treatment process...how it is beneficial to them...if they get cured, they will trust more...will share with other village people and gradually they will also believe in this way of practice. That will also help to increase my patient load compared to before. To succeed with this treatment practice, I have to give them some medicine to believe…" (FS_IDI_2_IP_06).

Participants recognised that individual behaviour change alone would not be sufficient to transform community prescribing practices. Several providers argued that wider implementation among all rural healthcare providers within the community would reduce patient confusion, minimise competition based on antibiotic prescribing, and increase public confidence in the revised treatment approach.

One participant explained:

"…Also following of guidelines should be started by all the village doctors...if that happens then patients will understand that not only this doctor (him)...everyone is following the same...then it is possible to overcome this challenge related to acceptance among patients…It is very important to break the community resistance...each village doctor - while following the guideline - will explain to them every time to enhance their understanding..." (FS_IDI_2_IP_07).

Despite these encouraging experiences, participants acknowledged that some patients remained dissatisfied because recovery occasionally took longer without antibiotics. Providers explained that these situations required additional counselling and reassurance regarding the long-term health benefits of following evidence-based treatment recommendations.

As one participant reflected:

"…The patients are also saying… They are saying that when I gave medicine previously, they used to recover so quickly… now it is taking more time to recover…I have told them that this is the system…previously we used to work in the wrong way…it was harmful for you…" (FS_IDI_2_IP_08).

Participants also described strategies for maintaining patient confidence while adhering to the stewardship guidelines. In situations where patients expected medicines during the consultation, providers sometimes prescribed symptomatic treatments, such as paracetamol, antacids, ORS, or other supportive medicines, rather than immediately prescribing antibiotics. These approaches were intended to reassure patients while allowing time for the illness to improve without unnecessary antibiotic exposure.

One participant explained:

"… At night, I made him drink ORS and gave him a few metrogyl tablets… If I don't give him any medicine, he will think that the doctor has given me only the ORS, how will I recover? That's why I gave him a Metrogyl 400, Antacid, Gas tablet. It will help him till the morning… He drank 2 litres of water with ORS…" (FS_IDI_1_IP_02).

4.6 Economic Feasibility

Most participants acknowledged that following the guideline-based treatment protocol had reduced, or was expected to reduce, their immediate income because medicines, particularly antibiotics, constitute an important source of earnings for rural healthcare providers. Delaying antibiotic prescribing or replacing antibiotics with supportive treatment reduced medicine sales, creating concern regarding short-term financial sustainability. However, many participants considered this reduction to be temporary and believed that providing effective treatment with fewer medicines would enhance their reputation and ultimately attract more patients.

One participant explained:

"The reason is when people will be benefited from my treatment they will tell others that among these rural practitioners in this area there is one person who cures with less medicine then I will earn fame. Gradually, more people will visit me and my earning will increase"... (FS_IDI_2_IP_04).

Not all participants experienced financial loss following implementation. Providers who owned pharmacies or generated additional income through medicine supply or collaboration with medically qualified practitioners perceived little or no negative financial impact, as alternative income sources compensated for reduced antibiotic sales.

As one participant stated:

"No, this changed practice has not affected my income. Here in my clinic MBBS doctor and dentist also sit every week and treat patients. Therefore, patients also purchase medicines that they prescribe. I also get orders of medicines from other clinics and supply medicines to them" (FS_IDI_2_IP_05).

Participants also recognised that the highly competitive nature of rural healthcare created additional economic uncertainty. Several providers expressed concern that withholding antibiotics might encourage patients to seek treatment from competing providers who continued to prescribe antibiotics according to patient demand. They feared that losing patients would not only reduce their current income but could also affect future patient attendance, particularly among patients travelling from distant villages who expected rapid recovery.

Nevertheless, many participants viewed these risks as temporary and believed that adherence to the guidelines would strengthen long-term practice sustainability. They explained that patients who experienced successful treatment with fewer medicines would

gradually develop greater confidence in their services, resulting in increased patient loyalty and improved professional reputation. Several providers also recognised that reducing unnecessary antibiotic use could help preserve antibiotic effectiveness by slowing the development of antimicrobial resistance, thereby maintaining the future value of antibiotics as an important treatment option.

"The reason is when people will be benefited from my treatment they will tell others that among these rural practitioners in this area there is one person who cures with less medicine then I will earn fame. Gradually, more people will visit me and my earning will increase"... (FS_IDI_2_IP_04).

Participants consistently perceived that implementation of the guidelines had reduced patients' out-of-pocket expenditure by encouraging the use of fewer, cheaper, and more appropriate medicines. Many explained that the medicines recommended within the guidelines were less expensive than those they had previously prescribed and that patients appreciated spending less while still recovering successfully. Providers believed that successful treatment with lower-cost medicines strengthened patient trust, enhanced their professional reputation, and ultimately generated positive economic returns through increased patient attendance.

"Medicines recommended in the guideline have reasonable price...I do not take fee for visit. I earn dispensing medicines. Now I can also offer 10% discount. Based on economic condition of patients to some of them I dispense medicine for free…" (FS_IDI_2_IP_04).

Another participant highlighted the broader benefits of the guideline recommendations:

"I think more options of different medicines at different stages of treatment and based on how serious it is - will be very helpful along with how possible side effects can be avoided...It will also help the patients to have increased trust and they can now save money…" (FS_IDI_2_IP_06).

Participants also observed that patients were gradually recognising the economic benefits of receiving fewer medicines, although this process required time. Rather than directly persuading patients about financial savings, some providers preferred allowing patients to experience these benefits themselves, believing that positive experiences would encourage wider acceptance through word-of-mouth within the community.

As one participant explained:

"Some of them are realizing, however, it is difficult to make them understand by us because they will take it differently. They will think we have some interest so we are discussing on this matter. So I will not discuss about it with them. This is to be realised so it will take time. Some of my patients are already telling others that if I visit this village doctors I cure with less expense…" (FS_IDI_2_IP_06).

Although participants generally perceived the guidelines to be economically advantageous for patients, not all providers viewed the changes positively from a business perspective.

One participant commented:

"...Maybe but not for me because not profitable for my patients…" (FS_IDI_2_IP_07).

Despite this concern, participants consistently emphasised that patient health and financial protection remained important considerations in their clinical decision-making. Several providers explained that the detailed, severity-based treatment recommendations enabled them to prescribe medicines more appropriately while simultaneously reducing unnecessary expenditure for patients.

Participants described several strategies for mitigating actual or anticipated income loss associated with guideline implementation. The most commonly reported strategy involved strengthening patient trust by demonstrating successful treatment outcomes using fewer medicines. Providers believed that patients who recovered successfully would recommend their services to others, generating a gradual increase in patient load that would compensate for reduced medicine sales.

"… the maximum patient in this area are Adivasi…and when they recover after using a small amount of money, they come with three more patients next time… that's why I am telling you that even after giving low price medicines, my overall income remains the same because of the increasing number of patients…" (FS_IDI_2_IP_01).

Several providers also viewed continuous patient education as an important economic strategy. By increasing awareness of the benefits of guideline-based treatment and reinforcing trust, they anticipated that patients would gradually become more accepting of reduced antibiotic use and continue seeking care from them.

One participant described this expectation:

"I will continue to make them aware about this treatment process...that will also help to increase my patient load compared to before. To succeed with this treatment practice, I have to give them some medicine to believe. Previously giving antibiotic I used to earn on an average Rs. 300 from one patient but with successful use of the guidelines I anticipate now I can treat 10 in place of 1 and I can earn 300 from them and thus I can compensate…" (FS_IDI_2_IP_06).

Participants also identified additional approaches for maintaining financial sustainability, including providing treatment on credit, offering discounts to economically disadvantaged patients, diversifying income through pharmacy ownership or medicine supply, and gradually transitioning existing medicine stocks before fully adopting the recommended treatment protocol. Importantly, some providers perceived stewardship itself as an investment in their future livelihood. They recognised that widespread antibiotic resistance would ultimately reduce treatment effectiveness and threaten their long-term ability to manage patients successfully.

"If my patients become antibiotic resistant, it is our loss. If 10 patients become resistant today, 100 will be resistant tomorrow...antibiotics will not work on them. It is dangerous for

us. Keeping in mind the steady earning in future, I have to accept this temporary income loss…" (FS_IDI_2_IP_07).

Participants also described several practical challenges that influenced the economic feasibility of implementing the guidelines. One provider explained that many patients were unable to afford the full course of recommended treatment, requiring providers to modify prescriptions according to patients' financial circumstances. In some situations, medicines were dispensed based on the amount of money patients carried rather than according to the complete treatment protocol, making full adherence to the guidelines difficult.

"Interviewer: Suppose, you have 7 or 8 patients daily and you can follow the guidelines for only three of them… are you able to properly follow the guidelines for those 3 patients? Interviewee: This is a question… Sometimes we have to give the medicine based on how much money they are carrying… sometimes I am unable to give them all the needed medicines as well…" (FS_IDI_2_IP_08).

4.7 Market Feasibility

Market feasibility explored how implementation of the antibiotic stewardship guidelines influenced medicine procurement practices, pharmaceutical supply chains, and relationships with medicine distributors**.** Overall, participants perceived the local pharmaceutical market to be sufficiently flexible to accommodate changes in prescribing behaviour, suggesting that market-related factors were unlikely to present major barriers to wider implementation.

Participants reported noticeable changes in their medicine procurement patterns following introduction of the guidelines. Reduced empirical antibiotic prescribing resulted in lower demand for several commonly dispensed antibiotics, while medicines recommended for supportive management—including oral rehydration solution (ORS), paracetamol, zinc supplementation, and other symptomatic treatments—became increasingly important components of clinic inventories.

"Now I keep more ORS, paracetamol and zinc because these are used more often than before. I buy fewer antibiotics unless they are really needed." (FS_IDI_2_IP_07)

Participants generally believed that medicine distributors and wholesalers would adapt to changing prescribing patterns without major disruption. Most considered market demand to be responsive to prescribing behaviour, with suppliers likely to modify procurement according to changing requirements.

"If doctors prescribe different medicines, the suppliers will eventually stock those medicines. The market changes according to demand." (FS_IDI_2_IP_02)

Nevertheless, several providers described occasional challenges in obtaining specific medicines recommended within the guidelines. When recommended products were unavailable, providers sometimes substituted alternative formulations or equivalent medicines based on local availability and clinical judgement.

"Sometimes the exact medicine mentioned in the guideline is not available. Then we have to use another medicine that is available locally." (FS_IDI_2_IP_05)

Another provider highlighted the practical realities of medicine procurement:

"If suppliers do not bring the medicines we need, sometimes we purchase them ourselves because treating the patient is our first priority." (FS_IDI_1_IP_09)

Importantly, participants did not perceive these supply issues as major barriers to implementation. Rather, they viewed them as manageable operational challenges that could be addressed through improved coordination with wholesalers, pharmacies, and pharmaceutical distributors. Several providers suggested that greater engagement with suppliers during future implementation phases would further facilitate adherence to guideline recommendations.

Overall, the findings suggest that market systems are capable of adapting to stewardship-driven changes in prescribing behaviour**.** Unlike financial incentives or patient expectations, medicine supply chains were not considered major constraints to implementation. This adaptability is encouraging for future scale-up because it indicates that community-based antibiotic stewardship interventions are unlikely to generate substantial disruption within local pharmaceutical markets, provided that recommended medicines remain consistently available.

4.8 Legal Feasibility

Legal feasibility emerged as the weakest implementation domain, reflecting limited awareness of antibiotic-related regulations and prescribing policies among rural healthcare providers (RHPs). Although participants demonstrated increasing understanding of appropriate antibiotic use following the orientation programme, discussions indicated that this knowledge was largely derived from the project training rather than from formal awareness of national antibiotic policies or legal regulations. Most participants perceived the guidelines primarily as practical clinical tools rather than as instruments supporting compliance with regulatory frameworks governing antibiotic use.

Overall, seven of the nine participants reported having little or no knowledge of existing antibiotic policies or legal regulations. Several participants explained that prior to receiving the orientation, their understanding of antibiotic prescribing was largely based on observing the prescribing practices of formally trained doctors rather than knowledge of legal requirements. The orientation programme therefore represented their first structured exposure to the principles of rational antibiotic use and stewardship.

“Yes… Previously we have knowledge about antibiotics from the prescriptions of other doctors… But I didn't have any knowledge about the law previously; my understanding was that other doctors are giving it so I am also giving it…” (FS_IDI_1_IP_02).

Another participant reported limited but important awareness regarding restrictions on dispensing antibiotics without a prescription:

"yes… I know a few things… drugs like antibiotics cannot be sold without prescription… Such as drugs like Azithromycin cannot be given to a patient without proper prescription of a doctor…in our village area people do not care about it and sell this medicine… but I know that… Considering this law is important…" (FS_IDI_1_IP_03).

Although awareness of legal regulations was generally low, participants recognised that inappropriate antibiotic use was widespread within rural communities. Several providers attributed this to the common expectation of rapid recovery among patients, which encouraged early and unnecessary antibiotic use. Participants believed that wider implementation of the antibiotic stewardship guidelines could contribute to reducing inappropriate prescribing practices and improving compliance with rational antibiotic use.

"This is happening here because everyone wants to do a quick treatment for the patient… That is the reason they are choosing antibiotics as their first medicine…If all of us (IPs) use these guidelines properly then it will be beneficial for all of us and for the patients…" (FS_IDI_2_IP_01).

Participants consistently viewed education rather than enforcement as the most appropriate strategy for improving adherence to antibiotic regulations. Several providers suggested that extending the orientation programme to all rural healthcare providers would strengthen understanding of appropriate antibiotic use, increase adherence to recommended prescribing practices, and improve the quality of patient care.

"*I believe that classes are to be arranged for them on one-to-one basis, they are to be explained what right use of antibiotics is and which is wrong use. If you can help your patient to cure in a proper way you will earn fame. Because the case of dehydration which I handled making referral, they came back to me to report, and they are very dissatisfied with IP (doctor) X and telling that to everyone…"* (FS_IDI_2_IP_04).

When asked about other rules or guidance relating to antibiotic use, participants indicated that they occasionally attended meetings organised by associations of rural medical practitioners where antibiotic prescribing was discussed. However, these meetings primarily focused on appropriate treatment practices rather than legal or regulatory requirements. Participants therefore distinguished between learning about good prescribing practices and understanding formal government regulations.

"No no… I do not know anything about any government law… We quack doctors have discussed which antibiotic can be given for which condition…Our rural practitioners… all of us seat together in a place…RMP training has happened in Kanchrapara… Dr. Arun Kumar… they are doing these meetings by themselves…" (FS_IDI_1_IP_02).

These findings suggest that professional networks and peer learning currently play a greater role than formal regulatory systems in shaping antibiotic prescribing practices among rural healthcare providers.

Participants consistently recommended expanding training on the antibiotic stewardship guidelines to a larger number of rural healthcare providers as a strategy for improving

adherence to appropriate antibiotic prescribing practices. Rather than advocating stricter enforcement alone, providers emphasised the importance of increasing awareness, strengthening clinical knowledge, and creating a shared understanding of rational antibiotic use within the wider provider community.

One participant reiterated the collective benefit of wider implementation:

"If all of us (IPs) use these guidelines properly then it will be beneficial for all of us and also for the patients…" (FS_IDI_2_IP_01).

Similarly, another participant emphasised the need for continued education:

"I believe that classes are to be arranged for them on one to one basis, they are to be explained what is right use of antibiotics and which is wrong use. If you can help your patient to cure in a proper way you will earn fame…" (FS_IDI_2_IP_04).

Participants also highlighted the need for greater monitoring of irrational prescribing practices and inappropriate pharmaceutical products. In particular, concerns were raised regarding the use of irrational fixed-dose combinations and banned medicines, which were perceived to contribute to inappropriate antibiotic use.

"I should mention one point here...nowadays different companies are preparing one medicine combining two antibiotics like combining Cefixime and Azithromycin. The doses of the two are different. I think this is not right. Use of irrational drugs is to be reduced...(we must) reduce the use of banned drugs…" (FS_IDI_2_IP_07).

5. Discussion

This study demonstrates that implementing antibiotic stewardship guidelines among rural healthcare providers (RHPs) in rural West Bengal is both feasible and acceptable. Unlike many stewardship interventions that focus primarily on increasing awareness of antimicrobial resistance (AMR), the guidelines were designed to address the practical realities of community-based practice through simplified, symptom-based algorithms, colour-coded severity classifications, and structured referral pathways.

A key contribution of this study is the demonstration that implementation feasibility is multidimensional. As summarised in Table 2, successful implementation was influenced by eight interrelated domains. Acceptability, technical feasibility, and operational feasibility emerged as the strongest facilitators of implementation, while economic, market, legal, and schedule factors shaped the sustainability of behaviour change. These findings reinforce implementation science theory, which recognises that intervention success depends not only on the characteristics of the intervention itself but also on the broader organisational, social, and policy context in which it is implemented (Damschroder et al., 2009; Proctor et al., 2011).

Table 2. Summary of Feasibility Assessment Across the Eight Dimensions of Implementation

Feasibility Domain	Key Facilitators	Key Barriers	Implications for Scale-up
Acceptability and usability	High provider willingness to adopt guidelines; perceived credibility of the guidelines; improved diagnostic confidence; simple language and symptom-based algorithms	Patient expectations for antibiotics; incomplete understanding of some treatment protocols; reluctance to completely stop antibiotic prescribing	Continue orientation programmes, refresher training, and practical mentoring to improve adherence and reinforce appropriate prescribing.
Technical Feasibility	User-friendly design; Bengali language; colour-coded severity classification; improved symptom recognition and referral decisions	Knowledge gaps regarding antibiotic classes, generic versus brand names, dosage calculations, and disease-specific algorithms	Develop digital decision-support tools and provide continuous technical support through refresher training and supervision.
Operational Feasibility	Easy integration into routine practice; flexible placement of guidelines; medicines generally available; improved workflow and clinical decision-making	Limited consultation time; difficulty consulting printed guidelines during practice; space constraints in clinics; reliance on memorisation	Introduce mobile application/PDF versions, phased introduction of new guidelines, and regular reinforcement through supportive supervision.
Social Feasibility	Strong provider–patient trust; increasing patient acceptance following successful treatment; improved patient counselling; growing awareness of rational antibiotic use	Persistent patient demand for antibiotics and injections; competition among providers; misconceptions regarding rapid recovery	Combine provider training with community awareness campaigns, patient education, and engagement of all rural providers within the locality.
Economic Feasibility	Reduced patient out-of-pocket expenditure; improved provider reputation; anticipated increase in long-term patient load; enhanced trust	Short-term reduction in medicine sales; dependence on dispensing income; existing medicine stock; competition affecting patient retention	Consider incentive mechanisms, strengthen patient awareness regarding economic benefits, and promote service-based rather than medicine-based practice models.
Market Feasibility	Availability of recommended medicines; adaptable pharmaceutical supply chains; distributor support; increased use of supportive medicines	Occasional unavailability of recommended medicines; substitution with alternative products; commercial preference for higher-margin medicines	Engage pharmaceutical distributors and pharmacies to ensure uninterrupted availability of guideline-recommended medicines and reduce inappropriate antibiotic promotion.
Legal Feasibility	Positive attitude towards rational antibiotic use; willingness to receive training; recognition of the	Limited awareness of antibiotic regulations; poor understanding of national AMR policies; widespread	Integrate regulatory education into stewardship training, strengthen monitoring of irrational drug use, continued advocacy for limited use of

	importance of appropriate prescribing	over-the-counter antibiotic availability	ACCESS antibiotics under guidance and engage provider associations to improve compliance.
Schedule Feasibility	Providers willing to invest time in learning; gradual incorporation into routine practice; repeated use improved confidence and recall	Limited time during consultations; difficulty memorising multiple guidelines; need for ongoing reinforcement	Adopt phased implementation with periodic refresher training, mentorship, digital learning tools, and continuous supportive supervision to sustain behaviour change.

One of the most important mechanisms underlying implementation was diagnostic empowerment. Providers repeatedly explained that the guidelines improved their ability to identify danger signs, assess disease severity, and determine when referral was necessary. Increased confidence in clinical assessment reduced uncertainty during consultations and enabled providers to delay or avoid unnecessary antibiotic prescribing. Previous studies have identified diagnostic uncertainty as a major driver of inappropriate antibiotic use among both formal and rural healthcare providers (Kotwani et al., 2010; Gautham et al., 2021). Our findings suggest that strengthening diagnostic capability may be a more effective approach to improving prescribing behaviour than focusing solely on knowledge about AMR.

The intervention also enhanced providers' confidence in implementing new prescribing practices and more likely to adopt new behaviours when they believe they possess the skills required to perform them successfully (Bandura, 1997). Participants described increased confidence in assessing symptoms, selecting appropriate treatment, explaining clinical decisions to patients, and making timely referrals. These improvements indicate that the guidelines functioned not only as an educational resource but also as a practical decision-support tool (Gautham et al,2014; Bloom et al 2011)

Operational and technical feasibility further supported implementation by enabling providers to integrate the guidelines into routine service delivery with relatively few disruptions. Participants appreciated the simple Bengali language, colour-coded treatment pathways, and structured symptom-based algorithms, all of which reduced the cognitive demands associated with clinical decision-making. Providers also adapted the intervention to suit their practice environment by reviewing the guidelines at home, displaying them within clinics, or consulting them during quieter periods. Such flexibility enhanced usability and facilitated gradual incorporation into routine clinical workflows. Although participants identified operational challenges, including limited consultation time, restricted clinic space, and difficulties memorising multiple treatment algorithms, these barriers were largely practical rather than conceptual. Importantly, providers proposed feasible solutions, including mobile applications, downloadable PDF versions, and periodic refresher training. These recommendations indicate that relatively modest implementation modifications could substantially strengthen long-term adoption and scalability.

A major finding of this study is that successful implementation extended beyond changes in provider behaviour and depended heavily on patient trust and community acceptance.

Rural healthcare providers practise within highly competitive community environments where prescribing decisions are strongly influenced by patient expectations and provider–patient relationships (Ayukekbong et al 2017; Holloway et al 2013; Ocan et al 2015). Consequently, stewardship interventions must address both provider behaviour and the social context in which prescribing occurs. Consistent with previous studies, participants reported that many patients continued to expect antibiotics or injections for common illnesses, reflecting widespread beliefs that these medicines provide faster or more effective treatment (Gautham et al., 2021; Laxminarayan et al., 2013). However, the present study demonstrates that providers increasingly relied on communication and patient education to negotiate these expectations. Rather than simply refusing patient requests, participants explained the reasons for recommending supportive treatment, discussed the potential harms of unnecessary antibiotic use, and gradually introduced concepts related to antimicrobial resistance during consultations. (Hallsworth et al 2016; Arnold et al 2005)

Perhaps the most important social finding was that successful treatment without antibiotics strengthened rather than weakened patient trust. Participants consistently described how positive clinical outcomes increased patients' confidence in guideline-based care and encouraged them to recommend providers to family members and neighbours. Trust therefore emerged as a central implementation resource linking clinical quality with sustained behaviour change. This finding extends previous research highlighting trust as a defining characteristic of rural healthcare in rural settings (Bloom et al., 2011; Peters & Bloom, 2012). In the present study, trust was not simply an existing attribute of provider–patient relationships but an outcome that was reinforced through improved quality of care.

Nevertheless, participants acknowledged that social barriers remain an important challenge. Competition from providers who continue prescribing antibiotics according to patient demand may undermine long-term adherence to stewardship principles. These findings suggest that provider-focused interventions alone are unlikely to achieve sustained improvements in antibiotic use. Future programmes should therefore combine provider training with community awareness campaigns, engagement of rural provider associations, and broader public education to promote shared understanding of rational antibiotic use.

Although acceptability, technical usability and operational practicality facilitated the initial adoption of the antibiotic stewardship guidelines, the findings demonstrate that long-term implementation depends on broader contextual factors**,** including provider livelihoods, pharmaceutical supply systems, regulatory awareness and the time required for behavioural change. These domains illustrate that antimicrobial stewardship within rural healthcare settings is not solely a clinical intervention but a health systems intervention that operates within complex social and economic environments.

Economic feasibility emerged as one of the important considerations influencing implementation. Participants acknowledged that reducing unnecessary antibiotic prescribing could initially decrease medicine sales and clinic income because medicine dispensing constitutes an important source of livelihood for many rural healthcare providers. Similar economic incentives have been identified as important drivers of antibiotic prescribing among rural providers across South Asia (Bloom et al., 2011; Gautham et al., 2021). However, unlike previous studies that have highlighted financial incentives

primarily as barriers to stewardship, participants in the present study frequently viewed the reduction in medicine sales as a short-term investment that would be compensated through improved reputation, increased patient trust and greater patient retention. This finding suggests that providers increasingly recognised the value of delivering high-quality care rather than maximising medicine sales, reflecting a gradual transition from product-based income generation to service-oriented healthcare.

An equally important observation was that providers perceived stewardship to be economically advantageous for patients. Reduced use of unnecessary antibiotics and greater reliance on supportive treatment lowered patients' out-of-pocket expenditure, which participants believed strengthened community trust and encouraged repeat consultations. These findings indicate that stewardship interventions may generate economic benefits for both providers and patients by simultaneously improving affordability and enhancing provider credibility. Future implementation strategies should therefore emphasise these shared economic benefits when engaging rural healthcare providers.

Market feasibility was generally favourable, suggesting that pharmaceutical supply chains are unlikely to represent a major obstacle to wider implementation. Participants reported that most medicines recommended in the guidelines were available through existing distribution networks and that suppliers were generally responsive to changing prescribing patterns. Nevertheless, occasional shortages of recommended medicines, substitution of alternative products, and financial incentives associated with branded medicines continued to influence prescribing decisions (Yadav P. 2015). These findings reinforce the need to involve pharmacies, distributors and pharmaceutical representatives as partners in community stewardship initiatives so that prescribing behaviour and medicine availability evolve together.

Legal feasibility remained the weakest implementation domain. Most participants had limited awareness of national antibiotic policies, antimicrobial resistance action plans or regulations governing antibiotic dispensing. Their understanding of rational antibiotic use originated largely from the project training rather than from formal regulatory systems. Importantly, however, participants did not demonstrate resistance to appropriate prescribing. Instead, they consistently requested additional education and wider dissemination of the guidelines among their peers. This finding suggests that capacity building and professional engagement may be more effective than regulatory enforcement alone in improving antibiotic stewardship among rural healthcare providers. Incorporating regulatory education into future stewardship programmes, alongside supportive supervision and engagement with professional associations, may strengthen alignment between clinical practice and national AMR policies.

Although schedule feasibility received comparatively less attention during the interviews, it emerged as an important implementation consideration. Participants consistently described stewardship adoption as a gradual process requiring repeated exposure to the guidelines, opportunities to practise new approaches, and reinforcement through routine clinical experience. Behavioural change therefore occurred incrementally rather than immediately following training. Similar observations have been reported in implementation research, where sustained practice change depends on ongoing learning, mentoring and feedback

rather than one-off educational interventions (Fixsen et al., 2005). These findings suggest that future stewardship programmes should adopt phased implementation approaches supported by refresher training, supportive supervision and digital decision-support systems to maintain implementation fidelity over time.

Collectively, these findings demonstrate that implementation is influenced by the interaction of multiple contextual factors rather than by provider knowledge alone. As illustrated in Table 2**,** high acceptability and operational feasibility provide the foundation for implementation, whereas economic, market, legal and schedule factors determine whether new prescribing behaviours can be sustained within routine practice.

6. Policy and programmatic implications

The findings have important implications for antimicrobial stewardship programmes in India and other low- and middle-income countries where rural healthcare providers remain an important source of primary healthcare. Rather than viewing this cadre solely as contributors to inappropriate antibiotic use, the findings demonstrate that they can become active partners in antimicrobial stewardship when provided with contextually appropriate clinical guidance and supportive implementation strategies.

A central implication of this study is that stewardship interventions should prioritise improving clinical decision-making rather than focusing exclusively on antimicrobial resistance awareness**.** Providers consistently adopted the guidelines because they improved symptom recognition, disease severity assessment and referral decisions. Strengthening diagnostic capability therefore appears to represent a more effective mechanism for changing prescribing behaviour than education about AMR alone.

The findings also support adopting a multicomponent implementation strategy for community stewardship. Training should be complemented by periodic refresher sessions, supportive supervision, digital clinical decision-support, patient awareness activities, engagement of informal provider associations, and collaboration with pharmaceutical supply chains. Addressing these interacting influences is likely to improve implementation fidelity and support long-term sustainability.

Finally, the study highlights opportunities to strengthen India's National Action Plan on Antimicrobial Resistance by explicitly engaging rural healthcare providers within community stewardship programmes. Given the large proportion of rural healthcare delivered by this cadre, integrating them into national stewardship strategies represents a pragmatic approach for improving antibiotic use while strengthening access to quality primary healthcare.

7. Limitations

Several limitations should be acknowledged. The study was conducted among a relatively small sample of rural healthcare providers from a single rural block in West Bengal. Although qualitative research seeks depth rather than statistical generalisability,

implementation experiences may differ across geographical regions, healthcare systems and provider networks.

The findings are also based primarily on participants' self-reported experiences and perceptions. Although providers described examples of changes in prescribing behaviour, objective measures such as prescription audits, patient outcome assessments or direct clinical observations were beyond the scope of this feasibility study. Consequently, the study cannot determine the extent to which reported behavioural changes translated into measurable reductions in antibiotic use.

Furthermore, the evaluation examined implementation during the early stages of guideline adoption. Longitudinal research will be required to determine whether these behavioural changes are sustained over time and whether they contribute to reductions in antimicrobial resistance. Future studies should also include the perspectives of patients, pharmacists, medicine distributors and policymakers to provide a more comprehensive understanding of stewardship implementation within community health systems.

8. Conclusion

This study demonstrates that implementing antibiotic stewardship guidelines among rural healthcare providers in rural West Bengal is highly feasible when interventions are designed to address the realities of community-based clinical practice. Providers readily adopted simplified, symptom-based guidelines that strengthened diagnostic capability, increased confidence in clinical decision-making and promoted more rational antibiotic prescribing. Rather than being driven primarily by awareness of antimicrobial resistance, behaviour change occurred because the intervention improved providers' ability to assess patients, determine illness severity and select appropriate treatment.

The findings further demonstrate that successful implementation depends on multiple interacting dimensions of feasibility. While acceptability, technical usability and operational practicality enabled initial adoption, sustained implementation was influenced by patient trust, economic incentives, medicine availability, regulatory awareness and opportunities for continued learning. This highlights the importance of adopting a systems perspective in which stewardship is supported through provider training, digital decision-support, community engagement, supportive supervision and enabling policy environments.

Overall, the study provides strong evidence that rural healthcare providers can make a meaningful contribution to antimicrobial stewardship when interventions are contextually adapted, practically relevant and supported through ongoing implementation strategies. Integrating this cadre into national and regional AMR programmes represents an important opportunity to improve antibiotic use, strengthen primary healthcare and contribute to efforts to contain antimicrobial resistance in India and other low- and middle-income countries.

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ANNEXURE-I

IN DEPTH INTERVIEW GUIDE: RURAL HEALTHCARE PROVIDERS

A. Acceptability and usability:

1. Are you using the guidelines in your daily practice? How did it change your practice? Share your experience of using these guidelines with examples.
   Probe: based on the answers-
   I) What are the aspects useful from the guidelines? Example with the actual scenario.
   II) What are the challenging aspects while using the guidelines? Give us examples with real scenarios.
   III) What are the recommended changes from your side based on the experience of using these guidelines?
   IV) Do you think it will affect your patient load? To what extent? Explain in detail.
2. Do you think that acceptance building is a continuous process? How long it will take to build acceptance? Explain with your perspectives.

B. Operational Feasibility: Behavioural areas:

3. How do you use these guidelines?
   Probe: Where do you keep it in your clinic? Do you look at the guidelines when a patient comes with these symptoms? Have you memorized these guidelines? If any other technique is used, ask for real-life examples.
4. When exactly do you start consulting these guidelines?
   Probe: does consulting with the guidelines create any challenges for you? What are they and how are you overcoming these challenges?
5. What changes have you identified in your AB dispensing pattern after starting using these guidelines? Is that affecting your practice? Please give us examples of how these are affecting you.
6. After using the guidelines, how are you assessing the illnesses? Are there any changes in the process of identifying the illnesses?
7. What was the previous process you practised? How is this different after using the guidelines?
8. Are all the medicines suggested in these guidelines available in your clinic? Are all of them accessible? Do you have any suggestions? What are they? What about the quality of these antibiotics suggested in the guidelines in terms of effectiveness, quality and cost?
9. In terms of understanding these guidelines, which parts are easy to understand and which parts are difficult? Please give us some examples.

C. Technical feasibility:

10. Is the terminology used in these guidelines easy to understand? What changes are required to make it better to understand and adopt?
11. What do you think about the design of these guidelines in terms of the font size, layout and colour use? Ask for example whenever needed.

Social areas:

12. What are the responses from your patients after you use the treatment from the guidelines? Give us real-life examples.
13. If you deny the request of giving antibiotics in the initial stage of illness by patients, what is the response and how are you handling it?

Referral or mentorship:

14. When are you referring your patients and to whom?
15. If they mention the name of a doctor, ask them about where he practices. How does he get to know about this doctor? Does he consult with this MBBS doctor before using these guidelines?
    Probe as needed: Identify the network.
    If they refer to a hospital, ask for the name of the hospital. Is there any specific doctor of the hospital he refers to?
    Ask for any examples if he did any referral of patients after using the guidelines. Tell us about the example where trying to identify any network available.

D. Schedule feasibility

16. According to your opinion, how long it will take to effectively operationalize these guidelines given your challenges?
17. How long it will take to get the acceptance among other stakeholders – pharmacist, retailers of antibiotics?
18. Do you think use of these guidelines can be made sustainable?

Future intention to use:

19. Do you have any plan to use the guidelines in your future practice? Ask why that is.
20. What strategies can we adopt to create a long lasting impact about these guidelines?
21. What strategies are to be adopted/ adjustments to be made to make the use sustainable?

E. Economic feasibility:

22. How does your business get affected due to the use of these guidelines? How are you planning to improve your economic loss? Please give us examples to understand the effect.

23. How far the guidelines are helpful to reduce Out Of Pocket Expenditure (OOPE) in healthcare seeking? If OOPE decreases at the community side in seeking care how it will increase patient turnover and help you to earn more? Explain what you think.
24. If economic benefits and health benefits of using these guidelines are explained to the community, how they will behave – what do you think? Explain with example.

F. Legal feasibility:

25. Do you know any laws about antibiotic dispensing? If yes, what is it and why do you think they are not followed? From where you have learnt it? How can we make people follow this law? If not, ask them from where they learn their practice and if there are any rules talk to them about AB .

G. Market feasibility:

26. From where are you purchasing these medicines? Is the use of these guidelines going to impact your relation with the MR and the distributors?

Orientation process:

27. What changes can be made in the orientation of these guidelines, in terms of time, explanation process, etc.
28. Please recommend how these guidelines can be further improved.