

Identifying Factors of Success in Implementing an Intervention for Management of
Inpatient Bacteriuria in Nova Scotia's Community Hospitals

by

Breanna E. Laffin

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Dalhousie University is located in Mi'kma'ki, the
ancestral and unceded territory of the Mi'kmaq.
We are all Treaty people.

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ABSTRACT

Background:

Antimicrobial resistance (AMR) is a growing global health threat, driven in part by inappropriate antibiotic use in hospital settings. Antimicrobial stewardship (AMS) programs aim to optimize prescribing, but implementation can be particularly challenging in small and medium-sized hospitals where infrastructure and resources are limited.

Objectives:

This thesis consists of a scoping review and a qualitative study. The scoping review mapped the existing literature on barriers and facilitators that influence AMS implementation in smaller hospital settings and the qualitative study identified context-dependent factors at the individual, unit, and organizational-levels that shaped the implementation of a multifaceted intervention targeting the management of bacteriuria in four community hospitals across Nova Scotia.

Methods:

The scoping review included 12 studies examining AMS implementation in small to medium-sized hospitals in high-income countries. The qualitative study used semi-structured interviews from feedback deliverers involved in the audit and feedback intervention. Data were analyzed thematically, first deductively coded to the Consolidated Framework for Implementation Research (CFIR) then inductively coded to identify unique context-driven themes.

Results:

The scoping review highlighted the need for tailored AMS strategies, strong leadership support, and alignment with local workflows. The qualitative study identified eleven themes spanning the five CFIR domains. Key barriers included limited time, high staff turnover, residual effects of prior clinical decisions, and feedback fatigue. Key facilitators included strong champion relationships, constructive communication, staffing consistency, contextual tailoring of feedback delivery, and system-level supports. Several themes, such as feedback repetition and perceived relevance, acted as both barriers and facilitators depending on their expression in context.

Conclusion:

Findings emphasize the importance of contextually responsive, relationship-driven implementation strategies in AMS programs. Both components of the thesis underscore the value of aligning interventions with the practical realities and relational dynamics of the hospital environments in which they are being implemented to expand the reach of AMS efforts.

LIST OF ABBREVIATIONS USED

AMR	Antimicrobial Resistance
AMS	Antimicrobial Stewardship
WHO	World Health Organization
IDSA	Infectious Diseases Society of America
SHEA	Society for Healthcare Epidemiology of America
UTI	Urinary Tract Infection
ASB	Asymptomatic Bacteriuria
NS	Nova Scotia
ID	Infectious Disease
CFIR	Consolidated Framework for Implementation Research
CIHI	Canadian Institute for Health Information
JBI	Joanna Briggs Institute
BCW	Behaviour Change Wheel
TDF	Theoretical Domains Framework
SWOT	Strengths, Weaknesses, Opportunities, and Threats
ASP	Antimicrobial Stewardship Program
EIN	Emerging Infections Network
EMR	Electronic Medical Record
BPA	Best Practice Alert
ARK	Antibiotic Review Kit
GLIA	Guideline Implementability Appraisal
COREQ	Consolidated Criteria for Reporting Qualitative Research
DASON	Duke Antimicrobial Stewardship Outreach Network
CDST	Clinical Decision-Making Support Tool
HMS	Hospitals Medicine Safety
CAP	Community-Acquired Pneumonia
IT	Information Technologies
PRISMA-ScR	Preferred Reporting Items for Systematic reviews and Meta-Analyses Extension for Scoping Reviews

PRESS

Peer Review of Electronic Search Strategies

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CHAPTER 1 - INTRODUCTION

1.1 Antimicrobial Resistance: A Global Health Crisis

The discovery of antibiotics stands among the most transformative achievements in modern medicine. By enabling the rapid treatment of previously deadly bacterial infections, antibiotics have dramatically reduced mortality and greatly heightened the safety of lifesaving medical interventions such as surgery, chemotherapy, and organ transplantation. (1) The majority of antibiotics in use today were developed during the "Golden Age of Antibiotics" (1928–1970s), a period when researchers harnessed the antimicrobial properties of natural products like fungi and soil bacteria to effectively combat infectious diseases. This therapeutic revolution fundamentally reshaped clinical practice and public health worldwide. (1)

Since the 1980s, however, the pace of antibiotic discovery has declined sharply while bacterial resistance to existing drugs has surged. (2) This mismatch of bacterial versus antibacterial development rates have led to the rise of antimicrobial resistance (AMR); a phenomenon that renders previously effective antimicrobials ineffective, even when treating common infectious diseases. AMR poses a significant threat to healthcare systems worldwide because resistant infections often require alternatives that are broader spectrum, have frequent or more severe side effects, and are more expensive, thus contributing to worse patient outcomes, prolonged hospital stays, increased healthcare costs, and increased mortality. (2)

In 2014, the World Health Organization (WHO) released its first report on AMR, recognizing it as a significant threat to global public health.(3) Since then, projections by expert groups across the world have underscored the urgency of the issue and suggest that by 2050, AMR could cause up to 10 million deaths annually, making it the leading cause of death worldwide. (4,5) AMR is not only a global concern but a pressing issue within Canada as well. In 2018, approximately 5,400 Canadian deaths were directly attributable to resistant infections, with an estimated economic burden of \$2 billion due to increased healthcare costs and lost productivity. Projections suggest that if resistance rates continue to rise, AMR could cost the Canadian healthcare system nearly \$120 billion and lead to an additional \$388 billion in lost GDP by 2050. (6) In response, Canada released the Pan-Canadian Action Plan on Antimicrobial Resistance in 2023, outlining coordinated strategies across human, animal, and environmental health sectors using a One Health approach. This plan identifies priority actions such as strengthening surveillance, supporting antimicrobial stewardship (AMS), and promoting innovation in diagnostics and treatments. (7) These efforts signal Canada's recognition of AMR as a national health priority requiring urgent, sustained action.

One of the most significant drivers of AMR is the inappropriate use of antibiotics. (8) This includes, but is not limited to, prescribing unnecessarily broad-spectrum antibiotics (those that target a wide range of bacterial species), initiating empirical therapy without adequate clinical assessment, and using antibiotics for viral or self-limiting infections. Such practices apply selective pressure on microbial populations, allowing resistant bacteria to survive, multiply, and spread their resistance traits. As bacterial resistance rapidly evolved the development of antibiotics has stagnated, leaving healthcare

providers with fewer effective treatment options for increasingly common infections.

This contributes to prolonged illness, poorer patient outcomes, and greater strain on an already overburdened healthcare system. (8)

1.2 AMS and the Barriers it Faces

Given the rising threat of AMR, the development of effective strategies to optimize and preserve the utility of existing antibiotics has become an urgent global priority.

Consequently, AMS has emerged as a cornerstone of efforts to combat AMR, as recognized by both international and national public health authorities. (7,9) A central goal of AMS is to reduce unnecessary exposure to broad-spectrum antibiotics while ensuring timely treatment of true infections. To accomplish this goal, coordinated strategies are employed to optimize the use of antimicrobial agents, improve patient outcomes, and minimize resistance. These efforts typically involve multidisciplinary healthcare teams working to align antimicrobial use with the best available evidence and local microbiological data, ensuring that patients receive the right antimicrobial, at the right dose, for the right duration, and only when clinically indicated. (7,10)

Despite the growing body of evidence supporting the effectiveness of AMS, its implementation continues to face substantial challenges across Canada, particularly in community hospitals - smaller healthcare facilities that typically serve suburban or rural populations and often operate without the robust infrastructure or specialist support available in tertiary academic centres. While AMS programs have demonstrated success in reducing inappropriate prescribing, improving patient outcomes, and mitigating AMR, the sustainability and scalability of these efforts remain constrained by numerous barriers.

(11) Organizationally, a lack of dedicated leadership and insufficient funding are frequently cited in the literature as major obstacles to establishing and maintaining AMS initiatives. (12) Many hospitals, especially smaller community sites, operate with limited resources and staff, making it difficult to allocate time and personnel to stewardship activities. (13)

In Canada, national-level coordination and policy support play a growing role in shaping AMS implementation. The Pan-Canadian Action Plan on AMR outlines a federal strategy for integrating stewardship into all healthcare settings, including community hospitals, with an emphasis on surveillance, education, and responsible antimicrobial use. (7)

Accreditation Canada has also incorporated AMS into its Required Organizational Practices, providing hospitals with a structured incentive to formalize stewardship efforts.

(14) However, stewardship efforts remain fragmented across provinces, and there is limited standardization in implementation approaches. (13) These gaps are particularly evident in smaller hospitals, where resource constraints, outdated health information systems, and high staff turnover disrupt continuity and hinder feedback-driven interventions.

Guidelines from the Infectious Diseases Society of America (IDSA) and the Society for Healthcare Epidemiology of America (SHEA) outline seven core elements of effective AMS programs—leadership commitment, accountability, drug expertise, action, tracking, reporting, and education—but implementing these in community hospitals is often difficult due to staffing shortages, limited resources, and competing clinical demands.

(10) In these settings, clinicians such as physicians, nurses, and pharmacists frequently

manage high workloads and multiple responsibilities, which can contribute to resistance toward new initiatives. This resistance is often driven by perceived workflow disruptions, lack of time, and unfamiliarity with stewardship principles. (15) Prescribers may also view interventions like audit and feedback or preauthorization requirements as burdensome, particularly when systems lack timely data or decision support. Moreover, while clinicians in academic centres often have access to dedicated AMS education, those in smaller hospitals may not, compounding awareness and engagement challenges. (16,17)

To influence prescribing behaviors, AMS programs employ a range of interventional strategies, including diagnostic stewardship, audit and feedback, and targeted education. Of these, audit and feedback, particularly when paired with education, has emerged as one of the most widely implemented and strongly recommended strategies, with evidence showing improvements in adherence to best practices and reductions in inappropriate prescribing. (10,11) This approach involves reviewing clinicians' prescribing patterns and providing targeted feedback to encourage evidence-based decision-making.

Diagnostic stewardship, meanwhile, focuses on improving the selection and interpretation of microbiological tests to inform appropriate treatment. Educational initiatives such as workshops, clinical guidelines, and point-of-care tools are also frequently layered onto other strategies to reinforce stewardship principles. When implemented with attention to core AMS elements, such as leadership, accountability, and education, these interventions have consistently demonstrated positive impacts on prescribing behaviors, patient outcomes, and resistance rates. (10,18)

While the overall effectiveness of AMS programs is well established, the magnitude of their impact can vary considerably depending on institutional resources, provider engagement, and the adaptability of interventions to local context. Notably, studies have also identified the financial benefits of AMS: for example, in 2019 Nathwani et al. (19) found that stewardship interventions, most commonly audit and feedback mechanisms, were associated with reductions in antimicrobial costs and overall healthcare expenditures. A recent review of reviews in 2024 by Hadi et al. (11) identified audit and feedback paired with education as the most effective strategy yet noted that most high-quality studies were conducted in large tertiary academic hospitals overlooking smaller hospitals that don't have the resources or infrastructure to implement. This is a notable gap in the literature in the North American context, as many hospitals in North America are smaller, community-based facilities that often lack the infrastructure or personnel to implement comprehensive AMS programs as outlined above. (20)

These challenges are particularly evident in smaller Canadian hospitals, including those in Nova Scotia (NS), where stewardship teams often operate without dedicated support, standardized infrastructure, or province-wide coordination. (13) AMR is a global issue, but resistance patterns, prescribing behaviors, and healthcare infrastructure vary widely by region, underscoring the need for context-specific solutions. Ultimately, the success of AMS hinges not only on evidence-based design but also on sustainable, locally tailored implementation. (10)

1.3 Implementing AMS Interventions

Implementation science offers a valuable framework to navigate these complexities, though it is currently underutilized when designing audit and feedback interventions. This discipline studies methods that promote the systematic uptake of research findings into routine practice to improve healthcare quality and effectiveness. In the context of AMS, implementation science supports the design of interventions that are not only evidence-informed but also responsive to local workflows, institutional culture, and available resources. For example, Colquhoun et al. identified theory-informed hypotheses for improving audit and feedback interventions, highlighting that effectiveness may be enhanced by addressing cognitive load, tailoring feedback to recipient motivation and priorities, and incorporating social engagement and reflection. (21) These findings underscore the importance of moving beyond intuitive or one-size-fits-all designs and instead to customized audit and feedback strategies matched to local context. This may include adapting formats to reflect specific departmental needs, embedding AMS tasks into routine clinical processes, or utilizing ongoing education to shift healthcare provider mindsets.

While AMR is a global health crisis, the solutions must be implemented locally and shaped by the specific clinical and organizational contexts in which they operate. Stewardship frameworks such as those from the IDSA and SHEA emphasize the importance of tailoring interventions to local epidemiology and targeting high-impact clinical conditions. (10,18). One such opportunity is the management of bacteriuria; a common indication for antibiotics where persistent gaps between evidence and practice

remain. As Section 1.3 will explore, optimizing antimicrobial use in the context of asymptomatic bacteriuria (ASB) presents a powerful and practical avenue for locally grounded stewardship improvement.

1.4 Bacteriuria: An Opportunity for Impactful Stewardship

Inappropriate antimicrobial use for bacteriuria has consistently been identified as a driver of AMR internationally, nationally, and in the local NS context. (2,22,23) Urinary tract infections (UTIs) are among the most common indications for antimicrobial use in hospitals, yet the overuse of urine cultures frequently leads to unnecessary treatment, especially in patients with ASB. The Choosing Wisely Canada campaign highlights the importance of avoiding antibiotics for ASB in most populations; however, adherence to these guidelines remains inconsistent. (22) This non-adherence is perpetuated by factors like the over-ordering of urine cultures to facilitate workflow and “just in case” prescribing mentalities rooted in a fear of missing serious infections. (24) The result is a clinical culture where deviation from established guidelines feels riskier than unnecessary antibiotic use, despite the long-term implications for AMR. Nevertheless, antibiotics are often prescribed for ASB due to diagnostic uncertainty, fear of missing serious infections, entrenched prescribing habits, or pressure from patients. (24)

NS provides a clear case study of the challenges in implementing AMS initiatives. A recent point prevalence survey identified inappropriate prescribing for bacteriuria in hospitals across NS. (23) Following this survey an AMS intervention that focused on improving management of inpatient bacteriuria in NS hospitals was implemented, yielding significant variability in impact across sites. Some hospitals demonstrated

improved prescribing in the early phases of implementation, while others showed minimal change or even regression in appropriate prescribing practices. These mixed results underscore the importance of understanding local context in AMS effectiveness and highlight the need to study the local environment and participants to create more flexible, tailored approaches to implementation.

Given its frequent occurrence and the modifiable nature of its management, bacteriuria represents an optimal target for AMS intervention. Numerous strategies, ranging from educational campaigns to audit-and-feedback mechanisms, have been developed and implemented in diverse healthcare settings to reduce the inappropriate treatment of bacteriuria. (11,25) A systematic review of AMS interventions for bacteriuria by Humphrey et al. conducted in 2022 (26) highlights the potential of such strategies to reduce unnecessary antibiotic use and improve clinical outcomes in hospitalized adults. However, while there is evidence supporting their efficacy, the scalability and feasibility of prospective audit and feedback for bacteriuria, particularly ASB remain underexplored. Challenges such as high testing volumes, delayed culture results, and diverse decision-making pathways complicate real-time intervention delivery for ASB. As a result, optimizing bacteriuria management presents a scalable opportunity for stewardship, but realizing this potential requires deeper insight into the contextual factors that influence implementation and sustainability—underscoring the importance of the current study.

1.5 The Larger Project

This thesis builds on the results of a broader intervention aimed at improving AMS for bacteriuria management in NS, a province that reflects many of the healthcare resource and implementation challenges common in community hospitals across Canadian due to its largely rural setting. The original project implemented a theory-informed AMS intervention across four NS hospitals, using a multifaceted approach that combined provider education and unit-level audit and feedback. Key participants in the study included hospitalists, unit nurses, pharmacists, and members of the provincial AMS team. These participants played key roles in implementing, monitoring, and/or evaluating the intervention's impact on prescribing behaviours. Although the intervention was grounded in best practices and considered current evidence, local barriers, and practical considerations to improving antimicrobial use in NS, the quantitative evaluation revealed variable uptake and mixed impact across study sites. Some hospitals demonstrated significant early improvements, while others experienced minimal change or even regression in adherence to evidence-based practices.

This variability in intervention impact raised important questions about contextual and organizational factors that shape the success of AMS strategies, particularly in under-resourced community settings. These hospitals often operate with limited infrastructure, staffing, and infectious disease expertise, all of which affect the feasibility of implementing and sustaining stewardship interventions. (12,13) National data suggest that small and medium-sized hospitals across Canada face similar constraints, and that AMS is often under-resourced in such settings. Yet, most AMS research and program

development continues to focus on large tertiary hospitals, leaving a significant gap in evidence for smaller institutions. (13)

To address this gap, a two-part investigation was undertaken. First, a scoping review synthesized existing literature on AMS implementation in community hospitals. Then, a qualitative study explored the implementation of the above-described AMS intervention at individual, unit, and organizational levels. Together, these complementary components provide both a broad view of implementation dynamics and a detailed, context-specific understanding of what enables, or undermines, stewardship success in smaller care settings.

The qualitative study was incorporated to gain deeper insight into how contextual elements, such as institutional culture, workflow structure, provider attitudes, and resource availability influence intervention uptake. While quantitative methods are well suited to identify trends and measure aggregate impacts, qualitative methods are uniquely positioned to reveal underlying situational complexities that drive quantitative results. (27) This approach helps explain why stewardship interventions are successfully adopted in some settings but not in others, offering insight into the complex, context-dependent nature of implementation.

This methodology aligns with recent calls to integrate implementation science more fully into AMS research in Canada. (7) Implementation science highlights the importance of tailoring evidence-based practices to local environments, identifying setting-specific factors of success, and designing strategies that align with the realities of institutional capabilities and constraints. In decentralized systems like Canada's and particularly in

provinces such as NS, where hospital staffing models and access to infectious disease expertise vary widely, this approach is essential to long-term stewardship success.

By examining an existing intervention and capturing the lived experiences of those involved in its implementation, this research offers both explanatory insight and practical guidance. It contributes to the growing body of AMS literature that emphasizes sustainability, adaptability, and the importance of health system context in driving behaviour change. Moreover, it aligns with broader federal and provincial priorities, such as those outlined in the Pan-Canadian Framework for Action on AMR, which highlight the need for localized, coordinated, and measurable AMS efforts across care settings (7,13)

Ultimately, this thesis serves as a bridge between intervention design and long-term implementation success. It aims to refine stewardship strategies for use in under-resourced community hospital environments and contribute to Canada's national effort to ensure equitable and effective AMS programming beyond large academic centers. (7) By defining the broader landscape of AMS implementation in small and medium-sized community hospitals and exploring key contextual factors influencing implementation success, this research supports the development of actionable stewardship recommendations that align with existing evidence.

1.6 Objectives and Rationale

The overarching objective of this thesis is to identify factors that influenced the implementation of a theory-informed AMS intervention for bacteriuria across NS

community hospitals. Through qualitative exploration of local AMS adoption informed by a scoping review of existing literature, this research aims to generate insights into why interventions are variably adopted and how future initiatives can be better adapted to under-resourced and non-tertiary care contexts.

Specifically, this thesis seeks to identify the individual, unit, and organizational-level factors influencing success of the intervention across different hospital contexts, and generate recommendations to support more context-sensitive, sustainable AMS implementation efforts in NS.

These findings will provide a contextually informed, evidence-based recommendations to improve AMS uptake and impact in healthcare environments often missing from the literature, helping ensure the benefits of AMS are equitably extended across the healthcare system.

CHAPTER 2 SCOPING REVIEW

2.1 Introduction

Antimicrobial resistance (AMR) is a leading global health threat that undermines the effectiveness of antibiotics and endangers the sustainability of modern healthcare systems. (9) Inappropriate antibiotic use is a major contributor to AMR. (8)

Antimicrobial stewardship (AMS) programs aim to address this issue through coordinated interventions that promote appropriate antibiotic use. These programs implement interventions that target metrics such as appropriate antibiotic selection, dosing, duration, and administration route to improve clinical outcomes and preserve antimicrobial efficacy. (10,28)

Much of the AMS literature is based in large, urban academic hospitals. These institutions typically benefit from a more robust infrastructure, access to infectious disease (ID) specialists, and electronic decision support tools. (11,29) In contrast, small and medium-sized community hospitals, defined here as non-academic institutions with fewer than 200 beds and often located in suburban or rural areas, (30) frequently operate with fewer dedicated AMS personnel, constrained diagnostic and IT capacity, and reduced access to ID support. (15) These contextual differences raise concerns about the applicability of AMS strategies developed in larger care settings with more access to support and resources to smaller institutions.

Despite increasing recognition of these unique challenges, it is uncommon for current practice-based research to stratify findings by hospital size or geographic location.

Existing reviews have focused on AMS effectiveness or impact and have identified barriers in broad hospital contexts, (31,32) but specific operational and contextual factors present in non-academic community hospitals remain unscrutinized. To our knowledge, no scoping review has exclusively examined barriers and facilitators to the implementation of AMS interventions in these settings.

2.1.2 Objective

The primary objective of this scoping review was to map existing literature that examined factors influencing the implementation of AMS interventions in small and medium-sized community hospitals located in high-income countries. A secondary objective was to identify key barriers and facilitators influencing the uptake, sustainability, and acceptability of these interventions.

2.2 Methods

This scoping review was conducted in accordance with the methodology described in the JBI Manual for Evidence Synthesis. (33) A protocol was developed *a priori* to guide the review process. The review followed the PRISMA-ScR reporting guidelines, (34) and a completed PRISMA-ScR checklist is included in **Appendix II**. A scoping review was selected as the most appropriate methodological approach due to the heterogeneous and context-specific nature of the literature on AMS implementation in community hospitals. Many studies emphasize descriptive insights over standardized outcomes, making them less suitable for meta-analysis. This approach allows for comprehensive mapping of available evidence and identification of implementation barriers and facilitators. (35)

First, the literature on AMS in community hospitals is heterogeneous, spanning qualitative studies, mixed-methods evaluations, and implementation case reports. Second, many studies prioritize context-specific descriptions over standardized outcome measures, making them unsuitable for meta-analysis. Scoping reviews are particularly suited to questions that aim to map the breadth and diversity of evidence, clarify conceptual boundaries, and identify knowledge gaps for future investigation. (34) This review will not only describe what interventions have been implemented in community hospitals, but will also identify factors influence their uptake, adaptation, and success in an effort to provide guidance on the design and tailoring of future AMS initiatives in similar settings.

2.2.1 Data Sources and Search strategy

A three-step search strategy was utilized in this review. First, an initial search of PubMed (via NLM) and Embase (via Elsevier) was undertaken to identify relevant articles and refine search terms. Words from titles and abstracts, as well as indexed terms used to describe the articles, were used to develop a comprehensive search strategy. The search strategy included both controlled vocabulary (e.g., MeSH, Emtree) and natural language terms, and was reviewed by an academic health sciences librarian. To ensure quality and rigor, the strategy was also assessed using the Peer Review of Electronic Search Strategies (PRESS) checklist as found in **Appendix III**. The databases searched included: Embase (via Elsevier), PubMed (via NLM), Cochrane Library (via Wiley), and CINAHL (via EBSCOhost). The most recent search was conducted on October 30, 2024. Full search strategies for each database are presented in **Appendix I**. Finally, reference lists of

all included studies were reviewed to identify additional studies that may have been missed by the comprehensive search.

This scoping review considered both experimental and quasi-experimental study designs including randomized controlled trials, non-randomized controlled trials, before and after studies and interrupted time-series studies. In addition, analytical observational studies including prospective and retrospective cohort studies, case-control studies and analytical cross-sectional studies were considered for inclusion. This review also included descriptive observational study designs including case series, individual case reports and descriptive cross-sectional studies. Qualitative studies that focused on qualitative data including, but not limited to, designs such as phenomenology, grounded theory, ethnography, qualitative description, and action research were also considered for inclusion.

No grey literature sources, conference proceedings, or unpublished studies were searched. This decision was made to ensure that all included studies met a minimum threshold of methodological transparency and peer review. Given the implementation-focused scope of this review, which required detailed reporting on study context, methods, and intervention components the inclusion of unpublished or non-peer-reviewed material was considered less likely to contribute meaningfully to the synthesis, particularly given the implementation-focused scope and the need for detailed methodological transparency.

2.2.2 Study Selection

To guide development of inclusion and exclusion criteria, this review used the PCC Framework. (34) The populations (P) included were prescribers and other healthcare providers working in settings and caring for hospital inpatients with a confirmed or suspected infection and/or their caregivers.

The concept (C) of interest is the implementation of AMS interventions aimed at improving antibiotic use in hospitals. This included interventions designed to reduce inappropriate prescribing, limit unnecessary microbiology testing, or those that engaged patients or caregivers to support appropriate use.

The context (C) considered in the review was small and medium-sized community hospitals located in high-income countries, as defined by the World Bank. (36) Small and medium hospitals were defined using the Canadian Institute for Health Information (CIHI) classification, where small hospitals have fewer than 100 staffed beds and medium hospitals have 100 to 199 staffed beds and lacking extensive specialist infrastructure. (30) These hospitals differ not only in size but in workforce composition, budget constraints, and local organizational culture, all of which may influence the feasibility and impact of AMS efforts. (15) Importantly, this review excludes studies that exclusively focus on large academic centers and critical care settings, where resource availability, patient complexity, and stewardship practices differ substantially.

Studies were excluded if they focused exclusively on immunocompromised individuals, critical care, or pediatric populations. Studies that focused solely on the impact of specific provider types (e.g., pharmacists or infectious diseases specialists), antimicrobial surveillance studies without an active AMS intervention, studies implementing or

evaluating diagnostic stewardship, and studies that did not identify or discuss factors influencing implementation were excluded. Finally, studies published in languages other than English were excluded. Consistent with JBI guidance for scoping reviews, a formal risk of bias assessment was not conducted, as the aim of the review was to map existing evidence rather than evaluate study quality. (33)

Following the search, all identified citations were imported into the review tool Covidence and duplicates were automatically removed. Titles and abstracts were reviewed independently by two members of the research team and compared. Full-text articles were then retrieved, uploaded into Covidence, and independently assessed by two reviewers, BL and KZ, to ensure alignment with the pre-defined inclusion and exclusion criteria. Reasons for exclusion at the full-text review stage were recorded within Covidence. Discrepancies at any stage of the selection process were resolved through discussion or adjudication by a third reviewer EB.

Given the complexity of AMS implementation, outcomes of interest that were extracted were implementation-related constructs such as barriers, facilitators, contextual influences, and target audience acceptability or satisfaction. The goal was to map the extent and nature of implementation-related findings across studies conducted in small hospital settings that recognized that success may be contingent on multiple interrelated factors.

2.3 Results

The screening process is summarized in **Figure 2.1** PRISMA flowchart for scoping review. A total of 5,385 records were identified through database searches, including Embase (n = 1,695), Cochrane (n = 1,484), PubMed (n = 1,365), and CINAHL (n = 841). After removing 2,560 duplicate records during pre-screening, 2,825 titles and abstracts were screened for relevance. Of these, 2,789 were excluded leaving 37 reports to be retrieved. No reports were excluded due to retrieval issues.

During full-text review, 25 studies were excluded for the following reasons: incorrect population (n = 7), incorrect study design (n = 6), incorrect setting (n = 5), incorrect outcome (n = 5), abstract or poster only (n = 1), and incomplete study (n = 1). This process resulted in 12 studies meeting the inclusion criteria and being included in the final scoping review. (16,17,37–46)

The included studies were published between 2011 and 2023 and were conducted in Australia (n=3), (38,39,41) the United States (n=7), (16,17,37,39,40,42,43) and the United Kingdom (n=2). (44,45) Study designs varied and included qualitative studies (n=4) (38,41,44,45) mixed-methods designs (n=5), (37,39,43,46) one survey-based descriptive study, (42) one prospective chart review, (40) one retrospective longitudinal analysis, (16) and one narrative review. (17)

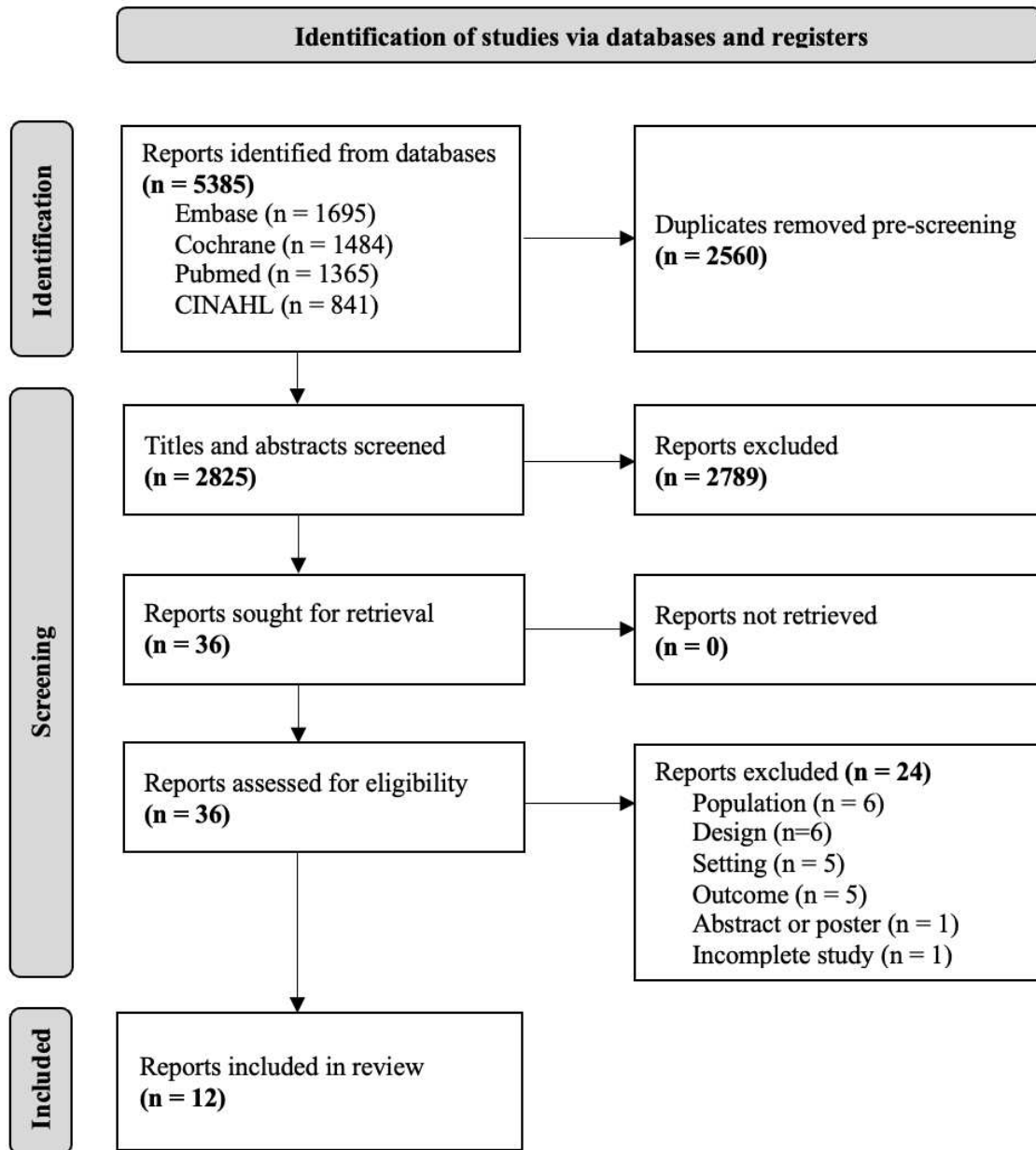


Figure 2.1 PRISMA Flow Diagram for Scoping Review

2.3.1 Study Characteristics

Characteristics of the included studies (aim, design, framework used, population, concept, and context) can be found in **Table 2.1**. Most studies included in this scoping review (n = 9) (16,17,37–40,42–44) focused on evaluating the implementation, effectiveness, or sustainability of AMS interventions, while a smaller number (n = 2) (41,45) examined the development or early-stage implementation of AMS strategies, including decision support tools and standardized protocols. Interventions described across the studies varied in scope and complexity. Audit and feedback mechanisms were featured in six studies, (16,17,39,42,44,45) and six studies (15,37,38,40,42,43) evaluated initiatives aimed at implementing clinical guidelines or national AMS recommendations such as local adaptation of prescribing protocols, clinician education, or integration of AMS tasks into routine care. Four studies described the integration of electronic decision support tools into clinical workflows, (37,40,43,45) and two evaluated the role of collaborative stewardship networks in providing implementation support and benchmarking. (16,38)

The target populations across studies predominantly included prescribers, AMS pharmacists, infectious disease specialists, and hospital leaders or administrators. These participants operated within small to medium-sized community hospitals or regional networks, often in rural or resource-limited settings (16,17,39,42) Several studies specifically examined contextual variations between hospital sizes or urban-rural classifications. (16,38)

Five of the included studies (37,38,41,45,46) explicitly applied theoretical frameworks to guide study design, data collection, or analysis. These included the Behaviour Change Wheel (BCW) and Theoretical Domains Framework (TDF), (37,41,45) the framework method, (38) as well as the Strengths, Weaknesses, Opportunities, and Threats (SWOT) framework. (46) The remaining seven studies, however, employed descriptive or inductive thematic analysis without reference to a formal theoretical model. (16,17,39,40,42–44)

Key barriers and facilitators to implementation are synthesized in **Table 2.2** Despite heterogeneity in design and scope, several cross-cutting barriers and facilitators to AMS implementation were identified. Structural barriers were prominent, including limited funding, personnel shortages—particularly of pharmacists and infectious disease specialists—and underdeveloped IT infrastructure. These challenges were particularly acute in smaller or rural hospitals with fewer internal resources. (16,17,39,42) Cultural and interpersonal barriers such as resistance to change, lack of ownership of AMS initiatives, fragmented interprofessional dynamics, and clinician discomfort with antibiotic de-escalation were also frequently reported. (39,42,44,45)

Although many studies described positive perceptions of audit and feedback systems, decision aids, or electronic alerts, the inconsistent use and poor integration of these implementation tools into daily workflows emerged as a common barrier to effective AMS implementation. (37,41,43,45) While these tools were seen as potentially valuable, their utility was often limited by technical constraints, lack of training, or workflow misalignment.

Facilitators of AMS success included visible and sustained leadership support, the presence of clinical champions, the use of standardized, evidence-based protocols to guide prescribing, and engagement with external stewardship networks that provided consultation, benchmarking, and longitudinal guidance. (16,38) Hospital-level contextual features also shaped AMS implementation; smaller hospitals more often relied on external facilitators and targeted support, while larger hospitals were typically better resourced to develop, implement, and sustain internal programs. (16,17,42)

Several studies identified key facilitators of AMS implementation including the importance of knowledge-user co-design, interdisciplinary collaboration, and local tailoring of interventions to increase feasibility and uptake. (17,44,45) Additional context-specific facilitators noted by Stenehjem et al. (17) included the simplicity and scalability of interventions, use of local champions without infectious disease specialization, business case development to secure leadership buy-in, integration into quality improvement structures, and point prevalence surveys to maintain momentum. Patient-related factors, particularly expectations for antibiotic prescriptions and influence on clinician decision-making, were also highlighted with provider communication strategies and public education campaigns serving as important facilitators for addressing these challenges. (43,44)

This review did not restrict inclusion to studies focused on bacteriuria, but in the context of this thesis it is important to note that none of the included interventions specifically targeted this condition. This highlights a gap in the literature that the qualitative component of this thesis begins to address.

Table 2.1 Characteristics of Studies Included in Scoping Review

Reference, Year, Region	Study Aim	Study Design	Theoretical Framework	Population and Context	Concept - Intervention Description
Alex WJ Chen et al., 2011 Australia (39)	To identify barriers to AMS program implementation and assess how the key performance indicators (KPI) used to measure program outcomes are used and valued in practice.	2 part mixed-methods study. Initial postal surveys identified KPI used and barriers to implementation. Semi-structured interviews were used to elaborate on survey results.	No formal theoretical framework	Directors of Pharmacy from public hospitals across the country responded to the postal surveys; hospital pharmacists, ID clinicians, and infection control nurses were interviewed.	Evaluation of barriers to AMS implementation and assessment of the perceived utility of KPIs
Birgir Johannsson et al., 2011 United States (42)	To describe the prevalence and characteristics of antimicrobial stewardship programs (ASPs) in hospitals across the United States, and to assess the financial support provided and ID physician involvement for these programs.	Cross-sectional survey of IDSA Emerging Infections Network members	No formal theoretical framework	Healthcare practitioners who managed inpatients.	A 14-question survey evaluated existing institutional ASPs, including preauthorization, post prescription review and feedback, and supplemental strategies (e.g., guideline development, education, IV-to-PO conversion). Assesses evolution from formulary restriction to tailored, feedback-oriented strategies in ASP design.
Edward Stenhjem et al., 2017 United States (17)	To describe common barriers and propose practical solutions for implementing ASPs in small hospitals (<200 beds), with a focus on tailoring strategies to local resources.	Narrative review with descriptive summaries from four hospital systems (Intermountain, Kaiser Permanente, Colorado Hospital Association, HCA).	No formal theoretical framework	Staff and leadership from small community hospitals in the U.S., often with limited ID.	Implementation-focused summary of strategies including telehealth-based ID support, non-ID champions, business case development, simplified metrics (e.g., DOT, DDD), local data collection, and embedding ASPs in existing hospital committees.

Reference, Year, Region	Study Aim	Study Design	Theoretical Framework	Population and Context	Concept - Intervention Description
Corrine E. Munoz-Plaza et al., 2016 United States (43)	To improve understanding of the drivers of inappropriate antibiotic prescribing for acute sinusitis and to develop a tailored intervention to reduce overuse, by embedding qualitative research within a learning healthcare system framework.	Explanatory sequential mixed-methods study; Phase 1 collected and analyzed quantitative data and Phase 2 used semi-structured interviews to collect qualitative data.	No formal theoretical framework	Participants included primary care and urgent care physicians at medical centres within an integrated healthcare delivery system (Kaiser Permanente Southern California).	A multi-component, staged intervention targeting unnecessary antibiotic prescribing for acute sinusitis. Components included provider education, EMR-based best practice alert (BPA), and embedded patient education materials.
M. Santillo et al., 2019 UK (45)	To comprehensively describe the planning, development, and optimization of the Antibiotic Review Kit (ARK), an intervention that aims to safely reduce antibiotic use through increased focus on facilitating the stopping of antibiotics when they are no longer needed.	Multistage qualitative and co-design study using a theory-, evidence-, and person-based approach to intervention development.	Person-Based Approach, Behaviour change wheel & COM-B model, TIDieR checklist, and Logistic model Development.	Doctors, pharmacists, and nurses participated across knowledge-user workshops and think-aloud interviews to develop and refine the ARK intervention and its components	A multicomponent ARK that included a decision aid, digital education, patient leaflet, implementation toolkit, and support team.
Neil Powell et al., 2019 UK (44)	To explore barriers and enablers to identifying and removing incorrect penicillin allergy labels (delabelling) in hospital inpatients.	Qualitative study using two focus groups and inductive thematic analysis.	No formal theoretical framework	Consultants, junior doctors (FY2/ST1), nurses, pharmacists, and a microbiologist.	Multidisciplinary Penicillin Allergy Delabelling Pathway
Courtney Ierano et al. 2019 Australia (41)	To evaluate perceptions the intrinsic characteristics of the national surgical prophylaxis guidelines that influence how easily and effectively the guidelines can be adopted and applied in real-world settings	Survey-based qualitative evaluation of the national surgical prophylaxis guidelines. The survey was the GuideLine Implementability Appraisal (GLIA) instrument.	TDF and Behaviour change wheel	Infectious disease physicians, a surgeon, an infection control consultant, anesthetists, and AMS pharmacists in hospitals across the state of Victoria.	Nationally developed guidelines that support appropriate, evidence-based prescribing of antibiotics for surgical prophylaxis

Reference, Year, Region	Study Aim	Study Design	Theoretical Framework	Population and Context	Concept - Intervention Description
C. K. Howell et al. 2019 United States (40)	To quantify time required for AMS activities and identify implementation barriers to remote ASPs and meet the Joint Commission Stewardship standard.	Prospective chart review of stewardship opportunities flagged by electronic clinical decision support tool Theradoc followed by cost-benefit analysis of remote antimicrobial stewardship.	No formal theoretical framework	Charts flagged by the Theradoc tool in a small community hospital.	A remote antimicrobial stewardship program (remote ASP), using a clinical decision support system (Theradoc) to flag potential stewardship opportunities.
Jaelyn L. Bishop et al. 2020 Australia (38)	To explore features that support sustainability of AMS programs in rural hospitals and make recommendations for improvement.	Qualitative study using semi-structured interviews and framework analysis to identify key features	Framework method	Pharmacists, ID physicians, microbiologists, general practitioners, and infection control consultants in rural hospitals across the country.	Exploration of organizational strategies and contextual features that support the sustainability of AMS programs in rural hospitals.
Rebekah W. Moehring et al. 2021 United States (16)	To assess the impact of a collaborative antibiotic stewardship network on antimicrobial use among participating hospitals and evaluate how ASP structure, resources, and activities evolved over time.	Retrospective longitudinal analysis using segmented regression over 42 months.	No formal theoretical framework	Duke Antimicrobial Stewardship Outreach Network (DASON) community hospitals that had been a part of the network for at least 36 months.	DASON, a collaborative, consultative network, provided remote antimicrobial stewardship program (ASP) support to community hospitals via site-specific implementation guidance, benchmarking, data feedback, structured needs assessments, protocols, and regular expert consultation. Participating ASP teams received annual performance feedback, monthly visits, and implementation assistance.

Reference, Year, Region	Study Aim	Study Design	Theoretical Framework	Population and Context	Concept - Intervention Description
Esra Alagoz et al. 2023 United States (37)	To describe barriers and facilitators to implementing a clinical decision-making support tool (CDST) targeting penicillin allergy de-labeling .	Qualitative component of a mixed-methods quality improvement project that used semi-structured interviews.	Theoretical Domains Framework (TDF)	Multidisciplinary inpatient and outpatient healthcare teams within a veteran’s affairs hospital.	Qualitative evaluation of locally developed CDST embedded in the EMR to guide penicillin allergy de-labeling based on risk stratification. CDST recommended one of three pathways: direct drug challenge (low risk), skin testing (moderate risk), or avoidance/desensitization (high risk).
Valerie M. Vaughn et al. 2023 United States (46)	To identify hospital-level contextual factors associated with variation in antibiotic overuse at discharge, and understand how they distinguishes high-, medium-, and low-performing hospitals.	Explanatory, sequential mixed-methods study with 2 surveys, semi-structured interviews, and organizational document analysis.	Strengths, Weaknesses, Opportunities, and Threats (SWOT) framework.	Selected facilities in the Michigan Hospitals Medicine Safety Consortium based on their rates of antibiotic overuse at discharge for community-acquired pneumonia (CAP) or urinary tract infections (UTI). Hospitalists, pharmacists, ASP leaders, and hospital leaders from selected hospitals were interviewed.	Organizational-level AMS strategies aimed at reducing antibiotic overuse at discharge for patients treated for community-acquired pneumonia (CAP) or urinary tract infection (UTI).

2.4 Discussion

This scoping review mapped the current literature examining the implementation of AMS interventions in small and medium-sized hospitals in high-income countries. Findings suggest that while AMS is recognized as a critical part of good patient care, its implementation in community hospitals is complicated by *structural, cultural and interpersonal and contextual challenges*. In addition to mapping the challenges in AMS implementation this review highlights implementation strategies and facilitators, offering insights to guide the effective and sustainable implementation of AMS interventions in under resourced small to medium sized community hospitals.

Table 2.2 Barriers and Facilitators Identified in Studies Included in Scoping Review, Stratified by the 5 CFIR Domains

CFIR Domain	Facilitators			Barriers		
	Findings	Description	Study Ref.	Findings	Description	Study Ref.
Inner Setting	Adaptability	Telehealth, flexible roles, and scope adaptation supported implementation.	(17,38)	Clinical workload burden	Staff were overburdened and unable to act on recommendations because stopping antibiotics was seen as lower priority in acute care.	(40,45)
	Dedicated Funding	Stable funding facilitated sustainability	(38)	Competing hospital priorities	AMS was deprioritized due to other initiatives.	(42)
	Educational resources	Ongoing education via newsletters, CE, and lectures.	(16,17)	Gaps in IT infrastructure and delayed data availability	Slow onboarding to integrate EMR data due to limited IT resources or low prioritization of the intervention.	(16,17, 42)
	Embedding in workflow	Interventions and meetings integrated into existing processes and regular workflow increased feasibility	(17,44, 45)	Difficulty accessing guidelines	Challenges accessing or updating guidelines at point of care led to reliance on clinical experience instead.	(43)
	EMR-integrated decision support	Best practice alerts assisted guideline adherence.	(43)	Education gaps and low seminar attendance	Insufficient AMS knowledge and training across staff members and lack of standardized educational content for staff, but low attendance to educational seminars	(39,41, 45)
	Hospital executive and leadership support	Support from leadership secured funding and ensured accountability.	(16,17, 38)	Environmental context & resources	High workload, limited space, and staffing shortages.	(37)
	Institutional support in larger hospitals	University hospitals provided stable staffing with defined roles.	(42)	Staffing Constraints	Lack of ID-trained, and stewardship-specific staff, specifically clinical pharmacists, particularly in rural/remote settings.	(16,39, 42)
	Interprofessional Dynamics & Cohesiveness	Stronger collaboration between hospitalists and pharmacists reduced overuse.	(46)	Inconsistent messaging	Communication breakdown between remote and onsite pharmacists.	(40)

CFIR Domain	Facilitators			Barriers		
	Findings	Description	Study Ref.	Findings	Description	Study Ref.
Inner Setting	Standardized ASP tools	Customized protocols, algorithms, and order sets supported ASP.	(16)	Inconsistent staff engagement	Variability in staff commitment to intervention goals.	(44)
	Support from Trust leadership	Leadership-endorsed protocols enabled standardization.	(43)	Insufficient funding	Lack of financial support.	(17,39,42)
	Tools and Infrastructure	High-quality stewardship tools and infrastructure support.	(39)	Lack of clarity about non-prescribers' roles	Pharmacists and nurses excluded from stewardship activities.	(45)
	Workflow diversity across hospitals	Variation in prescribing and charting systems complicated implementation.	(45)	Lack of continuity	Harder to educate new patients vs. long-standing ones.	(43)
				Lack of direct communication	Remote pharmacists couldn't relay ASP recommendations easily.	(40)
				Low culture collection	Lack of microbiology data hindered de-escalation decisions.	(17,40)
				Staff turnover	High prescriber rotation reduced AMS continuity.	(39)
				Time constraints	Short appointments limited patient communication, education, and other discussions.	(43,44)
Outer Setting	Established provider-patient relationship	Long-term trust fosters acceptance of non-antibiotic plans.	(43)	Limited access to ID expertise	Many smaller hospitals lacked on-site infectious disease consultants	(39)
	External guideline reinforcement	Support from trusted external bodies (e.g., Choosing Wisely®).	(43)	Patient expectations	Patients expect/demand antibiotics, pressuring providers to prescribe.	(43)
	Network support	External benchmarking, education, and consultative support from larger hospitals improved sustainability but was inconsistently available.	(16,17,38)	Patient satisfaction metrics	Can encourage inappropriate prescribing.	(43)
	Patient education and empowerment	Educating patients about risks and benefits increased engagement	(44)	Fear of patient "doctor shopping"	Concern that patients will switch providers if not given antibiotics.	(43)

CFIR Domain	Facilitators			Barriers		
	Findings	Description	Study Ref.	Findings	Description	Study Ref.
Outer Setting				Lack of continuity	Harder to educate new patients vs. long-standing ones.	(43)
				Patient resistance or uncertainty	Patients were reluctant to delabel due to past guidance or fears.	(44)
				Poor communication with primary care	Allergy status changes were not reflected in GP records.	(44)
				Perception of low risk in not delabelling	Some preferred to prescribe second-line agents rather than risk removing the label.	(44)
Characteristics of Individuals	Knowledge of and Comfort with Stewardship	High performers had more robust knowledge and comfort, particularly among clinical pharmacists.	(46)	Prescribing culture; Resistance to change from prescribers	Some physician resistance to ASP policies or formulary restrictions, though reportedly decreasing. Entrenched prescribing habits, lack of leadership for AMS.	(39,42,45)
	Awareness of modifiable causes of misuse	Recognition of modifiable factors like peer knowledge gaps.	(42)	Perceived risk of stopping	Clinicians hesitant to stop antibiotics without diagnostic certainty	(45)
	Use of correct terminology (allergy vs intolerance)	Clarifying terminology improved communication and action.	(44)	Non-interference culture	Reluctance to contradict senior prescribers	(45)

CFIR Domain	Facilitators			Barriers		
	Findings	Description	Study Ref.	Findings	Description	Study Ref.
Characteristics of Individuals				Lack of confidence among junior staff	Uncertainty about authority to stop antibiotics.	(45)
				Negative perceptions of e-learning	Found online tools unengaging or irrelevant.	(45)
				Antagonism from other specialties	Interprofessional tension regarding stewardship policies or authority.	(42)
				Overreliance on microbiology	Junior staff deferred to microbiologists rather than verifying allergy history	(44)
				Professional role boundaries (nurses)	Nurses limited by scope from documenting delabelling.	(44)
				Knowledge	Participants lacked procedural knowledge of de-labeling and CDST use.	(37)
				Skills	Limited hands-on experience with allergy history-taking, risk stratification, and test dosing.	(37)
				Beliefs about Capabilities	Clinicians were unsure of their competence, especially in emergencies.	(37)
				Beliefs about Consequences	Fear of triggering allergic reactions and bearing responsibility hindered willingness to de-label.	(37)
				Professional Role & Identity	Ambiguity over team ownership; deferment to allergy specialists due to perceived role limitations.	(37)

CFIR Domain	Facilitators			Barriers		
	Findings	Description	Study Ref.	Findings	Description	Study Ref.
Implementation Process	Interprofessional Collaboration	Stronger, team-based, collaboration between prescribers and non-prescribers (e.g., hospitalists, pharmacists, nurses) improved stewardship integration and mutual respect through shared responsibility.	(44–46)	Lack of antimicrobial use feedback mechanisms	Minimal or no feedback on antimicrobial use; described possible strategies to overcome (e.g., AMS team, feedback tools).	(39)
	ID physician support and engagement	Active involvement of ID physicians and pharmacists strengthened stewardship programs.	(42,46)	Paper-based tools viewed as burdensome	Extra paperwork was often ignored or lost in busy environments.	(44)
	Education and training	Provider and patient education improved evidence-based prescribing and communication. Used structured education, in-services, and clinical pathways.	(42–44)			
	Access to ID-trained experts	Support through site visits and consultation with ID specialists.	(16)			
	Feedback Mechanisms	Use of audit tools, post-prescription review, and benchmarking supported improvement, motivation, and adherence.	(41–45)			
	Toolkit and standardized strategies	Templates, guidance, structured tools, and tailored approaches helped fit interventions to local context.	(17,42,44,45)			
	Champion networks and leadership	Peer networks and local champions provided motivation, but programs were vulnerable without sustained leadership.	(38,45)			
	Knowledge-user co-design	Engaging target users in tool design improved feasibility and engagement.	(45)			

CFIR Domain	Facilitators			Barriers		
	Findings	Description	Study Ref.	Findings	Description	Study Ref.
	Specialist nurse models	Roles like sepsis nurses proposed to support implementation and delabelling efforts.	(44)			
	Point prevalence surveys	These help identify prescribing patterns and targets for ASP improvement.	(17)			
	Developing a business case	Creating a financial justification tailored to small hospital constraints helps secure resources.	(17)			
Innovation	Measurability	adherence and outcomes are measurable	(17,41)	Flexibility	Limited tailoring to patient/practice characteristics	(41)
	Clear, Concise and executable	Recommendations were clearly identifiable, concise, conditionally specific, and generally actionable.	(41)	Validity	Evidence quality and justification for recommendations not clearly presented	(41)
	Decision Aid categories	Categorizing prescriptions improved clarity in decision-making.	(45)	Computability	Electronic data often unavailable or difficult to integrate with local systems	(41)
	Short, focused online tool	Brief, tailored training modules increased acceptability.	(45)	Implementation Tools	Lack of specific, established resources or rollout strategies led to challenges applying intervention's tools and tracking decisions consistently	(41,45)
	Alignment	Recommendations align with clinical expectations; some variation in views (esp. among surgeons)	(41)	Uncertain evidence for cost-effectiveness	Lack of compelling data on ASP savings reduced institutional buy-in.	(42)
	Formulary restriction and preauthorization	Effective in some ASPs but not feasible everywhere.	(17,42)	Focus on high-cost or high-risk antibiotics	Helped justify ASP efforts at launch, and good for focused activities but didn't drive broad culture change.	(16,42)
	Simplicity and scalability	Simple, low-resource stewardship practices are more feasible and sustainable.	(17)			

2.4.1 Core Barriers

A key barrier across studies was the lack of structural capacity to support AMS. Resource limitations such as inadequate funding, underdeveloped IT systems, and a shortage of trained personnel like infectious disease (ID) specialists and pharmacists, were frequently reported. (37,39,40,42) These findings echo concerns that AMS frameworks designed for academic or tertiary centres may not translate well to smaller hospitals, where infrastructure, staffing, and diagnostic capacity are often constrained. (47) Without support from system-level functions such as electronic medical record integration or access to ID consultation, strategies that are often cited as effective in larger, resource-rich settings, like audit and feedback, become difficult to implement or sustain. (29)

Contextual, cultural, and interpersonal factors further hindered implementation. In many studies, AMS activities were perceived by staff as externally imposed, burdensome, or misaligned with daily clinical realities. (40,43,44) These perceptions were shaped by contextual challenges unique to smaller hospitals, including high workloads, limited administrative support, and a need for clinicians to fulfill multiple roles simultaneously. Negative attitudes toward stewardship were also reinforced by interprofessional silos, hierarchical workplace cultures, and hesitancy to challenge established prescribing norms. (46) While these barriers are not exclusive to smaller institutions, they may be magnified in rural or resource-limited settings where rotational prescriber models and limited institutional memory further disrupt continuity. In such environments, stewardship interventions must be low burden, regularly reinforced, and embedded within

existing systems, yet most rural hospitals lack the infrastructure to meet these requirements. (40,42) (Johannsson et al., 2011; Howell et al., 2019).

2.4.2 Implementation Strategies and Facilitators

Several strategies and facilitators that improved AMS implementation were identified.

Visible support from executive leadership and engaging local practitioners, often pharmacists or physicians with AMS expertise, to champion the intervention were critical for legitimacy and program sustainability. (38,41) These findings are consistent with the IDSA guidelines, which emphasize leadership buy-in and defined accountability as essential to stewardship success. (10)

Contextual tailoring was also presented as an effective implementation strategy. Studies found that AMS tools were more likely to be adopted when integrated into existing workflows, such as embedding decision support into electronic medical records or planning audit feedback to accommodate staff schedules. (37,40,43) Aligning interventions with local priorities and workflows enhances the uptake and fidelity of that intervention, which is supported by broader implementation literature. (28)

Co-designing AMS interventions with frontline staff significantly enhanced feasibility and engagement. When clinicians were actively involved in adapting educational materials, protocols, or audit tools, the resulting interventions were perceived as more relevant and actionable, which increased uptake and participation. (44,45) This approach aligns with implementation science guidance, which emphasizes that engaging

knowledge users, particularly in under-resourced settings, is critical to achieving sustainable change. (18)

Notably, few studies explicitly applied theory-informed frameworks such as the Behaviour Change Wheel or Theoretical Domains Framework. (37,38,41,45,46) This represents a missed opportunity, as behavioral theory can guide the systematic identification of barriers and inform the design of targeted strategies that are more likely to drive meaningful change. (47) For example, audit and feedback interventions rooted in behavioral theory have shown more consistent and robust improvements in prescribing compared to those developed without theoretical grounding. (15,21)

2.4.3 Implications for Practice and Research

Effective AMS implementation in small and medium-sized hospitals requires tailoring interventions to local resource constraints, securing leadership support, and engaging local champions. These findings underscore the importance of designing stewardship models that are not only evidence-based but also feasible, low-burden, and sustainable within constrained environments. Co-designing interventions with frontline staff, addressing cultural and interpersonal dynamics, and embedding stewardship into existing workflows are critical steps toward achieving long-term impact.

External stewardship networks offer a promising solution by providing remote consultation, benchmarking, and expert guidance, extending AMS capacity without requiring hospitals to independently develop full-scale internal programs. (16) Practical tools such as simplified audit templates, asynchronous education modules, and virtual

consultations have been shown to support implementation without overburdening local staff. (40) These approaches leverage the strengths of better-resourced institutions to support AMS in lower-resourced settings.

Patient-related factors also shape prescribing practices. Several studies reported that clinicians experienced pressure to meet patient expectations or satisfaction scores or were motivated by fear of causing harm. (37,43) These findings point to a need for improved communication training, standardized care protocols, and public education campaigns to recalibrate patient expectations around antibiotic use. (24)

Future research should continue to investigate how AMS interventions are implemented in small and medium-sized hospitals, particularly using qualitative and implementation science methodologies. Studies should explore how contextual factors, professional relationships, and organizational structures interact to shape intervention success.

Theory-informed approaches and established implementation frameworks, such as the CFIR, can support the design of more adaptable and transferable stewardship strategies across diverse hospital settings. (47)

2.4.4 Strengths and Limitations

A key strength of this review is its targeted focus on small and medium-sized hospitals in high-income settings; a group often underrepresented in AMS research despite delivering a significant proportion of inpatient care in North America. (20) By narrowing the scope to these non-academic contexts, this review provides practical, context-specific insights for health systems aiming to expand AMS beyond tertiary care institutions.

This review also followed a rigorous and transparent methodology, guided by the JBI Manual and the PRISMA-ScR framework, and included a comprehensive search across multiple databases with dual independent screening and data extraction.

However, several limitations should be acknowledged. First, the exclusion of grey literature may have led to the omission of innovative or informal AMS efforts, particularly those implemented outside of academic partnerships or published networks. Second, heterogeneity in study designs, terminology, and reporting limited the ability to synthesize quantitative outcomes or make comparisons across interventions. Third, many included studies focused on early-stage implementation or perceived barriers, with fewer addressing long-term sustainability, clinical outcomes, or program effectiveness.

Additional limitations include the inconsistent reporting of hospital characteristics. Not all studies clearly defined hospital size, rurality, or resource levels, which may influence transferability of findings. The use of theory-informed implementation frameworks was also inconsistent, limiting insight into how implementation science may have supported success. Lastly, while the review focused on high-income countries to ensure relevance to the Canadian context, this focus limits the generalizability of findings to middle- or low-income health systems, where AMS challenges may differ substantially.

Overall, the findings emphasize the need to design AMS strategies that are responsive to the specific capacities, constraints, and cultural dynamics of the settings in which they are implemented. Successful implementation depends on adaptable tools, sustained leadership support, interdisciplinary collaboration, and, critically, on applying theoretical guidance to navigate complexity and support long-term change.

2.5 Conclusion

This scoping review mapped existing evidence on AMS implementation in small and medium-sized community hospitals in high-income countries. These settings are often overlooked in stewardship literature, even though they represent a substantial portion of healthcare systems.

By focusing on non-academic, under-resourced hospitals, this review fills a critical gap by identifying context-specific barriers and facilitators to AMS implementation. Common challenges included staffing constraints, limited resources, and resistance to practice change. However, several consistent enablers emerged. Programs with visible leadership support, integration into daily workflows, and co-design with frontline staff were more likely to succeed. Adaptable delivery models, simplified tools, and interprofessional collaboration also contributed to feasibility and sustainability.

The review also underscores the limited use of theory-informed frameworks in this context, despite their potential to guide strategy selection and improve implementation fidelity. Greater use of these frameworks, paired with support from external networks, may help align evidence-based recommendations with real-world practice.

These findings can guide the adaptation of stewardship interventions to better fit the realities of small and medium-sized hospitals, helping to bridge the gap between theory and practice while expanding the reach of AMS programs and supporting more integrated, system-wide responses to AMR.

CHAPTER 3 QUALITATIVE STUDY

3.1 Introduction

Antimicrobial stewardship (AMS) programs are a cornerstone of global efforts to optimize antibiotic use and mitigate the escalating threat of antimicrobial resistance (AMR). (4,10) Among the many strategies employed within AMS, audit and feedback is widely used to promote evidence-based prescribing by providing clinicians with individualized or aggregate data on their prescribing practices alongside recommended guidelines. (21,48) While audit and feedback has demonstrated modest but consistent effectiveness in changing clinical behavior, its success is often contingent on how well it is adapted to local contexts, especially in smaller or resource-constrained hospitals. (21,48,49)

One such context-specific challenge is the inappropriate treatment of bacteriuria, particularly in cases of asymptomatic bacteriuria (ASB), which remains a persistent and well-documented concern in AMS. Despite strong clinical guidelines advising against antibiotic use for ASB in non-pregnant, immunocompetent adults, overtreatment remains prevalent in hospital settings across the world. (2,24) Contributing factors include diagnostic uncertainty, entrenched prescribing habits, and the perception that antibiotic treatment is safer or more efficient than careful observation. (15,50) In the Canadian context, a recent point prevalence survey of antimicrobial use in NS found that ASB was one of the most frequently mismanaged indications, with treatment decisions often driven by non-specific urinary symptoms or reflexive urine culturing in the absence of clear clinical indicators. (23) These findings were further compounded by structural and

organizational challenges, including limited access to infectious disease support, inconsistent stewardship infrastructure across community hospitals, and the absence of embedded audit and feedback processes. (21,23) Collectively, these issues underscore the need for stewardship interventions that are not only aligned with clinical guidelines but also tailored to the realities of local practice environments, particularly in under-resourced settings.

To answer this call for tailored, clinically informed AMS interventions, a mixed-methods project was initiated to develop, implement, and evaluate a multifaceted audit and feedback intervention aiming to reduce antibiotic use in ASB. This intervention combined targeted education with audit and feedback to address entrenched behaviours, promote evidence-aligned decision-making, and shift practice culture. Grounded in implementation science principles, this approach was designed to influence practices through tailored unit-level feedback, supportive engagement, and integration into existing clinical workflows. One hospitalist unit at each of four community hospitals participated in the intervention. While each site operated independently, all were supported through a coordinated structure that included a local implementation team and a centralized audit team. Each site designated a local champion pharmacist to deliver feedback and adapt messages to their unit context, and a local AMS pharmacist who provided ongoing support to the local champion. The audit team, composed of study and provincial AMS team members, conducted chart reviews of bacteriuria cases, compiled feedback, and communicated these findings monthly to the local team. They were also available to offer technical support, data interpretation, and broader implementation guidance as needed. Although AMS infrastructure varied by site, all participating hospitals lacked dedicated

full-time interprofessional stewardship teams, reflecting common limitations in community care environments.

This qualitative study contributes to the evaluation component of the larger project. Its objective is to identify contextual factors influencing the implementation of a multifaceted intervention designed to improve the inpatient management of bacteriuria across four community hospitals in NS, Canada, at the individual, unit, and organizational levels. By capturing the experiences of those directly involved in delivering and supporting the intervention, this study explores both the barriers and facilitators that shaped its implementation. These insights aim to inform the design, delivery, and adaptation of future AMS interventions in small and medium-sized hospitals, where sustainable, context-sensitive stewardship models are urgently needed.

3.2 Methods

3.2.1 Study Design

This was a qualitative descriptive study using individual, semi-structured interviews guided by the 2022 update of the Consolidated Framework for Implementation Research (CFIR) (51) to capture the dynamic interplay of organizational, individual, and systemic factors that influenced the intervention's implementation. This study aimed to explore contextual factors affecting the delivery and uptake of an audit and feedback intervention for inpatient bacteriuria management. Ethics approval was obtained from the Nova Scotia Health Research Ethics Board (REB #1024184), and all participants provided informed consent prior to their interviews.

3.2.2 Setting

The study was conducted across four hospitalist units in four distinct community hospitals in NS, Canada. These sites were participants in the province-wide multifaceted AMS initiative aimed at improving the appropriate management of bacteriuria.

3.2.3 Participants and Recruitment

Participants were recruited by e-mail using purposive sampling to capture the experiences of those directly involved in intervention development and implementation. Local champion pharmacists who delivered unit-level feedback and the local AMS support pharmacists were e-mailed by the study team to request their participation. Local champions then sent a prepared e-mail and recruitment poster to the unit to recruit healthcare workers who received feedback from the local champions.

3.2.4 Data Collection and Tools

Data were collected through semi-structured virtual interviews conducted between August and December 2024. All interviews were conducted by the lead researcher (BL), a Master of Pharmaceutical Sciences student trained in qualitative research methods. An interview guide was developed based on the CFIR, tailored to the specific context of the audit and feedback intervention. The guide was pilot tested with a local AMS pharmacist not involved in the study to assess clarity, relevance, and flow.

Interviews were conducted virtually and ranged from 20 to 60 minutes in duration. Only the participant and interviewer were present for each session. All interviews were audio-

recorded using the Microsoft Teams[®] built-in recording feature. Auto-generated transcripts were downloaded and manually reviewed by the lead researcher to ensure verbatim accuracy. Interview recordings and transcripts were securely stored on encrypted institutional servers.

This reporting aligns with the Consolidated Criteria for Reporting Qualitative Research (COREQ), a 32-item checklist designed to improve transparency and rigor in interview and focus group studies. (52) This checklist can be found in **Appendix IV**.

3.2.5 Analysis and Strategies to Ensure Trustworthiness

Interview transcripts were analyzed using a deductive-inductive approach. Initially, data were coded deductively to the five major CFIR domains. Within each domain, inductive thematic analysis was conducted to identify context-specific patterns and themes grounded in the data. Coding was performed using NVivo (version 14), and a detailed audit trail of codebook development and analytic decisions was maintained to ensure transparency.

To enhance the trustworthiness of the findings, all transcripts were independently coded by two researchers. Discrepancies were resolved through discussion, and regular peer debriefing sessions were held to challenge assumptions, refine themes, and ensure consistency in interpretation. These strategies supported credibility, dependability, and confirmability of the analysis.

3.3 Results

All four local champions and all four local AMS pharmacists involved in the intervention were interviewed. Due to high staff turnover in the year between implementation and data collection, unit nurses and physicians who received feedback could not be recruited. To contextualize the intervention, participants first described baseline management of bacteriuria. These accounts reflected limited coordination and variable awareness of AMS principles, with a tendency to culture and treat bacteriuria even in the absence of clinical symptoms.

Across the five CFIR domains—Implementation Process, Innovation Characteristics, Inner Setting, Outer Setting, and Characteristics of Individuals—eleven themes were identified as either barriers, facilitators, or both. A single cross-cutting factor, Staffing Consistency, emerged as a key modifier influencing all domains and the overall success of implementation. The identified themes and their associated CFIR domain are summarized in **Table 3.1** and quotes representing how each theme can pose as a barrier or facilitator can be found in **Table 3.2**.

Table 3.1. Summary of Identified Themes and Their Associated CFIR Domains

CFIR Domain	Identified Themes
Cross Cutting	Staffing Consistency
	Contextual Adaptation & Tailoring
Implementation Process	Dedicated Resources
	Feedback Frequency & Repetition
Innovation Characteristics	Clinical Context & Believability
Characteristics of Individuals	Constructive Communication & Relationship Building
	Practice Habits & Intervention Awareness
Inner Setting	Priority & Time Constraints
	Team Culture
Outer Setting	System Structures & Supports,
	Prior Clinical Decisions & Outdated Training

3.3.1 Cross-cutting Factor: Staffing Consistency

Staffing turnover, shift rotations, and the use of temporary staff were persistent barriers to implementation across all CFIR domains. During the implementation process, champions struggled to tailor messages quickly when turnover introduced new practitioners who repeated practices that earlier staff had already addressed. Turnover also influenced perceptions of the innovation itself: frequent turnover made the intervention appear less credible or relevant, particularly when feedback lacked clinical context or seemed disconnected from the practical challenges faced by rotating staff. Staffing inconsistency

also affected the characteristics of individuals by limiting opportunities to build trust, reinforce awareness, and support consistent engagement with the intervention.

Within the inner setting, turnover weakened team cohesion and institutional memory around AMS practices. Participants described the difficulty of maintaining continuity of feedback messaging, building rapport, and sustaining culture change on a unit where prescribers and nurses rotated frequently. Additionally turnover in the outer setting meant that local champions were sometimes reassigned to cover pharmacy shortages in other areas of the hospital, undermining efforts to deliver consistent feedback and build familiarity. Staffing shortages and reliance on rotational coverage within the inner and outer settings contributed to a misalignment between intervention goals and unit-level realities. This misalignment was particularly challenging to address in units with limited baseline exposure to AMS practices and interventions.

3.3.2 Implementation Process

Contextual Adaptation & Tailoring (Facilitator)

Adapting the audit and feedback intervention to align with unit-specific workflows, practices, and norms was a key facilitator of engagement. Champions who customized their delivery by adjusting examples, modifying presentation styles, or timing feedback to coincide with staff availability enhanced the relevance, credibility, and accessibility of their messages. This theme was closely linked with constructive communication, team culture, and system structures, since successful tailoring often relied on the champion's interpersonal connections to the unit staff, their awareness of the unit's culture, and the institutional and provincial supports and resources available to inform intervention

tailoring. Staffing inconsistency hindered adaptation efforts by limiting opportunities for champions to develop rapport or build on previous messaging. High turnover often required restarting the process, making it difficult to establish tailored delivery as a norm.

Dedicated AMS Resources (facilitator and barrier)

Participants emphasized the need for dedicated personnel, protected time, and logistical support. They consistently described how essential the research-funded stewardship pharmacist was, noting that without someone dedicated to the role of auditing charts, developing feedback, and communicating feedback to the local champions, implementation would not have been feasible. However, the time and staffing demand represented by the research pharmacist was noted as a barrier to long-term sustainability by some participants given existing shortages and how constrained staff's time already is with routine duties.

This theme was found to directly facilitate contextual adaptation and tailoring of the intervention by giving champions protected time to review audit feedback with the research pharmacist and clarify its clinical relevance. It was also closely related to system structures, since organizational and provincial supports often determined the availability of resources. It was also affected by time and priority constraints: even when resources were allocated, outside of a protected study setting they are predicted to be redirected in response to clinical pressures. Staffing inconsistency added further complexity, as frequent turnover reduced the long-term value of investments in training and orientation.

Feedback Frequency & Repetition (Barrier/ Facilitator)

Consistent and repeated feedback cycles reinforced key messages, helped disrupt habitual prescribing, decreased the frequency of unnecessary urine culturing, and addressed new staff's lack of intervention awareness. Participants initially favored monthly feedback sessions to establish patterns but later spaced them out to prevent disengagement from perceived lack of improvement. When delivered predictably, repetition acted as a behavioral prompt and supported learning. However, feedback that was repeated frequently without the context of what was prompting its repetition risked message fatigue and was thought to result in individual practitioner disengagement due to assumptions that group feedback doesn't apply to them. Message repetition can also demotivate practitioners because they perceive it as a lack of improvement despite their efforts.

This theme intersected with practice habits and time constraints, clinical context & believability, and contextual adaptation & tailoring. Champions had to carefully balance feedback frequency and repetition to maintain engagement, highlight areas for improvement, and deliver targeted messaging without overwhelming staff. Staffing inconsistency created uneven exposure: some team members received feedback multiple times, while others missed it entirely, fragmenting learning and reducing collective impact.

3.3.2 Innovation Characteristics

Clinical Context & Believability (Barrier / Facilitator)

The perceived credibility of feedback was influenced by its alignment with clinical realities. Feedback that seemed disconnected from actual patient care, especially when based on retrospective data without contextual detail, was often disregarded. When feedback aligned with day-to-day experiences, it was more likely to be accepted.

This theme overlapped with constructive communication, since trust in the messenger played a role, and with prior clinical decisions, where outdated practices sometimes conflicted with new recommendations. Staffing inconsistency contributed to the challenge, as transient or new staff lacked contextual understanding and were less likely to trust champions they did not know well.

3.3.3 Characteristics of Individuals

Constructive Communication & Relationship Building

Effective feedback was closely tied to the quality of communication and the strength of interpersonal relationships. Champions who were respectful, approachable, and responsive to staff concerns were more successful in promoting behavior change. Participants valued opportunities for dialogue and collaboration, rather than one-way messaging.

This theme supported many others, particularly believability, adaptation, and team culture. High staff turnover made it difficult to build and maintain relationships, disrupting the continuity of messaging. Champions often found themselves reintroducing

the intervention to new team members who were unfamiliar with the initiative or the champions themselves.

3.3.4 Inner Setting

Practice Habits & Intervention Awareness

Clinician awareness of the intervention, as well as the routines it aimed to shift, varied widely. Some were unaware of the initiative, while others struggled to modify deeply ingrained prescribing patterns. Reflexive prescribing, especially for older adults or patients with confusion, often persisted despite feedback.

This theme interacted with repetition, communication, and believability. Repeated, credible messaging was often necessary to overcome habit. However, staffing inconsistency diluted awareness efforts. New or part-time staff often missed orientation and were influenced by colleagues who had not been exposed to the intervention consistently.

Priorities & Time Constraints

Audit and feedback were often deprioritized during periods of high clinical demand. Even clinicians who supported AMS principles found it difficult to engage with feedback under time pressure. Champions also struggled to deliver meaningful feedback while managing acute care responsibilities.

This theme influenced and was influenced by many others, including dedicated resources, team culture, and feedback frequency. Staffing shortages further increased time pressures

by creating uneven workloads. As a result, both the delivery and uptake of feedback became inconsistent across staff and shifts.

Team Culture

A unit's openness to change and prevailing attitudes toward collaboration influenced how feedback was received. Teams that valued continuous improvement and mutual respect were more likely to integrate stewardship recommendations. Hierarchical or rigid team structures were more resistant.

Team culture was tightly connected to communication, feedback believability, and contextual tailoring. The presence of embedded champions contributed to a sense of shared ownership. However, frequent turnover and temporary staff made it difficult to maintain a consistent culture of engagement.

3.3.5 Outer Setting

System Structures & Supports

Broader organizational and provincial structures played a key role in shaping implementation. Access to reporting tools, leadership support, and alignment with quality improvement goals enabled champions to act with confidence and authority. System-level supports also enhanced data interpretation and feedback relevance.

This theme interacted with resources, adaptation, and team culture. Even when structures were in place, staffing inconsistency limited their impact. Without consistent personnel,

these systems were not always applied uniformly, leading to uneven implementation across settings.

Prior Clinical Decisions & Outdated Training

Prescribing decisions were often shaped by outdated practices or habits developed before the intervention. These habits were particularly difficult to reverse when decisions made upstream, such as urine cultures ordered in the emergency department, set a course for treatment that staff were hesitant to interrupt.

This theme connected with believability, practice habits, and communication. Champions needed to reframe long-held beliefs with evidence-based guidance, which was often met with resistance. Inconsistent staffing complicated these efforts, as new staff brought varying training backgrounds and champions had limited opportunities to provide repeated messaging.

3.3.6 Cross-theme interactions

The themes described above did not operate in isolation. Instead, they reflected a network of interconnected influences that shaped how feedback was delivered, received, and acted upon. For example, feedback that lacked clinical nuance or was delivered without contextual adaptation was often dismissed. This effect was amplified when messages came from unfamiliar individuals or were repeated without variation. However, when champions tailored content, aligned it with clinical realities, and delivered it through trusted relationships, staff were more receptive and engaged.

Interpersonal dynamics were central to effective implementation. Familiarity with the champion increased message credibility, while staff turnover disrupted trust and continuity. Communication, trust, and context all shaped the perceived legitimacy of feedback.

Inner setting barriers such as established routines, limited time, and competing priorities also constrained intervention success. Feedback was frequently deprioritized during periods of high demand, and in the absence of reinforcement, clinicians often reverted to habitual practices. In addition, upstream decisions and inconsistent messaging created confusion about how and when to apply AMS principles.

Finally, system-level supports such as leadership endorsement, access to data tools, and provincial alignment created important structural enablers. These supports allowed champions to adapt messages and respond to emerging challenges. However, their effectiveness was ultimately shaped by local realities, especially the presence or absence of consistent staffing.

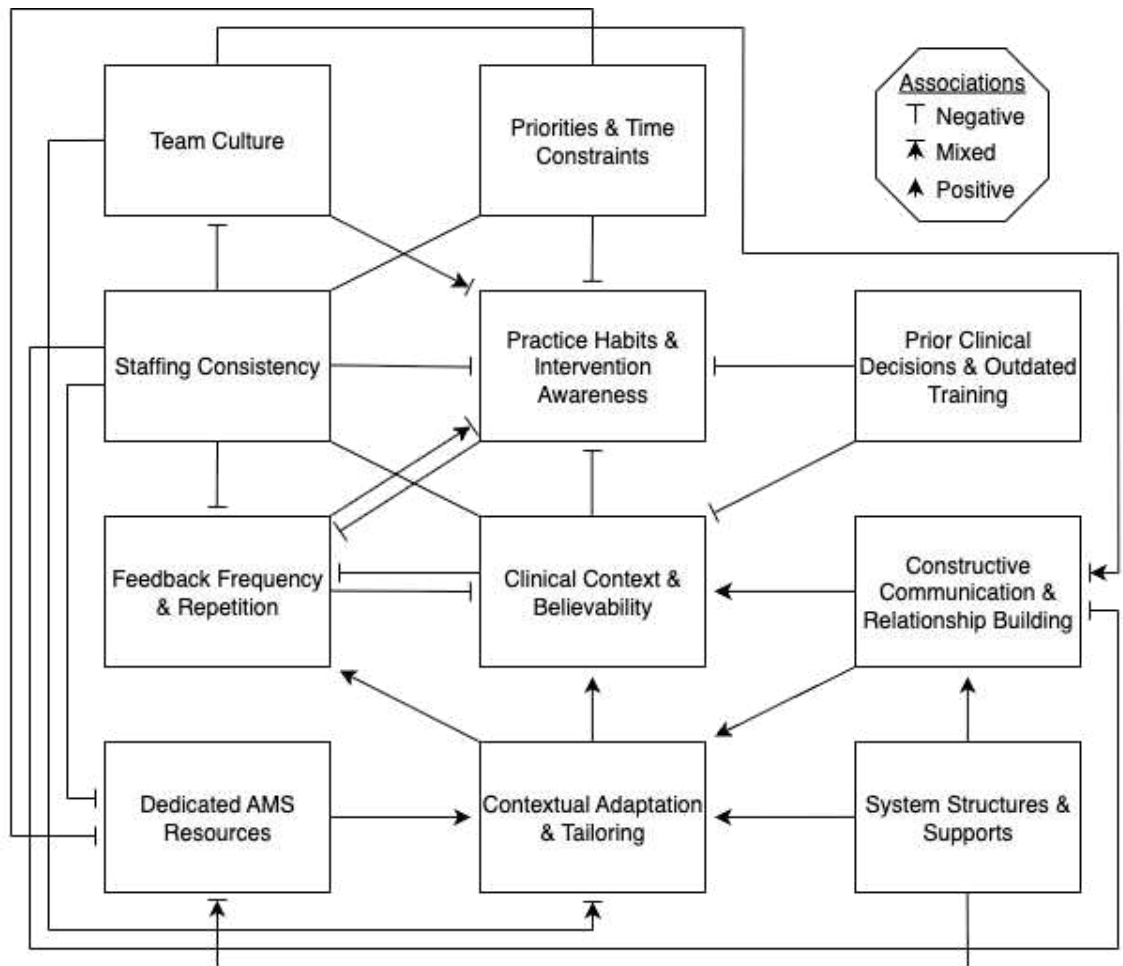


Figure 3.1 Connections Between Themes Identified in Qualitative Study

Table 3.2 Themes Identified in Qualitative Study with Representative Barrier and Facilitator Quotes When Available.

CFIR Domain	Identified Themes	Facilitator Quote	Barrier Quote
Cross-cutting	Staffing Consistency		"People initially were more attentive to appropriate UTI management, but that fell off due to high staff turnover" -D8
			"Like If D2 went there today, I'm sure there's probably maybe 10% of the same staff that were there when she was there. So, it's yeah, I mean, it's great at the time, but without consistency with all the movement, it's hard to sustain."-D1
Implementation Process	Contextual adaptation/tailoring	"So, trying to like hook [the feedback] up with like a unit based or service based regular education session that they would have and just instead of making an add-on try to put it during that time slot."-D7	"Yeah, it would almost need to be tailored specifically to each area to see what would work best. So, when you're trying to roll something out quickly, that's not really an option."-D7
		"I think they finally maybe got the message and that might have just been that staff became more aware of it or something over the time of the intervention. If the feedback was given repeatedly over and over, and maybe that's what it takes, right?"-D7	"you feel like you're beating a dead horse [...] Like I see the importance of it, but like how many times can we keep saying the same things over and over and not seeing change?"-D3
		"trying to like highlight positives but also still repeat because you're right of what you said about how if we kept having to say the same thing, they're not getting it."-D7	"They reduced how often they were doing it because of this over reporting to them,[...] it was identified that it's almost you know maybe too much too often.[...] I think there is benefit to [repeated feedback] for sure. Yeah, you need to identify where the education needs a place." -D5

CFIR Domain	Identified Themes	Facilitator Quote	Barrier Quote
	Dedicated Resources	"I'm an enabler, so my role is to give [D5] that dedicated time to do that wonderful work, and his job is to make it happen [...] I manage some of the like background logistical stuff to allow him to practice to his full scope." -D4	"The difficult thing to do is to balance the degree of benefit with the resources that's required to do the intervention as well [...] because it is pretty resource heavy." -D5
Innovation	Clinical Context & Believability		"it was sometimes hard with the retrospective nature you're like, well, could there be other things at play here like maybe they had a fever and they just didn't document it, or they thought they were treating something else [...] [the intervention] would always be [taken] with that grain of salt cautiousness unless it was like a real time feedback situation in which you could be like, no, no, this doesn't make sense right now." -D7 "[...] as much as the audit feedback form was great, I think that there's a lot of factors and barriers that aren't that you can't get from reading a chart [...]"-D2
Individual Characteristics	Constructive communication & relationship building	"When [D2] would call someone out, she doesn't call it out in an inappropriate way, she inquires [...] it's in her approach, she's a very approachable person." -D1	
Inner Setting	Practice Habits & Intervention Awareness	"[...] I think that provided some education to the nurses, so there was some benefit in that. I saw and nurses being more aware of when urine cultures were being done or questioning on why they were being done." -D5	"I think it's extremely hard to change practice [...] it's not an SOP, it's not a guideline, but it's just it's embedded in the in the culture"-D1

CFIR Domain	Identified Themes	Facilitator Quote	Barrier Quote
	<p>Priority & Time constraints</p>		<p>"So that was one and just I guess where nursing just felt like short staffed a lot of the time, kind of overworked, I felt like I needed to keep my kind of overview as brief as possible and concise as possible."-D6</p> <p>"It was definitely like a struggle finding a good time where I felt like I had active listeners. I feel like it's always a balance between you want to share this information and every project really deserves our time, but respecting people's time as well, so I always find that challenging."-D6</p>
	<p>Team Culture</p>	<p>"She was embedded in that interdisciplinary team on the unit and she's an excellent pharmacist. [...] She knows everybody by name and again, that trust is there. So if someone else did go in, I don't think it would be as effective as having someone who's already part of the team."-D1</p> <p>"I think that I think it's just an artifact of the relationship that our pharmacists have with our hospitalists and like the heavily interdisciplinary role that we play, particularly in antimicrobial management."-D4</p>	<p>"It's a hard thing to trust people. It's like they want to make sure that they know what they're talking about and that they're like respected and that they have like good information."-D7</p>

CFIR Domain	Identified Themes	Facilitator Quote	Barrier Quote
	<p>System Structures and Supports</p>	<p>"So, you know, I would communicate with [The local AMS pharmacist] and see kind of see what she thinks. She would reassure me on things that I could do "-D2</p>	<p>"People just feel so overwhelmed because they feel like, oh, there's always stuff coming at me. Like I think people feel almost like they're on their own in terms of like, like learning what they're supposed to be doing and like implementing that into the practice."-D7</p>
<p>Outer Setting</p>	<p>Prior Clinical Decisions & Outdated training</p>		<p>"What is being taught in the nursing programs around UTIs maybe doesn't quite align with what the evidence is and what we are trying to you know, the practice we're trying to change" -D1</p> <p>"what we saw was that a lot of patients were arriving with inappropriate cultures being taken prior to arriving on the floor from the emergency department [...] which was really frustrating to our nurses on our floor because [...] they knew that we were trying to improve prescribing and improving inappropriate samples from being taken." -D5</p>

3.4 Discussion

This qualitative study explored contextual factors influencing the implementation of a multifaceted intervention designed to reduce inappropriate treatment of ASB in four community hospitals in NS. The analysis identified 11 interconnected themes and one critical cross-cutting factor that affected all 5 CFIR domains. While the intervention was broadly feasible and well received by local champions, its success was perceived to rely on the ability to navigate logistical constraints, organizational culture, and interpersonal dynamics within resource-limited settings. In this context, “cultural” refers to prevailing norms, values, and attitudes toward change or feedback, while “relational” reflects the influence of trust, communication, and collaboration among staff on implementation success.

Facilitators of implementation included the integration of feedback into existing clinical routines, the flexibility to tailor messaging to specific unit contexts, and strong relationships between champions and frontline staff. These findings are consistent with existing implementation science literature, which emphasizes the value of contextual tailoring, credibility of the feedback source, and embedding interventions into everyday clinical practice. (48,50,53) The importance of these relational dynamics was particularly evident in findings related to trust, interpersonal communication, and champions’ integration within team culture. These results highlight the role of informal social capital and embedded relationships as powerful levers for change, especially in settings with limited formal stewardship infrastructure.

Barriers to implementation were linked to both structural constraints and cultural resistance. Time pressures, competing clinical priorities, and frequent staff turnover consistently limited opportunities for meaningful engagement with feedback. These findings align with literature identifying high workload and limited time as persistent barriers to quality improvement efforts in hospital settings. (15,50) In smaller units, feedback fatigue also emerged as a challenge. Participants described frustration when messages were repeated without visible impact, describing the experience as “beating a dead horse.” However, adjusting the timing and content of feedback helped manage this risk and re-engage staff. This flexible cadence reflects an important adaptive strategy and builds on prior studies that recommend tailoring both the format and frequency of feedback to local readiness and capacity. (54)

A novel contribution of this study is the recognition of the intervention’s retrospective nature as both a practical limitation and a challenge to credibility. Participants described tension between the intent of feedback and its perceived fairness, particularly when clinical context was missing from documentation. Retrospective audits were necessary due to COVID-19 restrictions in place at the time of implementation in NS. However, these findings suggest that future interventions should, where feasible, incorporate real-time or prospective feedback or, at minimum, provide additional clinical framing when retrospective data is used.

The outer setting also shaped implementation in important ways. Although the intervention targeted inpatient decision-making, participants emphasized that upstream prescribing practices, particularly those initiated in emergency departments, often

determined downstream antibiotic use. This misalignment highlights the limitations of targeting a single point in the care pathway and underscores the importance of considering the full diagnostic and treatment trajectory when designing stewardship interventions. These findings support prior research that emphasizes the interconnectedness of clinical microsystems and the risk of siloed AMS efforts. (55)

Several practical implications emerge from this study. First, implementation strategies should account for high staff turnover by building flexible, repeatable feedback mechanisms that can withstand personnel changes. Second, investing in relationship-building through embedded champions, establishing an open and constructive dialogue, and trust-building within and between teams may be just as important as the technical content of the feedback. Third, although the intervention required considerable resources to initiate, even modest investments in protected AMS time and logistical support were seen to yield substantial benefit. This suggests that short-term resourcing may support longer-term behavior change, particularly when interventions are designed to align with existing workflows.

This study has some limitations. We were unable to recruit frontline staff who directly received the feedback, primarily due to post-intervention turnover. This limited triangulation of perspectives and direct evaluation of feedback impact. However, this recruitment challenge reflects a key barrier highlighted in the findings: the instability of staffing in community hospitals. The difficulty in reaching original staff illustrates how turnover disrupts continuity, weakens institutional memory, and complicates long-term evaluation. Additionally, participants' recollections may have been affected by the time

elapsed between intervention delivery and data collection, introducing potential recall bias. Despite these limitations, the study offers valuable insight into the realities of implementing audit and feedback in resource-constrained hospital settings that are often underrepresented in implementation research.

Overall, this study reinforces the need for AMS strategies that are not only evidence-informed, but also responsive to local context, grounded in relationships, and resilient to workforce instability. Person-centered delivery of feedback, supported by credible messengers and appropriate infrastructure, appears to be a key mechanism for embedding stewardship into daily practice.

3.5 Conclusion

This study underscores that successful AMS in community hospitals depends as much on relationships and local context as on technical execution. Tailored delivery, embedded workflows, and trusted messengers drove engagement, while time pressures, staff turnover, and retrospective data limited perceived success. Across all domains staffing was highlighted as a key facilitator when it was consistent and a significant barrier when turnover was high.

To strengthen future efforts, AMS teams should choose champions strategically and protect the time they need to execute the intervention. There should be early investment in relationship-building and the intervention should be designed to adapt strategies to real-world conditions. To navigate system constraints and sustain intervention impact future interventions should aim to embed real-time feedback into routine practice, expand

to address identified upstream barriers, and consider developing a resource to streamline onboarding new staff to in-place initiatives.

CHAPTER 4 DISCUSSION

This thesis examined the factors that influenced the success of a theory-informed antimicrobial stewardship (AMS) intervention targeting asymptomatic bacteriuria (ASB) in community hospitals across Nova Scotia (NS). Using a mixed-methods design, it combined a scoping review of international literature on AMS implementation in small and medium-sized hospitals with a qualitative study of local experiences during intervention rollout. Together, these methods provided both a broad understanding of commonly reported barriers and facilitators and a deeper exploration of how these factors played out at the individual, unit, and organizational levels in the local context. The findings contribute contextually grounded insights into why AMS interventions are variably adopted across hospital sites and what strategies may support more sustainable, locally adapted implementation in under-resourced, non-tertiary care environments. By situating the intervention within the broader literature and the lived realities of NS hospitals, this thesis responds to a gap in AMS research and aims to support more equitable extension of stewardship benefits throughout the healthcare system.

4.1 Alignment with Canadian AMS Guidelines

The findings of this thesis align closely with Canadian national guidance on AMS, including the Public Health Agency of Canada's Framework for Action on Antimicrobial Resistance and Antimicrobial Use (7) and the Canadian Antimicrobial Stewardship Accreditation Standards. (14) Both emphasize interprofessional collaboration, context-sensitive feedback, and system-level supports such as electronic infrastructure and leadership engagement. However, this study adds nuance by demonstrating how, in the

absence of robust infrastructure, champions adapt through informal strategies such as relational engagement, informal learning (hallway discussions), and workflow-sensitive messaging in smaller community hospitals. These local innovations extend national guidance by illustrating how stewardship principles can be realized in small to medium sized community hospitals without sacrificing clinical relevance or provider buy-in.

4.2 Integration of Findings: Scoping Review and Qualitative Study

The scoping review identified a range of structural and contextual barriers to AMS implementation, including staffing shortages, limited access to infectious disease expertise, outdated information technology infrastructure, and inconsistent use of theory-informed implementation strategies. (10,49) In addition to these structural challenges, several studies noted contextual barriers such as resistance to change, hierarchical team dynamics, and limited engagement from frontline clinicians. Reported facilitators included leadership support, co-design with end users, and alignment with existing workflows and clinical routines. (50)

Themes identified in the qualitative study such as staffing consistency, priorities and time constraints, and dedicated AMS resources echoed findings from the scoping review but offered additional depth by illustrating how these factors were adapted to fit local conditions. In this thesis, staffing consistency referred to the turnover of clinical personnel, including nurses, physicians, and pharmacists. High staff turnover, the use of temporary or rotational staff, and shift changes among these health care providers made it difficult to maintain continuity in intervention delivery. One strategy that could mitigate

the impact of high turnover amongst nurses is engaging nurse educators and nurse managers, they often hold more stable positions and can help maintain continuity in messaging with new staff.

Staff perceptions of the accuracy of the intervention's feedback and the trustworthiness of the person delivering it shaped its believability. In settings with limited formal infrastructure, champions relied on informal strategies to make feedback feel timely and relevant. In addition to hallway conversations, participants described using safety huddles and casual check-ins during patient care to reinforce stewardship principles. These strategies helped integrate the intervention into daily routines and encouraged uptake through trusted, relationship-based communication.

While many studies in the scoping review did not report using theory to guide implementation, the qualitative study applied the CFIR framework to examine how local context influenced uptake. Factors such as turnover, workflow alignment, and interpersonal dynamics shaped how feedback was received and acted upon. Rather than focusing solely on what barriers and facilitators were present, the qualitative findings illustrated how champions adapted the intervention to address local constraints. These adaptations supported sustainability by helping champions align feedback with existing clinical rhythms, draw on existing relationships, and adjust their approach based on staff needs. These findings not only reflect common barriers and facilitators to AMS program implementation but also offer novel insights that deepen our understanding of what makes these interventions succeed or fail. To contextualize these results within the

broader AMS and implementation science landscapes, we must understand how they align with key literature.

4.3 Comparison with Existing AMS and Implementation Science Literature

Findings from both components of this thesis align with broader AMS and implementation science literature that emphasize the importance of designing interventions to be context-sensitive, relationally grounded, and integrated into daily practice. (15,48) The qualitative findings reflect existing work that highlights the role of champion credibility, alignment with workflows, and the perceived relevance of feedback. (54,55) They also extend this literature by demonstrating that the effectiveness of feedback depends not only on its content, but also on when, how, and by whom it is delivered. Specifically, participants described how delayed feedback, particularly when based on retrospective data, was sometimes perceived as less useful because it lacked clinical context or arrived too late to influence decision-making. This reinforces concerns in the literature about the limitations of delayed feedback in fast-paced clinical environments and reflects a broader challenge in bridging the gap between knowledge generation and practical application. (47,48)

In addition to reinforcing key implementation principles, this thesis contributes to the development of implementation science theory by demonstrating how CFIR domains apply to smaller community hospital environments. The findings highlight that the influence of inner setting factors, such as team culture, clinical priorities, and time constraints, can outweigh the influence of formal infrastructure in the outer setting. This

suggests that when designing interventions, a central focus should be on identifying the potential barriers and facilitators to its implementation in the context that it is being delivered in. Additionally, the champions guiding implementation should be embedded in the team that will be interacting with the intervention. Embedded champions have an innate knowledge of the inner setting and if they are given the tools to recognize barriers and facilitators to implementation as the intervention is being rolled out, they can make appropriate adaptations in real time within dynamic environments. Adjusting the intervention to the needs of the environment rather than forcing practitioners to conform to the intervention. These insights contribute to theory development by clarifying that primary drivers of change are not static across all environments. Oftentimes community hospitals have less, or slower, access to formal outer setting supports which appears to increase the importance placed on the supports they have established within the inner setting. The relationships between practitioners carry more weight in these settings so delivering the intervention through a trusted champion who is already embedded in the team may be central to driving success and sustainability of interventions when implemented in community hospitals.

While the findings of this thesis largely reinforce established principles in AMS and implementation science, they also reveal important nuances and gaps that are currently underrepresented in the literature. Many of the existing studies identified in the scoping review focused on structural facilitators and barriers such as leadership support, access to infectious disease expertise, or IT infrastructure, but the qualitative study revealed unique factors that significantly shaped AMS implementation in community hospitals. First, many of the reviewed studies did not apply theory-informed frameworks, which limited

their ability to explore how contextual and relational mechanisms influenced uptake. By applying the CFIR framework, the qualitative study uncovered how staffing turnover, interpersonal relationships, and alignment with daily workflows influenced the intervention's success. Second, informal strategies such as hallway conversations, peer modeling, and integration into safety huddles emerged as critical tools in settings where formal infrastructure was limited. These strategies were not commonly reported in the reviewed literature but played a key role in sustaining engagement and embedding stewardship principles. Third, the perceived credibility of feedback was shaped not only by data accuracy but also by the timing, delivery method, and trust in the messenger. This finding expands on existing studies that emphasize content alone. Finally, although staff turnover was mentioned in some reviewed studies, it was rarely treated as a central implementation barrier. This thesis showed that turnover disrupted continuity, strained team relationships, and affected how knowledge was retained and transferred across care teams. These insights suggest that implementation success in smaller hospitals depends not only on structural readiness but also on trust-based, context-sensitive strategies that are often overlooked in broader discussions of AMS.

Overall, the presence of consistent champions, flexible feedback delivery strategies, and even informal system-level supports played a critical role in shaping implementation outcomes. This underscores the need to design interventions that are not only technically sound but also well-matched to the social, cultural, and infrastructural realities of the settings in which they are delivered. (50,53)

4.4 Implications for AMS Design and Delivery in Community Hospitals

Together, the scoping review and qualitative study suggest several design principles for future AMS interventions in community hospitals, particularly those in NS. Feedback should be integrated into existing workflows, delivered in ways that respect staff time, and repeated often enough to reinforce key messages without causing fatigue or disengagement. Champions should be trusted, embedded members of the clinical team with dedicated time and institutional support to carry out AMS activities. (55)

Interventions that reflect local language, clinical priorities, and logistical constraints are more likely to gain traction and be sustained over time. Given the impact of staffing turnover on continuity, implementation strategies should include onboarding protocols, low-burden documentation tools, and feedback systems that can remain functional even as personnel change. This could include formal collaboration with nurse educators, who can help maintain intervention consistency by introducing intervention messaging during structured onboarding for new hires and reinforcing intervention messaging during in-service training.

Many prescribing decisions begin well before stewardship efforts can intervene, particularly in emergency departments or at the point of diagnostic testing. Expanding the scope of AMS interventions to include these upstream influencers, or coordinating messaging across departments, could help improve consistency and intervention reach. (15,50) However, the specific nature of ASB presents unique challenges to real-time feedback approaches. Participants described how antibiotic use for ASB is often driven

by positive urine culture results, which are commonly obtained without a physician order. These cultures are frequently acted upon reflexively, regardless of clinical symptoms. As a result, the volume and frequency of urine cultures in both hospital and community settings make it difficult to apply prospective audit and feedback to every case in a timely or resource-efficient way.

Given these constraints, future stewardship strategies targeting ASB may require a bundled approach that combines education, restriction of urine cultures orders in the absence of symptoms, and targeted feedback interventions. This multi-pronged strategy could help shift entrenched behaviors, reduce unnecessary testing, and support more judicious prescribing, even in settings where continuous prospective audit and feedback is not feasible.

4.5 Implementation Strategies: Recommendations from Findings

AMS programs should be designed with implementation science principles in mind from the beginning. This includes selecting strategies that are tailored to local context, drawing on established frameworks such as CFIR or the Theoretical Domains Framework, and planning for iterative adaptation based on real-world feedback. (21) Applying theory helps identify which components are likely to influence behavior change and supports the development of strategies that are feasible, acceptable, and sustainable within specific healthcare environments. (21)

Feedback mechanisms should be timely, grounded in relevant clinical scenarios, and, where possible, delivered close to the point of care. Although retrospective data can still be useful, relying exclusively on delayed feedback reduces its credibility and impact. To be most effective, feedback should reflect recent practice, align with staff workflows, and be delivered by individuals who are trusted and knowledgeable. Champions should be provided with training in communication and relationship-building, as interpersonal credibility is a key driver of engagement and behavior change. (53)

Programs may also benefit from regional partnerships that offer shared tools, benchmarking data, and consultation resources. These partnerships can reduce the burden on individual hospitals while promoting consistency in AMS practices across institutions. (4)

It is also important to recognize how the broader healthcare context has evolved. The COVID-19 pandemic led to significant increases in staff turnover locally, particularly among nurses, and created lasting disruptions in hospital operations. Participants described the post-pandemic period as one of persistent instability, with fewer opportunities for consistent feedback delivery and greater difficulty engaging staff who were already stretched thin. With that in mind, at the time of this thesis, 2025, the NS healthcare system is functioning in a prolonged recovery period from the 2020 pandemic. It is important to acknowledge that the barriers and facilitators identified in this thesis apply to the early pandemic when the multifaceted intervention was implemented, and they may be different than the barriers and facilitators affecting implementation today. Regardless, implementation strategies must account for the reality of constantly evolving

environments by building in flexibility, supporting staff resilience, and finding new ways to maintain continuity despite ongoing change.

4.6 Policy and Practice implications for Regional and National scaling

Given the cross-cutting challenges of staff turnover, workflow pressures, and the limited perceived credibility of delayed data, policy-level supports are critical to sustaining AMS capacity in community hospitals. The consistency of findings across both the scoping review and qualitative study suggests that these barriers are not unique to NS but are likely present in other small and medium-sized hospitals across Canada. This reinforces the broader relevance of these findings and highlights the need for coordinated stewardship strategies that extend beyond individual institutions.

Several specific, actionable recommendations emerge from this work. First, policies should prioritize the development and distribution of onboarding-ready AMS toolkits tailored to rotating clinicians, including concise reference materials, orientation scripts, and unit-specific prescribing guidance. Second, funding mechanisms should be introduced to support protected time for AMS champions, particularly pharmacists and nurse educators, whose consistency can help stabilize implementation in high-turnover environments. Third, provincial and national AMS networks could promote the creation of real-time feedback templates and messaging scripts that align with local workflows and can be delivered informally by trusted staff members. Fourth, there is a need for interoperable IT infrastructure that links emergency department and inpatient prescribing data, enabling more coordinated stewardship efforts across care transitions. Finally,

focused, ongoing, on-site education and training should be provided for both champions and frontline practitioners as a part of routine workflow on the unit. Champions should be trained in implementation strategies for the intervention, enabling them to adapt delivery in real time whereas frontline staff should have concise, context-specific education sessions delivered regularly to support the intervention's messaging. This education would consistently reinforce intervention messaging, facilitate the uptake of feedback by explaining clinical rationale, and ensure that the messaging reaches as many practitioners as possible within dynamic staffing environments.

These policy actions reflect factors identified in this thesis as central to success: relational credibility, workflow integration, feedback adaptability, and role consistency.

Strengthening system-level supports in these areas would help reinforce local efforts, ensure continuity in stewardship practice, and move AMS from a project-based initiative toward a sustained, embedded component of healthcare delivery across Canada.

4.7 Strengths and Limitations

The scoping review had several strengths. It focused on small and medium-sized hospitals in high-income countries, a group often underrepresented in existing implementation science literature. The review followed a systematic and transparent methodology aligned with the JBI Manual for Evidence Synthesis and provided a structured mapping of implementation barriers and facilitators across CFIR domains.

However, there were also limitations. The exclusion of grey literature may have resulted in the omission of novel or unpublished AMS strategies. Heterogeneity in study designs and outcome reporting limited the ability to synthesize quantitative findings, and only a

small number of studies explicitly used theory-informed models, which reduced the analytical depth in some areas.

The qualitative study demonstrated multiple strengths, including the use of the CFIR framework to guide data collection and analysis, the generation of rich, context-specific insights from individuals directly involved in intervention delivery, and the application of strategies to enhance rigour such as double coding and peer debriefing. The framework supported a comprehensive exploration of individual, organizational, and systemic factors influencing implementation and allowed findings to be clearly aligned with those from the scoping review. However, it also introduced challenges. Some constructs overlapped conceptually or proved difficult to distinguish in a small sample size, and the structured nature of the framework may have limited exploration of unexpected or relational themes that emerged inductively. Additionally, CFIR was designed primarily to assess implementation processes, and may not fully capture the interpersonal or cultural dynamics that shaped staff engagement in this context. Despite these limitations, the framework was a useful tool for grounding the study in established implementation theory and facilitating cross-study comparison.

A major limitation of the qualitative study was selection bias. Being unable to recruit the nurses and physicians who directly received the intervention feedback and limited the diversity of perspectives and restricted triangulation of how the intervention was perceived across different professional roles. The sample may also have been subject to selection or response bias, as participants who were more engaged with the intervention may have been more likely to agree to be interviewed. Additionally, the time elapsed

between the intervention and the interviews may have introduced recall bias, particularly in relation to specific details about feedback content and delivery.

Overall, the major strength of this thesis was the integration of two complementary methodologies that provided both breadth and depth. The scoping review established a broad foundation for understanding the literature on AMS implementation in smaller hospitals, while the qualitative study offered a focused, context-rich exploration of a specific intervention in NS. The use of the CFIR framework across both components allowed for thematic alignment and enhanced interpretability. However, the combination of methods also introduced challenges. Differences in the types of data available across the two components made it difficult to fully integrate findings. The absence of patient and bedside clinician perspectives in the qualitative study further limited the ability to assess downstream impact and overall acceptability of the intervention. Despite these constraints, the thesis contributes important insight into AMS implementation in under-resourced settings and offers theory-informed, context-sensitive recommendations to guide future work.

CHAPTER 5 CONCLUSIONS

This thesis examined the contextual factors influencing the implementation of a theory-informed antimicrobial stewardship (AMS) intervention targeting asymptomatic bacteriuria (ASB) in community hospitals, where resources, staffing stability, and formal infrastructure are often limited. Through a scoping review and a qualitative study, it identified recurring challenges and highlighted practical, context-sensitive adaptations that supported the uptake and integration of AMS in these environments.

Key findings included the value of trusted and embedded champions, feedback that is integrated into clinical workflows, and strategies grounded in interpersonal relationships. These elements proved central to overcoming the constraints of high staff turnover, limited protected time, and informal communication channels. The thesis fills an important gap in the literature by offering context-specific guidance for implementing AMS in smaller, community hospitals, settings that are often underrepresented in the research that informs national and provincial policies.

To scale AMS successfully in community hospitals, institutions require not only technical guidance but also the capacity to adapt interventions to their realities. This includes time to deliver feedback meaningfully, trust between champions and clinical teams, tools that support local adaptation, and system-level support to reinforce consistent practices. As this thesis demonstrates, stewardship efforts are most successful when context, communication, and consistency align. The findings reinforce the need for co-design, engagement with frontline staff, and alignment with existing workflows to promote sustainability.

By mapping factors that affect successful AMS intervention implementation in international literature and identifying factors at the individual, unit, and organizational levels that shaped the perceived success of a local AMS intervention, this thesis reflects on how the context in which we apply these interventions can help or hinder their implementation and suggests an evidence-informed path forward. It shows that a one-size-fits-all approach to AMS is insufficient. Instead, sustainable stewardship requires flexibility, relational trust between feedback deliverers and receivers, and implementation strategies that reflect the complexity of real-world care. In the end, the evidence in this thesis suggests that AMS is the most successful when context, communication, and consistency align.

APPENDICES

Appendix I - Scoping Review Search Strategies

Database	Search Strategy	Results (Oct 30, 2024)
Embase	'antimicrobial stewardship'/exp OR 'antimicrobial stewardship program'/exp OR 'antibiotic stewardship'/exp OR 'antimicrobial stewardship strategies' OR 'antimicrobial utilization' OR 'antimicrobial use'/exp OR 'antibiotic metrics' OR 'antimicrobial stewardship intervention' OR 'antimicrobial stewardship outcomes' AND 'intervention'/exp OR 'strategy'/exp OR 'health program'/exp OR 'program'/exp OR 'management'/exp OR 'clinical audit'/exp OR 'healthcare policy'/exp OR 'quality assessment'/exp OR 'quality evaluation' AND 'community hospital'/exp OR 'rural hospital'/exp OR 'hospital patient'/exp	976
Cochrane Library	"antimicrobial stewardship" OR "antimicrobial stewardship program" OR "antibiotic stewardship" OR "antimicrobial stewardship strategies" OR "antimicrobial utilization" OR "antimicrobial use" OR "antibiotic metrics" OR "antimicrobial stewardship intervention" OR "antimicrobial stewardship outcomes" AND "intervention" OR "strategy" OR "health program" OR "program" OR "management" OR "clinical audit" OR "healthcare policy" OR "quality assessment" OR "quality evaluation" AND "community hospital" OR "rural hospital" OR "hospital patient"	778
CINAHL	("Antimicrobial Stewardship" OR "Antibiotic Stewardship" OR "Antimicrobial Utilization" OR "Antibiotic Metrics" OR "Antimicrobial Stewardship Intervention" OR "Antimicrobial Stewardship Outcomes") AND ("Community Hospital" OR "Rural Hospital" OR "Hospital Patient" OR "Infection Control" OR "Medication Management" OR "Healthcare Quality" OR "Patient Safety") AND ("Intervention" OR "Strategy" OR "Health Program" OR "Program" OR "Management" OR "Clinical Audit" OR "Healthcare Policy" OR "Quality Assessment" OR "Quality Evaluation" OR "Best Practices" OR "Healthcare Improvement" OR "Policy Implementation")	432
PubMed	((("Antimicrobial stewardship"[All Fields] OR "Anti-Bacterial Agents"[All Fields] OR "Anti-Bacterial Agents/therapeutic use"[All Fields] OR "Anti-Infective Agents/therapeutic use"[All Fields] OR "Anti-Infective Agents"[All Fields] OR "Anti-Infective Agents/standards"[All Fields]) AND ("Delivery of Health Care, Integrated"[All Fields] OR "Health Policy"[All Fields] OR "Program Development"[All Fields] OR "Program Evaluation"[All Fields] OR "Clinical Audit"[All Fields] OR "Quality Assurance, Health Care/methods"[All Fields] OR "Health Services Research"[All Fields]) AND ("Rural Health Services"[All Fields] OR "Community Health Services"[All Fields] OR "Hospitals, Rural"[All Fields])) OR (("Antimicrobial stewardship"[Mesh] OR "Anti-Bacterial Agents"[Mesh] OR "Anti-Bacterial Agents/therapeutic use"[Mesh] OR "Anti-Infective Agents/therapeutic use"[Mesh] OR "Anti-Infective Agents"[Mesh] OR "Anti-Infective Agents/standards"[Mesh]) AND ("Delivery of Health Care, Integrated"[Mesh] OR "Health Policy"[Mesh] OR "Program Development"[Mesh] OR "Program Evaluation"[Mesh] OR "Clinical Audit"[Mesh] OR "Quality Assurance, Health Care/methods"[Mesh] OR "Health Services Research"[Mesh]) AND ("Rural Health Services"[Mesh] OR "Community Health Services"[Mesh] OR "Hospitals, Rural"[Mesh])))	685

Appendix II - PRISMA Checklist

Section	PRISMA-ScR Checklist Item	Response
TITLE	Identify the report as a scoping review.	Title identifies this as a scoping review.
ABSTRACT	Structured summary of key elements: background, objectives, eligibility, sources, methods, results, conclusions.	Structured abstract included in manuscript.
INTRODUCTION	Rationale for the review in the context of what is already known.	Introduction explains the need for AMS evidence in community hospitals.
INTRODUCTION	State the objectives or questions addressed.	Stated in both introduction and methods: to map AMS implementation in small/medium hospitals and identify influencing factors.
METHODS	Eligibility criteria: characteristics of sources (e.g. year, language, publication status).	Peer-reviewed studies in English from high-income countries; small/medium hospitals; excluded grey literature.
METHODS	Information sources and date last searched.	Embase, PubMed, CINAHL, Cochrane searched. Last updated October 30, 2024.
METHODS	Search strategy (full strategy for at least one database).	Included in Appendix I. Developed with librarian.
METHODS	Selection of sources of evidence (screening and eligibility process).	Titles and abstracts screened in Covidence by two reviewers. Discrepancies resolved by third.

METHODS	Data charting process: how data were extracted.	Data extracted by two reviewers independently. Discrepancies resolved via discussion.
METHODS	Data items: what variables were sought.	Implementation-related outcomes: barriers, facilitators, acceptability, context.
METHODS	Critical appraisal of individual sources of evidence (if done).	Not done; justified due to scoping nature.
METHODS	Synthesis of results: how data were handled and summarized.	Narrative synthesis guided by CFIR and themes.
RESULTS	Numbers of sources screened, assessed for eligibility, and included, with reasons for exclusions.	Provided via PRISMA flow diagram.
RESULTS	Characteristics of sources of evidence.	Table of included studies describes design, setting, intervention, and outcomes.
RESULTS	Critical appraisal within sources of evidence (if done).	Not done.
RESULTS	Results of individual sources of evidence.	Organized in thematic tables by CFIR domains.

Appendix III - PRESS Checklist

1. Translation of the research question

The research question is appropriately translated into searchable concepts using combinations of terms for 'antimicrobial stewardship', 'intervention', and 'community hospital'. The search strategies reflect the concepts of intervention, implementation, and healthcare setting.

2. Boolean and proximity operators

Boolean operators were used correctly, but parentheses were added to clarify groupings. Proximity operators are not applicable but could be considered for precision.

3. Subject headings

Subject headings (e.g., MeSH and Emtree) were used effectively in PubMed and Embase. Controlled vocabulary terms were not initially included in CINAHL or Cochrane but should be added.

4. Text word searching

Text word synonyms and variations were used well (e.g., 'antibiotic stewardship', 'antimicrobial use'). Suggested additions include implementation-related terms (e.g., 'implementation', 'adoption').

5. Spelling, syntax, and line errors

No spelling errors noted. Truncation (e.g., implement*) and consistent use of quotes are recommended for better retrieval.

6. Limits and filters

No inappropriate limits were applied. Language and human limits should be applied at the screening level, not during search. Grey literature was intentionally excluded, and this is described in the protocol.

APPENDIX IV - COREQ Checklist

Item	Guide Question/Description	Response
Domain 1: Research team and reflexivity		
1. Interviewer/facilitator	Which author conducted the interview or focus group?	BL (lead researcher)
2. Credentials	What were the researcher's credentials?	Master's student in Pharmaceutical Sciences
3. Occupation	What was their occupation at the time of the study?	Graduate student researcher
4. Gender	Was the researcher male or female?	Not reported
5. Experience and training	What experience or training did the researcher have?	Trained in qualitative interviewing
6. Relationship established	Was a relationship established prior to study commencement?	No
7. Participant knowledge of the interviewer	What did the participants know about the researcher?	Known to be a researcher evaluating the AMS intervention
8. Interviewer characteristics	What characteristics were reported about the interviewer?	Interest in implementation of AMS interventions
Domain 2: Study design		
9. Methodological orientation and theory	What methodological orientation was stated to underpin the study?	Qualitative descriptive using CFIR
10. Sampling	How were participants selected?	Purposive sampling
11. Method of approach	How were participants approached?	Email invitation
12. Sample size	How many participants were in the study?	10
13. Non-participation	How many people refused to participate or dropped out?	Not reported
14. Setting of data collection	Where was the data collected?	Virtual interviews via Microsoft Teams
15. Presence of non-participants	Was anyone else present besides the participants and researchers?	No
16. Description of sample	What are the important characteristics of the sample?	Healthcare providers involved in AMS implementation
17. Interview guide	Were questions, prompts, guides provided by the authors?	Yes, based on CFIR and pilot tested
18. Repeat interviews	Were repeat interviews carried out?	No
19. Audio/visual recording	Did the research use audio or visual recording to collect the data?	Audio recording via Microsoft Teams
20. Field notes	Were field notes made during and/or after the interview or focus group?	No
21. Duration	What was the duration of the interviews or focus group?	20 to 60 minutes
22. Data saturation	Was data saturation discussed?	Yes
23. Transcripts returned	Were transcripts returned to participants for comment and/or correction?	No
Domain 3: Analysis and findings		

24. Number of data coders	How many data coders coded the data?	Two
25. Description of the coding tree	Did authors provide a description of the coding tree?	Yes, based on CFIR
26. Derivation of themes	Were themes identified in advance or derived from the data?	Both (deductive CFIR + inductive within-domain)
27. Software	What software, if applicable, was used to manage the data?	NVivo
28. Participant checking	Did participants provide feedback on the findings?	No
29. Quotations presented	Were participant quotations presented to illustrate the themes/findings?	Yes
30. Data and findings consistent	Was there consistency between the data presented and the findings?	Yes
31. Clarity of major themes	Were major themes clearly presented in the findings?	Yes
32. Clarity of minor themes	Is there a description of diverse cases or discussion of minor themes?	Yes

Appendix V - Recruitment Letter Template

Subject: Invitation to participate in an interview to evaluate implementation of audit and feedback for patients with bacteriuria

Dear [Local Champion or AMS team member's Name],

I hope this message finds you well. My name is Breanna Laffin, and I am a Master's student working under Dr. Emily Black's supervision in the College of Pharmacy at Dalhousie University. I am writing to invite you to participate in an individual interview. The study aims to identify factors contributing to the success and challenges of the AMS intervention that you recently participated in, with the goal of optimizing future antimicrobial stewardship programs.

As a local champion (or antimicrobial stewardship team member) who played a pivotal role in the success of this intervention, your insights and experiences are invaluable to our research.

Study Details:

- **Interview Duration:** Approximately 60 minutes
- **Format:** Interviews will be conducted and recorded virtually via Microsoft Teams
- **Topics:** Your experiences implementing the intervention, perceived successes and challenges, and recommendations for future improvements

Additionally, we are seeking your assistance in disseminating a recruitment email to the healthcare workers who participated in the intervention. Your endorsement and support are crucial to ensuring a comprehensive evaluation.

Your participation will provide critical information that can help enhance AMS efforts and improve patient care. If you are willing to participate and assist in the recruitment, please reply to this email with your availability, and we will arrange a convenient time for the interview. As a token of our appreciation, you will be provided with a \$25 Amazon gift card.

Thank you for your dedication and contributions to this important initiative. I look forward to hearing from you.

Best regards,

Breanna Laffin (She/They)

APPENDIX VI - Interview Guide

Hello, and thank you for joining this interview. My name is Breanna, and I am a master's student in Pharmaceutical Sciences at Dalhousie University. This interview is part of a larger study that aimed to improve management of bacteriuria. As you may recall, between November 2022 and October 2023 unit level feedback was provided by a local champion (staff pharmacist) on your unit. Units were provided with feedback every 1-2 months on the number of urine cultures sent, the proportion of patients treated with an antimicrobial agent, the number of asymptomatic patients who received an antimicrobial agent, appropriateness of antimicrobial prescribing, best practices observed, and suggestions for improvement.

Our team is completing individual interviews with healthcare providers to better understand your experiences receiving unit level feedback on management of bacteriuria by pharmacists on your unit as part of this project. Your opinions are very important to us, as they will help us learn what worked well and what didn't, so we can improve future interventions.

This interview will be confidential, and your responses will be anonymous. If there are questions that you don't feel comfortable answering simply say skip and the interviewer will move on. If at any point you would like to withdraw your consent and stop the interview, please inform the interviewer, they will stop the recording and destroy any data collected up until that point. If you would like to remove your interview from analysis you may request so by contacting myself up to 2 weeks after the interview has been completed. Thank you again for agreeing to participate in this study, did you have any questions before we get started?

Domain	Construct	Core Questions	Possible Prompts
Innovation	Innovation source	How reliable was the feedback that you received on the management of bacteriuria for patients on your unit?	Prompt: What might make the feedback more reliable?
	Innovation Design	Consider the feedback that you received as a part of this intervention including the feedback forms and/or messages that were bundled with it. How could the feedback be more clear, easy to understand and/or accessible?	Prompt: What might improve clarity, accessibility, and understanding of the feedback?

Outer setting	Partnership and connections	<p>Before this intervention, how connected was your unit with the provincial antimicrobial stewardship team, the infectious disease division, and the pharmacy department?</p> <p>Please describe these connections and how the intervention may have changed those connections?</p>	<p>Prompt: What attitudes do people on the unit have towards receiving feedback from the provincial AMS team, other clinicians, and the pharmacy department?</p>
	External Pressure	<p>How did pressures on the unit (such as social pressures or competing priorities) affect the implementation and delivery of this intervention?</p>	<p>Prompt: Why were these pressures more influential than others?</p> <p>This can include social pressure from coworkers, superiors, management, patients, caregivers, and other competing priorities like workload</p>
Inner Setting	Relational connections	<p>How would you describe how you work with other colleagues on your unit? With colleagues you interact with in other areas of the hospital?</p>	<p>Prompt: To what extent do people work in teams? Is working in teams preferred by you? by management?</p>
	Learning centredness	<p>What is the general attitude towards continuous improvement and learning from mistakes on the unit?</p>	<p>Prompt: Are people generally willing to receive feedback based on performance?</p>
Individual Domain (characteristics)	Capability	<p>How effective was the local champion in delivering feedback on your unit?</p>	<p>Prompts: What helped (or hindered) the local champion's ability to effectively give feedback?</p> <p>Did the local champion have the scope and influence to fulfill their role?</p>

	Motivation	How motivated were you to participate in the intervention and receive feedback on management of bacteriuria on your unit?	
Outcomes addendum	Implementation	<p>We consider successful implementation of our intervention as delivery of feedback on managing inpatient bacteriuria to most nurses, pharmacists, and physicians on the unit every 1-2 months by a local clinical pharmacist.</p> <p>On a scale of 1 to 10, where 1 is unsuccessful and 10 is successful, how successful was implementation of audit and feedback on your unit?</p>	<p>Prompts:</p> <p>Why did you choose that number?</p> <p>What would it take to increase that number?</p>

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