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Interdisciplinary Collaboration among Physicians, Pharmacists, and Laboratory Technicians to Optimize Antibiotic Use and Combat Antimicrobial Resistance

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Abstract

Antimicrobial resistance (AMR) is a critical global public health challenge. Optimizing the use of antimicrobials is a key component of the global One Health response to preserve their effectiveness, guide the future discovery of new therapeutic agents, and mitigate adverse drug events. Antimicrobial stewardship is defined as "an organizational or healthcare-system-wide approach to promoting and monitoring the correct use of antimicrobials" (Chen et al., 2021). A collaborative practice model engaging physicians, pharmacists, and laboratory technicians addresses antibiotic optimization objectives through team-based care and team-specific workflows designed to enhance the integration of laboratory testing, pharmacotherapy, and the clinical decision-making process while adhering to provincial, federal, and institutional stewardship policies. This collaborative, cross-disciplinary, cross-institutional approach capitalizes on extensive, intertwined expertise in laboratory diagnostics, drug therapies, and clinical guidelines to bridge gaps across the optimization continuum, thereby mitigating the detrimental impacts of AMR.

Numerous institutional initiatives have demonstrated that multidisciplinary stewardship teams comprising physicians, pharmacists, and other health professionals have a positive effect in optimizing the use of antimicrobials (Tran et al., 2020). The resultant improvements in both the appropriateness of therapy commenced and patient outcomes provide compelling evidence of the advantages afforded by collaborative stewardship practice involving members of multiple professions.

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Keywords: Antibiotic stewardship; interdisciplinary collaboration; antimicrobial resistance; One Health; laboratory diagnostics; pharmacotherapy; cross-disciplinary practice; clinical microbiology.

1. Introduction

In 2017, the Health System embarked upon a multi-year strategy to address the spread of antimicrobial resistance and steward the appropriate use of antimicrobials. That same year, the World Health Organization identified antibiotic resistance as one of the three greatest threats to human health (Cars et al., 2016). The team includes physicians, pharmacists, and laboratory technicians who collaborate to optimize the use of antibiotics within the Health System while safeguarding high-quality, timely, and effective care provided across multiple departments. An initial inventory of Health-System antibiotic stewardship policies revealed extensive coverage of department-specific protocols for various antimicrobial agents but minimal comprehensive guidance for high-stakes prescribing decisions at the start of medical treatments; clinical teams typically retained discretion in the choice of empirical coverage. Social, organizational, and professional boundaries complicate access to timely, clear, and actionable information needed to determine appropriate starting treatments for infections and, subsequently, to refine choices as additional diagnostic data arrive; inter-departmental coordination remains challenge within the Health System.

2. Rationale for Interdisciplinary Collaboration

Antimicrobial resistance (AMR) poses a critical threat to the global efficacy of antibiotics. The alarming rise in resistant microorganisms severely limits treatment options and leads to increased morbidity, mortality, and healthcare costs. The World Health Organization (WHO) recognizes AMR as one of the top ten global public health threats and recommends urgent action across all sectors (N. Okeke, 2016). Recognizing AMR as a public health priority, many health systems implement antibiotic stewardship programs (ASPs) to optimize antibiotic use and curb resistance. Antibiotic stewardship encompasses coordinated strategies to improve the appropriateness of antibiotic prescribing and use across all settings of the health system. By optimizing the use of existing antimicrobials, ASPs can prolong their clinical utility and avert the need for the development of new, often costly, antibiotics. Key objectives of ASPs include improving the appropriateness of therapy, reducing the development of resistance, enhancing patient safety, and optimizing use of institutional resources. Antimicrobial stewardship (AMS) has recently emerged as an established model for the organized, multidisciplinary approach to optimizing the contribution of the laboratory toward the preservation of antibiotic effectiveness, ensuring timely and appropriate therapeutic interventions that are informed by comprehensive knowledge of local resistant organisms. Improvements in laboratory diagnostics now make it possible to establish a collaborative antimicrobial stewardship program among the physician-Pharmacist-

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Microbiologist team. Laboratory diagnosis plays a crucial role in evidence-based, rational antibiotic therapy and in limiting inappropriate prescriptions. Under the traditional model, healthcare professionals generally rely on the oral communication of laboratory results. An improved model encourages collaborative decision-making among the three professional groups to help bridge the gap between the clinical decision of physicians, the pharmacotherapy decision of Pharmacists, and the laboratory information of Microbiologists.

3. Roles and Responsibilities within the Team

Antimicrobial Stewardship Program (ASP) teams are institutional elements created to promote effective antimicrobial agent use via education and targeted intervention (H. F. Sakeena et al., 2018). ASPs are predominantly physician driven but are acknowledged to benefit from multidisciplinary involvement . The relevant professional expertise and distinctions are outlined below for the collaboration of physicians, pharmacists, and laboratory technicians. Each discipline is beset with distinct responsibilities and yet approaches the common objectives of antimicrobial agent optimization and antimicrobial resistance (AMR) mitigation.

3.1. Physicians

Interdisciplinary Collaboration among Physicians, Pharmacists, and Laboratory Technicians to Optimize Antibiotic Use and Combat Antimicrobial Resistance

Physicians play a pivotal role in initiating and modifying antibiotic therapy for patients. They conduct clinical assessments to evaluate disease severity, need for treatment, microbiological testing, and the appropriateness and dosing of empirical therapy. Patients receiving long-term antibiotics frequently require ongoing evaluations. Physicians are responsible for determining whether to escalate or relax treatment based on clinical responses and laboratory results. Stewardship policies aim to clarify waiting criteria for de-escalation at these various decision points.

Physicians across all departments must engage in these collaborative stewardship activities to foster a culture that prioritizes appropriate prescribing practices and encourages consultation with pharmacy, laboratory, and information technology colleagues. These activities supplement the stewardship leadership and oversight provided by infectious diseases specialists in the institution. Consistent alignment between policy statements and recommendations issued through these collaborative discussions enhances the perceived value of such interdisciplinary collaboration (Rynkiewich et al., 2022).

3.2. Pharmacists

Pharmacists contribute to antibiotic stewardship through formulary management, dosing optimization, safety monitoring, and patient education. Formulary management comprises

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selection, restriction, and renewal of agents. Dosing optimization aligns with pharmacokinetic–pharmacodynamic targets and incorporates therapeutic drug monitoring. Safety monitoring identifies drug–drug interactions, assesses appropriateness, and reports adverse events. Education promotes adherence and addresses concerns impacting therapy (H. F. Sakeena et al., 2018).

3.3. Laboratory Technicians

Rapid microbiology diagnostics conserve precious time for struggling clinicians, drive clinical decisions earlier than traditional methods, and bridge the critical gap between most laboratories and the clinic (N. Okeke, 2016). Facilities implement rapid nucleic acid-based tests at specimen collection to return organism identification within two hours and susceptibility predictions within five. Laboratories preconfigure these automated reports on limited formulary agents to highlight therapy compatibility with the empirical prescription transcribed on the request form. Groups conduct local surveillance for chronic resistance problems. Using routinely gathered data, they track key organisms, monitor new observations, and produce trend analyses to disseminate within the healthcare facility and, where possible, to neighbouring institutions, show casings authorities' commitment to stewardship and offering guidance on persistence, emergence, and precautionary measures.

4. Communication and Coordination Mechanisms

To optimize communication and coordination across the collaborative antibiotic stewardship team, structured mechanisms ensure timely, accurate information exchange. Regular rounds and stewardship meetings engage team members to discuss ongoing cases and strategies; information technology facilitates data sharing and access; protocols guide shared decision-making. Collectively, these frameworks strengthen engagement, trust, and accountability among physicians, pharmacists, and laboratory technicians, empowering collaborative interventions and enhancing stewardship across the health system.

Structured rounds and multidisciplinary stewardship meetings support continuous coordination. Antibiotic stewardship rounds occur at least once daily on all general medicine and chronic disease inpatient units; participation includes the antibiotic stewardship team and the team responsible for the clinical service. Additional multidisciplinary stewardship meetings occur at least weekly, inviting all stewardship team members. Agendas cover topics such as review of recent cases, proposed interventions for specific patients, and general stewardship strategies; attendees document decisions and communicate them back to their respective teams. These repeated interactions enable team members to articulate concerns, ask questions, and request specific interventions related to antibiotic use, fostering trust, rapport, and a shared mental model .

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Integrated health information technology platforms facilitate data collection and sharing across the hospital. Systems operate on a single secure network and share compatible patient identifiers. Laboratory data generated by interdisciplinary collaboration inform antibiotic therapy choice; team members publish guidelines summarizing laboratory procedures and practices, along with anticipated turnaround times from specimen receipt to result reporting. Clear access rights limit unauthorized alteration of antibiotics. Protocols specify conditions for withdrawal or modification of dosing recommendations, recording justifications within an integrated system.

Formalized, shared decision-making protocols streamline collaboration. Antibiotic therapy initiation, modification, and de-escalation, for example, require joint approval from both the pharmacy and microbiology representatives; team members agree on a standard process to facilitate timely acknowledgment. Provisions outline escalation paths to engage decision-makers when the standard process does not suffice, while documentation protocols ensure that cross-disciplinary involvement is visible (N. Okeke, 2016).

4.1. Structured Rounds and Stewardship Meetings

Many institutions have adopted structured rounds to facilitate collaborative decision-making for optimizing individualized drug therapy. Regular meetings have proven similarly effective in ensuring ongoing attention to antibiotic selection. The team holds one horizontal discussion on antibiotic stewardship per week. All authors participate, representing medicine, pharmacy, and laboratory services, and meetings generally last about 30 minutes. A pharmacy-facilitated team meeting focused on the use of specific agents has been established in addition to normal service provisions. Separate nominal group technique discussions enable detailed sharing of information across departments while maintaining the necessary brevity in stewardship meetings.

An agenda for the routine stewardship meeting is prepared beforehand and includes items such as circulating the previous meeting's notes and providing team members with updates on collaboration opportunities. If any questions arise about cases needing input, these issues are compiled into the agenda to be addressed collectively. Actionable decisions are recorded in the meeting minutes to help track the evolution of ongoing issues and clarify past judgments if further consultation is required. These proceedings are disseminated through a web-based platform to improve visibility of both collaborative efforts and remaining challenges.

Systems used to share important materials and messages must be compatible and accessible from multiple hospital locations; concurrent access to the same file is also advantageous. The chosen software permits modification of access rights to improve information integrity and manage document lifecycle. Cross-departmental procedures are documented to promote

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alignment and transparency on joint tasks. Joint approval is mandated for vertical decisions on treatment initiation, alteration, or cessation that affect multiple disciplines, thus reinforcing team collaboration. These arrangements are specified in the circulation criteria to facilitate ad hoc approval when needed. (L. McCreary et al., 2021)

4.2. Information Technology and Data Sharing

Timely access to patient information, laboratory data, and stewardship decisions is critical for optimizing empiric therapy, promoting de-escalation, and supporting formulary restrictions. Interoperable information technology (IT) systems facilitate timely collaboration by providing access to essential content while preserving data integrity and security. A shared electronic health record (EHR) enables each professional to view relevant clinical, laboratory, and stewardship data. Integration of stewardship decision documentation into the EHR, with compatible viewing rights, permits visibility of recommendations from other stakeholders. Stakeholder access to EHR content may need to reflect varying levels of privilege or authorisation.

Stewardship and laboratory IT applications support development, capture, and transmission of shared clinical records; documentation of clinically relevant tests and results; timely reporting of laboratory data; and rapid transmission of diagnosis and data to clinicians (Teodoro et al., 2012). System compatibility affects the deployment of these tools, especially in settings with diverse proprietary applications. Technical audits help identify and recommend co-deployment of institutional systems that support cross-professional collaboration. Implementation processes encompass validation of functionality, testing with representative clinical data, and definition of requirements for proper installation and routine operation. Regulatory documents should clarify installation obligations, endorsement protocols, and post-development support .

4.3. Shared Decision-Making Protocols

Among the various antibiotic stewardship strategies, shared decision-making on empirical therapy represents a particularly effective intervention for collaborative care teams that include both prescribing and tracking professionals (Blyer, 2016). Because rapid assessments are hampered by lengthy test turnaround times and extensive epidemiological considerations, selection of initial prescriptions is often based on situational factors rather than on in-team consensus—needlessly complicating later de-escalation moves as urgency fades (Rynkiewich et al., 2022).

When actual pathogens are subsequently identified, a consultative exchange should occur to assign appropriate and duration-optimizing therapies across all professional disciplines (Mol et al., 2004). Team members must ensure cross-professional agreement before finalization and implementation. The event is to be tracked within the institutional clinical system not

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only to enhance internal communication but also to reduce redundant external inquiries accompanying analogous requests received later through inter-institutional channels.

5. Antibiotic Stewardship Strategies

Antibiotic-use policies support standards of care for prescribing, collection of utilization data across hospitals, and awareness of antimicrobials used to develop additional local strategies. Establishing or reviewing institutional policies governing antimicrobial use to endorse principles of stewardship and encourage standardization according to local epidemiology, indicate empiric therapy guide use, and assure safety monitoring are commonplace components of such programs (F. Barlam, 2021). Pre-authorization before initiating restricted antimicrobials and near-patient participants in purposive guides surveys to generate report summaries complemented by expert interpretation are additional potential features of these activities. Evidence supports developing separate standing orders for dual evaluation of broad-spectrum therapy.

No comprehensive model embraces appropriate-prescribing activity across multiple professions and anticipated recommendations from laboratory technicians and pharmacists incorporated both forward and backward continuums are known to contribute to optimised organisation of therapy trips, warranting added details of practice initiatives pursued in these areas. The focus of interdisciplinary team engagement in the antibiotic-stewardship domain addresses frequent clinical difficulties in transferring critical accumulated knowledge from associated disciplines to expedite and refine decisions for optimal treatment. Activities designed to ameliorate therapy nonetheless typically devolve to individual disciplines despite a clear recognition of the high stakes entailed. Other consultative measures promulgated by governing bodies advocate multidisciplinary scrutiny of prescribed or recommenced antibiotics at predetermined points in the patient care trajectory but combine therapy examination with medication evaluation rather than either function in isolation.

5.1. Circulation and Review of Antibiotic Policies

Circulation of institutional antibiotic-prescribing policies, not relegated merely to an initial launch or occasional review, requires ongoing interdisciplinary circulation and revision. Coverage objectives incorporate a comprehensive, cross-disciplinary discourse encompassing initiation, modification, and termination of therapy; safety-prompted adjustments; and guidance on preparing, transitioning, and de-escalating empirical therapy. Such policies must adapt to evolving plantwide formulary coverage, local resistance patterns, and routinely prompted therapies. An integrated, interactive approach emphasizes cross-professional input on introduc-tions and emergent inquiries while distinguishing yet collectively addressing structural and therapeutic concerns.

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Initial antibiotic-use policies circulated across disciplines establish a foundation for local education, standardization, and immediate enhancement. Retrospective assessments of sophisticated antibiotic-prescribing policies applied in both teaching and community hospitals yield considerably reduced post-prescription intervention rates (Vitrat et al., 2014).

5.2. Empirical Therapy and De-Escalation

In the face of evolving antimicrobial resistance, the urgent need arises for a coordinated, system-wide approach that harmonizes prescribing practices and prioritizes the responsible use of antibiotics throughout the health system. Within complex adaptive systems such as health systems, the evolution of network structures gives rise both to new opportunities and to emergent behavior that can lead systems away from desired trajectories. Within the local health system, Infection Prevention and Control consistently identifies antibiotic misuse as a major driver of antimicrobial resistance, and the reliance on broad-spectrum agents as a particular concern. A comprehensive approach to antimicrobial stewardship is therefore essential (Álvarez-Lerma et al., 2006).

Public health authorities have set out ambitious goals for intersectoral collaboration as a means of enhancing health and well-being systems. Such collaboration requires building alliances, developing shared agendas, scheduling co-hosted events, and exchanging in-kind contributions across diverse sectors, including health, agriculture, education, and finance. Without effective coordination across public health components, segregated groups delivering complementary services may inadvertently frustrate each other's objectives; implementing intentional communications structures among them is critical. Institutions in the local health system have embraced these principles, yet interprofessional stewardship remains fragmented. Coordinated Antibiotic Stewardship Rounds bring together specialist and generalist users of antibiotics for real-time discussions of the appropriateness of ongoing therapy. Water-carrying roles remain sporadic and informal (Salahuddin et al., 2016).

5.3. Dose Optimization and Therapeutic Drug Monitoring

Antimicrobial pharmacokinetic-pharmacodynamic (PK-PD) targets serve as the foundation for dosage optimization of beta-lactams, glycopeptides, aminoglycosides, fluoroquinolones, and colistin, especially in critically ill patients. Some therapeutic drug monitoring (TDM) schedules can focus on the pharmacotherapeutic phase and help plan the next dose. Monitoring the pre-dose concentration during the pharmacokinetics phase is a priority for critically ill patients also taking drugs with TDM. For beta-lactams, PK-PD targets often consist of a free drug concentration above the minimum inhibitory concentration (fC-free-MIC) of 4 to 5 for 100% of the dosing interval, an fC-free-MIC ratio of 80 to 100% for Pseudomonas aeruginosa, or a time above the MIC to the time of infection duration (Nikolas et al., 2021) ; (Wong et al., 2014).

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5.4. Duration of Therapy and De-implementation of Inappropriate Use

Antimicrobial stewardship interventions have included strategies to curb inappropriate treatment duration as well as unnecessary initiation. Following what has been characterized as "the rise of the three-day antibiotic," cross-team discussions in intensive care concerning when and why to stop antibiotics often take place within a multidisciplinary framework involving critical care and microbiology experts (D. Nielsen et al., 2024) , with indications frequently documented in interdisciplinary rounds. Other examples include the establishment of automated time-out reminders at critical points in therapy to prompt assessment of continued need and compliance audits to track adherence (P Tverdek et al., 2024).

6. Laboratory Contributions to Stewardship

Laboratory personnel contribute to antibiotic stewardship by expediting the provision of actionable information for timely clinical decisions. Early, appropriate therapy improves prognosis in patients with serious infections and is an explicit stewardship aim (N. Okeke, 2016). The laboratory identifies the aetiologic agent of infection, contributes to the prescription and review of empirical therapy, and provides information on pathogen susceptibilities to guide de-escalation decisions. Stewardship efforts are strengthened by rapid reporting of microbial identification for priority profiles, explicit display of interpretive criteria for microbially-susceptible agents, and circulation of resistance-surveillance data to monitor trends and assess the impact of interventions.

Antimicrobial resistance is a global threat to human health, prompting calls for improved antibiotic stewardship across the health-care continuum (Rynkiewich et al., 2022). Inter-disciplinary use of laboratory data is warranted to inform interventions and further harness the laboratory's contribution to stewardship.

6.1. Rapid Diagnostics and Timely Reporting

Rapidly accessible diagnostics of bacterial infections coupled with timely reporting allow clinicians to make informed decisions regarding antimicrobial therapy as soon as patients are admitted to hospital, thereby setting the stage for effective de-escalation or shortening of unnecessary therapy before final culture and susceptibility test results become available. Providing clarity on the technical and staffing specifications of available laboratory services serves to enhance clinicians' awareness and understanding of tangible opportunities to optimize patient management.

Diagnostic test menu, turnaround time, and reporting pathway are systematically specified for broad-spectrum swabs, blood cultures and other sterile-site samples, chromogenic agar plates, and respiratory samples, with the objective of ensuring that testers remain cognizant of the potential for other analyses to facilitate timely alterations in management. Respective

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analyses in each case are explicitly indicated to promote collaboration between laboratory technicians and physicians.

6.2. Microbial Susceptibility Testing and Interpretation

Microbial susceptibility testing is fundamental to effective antibiotic stewardship and comprises three components: methodology, interpretive criteria, and reporting format. Testing is performed according to the internationally accepted standards of the Clinical and Laboratory Standards Institute (CLSI) and the European Committee on Antimicrobial Susceptibility Testing (EUCAST), alongside internal quality control to validate method performance for specific organisms and compounds. Microorganisms are categorized as susceptible, intermediate, or resistant based on inhibition diameters, minimum inhibitory concentrations (MICs), or growth inhibition ellipses. In addition to those compounds covered by CLISt and EUCAST breakpoints, specific interpretive information is provided for 21 other agents/microorganisms combinations (Lowman, 2015). To enhance clinical actionability, test results are disseminated in multiple formats adapted to context (Kroneislová et al., 2024).

6.3. Resistance Surveillance and Data Analytics

Laboratory techniques and participation in cross-disciplinary workflows underpin the collaboration's impact on antibiotic stewardship. Laboratory technicians rapidly generate critical diagnostic information that guides clinical decision-making on isolation, empirical therapy, and de-escalation. They employ diagnostic platforms with short turnaround times, initiate specimen processing on acceptance, and communicate results promptly (N. Okeke, 2016). Timely feedback reinforces the importance of appropriate sampling, optimizes care, and minimizes unnecessary treatment. Routine surveillance of antibiotic resistance patterns, tracked by source and location, is integrated throughout patient encounters. Surveillance data are analyzed to produce summary statistics, time trends, and visual displays. Continuous monitoring accentuates fluctuations in resistance, antimicrobial utilization, and antibiotic visibility, illustrating relationships across these dimensions. Resulting metrics inform team discussions and shape recommendations on formulary management, empirical therapy guidelines, and de-escalation criteria.

7. Pharmacist-Led Interventions and Pharmacotherapy Optimization

Antimicrobial stewardship programs (ASPs) have evolved from traditional provider-based initiatives into cooperative frameworks wherein pharmacists implement positive prescribing initiatives (Rosa Cantudo-Cuenca et al., 2022). The role of antimicrobial stewardship clinical pharmacists has expanded from student residency training to encompass rational use of restricted antibiotics, optimization of duration and frequency of existing therapy, management of drug-drug interactions and specific toxicities, and provision of patient education and adherence support (A. Sadeq et al., 2021).

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7.1. Antimicrobial Formulary Management

Formulary restrictions enable organizations to establish the criteria under which selected antimicrobials are prescribed and subject to review for renewal of approval after 6 to 12 months (W. Chung et al., 2013). The high prevalence of drug-drug interactions between antimicrobials and concomitant therapy has led to the endorsement of an antimicrobial safety-monitoring procedure to complement pre-access requests. Antimicrobials of concern are flagged upon entry into the system, triggering automated alerts for therapists and pharmacists (Rynkiewich et al., 2022). Monitoring plans delineate the necessary checks according to the specific drug combination and are included in the electronic monitoring system. The relevant databases are systematically reviewed for adverse events, enabling suggests in the notes function.

7.2. Drug-Drug Interaction and Safety Monitoring

Based on the input provided, here is a draft for the requested section.

The safety of patients receiving antibiotics may be compromised by the occurrence of adverse drug events after therapy initiation. A study found that 6.5% of hospitalized patients experienced an adverse drug event after receiving antimicrobial treatment; the most frequently involved antibiotics were beta-lactams, closely followed by fluoroquinolones, azoles, and metronidazole (Kuscu et al., 2018). Close monitoring of safety is thus critical for patients receiving broad-spectrum coverage, such as an empirical combination therapy targeting neutropenic fever or severe community-acquired pneumonia. Pharmacists also enhance drug-drug- interaction monitoring at the start and during therapy. Alerts for drug-drug interactions involving antimicrobials are generated by the pharmacy information system; if a drug-drug interaction is detected, the alert is reviewed and based on this assessment a monitoring plan is established. The plan is documented in the patient record along with an evaluation of severity and the plan is then reassessed and adjusted throughout follow-up.

7.3. Patient Education and Adherence Support

Patients typically require information about how to take antibiotics correctly, possible adverse effects, potential drug interactions, and the importance of continuing the treatment until the prescribed course is complete, even if they feel better before finishing. The duration of antibiotic treatments varies by infection and between individual patients; pharmacists can provide patients with relevant information, for instance, by writing the cessation date on the label. Educational materials such as pamphlets or brochures covering the same points can also help reinforce clinicians' oral communication (Pulcini & C. Gyssens, 2013).

Alcohol consumption is a common topic of patient inquiries. Instruction on abstaining from alcohol intake during therapy is generally unnecessary; although the combination can lead to

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adverse effects and reduced efficacy for a few antibiotics, compliance with therapy is far more important in controlling infectious diseases (Lee et al., 2015).

8. Quality Improvement and Evaluation Metrics

Quality improvement and evaluation metrics provide crucial insights into the effect of interdisciplinary collaboration among physicians, pharmacists, and laboratory technicians on antibiotic stewardship and resistance outcomes. Appropriate antibiotic use is evaluated using a range of process and outcome measures, alongside consideration of burden reduction and resource utilization. Sustained engagement requires monitoring of sustainability metrics and a commitment to cyclical change and continual knowledge translation. The collaborative practice addresses a number of barriers and cultural concerns.

To assess the impact of collaborative antibiotic stewardship practice, it is necessary to measure both the process of antibiotic prescribing and the resulting clinical outcomes. Indicators of prescribing appropriateness include the initial selection of agents, re-evaluation of ongoing therapy within 48–72 hours, frequency of broad-spectrum agents on the antimicrobial formulary and in empirical regimens, adherence to specified clinical criteria for prescribing, and average duration of therapy. Clinical outcome measures examine the absence of adverse drug events attributable to the agent or a preventable deterioration in the patient's infection within 14 days of starting therapy. Additional process measures include time to receipt of a microbiological prescription order and duration of therapy for organisms exhibiting high-level resistance.

Analysis of resource utilization focuses on the duration of hospitalization, post-discharge observations, generation of extra clinician orders, infection-related admissions, use of ancillary laboratory tests, non-infectious complications occurring during therapy, administration of additional antibiotics after therapy is stopped, healthcare-associated infections, and deaths not attributable to the specified infections. Overall cost savings for the hospital are estimated based upon a composite of these figures, as well as the volume of agents undergoing formulary scrutiny, requests for additional information regarding the use of specific agents, and undertaken educational interventions. The collaborative stewardship practice offers opportunities to enhance sustainability through governance engagement, iterative cycles of change, feedback on long-term impacts, promotion of local but sharable material, and the integration of existing resources with preservation of institutional identity (Powelson, 2018) , (Tonazzi et al., 2022).

8.1. Process Metrics and Outcome Measures

Overcoming antimicrobial resistance and preserving the efficacy of existing antibiotics require the collaboration of multiple health professionals, particularly physicians, pharmacists, and laboratory technicians. These three groups, each possessing knowledge and

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skills critical to improving antimicrobial use in a healthcare system-wide context, must therefore work together to optimize current practices. Systematic collaboration will ensure that interventions reflect an understanding of the points of care, distribution of therapeutic decision-making authority, and other aspects that influence each professional's ability to contribute. The establishment of antimicrobial stewardship programs is one mechanism through which cross-disciplinary models can be implemented. Such programs have been shown to sustain improvements in prescribing appropriateness after distinct pharmacist-led interventions.

Effective antimicrobial stewardship obligates clinical teams to initiate appropriate broad-spectrum empirical therapy based on pre-and postoperative infection-risk evaluations. Early identification and treatment of infections are vital. Recommendations to outline empirically acceptable options for various conditions, together with discussions of infection history, provision of high-yield diagnostic requests, and diversification of relevant laboratory test menus, can facilitate timely guidance. Team-based approaches spanning laboratory diagnostics, medication-use optimization, and information technology design as well as procurement and provision of educational materials specific to practitioner gaps have demonstrated positive outcomes. Complex interventions combining laboratory and medication-related strategies have achieved the widest benefits. Current evidence supports the focus of cross-disciplinary antimicrobial stewardship models on the identification of systems with antimicrobials in high demand, combined with obligatory review for guidelines compliance by all professional groups (Uda et al., 2022).

Metrics to quantify the ongoing effect of antimicrobial stewardship initiatives on healthcare-related infection management, the quality of clinical therapy, and patient safety form an essential element of improvement efforts. A wide range of process and clinical outcome measures have been defined. Prescribing appropriateness has emerged as a leading indicator: the proportion of healthcare-associated infections commencing with broad-spectrum or narrow-spectrum agents retains elevated levels even after routine multi-drug-resistant organism screening is integrated. The effective duration of therapy for infections is another extensively described alternative, equally pertinent in the absence of high-confidence prior therapy conduct. Monitoring of such parameters enables organizations to gauge improvement relative to baseline and guide interventions during subsequent cycles of activity. Major acquisitions undertaken with stewardship program support typically produce cascading benefits that can be tracked.

8.2. Burden Reduction and Resource Utilization

Antimicrobial resistance (AMR) is one of the most pressing public health challenges facing the globe, with a projected 10 million deaths annually by 2050, if left unchecked. Approximately 30% of all human antimicrobial prescriptions in Canada are considered

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inappropriate, leading to the Center for Communicable Disease and Infection Control to propose an Antimicrobial Stewardship Framework. Antimicrobial Stewardship programmes have been implemented to curtail inappropriate prescribing of antibiotics. Interdisciplinary collaboration between physicians, pharmacists, and laboratory technicians optimizes antibiotic use and minimizes the emergence of resistance.

The use of interdisciplinary collaboration to optimize antibiotic use has two objectives. The first goal is to improve the appropriateness of antibiotic therapy. The second aim is to reduce AMR through appropriate prescribing, thus enhancing patient safety and optimizing health-care resources.

Interdisciplinary collaboration between physicians, pharmacists, and microbiology technicians has a beneficial impact on the objective of optimizing antibiotic use in acute-care settings. Of note, a systematic review revealed that multidisciplinary or interdisciplinary approaches were associated with significantly reduced antibiotic consumption (A. Sadeq et al., 2021).

8.3. Sustainability and Continuous Improvement

Effective antimicrobial stewardship relies on continuous programme governance and quality-improvement activities to sustain positive impact over time. Governance arrangements define leadership responsibility, accountability for achieving stewardship objectives, and mechanisms for informing institutional stakeholders of progress and emerging challenges.

Cycles of change, systematic models that manage and guide the implementation of practice change, provide a framework to deliver further improvement within an established stewardship programme (Hamilton & Bugg, 2018). Each cycle involves problem identification, solution development, implementation, evaluation, and consolidation of the gains already achieved, while pursuing the next set of opportunities. To date, the implementation of intensive-cycle change, termed an enhanced programme, has been partially completed, with ongoing further enhancements under way.

Mechanisms for knowledge translation promote awareness of stewardship issues, engage internal and external expertise, and encourage practice reflection (Beedemariam Gebretekle et al., 2020). These mechanisms deliver timely reinforcement of progress in a context where attention inevitably shifts as other institutional priorities emerge.

9. Barriers, Facilitators, and Change Management

Interdisciplinary antibiotic stewardship programs rarely advance beyond initial interest. Barriers to full implementation unique to each health system can hinder collaborative antimicrobial strategies, preventive interventions for emerging resistance, or platform expansion for original programs. Limited interactions among health professionals cement

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doubts about benefits: participating clinicians remain uncertain whether infectious diseases knowledge fills gaps or whether training, process adjustment, and anticipatory action would suffice. Mandatory physician–pharmacist collaboration tied to stewardship accreditation assures antimicrobial accessibility and spurs application; collaborative models should nonetheless enlist laboratory technicians to conduct monitoring, analyze surveillance data, ensure prescribing appropriateness, and guide therapeutic choices.

Cultural–organizational obstacles include clinician hesitation to adopt training beyond individual practice. Record-keeping remains optional; many practitioners avoid accountability. Pre-existing structures often turn collaborative practice into solely transactional exchanges untethered from committed improvement, deterring richer consideration of collaborative options that enhance patient safety and care quality . Health professionals continue resisting teamwork that they do not perceive engaging all parties' expertise. Emphasis on hazard mitigation underpins clinician buy-in, incentivizes personal development, and clarifies joint involvement throughout the process.

Compliance with regulations from hospital boards, governmental bodies, and pharmacy staffs influences the migration toward species–country cross-professional care. Elected representatives already liaise with multiple entities on regulatory issues; teamwork does not contravene policies, and reliance on interpretation of existing guidelines safeguards institutional freedom. Transitioning from purely formulary access to consideration of drug choice, empiric therapy, and de-escalation reflects evolving harassment persistently linked to stewardship-centered antibiotic use (K. Saha et al., 2021). Shared documentation remains anchored to pharmacy authorization; additional mediation for broader dissemination would facilitate systems operation and clarify access rights among existing protocols, circumventing perceived need for new governance arrangements.

Effective change-management strategies encompass high-level sponsorship, education on risk–benefit calculus from collective implementation, engagement from influential stakeholders, and early consideration of desired health outcomes and measurement techniques. Presidential endorsement during kick-off meetings substantially raises program visibility, cultivates collective awareness of involvement benefits, and strengthens communication agendas between professional sectors. The chief executive officer's routine requests for updates to the governing council reinforce initial prominence and underscores sustained importance across a milieu of competing priorities.

Throughout the rollout, extensive stakeholder consultation—inclusive of broad organizational representation—further enhances credibility and finalizes the articulation of objectives devoid of imposition. Informal dialogues with clinical leaders in microteaming initiatives pre-emptively spotlight areas en route to cross-professional cooperation.

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Dedicated training sessions explain interactivity relevance to individual disciplines and larger safety questions while broadening understanding of participants' specialties. Delivery structures reinforce concurrent commitment through custom-tailored training, distinct for each profession, that respects distinct timelines for implementation by targeting urgency of competitor interests across programs (Mol et al., 2004). Multi-axis trainer involvement cultivates relationship-building, guidance on risk elucidation for assorted territories, and peer-level downgrading of hierarchy.

Exemplary arrangements across antibiotic-adjustment mechanisms and multi-faceted information dissemination furnish seamless access to existing pharmacy protocols amid interpolation of supplementary medications into the interactivity. Core attention gravitates toward organization and transmission of preparative knowledge that underpins and satisfies all public inquiries in advance of team formation. Collaboration operates from solely informative early phases; clarification of further joint engagement awaits secondary propagation through supplementary conduits.

Concise issue branding succinctly encapsulates the particular concern of prevailing competitiveness yet also incorporates references to safety, quality improvement, and optimal service design. Collective analysis of routine operations accompanying fresh professionalism guidance highlights the opportunity for joint advancement with substantial cross-participation input.

9.1. Cultural and Organizational Barriers

Prescribing and monitoring of antibiotic therapy are inherently collaborative activities. Antibiotics should only be given after clinically relevant specimen collection and appropriate targeted therapy when susceptibility results are available. Therefore, efficient coordination among the prescribing physician, the laboratory, and the pharmacist is essential.

Cultural and organizational barriers may impede such exchange, negatively affecting timely and accurate information transfer. Varying attitudes towards collaboration, hierarchies or bureaucracies perceived as excessive, unclear boundaries in competence, and a lack of common goals are among the obstacles to ad hoc or spontaneous cross-role coordination (Mol et al., 2004).

Physicians are generally university-trained, pharmacists typically receive higher vocational training, and laboratory technicians often possess a secondary education. Prescribing and monitoring of antibiotic therapy are ultimately assumed to be part of the physician's responsibilities, and it is important to clarify how the other two disciplines can best support that process, given their training and competencies. Antibiotic prescribing and monitoring require conceptual and practical knowledge spanning multiple fields. Multi-professional

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cross-pollination reduces overload and enhances appropriateness of therapy, safety, and resource efficiency (Teixeira Rodrigues et al., 2021).

9.2. Legal and Regulatory Considerations

Interdisciplinary collaboration among physicians, pharmacists, and laboratory technicians is governed by various legal and regulatory considerations. Organizations must comply with statutory and regulatory requirements, along with institutional policies that define the scope of practice for each discipline. Prior to implementing collaborative practices, teams must conduct thorough assessments of applicable laws and institutional frameworks, ensuring careful attention to compliance and accountability.

Professional practice acts, regulations, and institutional policies dictate the extent of authority and responsibility retained by each discipline in collaborative arrangements. Professional guidance documents can facilitate the development of collaborative agreements in accordance with these regulations. Two commonly adopted approaches for complying with pharmacy practice regulations in collaborative frameworks involve collaborative drug therapy management and medication therapy management (K. Saha et al., 2021).

The establishment of collaborative care among professionals from different disciplines necessitates adherence to pertinent laws and regulations. Determining the scope of authority to be assented for collaborative arrangements comprises an important aspect of this consideration. Individual and organizational accountability encompasses both professional regulatory obligations and organizational governance frameworks. Additionally, regulatory and institutional provisions concerning the retention and sharing of patient health information, along with other relevant data, must be regarded (Ur Rehman et al., 2018).

9.3. Strategies for Change Adoption

Adoption of interdisciplinary stewardship programs requires addressing barriers at clinical, organizational, and legal levels (Bouchet et al., 2020). Stewardship policies and physician training must delineate pharmacist and laboratory technician contributions to enable seamless communication and coordination within the team. Engaging senior leadership and participating stakeholders fosters buy-in while establishing training and education programs nurtures sustained interest.

Transitions in leadership and stewardship frameworks, establishment of new collaborative practices, and additional organizational changes necessitate ongoing promotion and foundational support . Engagement of senior leadership and diverse stakeholders at the outset ensures gap-filled, relevant programming. Reinforcement of the initial collaborative focus and provision of incremental education sustain momentum during protracted planning processes.

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10. Case Studies and Best Practices

Interdisciplinary collaborations among physicians, pharmacists, and laboratory technicians have been employed successfully by various health care institutions to optimize antibiotic use through stewardship initiatives. Three emblematic cases exemplify the breadth and general applicability of such team-based approaches, practically illustrating four key stewardship strategies. The University of Alberta Hospital employs structured multidisciplinary stewardship rounds to target appropriateness of empirical therapy with a focus on timely de-escalation and optimization of beta-lactam dosing for susceptible organisms. The Antimicrobial Stewardship Team and Clinical Microbiology Team at the University of Queensland Health undertake coordinated rounds via a shared platform to review requests for stop and re-start of restricted antimicrobials and to disseminate information on antimicrobial policies. The antimicrobial stewardship program at Mount Sinai Hospital in Toronto integrates collaborative approaches to sustain the achievement of target therapy duration across various infectious disease scenarios. Institutions prepared to implement stewardship initiatives can find interdisciplinary team-based antibiotics both feasible and meaningful.

11. Policy Implications and Global Perspectives

Policy formulation requires knowledge of the global antimicrobial resistance (AMR) crisis, AMR policy initiatives, and steps to advance cross-professional collaboration among specialists in different cardiovascular disciplines to promote proper antibiotic use through education, guidelines, and individual patient consultation (Calvo-Villamañán et al., 2023).

AMR, which threatens the sustainability of modern medicine, is a major global healthcare priority (H. F. Sakeena et al., 2018). The need for more coordinated efforts from policymakers and structured, sustainable stewardship programmes across the globe is urgent. Involving highly qualified team members from such fields can complement and boost these efforts and ensure appropriate treatment options for all patients.

12. Conclusion

Antimicrobial resistance (AMR) is an urgent and growing threat to public health, jeopardizing efforts to prevent and treat infections and perform essential procedures (N. Okeke, 2016). The World Health Organization (WHO) has articulated the problem and called for coordinated efforts to tackle it with high priority. Antimicrobial stewardship, which is defined by the WHO as a coherent set of actions to promote the responsible use of antimicrobials, is crucial to addressing AMR.

Substantial progress in implementing stewardship programmes in healthcare facilities has been achieved globally since AMR became a public health priority, with a significant amount of cross-disciplinary work being done in various countries. These initiatives have demonstrated benefits for the quality of care, safety, and AMR impact. The challenge is to

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adapt the goals, content, and approach of interdisciplinary collaboration on antibiotic use to the specific context of a given facility and its existing practices.

Physicians, pharmacists, and laboratory technicians have the potential to collaborate on an interdisciplinary basis to promote optimal antibiotic use and attenuate unwanted resistance. These professions share rapid access to patient data, such as clinical and laboratory information. The assessment of interdisciplinary collaborations in 25 countries, including around 200 hospitals and other healthcare facilities, has revealed that the only professionals with widely supported and systematically documented practice overlapping activities in antibiotic-related patient care are physicians and pharmacists.

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