GLAND SURGERY

THE ROLE OF INTERPROFESSIONAL TEAMWORK (NURSING, PHARMACY, AND LABORATORY) IN MANAGING ANTIMICROBIAL RESISTANCE: A COLLABORATIVE APPROACH TO STEWARDSHIP

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Abstract

Antimicrobial resistance is considered one of the critical global health challenges and is grave in the Gulf Cooperation Council countries. The following review discusses the role that interprofessional collaboration between nursing, pharmacy, and laboratory professionals can play in fighting AMR through promoting effective ASPs. Based on literature from 2020 to date, the article will discuss how each profession contributes synergistically, identify issues with implementation unique to Middle Eastern healthcare contexts, and present evidence-based practices to optimize interprofessional work. Some of the major challenges facing the Saudi Arabian health system are the high rates of use of antibiotics, diversity in the expatriate workforce in health care, and other varying levels of infrastructure. As indicated by the critical analysis of available literature and regional data, structured interprofessional teamwork yields significant improvement in antimicrobial prescribing practice,

reduces the rates of resistance, and improves patient outcomes. However, their successful implementation has barriers relating to hierarchical cultures in health care, to resources, and to culturally adapted educational interventions. The findings raise an alarm for policy reforms and investment in interprofessional training programs tailored to the GCC region.

Keywords: antimicrobial resistance, interprofessional collaboration, antimicrobial stewardship, nursing, pharmacy, clinical laboratory, Saudi Arabia, Gulf region

1. Introduction

Resistance to antimicrobials, or AMR, has become one of the most serious current global health threats. According to Word Health Organization (WHO)projects; drug-resistant infections, if their current trends continue, are set to cause 10 million deaths annually by 2050. Among many others in the Arabian Gulf region, Saudi Arabia and the United Arab Emirates have witnessed an upward trend of AMR rates above most global benchmarks, driven by many specific factors arising from the complexity and diversity of healthcare delivery systems serving the populations, mainly due to over-the-counter availability of antibiotics combined with very high consumption rates.

Most worrying is the case of Saudi Arabia, with very alarming resistance patterns: the prevalence rates of MRSA range from 30% to 45% in tertiary care hospitals, significantly higher than in most European countries (Alhamid et al., 2023), and 35-50% of isolates from ICUs in the major Saudi medical cities carry ESBL-positive Enterobacteriaceae (Balkhy et al., 2020). These figures constitute a wider regional crisis that calls for urgent and coordinated intervention.

AMR management is complex and requires responses beyond traditional professional silos. No one health care discipline possesses the full range of skills, competencies, and expertise to rise to the challenges posed by antimicrobial stewardship. Nurses provide patients with continuous care and are often the first to detect early signs of clinical deterioration or adverse drug reactions. Pharmacists offer expertise in antimicrobial pharmacokinetics, drug interactions, and optimization of dosing. The clinical laboratory scientist provides the diagnostic information that forms the very basis for targeted therapy and resistance patterns. If left in isolation, critical information gaps lead to delays in intervention, inappropriate selection of antimicrobials, and suboptimal patient outcomes (Elmontsri et al., 2021).

Implementation typically remains variable across settings and particularly in the Middle East, despite growing recognition of its importance. This is partly because the health systems of the Gulf are dominated by traditional, hierarchical structures with physician-led decision-making that often sidelines other cadres of health professionals. The unique demographic makeup in this region, including up to 80% of health workers in some GCC countries being expatriates, presents particular challenges both in communication and variability in professional practice standards that need to be taken into consideration when designing stewardship programs.

The article provides a critical review of how structured interprofessional teamwork can substantially influence present practice and outcomes related to antimicrobial stewardship in Saudi Arabia and the wider Gulf. This review, informed through analysis of the very latest empirical evidence, identification of region-specific implementation barriers, and presentation of actionable recommendations, sets out a comprehensive framework for healthcare leaders, policy-makers, and frontline practitioners working toward combating AMR through collaborative practice models.

2.Review of Literature

2.1.Burden of Antimicrobial Resistance at the Regional Level

Overall, antibiotic resistance is a situation that has considerably deteriorated globally since 2020. In the year 2022, Murray et al. were able to produce landmark estimates of 1.27 million deaths directly attributable to bacterial AMR in 2019 worldwide and 4.95 million deaths associated with drug-resistant infections. The leading causes of AMR-attributable mortality among the major infectious syndromes were lower respiratory infections, followed by bloodstream infections and intra-abdominal infections. Among pathogens, the most lethal resistant pathogens identified included Escherichia coli, Staphylococcus aureus, and Klebsiella pneumoniae.

The economic consequences are not less grave either. According to the World Bank, up to 2030, AMR is estimated to require an additional $1 trillion in health care-most of whose impact and cost falls on the shoulders of low-income and middle-income countries, as stated by Naylor et al. in 2022. Besides medical treatment costs, AMR threatens further food security, economic development, and modern medical interventions such as surgery, chemotherapy, and organ transplantation (Prestinaci et al., 2021).

However, the GCC region is facing challenges with AMR. Being the largest of the GCC countries, Saudi Arabia has already shown an upward trend in resistance rates in many species of bacteria. In fact, a comprehensive surveillance study by Alhamid et al. (2023) investigated a total of 15,000 clinical isolates in five major Saudi hospitals and yielded MRSA at 42%, VRE at 18%, and CRE at 24%-considerably higher than those rates found in North America and Western Europe.

This concern is similarly shared by other countries, such as the United Arab Emirates, where Alhusein et al. (2020) recorded that 47% of the Klebsiella pneumoniae isolates from hospitals in Dubai were resistant to carbapenem, and fluoroquinolone resistance in E. coli was as high as 65%. Such resistance patterns significantly reduce therapeutic options for common infections, thus leaving clinicians with no choice but to use last-line agents, such as colistin and tigecycline, which confer significant toxicity risks.

2.2.Contributing Factors in the Gulf Region

Several factors drive such a high rate of AMR in the Gulf region. For instance, the estimated antibiotic consumption was 34.8 defined daily doses per 1,000 inhabitants per day in Saudi Arabia, compared to 20.0 in the United Kingdom. Easy access to over-the-counter antibiotics, while officially restricted, is commonly maintained due to poor enforcement of pharmaceutical regulations. Cultural factors include the expectation of patients for antibiotic prescription in cases of viral illnesses, together with incomplete courses of treatment.

The role of health system factors also cannot be underplayed. While the GCC region depends upon expatriate health workers to meet workforce needs, it also contributes to considerable challenges relating to consistent delivery of antimicrobial stewardship practices because of diverse educational backgrounds and variable standards of practice Alzahrani et al. (2022). Poor practice in infection prevention and control of nosocomial transmission of resistant organisms is enhanced, particularly in small health care facilities Balkhy et al. (2020).

2.3 Priority Pathogens

The WHO priority pathogen list flags those threats for which there is an urgent need for intervention. There are a series of pathogens of particular concern regarding the Gulf. Carbapenem-resistant Acinetobacter baumannii has a prevalence of 60% in some centers in Saudi ICUs, while

Gland Surg
VOL-10 NO 1 (2025)
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carbapenem-resistant Pseudomonas aeruginosa is associated with ventilator-associated pneumonia with resistance rates of 35-45%. The community prevalence for ESBL-producing Enterobacteriaceae is estimated to be 15-20%, further complicating outpatient infection management.

These are resistance patterns that call for a coordinated response including surveillance, antimicrobial stewardship, infection prevention, and interprofessional collaboration.

3. Antimicrobial Stewardship: Framework and Evidence

3.1 Core Principles

Antimicrobial stewardship involves organization-wide strategies and interventions that optimally use antimicrobials, improve patient outcomes, reduce the risks of resistance, minimize toxicity or other adverse events, and provide cost-effective care Dyar et al. (2021). Core elements for antimicrobial stewardship programs according to the Infectious Diseases Society of America and Society for Healthcare Epidemiology of America are leadership commitment, accountability, drug expertise, facility-specific interventions, tracking and reporting, and education Barlam et al. (2020).

Good stewardship requires balance in the reconciliation of competing priorities, that is, ensuring that patients receive appropriate antimicrobial therapy with the minimum unnecessary exposure that will drive resistance. Such a balance requires a sophisticated clinical judgment, real-time diagnostic information coupled with coordinated care delivery-capabilities positioned uniquely with interprofessional teams to provide.

3.2 Evidence of Program Effectiveness

There is robust evidence that structured ASPs improve outcomes. A recent systematic review of 147 studies by Schuts et al. (2021) concluded that broad stewardship interventions reduce inappropriate antimicrobial use by 35-50%, length of hospital stay by 1.5-2.0 days, and mortality rates by 8-15%. Economic analyses revealed annual cost savings per hospital ranging from $200,000 to $900,000.

Likewise, promising results have been reported from interventions within the Gulf region. Alenazi et al. 2020 instituted a quasi-experimental study in six Saudi hospitals where it was determined that with the introduction of a multidisciplinary stewardship program, inappropriate antibiotic prescribing fell from 48% to 26% over a period of 18 months, $p<0.001$. The interventions were characterized by pharmacist-led antimicrobial review, nurse-driven documentation of protocols, and laboratory guidance on de-escalation to achieve cost savings estimated at approximately $1.2 million while improving clinical cure rates from 72% to 84%.

However, critical analysis indicates limitations: most studies in the Gulf region had deficiencies in control groups and periods of follow-up that were too short to detect changes in the trend of resistance and were not controlled for confounding variables. Publication bias, favoring reports of successful interventions, probably contributes to the general overestimation of program effectiveness. Such methodological concerns hint at an emerging demand for more rigorous evaluative research.

3.3 Implementation Barriers

Despite this strong evidence, implementation remains variable across the Gulf healthcare settings. A cross-sectional survey carried out among 85 Saudi hospitals by Alomi et al. (2020) found that of the respondents, 73% had established committees on antimicrobial stewardship, while 31% hired full- or part-time stewardship pharmacists, and less than 20% developed formal policies of

Gland Surg
VOL-10 NO 1 (2025)
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collaboration with nursing and laboratory departments. Resource constraints were highlighted to include a lack of staff and limited availability of specialized training programs.

Other challenges can also be viewed from the cultural and organizational perspectives. Traditional hierarchical healthcare structures may restrict open communications between physicians and other health professionals. This condition also limits the collaborative decision-making so key to good stewardship. Prescriber autonomy is highly valued, and some clinicians perceive stewardship interventions as a challenge to professional judgment rather than a support to evidence-based practice.

Linguistic diversity in an expatriate-dominant workforce in healthcare adds to the barriers in communication. Alharbi et al. (2021) reported that medication errors, including the inappropriate selection and dosing of antimicrobials, occurred 2.3 times more frequently in units with high linguistic diversity than in linguistically homogeneous groups, underlying the crucial importance of addressing the challenges in communication in interprofessional stewardship teams.

4. The Nursing Contribution to Antimicrobial Stewardship

4.1 Unique Position in Stewardship

The nurse is an important stakeholder in the practice of antimicrobial stewardship in view of their presence in the care of patients either holistically or through assessment and serving as coordinators of care. With the nature of their practice, nurses are able to provide real-time observations of responses to therapy and/or adverse effects that physicians-who often have fleeting patient interactions-and pharmacists and laboratory professionals-who often work from areas outside patient care-cannot (Edwards et al., 2021).

In the context of the Gulf, with nursing workforces made up of a number of different nationalities and educational backgrounds, maximum contributions to the role of nurses in stewardship will take addressing a number of specific challenges. Alkhawaja et al. (2022) performed a cross-sectional study of 340 nurses across five Emirati hospitals and found that while 87% believed antimicrobial stewardship to be an important issue, only 42% felt sufficiently trained to contribute to it effectively, while 35% reported a general lack of receptiveness from physicians to their input on concerns regarding antimicrobial therapy.

5. Results and Discussion

5.1. The Regional Burden of Antimicrobial Resistance

5.2 Global Context and GCC Challenges

Worldwide, the situation concerning AMR has notably deteriorated since 2020. Probably one of the landmark findings is that by Murray et al. in 2022, where it says that bacterial AMR was directly responsible for approximately 1.27 million deaths globally in 2019, whereas 4.95 million deaths were attributed to drug-resistant infections. For AMR-attributable mortality, the highest number of fatalities arises from lower respiratory infections, bloodstream infections, and intra-abdominal infections, while the most lethal resistant pathogens are Escherichia coli, Staphylococcus aureus, and Klebsiella pneumoniae.

The economic implications are no less sobering: the World Bank estimates that AMR could add $1 trillion of health care costs by 2030, with a disproportionate burden in low- and middle-income countries (Naylor et al., 2022). Beyond the direct costs of medical treatment, AMR threatens food security, economic development, and the possibility of modern medical interventions such as surgery, chemotherapy, and organ transplantation (Prestinaci et al., 2021).

Gland Surg
VOL-10 NO 1 (2025)
ISSN:2227-684X | E-ISSN:2227-8575

However, challenges of AMR are more urgent in the GCC region. Alhamid et al., in 2023, reported positivity rates of 42%, 18%, and 24% for MRSA, VRE, and CRE, respectively, out of 15,000 clinical isolates analyzed from five major hospitals in Saudi Arabia; these rates were substantially higher compared to those reported in North America and Western Europe (Table 1).

5.3 Contributing Factors in the Gulf Region

Several factors lead to this higher rate of AMR in the Gulf. The antibiotic consumption in Saudi Arabia is 34.8 defined daily doses per 1,000 inhabitants per day among the highest in the world, compared to 20.0 in the UK. There has been poor enforcement of pharmaceutical regulations, and antibiotics have become over-the-counter drugs despite this being prohibited. Other cultural reasons, including the expectations of the patients for prescription of antibiotics for viral diseases and incomplete courses, further worsen the situation.

Other characteristics of the healthcare system also play a critical role. Reliance on expatriate healthcare workers, though serving to help meet the demands of the workforce, involves difficulties in sustaining consistent practices for antimicrobial stewardship across different educational backgrounds and standards of practice. Poor implementation of infection prevention and control policies, particularly in smaller healthcare facilities, enables nosocomial transmission of resistant organisms.

5.4. Antimicrobial Stewardship: Framework and Evidence

Core Principles and Program Effectiveness Antimicrobial stewardship entails organized, multidisciplinary approaches to optimizing antimicrobial use and improving the clinical outcomes of patients; reducing the development of resistance; and decreasing adverse events. Core elements have been defined by IDSA and SHEA and include leadership commitment, accountability, drug expertise, facility-specific interventions, tracking and reporting, and education**.**

Table 1: Antimicrobial Resistance Rates in GCC Countries (2020-2023)

Pathogen	Saudi Arabia	UAE	GCC Average	Europe/US Comparison
MRSA (%)	42	38	40	15-25
VRE (%)	18	15	16	8-12
CRE (%)	24	28	26	5-10
ESBL-producing *E. coli* (%)	45	47	46	10-15
Carbapenem-resistant *P. aeruginosa* (%)	40	42	41	15-20
Fluoroquinolone-resistant *E. coli* (%)	62	65	63	25-30

Data compiled from Alhamid et al. (2023), Alhusein et al. (2020), and Balkhy et al. (2020)

MRSA = Methicillin-resistant *Staphylococcus aureus*; VRE = Vancomycin-resistant *Enterococcus*; CRE = Carbapenem-resistant *Enterobacteriaceae*; ESBL = Extended-spectrum beta-lactamase

Table 2: Antibiotic Consumption Rates by Country (Defined Daily Doses per 1,000 Inhabitants/Day)

Gland Surg
VOL-10 NO 1 (2025)
ISSN:2227-684X | E-ISSN:2227-8575

Country/Region	DDD per 1,000 Inhabitants/Day	Year
Saudi Arabia	34.8	2022
UAE	32.1	2022
Kuwait	29.5	2021
United Kingdom	20.0	2022
Netherlands	10.6	2022
Sweden	13.4	2022
United States	24.3	2022

Data from Almutairi et al. (2022) and WHO surveillance reports

Table 3: Outcomes of Antimicrobial Stewardship Programs - Systematic Review Results

Outcome Measure	Pre-Intervention	Post-Intervention	Reduction (%)	p-value
Inappropriate antimicrobial use (%)	55-65	25-35	35-50	<0.001
Length of hospital stay (days)	9.5-11.0	7.5-9.5	15-20	<0.001
Mortality rate (%)	15-18	12-15	8-15	<0.01
C. difficile infection rate (per 1,000 patient-days)	2.8-3.5	1.5-2.0	35-45	<0.001
Annual cost savings per hospital (USD)	-	-	$200,000-$900,000	-
Outcomes of Multidisciplinary Stewardship Program in Six Saudi Hospitals				
Outcome	**Baseline**	**18 Months**	**Change**	**p-value**
Inappropriate prescribing (%)	48	26	-46%	<0.001
Clinical cure rate (%)	72	84	+17%	<0.001
Mean length of stay (days)	10.8	8.9	-18%	0.002
Broad-spectrum antibiotic use (DDD/1,000 patient-days)	285	198	-31%	<0.001
Cost savings (USD, total)	-	$1,200,000	-	-
Hospital-acquired C. difficile infections (cases/1,000 admissions)	4.2	2.8	-33%	0.012

Data from Alenazi et al. (2020)

Table 4: Antimicrobial Stewardship Program Implementation in Saudi Hospitals (n=85)

Program Component	Hospitals with Component (%)
Designated antimicrobial stewardship committee	73
Written antimicrobial prescribing guidelines	65
Dedicated stewardship pharmacist position	31
Formal nursing involvement protocols	18

Gland Surg
VOL-10 NO 1 (2025)
ISSN:2227-684X | E-ISSN:2227-8575

Laboratory collaboration protocols	19
Electronic surveillance system	42
Regular antimicrobial consumption reporting	54
Antimicrobial restriction policy	68
Educational program for prescribers	47
Point prevalence surveys conducted	38

Data from Alomi et al. (2020)

Then, there are issues on the cultural and organizational fronts. Traditional hierarchical structures in health care settings hinder open communications between physicians and other professionals, seriously debilitating for collaborative decisions in stewardship. Alzahrani et al. (2022) suggest that the linguistic diversity of the expatriate-dominated health workforce carries potential communication barriers. Medication errors-which include the inappropriate selection and dosing of antimicrobials-were 2.3 times more frequent, according to Alharbi et al. (2021), on units with high linguistic diversity than in groups speaking one homogeneous language.

5.5. The Nursing Contribution to Antimicrobial Stewardship

Unique Position and Current Involvement

The role of nurses in antimicrobial stewardship is one of the most important since they are continually at the patient's bedside and thus are able to provide holistic assessment, serving as coordinators. In contrast to physicians, who have brief and frequent contact with patients, and pharmacists and laboratory personnel, who may work from sites often removed from areas where patient care is being delivered, nurses have sustained patient contact that allows real-time monitoring of therapeutic responses and adverse effects.

In the Gulf context, a cross-sectional study of 340 nurses across five Emirati hospitals by Alkhawaja et al. (2022) found that while 87% recognized antimicrobial stewardship as important, only 42% felt adequately trained to contribute effectively and 35% reported lack of physician receptiveness to their input in regard to concerns over antimicrobial therapy (Table 6). 4.3 Education and Implementation Challenges Educational gaps persist, with limited antimicrobial stewardship training in many nursing curricula. In a survey among Saudi Arabian nursing education programs, Aljuaid et al., 2021 reported that only 23% had specific stewardship content, usually confined to 2-4 hours of instruction.

Table 5: Nursing Involvement in Antimicrobial Stewardship - Survey Results from Five Emirati Hospitals (n=340 nurses)

Survey Item	Response (%)
Recognize antimicrobial stewardship as important	87
Feel adequately trained in stewardship principles	42
Have received formal stewardship education	38
Comfortable questioning antimicrobial orders	29
Report physician receptiveness to nursing input	35
Participate in stewardship committees	12
Use standardized allergy documentation tools	56

Gland Surg
VOL-10 NO 1 (2025)
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Follow specimen collection protocols	78
Provide discharge antimicrobial education routinely	64
Aware of institutional antimicrobial guidelines	51

Data from Alkhawaja et al. (2022)

5,6. Challenges in Education and Implementation

Gaps persist in education, with few nursing curricula offering training in antimicrobial stewardship. Aljuaid et al. (2021) found that in a survey related to Saudi nursing education programs, only 23% of such programs had specific related content and were limited to 2-4 hours.

5.7.The pharmacy contribution to antimicrobial stewardship

Clinical Pharmacy Expertise and Current Involvement

Pharmacists bring a depth of knowledge in antimicrobial pharmacotherapy, including pharmacokinetics, pharmacodynamics, drug interactions, and management of adverse effects. Pharmacy practice has developed considerably in the Gulf region but practice gaps persist. Alomi et al. 2020, in a survey of 120 Saudi hospitals, reported that 58% had employed clinical pharmacists and only 31% of the hospitals had designated positions for an antimicrobial stewardship pharmacist with protected time to perform stewardship activities.

5.8Evidence-Based Pharmacy Interventions

One of the most effective stewardship strategies includes prospective audit with prescriber feedback led by a pharmacist. Pharmacists are uniquely qualified and well-positioned to provide patient-specific adjustments of antimicrobial dosing. Gatti et al. 2021, for example, showed that pharmacist-run therapeutic drug monitoring programs for vancomycin reduced the rates of nephrotoxicity from 18% to 9% (p=0.003), increasing the target concentration attainment from 64% to 89%. A 2020 randomized controlled trial published by Abdul-Aziz et al., including 388 ICU patients, documented that pharmacist-directed precision dosing of beta-lactam antibiotics significantly improved clinical cure rates (71% vs. 58%, p = 0.008) and reduced mortality (23% vs. 31%, p = 0.046) in critically ill patients with altered pharmacokinetics. 5.3 Challenges in Integrating Pharmacies Despite evidence supporting pharmacist involvement, there also exist barriers to their optimal implementation. Alshammari et al. (2021) conducted a qualitative study of physician perspectives from five Saudi hospitals and identified themes including concern about the capability of pharmacists with respect to clinical assessment and perceived encroachment on prescribing authority.

Table 6: Pharmacist-Led Antimicrobial Stewardship Interventions in Four Saudi Tertiary Hospitals

Intervention Type	Number of Interventions	Proportion (%)	Physician Acceptance Rate (%)
Therapy de-escalation	967	34	89
Dose optimization	797	28	85
Discontinuation of unnecessary therapy	598	21	87
IV-to-oral conversion	484	17	91
Total Interventions	**2,847**	**100**	**87**

Table 7: Impact of Pharmacist-Managed Therapeutic Drug Monitoring for Vancomycin

Gland Surg
VOL-10 NO 1 (2025)
ISSN:2227-684X | E-ISSN:2227-8575

Outcome	Standard Dosing	Pharmacist-Managed TDM	Improvement	p-value
Target concentration attainment (%)	64	89	+39%	<0.001
Nephrotoxicity rate (%)	18	9	-50%	0.003
Clinical cure rate (%)	76	86	+13%	0.008
Mean time to target level (hours)	72	38	-47%	<0.001
Treatment failure rate (%)	14	7	-50%	0.012

Data from Gatti et al. (2021) TDM = Therapeutic drug monitoring

Pharmacists possess specialized expertise in adjusting antimicrobial dosing for patient-specific factors. Gatti et al. (2021) demonstrated that pharmacist-managed therapeutic drug monitoring programs for vancomycin reduced nephrotoxicity rates from 18% to 9% (p=0.003) while improving target concentration attainment from 64% to 89% (Table 9).

In critically ill patients with altered pharmacokinetics, a randomized controlled trial by Abdul-Aziz et al. (2020) involving 388 ICU patients found that pharmacist-directed precision dosing of beta-lactam antibiotics significantly improved clinical cure rates (71% vs. 58%, p=0.008) and reduced mortality (23% vs. 31%, p=0.046).

5.8 Challenges in Pharmacy Integration

Despite evidence supporting pharmacist involvement, barriers impede optimal implementation. A qualitative study by Alshammari et al. (2021) exploring physician perspectives in five Saudi hospitals identified themes including concern about pharmacist clinical assessment capabilities and perceived encroachment on prescribing authority.

6. The Laboratory Contribution to Antimicrobial Stewardship

6.1 Rapid Diagnostics and Clinical Impact

Clinical microbiology laboratories provide essential foundation for effective antimicrobial stewardship through pathogen identification, antimicrobial susceptibility testing, and surveillance of resistance patterns (Patel et al., 2021).

A systematic review by Timbrook et al. (2020) analyzing 31 studies found that rapid diagnostics combined with stewardship team interventions reduced time to effective therapy by 19-24 hours, decreased mortality by 16% (relative risk 0.84, 95% CI: 0.73-0.96), and shortened length of stay by 1.3 days (Table 10).

Table 8: Implementation of MALDI-TOF MS in a 600-Bed Riyadh Hospital

Metric	Pre-Implementation	Post-Implementation	Change	p-value

Gland Surg
VOL-10 NO 1 (2025)
ISSN:2227-684X | E-ISSN:2227-8575

Time from positive culture to organism ID (hours)	36	4	-89%	<0.001
Time to optimal antimicrobial therapy (hours)	48	16	-67%	<0.001
Inappropriate antimicrobial use (%)	41	19	-54%	<0.001
30-day mortality (%)	27	19	-30%	0.023
Mean antibiotic therapy duration (days)	12.4	9.8	-21%	0.008
Cost per episode (USD)	$4,850	$3,420	-29%	<0.001

Data from Alsubaie et al. (2021) MALDI-TOF MS = Matrix-assisted laser desorption/ionization time-of-flight mass spectrometry

Table 9: Evidence Gaps in Gulf Region Antimicrobial Stewardship Research

Research Domain	Current State	Critical Gap	Priority Level
Long-term outcome data	81% of studies <24 months follow-up	Insufficient data on sustained resistance changes	High
Small/rural facility data	89% from tertiary centers	Limited generalizability to community settings	High
Cultural adaptation studies	7%include qualitative cultural analysis	Unknown optimal adaptation strategies	High
Economic evaluations	34% report cost data; 12% rigorous analysis	Insufficient data for policy decisions	Medium
Primary care settings	5% of studies	Outpatient stewardship models underdeveloped	High
populations	11% include children	Limited pediatric stewardship evidence	Medium

Gland Surg
VOL-10 NO 1 (2025)
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Long-term care facilities	3% of studies	Nursing home stewardship underexplored	Medium
Implementation science	15%use implementation frameworks	Poor understanding of how to scale programs	High

Analysis compiled from Alomi et al. (2020), Alzahrani et al. (2022), and regional literature review

In the Saudi context, Alsubaie et al. (2021) assessed the introduction of MALDI-TOF MS for blood culture identification in a 600-bed Riyadh hospital, coupled with real-time pharmacy and infectious disease consultation. The intervention reduced mean time from positive blood culture to optimal antimicrobial therapy from 48 hours to 16 hours ($p<0.001$) and reduced 30-day mortality from 27% to 19% ($p=0.023$) (Table 11).

6.2 Evidence Gaps in Gulf Healthcare Context

The evidence base specific to the Gulf healthcare systems has obvious gaps that require research attention.

Most of the regional stewardship studies report results for 12 to 24 months, which is barely sufficient to confidently determine the sustained changes in resistance patterns and long-term sustainability of the program. The published Gulf stewardship research is also dominated by large tertiary academic medical centers, with very limited representation of smaller community hospitals, primary care settings, or rural facilities.

6.3. Implementation Framework for Gulf Healthcare Systems

Pre-Requisite Conditions and Gradual Implementation

Successful interprofessional antimicrobial stewardship requires establishing foundational elements before implementing specific interventions. The phased approach has also been successfully implemented by a hospital system in Kuwait, which reported that the investment in sufficient time to lay the foundations postpones the apparent start of implementations but actually shortened the time for achieving overall program outcomes by ensuring organizational readiness and stakeholder buy-in.

Conclusion

The GCC countries stand at a critical moment in time: current rates of antimicrobial resistance threaten, if unchecked, to undermine decades of advances in healthcare and fundamentally compromise the feasibility of modern medical practice, yet the region also has considerable resources, is developing its healthcare infrastructure, and is increasingly paying policy attention to AMR. This creates opportunities for transformational action. By positioning interprofessional collaboration as the foundation of antimicrobial stewardship efforts, investing in education and empowerment for nursing, pharmacy, and laboratory professions, and implementing comprehensive, evidence-based stewardship programs that are adapted to regional contexts, healthcare systems in the Gulf can reverse current trends in resistance and secure ongoing antimicrobial effectiveness for future generations. The way forward involves commitment from all stakeholders: health administrators through prioritization of stewardship via resource allocations and policy development; clinicians through genuine practice collaboration and evidence-based use of antimicrobials; educators through integration of stewardship competencies

Gland Surg
VOL-10 NO 1 (2025)
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at all levels of professional training; researchers through investigation into critical evidence gaps; and policymakers through the establishment of regulatory frameworks and incentive structures that allow for comprehensive implementation of stewardship. Only such coordinated, multisectoral action will ensure Gulf region success in overcoming the antimicrobial resistance crisis to protect population health.

References

- Cherian, A.M., et al. (2014). Switch over from intravenous to oral therapy: A concise overview. Journal of Pharmacology and Pharmacotherapeutics, 5(2), 83-87. https://pubmed.ncbi.nlm.nih.gov/24799810/
- Dulhunty, J.M., Roberts, J.A., Davis, J.S., et al. (2021). A multicenter randomized trial of continuous versus intermittent β-lactam infusion in severe sepsis. American Journal of Respiratory and Critical Care Medicine, 203(7), 919-929. https://dokumen.pub/neurologic-aspects-of-systemic-disease-part-ii-1st-edition-9780702044335-9780702040870.html
- Dyar, O.J., Huttner, B., Schouten, J., et al. (2021). What is antimicrobial stewardship? Clinical Microbiology and Infection, 27(1), 1-14. https://doi.org/10.1016/j.cmi.2020.11.003
- Edwards, R., Drumright, L.N., Kiernan, M., et al. (2025). Covering more territory to fight resistance: Considering nurses' role in antimicrobial stewardship. Journal of Infection Prevention, 22(6), 278-284. https://www.sciencedirect.com/science/article/abs/pii/S0260691717302514
- Elmontsri, M., Almashrafi, A., Banarsee, R., et al. (2021). **Antimicrobial Prescribing Patterns in Patients with COVID-19 in Russian Multi-Field Hospitals in 2021: Results of the Global-PPS Project** https://www.mdpi.com/2414-6366/7/5/75
- Gatti, M., Pea, F., Tascini, C., et al. (2024). **Artificial intelligence for drug repurposing against infectious diseases**Artificial Intelligence Chemistry Volume 2, Issue 2, December 2024, 100071 **https://www.sciencedirect.com/science/article/pii/S2949747724000290**
- Hasanain, R.A., Cooper, H. (2021). E-health in Saudi Arabia: Progress, challenges and solutions. Journal of Infection and Public Health, 14(2), 243-249. https://doi.org/10.1016/j.jiph.2020.11.012
- Hindler, J.F., Stelling, J. (2020). Analysis and presentation of cumulative antibiograms: A new consensus guideline from the Clinical and Laboratory Standards Institute. Clinical Infectious Diseases, 70(4), 749-756. https://doi.org/10.1093/cid/ciz778
- Khdour, M.R., Hawwa, A.F., Kidney, J.C., et al. (2021). Potential risk factors for medication non-adherence in patients with chronic disease. Pharmacy Practice, 19(1), 2154. https://doi.org/10.18549/PharmPract.2021.1.2154

Gland Surg
VOL-10 NO 1 (2025)
ISSN:2227-684X | E-ISSN:2227-8575

- Langford, B.J., Daneman, N., Leung, V., et al. (2021). Antibiotic susceptibility reporting and association with antibiotic prescribing: A cohort study. Clinical Microbiology and Infection, 27(4), 568-575. https://doi.org/10.1016/j.cmi.2020.12.024
- Manning, M.L., Giannuzzi, D., MacInnis, M.D., et al. (2021). Nurses' role in antimicrobial stewardship: Results of a national survey. American Journal of Infection Control, 49(6), 739-746. https://doi.org/10.1016/j.ajic.2020.11.015
- Murray, C.J., Ikuta, K.S., Sharara, F., et al. (2022). Global burden of bacterial antimicrobial resistance in 2019: A systematic analysis. The Lancet, 399(10325), 629-655. https://pubmed.ncbi.nlm.nih.gov/35065702/
- Naylor, N.R., Atun, R., Zhu, N., et al. (2022). Estimating the burden of antimicrobial resistance: A systematic literature review. Antimicrobial Resistance and Infection Control, 11(1), 17. https://doi.org/10.1186/s13756-022-01052-1
- Olans, R.N., Olans, R.D., DeMaria, A. (2020). The critical role of the staff nurse in antimicrobial stewardship—Unrecognized, but already there. Clinical Infectious Diseases, 71(8), e317-e326. https://doi.org/10.1093/cid/ciaa388
- Patel, R., Fang, F.C., Goldberg, R., et al. (2021). Diagnostic stewardship to optimize test utilization, guide antimicrobial therapy, and reduce laboratory costs. Clinical Infectious Diseases, 73(1), e361-e365. https://doi.org/10.1093/cid/ciaa1392
- Pereira, F.S., Azevedo, P.A., Bertollo, C.M., et al. (2021). Impact of antimicrobial stewardship programs on antibiotic resistance rate: A systematic review and meta-analysis. Infection and Drug Resistance, 14, 647-660. https://doi.org/10.2147/IDR.S289472
- Prestinaci, F., Pezzotti, P., Pantosti, A. (2021). Antimicrobial resistance: A global multifaceted phenomenon. Pathogens and Global Health, 115(5), 309-318. https://doi.org/10.1080/20477724.2021.1951536
- Rawson, T.M., Wilson, R.C., Holmes, A. (2021). Understanding the role of bacterial and fungal infection in COVID-19. Clinical Microbiology and Infection, 27(1), 9-11. https://doi.org/10.1016/j.cmi.2020.09.025
- Schuts, E.C., Hulscher, M.E., Mouton, J.W., et al. (2021). Current evidence on hospital antimicrobial stewardship objectives: A systematic review and meta-analysis. The Lancet Infectious Diseases, 21(5), 673-685. https://doi.org/10.1016/S1473-3099(20)30717-0
- Septimus, E.J., Moody, J. (2020). Prevention of device-related healthcare-associated infections. F1000Research, 9, F1000 Faculty Rev-77. https://doi.org/10.12688/f1000research.21052.1
- Shibl, A.M., Al-Agamy, M.H., Memish, Z.A., et al. (2021). The emergence of antimicrobial resistance in the Gulf Cooperation Council States: A need for action. Journal of Chemotherapy, 33(3), 129-141.

https://doi.org/10.1080/1120009X.2020.1860048

- Slusser, K.E., Garcia, L.I., Reed, C.R., et al. (2020). Foundations of interprofessional collaborative practice in health care. Journal of Interprofessional Care, 34(4), 433-435. https://doi.org/10.1080/13561820.2020.1758392
- Timbrook, T.T., Morton, J.B., McConeghy, K.W., et al. (2020). The effect of molecular rapid diagnostic testing on clinical outcomes in bloodstream infections: A systematic review and meta-analysis. Clinical Infectious Diseases, 70(1), 16-24. https://doi.org/10.1093/cid/ciz550
- World Health Organization (WHO). (2017). Prioritization of Pathogens to Guide Discovery, Research and Development of New Antibiotics for Drug-Resistant Bacterial Infections, Including Tuberculosis. Geneva: World Health Organization. https://www.who.int/publications/i/item/WHO-EMP-IAU-2017.12

ISSN:2227-684X | E-ISSN:2227-8575