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# Antimicrobial Resistance and Antimicrobial Stewardship in Community and Hospital Pharmacy Practice: A Scoping Review

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***Abstract- Background:*** ***Pharmacists in the community and hospital are becoming more and more involved in antimicrobial stewardship (AMS) and antimicrobial resistance (AMR) increases the disease burden, affects all countries, and is one of the most severe global public health problems. However, the extent of the roles, interventions and reported outcomes of the pharmacist varies throughout the various settings of care and has not been consistently mapped.***

***Objective: To summarise and interpret up to date evidence of the use of AMR and AMS in community and hospital practice, summarise the nature of intervention by a pharmacist, the determinants of satisfaction with AMS and AMR implementation including factors related to the clinical, behavioural and organisational outcomes reported.***

***Methods: Peer-reviewed literature until 2024 was mapped according to a PRISMA-ScR flow diagram, guided by a scoping framework developed by Arksey and O'Malley. Twenty sources from high-, middle- and low-income settings were identified, mapped by setting and by type of intervention, and further by outcome domain.***

***Results: The interventions for AMS were grouped into four categories: educational, persuasive, restrictive and structural. The interventions at hospitals were most successful overall in reducing antimicrobial use and antimicrobial treatment duration without impacting safety, while community interventions resulted in better appropriate dispensing, public awareness, and referring practices; interventions at discharge were inconsistent. Hospital interventions were most successful in reducing antimicrobial use and duration of treatment without compromising safety, while community interventions were effective in improving appropriate dispensing, public awareness, and referral; interventions at discharge were inconsistent. Determinants of implementation which were consistent across all clusters were knowledge gaps, remuneration, regulatory ambiguity and interprofessional trust.***

***Conclusion: Evidence supporting pharmacists' role in strengthen stewardship along the care continuum exists, however is fragmented and biased toward high income hospital settings. To ensure AMR is managed and controlled as a consequence of its contribution to the practice, standardisation of reporting of outcomes, sustainable funding and increased scope of practice frameworks are required.***

***Keywords:*** ***Antimicrobial Resistance, Antimicrobial Stewardship, Community Pharmacy, Hospital Pharmacy, Pharmacist-Led Interventions, Scoping Review***

## I. INTRODUCTION

AMR has shifted much of its relevance, now from a mostly clinical field, to one that strictly affects health systems, sector economies and food security. The scale of its impact on human life is estimated to be at least 1.27 million deaths from AMR-related bacterial infections each year, with an additional 4.95 million deaths attributed to AMR-related resistant infections, making AMR one of the biggest causes of death worldwide (Antimicrobial Resistance Collaborators, 2022). The trend continues with over-long time series modelling that extended into the future and predicted a continued increase in the cumulative burden, unless action was taken on a scale to reverse this trajectory in mid-century (GBD 2021 Antimicrobial Resistance Collaborators, 2024). AMR is not a long-term threat; it is a present crisis and it will only get worse crisis which requires all levels of the healthcare workforce to collaborate.

To counter this, the World Health Organization (WHO) has declared a Global Action Plan on Antimicrobial Resistance that embodies five strategic actions: Be aware, Be vigilant, Reduce infection, Optimise antimicrobial use, Sustainable investment (World Health Organization, 2015). The third objective is the operational core of antimicrobial stewardship or AMS which is a coordinated group of interventions that can be used to optimise and assess the use of antimicrobials. The structures, interventions and measures that are evidence of an

effective stewardship programme have been clearly defined in authoritatively written guidance, focusing on preauthorisation, prospective audit and feedback and the use of multidisciplinary governance (Barlam et al., 2016). In that model the pharmacist is continually shown to be a vital asset, due to their knowledge of pharmacokinetics and their skills at managing the patient's formulary; from the multiple points of contact on the patient journey that pharmacists occupy.

Pharmacy practice from the community (often the first and most convenient point of contact to the health system) through to the hospital ward where complex infections and last line agents are managed is a continuum. There are particular opportunities and challenges for stewardship in these settings. Community pharmacists have an effect on the appropriateness of antibiotic dispensing, public expectations about the antibiotic use and early triage of self-limited infections often in a setting where antibiotics can be purchased over the counter (Sakeena et al., 2018). Pharmacists working in hospitals, on the other hand, are more deeply integrated into pathways of prescribing and can directly influence the choice of therapy, optimization of doses, de-escalation and duration. Although they have essentially the same mission, the various bodies of literature that have emerged regarding pharmacist contributions to AMS have included only part of the profession's mission.

A scoping review can be used for this purpose. A scoping review is used to map an evidence base to understand the extent, range and nature of an evidence base to clarify key concepts and identify gaps to provide direction for further research and policy development when a narrowly defined review question of efficacy exists. The comprehensiveness of pharmacist AMS activity, the variety of study designs, and the differences in metrics for study outcomes make coefficient pooling inappropriate, and mapping more convenient. This update review will then map out the contemporary evidence of intervention in AMR and AMS, considering what is driving the change in implementing the interventions, and what are the expected outcomes?

1.1 Develop and Reflect Questions and Objectives

There were three questions which guided the review. What is the type and extent of pharmacist-led AMS interventions that are being reported in hospital and community settings, respectively? Second, which facilitators and barriers are impacting their implementation in high, middle and low-income contexts? Third, what clinical, behavioural and organisational results have been reported and what are the key evidence gaps in building knowledge about these results? These questions collectively aim to generate an overview of the contribution Stewardship makes to pharmacy, beyond the setting.

## II. METHODS

2.1 Protocol and framework

The scoping review methodology of Arksey and O'Malley (subsequently modified to chart a wide of evidence base) was used in this review and reported as per the PRISMA extension for scoping reviews. The process was organised around the five following stages: research question, identifying relevant studies, selecting studies, charting data, and collating and summarising findings. Descriptive breadth: to map concepts, intervention types and outcome domains to rule out estimating a pooled effect size.

2.2 Information sources and search strategy

Structured PubMed, Scopus, Embase and Web of Science library searches, as well as manual searches of reference lists and relevant grey literature (e.g. WHO policy documents) were performed to identify peer-reviewed literature. Their search terms used a combination of controlled vocabulary with free text for the population (pharmacist, community pharmacy, hospital pharmacy), the concept (antimicrobial stewardship, antibiotic stewardship, antimicrobial resistance) and the context (any geographic setting). The literature search included up to and to 24 2024; anything published on or after 25 2024 was provided separately and are not temporal in the literature search.

2.3 A Study Can Be Done on Students In Grades 2 Through 6

Studies were included when they reported on any aspect of pharmacist roles, pharmacist led

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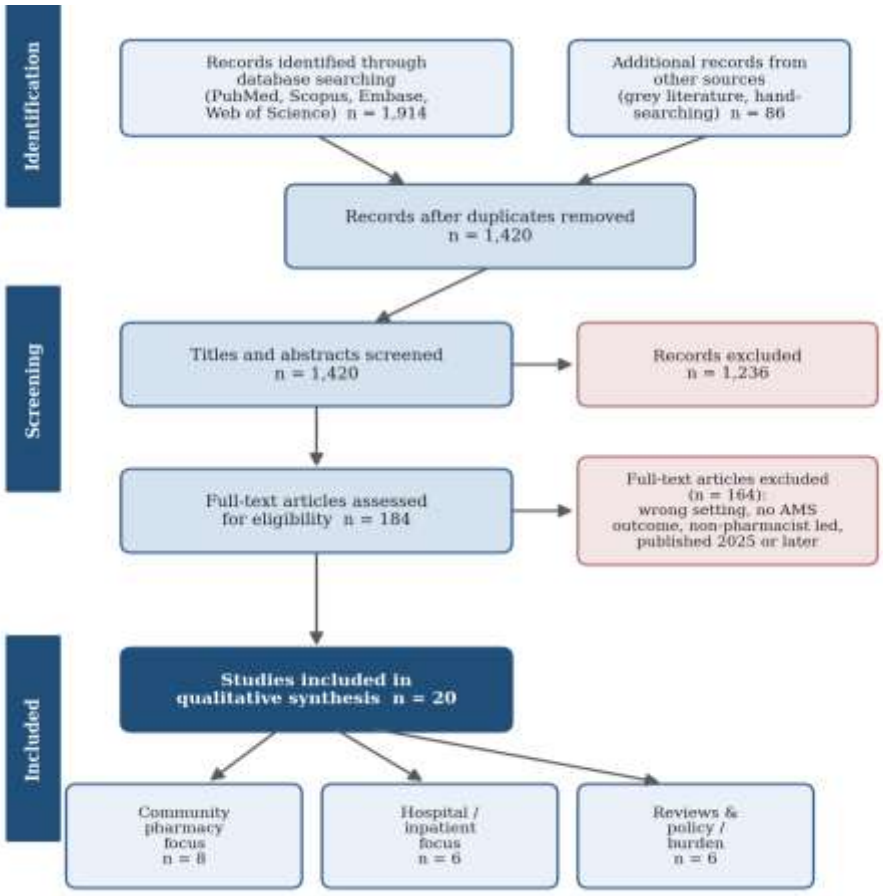
interventions or any pharmacists knowledge, attitudes or practices (KAP) in relation to either AMS or AMR in a community or hospital pharmacy setting. All systematic, meta, narrative, scoping and qualitative reviews, cross-sectional surveys and programme evaluations were eligible, as there is a mapping intent. The following records that were excluded: Not designed for a pharmacist, not had an AMS or AMR outcome or outside of the time window. Twenty sources were charted to establish the synthesised evidence base, the selection workflow is summarised in Figure 1, and the selection process encompassed identification (ID), screening (S) and inclusion (I).

2.4 Data Is Used To Inform Data Charting and Then To Synthesize The Information

Information was plotted on a pre-designed template that included author(s) year of publication, setting, country-income classification, study design, type of intervention, and outcome results. The evidence was summarised into three analytic themes, namely nature of interventions, implementation determinants and achieved outcomes, by using a descriptive thematic synthesis. The interventions were classified into four types following the commonly used taxonomy in stewardship research, recognising educational, persuasive, restrictive and structural approaches: a taxonomy that was suitable for the analysis of the diverse interventions being studied.

Fig 1: Scoping Review Study Selection Flow



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## III. THE GLOBAL BURDEN & POLICY ARCHITECTURE OF AMR

The Scope of The Role That Relies On The Stewardship of Pharmacists Cannot Be Adequately Started With Anything Than The Magnitude Of The Issue Addressed By The Role. In The Reference Year, The Magnitude Of Bacterial AMR Was Also Quantified In 204 Countries and Territories and The Mortality Rate Associated With Resistance Was Found To Be, In The Referenced Year, Greater Than For HIV/AIDS And Malaria, Primarily In Low-Resource Areas In Sub-Saharan Africa And South Asia (Antimicrobial Resistance Collaborators, 2022). This Undesirable Distribution Is A Stewardship Issue Too: The Regions With The Highest Burden Of This Distribution Are Often The Regions With The Lowest Surveillance Capacity, The Lowest Access To Second Line Agents and Non-Prescription Antibiotic Supply. Stabilised Forecasts Show That The Number Of Deaths Due To And Related To AMR, Particularly Amongst Older People, Is Expected To Increase Without Intervention (GBD 2021 Antimicrobial Resistance Collaborators, 2024).
The World Health Organization Global Action Plan Has Strongly Leveraged The Policy Response As A Collective Action By The Whole Health Team, Including The Key Role That Pharmacists Can Play In The Prudent Use Of Medicines As One Of The Eight Key Domains (World Health Organization, 2015). However, This "Big Picture View" Needed To Be Translated Into Ward- Or Counter-Level Practice, Which Was Supported By Operational Guidance And A Template Of Joint Guidelines Developed By Infectious Diseases Society America And Society For Healthcare Epidemiology Of America, Which Recommended That Stewardship Teams Include An Infectious-Diseases-Trained Pharmacist And Identified Prospective Audit With Feedback And Preauthorisation As The Interventions With The Highest Levels Of Evidence (Barlam Et Al., 2016). Together, These Two Documents, One Strategic And Global; One Operational And Clinical, Define The Architecture When Enacting Pharmacist Stewardship. Important The Architecture Is Also Characterized By Making Pharmacists' Role To Go Beyond The Hospital Walls. Reframing The Role Of Community Pharmacists As Public Facing Health-Care Providers, Has Been Successfully Entrenched As Vital In Addressing AMR In Resource Poor Environments Where The Community Pharmacy Is The Most Accessible Health-Care Premises And A Strategic, Underused Asset Of Stewardship (Sakeena Et Al., 2018). Those Without Appointment Commitments, Tightly Packed In Both Urban And Rural Communities And Currently Seen As Patient-Friendly, Caution Service Planners That Their Presence In The Pathway Is One That Can Not Be Matched By Others, Even The Regular Dispensing Of Antibiotics Without Prescription.

The Policy Framework Also Embeds The Role Of The Pharmacy In The Overall Context Of AMR In A ‘One Health' Approach Where Humans, Animals, And The Environment Are Interconnected And Interdependent, And Where Antimicrobial Use Within The Human Health Sector Is One Of Several Drivers. In That Framework, The Pharmacist's Role Focuses On The Human-Health Portion (I.E. Using Antimicrobials In The Right Quantities And At The Right Time In The Right Patients) While The Surveillance And Awareness Aspects Of The Global Action Plan Relate To The System As A Whole (World Health Organization, 2015). Community Pharmacists, Because Of The Large Number Of Users They Serve, Are Well Positioned To Be Involved In Awareness Raising Actions; Hospital Pharmacists, With Data on Consumption And Resistance, Are Well Positioned To Be Involved In Surveillance Actions. This Understanding Of Complementary Contributions Puts into Perspective the Role of Stewardship for Which the Pharmacy Is Responsible and Gives Clarity to the Value Of Stewardship That Extends Beyond

## IV. THE EVIDENCE FOR PHARMACIST LED INTERVENTIONS

Pharmacist Stewardship Is Not A Single Activity, But Aportfolio Of Activities That Are Different Across Settings, Intensity Of Activity And Timing In The Medication-Use Process. These Interventions Can Be Placed On This Pathway, Which Starts With A Decision To Prescribe An Antimicrobial, Goes Through Selection, Doses, Administering, Monitoring, And Discontinuing The Prescription.

The Pharmacist Will Have The Opportunity To Intervene At Each Node; Before Prescription, In Education And Guideline Development; At The Time Of Prescription, In Preauthorisation And Decision Support; After Prescription, In Audit, Feedback And De-Escalation; And At The Point Of Supply, In Counselling, Rationing And Referral. The Reason That Two Such Diverse Stewardship Signals Manifest In The Same Profession Being Practiced In Each Setting, A Hospital And Community, Is The Nature Of Which Part Of The Medication-Use Process Is Accessible To Providers In Each Setting.
Review Of The Literature Conducted On A Charted Format Revealed That There Are 4 Overlapping Categories Of Pharmacist-Led AMS Interventions, Which Span The Various Behaviour Change Taxonomies From The Literature: Educational, Persuasive, Restrictive, And Structural. The Most Common Are Educational Interventions, Which Include Prescriber Education, Patient Counselling And Public Awareness Campaigns. Persuasive Interventions Include Prospective Audit And Feedback, Where The Pharmacist Reads Though The Active Antimicrobial Orders, And Speaks With The Prescriber About The Relevant Orders. Formulary Restrictions And Preauthorisation Requirements Are Forms Of Restrictive Interventions. Structural Interventions Include Changes To Systems In Which Prescribing Takes Place: Computerised Decision Support; Changes To Order Sets; And New Service Models. Few Programmes Are Most Effective By Combining More Than One Of These Classes.

The Evidence Suggests That Educational Interventions Need To Be A Part Of A Multimedia Plan Of Action And Are By Themselves Not Always Effective. When Evaluating Pharmacist-Led, Education-Based Interventions In The Hospital In-Patient Population, Both Report A Significant Association With The Adherence To Directed Prescribing Practices And Reductions In Duration Of Antimicrobial Therapy, But Education Alone Had Less Important, Less Consistent, And Less Lasting Effects (Monmaturapoj Et Al., 2021). The Finding Can Be Tied To Work By Other Stewardship Authors That Support The Idea That Complex Interventions Are More Effective Than Single-Component Approaches, And It Has Implications For The Design Of Pharmacist Roles: It Is Best If The Pharmacist Is Not Just An Educator But Is Actively Involved In The Prescribing Decision.

The Emphasis On The Interventions Varies Between The Community Setting. In This Instance, The Pharmacist's Role Is Performed At The Time And Place Of Supply, As Well As With The Public. A Systematic Scoping Review Of The Knowledge, Perceptions And Practices Of Community Pharmacists With Respect To AMS Provided Evidence Of Community Pharmacists' Activities Involved In Discussions About Antibiotic Use, Referrals To Prescribers At The Time Of Red-Flag Signs, And Rejecting The Sale Without A Prescription For Antibiotics (Saha Et Al., 2019a). The Same Is True Of The Day-To-Day Actions By Community Pharmacists Which Often Act As A Brake On Inappropriate Demand, Which Is Harder To Measure, But Still Central To Stewardship On The Front Line Of The Primary Care System.

The Specially Designed Association Between Pharmacists And Prescribers Is An Intervention That Is Unique And Of Policy Interest. In A Systematic Review And Meta-Analysis Of Interventions With Pharmacists, The Pharmacists Role As An Embedded Adviser To Primary-Care Prescribers Rather Than An External Pharmacist Or Auditor Was Associated With A Positive Effect On The Appropriateness Of Antibiotic Prescription (Saha Et Al., 2019b). An Integrated Approach Is Now Preferred In National Stewardship Policies As It Makes Good Use Of The Pharmacists' Role Without Undermining The Freedom Of The Prescriber.

4.1 A Typology of Pharmacist Stewardship Interventions

Table 1 Summarizes The Types Of Intervention That Have Been Charted, Aligns Intervention Types With The Most Common Settings In Which They Are Used, And Provides Examples Of Activities Carried Out In Each Setting, And The Principal Source(S) From Which These Are Described. The Typology Is Not Exclusively Designed To Mirror Classifications, But Is Offered As A Means To Analyze And Can Also Be Used In Practice As An Analytic Instrument: In Practice, Interventions Often Bridge Typologies

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And Good Programmes Deliberately Mix Typologies.

Table 1: Typology of pharmacist-led antimicrobial stewardship interventions across community and hospital settings

| Intervention category | Predominant setting | Illustrative pharmacist activities | Representative sources |
|---|---|---|---|
| Educational | Both | Prescriber academic detailing; patient counselling on appropriate use and course completion; public awareness campaigns and AMS materials. | Monmaturapoj et al. (2021); Sakeena et al. (2018) |
| Persuasive | Hospital | Prospective audit and feedback on active antimicrobial orders; advice on de-escalation, IV-to-oral switch, and duration. | Barlam et al. (2016); Dighriri et al. (2023) |
| Restrictive | Hospital | Formulary restriction; preauthorisation of broad-spectrum and last-line agents; enforcement of restricted-antimicrobial policies. | Barlam et al. (2016); Otieno et al. (2022) |
| Collaborative / interface | Both | Pharmacist–prescriber collaboration to optimise primary-care prescribing; structured GP–pharmacist interface roles. | Saha et al. (2019b); Saha et al. (2021) |
| Supply-point / public-facing | Community | Declining non-prescription supply; triage and referral; counselling at point of sale; gatekeeping inappropriate demand. | Saha et al. (2019a); Khan et al. (2016); Sarwar et al. (2018) |
| Structural / programmatic | Both | Pharmacist-led AMS programme design; decision support; national quality-scheme interventions; LMIC programme implementation. | Hayes et al. (2023); Otieno et al. (2022); St. Louis & Okere (2021) |

## V. THE STEWARDSHIP OF HOSPITAL PHARMACY PRACTICE

Among the components of the inpatient stewardship team, the pharmacist is always referred to as a linchpin of the team; and the hospital has the longest track record and most solid evidence base. A review of the evidence surrounding the effect of the clinical pharmacist on CPSP revealed that interventions such as prospective audit and feedback, intravenous to oral conversions, therapeutic drug monitoring and de-escalation are linked to positive changes in antimicrobial use and patient outcomes across various different types of CPSP (Dighriri et al., 2023). The range of activities included within that review highlights the importance of the pharmacist to the stewardship team the role requires clinical pharmacology skills, knowledge of the costs of the formulary and simply being close to the prescribing record.

Much of the education-based intervention literature provides illumination to the ways in which hospital pharmacists can gain these benefits. The implementation of pharmacist-led, education-based interventions coupled with an education-based stewardship support had a positive effect on meeting guidelines for antimicrobial prescribing and helped reduce the length of antimicrobial treatments, without increasing mortality, which is a key safety outcome since clinicians have often expressed concern that stewardship would deny patients needed treatment (Monmaturapoj et al., 2021). It's a frequent and soothing discovery in the hospital literature and

irrefutably one of the reasons the profession's pharmacists have an argument to advance their authority in stewardship teams: No mortality penalty occurs when they do so.

These interventions need to be organised reasonably, and IDSA/SHEA guidelines continue to serve as the reference on how this organisation, with pharmacist and physician co-leadership, can be appropriately designed: the interventions need to be formally structured, using a programme that involves a pharmacist and a physician, and continuous measurement of interventions needs to take place (Barlam et al., 2016). This distinction between the two types of interventions that have the most evidence prospective audit with feedback and preauthorisation is important for the pharmacist because both are activities in which the pharmacist is particularly suited – the former having to do with his/her review of currently active orders, and the latter being performed with a role as a formulary gatekeeper.

However, the amount of hospital evidence is not the same throughout the world. The majority of the literature from which the foundation is drawn comes from high income countries where programmes have been developed in more advanced stages, and where there is more well-staffed, well-skilled and well-resourced pharmacy departments as well as surveillance. It's not just the lack of actions that contributed to that imbalance, however, as a Systematic Review of pharmacist-led stewardship programmes in sub-sahara Africa directly addressed this issue, finding that pharmacist-led programmes were feasible, beneficial, but were limited as a result of the fewness of workers, limited diagnostic capacity, and no guidance for policy on the intervention (Otieno et al., 2022). Perhaps the most clear-cut example of the disparity documented in this review between the high income and sub-Saharan literatures is how few working days have been devoted to each aspect of the high-income literature compared to the sub-Saharan.

A conceptual case for the pharmacist as a stewardship agent, separate to any one programme, has been developed. A commentary on the role of pharmacists in stewardship programmes highlighted the key roles that pharmacists can play, recognizing that their unique role as both an expertise for pharmacology and knowledge of the local resistance patterns combined with their routine interaction with the medication-use process make them perfectly positioned to fill major roles in stewardship governance, instead of them being pushed aside to a supporting role (Garau & Bassetti, 2018). A point that will be stressed repeatedly in the present review: The greatest good for the pharmacist is in his having a defined role and authority versus being left to local decisions. When the authority of a pharmacist is not clear, then prescription recommendations benefit less, as the division of authority is not agreed upon but depends on the prescriber acceptance.

Emergency departments are especially important because the substantial numbers of people in the hospital when they seek treatment at the ED are likely to have acute medical problems that require antimicrobial treatment, often under high acuity conditions with a lack of diagnostic certainty. Thus, a systematic review and meta-analysis of pharmacist led stewardship in the ED suggested that pharmacist engagement was significantly linked to an increase in the appropriateness of antibiotic prescribing highlighting the potential for pharmacist stewardship in fast-paced, acute environments where there is a lot of opportunity for wrongdoing and limited opportunity for intervention (Kooda et al., 2022). Emergency department (ED) care is recognized as being at the intersection of the community and inpatient care, with the presentation to the ED being undifferentiated and the inpatient treatment journey starting within the ED, so stewardship in the ED has influence in both directions: impacting the initial treatment provided in the community, and impacting the next level of care.

5.1 Out Patient Hospitals

There are a number of ambulatory and outpatient hospital environments that exist between the inpatient ward and community pharmacy in which the stewardship of pharmacists is gaining momentum. Extending the evidence base to illustrate the effect of pharmacist stewardship beyond the more traditional inpatient location, a scoping review of antibiotic

stewardship programmes involving pharmacists in outpatient settings in the USA mapped the clinical effects of these programmes, identifying that pharmacists are involved in ambulatory/outpatient clinics and increasing prescribing appropriateness across a range of indications (St. Louis & Okere, 2021). There are a significant proportion of antimicrobial prescriptions (and inappropriate prescribing) made outside the hospital ward and this is important evidence as pharmacist-led review can be used at scale to improve the quality of antimicrobial prescribing in these locations.

5.2 The Student Will Discuss the Concept of Stewardship in Community Practice

Where stewardship has been the most studied it is in the hospital setting and where the potential of stewardship is least realised is in the community pharmacy. Community pharmacists are in a very accessible role as they interact with people without an appointment, advise on minor ailments and in many jurisdictions serve something of a de facto initial point of contact for infection which may, or may not, require antibiotics. In developing countries, the role of the community pharmacist, as a key contributor to addressing issues of AMR, has been argued for as increasingly non-prescription supply drives up demand, whilst other service providers are likely to be less accessible at community level (Sakeena et al., 2018).

Studies from the empirical literature mostly describe knowledge, attitudes and practices of community care, and a systematic scoping review of the literature revealed that community pharmacists tend to have positive attitudes toward stewardship and appreciate their potential role, but there are gaps in the knowledge, confidence and access to guidance and others applying their stewardship services which limit their participation. (Saha et al., 2019a) This is a common theme in the community pharmacy evidence (positive attitude, but surrounded by issues of practice and education) and highlights a key opportunity for change: specific education and practice-relevant and available stewardship tools.

As seen in national implementation efforts, using this lever can lead to the best results possible. A community pharmacy AMS intervention, introduced throughout England as part of the English Pharmacy Quality Scheme (English PQS), scaled up a structured and incentivised programme for engaging the community pharmacy workforce around AMS, and demonstrated the potential for system-level interventions to effectively involve the community pharmacy workforce in AMS in a coordinated way (Hayes et al., 2023). The case study is useful as an example of a financial and regulatory tool, in the form of a national quality scheme, combined with behaviour change directly at frontline, which can expand stewardship within the community beyond local efforts.

This picture is completed with a qualitative picture of the lived experience of community pharmacy teams that can be surfaced through qualitative evidence. A qualitative study conducted among community pharmacists in Jordan revealed high professional responsibility for antibiotic stewardship but a number of contextual factors that hinder implementation such as patient expectations, pressures on the bottom line and access to obtaining antibiotics over the counter exist at the community pharmacist level (Saleh et al., 2021). The perceptions and experiences of members of the community pharmacy team in Scotland were explored through complementary work which found that stewardship was seen as legitimate and worthwhile although members of the community pharmacy team needed more clarity with regard to their role, training and support to be able to practice stewardship consistently (Tonna et al., 2020). These studies demonstrate that the community pharmacy workforce is enthusiastic to contribute, although in a significant and important way, the numbers of providing the necessary resources.

## VI. KNOWLEDGE, ATTITUDES AND PRACTICES AMONG THE SETTINGS

There is a considerable amount of cross-sectional literature examining knowledge, attitudes and practices of community pharmacists in a variety of national settings, which is consistently highly uniform. Few studies focused on community pharmacists in the Malaysian context have investigated these factors, but Khan et al. had a study,

involving community pharmacists in Selangor, which noted overall positive perception of stewardship and practice gaps among community pharmacists in relation to the stocking and dispensing of antibiotics without prescription and consistency of patient counselling (Khan et al., 2016). A cross-sectional study in Punjab also showed that there was a high level of variation in knowledge about antibiotics and stewardship in Pakistan and that this was difficult to increase due to a lack of training and resources (Sarwar et al., 2018). A survey of community pharmacists in Tasmania, Australia revealed good attitudes among pharmacists towards formal stewardship activities but low implementation of it, with a lack of frameworks and financial incentive identified as a barrier (Rizvi et al., 2018).

Taken collectively, and in comparison, with other studies, it appears community pharmacists are broadly orientated towards stewardship, but are limited by recurring factors including the paucity of training in stewardship, the lack of practice guidance specific to the community setting, commercial pressures and the requirement for a remuneration system to recognise stewardship as a billable professional service. The resemblance of the pattern from high, middle and lower income areas indicates that the challenge to community pharmacy stewardship is largely systemic and not attitudinal, and that a systemic approach is more likely to be successful.

6.2 Implementation challenge

Time necessarily lags between positive attitudes, or belief, and behaviour, and that's the recognition gap; this is the hallmark of the stewardship literature of the community pharmacist. The gap between attitudes and action is best viewed as a gap in capability and never as a gap in motivation. In this way, capability refers to a product of knowing, opportunity, as well as structural permission to act. Evidence from all over the world demonstrates that knowledge can be taught (Khan et al., 2016; Sarwar et al., 2018), opportunity can be offered in the redesign of services and by protected time (Hayes et al., 2023) and structural permission can be granted through national stewardship programmes, which legitimise and reward stewardship activity (Hayes et al., 2023). If all three are available, then the passive aptitude of the community pharmacist turns into a routine practice, while in the absence of any, the willingness turns into occasional and unconsistent practice. In each country's context, the studies discuss in turn what happens when 'little will equal a lot of can' pharmacists say that they want to do more than they can. Each of the Australian, Scottish and Jordanian studies, in different ways, describe what happens when willingness exceeds capability pharmacists say they want more to do than they can do (Rizvi et al., 2018; Tonna et al., 2020; Saleh et al., 2021).

This is a rewording of what has a practical corollary. When we look at the specifics of the message, interventions which focus solely on motivation, such as raising aw areness or exhorting people to take action in the domain of stewardship are likely to frustrate expectations because motivation is not usually the limiting factor. Capability building interventions (the provision of capacity in terms of knowledge, opportunity and structural permission) are more likely to be successful. Particularly the best national ones have recognised this; they have combined educational content with an institutional arrangement which allows the desired behaviour and gives it reinforcement. For policy makers, it means to support a willing labor force at a lower rate of investment and higher rate when it comes to armament.

## VII. MODERATION WILL EXAMINE THE FACILITATORS AND BARRIERS TO IMPLEMENTING THE STRATEGY

The second review question revolved around factors affecting the uptake or maintenance of pharmacist-led stewardship. Determinants emerged four times in the evidence mapped on the chart: at an individual practitioner level; organisation level; interprofessional level and health system level. Individually it is knowledge and confidence that are the determining factor. The cross sectional literature always report the lack of stewardship knowledge to be a barrier to practice (Sarwar et al., 2018; Khan et al., 2016) and also a lack of stewardship confidence in practicing it. Education is thus one of the most

critical enabling factors to other interventions' success, yet it is also the most prevalent intervention. Repeatedly, at an organisational level are found structures, guidelines and time. Based on the mentioned requirements, hospital pharmacists must have a formalised programme of audit and feedback, established authority and time to complete it (Barlam et al., 2016; Dighriri et al., 2023). Community pharmacists need some easy-to-access guidelines suiting their context and importantly a service model that allows stewardship in a commercial context (Saha et al., 2019a; Rizvi et al., 2018). The English Pharmacy Quality Scheme provides a good example of this process of turning a latent desire into ground-truth engagement, with both organisational and financial structures in place. English Pharmacy Quality Scheme provides a good example of how an organisational and financial structure can turn a latent willingness into ground truth engagement (Hayes et al., 2023).

The inter-professional aspect relates to the relationship among pharmacists and prescribers and whether or not recommendations are implemented. Multiprofessional working between pharmacists and GP's to optimize prescribing requires trust between both professions and well clarified roles (Saha et al., 2019b). Based on the qualitative evidence, these relationships can be detrimental if they have role ambiguity and unclear boundaries between the professions, but become advantageous if roles are clearly defined (Tonna et al., 2020; Saleh et al., 2021). On the health-print, regulation, remuneration and capacity of health-workforces are primary. In sub-Saharan Africa, potential programmes are tooled down due to lack of workforce (Otieno et al., 2022) and in community settings globally, the lack of a stewardship remuneration model is always a barrier to potential programme development (Rizvi et al., 2018).

By chopping out the various facilitators and barriers across the charted evidence and connecting them to the evidence as described specifically in the sources and mapped to policy and practice implications, Table 2 synthesises the content.

Table 2: Multilevel facilitators of and barriers to pharmacist-led antimicrobial stewardship, with implications for practice

| Level | Facilitators | Barriers | Implications & sources |
|---|---|---|---|
| Individual practitioner | Stewardship knowledge; confidence to intervene; positive professional attitudes. | Knowledge and confidence gaps; uncertainty about appropriate action. | Prioritise targeted, practice-relevant education (Khan et al., 2016; Sarwar et al., 2018). |
| Organisational | Formal programmes; accessible guidelines; protected time; incentive schemes. | Absent structures; commercial pressures; competing workload. | Embed stewardship in routine workflows and quality schemes (Hayes et al., 2023; Dighriri et al., 2023). |
| Inter-professional | Pharmacist–prescriber trust; clear role definition; collaborative models. | Role ambiguity; contested professional boundaries. | Define interface roles and collaborative pathways (Saha et al., 2019b; Tonna et al., 2020). |
| Health system | Enabling regulation; remuneration; adequate workforce; surveillance. | No remuneration model; workforce shortages; weak policy frameworks; non-prescription supply. | Align funding and regulation with stewardship goals (Rizvi et al., 2018; Otieno et al., 2022; Saleh et al., 2021). |

## VIII. THE RESULTS OF PHARMACIST-LED STEWARDSHIP

The third question in the review was related to the findings based on the evidence. These fall under 3 domains: Clinical & Microbiological outcomes, Antimicrobial-use & behavioural outcomes and Organisational & economic outcomes. The outcomes reported in the hospital setting the most consistently are reductions in antimicrobial consumption, and in the length of therapy, without a concomitant increase in death or treatment failure (Monmaturapoj et al., 2021; Dighriri et al., 2023). The factors of exposure reduction and safety are the factors that make this combination the most important result signal in hospital stewardship, and the basis of the role of pharmacists in the professional and economic sustainability in the hospitals.

The vast majority of literature in the community and the primary-care setting focusses on behavioural outcomes, which refers to changes in prescribing and dispensing behaviours. Collaborative working between a pharmacist and GP is related to better antibiotic prescribing for appropriateness (Saha et al., 2019b) and pharmacist activity in the outpatient setting has been associated with greater guideline-concordant prescribing for a variety of indications (St. Louis & Okere, 2021). Within the community, behavioral outcomes are often reported as changes in dispensing practice such as the decrease in the dispensing without prescription or increase in adequate counselling and referral but this is mostly reported by self-report or qualitative measures rather than through hard endpoints (Saha et al., 2019a; Khan et al., 2016).

There is also (less consistent) reporting of organisational and economic outcomes which, more and more focus is paid to these. The clinical effects of antimicrobial stewardship by the systemical review of antimicrobial stewardship roles of a pharmacist were well documented in the reduction of antimicrobial use, which is clearly associated with economic implications, mainly related to the cost of broad-spectrum and last-line agents and the cost of resistance-associated complications (Dighriri et al., 2023). Outcomes of a national programme (e.g. the English Pharmacy Quality Scheme) are organisational system level and are not only Clinical outcomes, but also the elements of coverage, reach, and embedding stewardship into routine practice (Hayes et al., 2023). However, there are some gaps to be filled, most notably, the quantifications of the cost-effectiveness of pharmacist stewardship, especially in community, are under-researched.

A cross-cutting observation is that outcome reporting is variable and often is expressed in a different way (setting-specific) across components, making synthesis and comparison difficult. Studies conducted in hospital settings are more likely to report antimicrobial-use variables and clinical outcomes, while community studies are more likely to report knowledge, attitudes and self-reported antimicrobial use practices; and few studies encompass both antimicrobial-use variables and clinical outcomes in both hospital and community settings. But that's a discovery: that there aren't standardised, transferable outcome measures in different settings makes it difficult for the field to show that the sector has being collectively contributing to good results in terms of containment of AMR, and to compare interventions on a common basis.

It is important to also differentiate the proximal and distal consequences. Proximal outcomes – change in prescribing appropriateness, antimicrobial consumption and duration of antimicrobial treatment can be measured directly and are reasonably confident that these changes are attributed to the intervention. Distal outcomes decreases in resistance rates, decreases in resistance-associated mortality, and cost savings in health care are the ultimate goals of stewardship, but are affected by a plethora of factors often unrelated to any one stewardship action and with extended timelines. The vast majority of the charted evidence is proximal, which is okay because of challenges of attribution, but what will make the case for stewardship stick with decision makers is establishing a proximal-to-distal relationship between these benefits and other endpoints of stewardship. Establishing that causal chain from changed prescribe to decreased resistance, to decreased cost – is one of the most significant methodological challenges for

the field and is one in which the kind of standardised, longitudinal measurement largely lacking is needed.

## IX. DISCUSSION

This scoping review identified, charted and summarized the current AMR and AMS evidence in community and hospital settings in three areas: AMR and AMS intervention nature, determinants of AMR and AMS intervention implementation and the outcomes from AMR and AMS interventions. Three main observations have been made. First, the nature of pharmacists' stewardship role varies according to the setting, hospital pharmacists can impact stewardship at the prescribing level via audit, restriction and optimisation while community pharmacists can impact stewardship in terms of supply, demand, and public understanding. Understanding this complementarity is crucial to preparing stewardship programs that utilize the full scope of the profession, not just hospital and community so as to stand alone.

Second, the factors influencing implementation to a large degree are structural in nature. The common issues are not the attitudes of pharmacists as they are always positive, but the lack of enablement as failing to have the necessary programmes, guidelines, protected time, inter-professional roles, remuneration, and policy structures in varied contexts. This discovery red scarfs the policy enter. The challenge is not so much whether pharmacists will become involved in stewardship, but about creating the conditions in which they can. Such structures are possible and are capable of mobilising the workforce at a National level as evidenced by the English Pharmacy Quality Scheme (EPQS) (Hayes et al., 2023).

Thirdly, the evidence isn't always available. It is concentrated in high-income hospital settings where it exists as well as the programmes and surveillance structures needed for rigorous evaluation of the AMR burden and where non-prescription supply is relatively sparse, and is comparatively weak in community settings and in low- and middle-income countries, where the burden of AMR is heaviest and non-prescription supply is most prevalent (Antimicrobial Resistance Collaborators, 2022; Otieno et al., 2022). This is the one most important gap in distribution of evidence vs distribution of need that came to mind from this review.

### 9.1 Policy implications

Several implications follow. The evidence is provided as evidence for practice, and supports multiple interventions that include education with audit, restriction or collaborative review. In terms of policy, the evidence indicates three key issues: to make investment in practice-relevant stewardship education for pharmacists in all settings more attractive; to standardise remuneration and service models for pharmacists that recognises stewardship as a billable professional activity, especially in community pharmacy; and to extend the development of structured national programmes, based on those which have proven to be effective in terms of reach, to mobilise the community workforce. In low- and middle-income contexts, the key priority is underpinning the pharmacist stewardship with infrastructure development, including: Pharmacist workforce, diagnostic infrastructure, and policy infrastructure (Otieno et al. 2022, Sakeena et al. 2018).

### 9.2 Limitations

The design and scope of this review has its limitations. In a scoping review, methodological quality of the studies and/or pooled effects are not evaluated as they are in a traditional review, nor is the review used to draw conclusions regarding effectiveness of specific interventions; hence, the descriptive synthesis does not conclude about effectiveness of specific interventions. The literature was limited to publications that occurred before the 2025 year and because of charted studies' differences in outcome reporting, direct comparisons are limited. Finally, the charted evidence is drawn from high-, middle-, and low-income hospital settings, but the underpinning literature is evenly more drawn to high-income contexts of hospital placement, and the findings to be read accordingly.

### 9.3 Future Directions Research

The gaps in the field of employability for young people in Europe led to the identification of four

research priorities. Firstly, well-established, portable outcome assessment tools are required to align hospital and community contexts and provide the opportunity to count on a community-wide basis the value added by pharmacy's contributions. Second, there needs to be strong economic evaluation of such remuneration models as they have been highlighted by the evidence as being a structural barrier, especially in the clinically challenging community setting. Third, implementation research of national quality schemes or other structural interventions to investigate how they can be adapted to different health systems, particularly in low and middle-income countries is required. Fourth, there is a need for more primary research in setting contexts that are most severely impacted by AMR, making headway on the current lack of alignment between settings of AMR stewardship research and of impact.

## X. CONCLUSION

Pharmacists are located throughout the health care continuum and are well placed to be part of a response to antimicrobial resistance, which is a growing and enduring challenge to the world's health. Pharmacist-led stewardship interventions including educational, persuasive, restrictive, collaborative, and structural interventions had a positive effect on antimicrobial use in both community settings and hospitals with interventions in hospitals being most consistently associated with reduced consumption and duration of therapy without impacting on safety, while interventions in community settings were most strongly associated with better appropriate supply, public awareness and referral. Structural factors (willingness, programme/guidelines, compensation, inter-professional definition, policy support) are critical, more so than attitudinal factors, for success. The evidence is still very variable, and is largely based on hospital settings and settings of and for the high burden low income countries compared to the community level and/or community pharmacy settings and contexts. This will need standardisation of pharmacy's outcome reporting, continuity in funding, increased scope of practice limits and a targeted realignment of research efforts to the location where there is the greatest need. Spread across the patient journey is the profession's unique strength and harnessing that strength is one of the most achievable avenues of the world's work to tackle ARM.

## REFERENCES

[1] Antimicrobial Resistance Collaborators. (2022). Global burden of bacterial antimicrobial resistance in 2019: A systematic analysis. The Lancet, 399(10325), 629–655. https://doi.org/10.1016/S0140-6736(21)02724-0

[2] Barlam, T. F., Cosgrove, S. E., Abbo, L. M., MacDougall, C., Schuetz, A. N., Septimus, E. J., Srinivasan, A.,

[3] Dellit, T. H., Falck-Ytter, Y. T., Fishman, N. O., Hamilton, C. W., Jenkins, T. C., Lipsett, P. A., Malani, P. N., May, L. S., Moran, G. J., Neuhauser, M. M., Newland, J. G., Ohl, C. A., … Trivedi, K. K. (2016). Implementing an antibiotic stewardship program: Guidelines by the Infectious Diseases Society of America and the Society for Healthcare Epidemiology of America. Clinical Infectious Diseases, 62(10), e51–e77. https://doi.org/10.1093/cid/ciw118

[4] Dighriri, I. M., Alnomci, B. A., Aljahdali, M. M., Althagafi, H. S., Almatrafi, R. M., Altwairqi, W. G., Almagati, A. A., Shunaymir, A. M., Haidarah, G. A., Alanzi, M. H., Hadadi, A. A., Suwaydi, H. M., Aqdi, M. J., Alharthi, H. N., & Alshahrani, A. F. (2023). The role of clinical pharmacists in antimicrobial stewardship programs (ASPs): A systematic review. Cureus, 15(12), e50151. https://doi.org/10.7759/cureus.50151

[5] Garau, J., & Bassetti, M. (2018). Role of pharmacists in antimicrobial stewardship programmes. International Journal of Clinical Pharmacy, 40(5), 948–952. https://doi.org/10.1007/s11096-018-0675-z

[6] GBD 2021 Antimicrobial Resistance Collaborators. (2024). Global burden of bacterial antimicrobial resistance 1990–2021: A systematic analysis with forecasts to 2050. The Lancet, 404(10459), 1199–1226. https://doi.org/10.1016/S0140-6736(24)01867-1

[7] Hayes, C. V., Parekh, S., Lecky, D. M., Loader, J., Triggs-Hodge, C., & Ashiru-Oredope, D. (2023). The national implementation of a community pharmacy antimicrobial stewardship intervention (PAMSI) through the English Pharmacy Quality Scheme 2020 to 2022. Antibiotics, 12(4), 793. https://doi.org/10.3390/antibiotics12040793

[8] Khan, M. U., Hassali, M. A. A., Ahmad, A., Elkalmi, R. M., Zaidi, S. T. R., & Dhingra, S. (2016). Perceptions and practices of community pharmacists towards antimicrobial stewardship in the state of Selangor, Malaysia. PLoS ONE, 11(2), e0149623. https://doi.org/10.1371/journal.pone.0149623

[9] Kooda, K., Canterbury, E., & Bellolio, F. (2022). Impact of pharmacist-led antimicrobial stewardship on appropriate antibiotic prescribing in the emergency department: A systematic review and meta-analysis. Annals of Emergency Medicine, 79(4), 374–387. https://doi.org/10.1016/j.annemergmed.2021.11.031

[10] Monmaturapoj, T., Scott, J., Smith, P., Abutheraa, N., & Watson, M. C. (2021). Pharmacist-led education-based antimicrobial stewardship interventions and their effect on antimicrobial use in hospital inpatients: A systematic review and narrative synthesis. Journal of Hospital Infection, 115, 93–116. https://doi.org/10.1016/j.jhin.2021.06.003

[11] Otieno, P. A., Campbell, S., Maley, S., Obinju Arunga, T., & Otieno Okumu, M. (2022). A systematic review of pharmacist-led antimicrobial stewardship programs in sub-Saharan Africa. International Journal of Clinical Practice, 2022, Article 3639943. https://doi.org/10.1155/2022/3639943

[12] Rizvi, T., Thompson, A., Williams, M., & Zaidi, S. T. R. (2018). Perceptions and current practices of community pharmacists regarding antimicrobial stewardship in Tasmania. International Journal of Clinical Pharmacy, 40(5), 1380–1387. https://doi.org/10.1007/s11096-018-0701-1

[13] Saha, S. K., Barton, C., Promite, S., & Mazza, D. (2019a). Knowledge, perceptions and practices of community pharmacists towards antimicrobial stewardship: A systematic scoping review. Antibiotics, 8(4), 263. https://doi.org/10.3390/antibiotics8040263

[14] Saha, S. K., Hawes, L., & Mazza, D. (2019b). Effectiveness of interventions involving pharmacists on antibiotic prescribing by general practitioners: A systematic review and meta-analysis. Journal of Antimicrobial Chemotherapy, 74(5), 1173–1181. https://doi.org/10.1093/jac/dky572

[15] Saha, S. K., Kong, D. C. M., Thursky, K., & Mazza, D. (2021). Antimicrobial stewardship by Australian community pharmacists: Uptake, collaboration, challenges, and needs. Journal of the American Pharmacists Association, 61(2), 158–168.e7. https://doi.org/10.1016/j.japh.2020.10.014

[16] Sakeena, M. H. F., Bennett, A. A., & McLachlan, A. J. (2018). Enhancing pharmacists' role in developing countries to overcome the challenge of antimicrobial resistance: A narrative review. Antimicrobial Resistance & Infection Control, 7, Article 63. https://doi.org/10.1186/s13756-018-0351-z

[17] Saleh, D., Abu Farha, R., Mukattash, T. L., Barakat, M., & Alefishat, E. (2021). Views of community pharmacists on antimicrobial resistance and antimicrobial stewardship in Jordan: A qualitative study. Antibiotics, 10(4), 384. https://doi.org/10.3390/antibiotics10040384

[18] Sarwar, M. R., Saqib, A., Iftikhar, S., & Sadiq, T. (2018). Knowledge of community pharmacists about antibiotics, and their perceptions and practices regarding antimicrobial stewardship: A cross-sectional study in Punjab, Pakistan. Infection and Drug Resistance, 11, 133–145. https://doi.org/10.2147/IDR.S148102

[19] St. Louis, J., & Okere, A. N. (2021). Clinical impact of pharmacist-led antibiotic stewardship programs in outpatient settings in the United States: A scoping review. American Journal of

Health-System Pharmacy, 78(15), 1426–1437. https://doi.org/10.1093/ajhp/zxab178

[20] Tonna, A. P., Weidmann, A. E., Sneddon, J., & Stewart, D. (2020). Views and experiences of community pharmacy team members on antimicrobial stewardship activities in Scotland: A qualitative study. International Journal of Clinical Pharmacy, 42(5), 1261–1269. https://doi.org/10.1007/s11096-020-01042-z

[21] World Health Organization. (2015). Global action plan on antimicrobial resistance. World Health Organization. https://www.who.int/publications/i/item/9789241509763