INTRODUCTION

Antimicrobials are one of the most important therapeutic classes of drugs, with the increasing emergence of resistance threatening their efficacy. Health care institutions are faced with the challenge of treating and preventing infections while reducing the emergence and spread of further resistance. The scientific literature is awash with reports of interventions deployed to address the problem of antimicrobial resistance.\(^1\)

Across the globe, concerned public health and governmental institutions are contributing to the debate on how best to tackle antimicrobial resistance by publishing reports, recommendations, and guidance.\(^2\)–\(^5\)

Despite the emergence of resistance limiting the efficacy of many existing antimicrobial agents and the international interest in this field, there is limited incentive for pharmaceutical companies to invest resources in discovering new antimicrobials.\(^6\)

The lack of new agents and increasing resistance to existing therapeutic options means that conservation of antimicrobials is pivotal to current efforts to treat microbial infections alongside interrupting transmission through effective infection prevention.
To this end, antimicrobial stewardship programs aim to give structure and direction to health care institutions trying to adopt a proactive approach to tackling resistance through the prudent use of antimicrobials.

Antimicrobial stewardship describes a host of initiatives designed to optimize the use of diagnostic and laboratory techniques to detect infections and ensure prompt, targeted, and appropriate antimicrobial therapy. Arguably, the aim of all the interventions in antimicrobial stewardship programs is to change behaviors of health care professionals to conserve the efficacy of existing antimicrobial agents while decreasing avoidable harm, including the emergence and transmission of resistance. The focus of this article is on the behavior change elements of antimicrobial stewardship programs.

THE KEY STAKEHOLDERS

The Role of Clinicians

What sets treatment of infections apart from other specialties is the universality of community- and health care–acquired infections. Individuals are at risk of being admitted to a hospital with an infection or acquiring an infection during a health care interaction. The responsibility for the treatment of that infection falls on whichever team of health care providers is responsible for the management of a patient. In many instances, infections are secondary to other medical diagnoses. This means that although medical microbiology and infectious diseases specialties are dedicated to the treatment of infections, in reality health care professionals across all specialties are required to be able to promptly diagnose and treat infections.

Effective stewardship programs should be integrated into existing medical specialties and perhaps led by local noninfection specialist champions. To facilitate acceptance of and adherence to local guidelines implemented as part of a stewardship program, it is necessary to involve opinion leaders within clinical specialties in the development and adoption of evidence-based recommendations. It is important to recognize the factors that will incentivize noninfection specialist health care professionals to change their antimicrobial prescribing behaviors. Research indicates the existence of a set of cultural rules, or a prescribing etiquette, that determines antimicrobial prescribing.

According to these rules, health care professionals adhere to locally drawn lines of authority when it comes to prescribing decisions for their patients and often base decisions on the experience of seniors in their field instead of adhering to antimicrobial stewardship guidelines set by infection specialists. This is to be expected because decision making in medicine is reliant on the experience of individual health care professionals, and the interpretation of evidence-based information requires human judgment. Therefore, an incentive to change behaviors in prescribing may be to acknowledge local hierarchies and include opinion leaders within medical specialties in setting up policies and guidelines in prescribing. This is particularly important because not all health care organizations have access to on-site infection specialists and microbiology laboratories. Interventions targeting antimicrobial prescribing behaviors need to be more inclusive and engage with all disciplines within medicine and the wider health care professional workforce.

Engaging Nursing in Antimicrobial Stewardship

Many innovative approaches have been advocated as effective solutions to the problem of delivering health services in areas with limited human resources. The World Health Organization (WHO) task shifting initiative encourages nurses to assume skills
and develop roles traditionally held by other professionals. Compelling examples of benefits achieved by these initiatives can be found, particularly in HIV and tuberculosis programs. With adequate training, support, and supervision, nurses can manage complex therapeutic regimens and provide cost-effective, quality care. Thus, it seems logical to take advantage of these experiences and incorporate them within the antimicrobial stewardship agenda.

Currently, the nursing presence in antimicrobial stewardships initiatives remains modest and seems limited to on-the-ground infection prevention and control roles. The implications for the increased involvement of nurses are profound, in particular as their role as organizational knowledge brokers is recognized.

Nurses can serve as repositories of antimicrobial knowledge; they can influence the antimicrobial decisions of other clinicians; and they can collect and evaluate clinical data to inform antimicrobial use. Policy makers and commissioners interested in increasing the involvement of nurses in antimicrobial stewardship programs can adopt different strategies: for example, they can opt to introduce new roles where particularly experienced and highly expert nursing individuals act as antimicrobial stewardship consultants, bridging the evidence regarding optimal antimicrobial use to the nursing sphere of practice, they may also encourage the wider adoption of increased antimicrobial stewardship skills and responsibilities for all nurses, focusing on core competencies acquired, for example, during prequalifying education.

**Pharmacists and Antimicrobial Stewardship**

The role of hospital pharmacists in antimicrobial stewardship programs needs to be made more prominent on an international level. In some health care settings, the role of the hospital pharmacist in stewardship activities is well established; however, there are still health care systems and models within which pharmacists play a more traditional role and are not integrated into stewardship practices. The knowledge and experience of pharmacists in delivering safety and quality improvement initiatives should be used in the clinical setting to ensure that antimicrobial therapies are prescribed optimally and that stewardship programs are delivered. Pharmacists are pivotal to patient safety pathways and often are in charge of the design and development of decision architectures in prescribing (eg, redesigning medication charts and setting up electronic prescribing systems). Using pharmacy resources across specialties can help augment the organizational efforts in optimizing antimicrobial usage.

To put these staff resources to optimal use, it is important to understand, work with, and shape the cultural and social rules that dictate the dynamics of how health care professionals interact with one another. Across the globe, health care organizations are working in greater multidisciplinary environments, and the key to successful teamwork requires an understanding of the champions and opinion leaders within clinical groups, who can then become engaged in stewardship activities and be encouraged to lead local interventions.

**Patient and Public Involvement**

Antimicrobial prescriptions, in community settings, where the bulk of prescribing occurs, are frequently issued in response to demands from patients rather than as clinical necessities. Prescribers may feel the urge to use antimicrobials as a quick and nonconfrontational resource to end a consultation, particularly at times of increased workload and demand, rather than investing time engaging in preventive or educational activities with their patients.
It is essential to equip patients with the necessary skills and confidence to identify when antimicrobials may be inappropriate and alternative self-care measures preferred. Different strategies have attempted to shape patient behavior in relation to antimicrobials. For example, national awareness campaigns have shown a reduction in the volume of antimicrobials demanded by patients.\textsuperscript{19,20} If patients are to be empowered to make effective decisions about antimicrobials, interventions need to be mindful of patient perceptions and expectations. For patients’ participation to be successful, their need for involvement has to be made clear and adequate support provided to both patients and health care professionals. Support can include educational material, such as leaflets, nonprescription pads, or placebo alternatives to antimicrobials, such as Thailand’s Antibiotics Smart Use Program, where, as part of a national stewardship initiative, rather than antimicrobials patients are given an evidence-based herbal remedy for simple colds and coughs.\textsuperscript{21}

**BEHAVIOR CHANGE INTERVENTIONS**

A Cochrane review evaluating interventions to improve antimicrobial prescribing, which included 89 studies from 19 countries, found that a range of interventions has demonstrated success in bringing about improvement in antimicrobial prescribing in hospitals.\textsuperscript{1} Overall, restrictive interventions were found more successful in the short term. This review found little evidence, however, comparing different types of interventions, and the majority of studies provided minimal insight into the sustainability and unintended consequences of the interventions described. Furthermore, the studies published to date have not assessed the utility of applying behavior change science to the design, implementation, and evaluation of any interventions antimicrobial prescribing.\textsuperscript{1,22} This is while evidence from qualitative studies in antimicrobial prescribing describe the impact of behavioral determinants and etiquette on prescribing.\textsuperscript{8,22} Further studies are necessary to evaluate the differences in efficacy between various stewardship interventions and the impact of inclusion of behavior change theory into the development and implementation of interventions. Future systematic reviews in antimicrobial prescribing need to assess interventions against these crucial criteria. To manage the myriad interventions used within stewardship programs, interventions should become a core component of patient safety programs across health care systems.\textsuperscript{25} To embed interventions into patient safety programs successfully, there needs to be a greater understanding of the prevailing systems and cultures in order that new interventions are integrated into existing decision architecture and pathways.\textsuperscript{24}

The use of technology to change behavior in health care is receiving increased attention.\textsuperscript{1} Anything from electronic prescribing to bespoke clinical decision support tools to mobile health systems is currently used in efforts to deliver antimicrobial stewardship interventions. There is no conclusive evidence as to the impact of using different technologies in delivering antimicrobial stewardship programs or the superior efficacy of using these systems over more simple interventions. Although using existing technology has benefits of reaching a bigger audience and easier dissemination of information, technological complexity may hinder uptake of interventions. In the global and local contexts, interventions must be developed to provide information at the lowest level of available technology.

**A GLOBAL APPROACH TO STEWARDSHIP**

It is important to put the efforts that are carried out in health care organizations into the wider context of the challenge of antimicrobial resistance and health care acquired infections.\textsuperscript{2–4} The determinants of antimicrobial prescribing are present at
many levels from the local to the global. A majority of the world population does not have access to adequate health care. Stewardship interventions need to take into account human factors and the local cultural and societal determinants of antimicrobial prescribing. Access to and the use of antimicrobials is not standardized across the globe, which is one of the key reasons for the rapid and devastating spread of antimicrobial resistance. To truly tackle the problem, there needs to be a global effort to shift attitudes toward optimizing the use of antimicrobials to conserve their efficacy.

An example of a successful initiative in a resource-limited setting is the accredited drug dispensing outlet model in Tanzania and Uganda whereby nonprofessional practitioners are trained to provide medications and education about these agents in remote areas where few pharmacies exist. This kind of approach across health systems to address antimicrobial stewardship illustrates the systems-thinking approach advocated by the WHO to antimicrobial resistance that takes into consideration the needs of the communities and tries to address the barriers to implementing optimized practice. The key message for all health systems implementing systems to ensure access to effective antimicrobial interventions has to be to look for simple solutions that address local cultures and can be scaled up to become self-sustainable. To address local cultures, there needs to be engagement with the wider frontline health care professional workforce.

In addition, governments should be looking increasingly to introduce strategies to tackle antimicrobial usage not only for human consumption but also for animal consumption. The incentives of antimicrobial usage are different in the agriculture and farming industry, where there is a financial incentive for use of antimicrobials to maximize profits. In these sectors, there needs to be a better understanding of the measures required to incentivize the farming and veterinary industries to change their antimicrobial consumption patterns, which can be done through advocacy, policy change, fiscal measures, and the establishment of minimum standards of practice.

SUMMARY

Emerging evidence suggests that antimicrobial prescribing behaviors are influenced by local culture and a prescribing etiquette that is understood and abided by all health care professionals. The specialist antimicrobial stewardship team model is only one of many approaches. Local cultural unspoken rules often play a more pivotal role than the recommendations of guidelines and policies drawn up by experts in deciding antimicrobial prescribing behaviors. Therefore, to implement successful interventions it is important to recognize the key drivers of prescribing behaviors and the incentives to alter behaviors and to incorporate these into stewardship programs. Additionally, the influence of frontline health care professionals, such as pharmacists and nurses, on antimicrobial prescribing needs to be developed further to increase the effectiveness of stewardship interventions. Antimicrobial stewardship needs to become a core element of patient safety programs in different health care settings. This review summarizes some key concepts in behavior change in antimicrobial prescribing and the gaps that exist in trying to address behavior change in this field. Although the focus is the use of antimicrobials in health care, it is important to not lose sight that antimicrobial use in humans is only part of the larger-scale ecology of antimicrobial resistance. To address stewardship on a global scale, research into the incentives and behavioral determinants of antimicrobial consumption in the veterinary and farming industry needs to be conducted parallel to the work in human medicine.
This research will close the stewardship loop across the different health care settings and sectors.

REFERENCES


