The Role Of Pharmacists In Antimicrobial Stewardship Programs: Strategies For Optimal Antibiotic Use

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1. Introduction to Antimicrobial Stewardship Programs

Antimicrobial stewardship programs (ASPs) are working in practice and industry to ensure the choices concerning medicines for infection that are made will function. This implies providing the antibiotic that is just appropriate at the proper dose for no longer than necessary. Having a "diagnosis" - whether or not the patient has a real viral or bacterial infection, and if so - what antibiotics will function - it will help. Patients who have a bacterial infection can heal more rapidly and have fewer symptoms, and can keep free from antibiotics that they do not require and their possible side effects. Multidrug-resistant (MDR) bacterial illnesses are difficult to manage since they often need antibiotics that are unknown and costly. Therefore, the globe faces a very huge concern as antibiotic resistance escalates. A crucial component of ASPs is limited use of antibiotics and discovering methods to practice pharmacists to be the main drivers in managing antibiotic demand.

In prescribing and using antibiotics optimally, the importance of the clinical pharmacist has long been recognized. The goals of the antimicrobial stewardship programs (ASPs) are to minimize the danger of spreading an infection, decrease the risk of promoting vulnerability, ensure that the true disease identification is accurate, and eventually reduce the adverse consequences of antibiotics. There are several hurdles to implementing an ASP, but the primary strategy for controlling the problems in clinical practice and clinical research is recognized as controlling the drug of the first option for the empirical antibiotic. However, recent studies support that it is possible to make the collaborative

strategy for more. A systematic review was done to gather quality information from controlled clinical trials to evaluate the implications and effectiveness of pharmacists' involvement in verbal communication with therapy management of patients undergoing antimicrobial treatment within an already established ASP in hospitals.

1.1. Definition and Importance of Antimicrobial Stewardship

Antimicrobial stewardship (AMS) is defined as 'an organisational or healthcare facility-wide program that applies scientifically sound strategies to optimise the treatment of infections. The goal is to improve patient outcomes from infection, minimise the health burden of untreatable infections, and reduce overall costs from unnecessary antimicrobial prescriptions. Activities may include ongoing evaluation to help practitioners improve decision-making and educate patients and families about the principles of appropriate antimicrobial use. The ultimate aim is to protect public health by improving the quality of life for patients and the safety of healthcare systems'. AMS strategies emphasise the promotion of appropriate antibiotic use as well as limiting the selective pressure for antimicrobial resistance. Through promoting the rational use of antimicrobial agents, AMS is seen as an important strategy in the initial combat against antimicrobial-resistant organisms. (Le et al., 2019)(Herranz-Alonso et al.2019)

The emergence of antibiotic resistances represents a challenge leading to increasing morbidity, mortality, and healthcare expenditure in daily clinical practice all over the world. The World Health Organization (WHO) has initiated a general campaign against antimicrobial resistance. This is an essential and important challenge for pharmacists to develop strategies for containing resistance in national, regional, and local antimicrobial stewardship programs (ASPs). The primary goal of any antimicrobial stewardship program is to maximize patient outcomes. The development of ASPs is considered as a basic requirement in healthcare. It encourages the stewardship of finite resources and prevents other negative consequences of antimicrobial use. An antimicrobial steward seeks to provide optimal clinical outcomes related to antimicrobials while minimizing unintended consequences such as toxicities and selection of resistant cells.

2. The Global Challenge of Antimicrobial Resistance

Antimicrobial resistance (AMR) constitutes one of the gravest threats to public health globally. The incidence of AMR can be partly ascribed to the reducing levels of antimicrobial discovery and new antimicrobial approvals. Also, the problem is compounded by the inappropriate use of antimicrobials as well as the misuse of these medications. The phenomenon of AMR is affected by behavioural, policy, and ecological factors, among others. As a result of the complex interplay of these determinants, AMR is observed to be a cross-cutting issue which does not confine itself to human health concerns alone. It is established that the use of antimicrobials exerts a direct impact on other humans, animals, and the environment. (Salgado et al.2019)(Trenfield et al.2)

The most effective strategy that has been proposed for combating the emergence and the spread of AMR involves the implementation of specific antimicrobial stewardship programs. These bodies present an effective measure for addressing the phenomenon by limiting the development of resistance while enhancing the proper use of antimicrobials and improving overall patient outcomes. Pharmacists are recognized as the leading clinicians who can significantly contribute to the successful implementation of antimicrobial stewardship programs. In addition, these clinicians have been identified to have a role to play in the extension of the lifespan of current antimicrobials to pave the way for the possibility of developing new drugs.

2.1. Factors Contributing to Antimicrobial Resistance

Resistance to antimicrobials (both antibacterial and antifungal) is one of the most significant threats to public health identified by global health organizations. This resistance has been observed since the introduction of antibiotics but continues to increase due to a combination of genetic and environmental factors that are complex, multifactorial, and not entirely known. Factors contributing to antimicrobial resistance can either be encoded in the genome of microorganisms or can develop during therapy and are classified below: (Stranges et al. 2019)(Khan et al. 2019)

I. Underlying conditions (Disease) II. Co-infections and patient comorbidities (1) Heterogeneous pathophysiological effects, affecting PBPK (e.g. acute and chronic widespread inflammation, sepsis) (2) Nutritional status (3) Microbiome and infection with other microorganisms III. Adaptation and de novo mutations in the

drug target and/or in other life-important cellular processes (4) Selection by antimicrobial therapy (4a) Infections in immune-compromised patients (4b) Infections in immune-competent patients (5) Mutations leading to low drug target binding affinity (6) Mutations leading to complete loss of drug target binding affinity (7) Changes at cell envelope and transport of the drug IV. Genetics and genomics (8) Bacterial species and genotype-specific genetic makeup, genomic plasticity, and intrinsic/acquired genetic determinants that contribute to lower antimicrobial susceptibility Factors related to the drug (e.g. kinetics and potency) V. Molecular diversity VI. Drug concentration and exposure (9) Sub-inhibitory exposure (10) Selection for resistant mutants due to sub-lethal drug exposure in vivo (11) Intracellular persistence/surviving (I/S) sub-populations (12) Regrowth of pre-existent susceptible mutants at the end of antimicrobial therapy Factors within the host VII. Drug distribution in the body, drug interactions, and pharmacogenomics.

While the section discusses the factors contributing to antimicrobial resistance, which are quite numerous, in the section of Abbreviation: ABSSSIs, acronym for Acute Bacterial Skin and Skin Structure Infections. Changing the factor related to the drug is repeated with a change of small bullets.

In the section preceding, I. Underlying conditions (Disease), the antibiotic concentrations about the sepsis support density of the last line of paper P.533. In the same paper, the figure of IL-6 levels showing median and interquartile range about the sepsis death data was also strongly supported to explain the characteristics of the patients who died from sepsis. To the best of our knowledge, few studies have examined the relationship between worsening of the patients with respect to the three facilities and hospital policy for sepsis. We also could not evaluate the association between SOFA score decreased from the time point of the blood collection and the change of the antibiotic concentrations after the blood collection. We suggest that the results of these studies must be analyzed with a greater cohort and would be informative to discuss whether these results lead to changes in the guideline in Japan.

3. Pharmacists as Key Players in Antimicrobial Stewardship

Pharmacists have played a major role in antimicrobial stewardship (AMS) since the early 2000s due to their knowledge of drugs and their utilization. The spectrum of optimized activities comprises

assisting in antibiotic selection, dosing, and route of administration, providing cost-effective medication management, conducting daily patient evaluations, and participating in AMS programs (ASPs). Consequently, their responsibilities correspond to activities, such as optimizing the pharmacists' therapeutic, condemned for optimal outcomes in the prevention or therapy of medication treatment, and to share to stop the emergence of resistance. (Salgado et al. 2019)(Ameri et al. 2019)(Westerlund & Marklund, 2019)

To optimize their care and lessen cost, pharmacists with AMS ability may furnish physical structure and clinical facility and might have enterprise time within community. Antimicrobial issuance for a few infectious is directed with the aid of information of microorganism feature for characters/browse and form of an immune reply from come contaminated hosts. Greater data is required in order to decide pharmacists' function in every of the 7 core actions, and to decide the effect of lumber of hurt to benefits in AMS. Furthermore, an assortment of abilities used to be used actions hold out by way of pharmacists and the place of pharmacists in the hospital are required for incorporation of conserved activities. Such desk look at guidelines can promote definition of the roles and tasks of staff to guide the implementation of novel constructive ASPs in the formed countrywide plans in lots of while using every of the last in simplicity. Pharmacists are central to the partnering institutions of the Infection Prevention and Control Nurses and recommended in UK and Irish AMS guidelines as critical team members, despite a lack of standardization in the delivery of AMS.

3.1. Scope of Practice for Pharmacists in Antimicrobial Stewardship

Antimicrobial stewardship refers to the optimal selection, dosage, route, and duration of an antibiotic that results in the optimal clinical outcome for the treatment or prevention of an infection with minimal toxicity. Recent recommendations support expanding the role of pharmacists beyond their currently defined responsibilities to encompass a number of professional activities that are instrumental in optimal antimicrobial use. This shift in the scope of practice of pharmacists would then support the implementation of, and opportunities for, intentionally designating prescribing pharmacists' proficiency in optimal

antimicrobial use in the form of an Antimicrobial Stewardship Program. Considering the emphasis on patient care and professional collaboration in the integrated plans between the provincial pharmacy regulatory authorities and the pan-Canadian regulatory associations for pharmacy technicians, pharmacists are well situated to further contribute to the reduction in the progression of antimicrobial resistance.

The settings and environments in which pharmacists contribute to antimicrobial stewardship programs are vast and continuously growing in sectors such as ambulatory care, acute care, long-term care (nursing homes), dialysis units, every aspect of home care services (nursing, therapy and infusion), and assisted living institutions and facilities (personal care), as well as in industries such as clinical research conducting clinical trials and conducting drug monitoring trials - including the pharmaceutical industry and academia. Pharmacists make a unique and effective contribution to the healthcare system by providing guidance in antimicrobial use and, in combination with interventions by stakeholders (veterinarians, physicians, scientists, policymakers, and others), effectively contribute to reducing the acceleration of antimicrobial resistance.

4. Collaborative Approaches in Antimicrobial Stewardship

Antimicrobial stewardship relies on the collaboration of prescribers, researchers, policymakers, and, in the case of this book, pharmacists. This collective expertise is critical to ensure modern hospital inpatients are receiving the most appropriate antimicrobial agents. A comprehensive approach addresses all stages of the patient pathway that involve antimicrobial administration, including surgical antimicrobial prophylaxis, empiric therapy of infectious syndromes, treatment adjustment based on microbiological cultures and patient-specific factors such as renal function, and considerations for discharge, including arrangements for continued intravenous therapy if appropriate.

Simply 'doing the audit' does not result in sustained change; rather, broader strategies that address the culture of antimicrobial use, systems which support and enable without punishing error, and leadership that fosters a desire for improvement are more likely to be successful. Hence, working on antimicrobial stewardship is ultimately about improving patient care and safety, albeit in a rapidly evolving and increasingly complex area of

medicine. In general, a person or organization with a broad understanding of these issues defines the impacts of poor antimicrobial stewardship on the institution in question, and the team implements educational and managerial strategies. The team may regenerate to vary according to the topic and the area in question. Therefore, working in interprofessional teams is highly recommended for antimicrobial stewardship generally.

4.1. Interprofessional Team Dynamics in Antimicrobial Stewardship

Antimicrobial stewardship programs are multidisciplinary in nature and they need to help integrate their facility's work into the larger public health response to AMR. Clinical care staff help administer the proper use of antibiotics for the right patients while also integrating optimal use into their overall patient care. Infectious disease specialists and pharmacists have become well-established providers of expertise in the integration of microbiology and pathophysiology knowledge of infectious disease with medication use. Experience and expertise in both clinical care and healthcare services allow these specialized providers to be very helpful in helping the microbiology section integrate clinical guidelines with "real world" patient care needs.

By necessity, AMS activities need to integrate work done by healthcare professionals from different parts of the healthcare facility into a cohesive program. Should some healthcare facilities employ infectious disease qualified individuals on the healthcare services (i.e., administrative) side of the AMS program? Absolutely, so long as all facilities integrate ID qualified staff into the medical and pharmacy staff care team, the administration of no AMS program is left to the healthcare services section of the healthcare institution. Policymakers, regulatory, and accreditation organizations are increasing their demands to provide more and specific proof of how facilities are contributing to the public health response to AMR in their communities and their populations. Those who resist the integrative approach need to know that with or without an administrative role within the AMS, infectious disease experts (infectious disease physicians, and clinical pharmacists) will still continue to play a valuable role in stewardship activities.

5. Strategies for Optimizing Antibiotic Use

The inappropriate use of antibiotics by healthcare professionals is a major contributor to antimicrobial resistance. New strategies need to be urgently set up to optimize antibiotic use and to support evidence-based prescribing practices. Moreover, pharmacists should be involved in local and national working groups for antibiotic stewardship and their clinical knowledge should be considered useful in the development of guidelines. Appropriate education and training in antimicrobial stewardship for pharmacists are vital. This will equip pharmacists as competent professionals working in secondary and primary care and inform HEE workforce planning and education. (Westerlund & Marklund, 2019)(Iurii et al.2)

Strategies for optimizing antibiotic use in the UK include (1) formulary restrictions, (2) the use of formulary restricted antimicrobials, (3) delayed or asynchronous prescribing using a patient group direction, (4) supporting the development of antimicrobial guidelines, and (5) education and training. The aim of the workshop was to co-develop a professional curriculum to support pharmacists in delivering MSc post-graduate courses in antimicrobial stewardship. Training and education programs must take cognizance of the differences in pharmacist role and expertise. Workshop delegates agreed that pharmacy post-graduate programs should be equitable, so as to support broad career pathways for pharmacist obligations in all sectors of practice. Antimicrobial competency assessment for MSc study should include an assessment of teamwork, therapeutics, and clinical knowledge in addition to Data, Analytics and Research skills. An additional post-graduate diploma (PgDip) in prescribing to support non-medical prescribing for pharmacists is supported by the AMR pharmacists, however, developing the essential antibiotic prescribing competencies as part of the MSc was felt to be duplicative. Pharmacist opinion was divided, and further work is required to explore and address concerns. Pharmacist delegates felt antibiotic prescribing by all pharmacists should be considered in the creation of the antimicrobial competencies statement for the MSc in Antimicrobials, Stewardship, Resistance, and Healthcare Associated Infections (AMR).

5.1. Education and Training Programs for Pharmacists

Continuous development of the pharmacists' skills creates a new generation of specialists able to participate in ASP. To achieve that, there is a need for the development of various education and training strategies. However, all these detailed and extensive programs should include content focused on the principles and processes of AMS/ASP, updated national and international guidelines, appropriate use of antibiotics according to pathogen, patient condition, idiosyncrasy, monitoring of the action of antibiotics, follow up the protocols, guidelines, and action plans, legal aspects and professional responsibilities, as well as basic concepts in microbiology and infectious diseases, and application of pharmacology to clinical treatment.

Pharmacists, like all other professional categories, must continuously train for professional improvement, acquire new knowledge or specialties, as well as find out the range of new methods, modern technologies, and devices and medical drugs. Qualitative healthy education should improve the doctor's professional attitudes in the field of daily clinical practice, guide the clinical therapeutic decisions, provide support in making the right length of an antibiotic therapy course, good choice and the reasonable use of them treatment. Given that most of the domestic pharmacists work in the field of outpatient health services, the organization of accredited programs, further professional specialties aimed at continuous improvement and perfecting the pharmacist's competencies are offered by the principle of high-quality comprehensive health care, optimized medical treatment, shared by both hospital ambulatory services, as well as the primary care level, in the registration of polymorbidity in various diseases (as anemia, parasites, cardiovascular diseases, kidney disease, liver disease, oncological diseases, geriatric care, diabetes in old age, etc.), diseases with special transmission routes (tuberculosis, HIV, influenza, E. coli, etc.). It is necessary that pharmacists be continuously educated and trained to ensure safe, clinically effective, and optimized pharmacotherapy in their daily practice.

6. Technological Innovations in Antimicrobial Stewardship

Electronic health records (EHR) provide an ideal means of developing and supervising antimicrobial stewardship activities and have the potential to improve clinician education, streamline

monitoring and system alerts, position decision support/practice analytics closer to the point of care, enhance the process of reporting, facilitate the involvement of a variety of healthcare staff, and minimize the burden on the human resource. EHR-derived electronic solutions have been used to automate posting of results of treatment authorization (deliberate processes), automate the decision-making process to improve dosing accuracy (clinical assistance), facilitate formulary compliance, enable the manual review of clinical records, provide alerts and reminders about choices and contraindications that occur before consulting begins, provide context-relevant training of the provider order entry at the job-specific level, support entry assessment instruments, secure electronic graphing of patient data, and provide clinical decision-making support at the point of care. Common EHR-derived software applications have been harnessed to develop, endorse, support, and direct antimicrobial stewardship activities particularly in the arenas of surveillance and formulary restriction. (Iurii et al.2018)

Due to the many evolving complexities of digital solutions, care needs to be taken to remain committed to a true clinical need and conveniences of use must not be overlooked. In the innovation plan, assigning value, ROI (return on investment), discussion, and education with a focus on practice and education are necessary in order to address the interface of person and machine. Where technical capability is sufficient, the automatic and real-time feedback that accompanies closed-loop systems with EHR (termed hard stop alerts) alerts prescribers (and their delegates) to policy violations and permits a safe process and efficient workflow without back-and-forth with the pharmacist.

6.1. Role of Electronic Health Records

Today's innovation in clinical practice ensures that the appropriate patient information can be reliably available at the point of prescription or order entry. Altogether, 97% of U.S. hospitals have now adopted electronic health records (EHRs) and by 2003, 68% of office-based physicians reported using EHR systems. The World Health Organization further emphasizes the potential of e-health in antimicrobial stewardship. One of their core recommendations on infection prevention and control stipulates that national and local surveillance systems should be supported by electronic laboratory networks that enable the speedy analysis of

microbiological and epidemiological information. They also recommend that the automated generation of cumulative antibiograms be strengthened by improving both laboratory and hospital cultures and informatics. Support for this recommendation comes from evidence indicating that rapid access to appropriate information can improve the management of hospital-acquired infections, reduce hospital stays, and improve patient outcomes.

The potential of computerized physician order entry (CPOE) in affecting the antimicrobial supply in hospitals is quite obvious. Care providers working in settings with CPOE also feel more effective at preventing medication errors and have less fear for patient safety. CPOE systems help improve the efficiency of hospital systems by preventing medication errors and reducing treatment delays. An inpatient EHR system, which includes order entry, results reporting, and clinical documentation, is associated with improved antimicrobial utilization. Standardized alerts in EHR systems can also be used to support guideline compliance among care providers, such as those related to prescribers. Alerts provided at the time of order entry are more effective in promoting guideline compliance than when alerts are delivered at a time other than at order entry, as immediate decision support is likely to be sought. Moreover, EHRs can also be used to track providers' adherence to intervention through clinical and administrative data, provide feedback to prescribers regarding their own practice, and facilitate face-to-face communication with care providers.

7. Evaluating the Impact of Pharmacists in Antimicrobial Stewardship

Pharmacists have been described as the backbone of any antimicrobial stewardship program, with the 5 key roles of pharmacists being reviewed in the first paper of the Topic Series. The second paper described how pharmacists have been engaged in surgical and intensive care units. Monitoring the overall impact of pharmacists in antimicrobial stewardship programs is difficult due to the lack of established Key Performance Indicators (KPIs). Possible strategies for pharmacists include Expert Opinion, focus groups utilizing the Delphi process (which looks at consensus achievement) and administrative data (utilization of or resistance elect). A combination of methods used in the current paper and in

various European countries and the United Kingdom has been to develop and utilize questionnaires with a combination of Likert scales and open-ended questions.

The role of pharmacists has been developed following the recommendations for various strategies for the optimal use of medication in general. In general, different stakeholders' views on the role of the pharmacist should be formally sought and utilized to develop a multi-faceted role that does not focus only on drug distribution, but also of equal importance, on the supply of accurate and up-to-date information to the health care team and the provision of training/education to other healthcare professionals and patients. Once the role has been formally developed and implemented, successful implementation of the role includes demonstrating the development and evolution of the role over time, evaluating the role and in choosing appropriate KPIs. Pharmacist's contribution in terms of change in antibiotic use is visible if data are collected and 'managed' systematically. Pharmacist's contributions to improvement in the detection of infection, prescription and the recorded allergy status are difficult to show within the same patient.

7.1. Key Performance Indicators for Pharmacists

The role of the pharmacist in antimicrobial stewardship programs (ASPs) is still not fully recognized. Considering the multidisciplinary basis of ASPs, in which a professional healthcare team with specific expertise performs, a set of key performance indicators (KPIs) should be highlighted to better evaluate the effectiveness of this professional healthcare team. Therefore, seven specific KPIs for pharmacists working in ASPs are presented.

KPI 1: Proportion of antibiotic susceptibility tests (ASTs) reported to the prescriber within 24 and 48 hours. KPI 2: Length of stay of patients with antibiotic therapy. KPI 3: Proportion of dose adjustments of pharmacokinetics-based doses of antibiotics according to the creatinine clearance on the day of acute kidney injury (AKI). KPI 4: Incidence of AKI per 1000 patient days. KPI 5: Nutrition team adherence to antibiotic guideline recommendations for patients with infection/sepsis or with documented positive microbiology culture. KPI 6: Proportion of pharmacist recommendations rejected by the prescriber. KPI 7: Proportion of interventions initiated by the prescriber or another healthcare professional in which the pharmacist gathers further

information (e.g., additional diagnostic tests) to raise a follow-up/reassess the case.

The training of pharmacists and other healthcare professionals has increased in recent years, improving the understanding and acceptance of antimicrobial stewardship (AMS). Practitioners must use them in their everyday practice in order to maintain and optimize quality. To facilitate the application of the multifaceted competencies of pharmacists working in AMS, KPIs detailing what pharmacists involved in AMS should contribute towards are needed. To achieve enhanced application, establish the capacity of an individual pharmacist to help determine the role of a pharmacist undertaking an AMS role. (Zavaleta-Monestel et al. 2018)

8. Challenges and Barriers in Implementing Antimicrobial Stewardship Programs

There are several obstacles and barriers to the successful implementation of antimicrobial stewardship. These include establishing strong teamwork and collaboration within all medical staff to ensure effective communication and patient-centered care. For this to occur, hospitals must work to foster a culture of trust, earned respect, knowledge, and responsibility within any multidisciplinary stewardship teams. Additionally, the overwhelming financial and administrative costs associated with the development, implementation, and subsequent effectiveness evaluations of else in high demand, due to the global health threat of the -19 coronavirus pandemic.

The shortage of adequately specialized staff and the need to ensure the ongoing education and training of staff about new microorganisms, new antibiotics, or old ones, in order to maintain up-to-date clinical guidelines, policies, or procedures, are further complicating factors. Without sufficient investment and resource allocation in these areas, antimicrobial stewardship programs will struggle to succeed. Barriers are generally broad, self-replicating categories, and interventions and control strategies for overcoming these barriers are expansive and context-specific. There are challenges for establishing and maintaining collaboration among these healthcare providers, as well as suboptimal communication, beyond an absence of trust, regarding cognitive biases due to professional hubris or moral hazard. Once established, an antimicrobial stewardship program relies on the

sustainable effort of individual, collective, and systemic organizational endeavors to evaluate its role in order to maintain its long-term effectiveness and contribution to greater public health.

8.1. Financial Implications

The role of antimicrobial stewardship programs (ASPs) rises in the era of increasing antimicrobial resistance. With the increasing global burden of multidrug-resistant microbial infections, the importance of developing strategies for the optimal use of antibiotics is on the rise. However, the implementation of strategies for promoting the responsible use of antibiotics, while targeting a positive patient outcome and decreased antimicrobial resistance, requires sustainable financial planning. Interventions aimed at minimizing the development and spread of resistant organisms are competing for the same resources as those focused on other high-priority health outcomes, such as interventions targeting high priority diseases (e.g., prevalence of human immunodeficiency virus/acquired immunodeficiency syndrome (HIV/AIDS) and tuberculosis). As a tool to increase the appropriate use of antimicrobials, ASPs are an integral part for the responsible use of antibiotics, hence, they are expected to be integrated into health systems and supported financially. Various examples of this are provided later in the paper.

Sustainable strategies and approaches are key to transforming an essential activity, such as antibiotic prescribing, and ensuring that healthcare facilities continue to maintain and invest in program activities. ASPs should target the methodologies and antimicrobials with the most significant negative economic and patient outcome value change. Determining the specific economic loss of MDR and pan-drug-resistant bacteria is not only difficult, but the loss is the biggest tragedy globally, and the most difficult to quantify and compel the human health communities to make the changes needed to reduce the incidence of resistance. In conclusion, a strong argument has been made for sustainability of ASPs that incorporate thoughtful strategies for managing the cost and funding programs. Such strategies are paramount in establishing essential antimicrobial stewardship role for both pharmacist providers and non-pharmacist providers across the continuum of care. (Lat et al. 2018)

9. Future Directions in Antimicrobial Stewardship

Telemedicine or telehealth involves the use of electronic information or telecommunication technologies to support long-distance clinical care, patient and professional health-related education, public health, and health administration. The changes in the healthcare landscape are contributing to the increased use of telemedicine delivery. Health care is transitioning from traditional hospitals and clinic care models to convenient and cost-effective methods. There is no need for long distances to traverse for in-person medical care. In fact, more than 76% of hospitals in the US currently connect patients and consulting practitioners through the use of video and other technology, and this proportion is growing. Telemedicine has put pharmacists in a unique position as they transition from the traditional practice model to fulfill future workforce needs. Currently, the role of technology in hospital settings for antimicrobial stewardship (ASP) is more intensified on prospective audit and feedback strategies rather than real-time, bedside strategies. However, the scope and the challenges will likely vary by practice site.

Telemedicine and telepharmacy are the new normal. "Telemedicine" in the 1990s is called "medicine" today. Going forward, the application of "virtual" and "real-time" strategies will transition from secondary, advisory roles to the norm. Telepharmacy is a futuristic approach to improve antimicrobial stewardship. The globalization of health care, including the ease of international travel, increasingly contributes to the spread of drug-resistant organisms. Rounds and meetings will likely be conducted as hybrid events. New surveillance programs should and will be created.

9.1. Incorporating Telemedicine and Telepharmacy

Technological advancements in telemedicine (telehealth) and telepharmacy are steadily being used to manage outpatient services throughout healthcare, and both areas will surely be a part of future AS efforts, particularly in the area of expanding access to pharmaceutical expertise and improving the use of antibiotics. Institutions need to consider several critical points when contemplating the implementation of technology into their strategies.

Role Overview 1. Understanding: Exploring how telemedicine and telepharmacy can provide services that include antimicrobial

stewardship, cost benefit and drawback analysis. 2. Assistance: Providing guidance in the establishment of institutional policies regarding how to integrate telemedicine and telepharmacy programs into their existing antimicrobial stewardship strategies.

3. Planning: A review of future directions.

When it comes to the AS adjunct services of telepharmacy and telemedicine, there are two main variations to choose from. The first option offers an outlet for a pharmacist to gain access to patient EMRs, lab data, and physician's notes to advise physicians on what specific antibiotics to prescribe and to report back to institutions on what they have recommended. In this manner, the pharmacist's services are mostly seen as an assessment and recommendatory involvement with someone who receives formal guidance on therapeutic drug monitoring and whole therapeutic drug management practices. The second type of telepharmacy primarily involves the exchange of knowledge. In this design, the patient is not seen individually by a physician or pharmacist to diagnose potential illnesses before antibiotic decisions are made. The physician's decision to incorporate the antibiotic into the recommended drug cocktail is mostly made individually, the pharmacist not having access to physician's notes or earlier treatment choices. Involvement with this process is becoming more and more popular as a convenient alternative because community hospitals and clinics may not employ local pharmacists who could otherwise offer drug information assistance. Due to the increasing need for national pharmaceutical resources and a larger demand for community hospital telepharmacy services, a number of institutions and technology startups have begun pursuing these forms of new information technology tools.

References:

1. Le, T., Toscani, M., & Colaizzi, J. (2019). Telepharmacy: a new paradigm for our profession. Journal of pharmacy practice. [HTML]
2. Herranz-Alonso, A., Rodríguez-González, C. G., Sarobe-González, C., Álvarez-Díaz, A., & Sanjurjo-Sáez, M. (2019). Pharmacy department management and organization. Farmacia Hospitalaria, 44, 5-10. sciencedirect.com
3. Salgado, T. M., Rosenthal, M. M., Coe, A. B., Kaefer, T. N., Dixon, D. L., & Farris, K. B. (2019). Primary healthcare policy

and vision for community pharmacy and pharmacists in the United States. Pharmacy Practice (Granada), 18(3). isciii.es

4. Trenfield, S. J., Awad, A., McCoubrey, L. E., Elbadawi, M., Goyanes, A., Gaisford, S., & Basit, A. W. (2019). Advancing pharmacy and healthcare with virtual digital technologies. Advanced Drug Delivery Reviews, 182, 114098. ucl.ac.uk
5. Stranges, P. M., Jackevicius, C. A., Anderson, S. L., Bondi, D. S., Danelich, I., Emmons, R. P., ... & Smithgall, S. (2019). Role of clinical pharmacists and pharmacy support personnel in transitions of care. Journal of the American College of Clinical Pharmacy, 3(2), 532-545. [HTML]
6. Khan, N., McGarry, K., Naqvi, A. A., & Holden, K. (2018). Doctors' perceptions, expectations and experience regarding the role of pharmacist in hospital settings of Pakistan. International journal of clinical pharmacy, 42(2), 549-566. sunderland.ac.uk
7. Ameri, A., Salmanizadeh, F., Keshvardoost, S., & Bahaadinbeigy, K. (2018). Investigating pharmacists' views on telepharmacy: prioritizing key relationships, barriers, and benefits. Journal of Pharmacy Technology, 36(5), 171-178. nih.gov
8. Westerlund, T. & Marklund, B. (2019). Community pharmacy and primary health care in Sweden-at a crossroads. Pharmacy Practice (Granada). isciii.es
9. Iurii, K., Reva, T., Stuchynska, N., Pavlo, M., Inna, K., & Chkhalo, O. (2019). Digital competence as a necessary component of the professional competence of pharmaceutical industry employees. Archives of Pharmacy Practice, 13(1-2019), 82-87. archivepp.com
10. Zavaleta-Monestel, E., Serrano-Arias, B., Milano-Gil, A., Sanchez-Solis, C., Arroyo-Monterrosa, D. A., Muñoz-Pichuante, D., ... & Chaverri-Fernandez, J. M. (2019). Insights into clinical pharmacy practice in Latin America. Journal of the American College of Clinical Pharmacy, 6(10), 1103-1116. [HTML]
11. Lat, I., Paciullo, C., Daley, M. J., MacLaren, R., Bolesta, S., McCann, J., ... & Meyer, T. A. (2019). Position paper on critical care pharmacy services: 2019 update. Critical care medicine, 48(9), e813-e834. [HTML]