Research, Society and Development, v. 11, n. 7, e51011729444, 2022
(CC BY 4.0) | ISSN 2525-3409 | DOI: http://dx.doi.org/10.33448/rsd-v11i7.29444

Antimicrobial Stewardship Programmes in Brazil: introductory analysis

Antimicrobial Stewardship Programmes no Brasil: análise introdutória

Antimicrobial Stewardship Programmesen Brasil: análisis introductorio

Received: 04/20/2022 | Reviewed: 04/28/2022 | Accept: 05/27/2022 | Published: 06/03/2022

Rochele Mosmann Menezes
ORCID: https://orcid.org/0000-0002-1548-1607
Universidade de Santa Cruz do Sul, Brasil
E-mail: rochelemenezes@unisc.br
Mara Rubia Santos Gonçalves
ORCID: https://orcid.org/0000-0003-1085-7510
Agência Nacional de Vigilância Sanitária, Brasil
E-mail: mara.goncalves@anvisa.gov.br
Magda Machado de Miranda Costa
ORCID: https://orcid.org/0000-0002-8251-6988
Agência Nacional de Vigilância Sanitária, Brasil
E-mail: magda.miranda@anvisa.gov.br
Eliane Carlosso Krumennauer
ORCID: https://orcid.org/0000-0002-8824-4573
Universidade de Santa Cruz do Sul, Brasil
E-mail: elianek@unisc.br
Géssica Milani Carneiro
ORCID: httsp://orcid.org/0000-0002-1133-5581
Universidade de Santa Cruz do Sul, Brasil
E-mail: gessicamilani@unisc.br
Cézane Priscila Reuter
ORCID: https://orcid.org/0000-0002-4549-3959
Universidade de Santa Cruz do Sul, Brasil
E-mail: cezanereuter@unisc.br
Jane Dagmar Pollo Renner
ORCID: https://orcid.org/0000-0003-0649-7081
Universidade de Santa Cruz do Sul, Brasil
E-mail: janerenner@unisc.br
Marcelo Carneiro
ORCID: https://orcid.org/0000-0003-3603-1987
Universidade de Santa Cruz do Sul, Brasil
Associação Brasileira dos Profissionais em Controle de Infecções e Epidemiologia Hospitalar, Brasil
E-mail: marceloc@unisc.br

Abstract
Introduction: Antimicrobial Stewardship Program (ASP) aims to reeducate the use of antimicrobials. Objective: To manage and evaluate the implementation of ASP in an Adult Intensive Care Unit in Brazilian hospitals. Method: Prospective cross-sectional study, reporting introductory data and factors that advised and helped to implement the ASP in 954 (55.6%) hospitals, corresponding to 25,565 beds, from all 27 Brazilian states.Results: Of the 954 hospitals, 453 (47.5%) have ASP, with the most regular factors being: 369 (81.5%) top management support; 343 (75.7%) availability of clinical protocols; 276 (60.9%) support and adherence by doctors and 259 (57.2%) official definition of the management team. The most difficult causes were: 202 (44.6%) operational team without defined or insufficient time; 134 (29.6%) lack of information technology support; 173 (38.2%) resistance or opposition from doctors and 116 (25.6%) lack of commitment from the teams. Conclusion: the implementation of ASP is an executable proposal for the optimization and rational use in the management of antimicrobials. In Brazil, this proposal will collaborate for direct actions in ICUs, guided by the government, with a relevant impact on the control of antimicrobial resistance. In Brazil, this proposal will contribute to direct actions in ICUs, guided by the government, with a relevant impact on the control of antimicrobial resistance. Brazil needs to improve all elements, with education and definition of responsibilities and professionals.
Keywords: Antimicrobial resistance; Stewardship; Antimicrobial.

Resumo
Introdução: Antimicrobial Stewardship Program (ASP) tem como objetivo reeducação no uso de antimicrobianos. Objetivo: Gerenciar e avaliar a implementação ASP em Unidade de Terapia Intensiva Adulto nos hospitais brasileiros. Método: Estudo prospectivo transversal, relatando os dados introdutórios e as fatores que assessoraram e auxiliaram

para implementação do ASP em 954 (55,6%) hospitais, correspondendo à 25.565 leitos, de todos os 27 estados btasileiros. Resultados: Dos 954 hospitais, 453 (47,5%) dispõem de ASP, sendo os fatores mais regulares: 369 (81,5%) apoio da alta direção; 343 (75,7%) disponibilidade de protocolos clínicos; 276 (60,9%) apoio e adesão por parte dos médicos e 259 (57,2%) definição oficial time gestor. As causas que mais dificultaram foram: 202 (44,6%) time operacional sem tempo definido ou insuficiente; 134 (29,6%) inexistência de suporte de tecnologia da informação; 173 (38,2%) resistência ou oposição dos médicos e 116 (25,6%) falta de comprometimento das equipes. Conclusão: a implementação de ASP é uma proposta executável para a otimização e uso racional no manejo de antimicrobianos. No Brasil, esta proposta colaborará para as atuações direta nas UTIs, orientadas pelo governo, com um impacto relevante no controle da resistência antimicrobiana. O Brasil precisa aprimorar todos os elementos, com prioridade a definição das responsabilidades e educação dos profissionais e familiares.
Palavras-chave: Resistência antimicrobiana; Stewardship; Antimicrobianos.

Resumen

Introducción: El Programa de Administración de Antimicrobianos (ASP) tiene como objetivo reeducar el uso de antimicrobianos. Objetivo: Gestionar y evaluar la implementación de ASP en la Unidad de Cuidados Intensivos de Adultos en hospitales brasileños. Método: Estudio transversal prospectivo, relatando datos preliminares y factores que aconsejaron y ayudaron a implementar el ASP en 954 (55,6%) hospitales, correspondientes a 25.565 camas, de los 27 estados brasileños. Resultados: De los 954 hospitales, 453 (47,5%) cuentan con ASP, siendo los factores más comunes: 369 (81,5%) apoyo de la alta dirección; 343 (75,7%) disponibilidad de protocolos clínicos; 276 (60,9%) médicos apoyaron y adhirieron y 259 (57,2%) definieron el equipo directivo oficial. Las causas más difíciles fueron: 202 (44,6%) equipo operativo sin tiempo definido o insuficiente; 134 (29,6%) falta de soporte informático; 173 (38,2%) resistencia u oposición de los médicos y 116 (25,6%) falta de compromiso de los equipos. Conclusión: la implementación de ASP es una propuesta ejecutable para la optimización y uso racional en el manejo de antimicrobianos. En Brasil, esta propuesta colaborará para acciones directas en las UCI, guiadas por el gobierno, con impacto relevante en el control de la resistencia a los antimicrobianos. Brasil necesita mejorar todos los elementos, priorizando la definición de responsabilidades y la educación de profesionales y familiares.
Palabras clave: Resistencia a los antimicrobianos; Stewardship; Antimicrobianos.

1. Introduction

Antibiotic administration programs are a set of interventions aimed at prescribing antibiotics in an appropriate and responsible manner. Because of this, it is one of the main strategies to face the current worldwide crisis of bacterial resistance. To limit these problems, programs have been established to limit unnecessary exposure to antibiotics, improve clinical outcomes, reduce the rate of resistance and decrease financial costs (Almulhim, 2019; Balkhy, 2018; Benić, 2018; Pulcini, 2018 & Quirós, 2020).

Therefore, the use of these tools supports the increase in prescription control, as well as its adequacy. Consequently, in the long term, a gradual decrease in antimicrobial resistance rates is achieved, which contributes to a better approach to the critical patient and the entire hospital environment. In addition, the effective participation of Hospital Infection Control Centers (CCIH), through these programs, assist in aspects related to the patient, in the management of costs and investments in the intensive care sector (Pulcini, 2018; Conway, 2017; Luther, 2018; Pitiriga, 2018; McCarthy, 2018).

In Brazil, in 2016, ANVISA prepared the National Program for the Prevention and Control of Infections Related to Health Care (PNPCIRAS) for the period (2016-2020). The main objective of this program is to reduce, at the national level, the incidence of HAI in health services, with some strategic actions, such as nationally reducing the incidence of priority HAIs, preventing and controlling the spread of microbial resistance in health services, consolidating the PNPCIRAS and consolidate the national system of epidemiological surveillance of IRAS. At the national level, antimicrobial management programs are gaining more and more space, in addition to having the support of public agencies. In 2018, ANVISA launched the National Guideline for the Development of a Management Program for the Use of Antimicrobials in Health Services, its main objective: To provide guidance to "health professionals in the design and implementation of programs to manage the use of antimicrobials in health services", thus promoting a reduction in resistance in cases of HAIs and increasing patient safety (ANVISA, 2018 & ANVISA, 2019).

The clinical management of antimicrobial use through the Antimicrobial Stewardship Program (ASP) worldwide aims at reeducation in antimicrobial therapy. The need to analyze the Brazilian national scenario is fundamental to design strategies due to geographic differences and to standardize government regulations. In this context, this study aimed to evaluate the implementation of ASP in the Adult Intensive Care Unit in Brazilian hospitals.

2. Methodology

This is a prospective cross-sectional, multicenter study with coverage throughout the Brazilian territory, available to 1,705 hospital institutions, totaling 27,709 adult ICU beds. Of these institutions, 954 (55.6%) joined the self-assessment, corresponding to 25,565 adult ICU beds, ccontaining the factors that advised and helped for the implementation of ASP.

The data were collected through an online government platform called Form SUS, carried out between July and August 2019. The evaluation criteria of institutions with ASP were grouped into six essential elements for the implementation of these programs, according to the National Guideline for Elaboration of Antimicrobial Use Management Program in Health Services, validated by specialists with satisfactory internal consistency (five elements with Cronbach's Alpha classification “Good / Excellent”).

The elements were: (E1) institutional support from senior management; (E2) definition of the responsibilities of each professional involved; (E3) education of professionals and family members; (E4) strategic actions to rationalize the prescription of antimicrobials; (E5) monitoring of ASP indicators and (E6) disseminating results at the institution (Gebretekle, 2018).

The database was structured in Excel 2013 software (Microsoft Corporation, Redmond, Washington, USA) and later imported into the Statistical Package for the Social Sciences (SPSS) version 23 (IBM, Armonk, USA) to perform the descriptive analysis of the based on absolute and relative frequency (Heo, 2015; Gebretekle, 2018).

3. Results

Of the 954 hospitals, 453 (47.5%) indicated having the ASP established and among the most regular factors that benefit the program is the support of discharge hospital management (81.5%) and the availability of clinical protocols based on the institutional profile (75.7%). Among the reasons that made the implementation of ASP difficult the components of the operational team, without defined time or insufficient time to carry out the activities of the ASP (44.6%) and the lack of technology support from the information (29.6%) (Table 1).

Table 1: Factors that favored and reasons that made it difficult to implement ASP: Antimicrobial Stewardship Program.

Facilitators	**N (%)**
Support from senior hospital management	369 (81,5%)
Availability of clinical protocols based on institutional profile	343 (75,7%)
Support and adherence by prescribing doctors	276 (60,9%)
ASP Official definition of a multiprofessional group (management team) responsible for ASP	259 (57,2%)
Difficulties	**N (%)**
Components of the operational team with no defined or sufficient time to perform ASP activities	202 (44,6%)
No information technology support	134 (29,6%)
Resistance or opposition from the prescribing doctors of the hospital	173 (38,2%)
Lack of commitment by hospital teams to implement ASP rules	116 (25,6%)

Statistical Package for the Social Sciences (SPSS), Version 23, (IBM, Armonk, USA).

Table 2 shows the geographical distribution of the 463 hospitals that have ASP implemented, according to the Brazilian region. It was possible to verify that 62% (SD + 24.1) of hospitals have an ASP. Of the 27 Brazilian states, there was an expressive implementation of ASP in the states of São Paulo 96 (21.2%), Rio de Janeiro 63 (13.9%), Paraná 47 (10.4%) and Minas Gerais 39 (8.6%). The southeast region stood out in this unprecedented investigation. As for the evaluated elements of the 453 (47.5%) Adult ICU that had ASP implemented, the medians were: E1 = 65.3%, E2 = 35.7%, E3 = 15.2%, E4 = 78.4% , E5 = 72.2% and E6 = 58.7%.

Table 2: Number of hospital institutions that have ASP implemented and the list of elements according to each Brazilian region.

Region	**N (%)**	**E1 □ (%)**	**E2 □ (%)**	**E3 □ (%)**	**E4 □ (%)**	**E5 □ (%)**	**E6 □ (%)**
North	25 (5,5%)	121,20 (71,3%)	78,00 (45,8%)	55,80 (50,7%)	239,60 (76,1%)	44,40 (63,4%)	66,00 (55,0%)
West-center	62 (13,7%)	120,16 (70,9%)	86,94 (52,7%)	49,92 (36,9%)	234,68 (73,3%)	47,18 (67,4%)	68,23 (56,8%)
South	78 (17,2%)	127,21 (74,8%)	89,42 (52,6%)	46,35 (34,3%)	239,10 (74,7%)	49,42 (65,8%)	72,31 (60,2%)
Northeast	86 (19,0%)	109,88 (64,6%)	77,98 (45,8%)	41,51 (33,2%)	228,31 (72,5%)	43,66 (62,8%)	65,35 (54,4%)
Southeast	202 (44,6%)	112,87 (66,3%)	74,48 (45,1%)	45,52 (32,5%)	236,68 (73,9%)	45,30 (60,4%)	73,42 (61,2%)

(E1) institutional support from senior management; (E2) definition of the responsibilities of each professional involved; (E3) education of professionals and family members; (E4) strategic actions to rationalize the prescription of antimicrobials; (E5) monitoring of ASP indicators and (E6) disseminating results at the institution. Statistical Package for the Social Sciences (SPSS), Version 23, (IBM, Armonk, USA).

4. Discussion

The findings of the present study, with regard to the reasons that complicated the implementation of ASP, are in line with the qualitative research carried out by Alghamdi, Atef-Shebl, Aslanpour and Berrou (2019) in hospitals in Saudi Arabia, stating that despite the existence of a national strategy provided by the Ministry of Health to implement ASPs their adherence remains low. Among the main barriers are the adherence to insufficient institutional clinical protocols, lack of human resources, fragmentation of teams, deficient communication, lack of education and training programs, deficiency in health information technology (IT) (Chambers et al., 2018).

In a study conducted in Canada by Black et al, (2019) the specific barriers that prevented the implementation of the management of the use of antimicrobials included the resistance of prescribers to the recommendations of other health professionals, unavailability of human resources, especially those professionals with expertise such as: infectologists and pharmacists, as well as indefinite time for ASP activities. However, the use of information technology has been recognized as a facilitator for the development of ASP, with regard to electronic prescriptions, computerized support for clinical decisions and the use of electronic applications (aps) as a way of making clinical practice guidelines available. Given the above, the current research is partially in accordance with the findings by the authors, diverging only in the topic related to information technology.

Charani et al, (2019) through a multicenter study carried out in five countries in 24 hospitals, realized that government support for ASP was essential in countries where the program does not exist (India, Burkina Faso). In countries where the program was present, government support for ASP was perceived as a barrier (England, France). Professional boundaries are one of the main cultural determinants that dictate involvement in initiatives with doctors recognized as leaders in ASP. The work of nurses and pharmacists was a major limitation in England. The medical and surgical specialty was identified as the most difficult to engage in each country. The leadership commitment and the appointment of a single person responsible for ASP are present in England, France and Norway, ensuring through this nomination the continuity of optimization and antimicrobial use strategies. In these countries, processes are in place to track antimicrobial use and resistance patterns at the hospital level. In addition, they implemented periodic notifications on the use of antimicrobials and resistance to health professionals in the institutions. These findings are in line with the existence of elements 2 (definition of the responsibilities of each professional involved), 5 (monitoring of ASP indicators) and 6 (dissemination of results in the institution) reported in the present study.

Regarding the elements 3 (education of professionals and family members), 4 (strategic actions to rationalize the prescription of antimicrobials), 5 (monitoring of ASP indicators) and 6 (dissemination of results in the institution), Gebretekle et al, (2018) showed that the The majority (>83%) of respondents agreed that education, active participation in infection control, institutional guidelines, access to antibiograms and prospective audits with interventions and feedback would be the most effective ways to reduce bacterial resistance. However, ASP strategies are currently not concretely supported by institutional or national policies and are not implemented uniformly in health facilities in the country, making it more difficult to persuade prescribers, who are concerned with the autonomy of prescription.

Still on the education element (E3), the main measures implemented in France were the training of health professionals, publication of guidelines, feedback to the doctor about their prescriptions and availability of rapid diagnostic tests. Many countries have trained doctors with educational material to explain to patients how to proceed in case of viral infection. In Canada, the government has introduced a specific authorization for the use of quinolones. In Denmark, there was a temporary suspension of the reimbursement of some antibiotics, in order to preserve them according to the bacterial profile.

In the United Kingdom, the antibiotic susceptibility test report must include at least 5 antimicrobial agents. It was concluded that these measures implemented were generally more persuasive than restrictive. But the crisis of bacterial resistance should lead to the implementation of more restrictive measures (Wang S, Pulcini C, Rabaud C, et al., 2015).

Saha et al, (2020) reported that one of the main ways to multiply knowledge and disseminate education about antimicrobials was through therapeutic guidelines (83.2%, 321/385) and controlled antimicrobial prescription strategies (72.2%, 278/385), in addition to followed by patient information flyers (20.2%, 78/384), reports on the use of prescription (15.5%, 60/384) and audit and feedback (9.8%, 38/384). In addition, the use of shared decision-making approaches involving the patient has also been shown to be effective in minimizing the use of antibiotics related to treatment expectations.

Hawes, Buising, Mazza (2020) identified six multidimensional components needed to structure and guide ASP actions, such as: governance, including a national action plan with appointment of responsibilities, accreditation of prescribers and practical policies; education of general practitioners and the general public on ASP and antimicrobial resistance (AMR); computer support, including decision support with patient information resources and prescription guidelines; involvement of pharmacist and nurse; monitoring the prescription of antibiotics and AMR with feedback to prescribing doctors; evidence-based actions on ASP and AMR with transposition into practice.

It is well known that all Brazilian regions need to improve the strategies related to element 3 (education of professionals and family members), so it is necessary to invest in information, training, inclusion of the stewardship theme in graduation, so that health professionals inserted in the operational teams antimicrobial management, have knowledge and understanding of the importance of implementing the protocols, and are multipliers of knowledge, developing actions aimed at education, both for the health team and for patients.

Due to the multicentric character and the originality of the study, considering Brazil as a diversified country within the health context, this research will serve as a basis for new actions related to the management of antimicrobials, making possible, through the identification of the main weaknesses, the modifiable barriers for implementation of ASP throughout the national territory. However, it is necessary to emphasize that this research exceeded expectations, since we evidence the implementation of ASP, even if partially, within Brazilian ICUs, making it possible to verify that the health system, as well as health professionals are increasingly engaged in the development of these activities.

5. Conclusion

The implementation of antimicrobial stewardship programs is an executable proposal for the optimization and rational use in the handling of antimicrobials in developing countries. In Brazil, this proposal will collaborate for the direct actions in the ICUs, guided by the government, with a relevant impact on the control of antimicrobial resistance. The results prove that Brazil needs to improve all elements, but special attention to E2 (definition of the responsibilities of each professional involved) and E3 (education of professionals and family members) must be a priority. This study traced an important Brazilian characteristic of the level of implementation of the programs of hospitals with adult ICU beds in Brazil.

Regarding future work, this work provides some options regarding the continued development of Antimicrobial stewardship programs in Brazil. ASP Maturity: For ASP to reach its maturity and consequent increase in usability, it is necessary that the program be tested more intensively among the other health systems available in Brazil. Creation of new protocols: Currently, the lack of institutional protocols regarding the use of antimicrobials may be contributing to the lack of education among professionals and the community about antimicrobial resistance. It is important to make institutions understand the seriousness of the program in order to contribute to the rational use of antimicrobials.

References

Alghamdi, S., Atef-Shebl, N., Aslanpour, Z. & Berrou, I. (2019). Barriers to implementing antimicrobial stewardship programmes in three Saudi hospitals: Evidence from a qualitative study. *Journal of global antimicrobial resistance.* 18: 284-290. https://doi.org/10.1016/j.jgar.2019.01.031.

Almulhim, A.S., Aldayyen, A., Yenina, K., Chiappini, A., & Khan, T. M. (2019). Optimization of antibiotic selection in the emergency department for urine culture follow ups, a retrospective pre-post intervention study: clinical pharmacist efforts. *Journal of pharmaceutical policy and practice.* 12: 1-7. https://doi.org/10.1186/s40545-019-0168-z.

ANVISA. (2019). Programa nacional de prevenção e controle de infecções relacionadas à assistência à saúde (2016-2020). http://portal.anvisa.gov.br/documents/33852/3074175/PNPCIRAS+2016-2020/f3eb5d51-616c-49fa-8003-0dcb8604e7d9.

ANVISA. (2018). Diretriz Nacional para Elaboração de Programa de Gerenciamento do Uso de Antimicrobianos em Serviços de Saúde. https://www20.anvisa.gov.br/segurancadopaciente/index.php/publicacoes/item/diretriz-nacional-para-elaboracao-de-programa-de-gerenciamento-do-uso-de-antimicrobianos-em-servicos-de-saude.

ANVISA. (2019). Projeto Stewardship Brasil. Avaliação Nacional dos Programas de Gerenciamento do Uso de Antimicrobianos em Unidade de Terapia Intensiva Adulto dos Hospitais Brasileiros. http://portal.anvisa.gov.br/documents/33852/271855/Projeto+Stewardship+Brasil/435012dc-4709-4796-ba78-a0235895d901.

Balkhy, H. H., El-Saed, A., El-Metwally, A., Arabi, Y. M., Aljohany, S. M., Zaibag, M. A. et al. (2018). Antimicrobial consumption in five adult intensive care units: a 33-month surveillance study. *Antimicrobial Resistance & Infection Control.* 7(156): 1-9. https://doi.org/10.1186/s13756-018-0451-9.

Benić, M. S., Milanič, R., Monnier, A. A., Gyssens, I. C., Adriaenssens, N., Versporten, A. et al. (2018). Metrics for quantifying antibiotic use in the hospital setting: results from a systematic review and international multidisciplinary consensus procedure. *Journal of Antimicrobial Chemotherapy.* 73(6): 50-58. https://doi.org/10.1093/jac/dky118.

Black, E. K., MacDonald, L., Neville, H. L., Abbass, K., Slayter, K., Johnston, L. et al. (2019). Health care providers' perceptions of antimicrobial use and stewardship at acute care hospitals in Nova Scotia. *The Canadian journal of hospital pharmacy.* 72(4): 263-270. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6699866/pdf/cjhp-72-263.pdf.

Chambers, A., MacFarlane, S., Zvonar, R., Evans, G., Moore, J. E., Langford, B. J., Augustin, A. et al. (2019). A recipe for antimicrobial stewardship success: Using intervention mapping to develop a program to reduce antibiotic overuse in long-term care. *Infect Control Hosp Epidemiol.* 40(1): 24-31. https://doi.org/10.1017/ice.2018.281.

Charani, E., Smith, I., Skodvin, B., Perozziello, A., Lucet, J., Lescure, F. et al. (2019). Investigating the cultural and contextual determinants of antimicrobial stewardship programmes across low-, middle-and high-income countries—A qualitative study. *PLoS One.* 14(1): 1-20. https://doi.org/10.1371/journal.pone.0209847.

Conway, E. L., Sellick, J. A., Horey, A., Fodero. K., Ottet, M. C. et al. (2017). Decreased mortality in patients prescribed vancomycin after implementation of antimicrobial stewardship program. *American journal of infection control*. 45(11): 1194-1197. https://doi.org/10.1016/j.ajic.2017.06.012.

Gebretekle, G. B., Mariam, D. H., Abebe, W., Amogne, W., Tenna, A., Fenta, T. G. et al. (2018). Opportunities and barriers to implementing antibiotic stewardship in low and middle-income countries: lessons from a mixed-methods study in a tertiary care hospital in Ethiopia. *PLoS One.* 13(12): 1-15. https://doi.org/10.1371/journal.pone.0208447.

Hawes, L., Buising, K. & Mazza, D. (2020). Antimicrobial Stewardship in General Practice: A Scoping Review of the Component Parts. *Antibiotics.* 9(8):498. https://doi.org/10.3390/antibióticos9080498.

Heo, M., Kim, N. & Faith, M. S. (2015). Statistical power as a function of Cronbach alpha of instrument questionnaire items. *BMC Medical Research* Methodology. 15(86): 1-9.
https://doi.org/10.1186/s12874-015-0070-6.

Luther, V. P., Shnekendorf, R., Abbo, L. M., Advani, S., Armstrong, W. S., Barsoumian, A. E. et al. (2018). Antimicrobial stewardship training for infectious diseases fellows: program directors identify a curriculum need. *Clinical Infectious Diseases.* 67(8): 1285-1287. https://doi.org/10.1093/cid/ciy332.

McCarthy, M. W. & Walsh, T. J. (2018). The rise of hospitalists: an opportunity for infectious diseases investigators. *Expert review of anti-infective therapy.* 16(5): 385-389. https://doi.org/10.1080/14787210.2018.1462158.

Pitiriga, V., Kanellopoulos, P., Kampos, E., Panagiotakopoulos, G., Tsakris, A. & Saroglou, G. (2018). Antimicrobial stewardship program in a Greek hospital: implementing a mandatory prescription form and prospective audits. *Future microbiology.* 13(8): 889-896. https://doi.org/10.2217/fmb-2018-0020.

Pulcini, C., Binda, F., Lamkang, A. S., Trett, A., Charani, E., Goff, D. A. et al. (2019). Developing core elements and checklist items for global hospital antimicrobial stewardship programmes: a consensus approach. *Clinical Microbiology and Infection*. 25: 20-25. https://doi.org/10.1016/j.cmi.2018.03.033.

Quirós, R., Angeleri, P., Zurita, J., Aleman, W., Carneiro, M. & Guerra, S. (2020). Impact of Antimicrobial Stewardship Programs in Latin American Adult Intensive Care Units: PROA-LATAM Project. *Infection Control & Hospital Epidemiology*. 41(S1): s520-s520. https://doi.org/10.1017/ice.2020.1203.

Saha, S. K., Kong, D. C. M., Thursky, K. & Mazza, D. (2020). A Nationwide Survey of Australian General Practitioners on Antimicrobial Stewardship: Awareness, Uptake, Collaboration with Pharmacists and Improvement Strategies. *Antibiotics*. 9(6):1–13. https://doi.org/10.3390/antibióticos9060310.

Wang, S., Pulcini, C., Rabaud, C., Boivin, J. M. & Birgé, J. (2015). Inventory of antibiotic stewardship programs in general practice in France and abroad. *Medecine et maladies infectieuses*. 45(4): 111-123. https://doi.org/10.1016/j.medmal.2015.01.011.