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Summary of theses and dissertations

Strategies for the safe use of antimicrobials by Nursing in the hospital environment: an integrative review

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ABSTRACT

Objective: to identify the strategies for the safe use of antimicrobials adopted by Nursing in the hospital environment. **Method:** an integrative review, carried out from June to July 2020, on the *LILACS*, *MEDLINE,* CINAHL, and *EMBASE* databases. Articles from 2015 to June 2020 were selected. For the analysis of the evidence levels, the Grading of Recommendations Assessment, Development and Evaluation was adopted. **Results:** eight articles were found, distributed in Nursing management and care strategies, related to the safe use of antimicrobials. **Discussion:** among the main managerial strategies, the role of the educator and the setting up of multidisciplinary monitoring committees stand out; and, among the care strategies, the technical specificities of antimicrobial stewardship. **Conclusion:** the main Nursing practical strategies found were professional education in the rational use and multidisciplinary monitoring of antimicrobial resistance in the hospital environment. It is believed that the identification of these strategies will contribute to the development of better practices in drug safety.

Descriptors: Nursing Care; Antimicrobial Management; Microbial Drug Resistance; Bacterial Drug Resistance.

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INTRODUCTION

Annually, it is calculated that the expenditure concerning the use of antimicrobials, in the European Union Countries, is 1.5 billion Euros per year. This amount is even more alarming if we consider that these costs are probably underestimated. It is estimated that the older adult population alone received approximately 51.6 million prescriptions of antibiotics in 2014[1].

The irrational use of antibiotics over the years has brought some complications, mainly in relation to the creation of bacteria resistant to antibiotic therapy[2]. According to the World Economic Forum, the presence of multi-drug resistant organism (MDROs) outbreaks was considered one of the 10 main factors of global risk in 2019[3].

Antimicrobial resistance is defined by the World Health Organization as the capacity of a microorganism to prevent or reduce the action of an antimicrobial. As a result, the treatments became inefficient, and the infections, persistent and even incurable. The antimicrobial class encompasses natural and synthetic drugs, used in the treatment of fungal, viral, bacterial, or parasitic diseases[4].

Antimicrobial resistance is a large threat to the world's public health, as it triggers a series of consequences that compromise not only the patients but all population, for example: increase in morbidity and mortality, as well as in the hospitalization period, among others that impose huge costs to all countries[4]. It is estimated that 700,000 deaths are caused annually by resistance to antimicrobials[5].

The rational use of the antimicrobials is directly linked to patient safety. In this context, the World Health Organization (WHO), in a partnership with the Joint Commission International (JCI), has set up international goals for patient safety, one of them having as objective to avoid harms to the patients and to reduce the negative consequences arising from care

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conducted in an unsafe manner. Goal 3 has the premise of improving the safety of high surveillance medications when there is a high percentage of errors and a high risk of adverse events. Errors in the drug administration stage have a high risk of causing severe adverse events, which can be related to bacterial resistance by the incorrect use of antimicrobials[6].

Thus, in the last years, the discussions regarding Antimicrobial Stewardship have increased considerably. Programs are being set up worldwide with the objective of optimizing the prescription of antimicrobial services in health to ensure the maximum pharmacotherapeutic effect, reducing the occurrence of adverse events (AEs) in the patients, preventing the selection and spread of resistant microorganisms and, thus, reducing the costs of assistance[4].

In the hospital environment, Nursing appears as the largest segment among health professionals, responsible for planning, administering, and caring for the patients that use antimicrobial therapy.

Among the activities of nurses regarding the safe use of antimicrobials, we highlight the following responsibilities: assuring that the bacterial cultures are conducted before administering the antibiotics; promoting discussions about the possible adverse effects caused by the antimicrobials; and reviewing the drug prescriptions daily, according to the treatment indicated by the physician[7]. In this context, their work, participation, and involvement become essential to ensure safety in the use of antimicrobials in order to prevent and reduce the microbial resistance[8].

In 2017, the American Nursing Association published a "whitepaper", exploring the potential function of a nurse in the stewardship and rational use of antimicrobials, aiming to demonstrate how nurses can become more engaged and take on the role of

leadership to promote am error-free and more efficient antimicrobial stewardship. This study aims to identify the strategies for the safe use of antimicrobials adopted by Nursing in the hospital environment.

METHOD

This is an integrative review, elaborated from six recommended stages: identification of the topic and selection of the research question; setting up criteria for the inclusion and exclusion of studies/sampling; search in the literature; definition of the information to be extracted from the selected/categorized studies; evaluation of the studies included/interpretation of the results; presentation of the review with knowledge synthesis[7]. This review adopted the recommendation from the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) checklist[10,11].

To build the research question, the PICO strategy was used: "P" corresponding to the population (nursing team); "I" to the intervention (strategies for the safe use of antimicrobials); "C" to the context (hospital environment); and "O" to the outcome (reduction of antimicrobial resistance). The research question built was the following: What are the strategies of the Nursing team related to the safe use of antimicrobials for the reduction of antimicrobial resistance in the hospital environment?

The criteria for the inclusion of the publications were articles available in full, in English, Portuguese, and Spanish, addressing the Nursing strategy related to the safe, rational use and the stewardship of antimicrobials in the hospital environment, published from 2015 to June 2020. The exclusion criteria were duplicate and review articles.

The search for the articles was carried out in the following databases: *LILACS* (*Literatura Latino-Americana e do Caribe em Ciências da Saúde*) via *BVS* (*Biblioteca Virtual de Saúde*); *Medline/PubMed* (Medical Literature Analysis and Retrieval System on-line); *CINAHL* (Cumulative Index to Nursing and Allied Health Literature); and

EMBASE (Excerpta Medica dataBASE). Access to the controlled databases was through the CAPES platform.

The following controlled words from the Medical Subject Headings (MESH) and the Embase Subject Headings (EMTREE) were used: "drug resistance, microbial"; "drug resistance, bacterial"; "antimicrobial stewardship"; "Nursing care"; as well as the following headings in the Health Sciences Descriptors (*Descritores em Ciências da Saúde*, DeCS) database: "resistência microbiana a medicamentos"; "farmacorresistência bacteriana"; "gestão de antimicrobianos"; "cuidados de enfermagem", and the following headings in Spanish (*descriptores*): "farmacorresistencia microbiana"; "farmacorresistencia bacteriana"; "Programas de optimización del uso de los antimicrobianos"; "Atención de enfermería". The search took place in 2020.

The headings were used in a controlled and non-controlled manner to obtain widespread search in the literature about the subject matter addressed aiming to find and analyze the available studies. The crossing of controlled and uncontrolled headings was mediated by the Boolean operators *"AND"* and *"OR"*.

From the selection and crossing of the controlled non-controlled headings, a PRISMA flowchart was built which is detailed at the beginning of the results, according to protocol recommendation[11].

Initially, analyses of the titles and abstracts were conducted; subsequently, an analysis of the studies in full, according to the inclusion criteria, and from which excerpts of interest were selected.

For the quality and evidence analysis, the Grading of Recommendations Assessment, Development and Evaluation (GRADE)[12] method was adopted for epidemiological studies was adopted and, for quantitative studies, GRADE-CERQual[13]. In both methods, the quality of the evidence is classified into four levels: high, moderate, low, or very low[12,13](Figure 1). In these methods, four components are used to

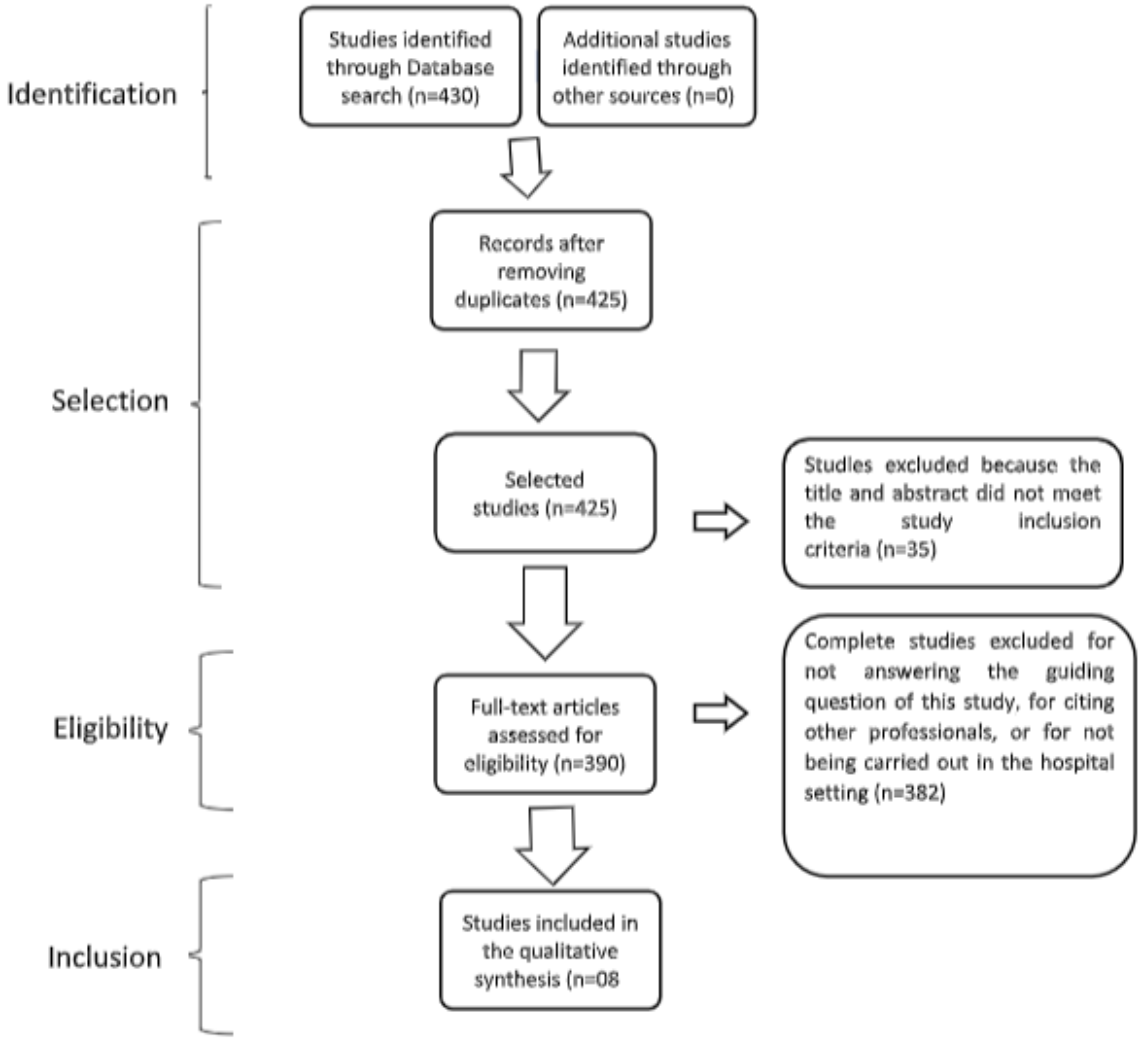
assess the level of evidence in the findings from the qualitative research review (also referred to as a synthesis of qualitative evidence): (1) methodological limitations; (2) coherence; (3) data adequacy; and (4) relevance.

The data are presented in a descriptive manner in order to understand the context of the available evidence on the safe use of antimicrobials.

Figure 1 - Adapted PRISMA flowchart[11]. Rio de Janeiro, RJ, Brazil, 2020.

RESULTS

Eight studies were selected, all international: five (62.5%) conducted in the United States of America, two (25%) in Europe and one (12.5%) in Australia. Regarding the year of the publications, five studies were from 2019 and one from 2020, which shows an increase in the discussion on the theme in the last year, as presented in the adapted PRISMA flowchart[11] in Figure1.



Source: Adapted PRISMA[11], 2020.

Regarding the level of evidence (Figure 2), only one study[14] was classified as with high level of evidence, which shows that research studies are still incipient on the theme.

All the studies analyzed highlighted the importance of the nursing team's performance to increase the safety of antimicrobial use. Nursing strategies

were highlighted in the main findings and will be discussed later.

In Figure 2, the eight studies were tabulated with the study authors and year, place and country(ies) of development, level of evidence according to GRADE, objective, method, and main findings.

Figure 2 - Synthesis of the studies included in the Integrative Review. Rio de Janeiro, RJ, Brazil, 2020

Authors/ Year	**Place/ Country(ies)**	**Level of Evidence** (GRADE/ GRADE-CERQual)	**Objective**	**Method**	**Main findings**
Ha D.R., ForteM.B., Olans R.D., OYong K., Olans R.N., Gluckstein D.P., et. al.2019[14].	Pomona Valley Hospital Medical Center, USA	High (GRADE)	To measure the use of antimicrobial drugs in four clinical groups by the nursing team as clinical support.	Longitudinal study with intervention	Compared to the 12-month pre-intervention period of the nursing team, there was a meaningful reduction in the use of antimicrobials by unit (791.2 vs.697.1 days of therapy by 1,000 patients/day; p = 0.03). The study demonstrated the well-implemented involvement of the nurses in activities of antimicrobial stewardship and in the prevention of infection.
Olans R.D., Olans R.N., Witt D.J. 2017[15]	Hospital, USA	Very low (GRADE CERQual)	To analyze the activities of antimicrobial stewardship that can be carried out by nurses.	Expert reports based on clinical experiences	Nurses are essential for the proper use of antibiotics. It describes the nursing actions for the rational use of antibiotics at admission, during hospitalization, and at patient discharge.

Carter EJ, Greendyke WG, Furuya EY, Srinivasan A, Shelley AN, Bothra A, et al.2019[16]	Hospital, USA	Moderate (GRADE CERQual)	To explore the attitudes of nurses in five of the antibiotic stewardship activities recommended by the workgroup at the CDC (Center for Disease Control).	Qualitative descriptive study. Focus group	Nurses can play an important role in antibiotic stewardship. Five nursing actions recommended for safe antibiotic stewardship are highlighted. These actions are ways of turning the nurse into an active partner in the rational use of antibiotics.
Castro-Sánchez E, Gilchrist M, Ahmad R, Courtenay M, Bosanquet J, Holmes AH. 2019[17]	Hospitals and health houses, United Kingdom	Moderate (GRADE CERQual)	To involve the participation of Nursing in antimicrobial stewardship by three broad models: vertical, horizontal, and hybrid.	Descriptive study	A variety of models articulating the participation of nurses in antimicrobial stewardship was already implemented in public sector organizations in the United Kingdom. It highlights the strengths and weaknesses of each model and describes the nurse's action in the reduction of antimicrobial resistance.
Jump RLP, Gaur S, Katz MJ, Crnich CJ, Dumyati G, Ashraf MS, et al. 2018[18]	Long-term care facilities, USA	Very low (GRADE)	To help long-term care configurations to set up programs of quality antibiotic stewardship.	Experience report	It highlights the creation of committees related to the rational use of antimicrobials; the creation of infection prevention and control protocols; the disclosure of antibiogram data; the need for measuring and monitoring antibiotic use; the implementation of the "antibiotic time out" and training of the professionals.

Ierano C, Thursky K, Peel T, Rajkhowa A, Marshall C, Ayton D. 2019[19]	Hospitals, Australia	Moderate (GRADE CERQual)	To identify barriers and enablers of appropriate prescription of surgical antimicrobial prophylaxis.	Qualitative study Focus group	The prescription of surgical antimicrobial prophylaxis is a complex and multi-professional process. Behavior changes are necessary to identify the barriers and enablers for the ideal prescription of antimicrobial prophylaxis.
Courtenay M, Burnett E, Castro-Sánchez E, Moralez de Figueiredo R, Du ToitB, Gallagher R, Gotterson F, et al. 2020. [20]	Hospitals, European countries	Moderate (GRADE)	To recognize the nurses as legitimate collaborators of the antimicrobial stewardship team during the COVID-19 pandemic.	Quantitative observational study	It demonstrates that, by involving nurses in the performance of their role in antimicrobial stewardship, there is awareness by the nurses of the importance of responsible antimicrobial management.
Lane, Michael A; Hays, Amanda J; Newland, Helen; Zack, Jeanne E; Guth, Rebecca M; Newland, Jason G. 2019.[21]	Hospital, USA	Moderate (GRADE)	To describe the development of an antimicrobial stewardship hospital program in an integrated health system.	Retrospective study	The implemented antimicrobial stewardship model facilitated the development of antimicrobial stewardship. Educational modules for patients and clinical decision support modules for professionals were included.

Source: Authors, 2020.

Among the main Nursing strategies described in the analyzed studies, we highlight the importance of activities for the prevention of infection and the specificities of the antimicrobial stewardship technique[14,16,18, 19,21].

We also highlight the importance of creating committees and protocols in the prevention and control of infection; the use of antibiogram data; measurement and monitoring of the antibiotic use; of indicators of epidemiological surveillance

of the infections related to health care; surveillance at the end of the administration of the antimicrobial; and training of professionals[18].

The work of the multi-professional team is widely cited, ratifying the importance of identifying barriers and enablers in the antibiotic prescription(18,19). Many studies highlight that the work of nurses is essential for the proper use of antibiotics both at hospital admission/screening and in the routine, during the hospitalization period and guidelines after discharge[15,18].

Nurses' awareness and patient education are also seen as necessary activities for the rational use of antimicrobials[20,21].

Thus, it is perceived, in a general manner, that Nursing care and managerial strategies were identified, which are related to the safe use of antimicrobials (Figure 3).

Figure 3 - Main Nursing managerial and care strategies. Rio de Janeiro, RJ, Brazil, 2020

Managerial strategies	Care strategies
Formation of Interdisciplinary Monitoring Committees	Appropriate hospitalization screening directed to the use of antimicrobial
	Multidisciplinary assistance with inter-professional collaboration
Training and updating for professionals through platforms	Use of protocols for surgical antibiotic prophylaxis
	Adequate time to start and administer the antibiotic therapy
	Re-evaluation of the antimicrobial plan every 2 to 3 days after the beginning of the antibiotic therapy

Source: Authors, 2020.

DISCUSSION

Among the searches conducted, all the studies highlighted the importance of the nurses in the management of antimicrobial use, some for having greater contact with the patients, since they are present from admission until discharge; others because they represent one of the largest workforces in Europe[22].

In the Brazilian reality, Nursing is also the largest professional category in the health field, strongly inserted in the Unified Health System (*Sistema Único de Saúde*, SUS) and working in the

public, private, philanthropic, and teaching sectors. In this sense, it is understood that the strategies adopted and managed by nurses can cause greater impact on the population[23].

A recent example of the importance of the nurse's work in the rational use of antimicrobials was evidenced during the coronavirus (SARS-CoV-2) pandemic. Nurses were the first health professionals to have contact with patients infected by this disease and to recognize the signs and symptoms. Therefore, COVID-19 concentrated the attention on the power and potential of nurses to promote antimicrobial stewardship[20].

Among the main managerial activities carried out by nurses to ensure antimicrobials use, a study highlights the formation of multidisciplinary Monitoring Committees, including a nurse in each hospital that would be devoted to the improvement in the quality of antibiotic stewardship. This committee is intended to track and use the data for evaluation, to set up goals, and to elaborate an annual report to be shared with the care team. This committee should also support and facilitate advanced training regarding the theme[18].

Well-implemented managerial programs require the active involvement of all health specialties to implement strategies, initiatives, and actions to reduce the antimicrobial resistance[27].

Another managerial strategy highlights the need for training and updating the professionals. A study points that, in addition to the regular training already provided for in the general training curriculum, in the practice, training materials are needed which are based on evidence, and the ideal is that nurses have available easy-access tools at the work station[18].

In this sense, the concept of education in health can take on a broader dimension, when it is accepted as a means of enabling the transformation of the professional working environment, with regard to professional development of the subjects by means of the learning process that this education modality can trigger, resulting in a dynamic and

complex movement, focused on better performance[30].

Managerial activities are aimed at creating adequate conditions for care implementation[28]. As described, these strategies are fundamental for planning the practice of care activities.

Among the practical care strategies related to the management of antimicrobials, it is evidenced that they must begin even during the screening for a hospitalization. Proper screening is part of the nurse's work during hospital admission, they must ask the patient about their drug allergy history, mainly about antibiotics, and signals and symptoms referring to these allergies[16]. It is important to record this information in a sequence in the medical chart in order not to lose it during hospitalization and so that everyone can access it.

In order for this information not to get lost during hospitalization, studies have been discussing communication among the professionals as part of successful antimicrobial stewardship. Inter-professional collaboration requires shared care in the decisions and antimicrobial treatment plans and in the expected outcomes referring to this therapy[20].

A recent research study on the main antimicrobial stewardship programs suggests that a multidisciplinary approach, with activities of antimicrobial stewardship incorporated into the direct care team's routine functions, offers advantages over the traditional model. [14] Professional interaction is fundamental for the institution to accomplish quality performance aiming at patient satisfaction and safety[29].

Another attention point would be the unnecessary use of "prophylactic" antibiotics, as this increases bacterial resistance and most often does not have the expected efficacy[18]. Antibiotics need to reach the minimum inhibitory concentrations in blood plasma for the prophylaxis action to be effective; it is for this reason that the time of administration of the first dose must be followed, administrations out of this time can increase the colonization of the surgical site and the risk of infection. In this sense, studies point to the

institution of protocols for the use of antibiotic prophylaxis in hospitals[18].

Another assistance strategy refers to the adequate time to start the antibiotic therapy. According to the 2016 International Guidelines for the Treatment of Sepsis and Septic Shock, speed in the administration is fundamental for the beneficial effects of the proper antimicrobials. The available data suggest that the early administration of proper intravenous antimicrobials after recognizing sepsis or septic shock produce ideal results: 1 hour is recommended as a minimum and reasonable target[30].

According to the recommendations of the international guidelines, the study selected in the analysis of this review ratifies that, when receiving the antibiotic prescription, the nurse must review it and plan all doses that will be used until the end of the referred administration[15].

In many institutions, nationally and internationally, it is common for nurses to have access to the results of laboratory and radiological examinations before the entire team. This practice allows the professional to analyze them and carry out this follow-up with the physician responsible for the treatment, which allows for the therapy to begin early, in a more agile manner, and for the monitoring to become safer.[15]

From the laboratory analysis and evaluation of the patient's condition, the intervals and staggering of antibiotics are adjusted. It is recommended to re-evaluate the antimicrobial treatment plan from 2 to 3 days after its initiation, and it can be decided to restrict, diminish or interrupt the therapy[18] or even change from a broad-spectrum to a narrow-spectrum antibiotic[16].

In a hospital in the United States, antimicrobial therapy reviews were defined upon active discussions documented between nurses and the round teams with regard to their indication and adequacy[14].

In Australia, nursing professionals are legally qualified to prescribe antimicrobials. Nurses are familiar with the administration of antimicrobials and with the operational environment; it is

considered that they have a positive impact on the development and implementation of an intervention in the surgical antimicrobial prophylaxis[19].

Also as a practical assistance strategy, it is recommended that the nurse evaluates the patient's daily progress and observes possible adverse events related to the antibiotic therapy. By means of this evaluation, treatment may be interrupted before the expected or even come to a determination for early end by an administration route, for example, changing the intravenous route to oral and anticipate hospital discharge. Perceiving if the outpatient antibiotic therapy will be able to be followed by the patient or even by the family member can assure a shorter time of hospital stay, patient satisfaction, and success in the treatment after discharge.[15]

According to recent publications, nurses are considered essential in the Antimicrobial Management Programs in virtue of their core position of communication, care coordination, monitoring the patient state 24 hours/day, safety and response to the antimicrobial therapy[24].

The role of the nurse as an educator of the patient or the responsible person can be also highlighted, giving instructions by means of leaflets, training and informative materials.

The educational strategy carried by a nurse with patients and family members is described in an American study as an essential tool for the prevention of the inadequate use of antibiotics and of the possible development of antimicrobial resistance during hospitalization and discharge[15]. Also in Brazil, education in health is a practice mainly developed by Nursing based on the users' health needs. However, education related to the use of antimicrobials is still very restricted to health professionals[24].

Increasingly, the importance of involving patients and including them in the decision to optimize antimicrobial stewardship efforts has become recognized[25]. Continuing education carried out by nurses was reported in the retrospective study that took place in the United States, which used shared

learning platforms for the team's use, including educational modules for patients and support for clinical decisions[21].

CONCLUSION

In light of the research objective, the strategies for the safe use of antimicrobials were categorized into managerial strategies and care strategies. Among the managerial, it is worth mentioning the formation of interdisciplinary monitoring committees and the provision of training and updating for professionals through platforms. Among the care strategies, the following stood out: appropriate hospitalization screening directed to the use of antimicrobial; use of protocols for surgical antibiotic prophylaxis; adequate time for the beginning and the administration of the antibiotic therapy; and reassessment of the antimicrobial plan every 2 to 3 days after the beginning of antibiotic therapy.

All these strategies are recommended to minimize the risk of antimicrobial resistance in the hospital context, making the practice of drug administration safer and contributing to the achievement of the WHO international goal. The importance of multidisciplinary care appears as the basis for the safe use of antimicrobials.

Despite the increase in the number of publications referring to this topic in the last year, no national study was found, only American and European ones, which distances the publications found from the Brazilian Nursing reality, both in the training and the work routine.

As a limitation of the study, we point to the fact that most of the studies have been conducted in only one research site, which reduces the possibility of inference of results and of the practices applied. Few articles referred exclusively to the performance of the nurse, most of them deal with the rational use of antimicrobials in a multi-professional manner, dividing the focus of the professional in prominence.

It is recommended that experimental studies be carried out, especially directed at national initiatives for the development of other strategies aimed

at guaranteeing safety in the use of antimicrobials in the hospital context.

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