



## Quality management tools applied to *Candida Auris* prevention and control measures

*Ferramentas de gestão da qualidade aplicadas às medidas de prevenção e controle de Candida Auris*  
*Herramientas de gestión de calidad aplicadas a las medidas de prevención y control de Candida Auris*

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### ABSTRACT

**Background and Objectives:** To report the experience of nurses from the Hospital Infection Control Committee (CCIH) in dealing with the *Candida Auris* outbreak in a health service using quality management tools. **Methods:** Experience report on prevention and control measures for the *Candida Auris* outbreak in a trauma referral hospital in Pernambuco using the methodological framework of the PDCA and 5W2H quality management tools. **Results:** An action/contingency plan was established for the lack of active laboratory and environmental screening/surveillance, lack of an internal and external patient flow protocol, limitations in the cleaning and disinfection steps, failure to adhere to precautionary measures, lack of knowledge about *Candida Auris*, and lack of human resources. **Conclusion:** The experience made it possible to reflect on the need for immediate action to adopt control measures and prevent the spread of an emerging fungus in the hospital environment. Faced with a new challenge to public health, care delivery needs to be effective to maintain a safe environment.

**Keywords:** *Candida auris*. Management for Continuous Quality Improvement. Patient isolation. Infection control.

### RESUMO

**Justificativa e Objetivos:** Relatar a experiência de enfermeiros da Comissão de Controle de Infecção Hospitalar (CCIH) para o enfrentamento do surto de *Candida auris* em um serviço de saúde com o uso de ferramentas de gestão da qualidade. **Métodos:** Relato de experiência sobre as medidas de prevenção e controle do surto de *Candida auris* em um hospital de referência de trauma em Pernambuco sob o referencial metodológico das ferramentas de gestão da qualidade ciclo PDCA e 5W2H. **Resultados:** Foi instituído plano de ação/contingência para ausência de rastreio/vigilância ativa laboratorial e ambiental, ausência de protocolo de fluxo interno e externo de pacientes, limitações nas etapas de limpeza e desinfecção, falha na adesão às medidas de precaução, falta de conhecimento sobre *Candida auris* e déficit de recursos humanos. **Conclusão:** A experiência possibilitou refletir sobre a necessidade da atuação imediata para adoção de medidas de controle e prevenção da disseminação de um fungo emergente no ambiente hospitalar. Diante de um novo desafio para saúde pública, a prestação de cuidados precisa ser efetiva para manter o ambiente seguro.

**Descritores:** *Candida auris*. Gestão para Melhoria Contínua da Qualidade. Isolamento de pacientes. Controle de infecções.

### RESUMEN

**Justificación y Objetivos:** Reportar la experiencia de enfermeros del Comité de Control de Infecciones Hospitalarias (CCIH) en el abordaje del brote de *Candida Auris* en un servicio de salud utilizando herramientas de gestión de calidad. **Métodos:** Informe de experiencia sobre medidas de prevención y control del brote de *Candida Auris* en un hospital de referencia de traumatología de Pernambuco, bajo el marco metodológico de las herramientas de gestión de calidad ciclo PDCA y 5W2H. **Resultados:** Se estableció un plan de acción/contingencia por la falta de control/vigilancia activa de laboratorio y ambiental, falta de protocolo de flujo interno y externo de pacientes, limitaciones en las etapas de limpieza y desinfección, incumplimiento de medidas de precaución, desconocimiento sobre *Candida Auris* y déficit de recursos humanos. **Conclusión:** La experiencia permitió reflexionar sobre la necesidad de actuar de forma inmediata para adoptar medidas para controlar y prevenir la propagación de un hongo emergente en el ambiente hospitalario. Ante un nuevo desafío para la salud pública, la prestación de atención debe ser eficaz para mantener el medio ambiente seguro.

**Palabras Clave:** *Candida auris*. Gestión para la Mejora Continua de la Calidad. Aislamiento de pacientes. Control de infecciones.

## INTRODUCTION

According to data from the World Health Organization (WHO), approximately 700,000 people die annually due to infections caused by resistant microorganisms, with estimates projected to reach 10 million people per year by 2050.<sup>1</sup> The magnitude of this problem requires that healthcare services have a commission tasked with structuring measures for the prevention and control of healthcare-associated infections (HAIs).<sup>2</sup> The control of HAIs is carried out by the Hospital Infection Control Committee (HICC), whose actions are planned and executed to minimize infections acquired in the environment, as well as the rate of multidrug-resistant microorganisms.<sup>3</sup>

Multidrug resistance is related to the ability of a microorganism to respond to treatment due to its resistance to medications. Such situations require precautionary and isolation measures appropriate to the type of infection in order to prevent its spread in the environment.<sup>4</sup> The causative agents are mostly bacteria, viruses, protozoa, and fungi, which are present in the environment and, above all, in hospital environments. Therefore, prevention and control actions, the development and application of precautionary and isolation protocols, management of antimicrobial use, and surface cleaning and disinfection protocols are essential for containing outbreaks in these environments.

As a recent example, Brazil has experienced an outbreak of *Candida auris* (*C. auris*), an emerging and multidrug-resistant fungal species that can cause serious infections in patients, especially those who are immunocompromised or who already have underlying diseases. This is a global emergency, as *C. auris* is referred to as a public health threat, given its high resistance to one or more classes of available antifungals. This fungus was first identified as causing disease in humans in 2009 in Japan, and since then, 13 countries have been affected. By the end of 2021, 3,270 infections and 7,413 cases of colonization had been reported.<sup>5</sup>

In the United States of America (USA), *C. auris* has been identified in 27 states, with the highest number of cases in California, Florida, Illinois, Nevada, New York, and Texas, where most occurred in chronic care facilities, but there have also been outbreaks in intensive care hospitals.<sup>6</sup> In Brazil, the first cases occurred in 2020 in Salvador, Bahia, and in December 2021 in Recife, Pernambuco. In May 2023, new outbreaks were reported in Pernambuco, and in June 2023, the first case was reported in the state of São Paulo, totaling 77 cases in the country.<sup>7</sup>

Since this microorganism is not endemic to Brazil, the occurrence of a single case in healthcare facilities is considered an outbreak. Therefore, to address this, the

following are considered: the difficulty of timely identification of isolates using routine laboratory methods; the fungus's long persistence in the environment; its resistance to various disinfectants; and the production of antifungal-tolerant biofilms.

It is noteworthy that, due to its high resistance, it can survive for weeks or months in the environment. Therefore, evidence suggests the environment as the main reservoir, facilitating the spread of the fungus through surfaces, contaminated equipment, and direct contact with patients. In this sense, Florence Nightingale's environmental theory, which focuses on the environment, states that all conditions existing in this environment can influence the individual's health-disease process.<sup>8</sup> Based on this understanding, it was possible to develop techniques for the prevention and control of healthcare-associated infections (HAIs).

For quality management and patient safety in healthcare services, concern for the environment is essential, as it reflects care based on controlling the environment surrounding the patient. From this perspective, the use of quality management methodologies and tools such as the PDCA Cycle and the 5W2H tool represent innovative and relevant models for change, as they facilitate the organization and development of actions applied to best practices in healthcare, as well as the strategic restructuring of processes in controlling outbreaks of this nature.<sup>9-10</sup>

The PDCA cycle aims to provide continuous improvement of processes for problem-solving through four phases, which seek Plan, Do, Check, and Act.<sup>11</sup> The 5W2H methodological tool uses seven words in English: what, why, who, where, when, how, and how much, to refer to the main points of an action plan.<sup>12</sup>

An action/contingency plan based on the PDCA Cycle and 5W2H management tools for analyzing a situation such as a *Candida auris* outbreak allows for defining, measuring, and proposing assertive and appropriate decision-making to mitigate or solve problems and their additional causes. As a public health problem, it is an undesirable result of a work process, requiring its identification and recognition of the additional causes for its occurrence in the context in which it presents itself.

Thus, in emergency situations and the suspicion or confirmation of infections by emerging microorganisms, it is important to disseminate knowledge about lived experiences in containing outbreaks due to their resistance and pathogenicity. Therefore, this study aims to report the experience of nurses from the Hospital Infection Control Committee (HICC) in dealing with a *C. auris* outbreak in a health service using quality management tools.

## METHODS

Nurses from the Infection Control Committee reported their experience on the operationalization of the action/contingency plan to deal with the *C. auris* outbreak in conjunction with a multidisciplinary committee composed of 12 members and consisting of the following professional categories: four doctors (two infectious disease experts, one intensivist and one clinician), five nurses, two biomedical scientists and one pharmacist who received advice from the following health authorities and experts: from the National Health Surveillance Agency (ANVISA), from the Pernambuco State Health Surveillance Agency (APEVISA), from the Center for Strategic Information in Health Surveillance (CIEVS) and from the Central Public Health Laboratory in Pernambuco (LACEN-PE).

This report follows the recommendations described in the technical note with guidelines for the identification, prevention, and control of *C. auris* infections in healthcare settings.<sup>13</sup> For the action plan, quality management tools such as the PDCA cycle were used, which consists of an iterative management method for problem-solving.<sup>14</sup> The cycle is based on four stages: P for plan, D for do, C for check, and A for act, and each of them is related to the actions performed (Table 1).

**Table 1.** PDCA cycle for prevention and control actions of the *Candida auris* outbreak in Recife, 2024.

PDCA Cycle Stages	
Plan	Analysis of the problem and additional causes (Brainstorming) Action/contingency plan (5W2H)
Do	Execution of the courses of action.
Check	Verification of the results obtained from the implemented courses of action.
Act	Review and sharing of action plans

The action/contingency plan took place in a reference trauma hospital in the state of Pernambuco, which has a total of 833 beds in the specialties of trauma and burns, clinical and surgical wards, surgical center, general Intensive Care Unit (ICU), neurological ICU and pediatric ICU. The institution had 47 confirmed cases during the year 2022.

The data were collected during the planning and execution of contingency actions for the control of *C. auris* in the institution. The first stage (Plan) consisted of identifying the problems and additional causes, defining the courses of action, creating the plan and improving processes. Also, for the planning stage, brainstorming and the 5W2H tools (What? - What?, Why? - Why?, Who? - Who?, Where? - Where?, When? - When?, How? - How? and How much? - How much does it cost?) were applied. The second stage (Do) consisted of involving the responsible individuals and executing the plan. The third stage (Check) consisted of analyzing whether everything was executed as planned and whether the expected result occurred. The fourth stage (Act) consisted of sharing the learning, standardizing the process, and reflecting on what could

be changed. The data were analyzed under the quality indicators and goals defined in the PDCA cycle, focusing on prioritizing the previously defined lines of action and continuously improving the processes.

The priority courses of action established for the emerging health condition were carried out systematically throughout 2022 and adjusted after each new discussion among the commission members and consultation with experts in the field during 2023. The last confirmed case in the series of cases occurred in September 2022, and since then, surveillance and monitoring actions have remained, considering the workflows and operational capacity defined by the commission members.

This study reflected the authors' opinions/experiences and the mobilization for strategic action plans implemented during the outbreak response period, based on scientific studies, technical notes, advice, and expert associations. Initially, with the participation of the Pernambuco State Health Surveillance Agency (APEVISA), a multidisciplinary committee was established to combat *C. auris*, defining responsibilities and priorities for actions to be developed in the hospital. The group included nurses and physicians from the Infection Control Committee (HICC), and representatives from the following management areas: medical, nursing, patient safety, cleaning service, waste management, pharmacy/supplies, and microbiology laboratory, to enable the development of integrated actions. This committee organized an activity schedule and met monthly, either in person or remotely, to plan best practices and strategies for controlling the spread of the fungus.

An outbreak of *Candida auris* is a public health problem and an undesirable outcome of a work process, making its identification and recognition of the additional causes for its occurrence in the context in which it presents itself necessary. The brainstorming tool was used as a technique to collect the main difficulties regarding prevention and control measures to address the *Candida auris* outbreak.<sup>15-16</sup>

## RESULTS

Brainstorming allowed for a situational diagnosis of the problem and the following additional causes in the planning stage: lack of active laboratory and environmental screening/surveillance, limitations in cleaning and disinfection steps, lack of internal and external patient flow protocol, failure to adhere to precautionary measures, lack of knowledge about *Candida auris*, and a shortage of human resources.

As an epidemiological alert, a *C. auris* outbreak requires an action/contingency plan, and its operationalization requires verifying the history of the problem through its frequency and mode of occurrence

to prioritize lines of action and responsibilities by individual or group, and to propose a deadline for solving the problem.

Thus, aiming at the execution of a more assertive action plan, the 5W2H tool was applied to support the formation and execution of the plan. The

action/contingency plan is represented in detail, presenting the necessary activities to be followed by managers and teams with a view to the opportunity for improvement suggested by the multidisciplinary committee for outbreak control (Table 2).

**Table 2.** 5W2H tool applied to the established courses of action. Recife, 2024.

<i>Candida Auris</i> outbreak						
What?	Why?	Who?	Where?	When?	How?	How much?
Active laboratory surveillance	Track users at highest risk of colonization/infection.	Infection Control Nurses; Microbiology Laboratory; LACEN-PE	Adult ICU; Trauma Emergency Room; PACU; Neurosurgery Ward	Weekly	Through the use of supplies - PPE, swabs, Sabouraud dextrose agar broth	Proposed price for supplies and laboratory analysis.
Active environmental surveillance	Tracking the presence of the fungus on high-touch surfaces in inpatient units.	Nurses from the Infection Control Committee; Microbiology Laboratory; LACEN-PE	Adult ICU; Trauma Emergency; Clinical Emergency; OR; PACU; Imaging Departments	To be defined according to schedule.	Through supplies - PPE, swabs with sponges, sterile plastic bags	Proposed price for supplies and laboratory analysis.
Internal and external patient flow protocol	Perform isolation or cohort studies for suspected/confirmed cases; Perform 3 consecutive biological samplings on contact patients; Perform consecutive biological sampling in high-risk scenarios for safe discharge/transfer;	Multidisciplinary committee; HICC team	Internal Regulation Unit; ICU (10 beds); Isolation ward (8 beds);	As needed	Through the development of protocols and SOPs by a multidisciplinary team and with expert advice.	No additional cost.
Cleaning and disinfection	Establish a cleaning and disinfection schedule according to the criticality of the inpatient area; Standardize an effective sanitizing agent for fungal control; Review/Develop SOPs for cleaning inpatient areas and environmental surfaces;	Cleaning service team; Health team responsible for cleaning electromedical equipment and health products;	Inpatient wards according to criticality.	Daily concurrent cleaning - with adaptations according to the criticality of the area; Weekly terminal cleaning - with adaptations according to the criticality of the area.	Through Supplies - PPE, sanitizing products, cleaning materials;	Proposed price for the necessary supplies and for the purchase of a suitable sanitizing product.
Precautionary measures	Establish best practices in the use of standard precautions and contact precautions.	Cleaning service team; Health team;	Inpatient wards according to criticality.	Daily use	Hand hygiene as directed; Supplies - PPE;	Preço proposto para os processos e insumos necessários

continue

Knowledge about <i>Candida Auris</i>	Disseminate knowledge about measures to prevent control fungus.	Multidisciplinary committee; Infection Control Committee team; PEC	Healthcare team; Cleaning service team	As needed	Production of teaching materials; Theoretical and theoretical-practical training; Webinars;	Sem adicio nal	custo
Human resources shortage	Increase the technical staff	State Health Department	Infection Control Committee team; Cleaning service team; Microbiology Laboratory	As needed	Fixed-term contract/Public competition	Compensation as per the public notice for hiring/competition.	

Abbreviation: HICC: Hospital Infection Control Committee; OR: Operating room; PPE: Personal Protective Equipment; LACEN - PE: Central Public Health Laboratory of Pernambuco; PEC: Permanent Education Center; SOPs: Standard Operating Procedures - PACU: Post-Anesthesia Care unit; ICU: Intensive Care Unit.

Based on the evidence identified in the guidelines and technical notes developed, the following courses of action were defined and described for the problem and the additional causes identified for the prevention and control of the spread of new cases (Table 3).

**Table 3.** Defining the courses of action based on the identified problem/additional causes. Recife, 2024.

Additional Problem/Causes	Course of action
Lack of active laboratory and environmental screening/surveillance.	Implementation of axillary/inguinal/nasal surveillance swab collection for patients at higher risk of colonization/infection in critical care settings; Implementation of axillary/inguinal/nasal surveillance swab screening/collection for contacts of positive patients; Implementation of environmental sampling in inpatient settings for positive patients and in settings for hospitalized patients at higher risk of colonization/infection; Definition of high-touch surfaces and electromedical equipment for environmental sampling (bed, IV stand, medication preparation station, infusion pump, mechanical ventilator, multiparameter monitor, non-invasive blood pressure cuff, thermometer, among others).
Limitations in the cleaning and disinfection steps	Planning/Scheduling of cleaning and disinfection stages for the environments; Standardization of cleaning and disinfection processes with appropriate sanitizers; Expansion of concurrent and terminal cleaning in isolation/cohort areas and critical service areas; Monitoring of cleaning quality using a fluorescent marker with ultraviolet light.
Lack of internal and external patient flow protocol.	Active case finding and clinical registration of confirmed, suspected, and contact cases from admission to outcome; Implementation of isolation areas and cohorts for suspected/confirmed cases according to clinical profiles and dependence on care and critical care; Implementation of screening and monitoring of patients who have been in contact with suspected/confirmed cases, observing the persistence of negative results in three consecutive laboratory tests on biological samples from contacts; Establishment of effective partnerships and communication with the microbiology laboratory to mitigate the spread and optimize workflows; Institution of precautionary measures.
Failure to adhere to precautionary measures.	Monitoring adherence to standard and contact precautions by healthcare teams and cleaning service professionals.
Lack of knowledge about <i>Candida Auris</i>	Continuing education for healthcare teams and cleaning service professionals in partnership with the Permanent Education Center, Study Center, and Telehealth Center of the Pernambuco State Health Department on topics of interest for addressing the outbreak.
Human resources shortage	Additional hiring of human resources for the Infection Control Committee, cleaning, and microbiology laboratory teams to implement the previously described action plans.

## DISCUSSION

The experience gained by nurses as members of the multidisciplinary committee allowed for an active process in epidemiological investigation and active

search for suspected/confirmed cases and contacts. The epidemiological investigation also made it possible to understand and situate the *C. auris* outbreak in order to evaluate the starting points, resources, and professionals involved in the systematization of actions.

The deliberation on the processes established based on quality management tools and assertive decision-making allowed for the identification and follow-up from the moment of admission to the health service to the clinical outcome of the cases. The support received from health authorities and specialists contributed to the successful outcome in containing *C. auris*.

The containment of an outbreak of this nature highlights the essential role of the nursing team in addressing it, not only because of their technical capacity, but also because it is a professional category that is predominantly at the patient's side. The plurality of nurses' training and their leadership capacity played a leading role in the active search for confirmed cases and isolation, the fight against disease transmission, and attention to protection, prevention, and control protocols for cases in epidemiological scenarios such as that of *C. auris*.<sup>17-18</sup>

Active laboratory and environmental surveillance are priority actions. The collection of nasal, axillary, and inguinal swabs from patients in these anatomical sites is corroborated by studies that point to the pathogen's predilection for these areas. And because it is a fungus that can opportunistically colonize/infect any part of the human body, such as the bloodstream and other locations that can be fatal, especially in immunocompromised patients or those with comorbidities. Thus, patients "invaded" by procedures, such as: mechanical ventilators, catheters for punctures and accesses, among others, are more exposed to contamination and more serious outcomes from the fungus.

A case series study conducted in the US between 2017 and 2022 indicated that a total of 192 hospitalizations due to *C. auris* occurred in 42 hospitals, mostly among adults with an average age of 68 years and of the male sex, with the majority in ICUs, and mechanical ventilation used in 43% of hospitalized patients. The average length of stay was 13 days and the in-hospital mortality rate was 21%.<sup>19</sup>

Furthermore, the fungus has the ability to survive and persist in the clinical environment, as colonization can persist for several weeks after initial contact. Thus, such procedures performed on the patient are routine in certain hospital environments, especially for critically ill patients. Accurate diagnosis of *C. auris* is important to control infection; however, laboratory diagnostic methods need to discriminate between the pathogen and other *Candida* species, since it presents phenotypic growth similarities.<sup>20</sup> In this sense, diagnoses must be rapid and accurate, taking into account that the fungus has high transmissibility, since the risk of severe and prolonged outbreaks constitutes an important public health problem.

Environmental samples were collected as an epidemiological investigation tool to assess the cleaning

and disinfection conditions of the environment, the identification of the fungus, and its persistence on surfaces. These collections allowed us to identify failures in the surface decontamination process and to review the cleaning and disinfection techniques used, mainly for their reuse after discharge. In this context, according to Florence Nightingale's environmental theory, sanitary knowledge should guide environmental monitoring so that it is possible to influence or modify the course of disease and contamination development. The existing sanitary conditions in the environment and the establishment of a safety culture are emphasized in Florence's work as essential for balance, understood in this scenario as the control of the spread of the pathogen in the environment and among patients.<sup>21</sup>

In Brazil, the Nightingale model anchors the construction of public health in favor of transformations in hygiene, promotion and prevention policies. The School of Nursing of the National Department of Public Health was the first to disseminate the Nightingalean principles in the country. Thus, nursing care based on her theory represents the epistemological legacy of the scientifically based nursing profession, which requires knowledge, investigation and action.<sup>22</sup> It is clear that the environmental model is logical and current, since nursing actions should be carried out based on identified needs.

The development of internal and external patient flow protocols allows for the promotion of patient safety and quality of care. The locations for isolation and cohorting of confirmed, suspected, and contact cases, according to clinical profiles and dependence on care and critical care, is an important measure for controlling the spread of the outbreak. In addition, it was necessary to develop a flowchart for safe exit from the units designated for cohorting or isolating suspected or confirmed cases and for the Home Care Service (HCS), as well as for carrying out examinations such as CT scans and MRI, and the use of the hemodialysis service.

The need to address the outbreak in the hospital demonstrated other weaknesses in the healthcare team, such as non-compliance during the use of standard and contact precautions, and concern about the adequacy and adoption of an appropriate technical barrier by all members of the healthcare team, and particularly by the nursing team responsible for comprehensive and systematic bedside care. Once established, the effects of this new scenario were also permeated by pressure from health authorities to contain the outbreak and doubts among the healthcare team due to a lack of knowledge about the new fungus. The resizing of the teams was strategic, as it allowed the team to divide tasks for surveillance and monitoring of the environment and confirmed patients, as well as ongoing education. Furthermore, it enabled the immediate development and

validation of standard operating protocols covering the topics of interest defined by the lines of action.

The actions planned for controlling the *C. auris* outbreak are influenced by Florence Nightingale's theory, which emphasizes nursing practice in sanitary care, maintaining physical and mental health in the face of illness, organizing work through management protocols and assistance based on scientific evidence, quality education and training, the importance of patient safety, and promoting comprehensive care.<sup>1</sup>

The outbreak in the institution is under control; however, it is necessary to be attentive to the environment and the provision of safe care, and to plan and implement strategies to combat drug-resistant infections. In addition, *C. auris* continues to be disseminated in other services, which leads to the conclusion that the threat may still persist.

The limitations of the study are associated with issues of various kinds, among which the complexity of dealing with an unknown fungus stands out, coupled with the urgent need for the establishment of specific protocols by the Infection Control Committee team, as well as the scarcity of scientific publications with practical examples to support in-service training. Since this is a report of professional experience in containing and controlling an emerging pathogen, this study can contribute to guiding the adoption and management of similar strategies in other healthcare settings. The leading role of nursing in the face of a significant public health challenge reveals nursing's contribution to global health in emergency situations, supported by a multidisciplinary, dynamic, and interactive process.

The experience reported allowed us to reflect on the need for immediate action by nurses from the Infection Control Committee to address a new public health challenge. The use of quality management tools enabled the systematization of actions to contain the outbreak in a timely and successful manner, controlling and preventing the spread of the fungus in the hospital environment. Infection control involves the need for decision-making, ensuring the quality of care, and promoting the safety of patients and healthcare workers. Actions must be continued regardless of outbreak control, because in a scenario of uncertainty and risk, the experience gained in the service should serve as an incentive to strengthen collaborative work among healthcare workers in order to prevent the occurrence of new outbreaks. This study reports the experience gained in a hospital setting, but it can help other healthcare professionals in managing or preventing outbreaks in similar conditions.

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## AUTHORS' CONTRIBUTIONS

**Emanuela Batista Ferreira e Pereira** contributed to project management, bibliographic research, abstract writing, introduction, methodology, discussion, interpretation and description of results, conclusions, review, and statistics. **Felipe Almeida Sales** contributed to abstract writing, review, and statistics. **Elizandra Cassia da Silva Oliveira** contributed to abstract writing, methodology, interpretation of results, conclusions, review, and statistics. **Marília Perrelli Valença** contributed to abstract writing, review, and statistics. **Felicialle Pereira da Silva Pereira** contributed to bibliographic research, abstract writing, introduction, methodology, discussion, interpretation and description of results, table preparation, conclusions, review, and statistics.

All authors approved the final version to be published and are responsible for all aspects of the work, including ensuring its accuracy and integrity.

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