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Crash carts in Intensive Care: development of a tool for situational assessment

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Abstract

Objective: To describe the process of developing and validating the content of a questionnaire aimed at evaluating the use and management of crash carts in Brazilian intensive care units (ICUs). **Methods:** A descriptive study with a quantitative approach was conducted to develop and validate the instrument, with stages of item construction based on theoretical references and content validation by a panel of multidisciplinary experts. The constructs addressed multidisciplinary collaboration and organizational support. Criteria of clarity, relevance, and comprehensiveness were applied, followed by the calculation of the Content Validity Index (CVI). The final version was pretested with 30 professionals working in ICUs, from January to February 2024. **Results:** In the first content analysis, an agreement rate of 90% was obtained for domains 1 to 4 and 100% for domain 5. Of the 37 items, 36 achieved an agreement rate of 100%, with only one item reaching 90%. In the second content analysis, all items achieved a minimum CVI of 0.8. Nevertheless, the assessment of the clarity of the title did not reach a minimum CVI of 0.8 (CVI = 0.6), and items 4 and 19 of the questionnaires received a score of "1" or "2," requiring revision. After revisions, changing the title of the instrument, and inserting an introductory paragraph to the questionnaire, a CVI ≥ 0.80 was obtained for all items in the third content analysis. The final instrument consisted of 37 items distributed across five domains, and the pretest resulted in adjustments to the wording and response options, thereby improving the clarity and applicability of the questionnaire. **Conclusion:** The questionnaire demonstrated satisfactory content validity and feasibility of application to the care team in ICUs. The instrument can contribute to situational diagnoses in health process management, enabling the systematic collection of data in the context of multiprofessional practice in Intensive Care.

Keywords: crash cart, critical care, intensive care unit, organization and administration, Surveys and questionnaires

Carros de emergência em Terapia Intensiva: desenvolvimento de ferramenta para diagnóstico situacional

Resumo

Objetivo: Descrever o processo de desenvolvimento e validação de conteúdo de um questionário voltado à avaliação do uso e gestão dos carros de emergência em Unidades de Terapia Intensiva (UTIs) brasileiras. **Métodos:** Estudo descritivo, com abordagem quantitativa, de desenvolvimento e validação de instrumento com etapas de construção dos itens com base em referencial teórico e validação de conteúdo por painel de especialistas multiprofissional. Os construtos incluem a colaboração multidisciplinar e a compreensão de suporte organizacional. Foram aplicados critérios de clareza, relevância e abrangência, com cálculo do Índice de Validade de Conteúdo (IVC). A versão final foi submetida a pré-teste com 30 profissionais atuantes em UTIs, no período de janeiro a fevereiro de 2024. **Resultados:** Na primeira análise de conteúdo a taxa de concordância obtida foi de 90% para os domínios 1 a 4 e de 100% para o domínio 5. Dos 37 itens, 36 apresentaram taxa de concordância de 100%, com somente um dos itens obtendo 90%. Na segunda análise de conteúdo, todos os itens alcançaram IVC mínimo de 0,8. Contudo, a avaliação da clareza do título não alcançou IVC mínimo 0,8 (IVC = 0,6) e os itens 4 e 19 do questionário receberam pontuação "1" ou "2", exigindo revisão. Após as revisões, alteração do título do instrumento e inserção de parágrafo introdutório ao questionário, obteve-se IVC ≥ 0,80 em todos os itens na terceira análise de conteúdo. O instrumento final foi composto por 37 itens distribuídos em cinco domínios e o pré-teste realizado resultou em ajustes de redação e opções de resposta, aprimorando a clareza e a aplicabilidade do questionário. **Conclusão:** O questionário demonstrou validade de conteúdo satisfatória

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e viabilidade de aplicação à equipe assistencial em UTIs. O instrumento pode contribuir para diagnósticos situacionais de gestão de processos em saúde, viabilizando a coleta sistematizada de dados frente à realidade de atuação multiprofissional em Terapia Intensiva.

Palavras-chave: kit de medicamentos e insumos estratégicos, cuidados intensivos, unidade de terapia intensiva, organização e administração, pesquisas e questionários

Introduction

The emergency cart is a hospital device designed to provide essential medications and materials for clinical emergencies and, by definition, must be systematically organized to enable rapid intervention.[1] The organization of the emergency cart facilitates prompt and appropriate care, particularly for critically ill patients and those with hemodynamic instability, such as those admitted to the Intensive Care Unit (ICU), where delays or difficulties in immediate care may result in treatment failure or prolonged hospitalization.[2]

The composition of an emergency cart may vary according to the institution, region, and healthcare specialty. Essential items include airway equipment, such as bag-valve masks, oral and nasal airways, oxygen masks, and nasal cannulas, as well as medications for the management of cardiopulmonary arrest (CPA) and arrhythmias. The internal contents are carefully distributed among drawers, with critical resuscitation drugs, intravenous access materials, and respiratory equipment organized to facilitate rapid and efficient access during emergencies.[3]

Studies indicate that the regulations proposed for this equipment have not achieved their primary objective, as significant problems have been identified in ICU emergency carts regarding organization and medication expiration dates, the presence of non-recommended drugs in stock, and the absence of standardized medications.[4–6] Although these findings highlight the need to better understand intensivist healthcare professionals' knowledge regarding the use of this equipment in order to address existing gaps, there is no tool available to conduct a situational diagnosis of the management processes involving emergency carts. Therefore, this article describes the process of developing and validating an instrument to measure the understanding of emergency cart use in ICUs by the Brazilian multidisciplinary team.

Methods

There is a preference for culturally adapting existing validated questionnaires rather than constructing new instruments; however, due to the absence of a tool capable of measuring healthcare workers' opinions regarding the use of emergency carts, it was necessary to develop and validate a questionnaire through standardized and systematic stages and methods, in accordance with the theoretical frameworks of Terwee et al.[7], Pittman and Bakas [8], and Coluci, Alexandre, and Milani [9], as shown in Figure 1.

Study population

The study population consists of Brazilian healthcare professionals. Inclusion criteria were: a degree in a health-related field, a Lato sensu postgraduate specialization in a clinical area, active registration with the respective professional council, and at least five years of professional experience in adult intensive care. No exclusion criteria were applied in this study.

Study design

This is a methodological study describing the processes of developing and validating a questionnaire to collect data on the understanding of ICU multidisciplinary teams regarding the use of emergency carts in their daily practice. In order to establish the conceptual structure of the instrument so that it reflects the complexities inherent to the intensive care environment, the constructs include multidisciplinary collaboration and the understanding of organizational support, aligned with the objective of identifying the needs of these professionals during emergency cart use.

For the development of the instrument items, it is necessary to use criteria that ensure clarity, specificity, and brevity, as well as vocabulary appropriate to the target population (9–10). Strategies supporting item generation include literature review, reports from the target population, expert opinions, and research findings.[8–9,11] The theoretical frameworks were used together with the opinion of two specialists—one in Clinical Pharmacy and one in Intensive Care—to compose the items that structure the questionnaire. Thus, the questionnaire was intended to adequately address issues relevant to the context of emergency cart use in ICUs, ensuring the instrument's contextual relevance and supporting the development of domains and items.[9,12]

Content validation

Validity is defined as the degree to which a measurement actually measures what it intends to measure and is categorized into face validity, content validity, criterion validity, and construct validity. [8,13]

Since the construction of the questionnaire assumes that each item contributes to defining the construct, it is considered a formative construct; therefore, its validation required steps to ensure item completeness and relevance. The validity of formative constructs cannot be assessed using covariance-based methods; thus, content validity was chosen to ensure coverage of all construct dimensions so that each item would be theoretically relevant and non-redundant.[14–15]

The content validity study using an expert panel strategy provides feedback on the quality of the developed questionnaire and objective criteria for evaluating each item, offering information on representativeness and clarity as well as a preliminary analysis of factorial validity [9,16–17]. Since the literature recommends expert panels composed of five to twenty specialists—particularly in fields such as healthcare, where content validity requires careful evaluation of technical aspects—for this study, content validation was conducted with the participation of five expert judges.[9,17] The judges were invited through a letter sent by email, including the justification for selecting the professional as a judge and the relevance of the study. Additionally, the proposed methodology for the expert panel's participation was described in the invitation.[9]

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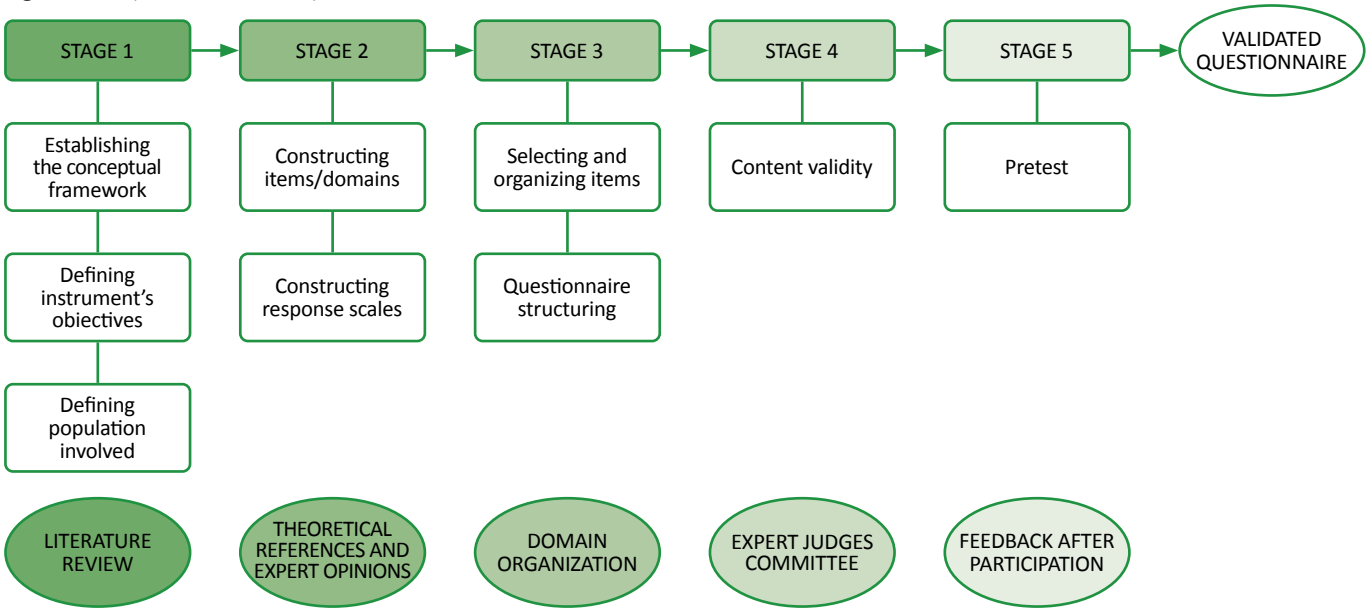
Figure 1. Steps used to develop the instrument.



Stages of content evaluation

The expert panel strategy was chosen to perform content validation; however, there is no consensus on minimum criteria for selecting judges to ensure multiprofessional representation.[9,16–18] In this sense, panel qualification was defined as a methodological premise of the study, considering that content validity depends directly on the evaluators' ability to judge the relevance, clarity, and representativeness of the items in relation to the investigated construct. The specialists were required to have diverse professional backgrounds to ensure that the instrument would be understandable and effective in conveying the objective of data collection in a relevant and engaging manner to intensivist professionals. Scientific production was not adopted as a mandatory criterion, since the study object is predominantly clinical and operational. Therefore, healthcare professionals working in Intensive Care with significant experience in the field were selected, as characterized in Table 1.

The expert committee participated in three distinct stages. In the first stage, the judges evaluated the initial questionnaire during the domain specification phase. Each domain of the instrument was assessed regarding whether it was adequately covered by its set of items. At this stage, the expert judges determined whether each item truly reflected its content and whether the related items should remain within the proposed domain. Thus, the committee's agreement rate was obtained by calculating the percentage of agreement for each domain. Agreement rates equal to or greater than 90% were considered indicative of adequate domains, whereas rates below 90% required discussion and domain modification.

In the second content analysis, the instrument was evaluated for clarity and relevance or representativeness. The expert panel assessed whether the items were related to the underlying concepts, whether they were relevant, and whether they met the proposed objectives. To this end, the title, format (layout), instructions, each item individually, and the instrument scoring (calculation and classification) were evaluated.

Table 1. Description of the profile of specialist professionals. Brazil, 2024.

Specialist	Education	Experience In Intensive Care
Nurse	Lato Sensu Specialization: Multiprofessional Residency in Emergency Care	> 5 years
Pharmacist A	Lato Sensu Specialization in Clinical Pharmacy	> 10 years
Pharmacist B	Lato Sensu Specialization: Multiprofessional Residency in Adult Intensive Care	> 10 years
Physiotherapist	Lato Sensu Specialization in Intensive Care Physiotherapy and Multiprofessional Residency in Intensive Care	> 5 years
Physician	Lato Sensu Specialization: Medical Residency in Internal Medicine and Intensive Care Medicine	> 5 years

Subsequently, each domain and the instrument as a whole were assessed for comprehensiveness, determining whether each domain was adequately covered by its set of items and whether all dimensions were included.

Agreement among committee members was quantitatively verified using the Content Validity Index (CVI). The calculation was performed based on the sum of responses "3" and "4" assigned by the expert judges to each item of the instrument, with a minimum agreement rate of 0.80 considered acceptable.[8–9,17,19]

In the third stage, the instrument revised according to the agreement levels and suggestions resulting from the previous stages was specifically evaluated with regard to the items that had been modified; this stage was necessary for approval of the revisions. All agreement rate and CVI calculations were performed using Microsoft Excel 2016.

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The specialists received specific instructions at each stage on how to evaluate each item, assess the instrument as a whole, and complete the questionnaire guiding the evaluation. Subsequently, a group discussion was conducted in which all suggestions and comments from panel members were presented and considered. All judges agreed to participate in the present study by signing the informed consent form (ICF).

Pre-test

In order to ensure that all questionnaire items were understandable, a pre-test procedure was conducted with a sample of 30 individuals from the instrument's target population.[9,12] These participants were healthcare professionals working in Intensive Care and were indicated by the expert judges, being recruited through social media via invitation messages. Each participant was asked, after completing the questionnaire made available through Google Forms, to provide feedback regarding item comprehension and response completion through an audio or text message. The contributions received were organized in Microsoft Excel spreadsheets for analysis.

If significant changes resulting from the pre-test were required, a new submission to the expert judges could be requested. All pre-test participants agreed to participate in the present study by consenting to the informed consent form. Sociodemographic variables of the pre-test participants were calculated using Microsoft Excel 2016 and presented as percentages, mean, and standard deviation (SD).

Ethical aspects

Ethical approval for the present study was granted by the Research Ethics Committee of the School of Pharmaceutical Sciences of Ribeirão Preto, University of São Paulo, under Approval Report No. 5,244,052.

Results

The questionnaire structured after item development comprised 37 questions and was divided into five domains (Table 2). To construct the response scale for the questions aimed at measuring workers' understanding, a Likert scale was chosen. This type of scale was selected due to its effectiveness in generating reliable and valid responses, facilitating statistical analysis and data interpretation, as well as providing a simple and intuitive response format for participants. [20–21]

Content analysis

The agreement rate obtained was 90% for domains 1 to 4 and 100% for domain 5. Additionally, the expert judges evaluated each item for clarity and representativeness. Of the 37 items, 36 achieved an agreement rate of 100%, while one item reached an agreement rate of 90%. At this stage, judges could suggest the inclusion or removal of items; however, no such suggestions were made by the expert panel.

Panel agreement was verified through calculation of the Content Validity Index (CVI) after applying a 4-point Likert-type scale to assess the relevance and representativeness of each item, as well as comprehensiveness, clarity, and pertinence.

Table 2. Structuring of the instrument by domains

Domain	Objective	Number Of Items
Healthcare professionals	Obtain the sociodemographic profile and professional experience of healthcare workers active in Intensive Care	06
Healthcare service	Description of the healthcare service structure and relevant characteristics regarding the presence of emergency carts in institutions	05
Intensive Care Unit (ICU)	Characterization of available infrastructure and care profile of ICUs	05
Emergency carts: usage	Establishment of work processes related to the routine use of emergency carts	08
Emergency carts: compliance	Detailing equipment regarding their technical aspects and availability	13

The judges were also able to provide suggestions and/or comments for item improvement, which were evaluated for acceptability. The evaluation of title clarity did not reach the minimum CVI of 0.8 (CVI = 0.6), indicating low agreement among expert judges regarding the concept assessed. Based on the panel's considerations and the need to revise the title due to the CVI below 0.8, the instrument was improved by adding an introductory paragraph to the questionnaire.

Although they reached the minimum CVI of 0.8, two questionnaire items also required revision because they received scores of "1" or "2." This revision was necessary since low scores indicate the possibility that such items could compromise the validity of responses.[18,22]

The second version of the questionnaire, incorporating the changes based on the CVI calculation and the comments and suggestions from the expert panel, was submitted for panel evaluation. In this assessment, all modifications were approved by the expert judges and contributed to achieving the desired clarity and representativeness of the questionnaire, with a CVI equal to 1.

Pre-test contributions

After validation by the panel, the questionnaire was submitted to a pre-test with 30 healthcare professionals working in ICUs, invited based on recommendations from the expert judges, between January 22 and February 23, 2024. The mean age of participants was 33.6 years (SD = 6.8), with 66.7% being female (n = 20). Regarding profession, nurses represented the largest group (36.7%; n = 11). Most pre-test participants held either a multiprofessional residency or a master's degree as their highest level of education, both accounting for 26.7% (n = 8). Participants came from four of the five Brazilian macro-regions, with the highest concentration in the Southeast region (46.7%; n = 14), followed by the Northeast region (30.0%; n = 9). Finally, the mean length of professional experience in intensive care was 6.1 years (SD = 4.3).

Five professionals provided observations on the questionnaire, which were used to revise the instrument (Table 3). Among the proposed modifications, the most notable were the simplification of the wording of questions regarding the use of emergency carts and the frequency of checking their contents, aiming to reduce ambiguity. Additionally, participants suggested including open-ended options to allow responses that better reflect clinical practice realities.

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Table 3. Contributions of pretest participants for the revision of questionnaire items. Brazil, 2024.

Original item version	Suggestion made	Revised item version
Does the ICU you work in have an exclusive Satellite Pharmacy*? *Satellite pharmacy: a decentralized unit attached to the sector of essential patient care and assistance.	Simplification of the Satellite Pharmacy definition	Does the ICU you work in have an exclusive Satellite Pharmacy*? *Satellite pharmacy: **pharmacy located in the dispensing demand sector itself, usually with high patient flow and emergency or intensive care services.**
These are situations in which the ICU you work in uses the emergency cart:	Simplification of the question to not inhibit responses about use	These are situations in which the emergency cart is used:
How often does the periodic check of the contents of the emergency carts in the ICU where I work occur?	Simplification of the question to not inhibit responses about use. Addition of an option allowing participant input.	The periodic check of the contents of the emergency carts occurs: **Addition of an option allowing participant input: 'Other:'**
Regarding standardization, I consider that the composition of the emergency carts meets the recommendations of the Brazilian Society of Cardiology (SBC)* in relation to priority levels I and II: *Standards available at: https://bit.ly/padronizacoesSBC	Description of items of interest (materials and medications), allowing participants to fully judge standardization.	Regarding **standardized medications and materials**, I consider that the composition of the emergency carts meets the recommendations of the Brazilian Society of Cardiology (SBC)* regarding priority levels I and II: **LEVEL I ITEMS: considered essential, needing to be immediately available for care.** **LEVEL II ITEMS: highly recommended, but must be available within a maximum of 15 minutes.** *Standards available at: https://bit.ly/padronizacoesSBC

These modifications contributed to improving the instrument's validity, ensuring that the final questionnaire was clearer and more appropriate for the target audience. Since these were minor adjustments that did not alter the instrument's core content, a new expert panel review was not conducted. This decision was based on the nature of the changes, which focused only on optimizing wording and adapting some response options without impacting the overall questionnaire structure.

Final format of the instrument

Administering the questionnaire through an online platform proved to be an appropriate approach for the purposes of this study. The tool was integrated into Google Forms due to its free-use policy and its compatibility with Microsoft Excel, which allows easy replication of the instrument. The finalized instrument is available in Supplementary Material 1.

Discussion

The use of online questionnaires is an efficient methodology for obtaining a wide range of responses from geographically dispersed participants, offering flexibility and anonymity, which can increase the honesty and depth of responses.[23] Moreover, this method is particularly useful in contexts where participants may have variable work schedules and limited opportunities to participate in face-to-face interviews, such as intensive care settings, where care is delivered in shifts to ensure 24-hour coverage.

The questionnaire structure was organized into domains, each representing a relevant dimension of the care context related to the use of emergency carts in ICUs, encompassing aspects ranging from professional and service characteristics to operational and technical issues related to the daily use of these devices. The development of questionnaire items considered factors directly related to patient safety, recognizing that understanding responsibilities for maintenance and proper use of these devices is essential for a rapid and coordinated response to life-threatening clinical situations.

The instrument development was carried out in a systematic manner, with particular emphasis on evaluation by expert judges. This evaluation enabled verification of item wording to ensure that the concepts were understandable and appropriately expressed, and to determine whether the items truly reflected the underlying concepts and were relevant and suitable to achieve the questionnaire's objectives. Content analysis, considering the participation of the multidisciplinary team both in the expert panel and in the pre-test, contributed to ensuring the questionnaire's applicability in a context as complex as intensive care. Thus, the methodology adopted in developing this tool highlights the importance of involving multidisciplinary teams in process management in healthcare services, since these professionals are the primary users of emergency carts in their daily practice.

The developed questionnaire represents an important tool for collecting data related to the use of emergency carts in ICUs. It demonstrated satisfactory content validity and can be used in situational diagnostic assessments as a useful instrument for identifying weaknesses in healthcare management processes. Although the instrument was developed and validated in the Intensive Care context, its structure encompasses organizational and operational aspects common to different hospital areas that use emergency carts. Therefore, the instrument may also support preliminary assessments in other care settings, provided that local specificities regarding resource availability and medication lists are respected and that contextual adaptations and additional validations are performed. Furthermore, the use of the questionnaire promotes standardization of data collection and facilitates identification of process weaknesses, as well as institutional and regional variations, from the perspective of the multidisciplinary team.

The present study has limitations that should be acknowledged, particularly regarding the generalizability of the findings and the instrument's applicability. The questionnaire was developed by Brazilian professionals based on clinical practices and health regulations in force in Brazil and, therefore, reflects specific characteristics of the national healthcare system. Although this context contributed to the instrument's development, it may limit its applicability in countries that do not share similar regulations or that have different organizational models for intensive care delivery.

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Additionally, the decision to administer the questionnaire virtually, although it offers potential cost reduction, flexibility, and broader reach, may limit participation among healthcare professionals with lower digital literacy or restricted internet access. Therefore, the use of the questionnaire requires caution and potential cultural adaptations when applied to other national healthcare systems.

Conclusion

The questionnaire developed proved to be a relevant tool for the situational diagnosis of healthcare process management, addressing the shortage of validated instruments that assess the use and organization of emergency carts from the perspective of the multidisciplinary team. The study included content validation by an expert panel, as well as the assessment of the instrument's clarity, comprehensibility, and applicability with the target audience through a pretest, strengthening its suitability for the ICU care context. Furthermore, it contributes to filling the gap in the need for systematized instruments tailored to the specificities of intensive care.

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Collaborators

Souza, IV: Conceptualization; methodology; investigation; formal analysis; supervision; writing — original draft; visualization; project administration; writing — review and editing. Nunes, MS: Investigation; formal analysis; validation; writing — original draft; writing — review and editing. Pinheiro-Rodrigues, JP: Investigation; formal analysis; validation; writing — review and editing. Assis, TJ: Investigation; formal analysis; validation; writing — review and editing. Lima, VV: Investigation; formal analysis; validation; writing — review and editing. Acioli-Lins, AT: Investigation; formal analysis; validation; writing — review and editing. Freato-Gonçalves, AM: Methodology; formal analysis; writing — original draft; writing — review and editing. Leira-Pereira, LR: Conceptualization; methodology; formal analysis; supervision; writing — original draft; visualization; project administration; writing — review and editing.

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Conf ict of interest statement

The authors declare no conflicts of interest related to this article.

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