






FREE COMMUNICATION

## VENOUS ACCESS INDICATION ALGORITHM FOR NEWBORNS IN NEONATAL INTENSIVE CARE UNIT

### HIGHLIGHTS

1. Indication of neonatal venous access
2. Acting of the nurse in the selection of venous accesses
3. Neonatal infusion therapy practice

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### ABSTRACT

**Objective:** to present an algorithm for the indication of venous accesses for newborns in Neonatal Intensive Care Unit. **Development:** descriptive study conducted in a Neonatal Intensive Care Unit in southern Brazil, in the period from 2017 to 2020 in two stages of idealization: design of the algorithm; and the adequacy based on the application according to observations made by the nurses involved. The developed algorithm contemplated the prediction of venous access for patients with indication for abdominal and other surgeries, premature infants stratified in gestational age higher and lower than 30 weeks, heart diseases with dependence or not on arterial channel and persistent neonatal hypoglycemia. According to the venous network, number of prescribed therapies, fasting, antibiotic therapy and vasoactive drugs, there is an initial indication for one type of catheter that may be followed by another according to need. **Conclusion:** the participation of nurses in the indication of venous access integrates interprofessional practices and increases neonatal care.

**DESCRIPTORS:** Nursing; Catheters; Intensive Care Units, Neonatal; Neonatology.

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## INTRODUCTION

The need for insertion and maintenance of venous access (VA) in newborns (NB) admitted to Intensive Care Units (ICU) is an essential action for the therapeutic process of these newborns, and represents a relevant portion of invasive procedures performed, causing pain during the period of stay in the Neonatal Intensive Care Unit (NICU).<sup>1</sup>

It is a complex practice that aims to reduce adverse events and raises evaluations on the indication and maintenance of the intravenous device with prior evaluation of the NB at the time of admission to the NICU, considering the systematization of care related to its use.<sup>1,2</sup>

The selection of intravenous devices for NBs contemplates factors related to the patient, the intended intravenous therapy, and the materials available. The main related factors to be considered are gestational age; weight; diagnosis; comorbidities; skin and venous network conditions; durability; and volume and characteristics of infused solutions.<sup>3-4,1</sup>

Among the main VAs used to assist in the treatment of newborns are peripheral venous accesses (PVA), the Peripherally Inserted Central Catheter (PICC), and the Umbilical Venous Catheter (UVC).

The PVA has rapid insertion and use with limitations related to infusion flow, pH of solutions (between five and nine), and osmolarity below 900mOsm/mL, which are tolerated by the peripheral vascular endothelium.<sup>5</sup> Its use is common; however, repeated punctures can cause local or systemic complications, in addition to the implications on the newborn's brain development. This sometimes makes it necessary to choose a safer, more prolonged use, and less traumatic device.<sup>6,7</sup> The PICC and the UVC are the most used central catheters in NICUs, both indicated for intravenous therapies with an expected time of more than seven days, dextrose greater than ten percent 10%, pH less than five or greater than nine.<sup>5</sup> They are differentiated as to technique and insertion moment, caliber, and duration, and may be mono or double lumen format.

Therefore, the proposal of an algorithm for the indication of VA in neonatology allows to contemplate and evaluate, in a safe way, the variables involved in this selection.

Thus, the objective of this study was to present an algorithm for the indication of venous accesses for newborns in the Neonatal Intensive Care Unit.

## DEVELOPMENT

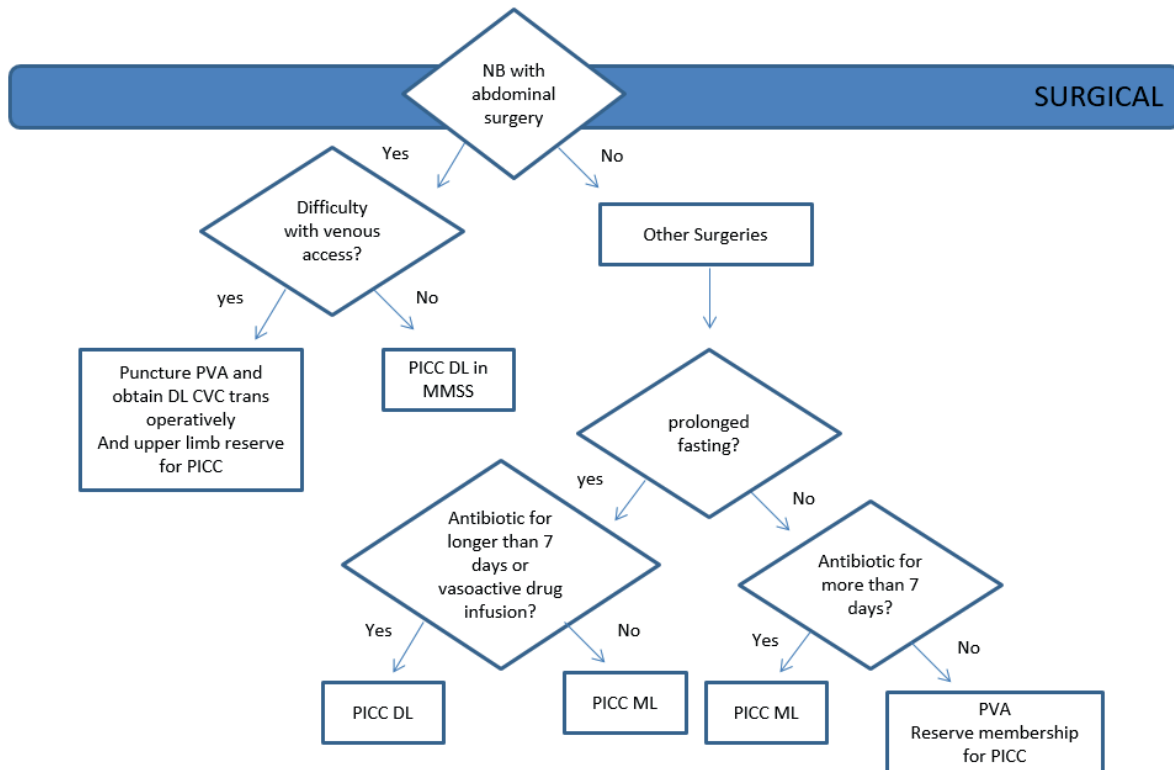
This is a descriptive study derived from a randomized clinical trial based on the use of double-lumen PICC in NICUs.<sup>1</sup> The study was conducted at the NICU of the Paraná Hospital of Clinics Complex (CHC-PR, in Portuguese), from 2017 to 2020.

The study was conducted in two stages: the first with the idealization and design of the algorithm based on the identification of the need for adequacy of practices for the correct indication of VA; and the second with the adequacy of this algorithm based on its application according to observations made by the nurses involved.

The project was approved by the Ethics Committee for Research with Human Beings with opinion no. 172,382.

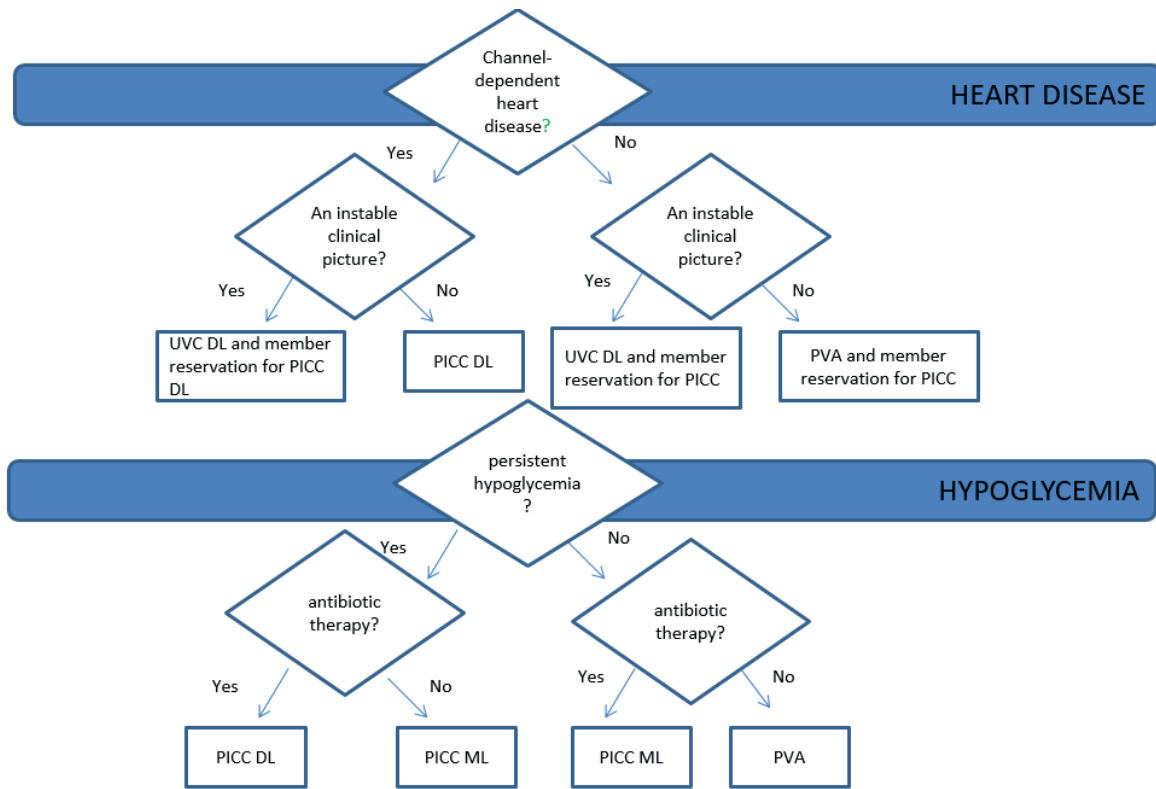
## Analysis of the objectives

The result of the study is the algorithm for indicating VA for NICU infants, shown below (Figures 1, 2, 3, 4, and 5).



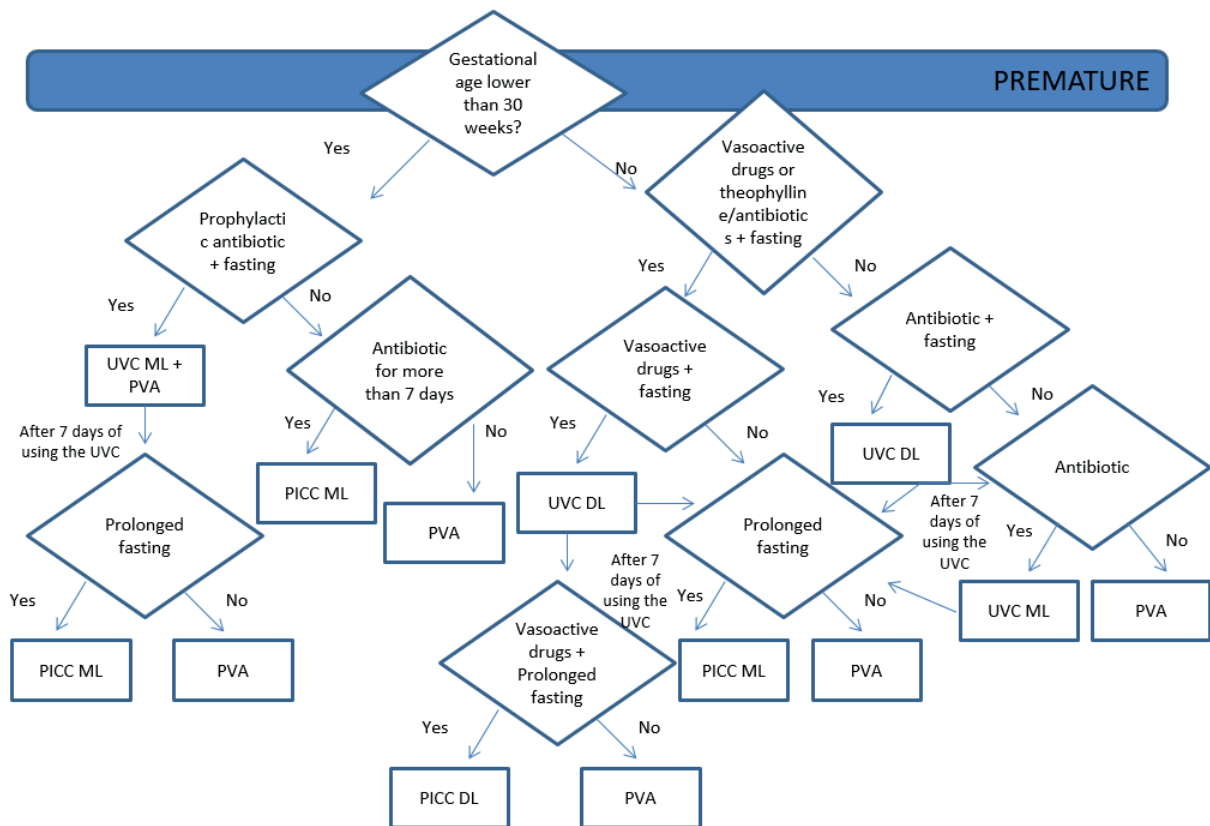
**Figure 1** - Indication algorithm for VA for NB with surgical picture. Curitiba, Paraná, Brazil, 2022

Source: authors (2022).



**Figure 2** - Indication algorithm for VA for NB with heart disease and hypoglycemia. Curitiba, Paraná, Brazil, 2022

Source: authors (2022).



**Figure 3** - Indication algorithm for VA for premature NB under 30 weeks. Curitiba, Paraná, Brazil, 2022

Source: authors (2022).

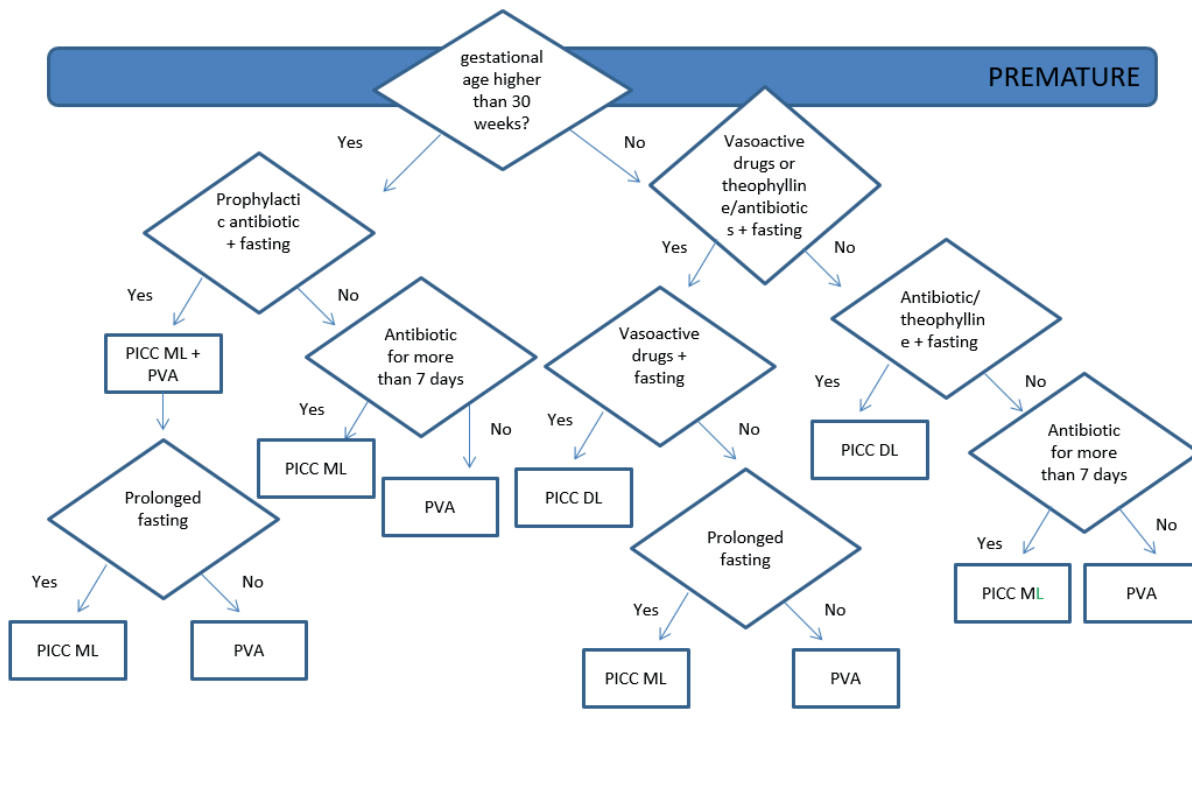


Figure 4 - Indication algorithm for VA for premature NBs older than 30 weeks. Curitiba, Paraná, Brazil, 2022  
 Source: authors (2022).

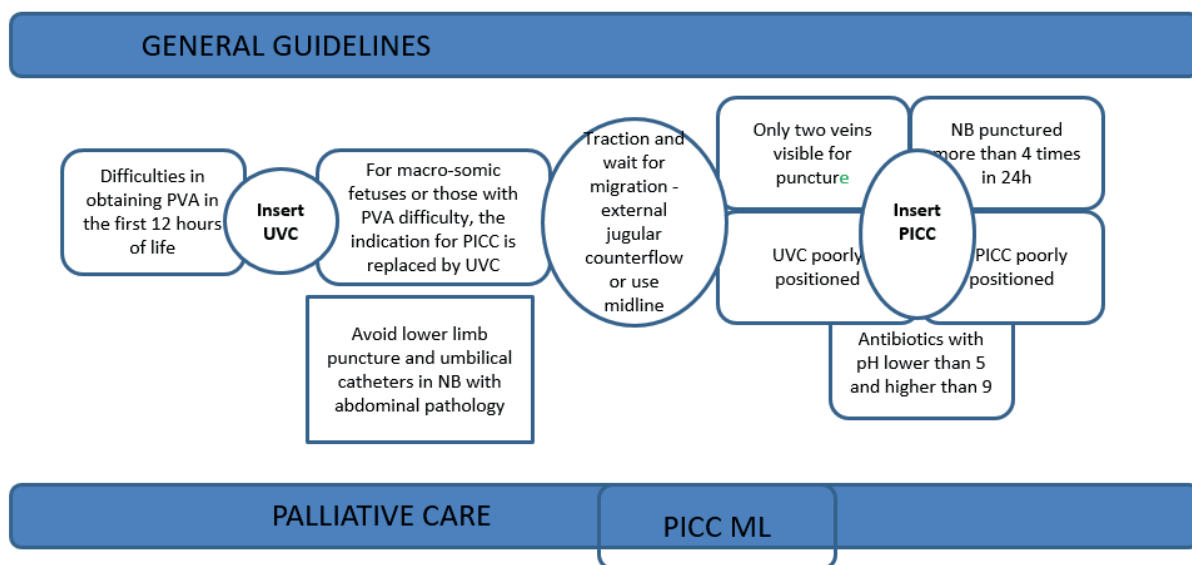


Figure 5 - General guidelines for indication for VA for NB and palliative care. Curitiba, Paraná, Brazil, 2022  
 Source: authors (2022).

Knowledge of the different pathologies of the NB at the NICU and the different therapies used are determinants for professional decisions on the use of VAs. The choice of the intravenous device may favor the neonatal patient by reducing the number of infusion

routes and the number of concomitant punctures/VA by choosing the appropriate number of lumens. Sometimes, at the time of choice, a device is chosen, which may be excessive or insufficient to maintain the treatment of the NB.

The algorithm was created by professionals involved in the insertion and maintenance of VAs, as it is an area of expertise and daily practice for nurses, who see the different possibilities of outcomes that interfere with the conduct adopted and the quality and safety of care.

This algorithm considers the gestational age ranges and clinical pictures of the NB, clinical stability, and therapeutic plan at the time of insertion of the devices. Thus, newborns requiring surgery after birth, heart disease, premature babies, hypoglycemic conditions, and general guidelines were considered.

For the NB requiring surgery soon after birth, two situations in which there is the possibility of insertion of central venous catheters were considered: when the NB presents abdominal malformations or pathologies (which influence the selection of the CVU and the insertion of the PICC in the lower limbs - LL); and when the NB presents other surgical conditions. The moment of catheter insertion was also considered based on the clinical conditions for the procedure. When it is possible to insert the PICC in the preoperative of abdominal malformation, the device is indicated as the first choice, double lumen (DL), aiming to minimize surgical intervention and associated risks with an insertion site preferably in the upper limbs (UL).

It is common to observe that the PICC inserted in the LL in these newborns cause more pathway alterations. Thus, the NB is deprived of procedures after surgery, preserving it from pain and handling. When the PICC is not inserted in this phase, it is recommended to conciliate the abdominal surgery of the NB with the insertion of a central venous catheter associated with the reserve of upper limbs for PICC insertion.

Regarding other surgical diseases, the insertion of the DL PICC is also indicated for patients with prolonged fasting and antibiotic therapy. In the case of isolated antibiotic therapy, without prolonged fasting, the mono-lumen (ML) PICC is indicated, while if this antibiotic is only indicated for prophylactic doses, it is recommended to reserve the upper limbs for the PICC (for cases of clinical worsening or sepsis) and use of PVA, considering that this therapy generally does not complete more than five days of IVT, and the most used drugs have neutral ph. Thus, it is possible to minimize the risks for the NB and wait for its evolution.

Considered individually, congenital heart diseases were listed according to their classification, and may or may not be of the canal-dependent type, which modifies the indication for use of the most appropriate catheter in relation to the number of lumens. For heart diseases without dependence on the ductus arteriosus, the indication for use of the PICC ML or DL varies according to the stability and clinical picture of the NB, which may require antibiotics, total parenteral nutrition (TPN) or vasoactive drugs.

In contrast, the indications for VA for channel-dependent heart diseases are based on the use of prostaglandins and, consequently, of DL central venous catheter (CVC), either PICC or UVC accompanied by reserve site for PICC, depending on the stability of the NB at the time of insertion. The use of PVA is not considered in these cases due to the need for exclusive and safe route for prostaglandin infusion as well as clinical instability and need for surgical correction, which requires preservation of the venous network.

The infusion of TPN is also one of the determining factors in the insertion of DL catheters, because its infusion requires an exclusive route due to the high degree of precipitation of lipids and the high risk of contamination. In addition, in general, TPN presents osmolarity incompatible with peripheral venous network, higher than 900 mOsm/L.<sup>5,7</sup>



When the NB presents hypoglycemia, the indication of CVC will depend on the condition developed by the NB. DL PICC is indicated for the NB with persistent hypoglycemia and need for antibiotic therapy, while the NB with isolated persistent hypoglycemia may receive ML PICC. If hypoglycemia responds to treatment, PVA is indicated with the recommendation to reserve upper limbs for PICC, considering a possible worsening of the condition during treatment. In case of difficulty in obtaining PVA, UVC should be considered, observing, however, the glucose infusion rate of the serum plans.<sup>5</sup>

Finally, the indication of VA for PTNBs depends on the gestational age (GA) with prioritization of UVC for NB with GA less than 30 weeks associated with the reservation of an insertion site for PICC. The use of the UVC as the first choice in this group is due to the need for minimal handling as well as skin maturity characteristics. The use of ML or DL devices varies according to the planned therapeutic plan.

For NB in palliative care, the ML PICC is indicated to promote the comfort of the patient and family and minimum support of hydration, analgesia, and some treatment to relieve discomfort according to the institutional protocols in force. The maintenance of the PVA in these cases predisposes to multiple punctures that impair the quality of life of the neonate during this period. There is no evidence that allows the use of hypodermoclysis in this population for hydration and analgesic therapy. Thus, using the PICC as a medium and long stay catheter with the least number of routes, aiming to reduce the risk of infection, is currently the most viable option.

Finally, the algorithm includes observations regarding the indication of catheters for: poorly visible venous network or limited number of visible and intact veins, difficulties in obtaining and maintaining PVA, poor positioning of the UVC or previous PICC. Possible therapeutic variations between the selection of the first and second CVC (from UVC to PICC) are also considered, so that the second one is not indicated, or its insertion is impossible due to the NB's conditions.

## FINAL CONSIDERATIONS

The participation of nurses in the indication of VA enables the integration of professional practices with increased safety and quality of care. There is an urgent need for guidelines that support objective professional conduct, based on experience and evidence.

The present study made it possible to observe the existing variation in indications and management possibilities of devices for use in intravenous therapy, reducing the probability of risks, resulting in coherent, directed, and assertive practices, in which the risk of infection, number of punctures, and use of resources are optimized.

The right and most precise indication as possible favors the minimum manipulation of neonates with reduction of adverse events related to the use of catheters. In this area, it is fundamental to reconcile therapeutic needs with the limits of invasive procedures and related risks.

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#### Role of Authors:

Substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data for the work - **Giacomozzi CMM, Giacomozzi LM, Silva RPVC da**; Drafting the work or revising it critically for important intellectual content - **Giacomozzi CMM, Giacomozzi LM, Silva RPVC da, Mittag BF, Nunes RCT**; Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved - **Giacomozzi CMM, Silva RPVC da**. All authors approved the final version of the text.

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