REVISTA DE ENFERMAGEM REFERÊNCIA
homepage: https://rr.esenfc.pt/rr/
ISSNe: 2182.2883

RESEARCH ARTICLE (ORIGINAL)

Validation of a Multidisciplinary Algorithm for the Safety of Critically Ill Adult Patients During Intra-Hospital Transport

Validação de um Algoritmo Multiprofissional Aplicado à Segurança do Paciente Crítico Adulto em Transporte Intra-Hospitalar

Validación de un Algoritmo Multiprofesional Aplicado a la Seguridad del Paciente Crítico Adulto en el Transporte Intrahospitalario

Cléton Salbego [1]
https://orcid.org/0000-0003-3734-9970

Ana Beatriz Sema Andreata [2]
https://orcid.org/0009-0009-4274-6162

Raysson Augusto Xavier Rubbo [2]
https://orcid.org/0009-0000-3802-265X

Robson Giovani Paes [2]
https://orcid.org/0000-0001-6899-4054

Liege Gonçalves Cassenote [3]
https://orcid.org/0000-0003-0833-4016

Etiane de Oliveira Freitas [3]
https://orcid.org/0000-0002-8589-2524

Patrícia Bitencourt Toscani Greco [4]
https://orcid.org/0000-0001-6999-5470

[1] Federal University of Mato Grosso do Sul, Department of Nursing, Coxim, Mato Grosso do Sul, Brazil

[2] Autonomous University Center of Brazil, School of Health Sciences, Curitiba, Paraná, Brazil

[3] Federal University of Santa Maria, Department of Nursing, Santa Maria, Rio Grande do Sul, Brazil

[4] Universidade Federal do Rio Grande, Escola de Enfermagem, Rio Grande, Rio Grande do Sul, Brasil

Corresponding author
Cléton Salbego
E-mail: cletonsalbego@hotmail.com

Received: 27.08.25
Accepted: 22.01.26

Abstract

Background: Intra-hospital transport of critically ill adult patients requires coordinated multidisciplinary care to ensure patient safety. The development of accessible and easily interpretable instruments, such as algorithms, may play a decisive role in this process.
Objective: To assess the content and face validity of a multidisciplinary algorithm aimed at enhancing the safety of critically ill adult patients in the context of intra-hospital transport.
Methodology: Methodological study conducted with 30 experts in a single round of validation. Items with a Content Validity Coefficient ≥ 0.80 were considered valid.
Results: The algorithm contains 46 items divided into four blocks, covering decision flows, risk stratification, and operational instructions for each stage of transport. The Content Validity Coefficient was 0.94 in the individual evaluation of items and 0.87 in the overall evaluation.
Conclusion: The algorithm was considered a valid and relevant instrument to support patient safety during intra-hospital transport, as well as clinical decision-making.

Keywords: algorithms; patient safety; patient transfer; decision making; intensive care units; validation study

Resumo

Enquadramento: O transporte intra-hospitalar de pacientes adultos críticos exige cuidado e assistência multiprofissional visando a segurança do paciente. A produção de ferramentas de fácil acesso e interpretação, tais como algoritmos, podem ser potencialmente resolutivas.
Objetivo: Construir e validar o conteúdo e aparência de um algoritmo multiprofissional voltado à segurança do paciente adulto crítico no contexto de transporte intra-hospitalar.
Metodologia: Estudo metodológico, realizado com 30 especialistas, em rodada única de validação. Considerou-se válido, os itens que apresentaram Coeficiente de Validade de Conteúdo ≥ 0,80.
Resultados: O algoritmo contém 46 itens, divididos em quatro blocos, contemplando fluxos decisórios, estratificação de risco, e instruções operacionais para cada etapa do transporte. O Coeficiente de Validade de Conteúdo foi de 0,94 na avaliação individual dos itens e, 0,87 na avaliação geral.
Conclusão: O algoritmo foi considerado um instrumento válido e relevante para a segurança do paciente durante o transporte, bem como a tomada de decisão.

Palavras-chave: algoritmos; segurança do paciente; transferência de pacientes; tomada de decisões; unidades de terapia intensiva; estudo de validação

Resumen

Marco contextual: El transporte intrahospitalario de pacientes adultos críticos requiere cuidados y asistencia multiprofesional con el fin de garantizar la seguridad del paciente. La creación de herramientas de fácil acceso e interpretación, como algoritmos, puede ser potencialmente decisiva.
Objetivo: Construir y validar el contenido y apariencia de un algoritmo multiprofesional orientado a la seguridad del paciente adulto críticamente enfermo en el contexto del transporte intrahospitalario.
Metodología: Estudio metodológico, realizado con 30 especialistas, en una única ronda de validación. Se consideraron válidos los ítems que presentaron un coeficiente de validez de contenido ≥ 0,80.
Resultados: El algoritmo contiene 46 elementos, divididos en cuatro bloques, que abarcan flujos de decisión, estratificación de riesgos e instrucciones operativas para cada etapa del transporte. El coeficiente de validez del contenido fue de 0,94 en la evaluación individual de los elementos y de 0,87 en la evaluación general.
Conclusión: El algoritmo se consideró un instrumento válido y relevante para la seguridad del paciente durante el transporte, así como para la toma de decisiones.

Palabras clave: algoritmos; seguridad del paciente; transferencia de pacientes; toma de decisiones; unidades de cuidados intensivos; estudio de validación

Escola Superior de Enfermagem de Coimbra

How to cite this article: Salbego, C., Andreata, A. B., Rubbo, R. A., Paes, R. G., Cassenote, L. G., Freitas, E. O. (2026). Validation of a Multidisciplinary Algorithm for the Safety of Critically Ill Adult Patients During Intra-Hospital Transport. *Revista de Enfermagem Referência*, *6*(5), e42867. https://doi.org/10.12707/RVI25.66.42867

Introduction

Critically ill patients, at imminent risk of death, require intensive and specialized care that involves continuous monitoring, the use of advanced technologies, and the intervention of a skilled multidisciplinary team capable of responding to complex clinical needs and ensuring patient stabilization (Oliveira et al., 2023).

The adult Intensive Care Unit (ICU) has a wide range of technological resources designed to ensure the stabilization and clinical maintenance of critically ill patients. These resources include continuous monitoring of vital signs, ventilatory support, hemodynamic stabilization, bedside mobilization, nutritional support, administration of high--alert medications, as well as laboratory and imaging tests (Oliveira et al., 2023). However, certain clinical needs cannot be fully met within the ICU, requiring patients to be transported to other departments.

Given the need for intra-hospital transport (IHT), the central problem of this study lies in the risks associated with moving critically ill patients. During transport, these patients become more vulnerable to adverse events, including communication failures among team members, the absence of standardized protocols, and inadequate transport planning. Thus, patient safety may be compromised if there is no synchrony among the professionals involved and if coordinated action is not maintained throughout the transport process (Matias & Sá, 2022).

There are consolidated international guidelines for the IHT of critically ill patients, as well as instruments such as checklists, flowcharts, and institutional protocols that aim to structure pre-transport assessments, team definitions, monitoring, and responses to adverse events. However, the literature reveals inconsistencies in practice and deficiencies in the integration of these recommendations across disciplines (Faculty of Intensive Care Medicine, 2021; Australasian College for Emergency Medicine, 2024). While studies show that checklists improve compliance and reduce incidents, they alone do not guarantee uniformity in clinical decisions during IHT. Thus, comprehensive instruments capable of articulating processes, roles, and responses to complications are necessary (Williams et al., 2020; Pinheiro et al., 2021).

The developed multidisciplinary algorithm aims to address these gaps by integrating, into a single instrument, elements of risk assessment, decision-making, team standardization, structured communication, and contingency management, offering objective and adaptable guidance to strengthen the safety and quality of IHT for critically ill adult patients. Therefore, the objective of this study is to construct and assess the content and face validity of a multidisciplinary algorithm focused on the safety of critically ill adult patients in the context of IHT.

Background

The ICU provides advanced monitoring and high-level care for patients. However, tests, interventions, or procedures performed outside the unit may be necessary, requiring IHT. This process is internationally recognized as a high-risk activity that requires meticulous preparation, a skilled team, effective communication, and adequate equipment to ensure clinical stability and prevent adverse events (Matias & Sá, 2022; Faculty of Intensive Care Medicine, 2021; Australasian College for Emergency Medicine, 2024). The literature shows that adequate prior preparation, including equipment verification, assessment of hemodynamic stability, contingency planning, and multidisciplinary coordination, is crucial to reducing complications during transport (Matias & Sá, 2022).

During IHT, technical failures involving medical devices, interruptions in infusion lines, loss of monitoring, human errors, and communication problems may arise, all of which are considered critical factors for patient safety (Mahran et al., 2025; Skoglund et al., 2024). In addition, factors such as mechanical ventilation, continuous sedation, use of inotropic agents, and longer transport times significantly increase the risk of clinical deterioration (Williams et al., 2020).

In IHT, adverse events are attributable to both physiological changes in the patient, such as desaturation, arrhythmias, and hemodynamic instability, and to technical failures, including accidental disconnections, oxygen depletion, or power failures (Juneja & Nasa, 2023). The incidence of equipment failures can range from 10.4% to 44%, reinforcing the need for systematic checks and the availability of resources for immediate stabilization (Arslan et al., 2024).

The intensive care nursing team plays a central role in coordinating IHT, leading the process, supervising technical tasks, and ensuring effective communication among the professionals involved (Dong et al., 2024; Skoglund et al., 2024). However, given the complexity and risk inherent in transport, these teams often face anxiety, cognitive overload, and insecurity, particularly when standardized instruments to guide decision-making are lacking (Juneja & Nasa, 2023). Thus, structured instruments such as guidelines, checklists, and algorithms are recognized as essential for reducing variability among teams, supporting rapid clinical decisions, and increasing the safety of critically ill patients (Wang et al., 2025).

In this context, the multidisciplinary algorithm for critical patient safety in IHT is relevant as it combines pre--transport assessment elements, eligibility criteria, team requirements, equipment verification, clinical decision flows, and contingency plans into a single instrument.

The algorithm offers standardization and immediate support for practice, reducing errors, strengthening communication, and standardizing conduct among the professionals involved, as well as increasing the predictability of actions and enhancing the safety and quality of care in IHT. Therefore, the objective of this study is to construct and assess the content and face validity of a multidisciplinary algorithm focused on the safety of critically ill adult patients in the context of intra-hospital transport.

Research question

Does the multidisciplinary algorithm for the safety of critically ill adult patients during IHT demonstrate content and face validity according to expert opinion?

Methodology

This was a methodological study guided by the Praxis Model for Technology Development (PMTD; Salbego & Nietsche, 2023). It was conducted from March to June 2025 and included two stages: algorithm construction and validation with a multidisciplinary panel of experts in adult intensive care. The study followed the recommendations of the Standards for Quality Improvement Reporting Excellence (SQUIRE 2.0; Ogrinc et al., 2016). The PMTD proposes a cyclical and dialectical movement for the creation and incorporation of solutions into practice. It is organized into four phases: pragmatic, productive/artistic, experimental, and revolutionary. This study carried out the productive/artistic phase (evidence-based technological construction) and the experimental phase (validation with the target audience and assessment of barriers and facilitators to product use).

To construct the algorithm, guidelines from the Intensive Care Society (ICS) and the Faculty of Intensive Care Medicine (FICM) were used, as they provide recommendations for the transfer of critically ill adult patients. In addition, a systematic review and a previous meta-analysis were used, which describe the most common adverse events occurring during IHT (Faculty of Intensive Care Medicine, 2021; Matias & Sá, 2022; Murata et al., 2022). Resolutions from the regulatory bodies of Medicine, Nursing, and Physiotherapy were consulted to identify the legal and ethical prerogatives related to care practice during IHT. The documents were read in their entirety to extract information related to best practices to be adopted by the multidisciplinary team to ensure patient safety and mitigate adverse events resulting from IHT.

Data extraction was performed using the following operational criteria: (1) interventions necessary for the assessment of critically ill patients, considering clinical conditions, the professional responsible for performing the assessment, and the patient's risk classification; (2) interventions inherent to the pre-transport phase; (3) risk classification during transport and recommended interventions, considering the professionals involved, indications for monitoring, and safety measures to be adopted; and (4) post-transport classification as definitive or non-definitive, as well as care procedures to be performed.

The algorithm was constructed with the aid of Microsoft Word and Lucidchart software. After its construction, the algorithm underwent content and face validity by a single round of evaluation conducted by a multidisciplinary panel of experts. The sampling was intentional and non-probabilistic, with no need for sample size calculation. A group of 140 experts with training in Medicine, Nursing, or Physiotherapy and experience in adult intensive care was invited electronically. The professionals were selected based on their technical expertise (practical experience in the context for which the instrument was developed) and scientific expertise (experience and intellectual production in patient safety and adult intensive care; Salbego & Nietsche, 2023). The selection was conducted by consulting the résumés available on the Lattes Platform of the Coordination for the Improvement of Higher Education Personnel (CAPES) in Brazil, WhatsApp® groups linked to associations of intensive care professionals, and by referral from specialists (snowball sampling technique). Professionals who did not respond within 15 days after three contact attempts by the researchers were excluded. The experts received an invitation via email or WhatsApp®, containing a link to Google Forms® to sign the Free and Informed Consent Form and complete the evaluation instrument anonymously. Thirty experts agreed to validate the algorithm. To assess content and face validity, the items in the algorithm were evaluated according to the criteria of clarity of language, theoretical relevance, and practical relevance, using a Likert scale ranging from 1 to 5 points. The response options were: (1) inadequate, (2) partially adequate, (3) neither inadequate nor adequate, (4) adequate, and (5) totally adequate.

The data collection instrument was organized into three parts: (1) sociodemographic and occupational characterization of the participants (13 questions); (2) analysis of the clarity, relevance, and pertinence of the content (12 questions); and (3) overall assessment of the content and face validity of the algorithm (13 questions; Costa et al., 2024).

The data obtained were exported to Microsoft Office Excel, organized, processed, and analyzed. Descriptive statistical analysis was performed using absolute and relative frequencies, minimum and maximum values, mean, and standard deviation, with IBM SPSS Statistics software, version 20.0.

The Content Validity Coefficient (CVC; Hernández-Nieto, 2002) was applied. The analysis was performed by calculating the item-level content validity coefficient (CVC_i) and the total content validity coefficient (CVC_t). The item error term (Pe_i) was also calculated to measure potential bias for each item. Content validity was attributed to items that achieved CVC ≥ 0.80, considering a 5% significance level (Hernández-Nieto, 2002). The reliability of the algorithm was calculated using the Intraclass Correlation Coefficient (ICC), and internal consistency was assessed using Cronbach's alpha.

The study was approved by the Research Ethics Committee of a Higher Education Institution in southern Brazil, under opinion number 5,760,062, dated November 16, 2022.

Results

The construction of the algorithm considered international guidelines, literature reviews, and documents published by regulatory bodies in Brazil, which enabled the identification of best practices, recommendations, and ethical and legal prerogatives related to IHT. The first version of the algorithm was structured into four blocks and 42 items. It was titled IHT Algorithm for Critically Ill Adult Patients.

The first block concerns the initial assessment, which includes confirmation of transport and verification of the patient's clinical condition. The second block corresponds to the pre-transport phase, focused on preparing the patient and the team, as well as reviewing devices and infusions. The third block refers to the transport phase and addresses the patient's transfer, accompanied by a multidisciplinary team, ensuring monitoring and safety throughout the journey. The fourth block relates to the post-transport phase and addresses the care provided after returning to the ICU.

The process of content and face validity involved the participation of 30 professionals: 66.7% (n = 20) with technical expertise and 33.3% (n = 10) with scientific expertise. Among the participants, 66.7% (n = 20) were nurses, 16.7% (n = 5) were physiotherapists, and 16.7% (n = 5) were physicians; 63.3% (n = 19) were female, and 36.7% (n = 11) were male. The workload ranged from six to 12 hours per day in the ICU. All participants reported having practical knowledge in the ICU and experience in IHT. The median length of service in adult intensive care was 4 years, and the mean age was 33.8 ± 7.7 years. Specialists from all regions of the country were represented, except for the Brazilian Northeast. This demonstrates the heterogeneity of the sample and its alignment with the PMTD in promoting technological assessment with professionals from different backgrounds and locations, allowing broader dissemination of knowledge. In terms of education, 66.7% (n = 20) were specialists, 16.7% (n = 5) held master's degrees, and 16.7% (n = 5) held doctoral degrees. Regarding the length of professional training, the median was 8 years.

The first version of the algorithm, submitted for content validation, included 42 items, which were evaluated individually according to the criteria of clarity of language, practical relevance, and theoretical relevance (Table 1). Regarding data analysis, the CVC_i was > 0.80 for all evaluated items. The same was observed for the CVC_t, in which the algorithm demonstrated clarity of 0.94, practical relevance of 0.94, and theoretical relevance of 0.95 (Table 1).

Table 1

Item-Level Content Validity Coefficients according to Clarity of Language, Practical Relevance, and Theoretical Relevance

Block	Clarity of Language		Practical Relevance		Theoretical Relevance	
	Mean	CVC_i	Mean	CVC_i	Mean	CVC_i
1	*4.77*	*0.95*	*4.73*	*0.95*	*4.80*	*0.96*
2	*4.60*	*0.92*	*4.63*	*0.93*	*4.60*	*0.92*
3	*4.70*	*0.94*	*4.63*	*0.93*	*4.67*	*0.93*
4	*4.70*	*0.94*	*4.73*	*0.95*	*4.83*	*0.97*
CVC_c		*0.94*		*0.94*		*0.95*
ICC		*0.71*		*0.79*		*0.66*
Cronbach's alpha		*0.85*		*0.89*		*0.82*
CVC_t		*0.94*				

Note. CVC_i = item-level content validity coefficient; CVC_c = Corrected Content Validity Coefficient; CVC_t = Total Content Validity Coefficient; ICC = Intraclass Correlation Coefficient.

The item error term (Pe_i) was < 0.0000000001, demonstrating that it was not a significant value capable of altering the CVC_i of the algorithm. In the reliability assessment, the algorithm demonstrated almost perfect internal consistency, obtaining Cronbach's alpha > 0.80 for the three evaluated criteria and 0.97 in the overall assessment of the instrument. The ICC was 0.71 for clarity of language, 0.79 for practical relevance, and 0.66 for theoretical relevance. The ideal ICC is ≥ 0.70; however, a lower ICC (0.66) was observed for theoretical relevance, indicating moderate agreement among experts (Table 1). This result may be associated with heterogeneity in academic background, professional experience, and conceptual perspectives on IHT.

In the overall assessment of the content and face validity of the algorithm, all items demonstrated satisfactory validity (Table 2).

Table 2

Calculation of the Content Validity Coefficient in the overall assessment of the algorithm

Item	Mean	CVC_i
1. The visual presentation is attractive and organized.	4.17	0.83
2. The sequence of instructions in the algorithm facilitates its practical application.	4.13	0.83
3. The selected colors are appropriate.	3.90	0.78
4. The language used is appropriate.	4.40	0.88
5. The information is clear and unambiguous.	4.30	0.86
6. The content is logically organized.	4.27	0.85
7. The content meets the objective proposed by the algorithm.	4.50	0.90
8. The content is scientifically accurate and up to date.	4.37	0.87
9. The algorithm is easy to use.	4.33	0.87
10. The algorithm is applicable to professional practice during intra-hospital transport.	4.53	0.91
11. I feel motivated to use the algorithm.	4.33	0.87
12. I would recommend the algorithm for use in healthcare services.	4.47	0.89
13. The use of this technology may contribute to safer intra-hospital transport.	4.60	0.92
CVC_t	4.33	0.87
ICC		0.94
Cronbach's alpha		0.97

Note. CVC_i *= item-level content validity coefficient;* CVC_t *= total content validity coefficient; ICC = Intraclass Correlation Coefficient.*

Based on the 42 evaluated items, the experts presented suggestions to improve the instrument in terms of clarity of writing and visual organization. Although all items achieved $CVC_i > 0.80$, suggestions for modification were proposed to enhance interpretative fluidity, facilitate practical use, and avoid redundancies.

Considering the experts' opinions, the accepted suggestions focused mainly on dividing some items into distinct actions to ensure greater clarity. Only one suggestion was not accepted, which proposed dividing each phase of the algorithm into separate pages. This decision was justified by the need to preserve the traditional structural characteristics of an algorithm, allowing fluidity in its interpretation and application.

After the adjustments, a new version of the algorithm was developed, containing 46 items distributed across the same four blocks (maintained as in the first version). Aspects related to visual presentation were reformulated to ensure better organization, clarity, and attractiveness. There was no need to exclude any items.

The final version of the algorithm is available for access and download at the following link:
https://1drv.ms/i/c/6b90b53c1c778195/ESYPVVCv-nxJLmevNJonoApsBW_eGO9wJLXKmV3C1CDG-mow?e=8ZjxwA

Considering facilitators for the usability of the algorithm, effective communication stands out, as it promotes better interaction among the professionals involved and ensures alignment of conduct. In addition, standardization of care was identified as a significant benefit, contributing to the reduction of adverse events, omissions, and subjective judgments (Figure 1).

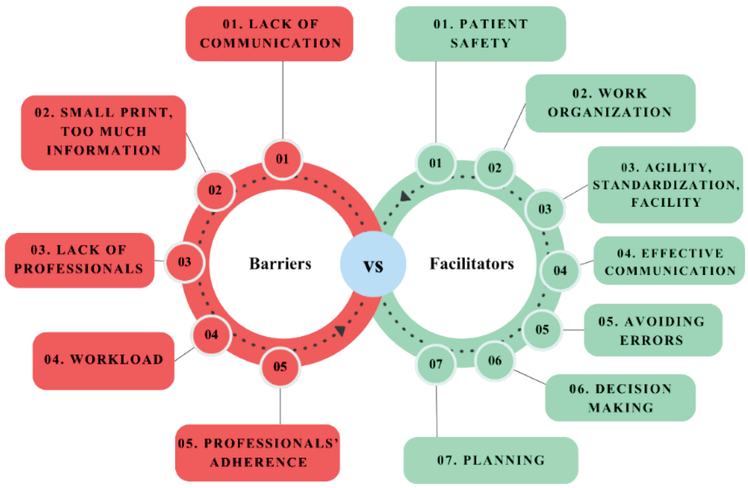
As for barriers, resistance to adherence, lack of training, and preference for traditional methods already consolidated in daily practice were mentioned. These aspects highlight the need for training and awareness among the team for the effective implementation of the algorithm.

In contexts of work overload and shortage of professionals, the use of the algorithm was identified as a challenge, mainly due to the requirement for a minimum team to ensure safe transport. This factor may generate the perception of increased operational burden.

Other operational aspects were also identified, such as the small font size, which hinders rapid reading, in addition to the need for frequent consultation of the algorithm due to the amount of information required, which may interfere with the workflow. Therefore, a link was provided to facilitate better visualization and implementation of the algorithm (Figure 1).

Figure 1

Barriers and facilitators to the algorithm's usability.



Discussion

The IHT of critically ill patients is a complex process structured into three phases: pre-transport, transport, and post-transport. The first phase exerts the greatest influence on the occurrence of adverse events. Studies indicate that the decision to transport a patient should always be preceded by a rigorous assessment of risks and benefits, as well as an analysis of the actual need for the examination or procedure (Arslan et al., 2024; Wang, Zhang, & Li, 2025). Checklists, standardized protocols, and clear intersectoral communication reduce errors and contribute to safety during IHT, especially when combined with adequate preparation of both the team and the patient (Arslan et al., 2024; Murata, 2022).

This study reaffirms this body of knowledge and advances it by translating recommendations into a structured, objective, and clinically applicable multidisciplinary algorithm, encompassing decision flows, risk stratification, and detailed operational instructions for each stage of IHT. Unlike isolated checklists or generic protocols, the constructed algorithm presents logical decision sequences, addresses different transport scenarios (unidirectional or bidirectional), and specifies the actions required of each team member. This represents a practical innovation, offering an integrated instrument capable of reducing variability in care, an aspect identified as one of the main factors associated with incidents during IHT (Williams et al., 2020; Juneja & Nasa, 2023).

Another contribution of the study is the incorporation of objective risk stratification criteria that differentiate among low-, medium-, and high-risk transports, guiding minimum team requirements, advanced support devices, monitoring standards, and necessary interventions. Although the literature indicates the need for trained teams with critical care skills, few studies demonstrate how to operationalize these requirements within clear and scalable workflows (Dong et al., 2024; Kinnunen et al., 2025). The validated algorithm contributes by systematizing this logic and establishing specific recommendations according to clinical classification, facilitating decision-making and the advance organization of human and material resources.

This study also advances the field by integrating elements of standardized communication, such as the requirement for prior contact with the destination sector, including transmission of essential clinical information, confirmation of scheduling, and verification of equipment availability, a step often neglected and associated with discontinuities in care. Although the literature highlights the importance of communication, there is no consensus on how to operationalize it. The algorithm offers explicit guidance applicable to routine IHT of critically ill patients (Skoglund et al., 2024).

The transport phase is marked by vulnerability and a high probability of adverse events, as the patient leaves a highly equipped environment, such as the ICU, and is cared for in transit, where there are physical constraints, reduced equipment availability, and a need for continuous monitoring (Wang et al., 2025). The literature describes technical failures involving infusion pumps, monitors, ventilators, disconnections of vascular accesses, accidental extubations, and oxygen depletion as frequent causes of incidents during transport, often associated with inattention or the absence of standardized monitoring flows (Williams et al., 2020; Juneja & Nasa, 2023). The algorithm defines appropriate multidisciplinary monitoring, particularly for transports classified as medium and high risk.

The post-transport phase, although recognized as essential, tends to be underemphasized in institutional protocols. Many adverse events occur after transport, particularly when immediate clinical reassessment is not performed, often due to the absence of instruments that systematically specify what should be verified upon arrival at the destination (Murata et al., 2022). The algorithm includes specific actions, such as reinstalling multiparameter monitoring, reviewing the ventilation circuit and cuff pressure, and inspecting venous access devices. This sequential and detailed organization strengthens continuity of care and reduces the likelihood of late deterioration, thereby enhancing patient safety.

The main contribution of this study lies in the integration of the three phases of IHT into a single multidisciplinary instrument, promoting greater predictability and alignment among teams. Among the limitations, the validation process involved specialists from specific professional backgrounds, which may have influenced variations in the theoretical evaluation of certain items. The algorithm has not yet been tested in real-world settings, limiting conclusions regarding its direct impact on incident reduction. In addition, its implementation may require institutional adaptations according to local resources and organizational structures.

Conclusion

The construction and validation of the multidisciplinary algorithm for IHT of critically ill adult patients demonstrated that it is a safe and consistent measure aligned with international evidence and guidelines. The instrument demonstrated content and face validity and was considered clear, relevant, and applicable by experts, establishing itself as an instrument capable of qualifying and standardizing conduct across the different phases of transport.

From a theoretical perspective, the algorithm contributes by consolidating a structured model that integrates clinical assessment, risk stratification, interprofessional communication, and decision-making, reinforcing the understanding of IHT as a complex clinical process requiring continuous coordination and surveillance. In practice, its use provides objective support to the multidisciplinary team, reducing variability in care, promoting safety, and strengthening continuity of care. For research, the study opens promising directions, particularly in evaluating the effectiveness of the algorithm in real-world settings, analyzing its impact on safety indicators, and integrating it with digital decision-support technologies.

Author contributions

Conceptualization: Salbego, C., Andreata, A. B., Rubbo, R. A.
Data curation: Salbego, C., Andreata, A. B., Rubbo, R. A.
Formal analysis: Salbego, C., Andreata, A. B., Rubbo, R. A.
Funding acquisition: Salbego, C., Andreata, A. B., Rubbo, R. A.
Investigation: Salbego, C., Andreata, A. B., Rubbo, R. A.
Methodology: Salbego, C., Andreata, A. B., Rubbo, R. A., Paes, R. G.
Project administration: Salbego, C.
Resources: Salbego, C., Andreata, A. B., Rubbo, R. A., Paes, R. G.
Software: Salbego, C., Paes, R. G., Freitas, E. O.
Supervision: Salbego, C.
Validation: Salbego, C., Paes, R. G., Freitas, E. O.
Visualization: Salbego, C., Paes, R. G., Freitas, E. O.
Writing – Original draft: Salbego, C., Andreata, A. B., Rubbo, R. A.
Writing – Review & editing: Salbego, C., Andreata, A. B., Rubbo, R. A., Paes, R. G., Cassenote, L. G., Freitas, E. O.

Acknowledgements

We express our sincere gratitude to all the experts who participated in this study, whose contributions were essential to the validation of the instrument.

References

Australasian College for Emergency Medicine, Australian and New Zealand College of Anaesthetists & College of Intensive Care Medicine of Australia and New Zealand. (2024). *Joint guidelines for the transport of critically ill patients* (4ª ed.).

Arslan, B., Sutasir, M. N., Kapci, M., Korkut, S., & Altinarik, S. (2024). Simulation-based enhancement of patient safety during intrahospital transport of trauma patients with COVID-19: A helipad scenario. *Cureus, 16*(8), e67484. https://doi.org/10.7759/cureus.67484

Costa, A. C., Mendes, L. A., Santos, L. M., Marcatto, J. O., Corrêa, A. R., & Kusahara, D. M. (2024). Elaboração e validação de algoritmo para o planejamento da administração de medicamentos intravenosos em neonatos. *Texto & Contexto Enfermagem*, *33,* e2023-0262. https://doi.org/10.1590/1980-265X-TCE-2023-0262pt

Dong, J., Yi, Y., Zhu, X., & Zhang, H. (2024). Status of knowledge, attitude and practice of clinical nurses towards the intrahospital transport of critically ill patients: A cross-sectional study. *Nursing Open, 11*(6), e2172. https://doi.org/10.1002/nop2.2172

Faculty of Intensive Care Medicine & Intensive Care Society. (2021). *Guidance on: The transfer of the critically ill adult*. https://www.ficm.ac.uk/sites/ficm/files/documents/2021-10/Transfer_of_Critically_Ill_Adult.pdf

Hernández-Nieto, R. A. (2002). *Contribuições para a análise estatística*. Universidade de Los Andes.

Juneja, D., & Nasa, P. (2023). Intrahospital transport of critically ill patients: Safety first. *Indian Journal of Critical Care Medicine, 27(9)*, 613–615. https://doi.org/10.5005/jp-journals-10071-24538

Kinnunen, A., Hagman, T., Paakkonen, H., & Saaranen, T. (2025). Constructing critical care nursing expertise: An integrative literature review. *Nurse Education Today*, *149,* e106668. https://doi.org/10.1016/j.nedt.2025.106668

Mahran, G. S., Mekawy, M. M., Abd El-Aziz, W. W., Ali, A. F., El Demerdash, D. A., & Sayed, M. M. (2024). Developing and validating a bundle for safe intra-hospital transporting of the critically Ill patients: Mixed qualitative design with Delphi approach. *Critical Care Nursing Quarterly, 47*(4), 378-399. https://doi.org/10.1097/CNQ.0000000000000518

Matias, A. R., & Sá, F. L. (2022). Intervenções da equipa multiprofissional no transporte de pacientes em estado crítico: Revisão sistemática de métodos mistos. *Escola Anna Nery, 26,* e20210452. https://doi.org/10.1590/2177-9465-EAN-2021-0452pt

Murata, M., Nakagawa, N., Kawasaki, T., Yasuo. S., Yoshida, T., Ando, K., & Okada, Y. (2022). Adverse events during intrahospital transport of critically ill patients: A systematic review and meta-analysis. *The American Journal of Emergency Medicine*, *52,* 13-19. https://doi.org/10.1016/j.ajem.2021.11.021

Oliveira, C. M., Pedro, F. M., Brito, A. G., Perdigão, K. F., Cassimiro, R. O., Ferreira, A. Q., & Santos, M. C. (2023). Atenção integral ao paciente crítico: Condutas, práticas e reflexões. *Revista Científica Multidisciplinar Núcleo do Conhecimento, 5*(6), 58–66. https://doi.org/10.32749/nucleodoconhecimento.com.br/saude/atencao-integral

Ogrinc, G., Davies, L., Goodman, D., Batalden, P., Davidoff, F., & Stevens, D. (2016). *SQUIRE 2.0 (Standards for Quality Improvement Reporting Excellence): Revised publication guidelines from a detailed consensus process. BMJ Quality & Safety, 25*(12), 986–992. https://doi.org/10.1136/bmjqs-2015-004411

Pinheiro, R. V., Salomé, G. M., Miranda, F. D., Alves, J. R., Reis, F. A., & Mendonça, A. R. (2021). Algorithms for the prevention and treatment of friction injury. *Acta Paulista de Enfermagem*, *34*, eAPE03012. http://dx.doi.org/10.37689/acta-ape/2021AO03012

Salbego, C., & Nietsche, E. A. (2023). Praxis model for technology development: A participatory approach. *Revista da Escola de Enfermagem da USP*, *57,* e20230041. https://doi.org/10.1590/1980-220X-REEUSP-2023-0041pt

Skoglund, K., Bescher, M., Ekwall, S., & Hammar, L. M. (2024). Intrahospital transport of critically ill patients: Nurse anaesthetists' and specialist ICU nurses' experiences. *Nursing in Critical Care*, *29*(5), 1142-1150. http://dx.doi.org/10.1111/nicc.13053

Wang, J., Zhang, X., Li, G., Lu, Y., Xie, R., Cui, M., Li, B., Du, L., & Ma, L. (2025). Implementing an intrahospital transport preparation (IHT) and management project for critically ill patients: Identification of barriers and facilitators using consolidated framework for implementation research (CFIR): A qualitative study. *BMJ Open*, *15*(1), e096290. https://doi.org/10.1136/bmjopen-2024-096290

Williams, P., Karuppiah, S., Greentree, K., & Darvall, J. (2020). A checklist for intrahospital transport of critically ill patients improves compliance with transportation safety guidelines. *Australian Critical Care, 33*(1), 20–24. https://doi.org/10.1016/j.aucc.2019.02.004