Content validation by judges of the instrument to assess nurses' knowledge about mechanical ventilation

Validação de conteúdo por juízes sobre o conhecimento de enfermeiras(os) sobre ventilação mecânica

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ABSTRACT | OBJECTIVE: Validate the content of an instrument designed to assess nurses' knowledge about Mechanical Ventilation. **METHOD:** Methodological, quantitative, validation study, carried out by obtaining a questionnaire, adapting and validating its content by judges. The questionnaire was validated using the Content Validity Index (CVI) by intensive care judges (nursing, medicine and physiotherapy). The questions addressed ventilation modes and settings, alarm settings and protective ventilation. The IVC assessed the proportion of judges in agreement (minimum of 80%) on a given question present in the instrument. **RESULTS:** In the first round, 9 items received CVI=100%. Only question 9 received a low score from one of the judges, reaching IVC=80% and, even so, reformulated. After reformulating this question and creating two others according to the judges' suggestions, the final version of the questionnaire was submitted to a new round of evaluation and included a CVI of 100%. **CONCLUSION:** This instrument presented linguistic equivalence and strong evidence of content validity in the Brazilian context, being able to determine an adequate evaluation of practices aimed at MV. Verifying knowledge related to MV is related to strengthening the practice of nurses in their fields of activity.

KEYWORDS: Validation Study. Surveys and Questionnaires. Nursing Education. Artificial Respiration.

RESUMO | OBJETIVO: Validar o conteúdo de um instrumento destinado à avaliação do conhecimento de enfermeiras(os) sobre Ventilação Mecânica. **MÉTODO:** Estudo metodológico, quantitativo, de validação, realizado com obtenção de questionário, adaptação e validação de conteúdo por juízes. A validação do questionário foi feita através do Índice de Validade de Conteúdo (IVC) por meio de juízes intensivistas (áreas de enfermagem, medicina e fisioterapia). As questões abordaram os modos e ajustes ventilatórios, ajustes de alarmes e ventilação protetora. O IVC avaliou a proporção de juízes em concordância (mínima de 80%) sobre determinada questão presente no instrumento. **RESULTADOS:** Na primeira rodada, 9 itens receberam IVC=100%. Apenas a questão 9 recebeu nota baixa por um dos juízes, atingindo IVC=80% e, mesmo assim, reformulado. Após a reformulação deste quesito e a criação de outros dois de acordo com sugestões dos juízes, a versão final do questionário foi submetida a uma nova rodada de avaliação e contemplou IVC de 100%. **CONCLUSÃO:** O presente instrumento apresentou equivalência linguística e fortes evidências de validade de conteúdo no contexto brasileiro, podendo determinar uma adequada avaliação das práticas voltadas à VM. A verificação do conhecimento relacionado à VM relaciona-se ao fortalecimento da prática de enfermeiras(os) nos campos de atuação.

PALAVRAS-CHAVE: Estudo de Validação. Inquéritos e Questionários. Educação em Enfermagem. Respiração Artificial.

1. Introduction

Mechanical ventilation (MV) is a life support tool necessary for patients with impaired gas exchange and ineffective respiratory patterns. It is one of the most used resources in intensive care units (ICU), performed through a machine that replaces, to varying degrees, the patient's ventilatory activity. Its objective is to restore the balance between oxygen supply and demand, alleviating the respiratory workload of patients with various clinical conditions.[1,2]

In this context, with the availability of technological equipment for the population, the need for its use has been increasing over the years. According to Kempker et al.[2] in a study conducted in the United States, the number of MV users increased from 429 to 1,275 cases per 100,000 adults between the years 2002 and 2017. Furthermore, with the onset of the COVID-19 pandemic in 2020, MV became an even more necessary tool, globally essential for the survival of patients affected by the severe form of the disease. An example of this was the city of Wuhan, the epicenter of the pandemic in China, which presented Acute Respiratory Distress Syndrome in 20% of patients diagnosed with COVID-19, with 12.3% of these requiring invasive ventilatory support.[3]

In addition to the need for MV, its complexity involving adjustments and modes according to the individual demands of patients is also critical. Therefore, for it to be a targeted and effective therapeutic approach, it requires the involvement of various members of the multidisciplinary health team.[4]

Given the importance of this strategy, especially in ICUs, it is essential that nurses are trained in the care inherent to mechanically ventilated patients. This requires safe practice from its implementation, monitoring, adjustment of ventilatory parameters, and supportive care to optimize its use and minimize adverse effects.[5]

In this regard, for nurses working with patients requiring MV, it is crucial to have knowledge from its assembly and testing, to implementing initial parameters with the medical team, monitoring, and adjusting alarms. Additionally, they must perform support actions, such as: assisting in orotracheal intubation, airway suctioning, securing and verifying the level of the endotracheal tube, monitoring cuff pressure, tracheostomy care and oral hygiene.[6-8]

Therefore, the understanding and responsibility of nurses in a systematic care approach should be supported by specific training and capacity-building to ensure safe and quality care for effective clinical management.[9]

To enhance the practice of these professionals that care for patients on MV, it is necessary to systematically assess their knowledge. However, despite the fundamental nature of this diagnostic stage in building knowledge, no validated evaluation tools were found at both national and international levels.[5,8,10-17]

Thus, considering the relevance of this topic in the work process of nurses and the lack of validated tools to assess nurses' knowledge about MV, the main objective of this study is to validate the content of an instrument designed to assess nurses' knowledge about mechanical ventilation.

2. Methods

This is a methodological study with a quantitative approach, initiated in July 2022 and completed in September of the same year, in a Brazilian capital. It was conducted in three stages: obtaining an instrument, adaptation, and content validation by experts. This strategy was planned and based on the principles formalized by Mary Lynn.[18]

The instrument acquisition stage (first stage) was carried out through an extensive literature review and was based on the structured questionnaire by Bucci et al.[17], published in 2021, which in turn was adapted and authorized for use through the study conducted by Rodrigues et al.[16], published in 2012. Therefore, the Bucci et al.[17] model was prioritized due to its more recent publication. The original questionnaire provided by these authors is available in the supplementary material.

After its selection and authorization for use, the second stage began with adjustments focused on the competencies of nurses regarding MV, as established by the Conselho Federal de Enfermagem - Cofen (Federal Nursing Council) resolution no. 639/20207, which includes: monitoring, alarm checking, initial adjustments, management of ventilatory parameters, and supportive actions for this strategy. The questions were adjusted to demonstrate clarity on the topic, with concise and direct content. The modifications were based on the review by Hickey and Giwa[1], the study by Stechinski et al.[6], and Cofen resolution 639/2020.[7]

The third stage consisted of content validation by experts, which required the assembly of a group of professionals with expertise in MV invited to participate in the study. The inclusion criteria were: being a professional working in adult ICU with a general, cardiac or neurological profile; availability for participation; completed specialization in intensive care; at least 5 years of professional experience in intensive care; and experience with the topic of mechanical ventilation. Five specialists agreed to participate as judges, comprising two nurses, two physiotherapists, and one physician. The sample size was defined by convenience. According to Alvarenga et al.[19], this number is considered the minimum required for content validation of an instrument. Additionally, an odd number could act as a tiebreaker among judges, if necessary.[19] Finally, the judges were asked to sign the Informed Consent Form (ICF) via a virtual form through Google Forms (Alphabet Inc.).

Using a mask of the instrument via Google Forms (Alphabet Inc.), the judges evaluated the agreement of each item in the questionnaire using the Content Validity Index (CVI). This index measures the proportion or percentage of judges who agree on specific aspects of the instrument and its items on a Likert scale from 1 to 4, where 1 = item not relevant; 2 = item needs revision to assess relevance; 3 = relevant item, needs minor changes; 4 = absolutely relevant item.[18,20]

Furthermore, the judges analyzed the information in the instrument according to the principles of Rubio et al.[21], which included: clarity of language (comprehensible and appropriate writing for the concept), practical relevance (representativeness of the construct) and theoretical relevance (whether the content of the item is indispensable in the target culture for measuring the construct). At the end, each item also had a comment field where the evaluators could provide more specific written observations.

For data analysis, items scored with "3" or "4" were considered representative, obtaining a CVI score between 0.8 and 1.00 (80 to 100% agreement) using the formula:

$$CVI = \frac{\text{(number of responses 3 or 4)}}{\text{(total number of responses)}}.$$

Items with a score lower than 0.8 were reviewed. After the adjustments reported by the judges individually, the questionnaire was submitted for final approval by all.

The preliminary version of the questionnaire obtained through the study by Bucci et al.[17] consisted of 8 items characterizing the sample and 11 questions assessing knowledge related to MV. However, the sample characterization items were not included in the content validation as they covered participant data, such as ICU of practice, gender, age, time since graduation, length of ICU experience, and postgraduate education. This version is available in the supplementary material.

The present study was part of a research titled "Knowledge of Nurses Working in Intensive Care on Mechanical Ventilation," approved by the Research Ethics Committee of Roberto Santos General Hospital, under opinion number 5.681.119 and CAAE 61022822.9.0000.5028. All judges who agreed to participate in the study signed an ICF.

3. Results

After the selection and acceptance of the judges, the first round of evaluation was initiated within a period of 7 days. At this point, 9 items received scores 3 or 4 according to the Likert scale, achieving a CVI=1. Only item 9 received a score 1 from one of the judges, resulting in an overall CVI=0.8. Although it reached the minimum score for content validation, it was partially reformulated (Table 1). The first version of the questionnaire is available in the supplementary materials file.

Table 1. Judges' Scoring According to the Content Validity Index in the First Version of the Questionnaire. Salvador/BA, 2022

Q.	Tematic	Judges' Scoring					
		Judge 1	Judge 2	Judge 3	Judge 4	Judge 5	CVI
1	Self-knowledge	3	4	3	4	4	1
2	Self-knowledge	3	4	4	4	4	1
3	MV assembly	4	3	4	4	4	1
4	Autonomy over the MV	4	4	4	4	4	1
5	MV adjustments	4	3	3	4	3	1
6	MV alarms	4	4	3	4	4	1
7	Concepts in MV	4	4	4	4	4	1
8	Concepts in MV	4	4	4	4	4	1
9	Concepts in MV	4	1	4	4	4	0.8
10	Protective MV	4	4	3	4	4	1

Subtitle: Q.: Question; CVI: Content Validity Index; MV: Mechanical Ventilation.
Source: the authors (2024).

The Table 2 demonstrates the synthesis of suggestions highlighted by the judges to ensure that the questionnaire questions were better understood. The main suggestions involved spelling adjustments, specification of nomenclatures, modification of terms to avoid ambiguous interpretations, removal of sections related to the SIMV (Synchronized Intermittent Mandatory Ventilation) mode, and the inclusion of a question about Ventilator-Associated Pneumonia (VAP).

Table 2. Synthesis of Judges' Suggestions Submitted in the First Version of the Mechanical Ventilation Questionnaire. Salvador/BA, 2022

Question	Thematics	Suggestion	Outcome
01	Self-knowledge	Check if the use of the terms "weak" and "insufficient" are not redundant	Suggestion Accepted
		Remove the term "weak"	Suggestion Accepted
		Portuguese corrections	Suggestion Accepted
02	Self-knowledge	Portuguese corrections	Suggestion Accepted
03	MV assembly	Specify in the question that it refers to invasive MV to avoid potential questioning regarding option B	Suggestion Accepted
04	Autonomy over the MV	Question with no suggested corrections	Maintained
05	MV adjustments	Remove the term "enabled or not sensitivity" from all alternatives that include it	Suggestion Accepted
		Considering that SIMV modes are no longer widely used in the adult population (except in very specific cases), I would exclude them from the alternatives, leaving only the basic modes: A/C pressure, A/C volume, and Spontaneous. However, I would include them specifically for the pediatric and neonatology population if the questionnaire is to be applied to them, as this population uses the mentioned ventilatory modes	Suggestion Accepted: Removed the alternatives related to SIMV, as the questionnaire will not be applied to professionals working in pediatrics or neonatology
		Include Spontaneous / PSV. Include Pressure Support	Suggestion Accepted
06	MV alarms	In the first item regarding high pressure, specify what is being obstructed (tube, circuit, etc.)	Suggestion Accepted
		In the first apnea alarm item, the term "drive" may not be recognized due to the lack of use of this terminology and could be replaced with "diaphragmatic muscular action"	Suggestion Accepted
07	Concepts in MV	Question with no suggested corrections	Maintained
08	Concepts in MV	Question with no suggested corrections	Maintained
09	Concepts in MV	Important question, but since there are already two questions about cycling, it might be interesting to address another topic. Perhaps something about ventilator care related to VAP. This is an important aspect where the nursing team can contribute significantly	Suggestion Accepted: Added a new question about VAP
10	Protective MV	It could be highlighted in the statement that the protective strategy aims to protect the lungs by preventing damage from various sources.	Suggestion not accepted due to redundancy

Subtitle: SIMV: Synchronized Intermittent Mandatory Ventilation; A/C: Assist-Controlled; PSV: Pressure Support Ventilation; MV: Mechanical Ventilation; VAP: Ventilator-Associated Pneumonia.
Source: the authors (2024).

After the first round, the questionnaire was reformulated and divided into two sections: the first part related to sociodemographic and self-assessment of educational questions, and the second part reserved for knowledge assessment questions. Following this, a new round of evaluation was conducted with the judges aiming for a new review. Subsequently, total agreement among the judges was achieved (CVI=1), the instrument was finalized and can be viewed in its entirety through the supplementary materials.

The final version of the questionnaire, after the inclusion of the question about VAP, consisted of 11 questions. The questions addressed the following topics: autonomy in ventilatory adjustment, MV setup, basic ventilatory modes, alarm adjustments, VAP and protective ventilation strategy. To answer these questions, an estimated time of 10 to 15 minutes was calculated. This time was designed to retain the nurse's attention without disrupting their work routine.

4. Discussion

Given the critical nature of patients cared for in ICUs, nurses' mastery of the inherent care related to MV is linked to knowledge about the mechanical ventilation device and the identification of complications. The difficulties faced by these professionals may be related to weaknesses in the dissemination of this knowledge from graduation to professional practice.[5]

This gap in content related to MV remains present in our current nursing education programs, where 86.4% of these professionals did not receive sufficient knowledge[5], and only 13.7% of postgraduate course curricula offer specific content on MV.[22] This justifies the demand for skilled professionals in providing intensive care with knowledge about MV.

Thus, items evaluated in the content validation of the questionnaire in this study, such as autonomy in ventilatory adjustments, basic ventilatory modes, alarm settings, VAP prevention, and protective ventilation, are part of the daily routine of intensivist nurses, who need to be aware of these aspects and have constant updates of acquired knowledge.

Given the complexity of treatment with MV, nursing professionals are required to have knowledge related to the necessary care to ensure patient safety. However, literature reveals that this knowledge is sometimes deficient due to weak training[5,23], particularly concerning best practices with MV. For example, the study by Martins et al.[5] showed that 77.5% of the evaluated nurses did not know how to identify the consequences and risks associated with MV. Additionally, other studies[8,16,17] have demonstrated inherent weaknesses in the care process, such as infection control and sedation, checking endotracheal tube fixation[8,17], aspiration of pulmonary secretions[16,17], observation of the ventilatory circuit's patency[16], and even lung auscultation during physical examination.[17]

Beyond knowledge level, autonomy in handling the MV equipment and understanding parameters and variables should be seen as fundamental in the care of critically ill patients. However, according to literature, a small proportion (less than 10%) of nurses feel confident and autonomous in ventilatory adjustments, alarm verification, participation in ventilator weaning, and maintaining the patency of the artificial airway.[16,17]

Therefore, considering the multiplicity of professionals in this intensive care environment, where each area of practice has a specific perspective, the perception of these nurses becomes crucial, especially regarding their role in MV care, the functions they perform, accurate documentation in nursing records, and indications for this therapy and its ventilatory parameters.[6]

From this analysis, the knowledge-building cycle provided by a continuing education program must be continuous and transversal[23], with essential information and knowledge about MV and its specifics being adequately shared. At the same time, it is important to identify the weaknesses of these professionals through the application of a specific, targeted, and validated assessment.

Thus, for the execution of this work, after an extensive literature review, reformulation, and validation of the questionnaire by expert judges in intensive care, the present content validation instrument for evaluating the knowledge of nurses working in intensive care on MV was created with a final CVI=1, favoring its targeted application to the referred population.

During the initial literature review stage, ten national and international studies[5,8,10-17] were found that evaluated nurses' knowledge regarding MV. None of these studies demonstrated a described process for validation based on a methodology. According to this criterion, validation is a procedure of utmost importance to determine that the instrument measures exactly what it proposes to measure. Therefore, as the assessment of the knowledge of a particular population does not have a specific statistical test to validate its content, a qualitative approach involving specialists in this area is necessary.[24]

Thus, the content validation process by specialist judges stands out as a support to discussions on the topic, expanding the perspective of analysis from their diverse viewpoints.[25] This aspect supports the validation of questionnaires related to professional topics on MV, quality of life reported by patients under MV in the ICU[26], evaluation of nurses' knowledge about elderly patients[27], and other health areas such as orthodontic experience[28] and patients' knowledge about diabetes mellitus.[29]

This study has some limitations: (1) regional validation, despite the specialist judges' expertise on the subject, Brazil, being a vast country, has various regions with different nursing practices (some areas focus more on VAP than on ventilatory adjustments themselves); (2) the evaluative content of this questionnaire was based on basic MV topics and VAP, and does not cover knowledge on asynchronies or other advanced MV subtopics; (3) the number of questions, although the application time is short, may be insufficient to capture a detailed assessment of professional knowledge; (4) the use of only one content validity measurement model.

5. Conclusion

The developed instrument was considered to have content validity evidence by the group of specialist judges. It exhibits appropriate appearance, comprehension, and relevance, making it suitable for the target population. Thus, the instrument can be used in other studies aimed at evaluating the knowledge of nurses working in intensive care about MV, generating comparative results across various settings.

Moreover, the contributions of this study to the field of nursing relate to the need for assessing knowledge related to MV, in order to strengthen the practice and fields of action of nurses, so that confidence and safety in caring for critically ill patients result in increasingly effective care. This can be achieved through ongoing education on the topic, which should be conducted whenever a knowledge gap on this subject is identified.

Authors contributions

The authors declared that they have made substantial contributions to the work in terms of the conception or design of the research; the acquisition, analysis or interpretation of data for the work; and the writing or critical review for relevant intellectual content. All authors approved the final version to be published and agreed to take public responsability for all aspects of the study.

Conflicts of interest

No financial, legal, or political conflicts involving third parties (government, private companies and foundations, etc.) have been declared for any aspect of the submitted work (including but not limited to grants and funding, advisory board membership, study design, manuscript preparation, statistical analysis, etc.).

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