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ORIGINAL REPORT

Development and validity of tutorial guide for using lung ultrasound to identify "Excessive Fluid Volume" nursing diagnosis in patients with heart failure

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Abstract

Purpose: The purpose of this study was to create and assess the content validity of a tutorial guide to identify the "Excessive Fluid Volume" nursing diagnosis in individuals with heart failure using lung ultrasound.

Methods: The study was divided into two phases. In the first phase, a literature review was conducted with the aim of developing a tutorial guide for performing lung ultrasound (LUS) to identify the "Excessive Fluid Volume" nursing diagnosis. In the second phase, the developed tutorial guide was initially assessed by a group of experts to assess the stages for image acquisition. Subsequently, another group of experts assessed the tutorial guide in terms of its indications, interpretation, and management. The content validity ratio (CVR) was calculated to analyze the agreement among experts.

Results: A total of 24 articles were included in the tutorial guide development. Initially, the guide was assessed by 10 experts, and after three rounds, a critical CVR value was obtained. In the second phase, the guide's indications, interpretation, and management were assessed by 14 nurses, achieving a CVR value of 1.0. The guide includes three indications for insonation, 17 stages related to acquiring pulmonary insonation, three possible interpretations of ultrasound images to identify the defining characteristics of pulmonary congestion and pleural effusion, and five potential nursing interventions.

Conclusion: The tutorial guide for identifying the "Excessive Fluid Volume" diagnosis in patients with heart failure was developed and demonstrated adequate evidence of content validity.

Implications for practice: The tutorial guide developed can be used by nurses to assess the presence of the "Excessive Fluid Volume" diagnosis in different nursing care scenarios for patients with heart failure.

KEYWORDS
heart failure, nursing diagnosis, standardized nursing terminology, ultrasonography, validation studies

1 | INTRODUCTION

A systematic and qualified nursing assessment supports accurate and clinical judgment, leading to valid nursing diagnoses, which guide planning of nursing care to reach patient outcomes (Juvé-Udina et al., 2017; Mohammed Iddrisu et al., 2018; Tan et al., 2021; Zambas et al., 2016; Wiseman et al., 2024). Early recognition of preventable, life-threatening situations and timely escalation of care largely depend on nursing standards of practice, which also coincide with the stages of the nursing process (American Nurses' Association, 2021; Bose et al., 2016; Iddrisu et al., 2018; Juvé-Udina et al., 2017; Wiseman et al., 2024).

Physical assessment, a fundamental aspect of nursing assessment, has traditionally relied on the four pillars of inspection, palpation, percussion, and auscultation. However, insonation has been proposed as a fifth pillar by physicians (Narula et al., 2018) and is increasingly being incorporated into nurses' physical assessments to support decision-making (Moosavi et al., 2023; Santos et al., 2024; Totenhofer et al., 2021; Tromp et al., 2024; Zisis et al., 2022).

During physical assessment, asymptomatic subclinical pulmonary congestion can go unnoticed. Individuals with chronic heart failure (HF), including those clinically stable, often present with varying levels of pulmonary congestion (Domingo et al., 2021; McDonagh et al., 2021), one of the most common signs, strongly associated with high readmission and mortality rates (Palazzuoli et al., 2018; Platz et al., 2017).

Although traditional physical assessment and complementary exams are useful for assessing the volemic status of individuals with HF, they have several limitations (Domingo et al., 2021). Compensation risk scores based on signs and symptoms are subjective and may not detect pulmonary congestion, especially in its early stages. Furthermore, natriuretic peptides show great variability even among individuals with similar signs and symptoms. Chest radiography also presents high variability among observers, and the absence of radiographic findings does not exclude the possibility of elevated pulmonary capillary pressures and subsequent congestion (Domingo et al., 2021; Palazzuoli et al., 2018).

This variability in clinical, laboratory, and radiological assessments in individuals with decompensated HF may explain the significant differences in the prevalence of the NANDA-International (NANDA-I) "Excessive Fluid Volume" (code 00026) nursing diagnosis in these individuals (Oliveira et al., 2024). This explains the need for techniques that aid in the early detection of pulmonary congestion, from home care to hospitalized patients.

Lung ultrasound (LUS) has gained widespread acceptance, as it allows for lung aeration assessment by identifying artifacts known as A-lines and detecting ultrasound signs of pulmonary consolidation, pneumothorax, pleural effusion, and pulmonary congestion. Pulmonary congestion is characterized by an increase in extravascular fluid, which produces vertical ultrasound artifacts originating from the pleural line called B-lines (Smit et al., 2021; Zong et al., 2020). Systematic literature reviews (Dong et al., 2023; Maw et al., 2019) have demonstrated the high sensitivity and specificity of LUS in the early detection of pulmonary congestion, with higher accuracy than other diagnostic methods, such as chest radiography (Chiu et al., 2022; Nakao et al., 2022).

In addition to its greater sensitivity in detecting early signs of congestion, LUS can predict adverse outcomes, such as readmission or death within 90 days in individuals with HF. In a multicenter prospective study conducted by nurses to assess the effectiveness of a simplified bedside ultrasonography protocol before hospital discharge in patients admitted with decompensated HF, it was found that the presence of more than 10 B-lines increased the likelihood of readmission within 90 days after discharge by threefold and the probability of death within 90 days after discharge by fivefold (Zisis et al., 2022). The use of LUS in outpatient settings for individuals with HF has shown several advantages, including the prediction of hospitalization or emergency room visits within 6 months and increased mortality risk when more than three B-lines are detected (Platz, 2016). Additionally, it improves the accuracy of clinical assessments compared to lung auscultation (Maw et al., 2019).

Given the strong evidence supporting the use of LUS to detect signs of pulmonary congestion in individuals with HF, this technology could be employed in physical assessment by nurses to identify the "Excessive Fluid Volume" nursing diagnosis, defined as "Surplus retention of intracellular and/or extracellular fluids, not including blood" (Herdman et al., 2024). LUS data could provide more objective and early detection of this dysfunctional health response by identifying an increase in B-lines or the presence of pleural fluid accumulation compared to X-Rays and physical examination. This is particularly significant, considering that the clinical signs of individuals with HF often present later compared to changes detectable by LUS.

The use of LUS to identify the "Excessive Fluid Volume" nursing diagnosis could enhance the accuracy of this diagnosis, as this health dysfunction is one of the main clinical signs in patients with decompensated HF. This, in turn, could reduce the divergence in the prevalence of this nursing diagnosis in this population, as indicated by the results of a systematic review, which observed that the prevalence of the "Excessive Fluid Volume" nursing diagnosis ranges from 4.65% to 88.0% (Paneque-Sánchez et al., 2024).

In literature, there is an LUS protocol known as I-AIM, which divides the ultrasound protocol into indication, image acquisition, interpretation, and management (Kruisselbrink et al., 2017). These existing protocols focus on diagnosis and therapeutic management prescribed by physicians. However, several studies demonstrate that the use of point-of-care ultrasonography by nurses can increase patient safety and enable the early detection of clinical situations that may raise mortality risks (Santos et al., 2024). Therefore, nursing knowledge, evidence-based clinical reasoning, and decision-making should be improved in interpreting LUS findings, especially in high-risk populations, such as those with HF. This highlights the need for specific nursing guidelines to assist nurses in clinical diagnostic reasoning, aiming for more accurate identification of nursing diagnoses (Totenhofer et al., 2021).

TABLE 1 Modified I-AIM (Indication, Acquisition, Interpretation, and Management) protocol to I-AIN (Indication, Acquisition, Interpretation, and Nursing Intervention).

I-AIM	I-AINI nurses
I—Indication: main indications for performing LUS	I—indications: main indications for performing LUS in patients with HF
A—acquisition: each stage for conducting LUS	A—acquisition: demonstrating each stage for conducting LUS
I—interpretation: referred to the interpretation of images	I—interpretation: referred to the interpretation of images and, for the purposes of this study, with the link between the findings and the defining characteristics of the NANDA-I "Excessive Fluid Volume" diagnosis (Herdman et al., 2024)
M—management: referred to the possible treatments that can be implemented	"NI"-Nursing Intervention: possible nursing interventions based on the Nursing Interventions Classification (NIC) (Butcher et al., 2020) were suggested.

To the best of the authors' knowledge, no protocol or guide has been identified that assists nurses in clinical reasoning based on LUS findings to diagnose "Excessive Fluid Volume" in individuals with HF, so this study aimed to create and assess the content validity of a tutorial guide to identify the "Excessive Fluid Volume" nursing diagnosis in individuals with HF, using LUS.

2 | METHODS

2.1 | Ethical aspects

The project was submitted and approved by the Research Ethics Committee at Federal University of São Paulo and received approval number 5.721.280.

2.2 | Study design

This was a psychometric study performed in two phases:

Phase 1 comprised the creation of a tutorial guide to identify the "Excessive Fluid Volume" nursing diagnosis in individuals with HF using LUS based on a modified version of the I-AIM (Indication, Acquisition, Interpretation, and Management) (Bahner et al., 2012) called the I-AINI model. Indeed, the I-AIM model was developed for the use of LUS by physicians, while in this study, a modified version of this model was created for use of LUS by nurses. In the Table 1, the I-AIM protocol is presented with the correspondence for each letter, and next to it, the modifications to the protocol for use by nurses are listed.

Phase 2 refers to tutorial guide content validity assessment by experts.

Sample

For the second phase, experts were selected to assess the tutorial guide content validity in two stages with a minimum of five experts. In the first stage, experts had to assess acquisition (each stage for conducting LUS). For this reason, healthcare professionals (nursing, physician, and physiotherapist) with at least a specialist degree and clinical and/or teaching expertise on LUS were considered experts. In the second stage, experts needed to assess indication, interpretation, and nursing intervention and were selected based on the following criteria: being a nurse with clinical and/or teaching expertise on LUS or in nursing classification systems, particularly the NANDA-I language or NIC.

Content validity was conducted in two stages to accommodate distinct inclusion criteria. In the first stage, we required experts proficient in performing LUS regardless of their professional category. In the second stage, we sought expert nurses with experience in nursing classification systems and proficiency in performing LUS.

First phase: Creation of the lung ultrasound tutorial guide for nurses based on the I-AINI

To create the tutorial guide, a narrative literature review was conducted. The first narrative review was conducted to identify the main indications, methods of acquiring LUS images, and interpretation of findings in individuals with HF. Studies were included if their focus was on performing LUS in adults with HF. Therefore, primary and review studies were included in either Portuguese or English and published from 2021 to 2023, regardless of whether the review studies cited the primary studies included in this review.

Pathophysiological review studies, letters to the editor, and those that did not directly involve the performance of LUS, which included pediatric patients or patients with multifactorial shock or chronic coronary artery disease, were excluded.

Articles were searched in electronic databases available through *Biblioteca Virtual de Saúde* (Virtual Health Library), which includes PubMed MEDLINE, LILACS, BDENF, Web of Science, and Scopus. The search strategies included standardized MeSH and DeCS (Health Sciences Descriptors) descriptors:

Search #1: (lung ultrasound) AND (acute heart failure)

Search #2: (("lung"[MeSH Terms] OR "lung"[All Fields]) AND ("diagnostic imaging"[MeSH Subheading] OR ("diagnostic"[All Fields] AND "imaging"[All Fields]) OR "diagnostic imaging"[All Fields] OR "ultrasound"[All Fields] OR "ultrasonography"[MeSH Terms] OR "ultrasonography"[All Fields] OR "ultrasonics"[MeSH Terms] OR "ultrasonics"[All Fields] OR "ultrasounds"[All Fields] OR "ultrasound s"[All Fields]) AND (("acute"[All Fields] OR "acutely"[All Fields] OR "acutes"[All Fields]) AND ("heart failure"[MeSH Terms] OR ("heart"[All Fields] AND "failure"[All Fields]) OR "heart failure"[All Fields]))) AND (2021/1/1:2023/12/31[pdat])

According to the inclusion and exclusion criteria, articles were selected by two researchers independently, initially by reading the title and abstract. For those selected articles, a full-text reading was carried out. If any disagreement was present regarding the inclusion or exclusion of articles, a consensus was reached through discussion between the two researchers. For each selected article, the following information was extracted by the two independent researchers: title, year of publication, objective, study design, stages for performing LUS, and LUS findings and their clinical interpretation.

The data gathered from the studies informed the development of key indications for performing LUS along with the necessary stages for acquiring ultrasound images. Moreover, the data provided a framework for interpreting the findings of LUS to identify the "Excessive Fluid Volume" nursing diagnosis based on two defining characteristics: pulmonary congestion and pleural effusion.

The second narrative review was conducted to identify the main nursing interventions related to "Excessive Fluid Volume" for patients with acute HF. The process of selecting articles followed the same approach as used in the first literature review, and data extraction was performed by two researchers.

Second phase: Tutorial guide content validity assessment

After creating the tutorial guide on how to use LUS for nurses, the guide was submitted to content assessment in two distinct stages (A and B). In stage A, the stages for performing LUS (image acquisition) were e-mailed to experts to assess for clarity and theoretical and practical relevance on a dichotomous scale: 1 for "agree" and 2 for "disagree", with space provided for suggestions for each assessed item. In stage B, data on LUS indications and image interpretation were e-mailed to a new group of nurse experts for assessing clarity, theoretical relevance, and practical relevance on a dichotomous scale: 1 for "agree" and 2 for "disagree" (Ayre & Scally et al., 2014).

Eligible experts were selected using the snowball sampling technique, and the Delphi technique was used to assess content validity until satisfactory validity values were reached. The initial seed was generated by the researchers' network. Invitations to participate in the study were e-mailed, including a link to a Google Form survey that contained three forms: the consent form, a demographic and professional form to collect information on experts, and the tutorial guide form with questions about its items for assessing its content validity.

Based on the LUS image interpretation, experts in stage B were asked if they agreed that such changes could support the identification of the defining characteristics of pleural effusion and pulmonary congestion, as well as the possible nursing interventions to be implemented for the nursing diagnosis under study.

The assessed indicators were defined as clarity of language refers to how easily a message can be understood, free from confusion or ambiguity. It involves using simple, precise, and direct language to effectively convey ideas; theoretical relevance refers to the significance of a concept, theory, or study in advancing knowledge within a specific field; and practical relevance refers to the applicability of a concept, theory, or study in real-world situations.

Data analysis

Data analysis was performed using the Statistical Package for the Social Sciences (SPSS) version 22.0. Expert demographic and professional characteristics were described using absolute and relative frequencies as well as measures of central tendency (mean and median) and dispersion (standard deviation, minimum and maximum values, and quartiles).

For each indicator (clarity, theoretical and practical relevance), the content validity ratio (CVR) proposed by Lawshe (1975) was calculated. A minimum of five experts were established for the CVR calculation, which was computed as follows: $CVR = (Ne-N/2)/(N/2)$, where Ne represents the number of experts who agreed with the indicator (scoring 2) and N is the total number of experts.

The critical CVR values established for assessing image acquisition were 0.53 ($p = 0.04$), in the first round, with feedback from 10 experts, and 0.75 ($p = 0.03$), in the second and third rounds, with feedback from eight experts (Ayre & Scally et al., 2014). For assessing indication, interpretation, and nursing intervention, the critical CVR was 0.57 ($p = 0.02$) based on feedback from 14 experts.

RESULTS

In the first narrative literature review, 23 articles (Supporting Information) were included, and the LUS tutorial guide for nurses was created, containing three indications for performing LUS, 20 stages for image acquisition, and four possible images interpretation. In the second narrative literature review, four articles were selected that supported the identification of five nursing interventions related to the "Excessive Fluid Volume" diagnosis: Fluid Monitoring (4130), Respiratory Monitoring (3350), Vital Signs Monitoring (6680), Water Control (4120), and Energy Control (0180) (Butcher et al., 2020).

In the second phase, stage A (stages for performing LUS) was emailed to 16 experts, and feedback was received from 10 (62.5%) of them. Most respondents were female nurses, with a mean age of 35 years. All respondents had LUS experience, with a mean of 5 years of experience, as detailed in Table 2.

In the second phase, stage A, three rounds of assessment were needed to achieve a CVR greater than 0.75, with feedback from 10 experts in the third round. The main suggestions included improving the descriptive details of each stage, separating the stages for assessing lung aeration and pleural effusion, and incorporating the use of a linear transducer for LUS. The final version of the guide on image acquisition on LUS included 17 stages. The mean CVR values were 0.96 for clarity, 0.95 for theoretical relevance, and 0.92 for practical pertinence (Table 3).

TABLE 2 Demographic and professional characteristics of experts.

	First group of experts (*n* = 10)	Second group of experts (*n* = 14)
Age, mean (SD)	35.8 (5.92)	38.0 (8.8)
Female sex, *n* (%)	6 (60.0)	8 (57.0)
Profession, *n* (%)		
Nurse	8 (80)	14 (100)
Physician	1 (10.0)	0
Physiotherapist	1 (10.0)	0
Highest educational degree, *n* (%)		
Specialist in cardiology	0	5 (35.7)
Doctoral degree	1 (10.0)	5 (35.7)
Master's degree	9 (90.0)	3 (21.5)
Postdoctoral fellowship	0	1
Experience with lung ultrasound *n* (%)[a]	10 (100.0)	13 (92.8)
Teaching	3 (30.0)	8 (57.0)
Research	1	7 (50.0)
Bedside care	7 (70.0)	11 (78.0)
Experience with Nursing Classification Systems, *n* (%)[a]	NA	14 (100)
Teaching	3 (30.0)	8 (57.0)
Research	1 (10.0)	4 (28.0)
Bedside care	7 (70.0)	14 (100)

Note: *n*, absolute number; SD, standard deviation.
[a]Question allows for more than one answer.

In the second phase, stage B (LUS indications, image interpretation, and possible nursing intervention) was e-mailed to 22 nurses with expertise on LUS and standardized Nursing Language Systems. Feedback was received from 14 nurses, the majority of whom were women with advanced qualifications such as doctoral and master's degrees. Thirteen of these nurses had experience in teaching, research, and clinical practice, and all had expertise in standard nursing diagnoses and nursing interventions classifications (see Table 2).

In the CVR analysis, all items assessed for clarity, theoretical relevance, and practical relevance achieved a critical CVR value equal to or greater than 0.53 ($p = 0.03$). Suggestions included improvements in textual description, grammar, and the inclusion of additional clinical signs to enhance the pulmonary insonation guide. Moreover, 100% of judges (CVR equal to 1.0) agreed with the identification of the pulmonary congestion and pleural effusion defining characteristics for the "Excessive Fluid Volume" nursing diagnosis based on lung insonation images. Regarding the selected nursing interventions, there was total agreement among all the judges (Table 4).

Figure 1 shows the tutorial guide to identify the "Excessive Fluid Volume" nursing diagnosis in individuals with HF using LUS.

DISCUSSION

LUS is a useful tool for assessing patients with HF in different clinical plans, allowing for regular assessment of pulmonary congestion in those patients with clinical signs of ventricular decompensation (congestion or low cardiac output) and also for monitoring responses to multiprofessional interventions in patients with acute ventricular failure (Palazzuoli et al., 2018; Picano & Pellikka, 2016; Platz et al., 2017; Xu et al., 2023), justifying the need for the development and validity of content for a guide to assist nurses in identifying the "Excessive Fluid Volume" nursing diagnosis through the use of ultrasound.

LUS can be performed by nurses to identify the "Excessive Fluid Volume" nursing diagnosis, and its correct execution is essential to guarantee the nursing diagnostic accuracy. Moreover, optimizing clinical management strategies is essential, allowing the advancement of knowledge about the diagnostic process and increasing the reliability of clinical studies on nursing diagnoses (Peres et al., 2016).

To develop and validate LUS, the research team first modified the I-AIM model to apply it in nursing, using the I-AINI model for this purpose. The LUS tutorial guide was then developed and validated with a panel of experts in two stages. Two stages were planned because we needed different types of experts. The guidance of the group of evaluators who are heterogeneous was also followed, that is, with different academic backgrounds, titles, and areas of activity, increasing the level of analysis of the guide (Almanasreh et al., 2019; Furr et al., 2022). To analyze agreement in both phases, we chose to calculate the content validity index, as this test considers the number of judges for adequate evidence of validity, reducing the risk of assessment biases (Almanasreh et al., 2019; Ayre & Scally et al., 2014). With the results of CVR, we obtained very high critical values, demonstrating high agreement among experts in relation to the topics covered in terms of clarity, theoretical relevance, and practical applicability, thus demonstrating the robustness of this pulmonary insonation guide for identifying the "Excessive Fluid Volume" nursing diagnosis.

According to feedback of experts, the LUS tutorial guide with the following characteristics was validated. As for the image acquisition domain, appropriate guidance actions were included for both patients and family members/companions, as it is known that such interventions help reduce anxiety and ensure patient cooperation during the examination, in addition to establishing realistic expectations about the possible results and limitations of the procedure. The type of transducer to be chosen was sequentially included, since the choice of transducer affects the image quality and lung insonation accuracy. The recommendation to maintain patients in a supine position at 30° or 45° or even sitting was maintained, as studies show that such positioning facilitates the visualization of the pulmonary structures, allowing gravity to distribute liquids within the transit so that they can be detected more easily by ultrasound (Gargani et al., 2023; Rocca et al., 2023; Santus et al., 2023).

The need to adjust the device to optimize image quality was also included, in addition to the insonation points, in which the recommendation for the use of six insonation points in each hemithorax

TABLE 3 Mean content validity ratio values for clarity and theoretical and practical relevance for image acquisition in lung ultrasound.

Stage	Activities	Clarity	Theoretical relevance	Practical relevance
1.	Identify patient according to institutional protocol.	1.0	1.0	1.0
2.	Instruct patient and family about indications for the exam, limitations, and discomforts.	1.0	1.0	1.0
3.	Select the convex or linear transducer to perform the exam.	1.0	1.0	1.0
4.	Position patient in the supine position at 30° or 45°.	1.0	1.0	1.0
5.	Adjust the ultrasound device for better image acquisition in terms of frequency, depth, brightness, and focus as needed.	1.0	1.0	1.0
6.	Position the convex or linear transducer in a longitudinal position with the transducer orientation marker facing patient's head in the midclavicular line in the right and left upper and lower quadrants.	1.0	1.0	1.0
7.	Position the convex transducer in a longitudinal position with the transducer orientation marker facing patient's head in the midaxillary line in the right and left upper and lower quadrants.	1.0	1.0	1.0
8.	Position patient in lateral decubitus or sitting, if possible.	1.0	1.0	1.0
9.	Position the convex transducer in a longitudinal position with the transducer orientation marker directed toward patient's head in the middle of the right and left upper and lower posterior quadrants on the hemiscapular line.	1.0	1.0	1.0
10.	If possible, ask patient to inhale deeply and exhale in each lung field evaluated.	1.0	1.0	1.0
11.	Identify the pleural penetration signal and the presence of A-lines (horizontal) in each lung field assessed in two-dimensional brightness mode.	1.0	1.0	1.0
12.	Identify the presence of B-lines (vertical) in each lung field assessed in two-dimensional brightness mode.	1.0	1.0	1.0
13.	Identify the presence of lung consolidation and the presence of C-lines in two-dimensional brightness mode.	1.0	1.0	1.0
14.	Identify the presence of the pleural space (square sign) in two-dimensional brightness mode and the sinusoid signal in the temporal movement mode (M-mode) in the region of the intersection of the horizontal line at the level of the lower quadrant point with the posterior axillary line (PLAPS point).	0.75	1	0.75
15.	Assess the absence of pleural penetration in two-dimensional brightness mode and in temporal movement mode (stratosphere or barcode signal).	1.0	1.0	1.0
16.	Assist or remove excess gel from patient's skin and position patient in bed after the exam.	1.0	1.0	1.0
17.	Record exam findings in patient's record.	1.0	1.0	1.0

Abbreviation: PLAPS, posterior and/or lateral alveolar and/or pleural syndrome.

was chosen in this study, totaling 12 insonation points, aiming for greater coverage in the assessed area. However, it is worth highlighting that insonation from 4 to 12 insonation points has adequate sensitivity and specificity, according to a systematic review with studies that assessed the accuracy of pulmonary insonation in detecting acute lung edema (Dong et al., 2023; Gargani et al., 2023; Palazzuoli et al., 2022).

It was included in the data acquisition domain to be observed during lung insonation, which facilitates nurses' learning and clinical reasoning, that is, pleural penetration and the presence of A-lines and B-lines, which may indicate the presence of pulmonary congestion, C lines, which indicate some infectious process in the lung parenchyma, and also the presence of anechoic images in the lung base, which indicate the presence of pleural effusion (Gargani et al., 2023; Rocca et al., 2023; Santus et al., 2023).

In the interpretation domain, two possible changes identified in lung insonation were listed as being able to guide nurses in identifying the "Excessive Fluid Volume" nursing diagnosis, that is, pulmonary congestion and pleural effusion which are defining characteristics of this diagnosis (Herdman et al., 2024). The B-lines indicate the presence of interstitial or alveolar fluid, and the increase in the number of these lines indicates pulmonary fluid overload, which is interpreted as pulmonary congestion, in addition to the presence of fluid from the pleural space indicative of pleural effusion.

In the last domain of the tutorial guide, five NIC nursing interventions were selected for the "Excessive Fluid Volume" diagnosis based on four articles selected on the second narrative literature review. These interventions were supported by three cross-sectional studies and one study published by the American Association of Heart Failure Nurses as a scientific statement (Fraser et al., 2024; Nascimento

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TABLE 4 Final content validity ratio for clarity, theoretical and practical relevance of the indication, and interpretation of lung ultrasound images.

Items assessed for content validity ratio	Clarity	Theoretical relevance	Practical relevance
Indication of pulmonary insonation in patients with clinical signs of heart failure			
Patients complaining of dyspnea on safety, dyspnea on minimal exertion, weight gain, and reduced urinary output associated with signs of "Excessive Fluid Volume."	1.0	1.0	1.0
Patients with clinical signs of low cardiac output: altered level of consciousness, arterial hypotension, cold extremities, cold and clammy skin, nausea, and vomiting associated with clinical signs of pulmonary congestion.	1.0	1.0	1.0
Monitoring responses to professional interventions in patients with acute ventricular failure.	1.0	1.0	1.0
Interpretation of lung ultrasound data for identification of "Excessive Fluid Volume" nursing diagnosis			
The presence of pleural sliding and A-lines in all lung fields indicates the presence of normal lung aeration indicating the absence of pulmonary congestion.	0.73	0.73	0.73
The presence of more than three B-lines in each lung field with a regular pleural line is related to pulmonary congestion.	1.0	1.0	1.0
The greater the number of B-lines, the greater the degree of pulmonary congestion.	0.73	1.0	1.0
The presence of anechoic images at the lung base with or without the jelly fish sign is indicative of pleural effusion and together with the presence of B-lines is indicative of pulmonary congestion.	1.0	1.0	1.0

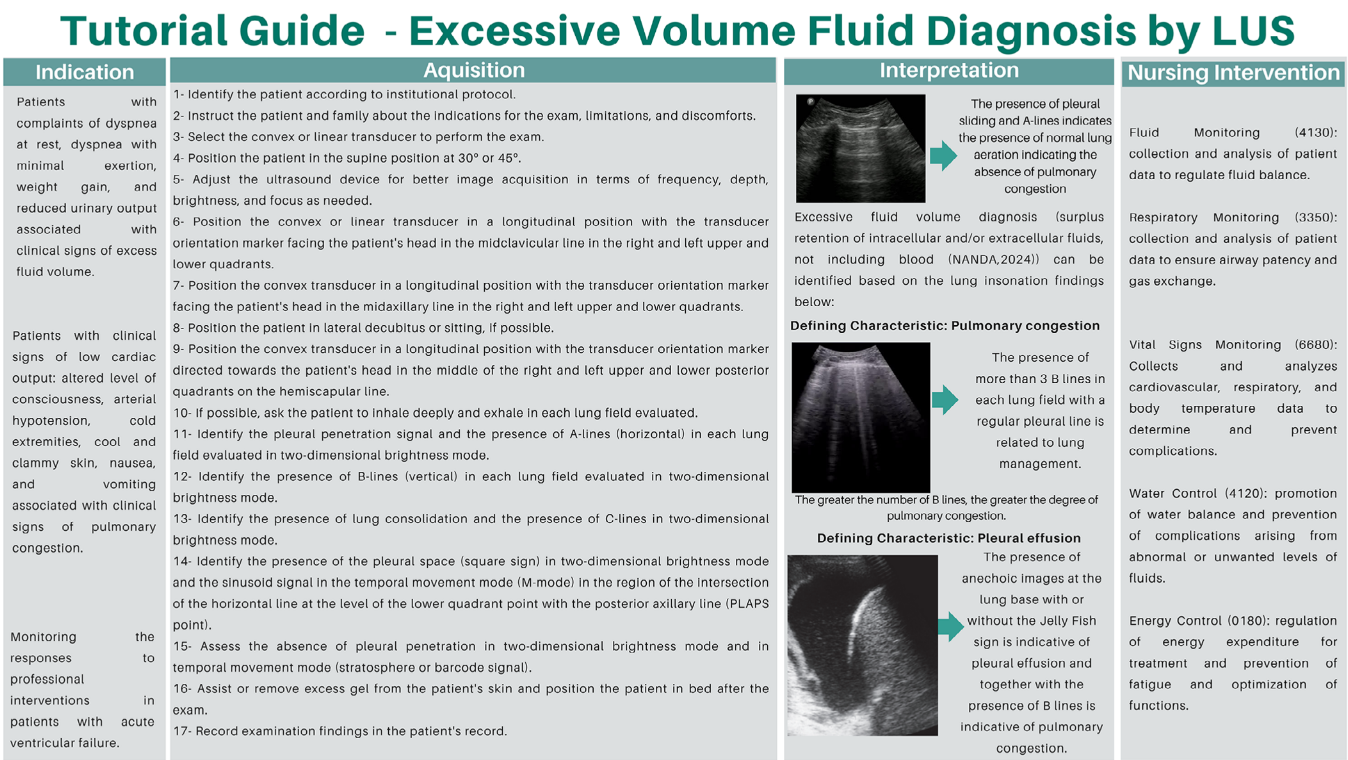

FIGURE 1 The validated tutorial guide for identifying the "Excessive Fluid Volume" diagnosis for patients with heart failure. São Paulo, SP, Brazil.

et al., 2019; Padua et al., 2022; Sousa et al., 2016). These nursing interventions encompass specific nursing activities aimed at hemodynamic control, fluid monitoring, water control, and energy management. They are related to interventions designed to assist in the compensation of patients admitted with HF, specifically by reducing volume overload to improve cardiac performance.

From the perspective of increasing accuracy in identifying "Excessive Fluid Volume" nursing diagnosis in patients with HF, this tutorial guide, developed and validated, needs to be applied in clinical practice to assess its effect on identifying the nursing diagnosis under study and, consequently, on implementing interventions aimed at controlling the health dysfunction in question.

LIMITATION

In light of this study, some needs for continuity are evident, as this guide has not yet been applied in clinical practice to support nurses' clinical reasoning, which was considered a limitation of this study.

IMPLICATION FOR NURSING PRACTICE

The tutorial guide developed and validated can be used in clinical nursing practice to identifying the "Excessive Fluid Volume" nursing diagnosis through the use of LUS. Moreover, its use is also suggested in education, as this guide can be used to teach the use of LUS for nurses not only as a technical procedure but also as a means to enhance diagnostic reasoning. Finally, the guide can also be utilized for research on this topic, such as for validity studies of this diagnosis.

CONCLUSION

A tutorial guide for performing lung insonation was created to identify the "Excessive Fluid Volume" nursing diagnosis and included three indications for pulmonary insonation, 17 stages related to acquiring pulmonary insonation, three possible interpretations of ultrasound findings, and five possible nursing interventions to link to the "Excessive Fluid Volume" diagnosis. The tutorial guide was validated through content validity, as indicated by the adequate levels of agreement achieved among a heterogeneous group of experts.

AUTHOR CONTRIBUTIONS

Maria Camila Rodrigues, Thiago Vital da Silva, Hellen Caroline da Silva Teixeira were involved in conceptualization, data collection, data analysis, and writing original draft. Camila Takao Lopes, Juliana de Lima Lopes, Fernanda Raphael Escobar Gimenes, and Fabio D'Agostino contributed to manuscript writing and and critical revisions for important intellectual content. Vinicius Batista Santos contributed to study design, data collection, data analysis, study supervision, manuscript writing, and critical revisions for important intellectual content.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

ETHICS STATEMENT

The study was approved by the Research Ethics Committee of the Federal University of São Paulo and was approved under Opinion 5.721.280.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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