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Impact of Educational Intervention on Noninvasive Ventilation (NIV) in Nurses and Students

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ABSTRACT

Background: Proficient management of noninvasive mechanical ventilation (NIMV) demands competence, coupled with their seamless mobilization in clinical practice in managing respiratory failure. The COVID-19 pandemic necessitated the rapid integration of less experienced professionals and nursing students into Intensive Care Units (ICUs), highlighting a need for efficient NIMV training. This study aimed to evaluate the impact of a theoretical-practical training and simulation-based educational strategy in improving NIMV knowledge and clinical competence.

Method: Teaching sessions were conducted between April and June 2021. Participants underwent a 3-h theoretical-practical session followed by a 1.5-h simulation. Knowledge acquisition was assessed using an ad hoc multiple-choice test. Separately, self-perceived competence was evaluated using the validated COM-VA questionnaire at three time points: preintervention, posttheoretical-practical formation and postsimulation. Nonparametric statistical tests were used to analyse the changes in knowledge and competence.

Results: The study included 66 participants (30 students and 36 professionals) and found significant improvements in both knowledge and self-perceived competence across the educational intervention. Knowledge test scores rose from 82.2% preintervention to 90.2% postsimulation ($p < 0.05$). Median COM-VA scores also significantly increased from 6.82 (IQR = 1.33) preintervention to 7.38 (IQR = 1.45) postsimulation ($p < 0.001$). While the theoretical-practical session led to the largest knowledge gain, simulation provided additional benefit.

Conclusion: A combined theoretical-practical and simulation-based educational intervention demonstrated effectiveness in significantly enhancing the knowledge and self-perceived clinical competence of nursing students and professionals in our study group in NIMV management. This rapid and effective training strategy has important implications for preparing healthcare personnel, particularly during emergency situations like the COVID-19 pandemic, potentially contributing to improved patient safety.

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1 | Introduction

Noninvasive mechanical ventilation (NIMV) is a vital, safe and effective method for managing respiratory failure, helping patients breathe without needing intubation and avoiding associated complications [1].

It has become an essential technique in managing acute respiratory failure (ARF) and chronic (CRF) respiratory failure (ARF) [2]. Its use has grown significantly over the last decades [3, 4], especially during the COVID-19 pandemic [5]. This unprecedented situation led to a significant increase in patient admissions to Intensive Care Units (ICUs), creating a critical shortage of specialised healthcare professionals. To address this, staff from other units and fourth-year nursing students were quickly incorporated into the ICUs. These rapidly deployed professionals and students often lacked the necessary skills and training for effective noninvasive ventilation (NIV) management, as the emergency prevented adequate preparation. Studies have shown that incidents related to patient safety are prevalent in critical care settings, emphasising the need for competent professionals [6]. Nurses are particularly vital in NIMV care, responsible for crucial tasks like interface selection, positioning, direct patient care and data recording [7]. The success of NIV treatment often depends on their experience and knowledge [8–10].

> "Nurses are particularly vital in NIMV care, responsible for crucial tasks like interface selection, positioning, direct patient car, and data recording. The success of NIV treatment often depends on their experience and knowledge."

Competence in NIV management requires a combination of knowledge, skills, attitudes and values, as well as the mobilization of these components to the real context or situation [11]. Ongoing professional development is crucial for healthcare providers to achieve these specialised competencies [12]. In fact, education is key in preventing incidents and should include specific programmes for recognising and managing critically ill patients, ensuring that professionals are adequately trained [13].

During a critical situation, there is no time to pause and think about the next step; actions and protocols must flow naturally. Training for emergencies must be rapid, precise and effective.

This study aimed to determine whether a theoretical-practical training and simulation-based education session improved participants' knowledge and self-perceived clinical competence in NIMV management.

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2 | Materials and Methods

2.1 | Study Design

Quasi-experimental longitudinal study conducted at Hospital Tortosa Verge de la Cinta from April to June 2021.

2.2 | Participants

2.2.1 | Inclusion Criteria

Participants eligible for this study included:

- Newly hired nurses working in the Intensive Care Units (ICUs) of Hospital Tortosa Verge de la Cinta during the COVID-19 pandemic.
- Fourth-year nursing students enrolled in the 'Clinical Practices IV in Critical Care Patients' course at Rovira i Virgili University.

2.2.2 | Exclusion Criteria

Individuals were excluded from participation if they met any of the following criteria:

- Healthcare professionals who were on sick leave or vacation during the data collection period of the study.
- Nursing students who were participating in a mobility programme at the time of the study.
- Individuals who declined to participate or did not provide informed consent.

A nonprobabilistic convenience sampling method was used to select the participants. All participants underwent the same training experience, which included theoretical-practical formation and simulation on NIV.

2.3 | Data Collection

2.3.1 | Instruments

The study's process is outlined in Figure 1. Sociodemographic and occupational variables were collected using a physical (paper) ad hoc questionnaire, which included: gender, age, participant type (student/professional) and professional experience (≤ 1 year; ≤ 1–3 years; > 3 years).

2.3.2 | Assessment of Participants' Knowledge

Participants' knowledge was evaluated using a 12-item multiple-choice test with five possible answers (Table 1), developed by experienced researchers based on an extensive literature review and current clinical guidelines concerning NIMV. To ensure

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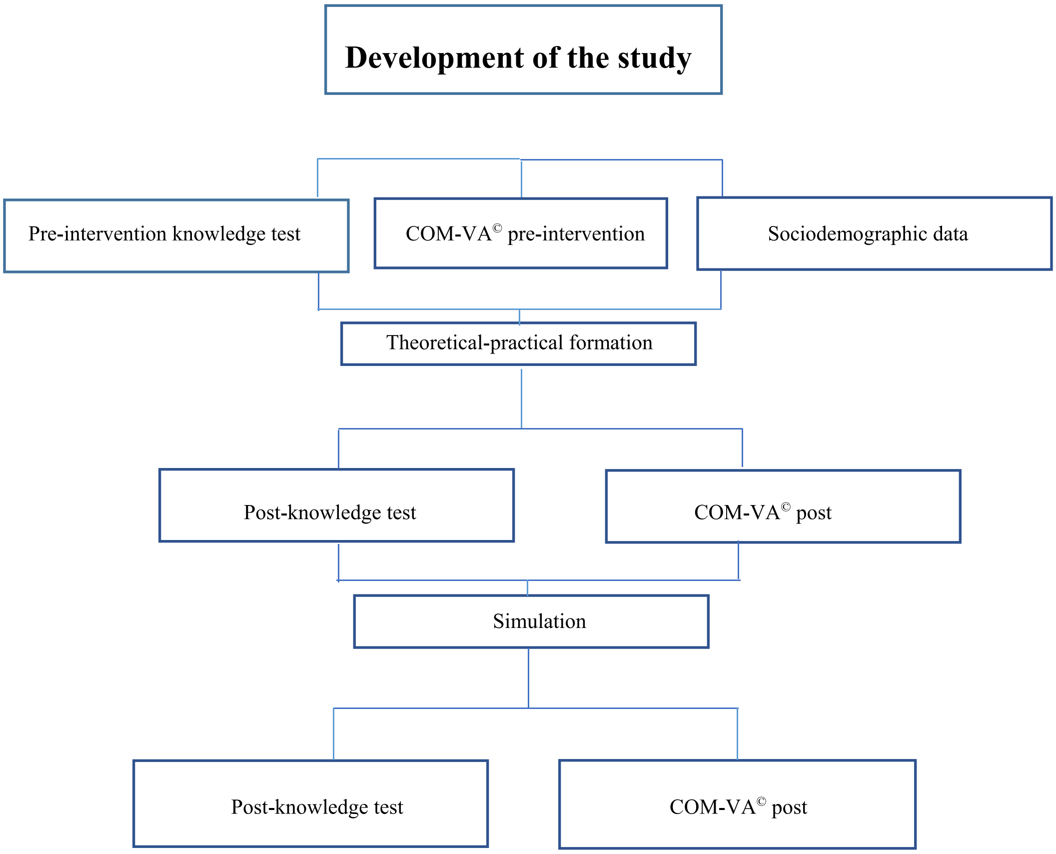

FIGURE 1 | Study development. Own elaboration.

content validity, the questions were developed to cover key areas of NIV knowledge relevant to the learning objectives of the educational intervention and were reviewed by clinical experts in NIMV for accuracy and relevance. Each correct response was assigned a score of 1 point, yielding a total possible score ranging from 0 to 12.

Participants received the same knowledge test by the study's principal investigator before the intervention, after attending the theoretical-practical formation, and once the simulation was completed. All tests were collected immediately after completion.

The study analysed the following variables:

- Participants' knowledge of NIV indications (Questions 1, 2 and 9), ventilator programming (Questions 3 and 7), nursing interventions during NIMV (Questions 8, 10, 11 and 12), predictive factors for NIV failure (Question 6) and suitable material and type of interface for NIV (Questions 4 and 5).

2.3.3 | Assessment of Self-Perceived Competence

Participants' self-perceived nursing competencies were measured using the validated COM-VA questionnaire [14] . This questionnaire assesses 30 competency items across six domains, scored from 0 (*Very poor*) to 10 (*Excellent*), with 5 being the minimum acceptable. It demonstrated strong internal consistency ($\alpha = 0.971$) [15]. Participants completed the questionnaire before the intervention, after theoretical-practical formation and after the simulation.

2.4 | Procedure

The educational content for the intervention was carefully developed following the latest NIV recommendations from Spanish Scientific Societies [16].

To ensure accuracy and relevance, both the research team and experienced clinical experts rigorously reviewed all training materials and simulation scenarios. The educational intervention consisted of a 3-h theoretical-practical formation covering topics such as respiratory failure (pathophysiology and causes); noninvasive mechanical ventilation (modes and nursing care); indications for NIV (acute patient and complex chronic patient); followed by a 1.5-h simulated activity.

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The theoretical-practical formation was delivered by experienced clinical professionals (one intensivist and five nurses) from the hospital's Intensive Care Unit, ensuring the practical

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TABLE 1 | Knowledge survey on NIV for participants.

1. What is the objective of NIV?
   (a) Recover hypoxemia
   (b) Recover respiratory acidosis
   (c) Achieve appropriate PaCO2
   (d) All are true
   (e) All are false

2. When VNI is indicated?
   (a) Exacerbated COPD with respiratory acidosis
   (b) Obesity Hypoventilation Syndrome (OHS)
   (c) Difficult weaning
   (d) Pneumonia
   (e) All are true

3. The ventilator modes are:
   (a) IPAP and EPAP mode
   (b) PSV/NIPSV mode
   (c) PAV and PAIV
   (d) BIPAP and PSV mode
   (e) BIPAP and CPAP mode

4. What resources are needed for NIV?
   (a) Human resources and interfaces
   (b) Human resources, interface and ventilator
   (c) Human resources, interface, ventilator and fixations
   (d) Human resources, interface, tubing, ventilator and fixations
   (e) All are false

5. The choice of interface type depends on:
   (a) Patient's choice
   (b) Proper adaptation of the interface to the patient's anatomy
   (c) Medical choice
   (d) All are true
   (e) All are false

6. It is a sign of poor evolution of NIV:
   (a) Adaptation to NIV
   (b) Improvement to respiratory status
   (c) Agitation
   (d) Improvement of arterial blood gas parameters
   (e) Decrease in dyspnoea

7. What are the programmable parameters on the ventilator?
   (a) IPAP, EPAP and Ti
   (b) IPAP, EPAP, Ti, ramp, FiO2
   (c) Only FiO2
   (d) All are true
   (e) All are false

8. Conjunctivitis is a common complication of NIV:
   (a) Only when the patient is using a mask interface
   (b) Only when the patient is using a helmet interface
   (c) It is not a common complication
   (d) The statement is true
   (e) All are false

9. Is the need for endotracheal intubation and cardiopulmonary arrest contraindications:
   (a) Absolute contraindications for NIV
   (b) Relative contraindications for NIV
   (c) Not contraindications for NIV
   (d) Contraindications are related to the type of patient
   (e) NIV is always indicated even in these two scenarios

(Continues)

TABLE 1 | (Continued)

10. Does NIV require nursing care:
   (a) Never
   (b) Always
   (c) Only if the patient is highly dependent
   (d) Only paediatric patients
   (e) Yes, but only for cleaning and maintaining the equipment

11. Pressure area control and the occurrence of ulcers are:
   (a) A nursing intervention related to NIV
   (b) A nursing intervention that is rarely performed
   (c) A nursing intervention performed by patients and/or family members themselves
   (d) All are false
   (e) A and b are true

12. Is it necessary to provide tailored feeding for each patient with NIV?
   (a) Yes, whenever possible
   (b) Never, since if we remove the NIV, the patient desaturates
   (c) If possible, we will offer the patient energy-rich and easily swallowable foods
   (d) a and c are true
   (e) It is better to insert a nasogastric tube and start enteral feeding

relevance and clinical accuracy of the information shared. It included lectures and practical workshops, where participants learned about NIV equipment and its assembly. Knowledge was assessed with a pretest before the lecture and a posttest along with the COM-VA questionnaire after the training.

The 1.5-h simulation, held a week after the theoretical-practical training, adhered to the *Healthcare Simulation Standards of Best Practice* [17] and was carefully supervised and approved by both the research and clinical teams. To enhance the ecological validity and relevance of the simulation, the scenario focused on a standardised patient with acute respiratory failure treated using NIMV in a simulated ICU setting. Each session included 11 participants; two acted as nurses, while the others observed for debriefing. Clear learning objectives, aligned with theoretical content, guided the simulation. Participants were briefed on the scenario (patient diagnosis, treatment plan and learning objectives), engaged in the simulation and then completed both the knowledge test and COM-VA questionnaire afterward.

'Three hours of theory-practice and 1.5 h of simulation boosted NIV management'.

2.5 | Data Analysis

A descriptive analysis was conducted using frequency and percentage for categorical variables and mean, standard deviation and range for continuous variables. Additionally, the percentage change in knowledge and skills was also calculated.

COM-VA scores across the three intervention stages (preintervention, posttheoretical-practical formation and postintervention) were described using median and interquartile range.

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To detect statistically significant differences among COM-VA values and among the three stages of the intervention, the non-parametric Friedman test was used. To detect differences between pairwise combinations of stages of the intervention, the non-parametric Kruskal–Wallis test was used. To quantify the change, the difference between the stages of the intervention and the percentage variation rate were calculated.

Preintervention, posttheoretical-practical formation and postintervention knowledge were described using frequency and percentage of correct and incorrect responses. The McNemar test was used to detect statistically significant differences between intervention stages.

For each stage of the intervention, the ratio of correct to incorrect responses was calculated overall and according to whether the participant was a professional or a student, by summing all correct responses and dividing by the sum of all incorrect responses.

For statistical analyses, IBM SPSS version 20 and Microsoft Excel 2016 were used. A significance level of $p < 0.05$ was considered.

2.6 | Ethical Considerations

The study received approval from the Ethical Committee for Research with Medicines (CEIm) of the Pere Virgili Health Research Institute (IISPV) (256/2020), as well as from the management of all participating centres. Permission was also secured from the author of the COM-VA questionnaire for its use. Each participant provided informed consent, and their anonymity was guaranteed through coded questionnaires and knowledge surveys. All research was conducted in compliance with the Helsinki Declaration.

3 | Results

3.1 | Sample Characteristics

The study included 66 participants (30 students and 36 professionals), achieving a 100% participation rate. The mean age was 29.3 years (SD = 11.17), with 90.7% (60) being female. Among the participants, 54.5% were professionals. Regarding professional experience, participants ranged from less than 1 year to over 3 years, with the majority (59.0%) having less than 1 year of experience. Within the student group, 96.67% were female. The mean age of the students was 23.83 years (SD = 5.96 years), and none had prior experience. Regarding the professional group, 86.11% were female, and their mean age was 34.03 years (SD = 12.40 years). Among the professionals, 44.44% had between 1 and 3 years of experience, 47.22% had more than 3 years of experience, and the remaining data were missing (Table 2).

3.2 | Results on Participants' Knowledge Test

This study assessed participants' knowledge both before and after an educational intervention comprising theoretical-practical training and simulation. Initial comparisons of preintervention knowledge test results revealed significant improvements in certain areas, though not uniformly across all knowledge domains (Table 3). Subsequently, an analysis of the level of knowledge at the beginning and end of the educational intervention was conducted for all participants. In Table 4, we observe how participants' level of knowledge changed throughout the different stages of the intervention, which included theoretical-practical formation and simulation.

Before the intervention, participants answered 82.2% of the test questions correctly. After the completion of the first phase of the intervention (theoretical-practical formation), this percentage significantly increased to 89.8% and continued increasing up to 90.2% after the second phase of the intervention (simulation), showing a total improvement of 9.15%.

"Before the intervention, participants answered 82.2% of the test questions correctly. After the completion of the first phase of the intervention (theoretical-practical formation), this percentage significantly increased to 89.8% and continued increasing up to 90.2% after the second phase of the intervention (simulation), showing a total improvement of 9.15%."

TABLE 2 | Sociodemographic variables of the participants.

	Total		Students		Professional	
Total (n,%)	**66**	**100**	**30**	**45.40**	**36**	**54.50**
Sex (n,%)						
Male	6	9,09	1	3.33	5	13.89
Female	60	90.91	29	96.67	31	86.11
Age (Mean, SD)	29.30	11.20	23.83	5.96	34.03	12.40
Experience (n,%)						
≤ 1 year	39	59.09				
< 1–3 years	9	13.64			16	44.44
> 3 years	18	27.27			17	47.22

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TABLE 3 | Participants' knowledge test results pre and post intervention.

Test questions	Answers	Preintervention n = 66	Preintervention %	Postintervention n = 66	Postintervention %	p (1–3)[c]
1. What is the objective of NIV?	Incorrect	9	13.6	6	9.1	0.453
	Correct	57	86.4	60	90.9	
2. **When is NIV indicated?**	Incorrect	13	19.7	6	9.1	0.065
	Correct	53	80.3	60	90.9	
3. What the ventilatory modes are?	Incorrect	16	24.2	7	10.6	**0.049**
	Correct	50	75.8	59	89.4	
4. **What resources are needed for NIV?**	Incorrect	5	7.6	0	0	Na
	Correct	61	92.4	66	100	
5.The choice of interface type depends on:	Incorrect	21	31.8	15	22.7	0.263
	Correct	45	68.2	51	77.3	
6. It is a sign of poor NIV progression …	Incorrect	1	1.5	1	1.5	0.999
	Correct	65	98.5	65	98.5	
7. What are the programmable parameters on the ventilator?	Incorrect	15	22.7	9	13.6	0.21
	Correct	51	77.3	57	86.4	
8. **Conjunctivitis is a common complication of NIV**	Incorrect	18	27.3	13	19.7	0.227
	Correct	48	72.7	53	80.3	
9. **The need for endotracheal intubation and cardiopulmonary arrest are contraindication for NIV:**	Incorrect	21	31.8	6	9.1	**< 0.001**
	Correct	45	68.2	60	90.9	
10. Does NIV require nursing care?	Incorrect	4	6.1	0	0	Na
	Correct	62	93.9	66	100	
11.**Pressure area control and the appearance of pressure ulcers is**	Incorrect	6	9.1	4	6.1	0.625
	Correct	60	90.9	62	93.9	
12. **Is it necessary to provide adapted feeding for each patient with NIV?**	Incorrect	12	18.2	11	16.7	0.999
	Correct	54	81.8	55	83.3	

Note: P (1–3) Comparison of preintervention and postintervention knowledge test questions and answers.

TABLE 4 | Percentage of change in the level of knowledge according to the stage of the intervention.

Professionals and students	Preintervention n	Preintervention %	Δ (%)	Posttheoretical-practical formation n	Posttheoretical-practical formation %	Δ (%)	Postintervention n	Postintervention %	Δ (%)
Correct answers	651	82.2	4.62	711	89.8	8.78	714	90.2	9.15
Incorrect answers	141	17.8		81	10.2		78	9.8	
Total	**792**			**792**			**792**		
Δ (%) Percentage of change									

Note: Results on participants' COM-VA scores.

Regarding incorrect answers, before the intervention, 17.8% of responses were incorrect. After the theoretical-practical formation, this decreased to 10.2%, indicating a reduction of 7.6% in incorrect answers. Following the simulation, the percentage of incorrect answers remained low at 9.8%.

3.3 | Results on Participants' COM-VA Scores

The analysis of participants' competency levels throughout the different stages of the intervention (theoretical-practical formation and simulation) revealed that before the intervention,

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TABLE 5 | Evolution of the competency level of the COM-VA questionnaire according to the stage of the intervention.

	Mean (RIQ)	p (1-2-3)	Δ (%) (1–3)	p (1–3)	Δ (%) (1–2)	p (1–2)	Δ (%) (2–3)	p (2–3)
COM-VA preintervention	6.82 (1.33)							
COM-VA posttheoretical-practical formation	7.30 (1.00)	< 0.001	0.56 (8.21)	< 0.001	0.48 (7.04)	< 0.001	0.08	0.009
COM-VA postintervention COM-VA	7.38 (0.97)							

Abbreviations: IQR, Interquartile Range; posttheoretical-practical formation, postintervention; Δ%, difference in medians and percentage change; 1–2, Wilcoxon test comparing baseline COM-VA score; posttheoretical-practical formation; 1–3, Wilcoxon test comparing baseline COM-VA score; postintervention; 1–2-3, Friedman test comparing baseline COM-VA score; 2–3, Wilcoxon test comparing posttheoretical-practical formation COM-VA score; postintervention COM-VA score.

the median competency level (preintervention COM-VA) was 6.82 with an interquartile range (IQR) of 1.33. This indicates autonomous, correct performance by participants before the educational intervention.

After the theoretical-practical training, a statistically significant improvement ($p < 0.001$) in participants' competency levels was observed. The median COM-VA score increased to 7.30, representing a 0.48-point rise from the preintervention median and a 7.04% overall improvement.

Following the simulation phase, an additional improvement in competency level was observed. The median score of the postsimulation COM-VA increased to 7.38, representing an increase of 0.08 points compared to the postclass COM-VA and an increase of 0.56 points compared to the preintervention COM-VA. This improvement was also statistically significant ($p < 0.001$). The percentage of improvement between the postclass and postsimulation COM-VA was 1.17%, while the percentage of improvement between the preintervention and postintervention COM-VA was 8.21% (Table 5).

"Following the simulation phase, an additional improvement in competency level was observed."

4 | Discussion

This study aimed to evaluate the effectiveness of an educational intervention combining theoretical-practical training with simulation on the knowledge and skills of nursing students and professionals in NIV management. Our findings indicate that this educational approach significantly enhanced participants' knowledge and practical competencies. These key results set the stage for further discussion, where we will synthesise our findings with existing literature and explore their broader implications.

In terms of knowledge, we observed significant improvement following the theoretical-practical formation, with further gains after simulation. This aligns with findings from other studies that have explored the effectiveness of blended learning and simulation approaches in healthcare education. For instance, studies by Checkour and colleagues [18] and Vallee and colleagues [19] have consistently demonstrated that combining didactic teaching with active learning strategies, such as simulation, leads to enhanced knowledge acquisition and retention compared to traditional lecture-based methods alone. Our results corroborate this, demonstrating notable improvements in correct answers after the theoretical-practical formation, which further increase after the simulation. This suggests that the theoretical foundation provides the necessary cognitive framework, while simulation offers opportunities for active application and deeper understanding [20]. The continued improvement in knowledge after simulation underscores its role in knowledge consolidation, a finding supported by studies emphasizing the experiential nature of simulation in reinforcing learning [21].

Similarly, the upward trend in self-perceived competency levels, as measured by the COM-VA questionnaire, mirrors the positive impact of simulation on clinical skills development reported in the literature. Several studies indicate that simulation-based education can lead to significant improvements in various nursing competencies, including critical thinking, decision-making and technical skills [21, 22]. This observed increase in self-perceived competency within our study is particularly relevant, suggesting not only an immediate positive impact from the intervention but also a potential for participants to apply the knowledge acquired, as reflected in their own assessment of their abilities. While our study's design does not directly measure long-term retention, this upward trend in self-perception aligns with broader literature suggesting that active learning methods can support more robust knowledge application.

Our findings extend this to the specific context of NIMV, indicating that the intervention not only enhances theoretical knowledge but also translates into improved self-perceived competence in applying this knowledge in practice. The fact that the greatest improvement in competency was observed after the theoretical-practical phase, with a continued significant increase after simulation, suggests a synergistic effect of the two educational modalities. The theoretical foundation likely provides the initial understanding of the principles and procedures, while simulation allows for the application and refinement of these skills in a safe and controlled environment, ultimately boosting confidence and perceived competence [23].

The relevance of such educational interventions during crises like the COVID-19 pandemic cannot be overstated. The rapid deployment of healthcare professionals, often with limited experience in critical care, necessitated efficient and effective training strategies.

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The attention to the COVID-19 crisis required a large number of professionals and nonspecialised students to manage patients with acute respiratory failure. Our findings support that combined traditional education and simulation serve as a rapid and effective means of equipping healthcare professionals and students with the necessary knowledge and competencies to manage complex respiratory conditions like those seen in COVID-19. Several other studies have used comparable strategies to ours, including seminars and workshops, clinical simulation, e-learning techniques, flipped classrooms and video conferencing [24–28] all aimed at meeting the training demands for professionals and students during the COVID-19 pandemic crisis. This aligns with the call for innovative educational approaches to address urgent training needs during public health emergencies [29]. The significant evolution in both knowledge and competency observed in a short period highlights the potential of such focused interventions to act as a protective factor for patient safety by ensuring a more prepared workforce [30].

"The significant evolution in both knowledge and competency observed in a short period highlights the potential of such focused interventions to act as a protective factor for patient safety by ensuring a more prepared workforce."

In summary, the educational intervention, which included theoretical-practical formation and simulation, had a positive and cumulative impact on the preparation of students and professionals, demonstrating a significant improvement in understanding and skills regarding NIV. Simulation, although contributing to a lesser improvement compared to traditional training, still represented a significant advancement in the development of participants' knowledge and competencies.

5 | Implications

The outcomes of this study hold notable implications for clinical practice and education. Our findings validate the integrated theoretical-practical training alongside simulation as an efficacious method for enhancing Noninvasive Ventilation (NIMV) knowledge and skills in both nursing students and practising professionals. This evidence supports the wider adoption of such interventions within both initial and continuous professional development programmes. Training programmes should strategically incorporate both didactic and experiential learning opportunities to maximise knowledge acquisition and skill development. The observed sustained knowledge progression following the simulation phase underscores its critical role in reinforcing theoretical concepts, establishing it as an indispensable component of the learning process, not merely supplementary. Furthermore, the demonstrated increase in self-perceived competency levels, as evidenced by COM-VA scores, signifies the intervention's success in improving not only knowledge retention but also its practical application, which is vital for high-quality patient care. The relevance of such educational interventions is particularly salient in healthcare crises, like the COVID-19 pandemic, where rapid acquisition of specific competencies is paramount, with the observed improvements suggesting a protective effect on patient safety. Hospitals and educational institutions should consider developing and implementing similar rapid training programmes to address urgent workforce needs.

"Hospitals and educational institutions should consider developing and implementing similar rapid training programmes to address urgent workforce needs."

Finally, these results provide a compelling justification for increased investment in clinical simulation within healthcare training, acknowledging its substantial contribution to developing essential clinical skills.

6 | Limitations

Despite positive findings, this study has several limitations. The relatively small sample size of 66 participants, though achieving a 100% response rate and yielding statistically significant results, necessitates cautious interpretation of inferential conclusions. This sampling method was a necessity dictated by pandemic circumstances.

Furthermore, the reliance on self-reported competency levels introduces a potential self-perception bias, where participants might overestimate their abilities. The absence of a control group also limits the ability to definitively attribute observed improvements solely to the intervention, as external factors could have played a role.

Finally, the study measured immediate improvements in knowledge and competencies postintervention. Future research should assess the long-term sustainability of these gains, as it is crucial to determine if these improvements persist over time.

7 | Future Directions

Future research will explore the long-term impact and knowledge retention postintervention. Comparative studies are needed to assess this method's effectiveness against other NIV training approaches. Analysing factors influencing participant improvement, like prior experience, will provide valuable insights. A critical direction is evaluating whether improved knowledge and competence translate to better clinical outcomes for NIMV patients. Finally, the applicability of this training strategy in other healthcare areas warrants investigation. Follow-up studies may determine the need for reinforcement interventions. This multi-faceted approach will further refine educational practices.

8 | Conclusion

This study effectively demonstrates that a combined theoretical-practical formation and simulation-based educational strategy positively impacts the knowledge and skills of nursing students and professionals in NIV management. Participants acquired foundational knowledge on NIV objectives, indications and resources and critically applied this learning in a realistic simulated clinical scenario. The significant improvements observed

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in both knowledge and skills after just two sessions underscore the efficiency and relevance of this training approach, particularly for rapidly enhancing healthcare personnel capabilities during emergency situations like the COVID-19 pandemic, thereby contributing to enhanced patient safety. While acknowledging limitations such as the relatively small sample size and the absence of a control group, factors that future research should address with long-term follow-up, our findings reinforce that integrating theoretical-practical education with simulation serves as an invaluable tool for preparing healthcare professionals to competently manage life-threatening situations.

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Author Contributions

Elsa Pla-Canalda: conceptualization, data curation, investigation, writing – original draft. **Maria Francisca Jiménez-Herrera:** conceptualization, methodology, project administration, supervision, validation, writing – review and editing. **José Fernández-Sáez:** formal analysis. **Pablo Concha-Martínez:** investigation. **Estrella Martínez-Segura:** conceptualization, project administration, supervision, validation, writing – review and editing.

Ethics Statement

The study was approved by the Ethical Committee for Research with Medicines (CEIm) of the Pere Virgili Health Research Institute (IISPV) (256/2020) and the respective managements of the participating centers. Authorization was also obtained from the author of the COM-VA questionnaire for its use.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

References

1. G. Lázaro Betancourt-Reyes, "Effectiveness of NonInvasive Mechanical Ventilation in Patients With Acute Respiratory Failure," *Revista Electrónica Dr. Zoilo E. Mar Vidaurreta* 43, no. 2 (2018), http://www.revzoilomarinello.sld.cu/index.php/zmv/article/.

2. R. Scala and L. Pisani, "Noninvasive Ventilation in Acute Respiratory Failure: Which Recipe for Success?," *European Respiratory Review* 27, no. 149 (2018): 180029, https://doi.org/10.1183/16000617.0029-2018.

3. A. Esteban, F. Frutos-Vivar, A. Muriel, et al., "Evolution of Mortality Over Time in Patients Receiving Mechanical Ventilation," *American Journal of Respiratory and Critical Care Medicine* 188, no. 2 (2013): 220–230.

4. A. J. Walkey and R. S. Wiener, "Use of Noninvasive Ventilation in Patients With Acute Respiratory Failure, 2000-2009: A Population-Based Study," *Annals of the American Thoracic Society* 10, no. 1 (2013): 10–17.

5. S. Piva, M. Filippini, F. Turla, et al., "Clinical Presentation and Initial Management Critically Ill Patients With Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) Infection in Brescia, Italy," *Journal of Critical Care* 58 (2020): 29–33.

6. Agencia de Calidad del Sistema Nacional de Salud, "Incidentes y eventos adversos en medicina intensiva. Seguridad y riesgo en el enfermo crítico," SYREC 2007. Minist Sanidad, Polit Soc e Igual, (2009);1–302, https://www.mscbs.gob.es/biblioPublic/publicaciones/recursos_propios/resp/revista_cdrom/VOL93/ORIGINALES/RS93C_201901004.pdf.

7. M. Raurell-Torredà, E. Argilaga-Molero, M. Colomer-Plana, A. Ródenas-Francisco, and M. Garcia-Olm, "Conocimiento y habilidades de enfermeras y médicos en ventilación mecánica no invasiva: equipamiento e influencias contextuales," *Enfermería Intensiva* 30, no. 1 (2019): 21–32.

8. N. Ambrosino and G. Vagheggini, "Noninvasive Positive Pressure Ventilation in the Acute Care Setting: Where Are We?," *European Respiratory Journal* 31, no. 4 (2008): 874–886.

9. J. V. Lightowler, J. A. Wedzicha, M. W. Elliott, and F. S. F. Ram, "Non-Invasive Positive Pressure Ventilation to Treat Respiratory Failure Resulting From Exacerbations of Chronic Obstructive Pulmonary Disease: Cochrane Systematic Review and Meta-Analysis," *British Medical Journal* 326, no. 7382 (2003): 185–187.

10. J. L. Lopez-Campos, C. Garcia Polo, A. Leon Jimenez, A. Arnedillo, E. Gonzalez-Moya, and J. J. Fernandez Berni, "Staff Training Influence on Non-Invasive Ventilation Outcome for Acute Hypercapnic Respiratory Failure," *Monaldi Archives for Chest Disease* 65, no. 3 (2006): 145–151.

11. M. Gómez, "Evaluación de competencias en el Espacio Europeo de Educación Superior (Tesis doctoral)," 2013, retrieved on March 25, 2022, https://eprints.ucm.es/id/eprint/21343/.

12. J. Chicca and T. Shellenbarger, "Connecting With Generation Z: Approaches in Nursing Education," *Teaching and Learning in Nursing* 13, no. 3 (2018): 180–184, https://doi.org/10.1016/j.teln.2018.03.008.

13. G. B. Smith, "In-Hospital Cardiac Arrest: Is it Time for an In-Hospital 'Chain of Prevention'?," *Resuscitation* 81, no. 9 (2010): 1209–1211.

14. M. Peya and M. E. Juvé, "Competency Evaluation and Leadership," in *101 Global Leadership Lessons for Nurses*, ed. N. R. Gantz (2009): 79–85. Sigma Theta Tau International.

15. M. E. Juvé, "Proyecto COM_VA. Definición y evaluación de competencias asistenciales de la enfermera en el ámbito hospitalario," (2005): 1–3, retrieved February 25, 2023, https://www.scele.org/archivos/resumen_eulalia_juve.pdf.

16. E. Separ, "Recomendaciones sobre la utilización de la ventilación no invasiva y terapia de alto flujo con cánulas nasales en el paciente adulto, pediátrico y neonatal con insuficiencia respiratoria aguda grave,". Documento de Consenso de las Sociedades Científicas Esp. Doc español consenso sobre la Util del Soporte Respir No invasivo en el Paciente con Insufic Respir aguda grave, (2020).

17. P. I. Watts, D. S. McDermott, G. Alinier, et al., "Healthcare Simulation Standards of Best PracticeTM Simulation Design," *Clinical Simulation in Nursing* 58 (2021): 14–21, https://doi.org/10.1016/j.ecns.2021.08.009.

18. M. Chekour, Y. Z. Seghroucheni, M. A. Tadlaoui, and M. M. Hafid, "Blended Learning and Simulation for Teaching Electrical Concepts to High School Pupils," *Journal of Turkish Science Education* 19, no. 4 (2022): 1119–1134.

19. A. Vallee, J. Blacher, A. Cariou, and E. Sorbets, "Blended Learning Compared to Traditional Learning in Medical Education: Systematic

1743498x, 2025, 5, Downloaded from https://asmepublications.onlinelibrary.wiley.com/doi/10.1111/tct.70168 by Spanish Cochrane National Provision (Ministerio de Sanidad), Wiley Online Library on [06/10/2025]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

Review and Meta-Analysis," *Journal of Medical Internet Research* 22, no. 8 (2020): 1–19.

20. C. L. Chang, N. F. Dyess, and L. C. Johnston, "Simulation in a Blended Learning Curriculum for Neonatology," *Seminars in Perinatology* 47, no. 7 (2023): 151824, https://pdf.sciencedirectassets.com/273259/1-s2.0-S0146000523X00081/1-s2.0-S0146000523001271/main.pdf?X-Amz-Security-Token=IQoJb3JpZ2luX2VjEIj%2F%2F%2F%2F%2F%2F%2F%2F%2F%2F%2FwEaCXVzLWVhc3QtMSJHMEUCIQDicVDpg2kDeS%2B2xTrGpIKsEL2b3A9JtiyEHzHQMDPgVwIgAKSuJk76.

21. L. Du, L. Zhao, T. Xu, et al., "Blended Learning vs Traditional Teaching: The Potential of a Novel Teaching Strategy in Nursing Education—A Systematic Review and Meta-Analysis," *Nurse Education in Practice* 63, no. October 2021 (2022): 103354, https://doi.org/10.1016/j.nepr.2022.103354.

22. E. R. Cohen, J. Feinglass, J. H. Barsuk, et al., "Cost Savings From Reduced Catheter-Related Bloodstream Infection After Simulation-Based Education for Residents in a Medical Intensive Care Unit," *Simulation in Healthcare* 5, no. 2 (2010 Apr): 98–102.

23. Y. H. Kim and K. S. Jang, "Effect of a Simulation-Based Education on Cardio-Pulmonary Emergency Care Knowledge, Clinical Performance Ability and Problem Solving Process in New Nurses," *Journal of Korean Academy of Nursing* 41, no. 2 (2011): 245–255.

24. A. Dedeilia, M. G. Sotiropoulos, J. G. Hanrahan, D. Janga, P. Dedeilias, and M. Sideris, "Medical and Surgical Education Challenges and Innovations in the COVID-19 Era: A Systematic Review," *In Vivo* 34 (2020): 1603–1611.

25. D. A. Díaz-Guio, J. Ospina-Vélez, and A. Ricardo-Zapata, "COVID-19: una crisis que requiere medidas de formación urgentes," *Revista Latinoamericana de Simulación Clínica* 2, no. 1 (2020): 6–8.

26. S. T. Mak and H. K. Yuen, "Oculoplastic Surgery Practice During the COVID-19 Novel Coronavirus Pandemic: Experience Sharing From Hong Kong," *Orbit (London)* 39, no. 4 (2020): 316–318.

27. S. M. Martinelli, F. Chen, R. S. Isaak, J. L. Huffmyer, S. E. Neves, and J. D. Mitchell, "Educating Anesthesiologists During the Coronavirus Disease 2019 Pandemic and Beyond," *Anesthesia and Analgesia* 132, no. 3 (2021): 585–593.

28. J. O. Woolliscroft, "Innovation in Response to the COVID-19 Pandemic Crisis," *Academic Medicine* 95, no. 8 (2020): 1140–1142.

29. WHO, "WHO Director-General's Opening Remarks at the Media Briefing on COVID-19-11 March 2020," (2020), Available from: https://www.who.int/director-general/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19---20-march-2020.

30. J. Reason, "Human Error: Models and Management," *BMJ* 320, no. 7237 (2000): 768–770.

1743498x, 2025, 5, Downloaded from https://asmepublications.onlinelibrary.wiley.com/doi/10.1111/tct.70168 by Spanish Cochrane National Provision (Ministerio de Sanidad), Wiley Online Library on [06/10/2025]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License