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Effectiveness of Virtual Reality in Undergraduate Nursing Education on Pneumonia

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Abstract

Background/Objectives: Virtual training is an innovative educational technology that offers students a more engaging and interactive experience compared to traditional classroom-based learning. This study aims to compare the effectiveness of traditional and virtual reality training methods in enhancing nursing students' knowledge and skills related to pneumonia care. **Methods**: A total of 120 nursing students were randomly assigned into a virtual reality group and a control group to study the pneumonia subject, comprising of 2 hours of theoretical lessons and 8 hours of hands-on training. At the end of the course, the knowledge and skill scores were compared between the students in the virtual reality and traditional training groups using independent samples t-tests. **Results**: Students in the traditional training class scored higher in pneumonia-related knowledge compared to those in the virtual reality training group. In contrast, students participating in the virtual reality training group (mean score: 75.5, CI 72.1 to 79.0) demonstrated a higher score on a practical test aimed to assess nursing skills associated with pneumonia than those in the traditional training class (mean score: 87.3, CI 83.8 to 90.8). **Conclusions**: This study identified significant differences in the effectiveness of traditional and virtual reality training methods in nursing education related to pneumonia care. These findings suggest that traditional methods remain effective for consolidating foundational knowledge, while virtual reality training enhances hands-on competencies.

Keywords: virtual reality training; traditional training; nursing education

1. Introduction

Virtual training is an innovative educational technology that offers students a more engaging and interactive experience compared to traditional classroom-based learning.[1] Amid the Covid-19 pandemic, virtual training became a crucial method for fulfilling the clinical training requirements of medical professionals, effectively overcoming multiple challenges. Its significance continues to grow as the approach develops further.[2] Wearing a VR device immerses users in a simulated learning environment, providing a sense of real experience.[3] Developing a VR scenarios requires a significant amount of time,[4] and training sessions are conducted to guide students before the core

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curriculum begins. These sessions include activities focused on seeing, hearing, and performing actions within a three-dimensional clinical environment, providing practical experience.[5]

Virtual reality (VR) has primarily been used in technical higher education fields such as engineering, computer science, and astronomy.[6] However, VR has started to play a crucial role in developing skills within health education.[7] A systematic review conducted by Bracq 2019 et al., concluded that a virtual training program designed to develop soft skills, such as teamwork, communication, and attitude, among health professionals could serve as a continuous learning pathway for students in the future.[8] The future of nursing depends on the continuous pursuit, creation, and implementation of innovative nursing programs. By integrating innovation into nursing education, we can optimize resource use for educational development while harnessing the creativity of both teachers and students. This approach fosters a learning and working environment that is conducive to their growth.[9] Research conducted by scholar Jung-Hye Lim (2021) involving 31 nursing students found that VR training improved students' practical skills, critical thinking abilities, and independence in work. This highlights its effectiveness as a fundamental part of medical training.[10] Researcher Ayman K. Bani Salameh et al. (2023) examined nursing students who participated in VR training by dividing them into control and experimental groups. The results showed that the experimental group had higher average scores in satisfaction, self-confidence, and performance compared to the control group, suggesting that this training method enhances these aspects for students. [11] However, there is a growing need to introduce new teaching techniques to address emerging challenges. Factors such as client safety, the prevention of medication errors, and insufficient practice time indicate the need for teachers to implement new technology-based teaching methods.[12]

In Mongolia, nursing students often lack the legal authority to provide certain types of direct client care, making it difficult for them to practice independently. Since 2022, the School of Nursing at the Mongolian National University of Medical Sciences (MNUMS) has installed VR equipment in preparation for implementing a new teaching method. In the fall semester of 2022–2023, this technology was incorporated into the training of nursing graduates. This study is based on the belief that presenting clinical cases, environments, interactions, equipment, practical skills, treatments, and care in a more tangible way will make it easier to monitor clinical errors and their causes. This approach aims to support learners' educational outcomes and engagement, improve concentration, boost confidence, enhance knowledge and skills, and reduce the fears encountered during real clinical practice. This study aims to compare the effectiveness of traditional and VR training methods in enhancing nursing students' knowledge and skills related to pneumonia care.

2. Materials and Methods

2.1. Participants

A total of 120 fourth-year nursing students enrolled in a bachelor's program participated in this study, which employed a convenience sampling method. 60 participants were assigned to the control group and 60 to the experimental group using a computer-generated assignment. We included students who were 21 years or older, had a minimum grade point average of 1.7, and had not previously studied the subject of this course. The study was conducted from November 15 to December 25, 2023. Informed consent was obtained from all individual participants included in the study. The study was approved by the Ethics Committee, Mongolian National University of Medical Sciences (№2023/3-09). The subject “Nursing Care for Internal Medicine II” the students selected to take consisted of a total of 2 hours of theoretical instruction and 8 hours of practical training. The objectives of the training, implementation strategies, and methods for evaluating the training outcomes are presented in Table 1.

 doi:10.20944/preprints202508.0300.v1

Table 1. Training objectives, implementation strategies, and methods for evaluating training outcomes.

Activity	Experimental (VR training) group	Control group
Practice training	The VR-based training was conducted by four instructors with over seven years of experience in clinical education and training in VR teaching methods. They organized the training according to a unified schedule in the five VR training rooms at the Simulation Skills Center of the School of Nursing.	The traditional training was conducted by four instructors with over seven years of experience. The sessions were organized according to a unified schedule in the Simulation Skills Center of the School of Nursing and in the specialized training rooms of affiliated referral hospitals.
Time capacity	- 2 hours lecture - 8 hours practice	
Training objectives	During pneumonia: - Common symptoms in patients - Patient identification and diagnosis - Patient assessment - Diagnostic procedures - Treatment and care Infection prevention and control	
Teaching methods	According to the unified class schedule, 120 students attended the lecture in person. Additionally, the lecture video content was uploaded to the students' e-learning system.	
	- Three practical training sessions were conducted directly, using VR-based clinical cases.	- Using clinical cases, problem-based discussions, repetition of practices, and bedside training were conducted directly.
Evaluation	A comprehensive evaluation sheet comprising 84 criteria and a 20-question knowledge assessment test were used to assess skills and knowledge, respectively.	

2.2. Knowledge Assessment

A 20-question knowledge assessment test covering common symptoms, diagnostic procedures, treatments, and care for patients with pneumonia was created using standard nursing textbooks[13,14] to evaluate understanding of common symptoms, diagnostic tests, treatments, and patient care related to pneumonia. Each question has been discussed with teachers for further evaluation (Appendix 1).

2.3. Skill Assessment

A comprehensive evaluation sheet comprising 84 criteria was developed based on the standard nursing textbook and national standard guidelines[13,15] for the identification, evaluation, monitoring, and information reporting to the physician of the client. This includes procedures such as administering treatment, providing oxygen, performing oropharyngeal suctioning, inserting a flexible catheter into a vein, connecting a drip to an automatic infusion pump, and administering intravenous injections[13,15] (Appendix 2).

2.4. Statistical Analysis

R version 4.2.2 was used to perform descriptive and inferential statistics. Mean values and standard deviations (SD) for participants' demographics such as age, sex, and grade point average were determined in descriptive statistics. Differences in demographic characteristics between the two groups (traditional training and VR) were determined using an independent samples t-test. Independent samples t-tests were used to determine statistically significant differences in academic performances in relation to the knowledge and skills towards pneumonia between the two groups. Statistical significance was considered as a p value of less than 0.05.

 doi:10.20944/preprints202508.0300.v1

3. Results

A total of 120 fourth year nursing students divided equally into the two groups, namely, traditional training and VR groups were recruited into the study. No differences in participants' mean age, grade point average, experience with VR and sex ratio were observed between the two groups (Table 2).

Table 2. Participant demographics and characteristics (N=120).

Variables	Total	VR	Traditional training	p
Age (Mean ± SD)	22.7 ± 2.3	22.4 ± 1.2	22.9 ± 3.1	0.18
Sex (Female, %)	100	100	100	1.0
GPA score (out of 4)	3.3 ± 0.3	3.3	3.2 ± 0.3	0.33
Previous experience with VR (Yes, %)	0	0	0	1.0

p-value: the differences between the two groups were assessed using independent t-tests, GPA – grade point average, VR – virtual reality.

Comparison of knowledge and skills between the traditional training and VR groups after (post-intervention) the implementation of VR in a pneumonia nursing class

Statistically significant differences in exam scores for nursing knowledge and skills were observed between students assigned into the traditional training and VR groups (Table 3). When comparing exam scores designed to evaluate nursing students' knowledge of pneumonia in the two groups at the end of the class, students assigned to the traditional class outperformed those in the VR training class. In contrast, nursing students participating in the VR training group (mean score: 75.5, CI 72.1 to 79.0) demonstrated a higher score on a practical test aimed to assess nursing skills associated with pneumonia than those in the traditional training class (mean score: 87.3, CI 83.8 to 90.8).

Table 3. Comparison of scores between the VR and traditional training class groups.

Variables	VR training	Traditional training	Differences (95% CI)	p
Knowledge (out of 100)	70.0 (13.5)	84.1 (10.0)	-14.1 (-18.5 to -9.8)	< 0.0001
Skill (out of 100)	87.3 (13.9)	75.5 (13.1)	11.8 (6.9 to 16.7)	< 0.0001

p-value: the differences between the two groups were assessed using independent t-tests.

4. Discussion

To the best of our knowledge, no previous study has implemented VR-based medical education training in Mongolia, making this research a preliminary yet important contribution to the field. As the future of vocational education increasingly depends on the development and implementation of innovative programs, this study highlights the potential of VR in enhancing clinical education outcomes. Implementing new innovations in our programs presents us with an opportunity to offer to others.[9] This study is the first in Mongolia to compare nursing students' knowledge and practical skills related to pneumonia following either traditional or VR-based training. Students were evenly assigned to a traditional or VR training group, and statistically significant differences were observed in both theoretical and practical performance.

Students in the traditional training group achieved higher scores on the written examination assessing theoretical knowledge of pneumonia compared to their peers in the VR group. This outcome is consistent with findings by Kiegaldie and Shaw (2023), who concluded that while VR is highly effective for skill-based learning, its contribution to theoretical knowledge acquisition is limited—particularly when learning objectives are not explicitly aligned with cognitive learning principles.[1] Similarly, Woon et al. (2021), in their systematic review and meta-analysis, reported

 doi:10.20944/preprints202508.0300.v1

that although VR supports knowledge development, its overall impact on cognitive learning outcomes remains modest in comparison to traditional instruction when pedagogical design lacks cognitive optimization.[16] In a related study, Al-Mugheed et al. (2023) investigated the effects of a game-based VR phone application combined with online education on nursing students' knowledge, attitudes, and compliance with standard precautions. While improvements were observed in attitudes and compliance, the gains in theoretical knowledge were comparatively limited relative to structured, theory-driven online instruction.[17] Medel et al. (2024) similarly noted that although VR simulation enhanced students' engagement and satisfaction, improvements in knowledge acquisition were inconsistent—particularly for abstract or conceptually demanding content areas.[18]

The superior performance of students in the traditional instruction group may be attributed to the clear, linear delivery of content, alignment with well-defined learning objectives, and students' familiarity with conventional classroom formats. Traditional pedagogical approaches may also provide a more stable cognitive framework to support note-taking, textbook engagement, and memorization—elements that are essential for mastering theoretical subjects such as nursing fundamentals and the management of pneumonia.[3,6,7,16] Despite their immersive and engaging qualities, VR-based learning environments may contribute to cognitive overload, particularly for learners who are still developing foundational knowledge.[3,6,7] When VR simulations emphasize procedural realism over theoretical clarity, students may struggle to process, organize, and retain relevant conceptual information. For example, Jung et al. (2021) evaluated the use of a VR intravenous injection simulator incorporating haptic feedback and highlighted its value for psychomotor skill training; however, the study did not demonstrate substantial improvements in knowledge acquisition.[19] Collectively, these findings reinforce that traditional instruction remains particularly effective for supporting the development of foundational theoretical knowledge in nursing education.[1,3,6,16,18]

In contrast to theoretical knowledge acquisition, students in the VR training group demonstrated significantly higher performance in the practical skills examination, with a mean score of 87.3 (95% CI: 83.8 to 90.8), compared to 75.5 (95% CI: 72.1 to 79.0) in the traditional group. These findings are consistent with a growing body of evidence indicating that VR–based simulation enhances clinical skill development more effectively than conventional instructional methods.[1,10,11,18–23] Several factors may account for this advantage. VR environments offer immersive, interactive, and repeatable practice opportunities, allowing learners to engage in hands-on experiential learning without the risks associated with real patient care.[6,7,11,16,19,20,23] For instance, Salameh et al. (2024) demonstrated that VR training significantly improved nursing students' self-confidence, procedural skill, and physiological readiness.[11] Similarly, Lange et al. (2020) found that immersive VR supported students in developing procedural competence and confidence through safe repetition.[20]

Furthermore, studies focusing on specific skills support this trend. Bobade and Shambharkar (2024) examined intravenous cannulation training among 60 nursing students and reported that VR simulation produced superior skill and knowledge outcomes compared to traditional instruction.[21] Park and Yoon (2021) demonstrated improvements in catheterization skills, confidence, and satisfaction following VR simulation.[22] The integration of haptic feedback, as shown by Jung et al. (2021), further enhanced psychomotor skill development by providing tactile realism.[19] Additionally, Yoon et al. (2021) and Lee and Han (2022) confirmed that VR simulations significantly improved procedural accuracy, learner confidence, and clinical decision-making.[23,24]

These findings are particularly significant in the context of increasingly constrained clinical placement opportunities in nursing education. Due to patient safety concerns, limited case availability, and institutional restrictions, nursing students often have insufficient opportunities to independently perform clinical procedures during training.[10,11,20,23] This lack of hands-on experience presents a persistent challenge in bridging the gap between theoretical learning and clinical competence. VR simulation offers a promising solution to this educational gap by providing a controlled, immersive, and risk-free environment in which learners can safely apply their

 doi:10.20944/preprints202508.0300.v1

theoretical knowledge, repeatedly practice technical skills, and develop clinical reasoning capabilities.

Lim (2021) and Chang and Lai (2021) demonstrated that the use of VR scenarios significantly improved nursing students' procedural performance and learner engagement, affirming VR's potential in skills acquisition and active learning.[10,25] Similarly, Park and Yoon (2021) reported that VR-based simulation for catheterization led to notable improvements in students' practical skills, self-efficacy, and satisfaction.[22] These cumulative results underscore the growing value of VR in bridging the gap between theoretical understanding and clinical performance, and in preparing nursing students for the demands of real-world healthcare.

Despite the promising findings of this study, several limitations must be acknowledged. First, the sample was drawn from a single institution, which may limit the generalizability of the results to other academic or clinical contexts. Second, the study did not assess long-term retention of knowledge or skills, thereby constraining conclusions about the sustained effectiveness of either training modality. Third, potential differences in digital literacy among participants were not measured or controlled for, which may have influenced the outcomes observed in the VR group.

5. Conclusions

This study identified significant differences in the effectiveness of traditional and VR training methods in nursing education related to pneumonia care. Students in the traditional training group demonstrated higher performance on written examinations assessing theoretical knowledge, likely due to the structured content delivery and well-established pedagogical approaches inherent in conventional instruction. In contrast, students in the VR training group achieved significantly higher scores on practical assessments, indicating the benefits of immersive simulation environments for developing psychomotor and clinical decision-making skills. These findings suggest that traditional methods remain effective for consolidating foundational knowledge, while VR training enhances hands-on competencies. Integrating both modalities into nursing curricula may offer a more comprehensive and effective educational strategy. Future research should explore long-term learning outcomes, cost-effectiveness, and the optimal pedagogical balance between traditional and VR-based training in nursing education.

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Data Availability Statement: The data presented in this study are available on request from the corresponding author. The data are not publicly available due to privacy restrictions.

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Abbreviations

The following abbreviations are used in this manuscript:

VR Virtual reality

Appendix A

Appendix A.1. Knowledge Assessment Questionnaire

1	What are the symptoms of pneumonia?	1. Dry cough 2. Fever 3. Shortness of breath 4. Excessive sweating 5. Weight loss
2	What actions should be taken if the oxygen level in the blood of a patient with pneumonia is unstable?	1. Provide supplemental oxygen through a nasal cannula at 6 liters per minute 2. Administer oxygen via a mask at 15 liters per minute 3. Place the patient on a ventilator 4. Assess the patient's condition 5. Perform suctioning
3	The primary treatment for a patient with pneumonia is oxygen therapy.	1. Strongly disagree 2. Disagree 3. Moderate agree 4. Agree 5. Strongly agree
4	When evaluating a patient with pneumonia, choose the key symptoms to focus on, including:	1. Cyanosis of the lips or extremities 2. Cold sweat 3. Decreased oxygen blood levels 4. Increased respiratory rate 5. Difficulty breathing
5	What is the threshold level for oxygen saturation in the peripheral blood at which oxygen should be administered?	1. 94% 2. 88% 3. 80% 4. 75% 5. 70%
6	Choose the primary pathogen that causes pneumonia:	1. Streptococcus 2. Staphylococcus 3. Influenza virus 4. Cytomegalovirus 5. Fungus
7	Name common risk factors that increase susceptibility to pneumonia. (Multiple answers):	1. Underwent surgery 2. Elderly 3. Smoking 4. Chronic underlying conditions 5. Weakened immune system
8	Pneumonia in adults is different compared to children and the elderly.	1. Yes 2. No
9	What are the main diagnostic tools and tests used to confirm the diagnosis of pneumonia?	1. Ultrasound 2. Chest X-ray 3. Blood test 4. Physical examination 5. Ask questions
10	During pneumonia, the following tests may show changes:	1. General blood test 2. Biochemical analysis 3. Urinalysis 4. Bacteriological analysis 5. Sputum analysis

 doi:10.20944/preprints202508.0300.v1

11	Hospitalization for pneumonia is generally required in the following situations:	1. Higher fever 2. Severe pneumonia 3. Excessive Sputum Production 4. Respiratory Distress 5. Severe Weakness and Fatigue
12	Are antibiotic choices effective in treating pneumonia?	1. Yes 2. No
13	Do you think it is important for healthcare professionals to provide the best possible care for clients with pneumonia?	1. Not important 2. Slightly important 3. Moderately important 4. Not very important 5. Extremely important
14	Do you agree that providing attentive care to patients with pneumonia significantly improves their well-being and chances of recovery?	1. Strongly disagree 2. Disagree 3. Moderate agree 4. Agree 5. Strongly agree
15	Are you ready to educate patients and the public on preventive measures for pneumonia infection, including the use of masks, respiratory health, and hygiene practices?	1. Not prepared 2. Slightly prepared 3. Moderately prepared 4. Well prepared 5. Extremely prepared
16	Are you confident in your ability to recognize the signs and symptoms of pneumonia?	1. Not confident 2. Slightly confident 3. Moderately confident 4. Not very confident 5. Extremely confident
17	Do you believe that pneumonia is a serious health issue?	1. Not confident 2. Slightly confident 3. Moderately confident 4. Not very confident 5. Extremely confident
18	When assessing a patient with pneumonia, what signs of respiratory distress should a nurse consider?	1. Shortness of Breath (Dyspnea) 2. Use of Accessory Muscles for Breathing 3. Cyanosis of Lips and Nose 4. Swelling (Edema) 5. Fatigue or Weakness
19	List important questions to ask when identifying and assessing a patient. (Multiple answers):	1. When were you born? 2. What is your blood type? 3. What is the reason for your hospital admission? 4. Have you been under a lot of stress recently? 5. Have you been taking any medication?
20	Assess the patient's physical condition:	1. Assessing Pain 2. Measuring Arterial Blood Pressure 3. Checking Body Temperature 4. Performing an ECG (Electrocardiogram) 5. Performing Suctioning

Appendix A.2. Nursing Care During Pneumonia

№	Practical procedure	Assignment /Student's Name/	Yes	No
Date of Assessment:				
1.	**Identifying and assessing the patient**	Entering the patient's room		
2.		Reviewing the patient's history		
3.		Verify the procedure you are about to perform		
4.		Introducing yourself		

 doi:10.20944/preprints202508.0300.v1

5.			Sanitizing the hands
6.			What is your name?
7.			When is your birthday?
8.			What is your blood type?
9.			Have you had any previous illnesses?
10.			Have you been hospitalized before?
11.			Under what admission process or method were you admitted to the hospital?
12.			How did you get to the hospital?
13.			What was the reason for your hospitalization?
14.			Have you had any previous surgeries?
15.			Do you smoke?
16.			Do you consume alcohol?
17.			Who is your primary caregiver?
18.			What is your religion?
19.			Have you been under a lot of stress recently?
20.			Are you currently taking any medications?
21.			Have you ever had an allergic reaction to medication?
22.	**Assessing the physical condition**	**Assessing pain**	Where are you experiencing the most pain right now?
23.			Are you experiencing pain anywhere in your body right now?
24.			If 0 represents no pain and 10 represents the worst pain imaginable, what would your pain score be
25.		**Measuring vital signs**	Sanitizing the hands
26.			Verify the patient's information
27.			Monitor vital signs
28.			Measure blood pressure
29.			Connect the monitor / place the electrodes/
30.			Measure body temperature in the ear
31.			Place the pulse oximeter on the finger
32.	**Inform the doctor about the patient's condition**		Nurse [your name] here. Patient Bat-Erdene with registration number 02210524 has suddenly developed respiratory distress.
33.			The patient is hospitalized and receiving treatment for a pneumonia diagnosis.
34.			Respiratory rate has increased to over 26 breaths per minute, and SpO_2 has decreased to 80%
35.			Currently, 15 liters of oxygen are being administered using a non-rebreather mask.
36.			The lips and hands are cyanotic, and the patient is sweating cold perspiration.
37.			Mark when all practical procedures have been completed.
38.	**Perform practical procedures according to the doctor's instructions**		Restrict food
39.			Determine if the patient has any medication allergies / Have you ever had an allergic reaction to medication?
40.	**Re-assess the pain**		Where are you experiencing the most pain right now?
41.			Are you experiencing pain anywhere in your body right now?
42.	**Treatment (10 Rights of Medication Administration)**		Administer treatment according to the doctor's instructions.
43.			Read 3 times to prepare the medicine.
44.			Attach the medication label to the medication that matches the prescription.
45.			Clean the rubber stopper of the infusion bottle with an alcohol swab.
46.			Connect the prepared infusion set to the infusion bottle.

 doi:10.20944/preprints202508.0300.v1

47.		Press the bulb of the infusion set and fill the bulb up to half with the infusion.
48.		Open the clamp of the infusion set and let the fluid run through to expel any air from the system.
49.		Check the infusion set to ensure there are no remaining air bubbles, and then close the clamp of the infusion set.
50.		Hang and secure the prepared infusion bag on the infusion stand.
51.		The nurse selects the site for administering the injection.
52.		Before administering medication, verify the patient's information: Could you please tell me your name and date of birth?
53.		Explain and introduce the purpose of the treatment to the patient.
54.	**Insert a flexible needle**	Apply a tourniquet and select the injection site.
55.		Sanitizing the hands
56.		Disinfect the injection site.
57.		Insert the flexible needle at a 15-degree angle with the bevel facing upward.
58.		When blood returns to the end of the flexible needle, release the tourniquet, apply gentle pressure at the needle's tip to control the blood flow, and slowly withdraw the needle. Then, cover the needle with its cap.
59.		Secure the flexible needle with an adhesive bandage.
60.		Record the date, time, and size of the needle on the adhesive bandage used for securing the needle.
61.	**Connect the infusion pump.**	The nurse selects 'IV Therapy-infusion pump'.
62.		Connect the infusion pump.
63.		Set the drip rate as specified on the medication administration sheet /60/.
64.		Open the infusion set clamp.
65.		Press the 'START' button on the infusion pump to begin.
66.	**Administer oxygen.**	Select 'Oxygenation' on the nurse's trolley.
67.		Go to the high-flow device.
68.		To start high-flow oxygen therapy, connect the wall O2 line to the wall.
69.		Give advice ➢ It seems like you're having trouble breathing due to low oxygen levels. ➢ I'm going to start providing high-flow oxygen through your nasal cannula now. ➢ Your nasal passages might become a bit dry.
70.		Insert the oxygen nasal cannula into the patient's nose.
71.		Adjust and confirm the FIO2 setting on the high-flow device according to the instructions /60/.
72.	**Performing Suctioning**	The nurse selects 'Suction'.
73.		To perform suctioning, go to the front of the suction unit and check and confirm the suction pressure.
74.		Prepare a single-use sterile saline solution.
75.		Connect the suction catheter to the suction line.
76.		Sanitize your hands
77.		Put on gloves.
78.		With one hand, press the connector of the suction line, and with the other hand, hold the tip.
79.		Explain the procedure.

 doi:10.20944/preprints202508.0300.v1

		You seem to be having difficulty breathing. I am going to perform suctioning now.
80.		Dip the tip of the catheter into the saline solution, press the connector, and check if the solution is being suctioned properly.
81.		Take the prepared suction catheter to the patient's mouth and perform suctioning.
82.		Dip the tip of the catheter into the saline solution and flush the solution through the catheter again.
83.	**After the procedure**	Remove your gloves and complete the nursing procedure.
84.		Review and document the performed actions.
	EVALUATION	Total score of correctly performed actions
		Percentage score
	CHECKED BY	Instructor signature

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