

Pilot Utilization of Simulation-based Training among Interprofessional Teams in Proning Pregnant and Obese/Overweight Patients Experiencing Acute Respiratory Failure

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ABSTRACT

Background. The Prone Pillow for Pregnant Patients using the (4P) 2.0 prototype was developed to address the unique challenges in proning pregnant patients with COVID-19 in a tertiary hospital. A lack of training in proning particularly pregnant and overweight patients has led to patients with severe ARDS not receiving this life-saving intervention.

Objective. The current study aimed to evaluate the impact of an interprofessional simulation-based training program on providers' perception, knowledge, and confidence in proning of pregnant patients with Acute Respiratory Distress Syndrome due to COVID -19 or other causes.

Methods. A total of 124 healthcare workers who took part in the management of patients in COVID wards and ICUs participated in the study. The simulation workshop was conducted on May 2022 and the participants were divided into interprofessional teams. Standardized patients and mannequins were used to simulate patients with ARDS. Standardized checklists for proning were used. The participants were debriefed after. The participants completed pre- and post-simulation questionnaires.

Results. After the simulation workshop, the participants' perception on the benefit of prone position in the ventilation of patients with ARDS, level of confidence in handling proning of pregnant patients, comfort in speaking to patient and next of kin regarding prone ventilation, and knowledge on proning significantly improved. Subgroup analysis showed statistically significant improvements in knowledge scores among registered nurses, resident physicians, and participants with varying degrees of experience managing COVID-19 patients and proning pregnant patients. Majority of participants deemed it was easy to turn patients in the prone position using the supportive pillow as well as expressed confidence in doing the procedure.

Conclusion. Interprofessional simulation-based training of healthcare workers improved providers' knowledge and confidence in proning pregnant patients. Simulation based training also improved the comfort of the healthcare professional in advising the patient and next of kin on the benefits of proning.

Keywords: prone positioning, pregnant, interprofessional simulation-based training, simulation, supportive pillow

Poster presentation – Faculty Research Forum, October 2024, College of Medicine, University of the Philippines Manila.

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INTRODUCTION

On March 11, 2020 the World Health Organization (WHO) declared COVID-19 a worldwide pandemic.¹ In October 2021, there were over 248 million confirmed cases and over five million deaths due to COVID-19 worldwide.² In the Philippines, it affected over 2,795,000 people with more than 43,000 deaths in early November 2021.³ A major consequence of patients diagnosed with COVID-19 is pneumonia leading to acute respiratory distress syndrome (ARDS). Several methods were seen to be viable in managing COVID-induced ARDS including intubation, low tidal volume, venous extracorporeal membrane oxygenation (ECMO), high positive end-expiratory pressure (PEEP),⁴ noninvasive positive pressure ventilation, high flow nasal cannula, and awake prone positioning⁵.

The prone position has been recommended for various benefits for people in respiratory distress. It has been seen to decrease respiratory rate and systolic blood pressure significantly with increased oxygen saturation as compared to other positions.⁶ Physiologically, prone positioning reduces ventral-dorsal transpulmonary pressure difference,⁷ reduces lung compression,⁸ and improves lung perfusion⁹.

Several studies¹⁰⁻¹⁴ have also shown that early prone positioning improves oxygenation and especially during the subacute phase¹⁰. Moreover, in severe ARDS and community-acquired pneumonia¹⁵ prone positioning has been seen to decrease mortality,^{10,13} and has an additive effect when used in conjunction with adjunctive therapies¹⁰.

Interprofessional simulation-based training has been an important component of education and training among healthcare professionals.^{16,17} It has been seen to improve patient safety¹⁸, and particularly in the management of obstetric emergencies¹⁹. Thus it is important to integrate this approach in training healthcare professionals in preparation for crisis situations. Simulation allows not only training of the necessary technical skills but also non-technical skills, such as communication and teamwork.

OBJECTIVES

This current study aimed to evaluate the impact of an interprofessional simulation-based training program on healthcare providers' perception, knowledge, and confidence in proning of pregnant patients with Acute Respiratory Distress Syndrome due to COVID -19 or other causes. Specifically, the study aims to:

- Describe the demographics of interprofessional teams that participated in the simulation-based training.
- Describe the outcomes of interprofessional simulation-based training.

MATERIALS AND METHODS

Study Design

This study used a comparative before-and-after study design to determine the impact of the interprofessional simulation-based training program on the healthcare providers' perception, knowledge, and confidence in proning pregnant and obese/overweight patients with ARDS.

Study Sample, Sample Size, and Study Site

All healthcare workers involved in the care and management of patients experiencing ARDS in the UP Philippine General Hospital underwent training and simulation exercises on May 2022. The participants were divided into interprofessional teams consisting of residents and fellows (obstetricians, anesthesiologists, and pulmonologists), nurses, midwives, nursing assistants, and institutional workers.

Training Program and Data Collection

The current study used the supportive pillow (Prone Pillow for Pregnant Patients or 4P 2.0) developed by Habana et al.¹⁶ The 4P prototype 2.0 showed potential for better and safer patient and healthcare worker safety as shown by the positive feedback with the use of the pillow in the said study. The Noelle* Maternal and Neonatal Birthing simulator had an endotracheal tube, intravenous line, ECG electrodes, uterine and fetal heart tone transducers to simulate an intubated pregnant patient. Standardized patients were used to simulate an awake pregnant patient in ARDS. The proning checklists for both awake and intubated patient used in the study by Habana et al. were used.¹⁶ The steps in the checklist were demonstrated by the training team step by step for both the awake and intubated patients. The checklist was used to confirm that all the steps were followed in the correct order. The participants were debriefed by teams after. The participants completed pre- and post-simulation questionnaires which aimed at assessing their knowledge and satisfaction on the usability of the supportive prone pillow among obese/overweight or pregnant patients in acute respiratory failure. Figure 1 shows a schematic diagram of the simulation-based training program.

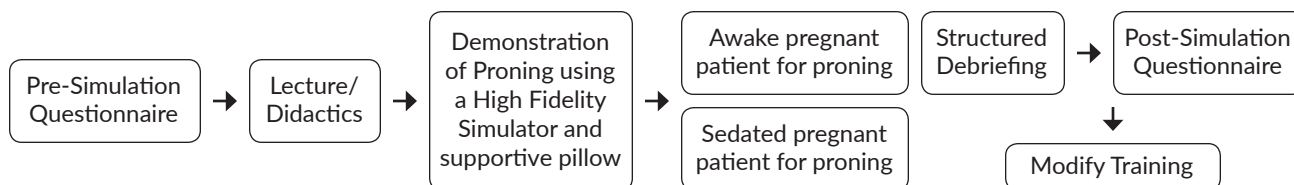


Figure 1. Schematic diagram of simulation-based training program.

Data Analysis

Descriptive statistics such as mean was used to present the ordinal rating variables while frequency and percentage were used for categorical data. Wilcoxon sign rank test was utilized to compare the participants' pre- and post-simulation perception on proning while McNemar test was used in comparing their preferred training method. To compare the total pre- and post-simulation test scores, paired T-test was utilized. The level of significance was at 5%. Subgroup analysis was done. Paired t-test for each participant profile was applied.

RESULTS

Participant Demographics

A total of 124 healthcare workers were included in the training sessions (Table 1). The breakdown of the participants was as follows – physicians (residents 26.6% and fellows 10.5%), registered nurses (25.8%), midwives (24.2%) and institutional workers (12.1%). All participants had taken care of COVID patients. Around half of them (50.8%) had been assigned to COVID areas for more than 2 years, 40% for 1-2 years and 9.2% for less than a year only. In terms of experience in proning patients with ARDS, the majority already handled patients necessitating the procedure – 8.3% had more than 10 patients, 10.8% handled 6-10 patients and 45.8% handled just 1-5 patients. Thirty five percent (35%) had no experience in proning.

No patients were recruited in the study due to the rapid decrease in admissions who experienced acute respiratory failure.

Training Outcomes

Table 2 shows the participants' perception about proning pre- and post-simulation workshop. Results reveal that after the workshop on the use of the supportive pillow, the participants' perception on the benefit of prone position in the ventilation of patients with ARDS improved from 4.02 to 4.54 ($p = 0.0001$) and the difference is significant. Prior to the workshop, only 35.0% strongly agree on the benefit of prone positioning, but it increased to 63.2% after the simulation workshop.

Likewise, the participants' level of confidence in handling proning of pregnant patients has also significantly increased from a mean of 2.99 to 4.08 after the intervention ($p = 0.0001$) and the difference is likewise significant. Initially, only 5.7% was confident in handling proning of pregnant patients but it increased to 35% after the simulation.

The participants' comfort in speaking to the patient and next of kin regarding prone ventilation has also significantly improved from 3.37 to 4.14. Only 11.4% initially expressed comfort but it increased to 41% after the intervention.

With regard the training methods preferred by the participants to feel more comfortable in the placement and/or management of a pregnant patient with ARDS in prone,

Table 1. Profile of Participants

	Frequency	%
Position		
Registered Nurse	32	25.8
Midwife	30	24.2
Institutional Worker	15	12.1
Physician (Resident)	33	26.6
Physician (Fellow)	13	10.5
Others	1	0.8
Years of taking care of COVID patients		
<1 year	11	9.2
1 to 2 years	48	40.0
>2 years	61	50.8
Number of patients with ARDS undergoing prone position handled		
Zero	42	35.0
1 to 5	55	45.8
6 to 10	13	10.8
>10	10	8.3
Number of pregnant patients with ARDS undergoing prone position handled		
Zero	67	55.4
1 to 5	51	42.1
6 to 10	2	1.7
>10	1	0.8

there was no significant difference on the proportion of participants who prefer didactic lecture, video demonstration, and live demonstration and simulation with the team.

Table 3 shows the comparison of the participants' knowledge about proning pre- and post-simulation workshop. The mean pretest score of participants was 1.77 and it has significantly increased and improved to 2.35 after the intervention ($p = 0.0001$). Their difference was 0.5806.

Table 4 shows the satisfaction rating of participants on the use of proning pillow. Almost 81% (40.9%, strongly agree and 40% agree) deemed that it was easy turning the patients to prone position using the supportive pillow. The mean score is also high at 4.21. Likewise, 82.6% expressed confidence in turning the patient prone using the supportive pillow (42.6% strongly agree and 40% agree). The mean score is also high at 4.25. Results also reveal that 86.1% (46.1% strongly agree and 40% agree) think that the pillow is appropriate in accommodating the intubation equipment. The resulting mean is also high at 4.32. Lastly, 77.9% (38.1% strongly agree and 39.8% agree) think that it was easy to attach the transducers to the uterus to detect contractions and fetal heart tones. The resulting mean was likewise high at 4.15.

Table 5 presents the subgroup analysis of pre- and post-simulation knowledge scores across various participant profiles. Among the healthcare team roles, significant improvement was noted for both resident physicians (from 2.39 to 3.00, $p = 0.011$) and registered nurses (from 1.72 to 2.50, $p = 0.022$).

When analyzed by experience caring for COVID-19 patients, participants with more than two years of experience

Table 2. Comparison of Participants' Perception about Proning Pre- and Post-Simulation

	Pre-Test			Post-Test			p value
	Mean	n	%	Mean	n	%	
<i>Prone position ventilation would be beneficial to pregnant patients with ARDS</i>							
Strongly disagree	4.02	2	1.6	4.54	0	0.0	0.0001
Disagree		2	1.6		0	0.0	
Neutral		31	25.2		11	9.4	
Agree		45	36.6		32	27.4	
Strongly agree		43	35.0		74	63.2	
<i>I am confident in handling proning of a pregnant patient</i>							
Strongly disagree	2.99	10	8.1	4.08	0	0.0	0.0001
Disagree		20	16.3		3	2.6	
Neutral		61	49.6		26	22.2	
Agree		25	20.3		47	40.2	
Strongly agree		7	5.7		41	35.0	
<i>I am comfortable speaking to the patient and next of kin regarding prone ventilation</i>							
Strongly disagree	3.37	5	4.1	4.14	0	0.0	0.0001
Disagree		11	8.9		3	2.6	
Neutral		54	43.9		26	22.2	
Agree		39	31.7		40	34.2	
Strongly agree		14	11.4		48	41.0	
<i>Training methods we can provide to help you feel more comfortable in assisting with the placement and/or management of a pregnant patient with ARDS in prone</i>							
Didactic lecture	-	90	84.9	-	89	81.7	1.000
Video demonstration		98	92.5		97	89.0	0.727
Live demonstration		100	94.3		104	95.4	1.000
Simulation with the team		99	93.4		106	97.2	0.063
Actual patient experience		91	85.8		1	0.9	0.000*

Table 3. Comparison of Participants' Knowledge about Proning Pre- and Post-Simulation

	Mean	SD	Difference	p value
<i>Pre-test score</i>	1.77	1.10	0.5806	0.0001*
<i>Post-test score</i>	2.35	1.25		

*Significant, paired t test was used

demonstrated significant improvement in scores (from 1.96 to 2.58, $p = 0.001$).

Participants who had limited experience with proning patients with ARDS also benefited significantly from the training. Those with no prior experience (from 1.79 to 2.33, $p = 0.001$) and those who had handled 1 to 5 patients (from 1.78 to 2.31, $p = 0.001$) improved.

Lastly, all healthcare workers who had experience in proning pregnant patients with ARDS had significant improvement in their test scores. Those with no prior experience (from 1.82 to 2.36, $p = 0.001$), those with experience in 1 to 5 cases (from 1.86 to 2.37, $p = 0.002$), and those who handled 6 to 10 cases (from 0.50 to 1.50, $p = 0.000$) improved.

Table 4. Satisfaction Rating on Proning Pillow

	Mean	n	%
<i>It was easy turning the patient to prone using the supportive pillow</i>			
Strongly disagree	4.21	0	0.0
Disagree		1	0.9
Neutral		21	18.3
Agree		46	40.0
Strongly agree		47	40.9
<i>I am confident in turning the patient prone using the supportive pillow</i>			
Strongly disagree	4.25	0	0.0
Disagree		0	0.0
Neutral		20	17.4
Agree		46	40.0
Strongly agree		49	42.6
<i>The pillow is appropriate in accommodating the intubation equipment</i>			
Strongly disagree	4.32	0	0.0
Disagree		0	0.0
Neutral		16	13.9
Agree		46	40.0
Strongly agree		53	46.1
<i>It was easy to attach the transducers to the uterus and fetal heart tones</i>			
Strongly disagree	4.15	0	0.0
Disagree		1	0.9
Neutral		24	21.2
Agree		45	39.8
Strongly agree		43	38.1

Table 5. Subgroup Analysis of the Scores across Different Participant Profiles

	Pre-Test	Post-Test	p value
Position			
Registered nurse	1.72	2.50	0.022*
Midwife	1.37	1.50	0.257
Institutional worker	1.13	1.67	0.068
Physician (Resident)	2.39	3.00	0.011*
Physician (Fellow)	2.08	3.15	0.144
Years of taking care of COVID patients			
<1 year	1.00	2.25	0.254
1 to 2 years	1.73	2.09	0.428
>2 years	1.96	2.58	0.001*
Number of patients with ARDS undergoing prone position handled			
Zero	1.79	2.33	0.001*
1 to 5	1.78	2.31	0.001*
6 to 10	2.00	2.46	0.121
>10	1.70	2.40	0.089
Number of pregnant patients with ARDS undergoing prone position handled			
Zero	1.82	2.36	0.001*
1 to 5	1.86	2.37	0.002*
6 to 10	0.50	1.50	0.000*
>10	1.00	2.00	-

*Significant, paired t test was used

DISCUSSION

Team-based care is critical in healthcare settings especially in high-risk situations.¹⁷ There is now an increased need for interprofessional education in healthcare training. Simulation is a teaching learning strategy that can be used for conducting interprofessional education.¹⁸ The use of simulation in training the healthcare professionals in proning pregnant and obese/overweight patients allowed the learners to interact in a shared experience in a safe space. Considering the clinical scenario of proning a pregnant or obese patient with ARDS due to COVID-19 training using a standardized checklist by simulation allows “mistakes to be made” in an environment that is followed by debriefing without compromising patient safety. The training allowed the implementation of shared learning outcomes while in high intensity situations.

High-fidelity simulation is a skill development pedagogy that uses an advanced technology mannequin and standardized patients.¹⁹ Through the use of high fidelity simulation, the training was able to implement both technical and non-technical skills specifically verbal and non-verbal communication, delegation, collaboration, and coordination among the members of the healthcare team. These are particularly important as proning a pregnant patient with ARDS would require multiple steps that should be done in sequence according to the institutional protocol. Studies show that simulation-based training not only improves learning outcomes for health professionals but also develops their

clinical performance and more importantly their confidence in teamwork skills and interdisciplinary collaboration.²⁰ The method also provided insight and clear demarcation of the roles and responsibilities of the various disciplines involved in proning pregnant patients.

Through the simulation-based training program, multi-disciplinary teams were able to be capacitated with all having sufficient knowledge and positive attitudes regarding proning obese and pregnant patients. Teamwork, coordination and leadership, in healthcare personnel were taught by doing. The participants’ ease in speaking to the patient and next of kin regarding prone ventilation was also significantly improved by the training. Communication in advising the awake patient and the next of kin for both awake and intubated patients was also part of the training. Notably, the subgroup analysis demonstrated that knowledge gains were not uniform but were particularly significant among resident physicians and registered nurses. Additionally, healthcare workers with limited or no prior experience in proning—whether of ARDS patients in general or pregnant patients specifically—showed marked improvement in post-training knowledge scores. This underscores the value of simulation-based training in addressing skill and confidence gaps in less experienced providers. This simulation-based team training approach has also seen to be beneficial in similar cases.²¹⁻²⁶

CONCLUSION

The current study showed that Interprofessional simulation-based training of healthcare workers improved providers’ knowledge and confidence in proning pregnant patients. Simulation-based training also improved the comfort of the healthcare professional in advising the patient and next of kin on the benefits of proning. The study further demonstrates the effectiveness of a simulation-based learning program in capacitating multi-disciplinary teams. However, its effectiveness in terms of transfer of learning from simulation to actual patient cases is yet to be known.

Recommendations

It is recommended to engage multi-disciplinary learning groups in capacity building activities that will be commonly encountered by the healthcare professionals. Furthermore, the simulation-based learning methodologies may be well-utilized in these capacity building initiatives. Due to the decline in COVID-19 patients experiencing ARDS admitted in the hospital, it may be recommended to investigate the attitudes of learners regarding what they have learned after a period of not proning patients to determine an optimal retraining schedule.

Acknowledgments

The authors would like to thank the UP National Institutes of Health for funding the current project under the Faculty Research Grant. Moreover, the authors would

like to thank Dr. Koleen Pasamba for her assistance in the early preparations for the training, Ms. Jael C. Gonzales for her services as research assistant, and Mr. Dindo Medina of Multiflex RNC Philippines, Inc. (MRPI) for fabricating the 4P 2.0 prototypes.

Acknowledging the following fellows from the Division of Pulmonology who helped during the training: Dr. Charlie Clarion, Dr. Mary Bianca Ditching, Dr. Rachelle Dela Torre, Dr. Jan Jesse Lomanta, Dr. Allyce De Leon, Dr. Ria Cortez, Dr. Cristina Ferrer, Dr. Jan Christian Feliciano, and Dr. Patricia Pintac. Mr. William Ayaso of the Department of Obstetrics and Gynecology also helped in the preparation of the equipment used.

Statement of Authorship

All authors certified fulfillment of ICMJE authorship criteria.

Author Disclosure

All authors declared no conflicts of interest.

Funding Source

This study received a faculty grant from the National Institutes of Health.

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