



*Practice of Respiratory Therapists and ICU Physicians Regarding Weaning Criteria
from Mechanical Ventilation at Public Hospitals in Sana'a City-Yemen 2024*

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Abstract

Background: Mechanical ventilation as an oxygenation and ventilation support in patients who cannot have natural respiration due to any reason has been saving patients lives, Prolonged mechanical ventilation increases the risk of pneumonia, barotrauma, tracheal injuries, and musculoskeletal deconditioning. At the same time, delayed weaning is associated with increased morbidity, mortality, hospital stay, and risk of long-term care facility discharge.

Methods: A descriptive cross-sectional study was conducted in public hospitals in Sana'a City Yemen, the study population consisted of all Respiratory Therapists & ICU Physicians (131) who worked in the intensive care unit (ICU) during the study period according to shift duty, the conveniences sampling technique was applied, the final sample size was administered questionnaire was used to collect the data, statistical package for social sciences SPSS was used to data analysis. A pilot study was conducted and the validity and reliability of the questionnaire were also tested.

Results: About Two-third (67.9%) of participants were male, and (56.5%) of them were married, with belonged age group between (26-and 30) years old (43.5%). More than half (59.5%) of them had diploma degrees, while (62.6%) of them have years of experience from (1 –5) years. Most (63.4 %) of the partic-

ipants have specialty respiratory therapists, while (36.6%) of them were ICU physicians. More than three quarters (78.6%) of participants had courses training in MV, while only (21.4%) of them didn't have courses training in MV, The Majority (89.3%) of participants had training courses about weaning criteria from MV, while only (10.7%) of them were didn't have training courses about weaning criteria from MV. More than half (58.0%) of participants had adequate practice regarding weaning from mechanical ventilation, while (42.0%) of them had inadequate practice regarding weaning from mechanical ventilation.

Conclusions: We conclude that significant difference association between the level of practice weaning from mechanical ventilation and the demographic characteristics of participants regarding training courses in mechanical ventilation at (p -value=0.018), we recommended respiratory therapists and ICU physicians should increase their level of practice regarding respiratory care and gaining more general skills in mechanical ventilation specifically in the weaning criteria through continuous practical training according to evidence-based practice and reading different books and resources.

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Introduction

Mechanical ventilation is an established supportive treatment for patients with various forms of respiratory failure. Despite the widespread use and clear benefits of mechanical ventilation, it is not a risk-free intervention. Prolonged mechanical ventilation increases the risk of pneumonia, barotrauma, tracheal injuries, and musculoskeletal deconditioning. At the same time, delayed weaning is associated with increased morbidity, mortality, hospital stay, and risk of long-term care facility discharge [1].

Weaning from mechanical ventilation (MV) is the process by which a patient is liberated from a ventilator. It begins with a readiness assessment and ends with liberation, usually by extubation. A successful weaning process should discriminate between patients who might fail in the extubation and need reintubation from those who might be successful and maintain spontaneous breathing without mechanical support [2].

Weaning covers the entire process of liberating the patient from mechanical ventilation support and from

the endotracheal tube to independent breathing. This process consists of "3" key steps: the first step when the patient's clinical conditions permit it, ventilation supports are progressively decreased (Ready weaning); the second step, a spontaneous breathing trial (SBT) assesses the patient's capability to breathe autonomously (Ready breathing); and third step, the patient is liberated from ventilation support (Ready extubation), the clinical goals of weaning are twofold: first, to promptly identify those patients who are ready to begin the process of weaning, and second, to optimize the weaning regime to reduce the transition time from dependence to independence from mechanical ventilation (MV) [3].

Prolonged mechanical ventilation (PMV) and weaning failure are factors associated with prolonged hospital length of stay and increased morbidity and mortality. In addition to the individual challenges that stress patients and their families, the resource-intensive care these patients receive places a significant burden on the public health system. These burdens often persist over the long term, especially in the case of weaning failure with subsequent home mechanical ventilation (HMFV) [4].

Respiratory therapists play a vital role in facilitating the process of weaning the patients from mechanical ventilation, it also reduces the patient's time on a ventilator this is done by performing some procedures with the assistance of an intensive care specialist such: daily assisting physician in diagnosis breathing problems and providing patients care, ability to assessment patients' investigation such as (arterial blood gases ABG –chest x-ray CXR –complete blood count CBC –Electrolytes and act.), also the respiratory therapists play role in administering respiratory medications with performing chest physiotherapy and monitoring patients physiological responses to treatment.

Methods

A descriptive, cross-sectional study was conducted among respiratory therapists & intensive care unit (ICU) physicians who are working in intensive care units over Seven months, From 15 August 2023 to 18 February 2024, at sex public hospitals in Sana'a City, Yemen that include (Al-Thowrah General Hospital Authority, Al-Kuwait University Hospital, Al-Sabeen Maternity & Child Hospital, 22 May hospital, Palestine Maternity & Child Hospital, Republican Teaching Hospital Authority). One hundred thirty one participants were enrolled using a convenience sampling technique.

Data were collected through a self-administered questionnaire developed from previous studies [5,6 &10].

This questionnaire consists of three parts:

Part I: Demographic Characteristics: covered seven questions for hospital name, age, marital status, educational level, Years of experience, etc...

Part II: Respiratory Therapists & ICU Physicians training course in mechanical ventilation and weaning criteria covered two questions.

Part III: Practice of Respiratory Therapists & ICU Physicians regarding Weaning Criteria from Mechanical Ventilation. which included four sections as the following categories:

- **Section one:** Respiratory Therapists & ICU Physicians practice regarding weaning Readiness Criteria, the questions number from (1 to 14).

- **Section tow:** Respiratory Therapists & ICU Physicians practice regarding Weaning Intervention Criteria, the questions number from (1 to 7).
- **Section three:** Respiratory Therapists & ICU Physicians practice regarding Weaning Tolerance Criteria, the questions number from (1 to 5).
- **Section four:** Respiratory Therapists & ICU Physicians practice regarding Weaning extubation Criteria, the questions number from (1 to 3).

The scoring system assigned each response to the items in the questionnaire was given (2 scores) for yes performance practice, (1 score) for some time practice, and (0 score) for those who didn't perform practicen Adequate practice ($\geq 80\%$) of participants had satisfactory practice Inadequate practice ($< 80\%$) of participants didn't have satisfactory practice regarding weaning from mechanical ventilation [7].

Approval of the study was obtained from the ethical committee of the Faculty of Medicine and Health Sciences at Al-Razi University and the principals of the hospitals. Informed written and verbal consent was obtained from all participants, who had the right to accept or withdraw from the study.

Statistical Analysis

A computer analysis program, Statistical Package for the Social Sciences (SPSS 21.0), was used for statistical analysis. Descriptive statistics were used to interpret demographic data and descriptive measures, including frequency and percentage for categorical variables, and mean and standard deviation for numerical variables. The chi-square test for categorical data was used to find the association between knowledge level and demographic characteristics. A P-value ≤ 0.05 was considered significant.

Results

The study sample consisted of 131 participants. About two-thirds (67.9%) of participants were male, and (56.5%) of them were married and belonged age group between (26 and 30) years old (43.5%). More than half (59.5%) of them had diploma degrees, while (62.6%) of them have years of experience from (1 -5) years.

More than one-third (35.1%) of participants worked at Al-thawrah general hospital authority, followed by

(22.9%) of participants worked at republican teaching hospital authority, while only (6.9%) of them were worked in 22 May hospital.

Most (63.4 %) of participants have specialty respiratory therapists, while (36.6%) of them were ICU physicians. (Table 1)

Table 1: Demographic Characteristics data of Participants (N: 100)

Demographic characteristics	F	%	
Sex	Male	89	67.9
	Female	42	32.1
Marital status	Single	57	43.5
	Married	74	56.5
Age group	From 21 to 25 years	23	17.6
	From 26 to 30 years	57	43.5
	From 31 to 35 years	28	21.4
	More than 35 years	23	17.6
Level Education	Diploma degree	78	59.5
	Bachelor degree	15	11.5
	Master degree	21	16
	Bord	16	12.2
	Other specify	1	0.8
Years of ICU Experience	From 1 to 5 years	82	62.6
	From 6 to 10 years	32	24.4
	More than 10 years	17	13

The Majority (89.3%) of participants had training courses about weaning criteria from MV, while only (10.7%) of them didn't have training courses about weaning criteria from MV. (Figure 1)

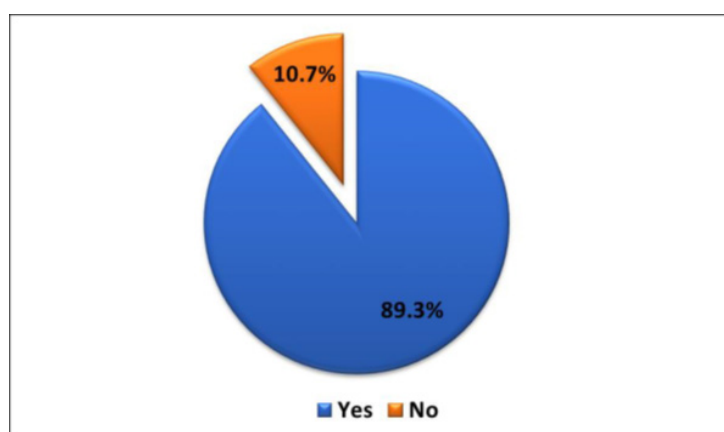


Figure 1: Demographic Characteristics of participants according to training courses about weaning criteria from MV (n=131)

The results showed that most (60.6%) of participants had total practice regarding to readiness criteria of weaning from mechanical ventilation. and (26.8%) of them had sometime practice regarding readiness criteria for weaning from mechanical ventilation. While only (12.6%) of them didn't have practice regarding readiness criteria for weaning from mechanical ventilation. (Table 2)

Table 2: Distribution of Participants' Practice regarding Readiness Criteria of Weaning Mechanical Ventilation (n=131)

Items	Yes		Sometime		No	
	F	%	F	%	F	%
Hemodynamically stable, adequately resuscitated, and does not require vasoactive support	107	81.7	21	16	3	2.3
SaO ₂ greater than 90% on FiO ₂ 40% or less, PEEP 5 cm H ₂ O or less	107	81.7	21	16	3	2.3
Chest radiograph reviewed for correctable factors; treated as indicated	100	76.3	26	19.8	5	3.8
Metabolic indicators (serum pH, major electrolytes) within normal range	105	80.2	23	17.6	3	2.3
Hematocrit more than 25%	36	27.5	64	48.9	31	23.7
Systemically hydrated (weight at or near baseline, balanced intake, and output)?	51	38.9	51	38.9	29	22.1
Nourished (albumin >2.5, parenteral/enteral feedings maximized)?	53	40.5	44	33.6	34	26
Electrolytes within normal limits (including Ca, Mg ⁺ , PO ₄)?	72	55	40	30.5	19	14.5
Absence of bowel problems (diarrhea, constipation, ileus)?	42	32.1	54	41.2	35	26.7
Improved general body strength and endurance (e.g. out of bed in a chair, progressive activity program)?	68	51.9	40	30.5	23	17.6
Core temperature more than 36°C and less than 39°C	84	64.1	32	24.4	15	11.5
Adequate management of pain/anxiety/agitation	81	61.8	36	27.5	14	10.7
No residual neuromuscular blockade	93	71	28	21.4	10	7.6
ABG values normalized or at the patient's baseline	113	86.3	12	9.2	6	4.6
Total	79	60.6	35	26.8	16	12.6

The results also showed most (71.0%) of the participants had practice for if the patient fails tolerance criteria, increasing PSV or adding ventilator rate as needed to achieve “rest” settings, followed by about (34.4%) of them had sometimes practice toward repeat wean attempt on PSV 10 cm after a rest period (minimum, 2 hours), while (25.2%) of them didn't have practice regarding reduce ventilator rate, then convert to pressure-support ventilation (PSV) only.

On the otherhand regarding total practice, nearly two-thirds (64.7%) of participants had total practice toward intervention criteria from mechanical ventilation, followed by (25.3%) of them had sometimes practice, while only (10%) of them didn't have practice toward intervention criteria from mechanical ventilation. (Table 3)

Table 3: Distribution of Participants' Practice regarding Weaning Intervention Criteria from Mechanical Ventilation (n=131)

Items	Yes		Sometime		No	
	F	%	F	%	F	%
Reduce ventilator rate, then convert to pressure support ventilation (PSV) only.	72	55	26	19.8	33	25.2
Wean PSV as tolerated to 10 cm H ₂ O or less.	83	63.4	36	27.5	12	9.2
If the patient meets tolerance criteria for at least 2 hours on this level of support and meets extubation criteria.	90	68.7	31	23.7	10	7.6

If the patient fails tolerance criteria, increase PSV or add ventilator rate as needed to achieve “rest” settings.	93	71	29	22.1	9	6.9
Review weaning criteria for correctable factors.	90	68.7	34	26	7	5.3
Repeat the weaning attempt on PSV 10 cm after a rest period (minimum, 2 hours).	75	57.3	45	34.4	11	8.4
If the patient fails the second wean trial, return to rest settings and use a “long term” ventilation weaning approach.	90	68.7	31	23.7	10	7.6
Total	85	64.7	33	25.3	13	10

most (72.5%) of the participants had practiced for a Sustained respiratory rate greater than 35 breaths/min, followed by about (33.6%) of them sometimes had practiced toward SaO₂ less than 90%, while (16.8%) of them didn't have practice regarding Systolic blood pressure exceeding 180 mm Hg or less than 90 mmHg. (Table 4)

Table 4: Distribution of Participants' Practice regarding Tolerance Criteria of Weaning from Mechanical Ventilation (n=131)

Items	Yes		Sometime		No	
	F	%	F	%	F	%
Sustained respiratory rate greater than 35 breaths/min	95	72.5	18	13.7	18	13.7
SaO ₂ less than 90%	81	61.8	44	33.6	6	4.6
Tidal volume 5 mL/kg or less	88	67.2	33	25.2	10	7.6
Sustained minute ventilation greater than 200 mL/kg/min	81	61.8	31	23.7	19	14.5
Labored respiratory pattern	92	70.2	30	22.9	9	6.9
Increased anxiety, diaphoresis, or both	77	58.8	39	29.8	15	11.5
Sustained heart rate greater than 20% higher or lower than baseline	81	62.3	40	30.8	9	6.9
Systolic blood pressure exceeding 180 mm Hg or less than 90 mm Hg	76	58	33	25.2	22	16.8
Total	84	64.1	34	25.6	14	10.3

The results showed that Majority by (88.5%) of the participants had practiced making good cough and gag reflexes and were able to protect the airway and clear secretions, followed by (23.7%, 22.1%) of participants who had sometimes and didn't perform practice toward able to move air around ETT with the cuff deflated and end of tube occluded, on the otherhand regarding total practice, more than three quarters (76.3%) of participants had practiced regarding extubation criteria of weaning from mechanical ventilation, followed by about (14.8%) of them had sometimes practiced toward extubation criteria, while (8.9%) of them didn't practice regarding extubation criteria of weaning from mechanical ventilation. (Table 5)

Table 5: Distribution of participants' practice regarding extubation criteria of weaning from mechanical ventilation (n=131)

Items	Yes		Sometime		No	
	F	%	F	%	F	%
Mental status: alert and able to respond to commands	113	86.3	16	12.2	2	1.5
Good cough and gag reflex and able to protect the airway and clear secretions	116	88.5	11	8.4	4	3.1
Able to move air around ETT with the cuff deflated and the end of the tube occluded	71	54.2	31	23.7	29	22.1

Total	100	76.3	19	14.8	12	8.9
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In regard to the level of practice of respiratory therapists and ICU physicians regarding weaning criteria from mechanical ventilation, more than half (58.0%) of participants had adequate practice, while (42.0%) of them had inadequate practice regarding weaning from mechanical ventilation. (Figure 2)

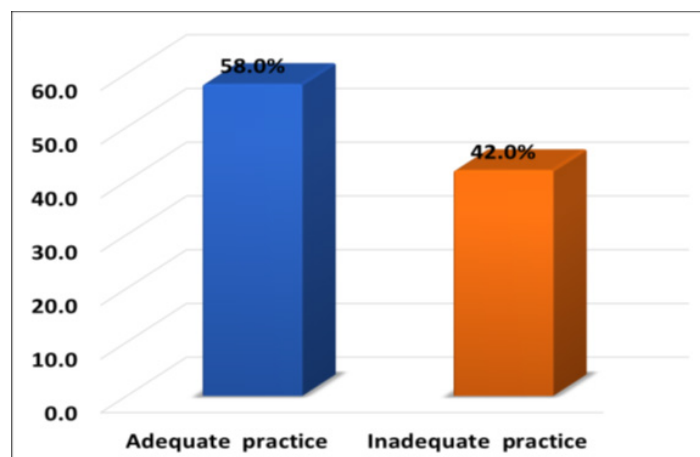


Figure 2: Shows the total practice level of participants regarding weaning from mechanical ventilation (n=131)

There is statistically significant difference association between the level of practice weaning from mechanical ventilation and demographic characteristics of participants regarding training course in mechanical ventilation at (p-value=0.018).

Table 5: Association between demographic characteristics of participants and practice level regarding weaning from mechanical ventilation.

Demographic Characteristics		Total Practices Level				P value
		Adequate Practice		Inadequate Practice		
		F	%	F	%	
Hospital Name	Al Thawra General Hospital Authority	28	21.4	18	13.7	0.887
	Republican Teaching Hospital Authority	17	13	13	9.9	
	Al Kuwait University Hospital	8	6.1	8	6.1	
	Al Sabeen Maternity & Child Hospital	8	6.1	4	3.1	
	Palestine Maternity & Child Hospital	11	8.4	7	5.3	
	22 May Hospital	4	3.1	5	3.8	
Specialty Name	Physician	25	19.1	23	17.6	0.295
	Respiratory Therapist	51	38.9	32	24.4	
Sex	Male	49	37.4	40	30.5	0.318
	Female	27	20.6	15	11.5	
Marital Status	Single	33	25.2	24	18.3	0.925
	Married	43	32.8	31	23.7	
Age (Years)	From 21 to 25 years	12	9.2	11	8.4	0.75
	From 26 to 30 years	34	26	23	17.6	
	From 31 to 35 years	16	12.2	12	9.2	

	More than 35 years	14	10.7	9	6.9	
Education Level	Diploma degree	47	35.9	31	23.7	0.694
	Bachelor degree	8	6.1	7	5.3	
	Master degree	13	9.9	8	6.1	
	Bord	8	6.1	8	6.1	
	Other specify	0	0	1	8	
Years of ICU Experience	From 1 to 5 years	50	38.2	32	24.4	0.131
	From 6 to 10 years	14	10.7	18	13.7	
	More than 10 years	12	9.2	5	3.8	
Training Course in MV	Yes	72	55	45	34.4	0.018
	No	4	3.1	10	7.6	
Training courses about weaning criteria from MV	Yes	63	48.1	40	30.5	0.161
	No	13	9.9	15	11.5	

Discussion

Weaning from Mechanical ventilation (MV) is the process of gradually withdrawing artificial ventilation to intubated patients for a short or long time in a critical care setting. Weaning patients from the ventilator is a complex and challenging task for respiratory therapists and ICU physicians, knowing and practicing criteria are essential to successful patient outcomes with MV [8].

The finding of the current study showed that nearly two-thirds (61.8%) of participants had practice readiness criteria regarding adequate management of pain/anxiety/agitation, while (71.0%) of them had practice regarding no residual neuromuscular blockade.

The findings of the present study are approximately in the same line with another study conducted by 9 in the United States of America toward readiness weaning from MV, who found about (52%) of respiratory therapists, were assessed the adequate management of pain/anxiety/agitation, while (70.5%) of them stop sedation and muscle relaxants drugs.

The findings of the present study agree with a study conducted in United States 10 about Weaning Patients from the Ventilator, which found more than half (58%) of ICU staff had total intervention practice toward weaning criteria from mechanical ventilation, while only (14.6%) of them didn't have practice toward intervention criteria from mechanical ventilation.

The results showed most (72.5%) of participants had practiced for a sustained respiratory rate greater than 35 breaths/min, followed by about (30.8%) of them sometimes had practiced toward a Sustained heart rate greater than 20% higher or lower than baseline, while (16.8%) of them didn't have practice regarding Systolic blood pressure exceeding 180 mm Hg or less than 90 mmHg.

This finding agreed with another study conducted in Muncie, Indiana on the practice of ICU staff regarding tolerance criteria for weaning criteria from MV 11, which found that (74%) of ICU staff practice for Sustained respiratory rate greater than 35 breaths/min, and about (24.1%) of them sometimes had practice toward Sustained heart rate greater than 20% higher or lower than baseline.

The results showed that most (86.3%) of participants had practice toward Mental status: alert and able to respond to commands, followed by (23.7%, 22.1%) of participants who had sometimes and didn't perform practice toward able to move air around ETT with the cuff deflated and end of tube occluded.

This finding agrees with a study conducted by 12, about the Effect of Instructional Guidelines on respiratory therapists' Performance Regarding the Weaning of Patients from Mechanical Ventilation in Egypt, about (81.5%) of participants practiced assessing the Mental status and level of consciousness before extubation patients.

The finding of the current study showed that, the total level of practice for participants regarding weaning from mechanical ventilation. More than half (58.0%) of participants had adequate practice, while (42.0%) of them had inadequate practice regarding weaning from mechanical ventilation.

The findings of the present study agreed with another study conducted in Nepal, 13 about physicians' practice Regarding the Weaning Criteria of Patients with Mechanical Ventilation in a Teaching Hospital, in Nepal. Who reported about (50.9%) of physicians had adequate practice, while the majority (49.1%) of physicians had inadequate practice regarding weaning from mechanical ventilation.

Limitations of the Study

The current study was conducted in the ICUs of 6 public hospitals in Sana'a City and had few numbers of participants, therefore findings may not be representative of the general population of respiratory therapists and ICU physicians in Yemen. This may threaten the external validity of the findings hence another research on this area with a large sample size is required.

Conclusion

Respiratory therapists and ICU physicians should be improve their practice by attendance in any Continuous learning and training courses in hospitals focused on caring for patients under mechanical ventilation.

Should increase their level of practice regarding respiratory care and gain more general skills in

mechanical ventilation specifically in the weaning criteria This can be achieved by continuous practical training according to evidence-based practice and reading different books and resources. Hospitals should be Providing regular and continuous training and retraining for respiratory therapists and ICU physicians on respiratory care profession for patients in the intensive care unit specifically who are with mechanical ventilation. Further research should be conducted to test practice levels of respiratory therapists and ICU physicians prior to and after the educational program on evidence-based guidelines for weaning criteria and long-term for Patients Requiring Prolonged Ventilation [9,11-13].

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