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Original Article

A Survey of Mechanical Ventilation Weaning Practices in ICUs of Bangladesh

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Abstract:

Objective : *To determine mechanical ventilation discontinuation (weaning) practices in Bangladesh as there is currently no data available on this issue.*

Method : *Analyzing the Survey on Bangladeshi respondents using questionnaire developed by and used by a pan Asian study where Bangladesh critical care physicians participated.*

Result : *40 physicians from 10 ICUs of Bangladesh participated. Majority of our participating doctors (62.5%) came from private for profit hospital. 19 out of 40 respondents were certified in critical care medicine. In our study spontaneous breathing trial (SBT) was liberally used with pressure support being used by 30% respondents. Most of the extubation trial took place during day. As criteria for extubation, respondents mainly considered consciousness and cooperation and along with gag reflex, cough strength, suction frequency and cuff leak at different times. Noninvasive ventilation (NIV) was commonly used for early extubation in cases of COPD, cardiogenic pulmonary edema, neuromuscular disorders, post-operative cases and obesity. Slightly less than half of respondents did not follow any sedation protocol and 42.5% followed weaning protocol. Protocolized weaning by nurses are not known to be practiced in Bangladesh.*

Conclusion : *Weaning practices are diverse in Bangladeshi ICUs. Protoclized weaning is rarely practiced in Bangladesh.*

Key words: *ICU, Weaning, Mechanical Ventilation.*

Introduction :

Mechanical Ventilation (MV), or assisted ventilation, is the medical term for artificial ventilation where mechanical means are used to assist or replace spontaneous breathing. It is indicated when the patient's spontaneous breathing is inadequate to maintain life, as prophylaxis for imminent collapse of other physiologic functions, or ineffective gas exchange in the lungs. Mechanical ventilation is termed as invasive when endotracheal tube is placed within trachea as opposed to noninvasive ventilation.

Weaning is the process of decreasing the amount of support that the patient receives from the mechanical ventilator, so the patient assumes a greater proportion of the ventilator effort. Although MV is indispensable to maintain life at a crucial moment, maintaining it for prolonged duration is associated with significant complications and patient discomfort both physiological and psychological[1,2]. Because of complications and negative experience, prompt discontinuation is warranted.

Information on weaning from clinicians in North America, Europe, Australasia and India can be gathered from pre-existing survey data[3-6]. In spite of its being the largest and most populous continent, there was no survey done on weaning in major parts of the Asia until recently and most importantly, it differs from other parts of the world in terms of structure, organization, and delivery in Asia, which was related to hospital funding source and size, and country income[7].

There is some evidence of a reduction in the duration of mechanical ventilation, weaning duration and ICU length of stay (LOS) with use of standardized protocols, but there is significant heterogeneity among studies and an insufficient number of studies to investigate the source of this heterogeneity[8]. There is a clear need for weaning protocols to take account of the social and cultural environment in which they are to be implemented[9].

Leung et al in a recently published[10] land mark study done on ICUs of Asia between 2016 and 2017 concluded that a substantial minority of Asian intensive care specialists do not wean patients in accordance with best available evidence of current guidelines and there is clinical equipoise regarding benefit of protocolized weaning. This Asian study was a multinational survey of 2074 specialist doctors working in ICUs of twenty countries and regions of Asia to characterize clinicians stated weaning practices. Bangladesh was one of the participating countries with forty doctors filling out the survey data sheet for this study.

In light of the above, as a part of Asian study, an independent survey was done on the participating doctors from Bangladeshi ICUs to bring the prevalent weaning process to light and obtain data to facilitate the design of protocolized weaning to suit the need of the ICUs of Bangladesh.

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Materials and methods:

The survey period was from September 2016 to June 2017. Our study is a sub analysis of Pan Asian Study [10] which was an international, cross-sectional, self-administered survey on the specialist doctors or equivalent who spent at least 10% of their clinical time working in a ward that was recognized by their respective hospital as an ICU and capable of providing invasive MV. Only specialists working in adult ICUs were included in our study. The specialist participants were invited by the corresponding author /investigator of this study. We used the survey questionnaire used by the parent study[10] and the survey questionnaire was developed and validated as per guide lines by Burns et al [11] to capture reported practices when weaning patients who have been invasively ventilated for at least 24 hours.

Participation was voluntary and participants were chosen by a snowball method. Consent was assumed by questionnaire completion and return. No incentives were offered. Prior to starting the survey, eligibility was checked, based on self-reported answers to questions on eligibility.

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Weaning was defined as the process of adjusting ventilator support with the goal of removing patients from invasive support during the recovery phase (i.e. after at least partial resolution of the acute illness precipitating intubation). A spontaneous breathing trial (SBT) was defined as a focused assessment of the patient's capacity to breathe spontaneously with any one of a number of techniques e.g; T-piece, Continuous Positive Airway Pressure (CPAP), Pressure Support (PS) with minimal assistance. Nurse (or respiratory therapist)-led protocolized weaning was defined as a process by which the ventilator is adjusted by strictly following a structured guideline without routine intervention by doctors once patients were identified as ready to wean. Such protocolized weaning is not known to be practiced in Bangladesh.

Statistical analysis:

Continuous data are presented as medians (interquartile range or IQR). Categorical data are presented as frequencies (percentage). In reporting percentages, missing items were excluded from analysis. No data were imputed and results are given as percentage of respondents to each question. Categorical data were compared by Pearson Chi-Square test.

For some survey items, Likert scale responses were collapsed and dichotomized for the purpose of analyzing the results in a way that was relevant to the question e.g. frequently, usually/always clustered to reflect consistent use (61-100% of the time) and referred as "frequently-always", while never/rarely, infrequently, sometimes together represented occasional use (0 – 60%).$P<0.05$ was considered as statistically significant. All statistical analysis was carried out using IBM SPSS Version 20 (IBM Corp, Armonk, NY).

Result:

Demographics:

A total of 40 doctors from ten ICUs from Dhaka, took part in the survey. Their demographic data are given in Table 1 which shows that majority of them (62.5%) work in private for profit hospital, 47.5% are certified in critical care medicine, average years of their clinical practice is 07 years and on average, 90% of their working time is spent in ICU. Regarding the hospitals, 35% are university affiliated, most of the ICUs (75%) are multidisciplinary, 82.5% have physiotherapists and on average, number of ICU bed is 13, daily ICU admission is 3 and nurse-patient ratio is 1:2.

Table 1:

Demographic data	Number (% of total respondents) unless otherwise stated (n=40)
Hospital funding model	
Public hospital	13 (32.5)
Private for-profit hospital	25 (62.5)
Private not-for-profit hospital	2 (5.0)
University affiliated hospital	14 (35.0)

Closed ICU model	11 (27.5)
Type(s) of ICU	
Cardiac surgical	1 (2.5)
Coronary care	1 (2.5)
Medical + Surgical	3 (7.5)
Multidisciplinary	30 (75.0)
Medical+ Multidisciplinary	2 (5.0)
Multidisciplinary+ Coronary Care	1 (2.5)
Medical+Surgical+Neurosurgical	1 (2.5)
Medical+ Coronary care +Neurosurgical	1 (2.5)
Median (IQR) Intensivist resident in ICU outside office hours	11 (4-34)
Certification in critical care medicine	19 (47.5)
Median (IQR) ICU beds	13(7-20)
Median (IQR) ICU admissions per day	3 (2-4)
Median (IQR) Years of practice	7 (4.25-12.75)
Median (IQR) % of working time spent in ICU	90 (50-100)
Median (IQR) nurse to patient ratio	1:2 (>1:1 – 1:2-2.9)
Physio therapists in ICU	33 (82.5)
Median (IQR) Physio/respiratory therapist: patient ratio	1:11-15 (1:4-6 – 1:15-20)

Readiness for weaning:

Table 2 depicts the criteria of readiness for weaning practiced by the respondents. Table 3 shows that larger number of the respondents (62.5%) choose frequently always screen patients daily to assess for readiness for weaning, while 15% and 5% choose to screen twice daily and more than twice daily respectively for this assessment.

Table 3 :

Readiness for weaning	n=40 (%)
Frequently-always screen patients daily	25 (62.5)
Frequently-always screen patients twice daily	6 (15.0)
Frequently-always screen patients >twice daily	2 (5.0)

Initial step in weaning:

Majority of the respondents (97.5%) use SBT as the first step in weaning. The method of SBT used by them is shown in Table 4. There was no major preference found for the initial SBT. 22.5% use T piece without CPAP off ventilator, 20% use pressure support without PEEP, 17.5% use pressure support with PEEP, 12.5% use CPAP alone on ventilator and 10% use T piece without CPAP on ventilator.

Table 4: Method of SBT

Method	% of respondents who used method frequently-always
T piece with CPAP, off ventilator (n=40)	7.5
T piece without CPAP, off ventilator (n=40)	22.5
T piece without CPAP, on ventilator (n=40)	10.0
Pressure support with PEEP(n=40)	17.5
Pressure support without PEEP (n=40)	20.0
CPAP alone, on ventilator (n=40)	12.5
Automatic tube compensation (n=40)	2.5

Table 2: Criteria of readiness for weaning

Criteria	% of respondents that use or consider variable (n=40)	Threshold above or below which majority of respondents who use variable would typically consider a patient ready to wean
Glasgow Coma Score	20(50.0)	≥9-11
Level of sedation	14(35.0)	≤Light sedation
Norepinephrine requirement	21(52.5)	≤0.01-0.07 μcg/kg/min
Heart rate	17(42.5)	≤120 beats/min
Respiratory rate	17(42.5)	≤17-22
Oxygen saturation by pulse oximetry	12(30.0)	≥96%
Arterial oxygen tension	36(90.0)	≥5 kPa (60 mmHg)
Fractional inspired oxygen	11(27.5)	≤0.5
Positive end-expiratory pressure (PEEP)	19(47.5)	≥8 cm H2O
Arterial carbon dioxide tension	31(77.5)	≤6 kPa (45 mmHg)
pH	19(47.5)	≥7.35
Minute ventilation	17(42.5)	≤10-11 l/min
Rapid shallow breathing index	14(35.5)	≤105
Negative inspiratory force	9(22.5)	≥ -16 to -20 cm H2O
Inspiratory pressure above PEEP	34(85.0)	≤5-7 cm H2O

Modes of Weaning:

The modes of weaning used by the respondents are shown in Table 5. It is seen that in between the trials of SBT, 30% of them provide pressure support to the patients, while 27.5% use SIMV with pressure support. On the contrary, 7.5% and 17.5% use only pressure support alone and SIMV with pressure support respectively. Respondents reported that the median (IQR) number of times that patients in their units were assessed for titration of ventilator support in their ICU was 4 (3-6) during the day (7 am to 7 pm) and 1 (1-3) at night (7 pm to 7 am).

Table 5 : Modes of weaning

Modes	% of respondents who used mode frequently-always
Pressure support alone (n=40)	3(7.5)
SIMV with pressure support (n=40)	7(17.5)
Spontaneous breathing trials with:	
Pressure support in between trials (n=40)	12(30.0)
SIMV with pressure support in between trials (n=40)	11 (27.5)
Volume preset assist control in between trials (n=40)	3(7.5)
Pressure preset assist control in between trials (n=40)	5(12.5)
Pressure-limited mode with volume-guarantee in between trials (n=40)	1(2.5)

Indications for re-instituting a higher level of ventilator support during the weaning process are given in Table 6.

Extubation:

When asked about the criteria for extubation, all of the respondents considered consciousness and cooperation, 87.5% gag reflex, 82.5% cough strength and 80% considered both suction frequency and cuff leak. When considering consciousness, 72.5% of them selected "calm, awakens easily, follows commands" as the criterion for extubation. Most (65%) felt the patient's cough strength should be moderate at least. Majority of the respondents (95%) routinely stop feeds before extubation. Amongst these, the median (IQR) duration of fasting was 4 (2-6) hours.

Non-Invasive Ventilation (NIV):

Table 7 shows that 20% of the respondents never practice early extubation directly to NIV as a weaning strategy that aims at reducing the duration of invasive ventilation, 15% never use prophylactic NIV immediately following extubation in patients at high-risk of extubation failure and 7.5% never use NIV as a rescue treatment for respiratory failure developing after extubation. The conditions in which NIV was most commonly used for these three indications were chronic obstructive pulmonary disease (25%, 20% and 32.5% respectively), cardiogenic pulmonary oedema (12.5%, 15% and 17.5%), neuromuscular disease (10%, 17.5% and 15%), post-operative (15%, 7.5% and 12.5%) and obesity (15%, 12.5% and 5%).

Table 6:

Variable :Qualitative/ Quantitative	% respondents who do not use/consider variable*-n=40)	% respondents who use/consider this variable (n=40)	
Qualitative			
Mental status change	35(87.5)	5(12.5)	
New cardiac arrhythmia	39(97.5)	1(2.5)	
Accessory muscle use	34(85.0)	6(15.0)	
Sweating	33(82.5)	7(17.5)	
Abdominal paradox	34(85.0)	6(15.0)	
>1 clinical features	25(62.5)	15(37.5)	
Quantitative		**Reduction (% of respondents, [median threshold])**	**Increase (% of respondents, [median threshold])**
Systolic blood pressure	7(17.5)	11 (27.5) [-20%]	5(12.5) [+20%]
Heart rate	1(2.5)	6(15.0) [≤60 beats/min]*	5(12.5) [≥120 beats/min]
Respiratory rate	6(15.0)	4(10.0)[<8 breaths/min]]*	6(15.0) [>30 breaths/min]
Oxygen saturation	1(2.5)	20(50.0) [≤90%]	----------
PaO_2	1(2.5)	32(80.0) [≤8 kPa, 60 mmHg]	----------
Arterial pH	7(17.5)	13(32.5) [≤7.2]	14(35.0) [≥7.5]
Increase in $PaCO_2$ from baseline	1(2.5)	----------	11(27.5) [≥2 kPa, 15 mmHg]

Table 7:

Never use NIV	(n=40)
To allow early extubation	8(20.0)
Prophylactically, in patients at high risk of extubation failure	6(15.0)
As rescue treatment for respiratory failure developing after extubation.	3(7.5)

Staff involved in different aspects of weaning:

Consultant /Intensivists were the staff group most commonly identified as being involved in each weaning task except for actual extubation. Approximately 82.5% of respondents worked in ICUs where Physio/respiratory therapists were present and the ratio between Physio/ respiratory therapists to patients is 1:11-14. Data regarding information about staffs working in different aspects of weaning are given in Table 8. which shows percentage of respondents indicating that specified staff groups were involved in weaning tasks. The number of respondents refers to the number who were in an ICU where that particular staff group was involved in weaning.

Use of sedation protocol or guideline:

It is to mention that 47.5% of the respondents generally do not follow any sedation protocol or guideline, while 37.5% follow and rest of them are uncertain in this aspect (Table 9). Besides, 42.5% work in an ICU where a weaning protocol is being followed; among them 25% frequently always follow the protocol or guideline.

Table 9:

Sedation protocol or guideline	(n=40) %
Generally follow	15(37.5)
Generally do not follow	19(47.5)
Uncertain	6(15.0)
Weaning protocol	
Work in an ICU with a weaning protocol	17 (42.5))
Frequently-always follow protocol	10 (25.0)

Nurse or Respiratory therapist led protocolized weaning:

Figure 1 & 2 show respondents' agreement with the statements "evidence clearly supports protocolized weaning over non-protocolized weaning" and "the data on protocolized weaning do not apply to my practice". Neither nurse staffing ratios nor the presence of respiratory therapists were associated with responses to this statement.

Table 8: Data about staffs working in different aspects of weaning

	Respiratoy Therapists	Attending or Consultant Intensivists	Senior Trainees	Junior Trainees	Nurse	Physio therapists	Other clinician
Screening for readiness to undergo a SBT	2(5)	14(35)	4(10)	7(17.5)	5(12.5)	7(17.5)	1(2.5)
Decision to conduct a SBT (or assess the ability to breathe spontaneously)	0	15(37.5)	20(50)	5(12.5)	0	0	0
Actual conduct of SBTs	3(7.5)	13(32.5)	8(20)	12(30)	3(7.5)	0	1(2.5)
Decision to adjust ventilator settings	0	12(30)	22(55)	3(7.5)	2(5)	0	1(2.5)
Actual adjustment of ventilator settings	1(2.5)	14(35)	16(40)	8(20)	1(2.5)	0	0
Decision to extubate	1(2.5)	21(52.5)	15(37.5)	3(7.5)	0	0	0
Actual extubation	0	14(35)	10(25)	3(7.5)	13(32.)	0	0
Decision to perform a tracheostomy	2(5.0)	33(82.5)	5(12.5)	0	0	0	0

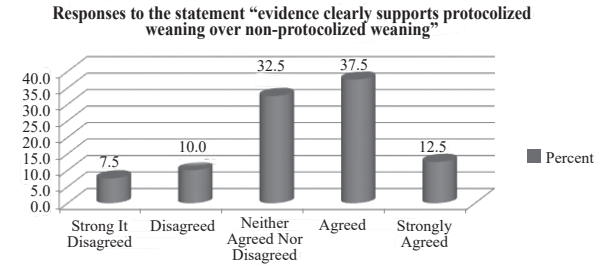

Figure 1

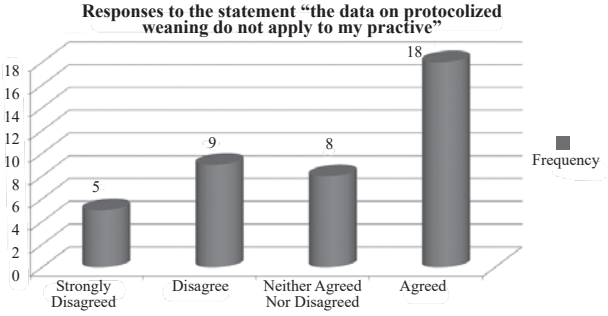

Figure 2

Discussion:

In our study a total of 40 doctors took part in the survey, majority of them (62.5%) work in private for profit hospital, 47.5% are certified in critical care medicine, 90% of their working time is spent in ICU. Regarding the hospitals, 35% are university affiliated, most of the ICUs (75%) are multidisciplinary, 82.5% have respiratory therapists and on average, number of ICU bed is 13, daily ICU admission is 3 and nurse-patient ratio is 1:2.

We found that in between the trials of SBT, 30% of them provide pressure support to the patients, while 27.5% use SIMV with pressure support. On the contrary, 7.5% and 17.5% use only pressure support alone and SIMV with pressure support respectively.

This study by Leung et al[10] revealed that majority of the respondents (97.5%) use SBT as the first step in weaning. There was no major preference found for the initial SBT. It is to mention that 22.5% use T piece without CPAP off ventilator, 20% use pressure support without PEEP, 17.5% use pressure support with PEEP, 12.5% use CPAP alone on ventilator and 10% use T piece without CPAP on ventilator.

Our study respondents reported that the median (IQR) number of times that patients in their units were assessed for titration of ventilator support to assess for readiness for weaning in their ICU was 4 (3-6) during the day (7 am to 7 pm) and 1 (1-3) at night (7 pm to 7 am).

The parent study[10] done by Leung et al reported that, larger number of the respondents (62.5%) choose frequently always screen patients daily to assess for readiness for weaning, while 15% and 5% choose to screen twice daily and more than twice daily respectively for this assessment. The same study showed that most respondents (86.5%) reported frequently-always screening patients daily for readiness for weaning, with corresponding figures of 29.5% and 12.1% for twice daily and more than twice daily screening, respectively.

A recent meta-analysis suggested that T-piece SBTs are the optimal method for evaluating weaning readiness.[12] Nevertheless, another meta-analysis found that PSV resulted in higher rates of successful extubation than T-piece SBTs.[13] Moreover, the latest American Thoracic Society guidelines for weaning recommend PSV SBTs with moderate-quality evidence.[14]and this support our study findings. Thus, further investigation is needed to determine the best approach for SBTs.

One study done by Hernándezet al[15]claimed that among high-risk adults who have undergone extubation, high-flow conditioned oxygen therapy was not inferior to NIV for preventing reintubation and postextubation respiratory failure. High-flow conditioned oxygen therapy may offer advantages for these patients.

Despite multiple randomized controlled trials (RCTs) and systematic reviews addressing strategies for this more prolonged and gradual wean, no consensus exists regarding the optimal ventilatory mode to use for weaning[16–20].

According to our parent study[10] 98.7% of respondents considered consciousness and cooperation, 98.7% cough strength, 90.1% suction frequency, 82.3% gag reflex and 75.2% cuff leak as criteria for extubation. When considering consciousness 67.5% of all respondents selected "calm, awakens easily, follows commands" as the most common criterion used to assess readiness for extubation. Most (64.6%) felt the patient's cough strength should be moderate at least. A small majority of respondents (56.3%) routinely stop feeds before extubation. Amongst these respondents, the median (IQR) duration of fasting prior to extubation was 4 (2-6) hours.

In our study we found all of the respondents considered consciousness and cooperation, 87.5% gag reflex, 82.5% cough strength and 80% considered both suction frequency and cuff leak as criteria for extubation. When considering consciousness, 72.5% of them selected "calm, awakens easily, follows commands" as the criterion for extubation. Most (65%) felt the patient's cough strength should be moderate at least. Majority of the respondents (95%) routinely stop feeds before extubation. Amongst these, the median (IQR) duration of fasting was 4 (2-6) hours.

Several studies have suggested that prophylactic non-invasive ventilation (NIV) could help to prevent post-extubation respiratory failure in patients at high-risk for extubation failure [21-24].

According to Brochard et al[25]in chronic obstructive pulmonary diseases (COPD), the use of NIV significantly reduced the need for endotracheal intubation (which was dictated by objective criteria): 11 of 43 patients (26 percent) in the noninvasive-ventilation group were intubated, as

compared with 31 of 42 (74 percent) in the standard-treatment group (P<0.001).

In our study it has been shown that to allow early extubation, 20% of the respondents never practice NIV as a weaning strategy that aims at reducing the duration of invasive ventilation, 15% never use prophylactic NIV immediately following extubation in patients at high-risk of extubation failure and 7.5% never use NIV as a rescue treatment for respiratory failure developing after extubation. The conditions in which NIV was most commonly used for these three indications were COPD (25%, 20% and 32.5% respectively), cardiogenic pulmonary oedema (12.5%, 15% and 17.5%), neuromuscular disease (10%, 17.5% and 15%), postoperative (15%, 7.5% and 12.5%) and obesity (15%, 12.5% and 5%). These findings are similar to study of Brochard et al.

Study done by Bekkevold et al[26] showed that of the study ICUs 85% reported using sedation scales, while 39% had sedation guidelines and 55% had weaning protocols. Interestingly, the data indicate that the units which reported using sedation guidelines and ventilator weaning protocols had significantly longer mean ventilator time and mean length of stay.

More use of sedation and pain assessment tools in the Nordic countries than in non-Nordic countries has been reported [27]. Two-thirds of units that reported having sedation guidelines answered they were using them “Often” or “As a rule.” Nurses’ attitudes impact sedation, and addressing attitudes may be necessary to succeed in changing practices [28].

In our study 47.5% of the respondents generally do not follow any sedation protocol or guideline, while 37.5% follow and rest of them are uncertain in this aspect. Besides, 42.5% work in an ICU where a weaning protocol is being followed; among them 25% frequently always follow the protocol or guideline.

In our study majority of respondents supported the need for protocolized weaning but majority admitted of not practicing it (Fig 1, Fig 2). According to Jordan et al[9] usefulness of weaning protocols including protocolized weaning may be dependent on social and cultural environment of IC. In our study we did not ask about the use of high flow nasal oxygen as evidence of its utility in facilitating successful extubation has emerged[29-30]. There were some limitation in our study. Firstly we relied on reported rather than observed behavior of our respondents. This conclusion was also made by our parent study. Secondly, number of respondents as well as number of participating ICUs were small and the study was restricted to city of Dhaka only. As such our study observation was not representative of the whole country.

Our study was self-funded and authors had no conflict of interest.

Conclusion:

Majority of our participating doctors (62.5%) came from private for profit hospital. 19 out of 40 respondents were certified in critical care medicine. In our study SBT was liberally used along with 30% respondents using pressure support. Most of the extubation trial took place during day. As criteria for extubation respondents mainly considered consciousness and cooperation and along with gag reflex, cough strength, suction frequency and cuff leak at different times. NIV was commonly used for early extubation in cases of COPD, cardiogenic pulmonary edema, neuromuscular disorders, post-operative cases and obesity.Slightly less than half of respondents did not follow any sedation protocol and 42.5% followed weaning protocol. Protocolized weaning by nurses or respiratory therapists are not practiced in Bangladesh.

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