Protocol for Ventilator Care

Government of Nepal
Ministry of Health & Population
Department of Health Service
Teku, Kathmandu

Government of Nepal
Ministry of Health and Population
Division of Health Services
Nursing and Social Security Division
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About the Protocol

This protocol is aimed at providing the step-by-step approach in the care of mechanical ventilator patients in ICU. The medical officers and nursing staffs working in ICU will be benefited with the protocol.

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Abbreviations

ABG	Arterial Blood Gas
ARDS	Acute respiratory distress syndrome
AVPU	Alert, verbal, pain, unresponsive
BMV	Bag mask ventilation
BLS	Basic Life Support
BVV	Bag valve ventilation
Spvo2	Central venous oxygen saturation
CSV	Continuous spontaneous ventilations
CMV	Continuous Mandatory ventilation
CMV	Control mechanical ventilation
CNS	Centre nervous system
ETT	Endotracheal tube
ET	Endotracheal
$ETCo_2$	End- tidal Carbon dioxide
GCS	Glasgow coma scale
ICU	Intensive care unit
ICP	Intracranial pressure
Pao_2	Partial pressure of oxygen
Spo_2	Peripheral capillary oxygen saturation
$PaCo_2$	Partial pressure of carbon dioxide
PEEP	Positive end expiratory ventilation
Po_2	partial pressure of oxygen
Co_2	partial pressure of carbon dioxide
RASS	Richmond agitation sedation scale
SAT	Spontaneous awakening trial
SAS	Sedation agitation scale
Sao_2	Oxygen saturation
O_2	Oxygen
OGT	Oro-gastric tube
NIPP	Non Invasive positive pressure ventilation
NPO	Nil Per Oral

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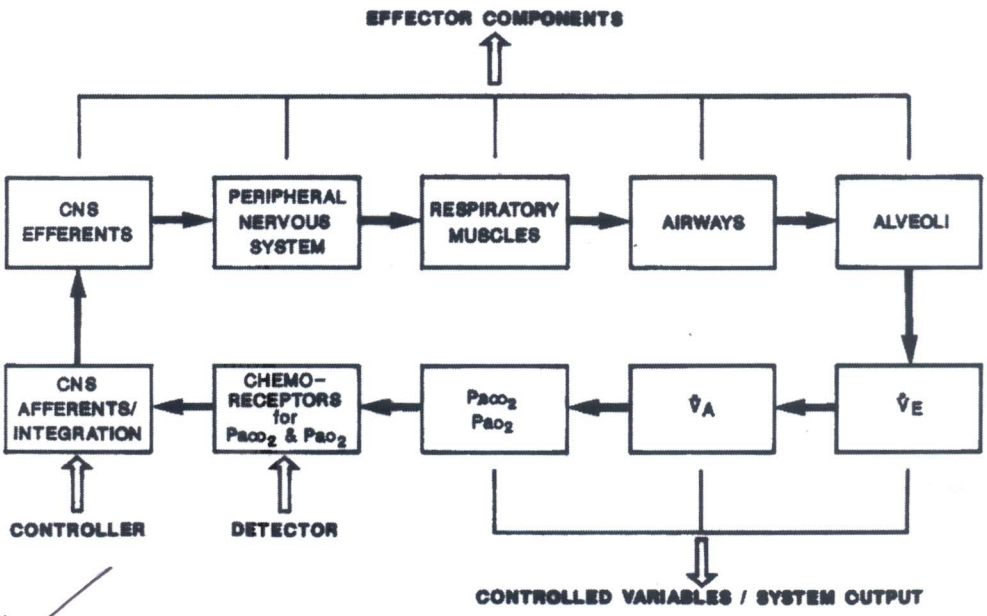
Fundamental of Mechanical Ventilation

Respiratory Physiology

The respiratory system can be regarded as having four functional and structural components:

1. The central nervous system (CNS) component (chemoreceptors, the controller [respiratory center in the medulla], and CNS afferents)
2. The chest belows component (composed of the peripheral nervous system, respiratory muscles, and the chest wall and soft tissues surrounding the lung)
3. The airway component
4. The alveolar component. (Together they form the effector arm of the respiratory system's feedback and control loop.)



Flow Chart No. 1 : Components of the Respiratory System

When all four components function correctly, their sequential actions result in normal pulmonary gas exchange:

1. The CNS controller initiates respiratory drive by generating neural output. The rate and intensity of its output are determined by the feedback provided by peripheral chemoreceptors (monitoring PaO2 and PaCO2) and central chemoreceptors (monitoring PaCO2 or its effects) and by input from other neural sources.
2. The neural impulses from the CNS controller traverse the spinal cord and the phrenic and other motor neurons and reach the diaphragm and other respiratory muscles.
3. In response, these muscles expand the chest cavity, displace adjacent abdominal contents, and produce negative (sub atmospheric) pleural pressure within the thorax.
4. This negative pressure is transmitted to the alveoli, creating a gradient between the alveoli and atmospheric pressure at the mouth. In response, air flows through the conducting airways to the alveoli, leading to lung inflation.

5. Finally, alveolar O2 passively diffuses across the alveolar-capillary membrane so that red blood cells become fully equilibrated with alveolar PO2 as they pass through alveolar capillaries. The same process, but in the reverse direction, occurs for CO2.

A. Introduction to Mechanical Ventilation

Mechanical ventilation is a life-saving treatment to support patients when they are unable to ventilate and oxygenate on their own. The skills required by health teams, in particular of nurses to manage a ventilation unit are typically standardized to ensure safe handling of ventilation equipment and for proper management of patients during their course of care. Mechanical ventilation uses endotracheal intubation and a ventilator to replace spontaneous respiration and ventilation. The ventilator provides the functions of the respiratory muscles; the endotracheal tube establishes a patent and unobstructed airway; and, the exogenous oxygen source gives a patient a therapeutic concentration of the gas.

B. Model of Basic Elements of a Volume-Cycled Ventilator

The ventilator delivers a preset tidal volume (symbolized by the piston and cylinder) via the inspiratory tubing and humidifier to the patient. The exhalation valve is closed by positive pressure during inspiration. At the start of exhalation, the valve opens and the expired gas exits the circuit via the expiratory tubing (normally the exhaled gas reenters the ventilator to monitor its volume). The pressure gauge on the console reflects pressure proximal to the inspiratory tubing.

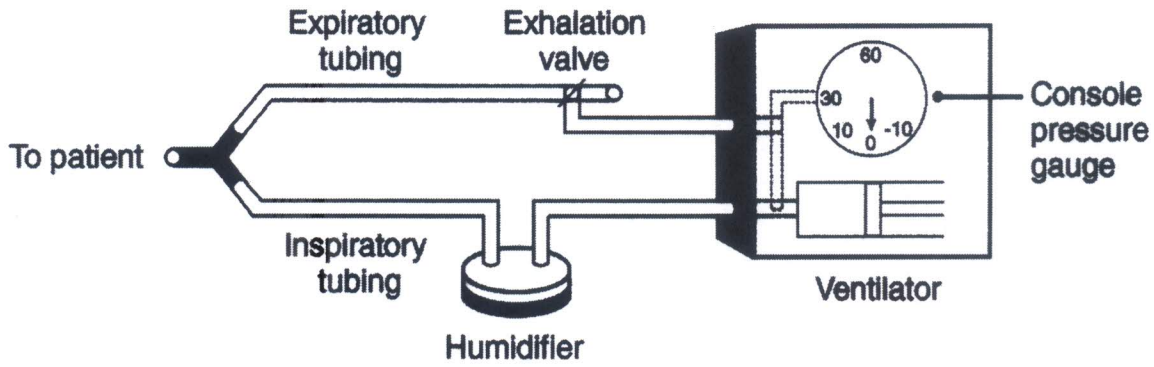


Figure No. 1 : Elements of Mechanical Ventilator

i Ventilator Classification System

Classification of ventilator based on the following parameter

a. Control variable
   - Pressure
   - Volume

b. Breath sequence
   - Continuous mandatory ventilation (CMV): actual rate may be greater than the set rate with the patient-triggered breaths; backup rate is the minimum value in case of apnea.
   - Intermittent mandatory ventilation (IMV): spontaneous breaths allowed between mandatory breaths; backup rate is the minimum value if apnea occurs.
   - Continuous spontaneous ventilation (CSV): all breaths are patient-triggered.

   There are a wide variety of mechanical ventilation modes and it is beyond the scope of this module to review them all. Commonly used modes of mechanical ventilation are outlined in the section below.
   - **Controlled Mechanical Ventilation**: Respiratory rate and tidal volume are adjusted to deliver a specific minute ventilation. A patient cannot trigger the ventilator to deliver a

breath. Ventilator-delivered breaths end when a set volume of air has been delivered or when a specific duration of inspiration is reached. Controlled mechanical ventilation (CMV) is used for patients who are pharmacologically paralyzed or comatose.

- **Assist-Control:** Respiratory rate and tidal volume are adjusted to deliver a specific minute ventilation. The patient's spontaneous inspiratory efforts can initiate (trigger) the ventilator to deliver breaths that have the same tidal volume as the breaths delivered by the ventilator. Ventilator-delivered and patient-initiated breaths are ended when a set volume of air has been delivered or when a specific duration of inspiration is reached. Assist-control (AC) is used for patients who are in acute respiratory failure.
- **Synchronized Intermittent Mandatory Ventilation:** Respiratory rate and tidal volume are adjusted to deliver a specific minute ventilation. A patient can breathe spontaneously between the ventilator-delivered breaths, but with synchronized intermittent mandatory ventilation (SIMV) the ventilator is adjusted so that spontaneous breathing and ventilator breaths do not interfere with one another
- **Pressure support ventilation (PSV):** The clinician sets only the inspiratory pressure above PEEP in a spontaneously breathing patient. Whenever the patient triggers a breath, the ventilator delivers this pressure. When a threshold decrease in inspiratory flow is reached, the inspiratory boost is terminated.

ii Objectives of Mechanical Ventilation

a. To overcome the mechanical problem
   - Rest/unloading of the fatigued/overloaded inspiratory muscles
   - Prevention or treatment of the lung atelectasis
   - An adjunct to anesthetic or neuromuscular blockade
   - Treatment for flail chest

b. To regulate gas exchange
   - Reverse hypoxemia in patients with respiratory failure
   - Keep PaCO2 lower than normal in patients with raised intracranial pressure
   - Normalize the PaCO2 in patients with muscle fatigue or neuromuscular disease

c. To increase the lung volume

iii Definition of lung mechanics parameters:

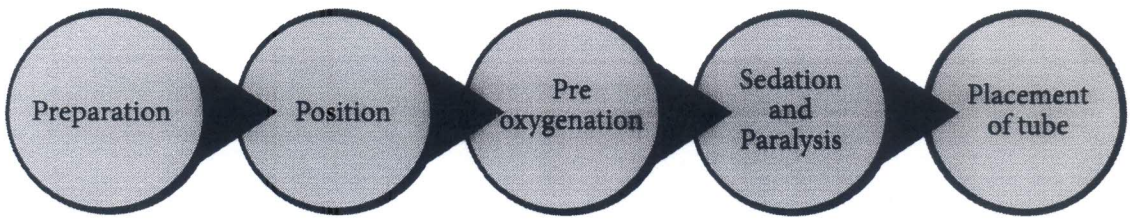
1. **Respiratory rate**: The number of breaths provided by the ventilator each minute. The abbreviation for the frequency of respiratory rate is f.
2. **FiO2:** Fractionated inspired oxygen, the percentage of oxygen delivered by a ventilator in each breath.
3. **Tidal volume (TV or V_T)**: The volume of air inhaled with each breath, expressed in milliliters
4. **Peak inspiratory pressure (PIP)**: The pressure needed to provide each breath. Target PIP is below 30 cm H_2O. High PIP may indicate a kinked tube, a need for suctioning, bronchospasm, or a lung problem, such as pulmonary edema or pneumothorax.
5. **Positive end-expiratory pressure (PEEP):** The pressure in the alveoli at the end of expiration. Compliance: Represents the ease of inflation and lung expansion
6. **CPAP:** Continuous positive airway pressure is a spontaneous breathing mode on the ventilator that is similar to PEEP
7. **BiPAP:** Bi-Level Positive Airway Pressure, commonly known as BiPAP uses noninvasive ventilation support that combines positive support ventilation (PSV) and positive end expiratory pressure (PEEP).

Endotracheal Intubation

Endotracheal intubation is used when there is

1. **Inability to maintain airway patency**
2. **Inability to protect the airway against aspiration**
3. **Failure to ventilate**
4. **Failure to oxygenate**
5. **Anticipation of a deteriorating course that will eventually lead to respiratory failure**

S.N.	Areas to assess	Points for assessment	Yes	No
1	Indications for Intubation	Definitive indications for intubation		
2	Patient preparation	IV access		
		Patient Position		
		Airway Assessment		
		Preoxygenation		
		Hemodynamic stability		
3	Equipment preparation	Equipment ready		
		Monitor attached (ECG, SpO2, BP)		
		Drugs ready		
4	Team Preparation	Roles allocated		
5	Preparation of difficulty	Plan A, Plan B		



Flow Chart No. 2 : Steps of Intubation (5Ps)

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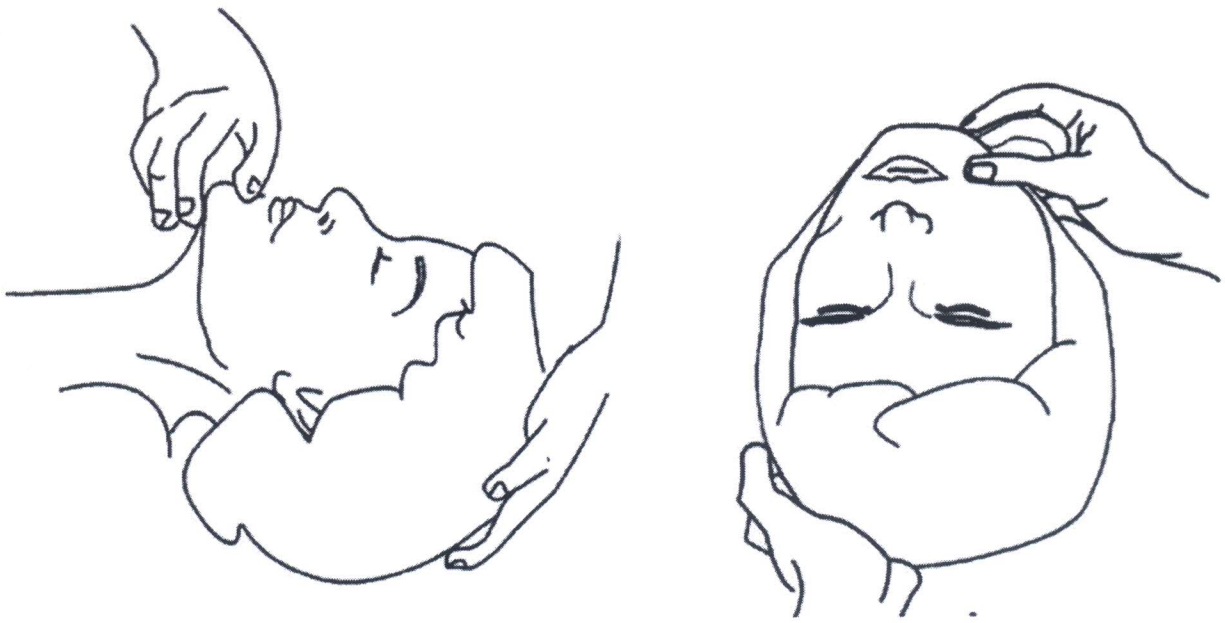

Figure No. 2 : Positioning of Head

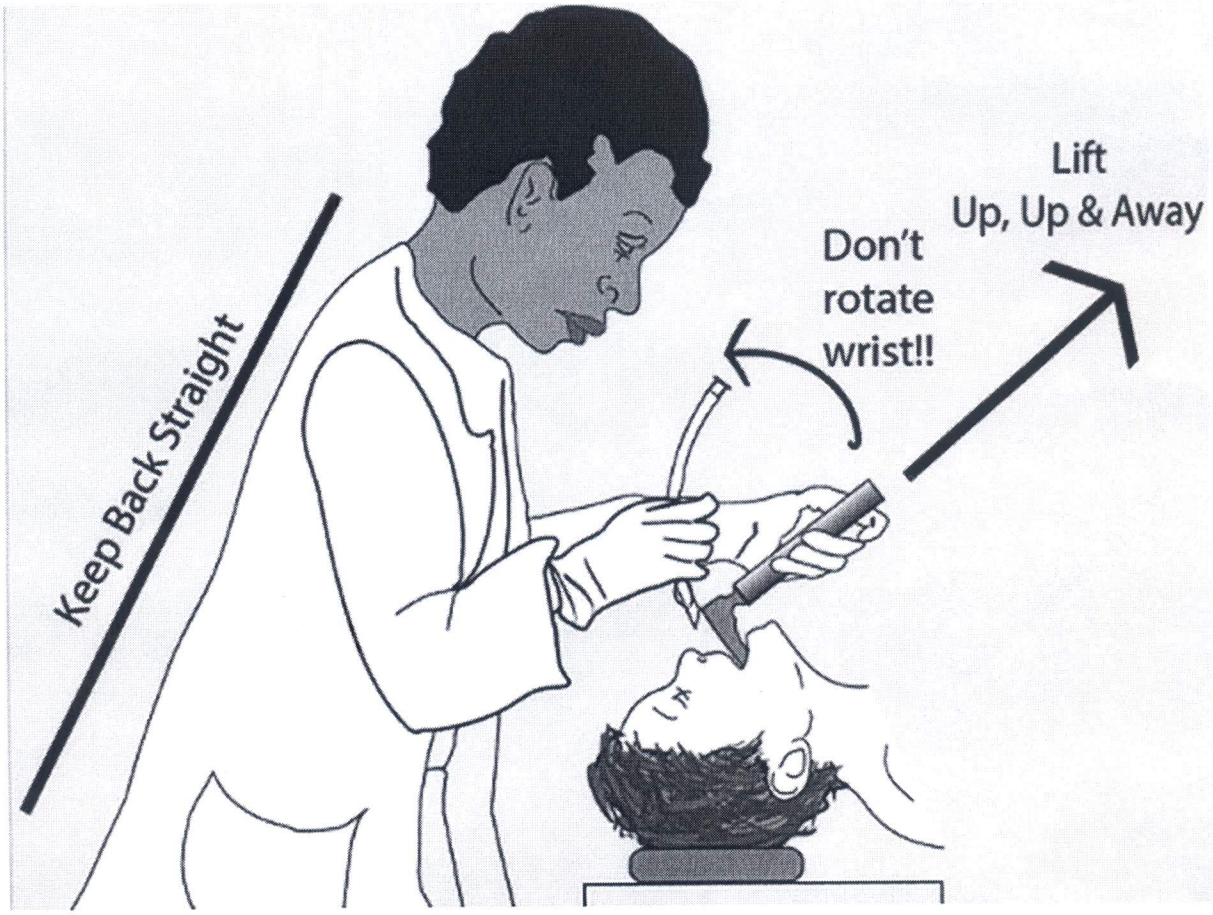

Figure No. 3 : Placement of Tube

A. Indications

1. Inability to maintain the airway patency
   a. Respiratory burns
   b. Anaphylaxis
   c. Facial or neck trauma
2. Inability to protect the airway against aspiration
   a. Decrease consciousness e.g. drug overdose, coma, head injury
3. Failure to ventilate
   a. Status asthmaticus, severe COPD
4. Failure to oxygenate
   a. Diffuse pulmonary edema
   b. ARDS
   c. Large Pneumonia
   d. Pulmonary embolism
   e. Cyanide or carbonmonoxide toxicity, methemoblobinemia
5. Anticipation of a deteriorating course that will eventually lead to respiratory failure
   a. Trauma patient with life threatening injuries
   b. Stab wound to neck with expanding hematoma
   c. Septic shock with multi-organ failure
   d. Intracranical haemorrage with altered mental status

B. Patient preparation

1. Secure reliable IV/IO access
2. Optimize patient position – head up, lower cervical spine is flexed and upper cervical spine is extended (sniffing position)
3. Airway assessment – Quick assessment of airway should be done to find out risk of difficult intubation that includes mouth opening, flexion/ extension of neck, loose teeth, prosthesis
4. Preoxygenation – Preoxygenate with 10-15 liters per minutes of oxygen with tight fitting mask for about 3 minutes to prevent possible hypoxemia during the process of intubation
5. Hemodynamics – hemodynamics should be optimize with fluids or ionotropes or vasopressors to prevent possibility of hemodynamic collapse during intubation

C. Equipment preparation

1. Monitoring – Standard monitoring should include pulse oxymetry, capnography, blood pressure, heart rate, ECG
2. Check equipments – Equipment required includes mask of different sizes, Bag and mask device, endotracheal tubes of different sizes, Laryngoscopes blade of different sizes, laryngoscope handle with battery, inflating syringes, suction device, fixing tape, stethoscope
3. Check drugs – At least one drugs from each groups should be available. A.Opioids: fentanyl, morphine. B. sedatives/hypnotics: midazolam, propofol, ketamine, sodium thiopentone C. Paralyzing agents: Vecuronium, Atracurium, Succinylcholine

D. Team preparation

1. Composition of team and roles of individual members of the team should be specified.
2. Team should include one team leader, intubator, intubator assistant, person for drugs and monitoring.
3. Team leader is responsible for introducing the team members and their roles.
4. In case of difficult situation, team leader should know to whom to ask for help and the person to communicate for help.

E. Preparation for difficulty

1. The team should have primary plan and plan for failure
2. Failure of intubation after a maximum of three attempts should be declared as failed intubation and should immediately move to plan B

F. Steps for tracheal Intubation

1. Check the equipment (laryngoscope, blades of an appropriate size for the patient, assure that the light works, check ETT cuff for leaks)
2. Assemble all materials close at hand (laryngoscope, ET tube sizes, 10mL syringe, securing device, BVM, suction equipment, stethoscope)
3. Position of the patient: Unless contraindicated (e.g. trauma) elevate the head of the about 10cm with pads under the occiput and extension of the head into the sniffing position
4. Preoxygenate the patient with 100% oxygen for 3 minutes
   a) Open the patient's mouth with the right hand (remove any dentures)
   b) Grasp the laryngoscope with left hand
   c) Insert the blade between the teeth (be careful not to break a tooth)
   d) Pass the blade to the right of the tongue and advance the blade into the hypopharynx, pushing the tongue to the left
   e) Lift the laryngoscope upward and forward, without changing the angle of the blade, to expose the vocal cords
   f) Ask for gentle downward cricoid pressure to lower the trachea to facilitate tube passage and to compress the epiglottis and prevent aspiration
   g) Pass the tube through the vocal cords
   h) Withdraw the stylet if used
5. Connect the bag-valve mask and begin ventilation with 100% oxygen.

G. Confirmation of tube placement

1. Direct visualization of the tube passing through the cords
2. Misting of the tube with respirations (not always reliable)
3. Movement of the chest with respirations
4. Auscultation (5 points auscultation, anterior chest and axillary region of each sides and epigastric region)
5. Wave form capnography
6. Rising or stable O2 saturation
7. Clinical improvement of the patient

H. Commonly used drugs

1. Opioids
   a. Fentanyl – 1-2mcg/kg
   b. Morphine – 0.1mg/kg
2. Sedation and hypnotics
   a. Midazolam – 0.1-0.3mg/kg
   b. Propofol – 1-2mg/kg
   c. Ketamine – 1-2mg/kg
   d. Sodium thiopentone – 4-6mg/kg
3. Paralyzing agents
   a. Vecuronium – 0.15-0.25mg/kg
   b. Atracurium – 0.4-0.5mg/kg
   c. Rocurium - 0.6-1.2mg/kg
   d. Scuccinylcholine – 1-2mg/kg

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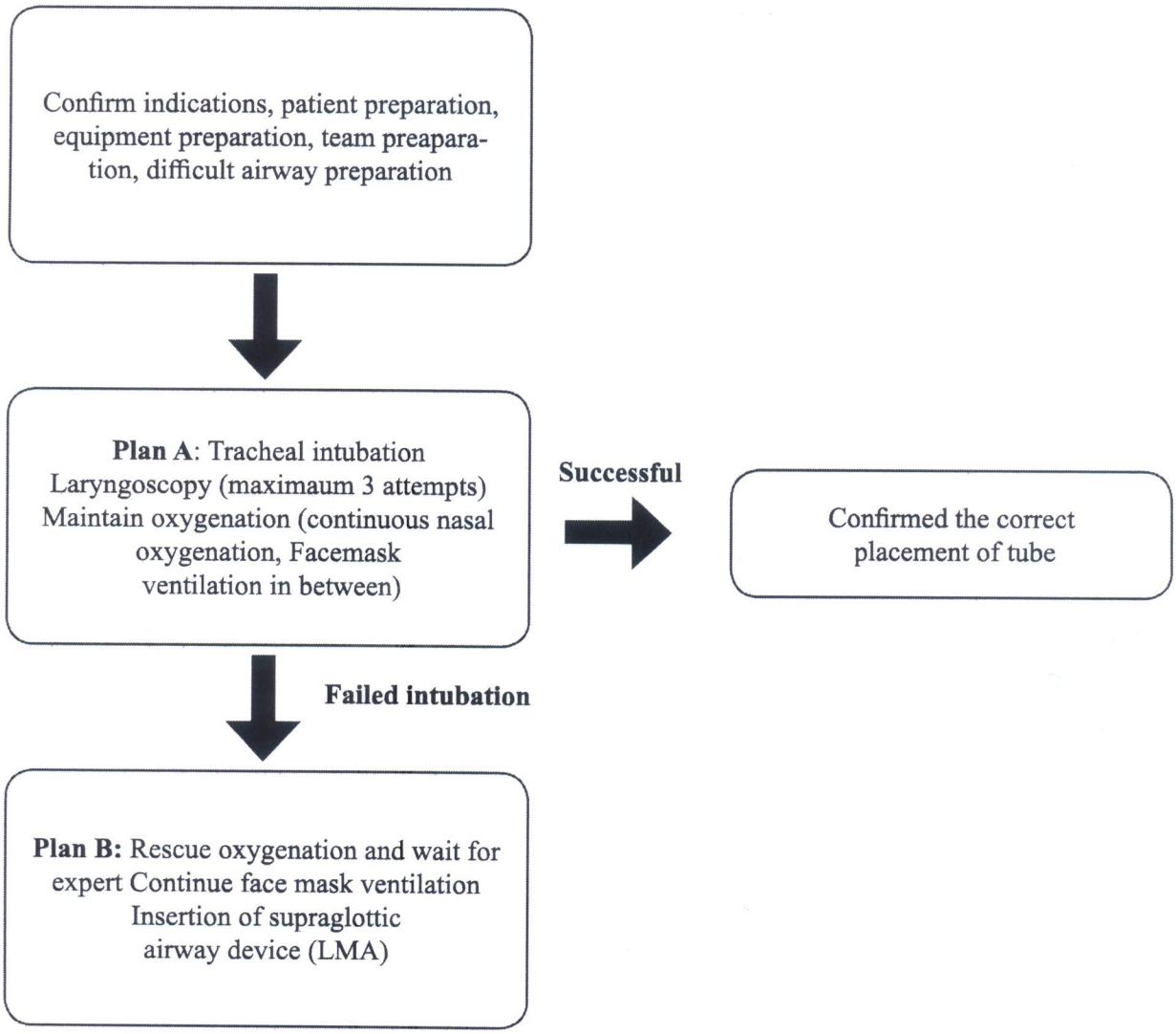
I. Initial ventilator setting

1. Mode: Assist control
2. Tidal volume: 6-10ml/kg
3. Respiratory rate: 10-14breaths/min
4. FiO_2: 100%
5. PEEP/PS: 5/5 cmH_2O

Procedure for Endotracheal intubation



Flow Chart No. 3 : Endotracheal Intubation

Daily Care of Patient on Ventilator

A. **Endotracheal tube care**
Observe and document
   a. Size of ET tube:
   b. Position of ET tube:
   c. Date of ET tube insertion:
   d. Cuff pressure: (Desired Pressure - 20-30cm of water)
   e. Patency of ET tube

B. Pulmonary assessment

S.N	ASSESSMENT	Yes	No
1.	**INSPECTION** i Bilateral rise of chest		
2.	**AUSCULTATION** i. Bilateral equal air entry ii. Crackles iii. Wheezes iv. Ronchi v. Stridor vi. Pleural rub		

Check and confirm

S.N	TESTS	Yes	No
1.	$ETCO_2$		
2.	Arterial blood gas		
3.	Laboratory tests		
4.	Chest x-ray		

C. Ventilator settings and alarm
   a. Check the ventilator settings:
- Mode:
- Tidal volume (VT),:
- Respiratory rate:
- Fraction of inspired oxygen (FiO2) :
- PEEP:
- Pressure support:
- Peak inspiratory pressure (PIP),
- Inspiratory and expiratory ratio(I:E ratio)

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a. **Check the alarm settings**

- Set the alarm limits
- Never keep alarm system muted
- Never ignore the alarm.

D. Moisture and Humidification

It is important to heat and humidify the air delivered from a ventilator. Dry, cold air can damage the delicate tissues of the airways and cause mucus plugs. Heat and humid ity can be delivered in 2 different ways:

- **HME: (heat moisture exchangers):** Small filter type device placed in the vent circuit that captures the heat and moister exhaled from the patient's own breath. It stores it in the filter and then returns it to the patient with the next inhaled breath.
- **Heated Humidifier:** An external heated humidifier that attaches to the ventilator. The humidifier temperature should be similar to body temperature 98.6°F or 37°C. Condensation can collect in the tubing and should be removed by draining the water.

E. Tracheobronchial Hygiene:

- Ascultate and assess
- View the chest X-ray
- Determine the need for suctioning
- Suction as per need

Types of suctioning

Closed System Suctioning

The patient remains attached to the ventilator, or their supplemental breathing device, and a reusable inline (enclosed) catheter is used for ET suction during closed endotracheal suctioning.

- Remaining connected to the ventilator helps prevent both the loss of positive end expiratory pressure (PEEP) and the loss of lung volume.
- The use of Closed System Suctioning may prevent hypoxia and decreases in lung volume for both pediatric and adult patients
- Using Closed System Suctioning also has the potential for lessening the spread of infection to patients and

Open Endotracheal Suctioning

The patient is temporarily removed from the ventilator to breathe freely, or manually ventilated during open endotracheal suctioning.

Types of ET Suctioning

There are two methods of estimating depth of catheter insertion.

i Deep ET suction; the catheter is inserted until it is beyond the tip of the ETT. Deep suctioning is usually needed when there are large amounts of secretions in the lower airways. The drawback with deep ET suction is that there is some degree of mucosal injury and the potential for bleeding, as well as the possibility of vagal stimulation and bradycardia.

ii Shallow technique, which is also considered minimally invasive. With shallow ET Suction, the catheter is inserted only to the tip of the ETT, thereby avoiding injury to the airway.

Premeasured suctioning requires that the approximate depth to the tip of the ET Tube be estimated by using a suction catheter that has graduated centimeter markings. The centimeter marking of the ET Tube at the lip is then noted before the suction catheter is inserted to the same distance that exists from the lip to the tip of the ETTube. There is also no cough stimulated with shallow ET Suction, which means that the maneuver will only clear secretions from within the lumen of the ET Tube.

Technique of ET suctioning

1. Hyperoxygenation (100% OXYGEN FOR 2 MINUTES) before and after suctioning.
2. Maintain aseptic techniques while suctioning.
3. Monitor the cardiac monitor, pulse oximeter during and soon after suctioning
4. Don't instill normal saline solution into the endotracheal tube in an attempt to promote secretion removal.
5. Limit suctioning pressure to the lowest level needed to remove secretions i.e. 70-150 mm of Hg except when there are thick secretions, where up to 200 mm Hg is used with the appropriate suction catheter size
6. Suction for the shortest duration possible i.e. less than 10 secs
7. Carry out effective chest physiotherapy

Nebulization: Nebulize as per need and order

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Checklist for Suctioning

Name of patient:
Age/ sex :
Diagnosis:

SN	PROCEDURES	YES	NO
1	Identify indications for suctioning.		
2	Hand hygiene		
3	Explain procedure to patient		
4	Assemble necessary equipment:		
	a. Ambu bag and mask		
	b. Suction device with connecting tubing		
	c. Sterile suction catheter or in-line suction catheter.		
	d. Normal saline for clearing tubing.		
	e. Sterile or clean gloves, mask and goggles or face shield		
	f. Yankauer suction-tip catheter		
	g. Check for emergency drugs maily • Adrenaline • Atropine • Calcium • Sodabicarbonate • Xylocard		
	h. Check for ET tubes of different sizes, lagyngscope and other emergency equipments.ie stylets, gloves of different sizes, airways etc		
5	Prepare for suctioning:		
	a. Wear personal protective equipment.		
	b. Prepare catheter for suctioning (attaches to connecting tubing; check the susction and to make sure at 70-150 mm Hg). and its functioning status		
	c. Hyperoxygenate(100% for 2 minutes) before and after suctioning using ventilator 100% O_2 setting or ambu bag.		
6	Stabilize ET/Tracheal tube while inserting catheter into ETtube without application of suction during inspiratory phase.		
7	Apply intermittent suction while rotating catheter for open suctioning		
8	Apply continuous suction and pulls straight back for closed suction during expiratory phase.		
9	Limit suctioning pressure to the lowest level needed to remove secretions ie 70-150 mm of Hg		
10	Time not to exceed 10seconds.		
11	Resume oxygen delivery system.		

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F. Nutrition:

- Auscultate bowel movements
- All ventilated patients must receive an Orogastric tube. (Relieves gastric distension and prevents aspiration). Nasogastric tube should be used only when orogastric tube is contraindicated.
- Use 14 FG tube for adult patient.
- Enteral nutrition to support the patient's metabolic needs and defend against infection.
- Start early feeding i.e. 24 - 72 hrs. of ICU admission

Orogastric Tube- Checking the Position

1. Prior to accessing a OGT for any reason the location of tube should be ensured Coughing, vomiting and movement can move the tube out of the correct position. The position of the tube must be checked:
   - Prior to each feed
   - Before each medication
   - Before putting anything down the tube
   - If the patient has vomited
2. The following observations should be done and obtain a gastric aspirate to establish tube position.
   - Ensure taping is secure
   - Observe and document the position marker on OGT – compare to initial measurements.
   - Observe patient for any signs of respiratory distress
3. The correct position of the tube should be confirmed by Injecting 10-20 ml of air down the tube and auscultating the epigastric area.
4. All the patients receiving feedings must be placed in the semi recumbent position withhe head of bed elevated to al teast 45 degrees.
5. Enteral feeding for patient who has undergone recent abdominal and bowel surgeries may require prior discussion with surgeon before commencement of feed.

Total calorie requirement: 25-30Kcal/kg/day

- Start with 50% of required Calorie
- Built up to 80% of the target Calorie over 72 hours

Total Protein Requirement : 1.5 - 2 g/kg protein per day

- Add Protein Supplement (PS) Powder in Each Feed to meet the requirements
- When Protein is preferred; 10 gm powder = 7 gm protein

Intermittent Bolus Enteral feeding:

1. Start with 50ml DNS/ clear liquids every 2 hours for 3 times
   - Progress to other Liquid diet / Blended Tube Feed
   - Low Volume Feeding is recommended.
   - 200 ml or Less in Each Feed
   - At Least 10 Feeds
   - Start at 50 ml and increase by 50 ml after every feed till calorie needs are met.
2. Aspirate every 4-6 hourly
   - If Aspirate < 50% of previous feed return aspirate to patient. Increase by 50 ml after every feed till caloric needs are met.
   - If Aspirate >50% of previous feed, (called as - High Gastric Residual Volume); AND/ OR if the patient reflux, the stomach should be emptied, feedings held for 2 hours, and then reduce rate by 50% of initial bolus.

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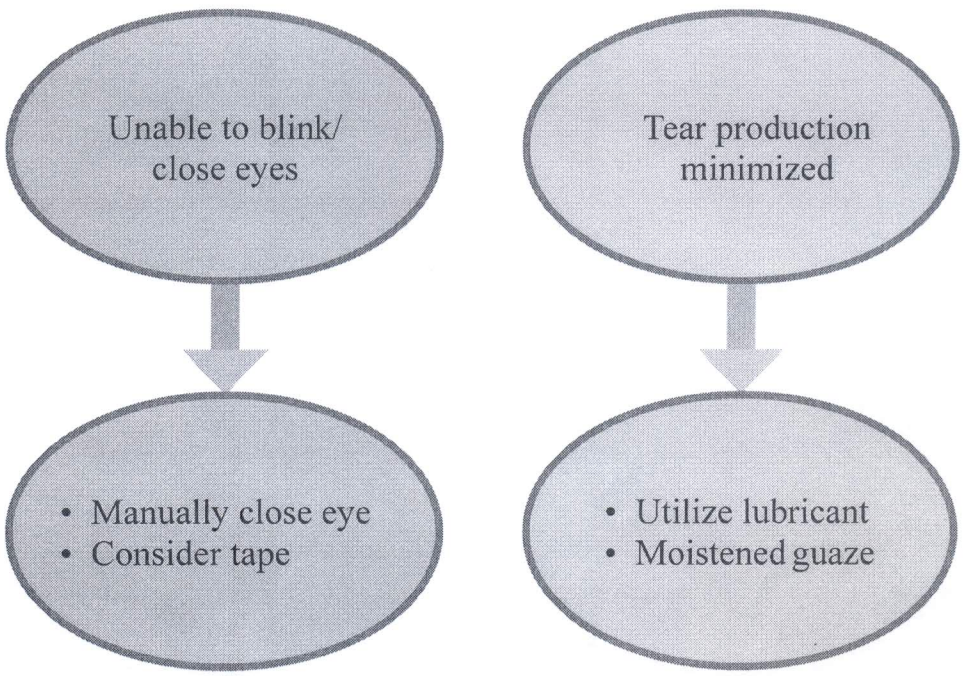
3. Use Naso-jejunal jube for feeding in patients with feeding intolerance, high gastric residual volumes and acute pancreatitis.
4. Use motility agents if required:
5. Motility agents to be used in patients who experience feeding intolerance (high gastric residuals, emesis).
   - IV metoclopramide 10-20 mg 6-8 hourly And / Or
   - PO Erythromycin 125 mg QID or 250 mg QID

G. Hygiene/Eye Care



H. Oral Care

S.N	Procedures	Yes	No	Remarks
1.	Suction the oral cavity as per need.			
2.	Use of 0.2% chlorhexidine mouth wash			
3.	Oral care 6 hourly.			
4.	Brush teeth 2 times per day to remove dental plaque			

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I. Pressure Ulcer Prevention

S.N	Procedures	M	E	N	Remarks
1	BRADEN Risk Assessment (Annex I,)				
2	Skin Assessment and Care				
3	Nutrition Assessment and Care				
4	Repositioning 2 hourly				
5	Air Mattress				
6	Surface Support				
7	Heels elvated by pillows				
8	Medical Device/ Tubes Care				

J. Monitoring for Infection

- Observe closely for fever
- Observe for infection in central line and arterial line
- Observe colour, consistency, and amount of the sputum / secretions with each suctioning.

K. Maintain Patients Safety

- Use soft restrainers whenever necessary.
- Use the side rails
- Secure catheters (Foleys /central venous/ arterial) and tubings with adhesives.
- Assess for delirium.

S.N	Daily Screening for delirium	Remarks
1.	Use of RASS Scale ((See annex II and 4 AT Test (See annex III)	
2.	Sedative Cessation	
3.	Pain Management	
4.	Reorientation	
5.	Sensory Stimulation	
6.	Early Mobilization	
7.	Sleep Promotion	
8.	Family Involvement in care	

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L. Communication

- If conscious, explain the environment, procedures, co-operation expected etc.
- Use verbal & nonverbal methods
- Use written method if necessary
- Reassurance and support the patient during the period of anxiety, frustration and hopelessness
- Document patient's emotional
- response and any signs of psychosis
- Include family in the care

M. Pain Management

- Assess pain level using a reliable scale.
- Visual analog pain scale

Tools to Rate Pain

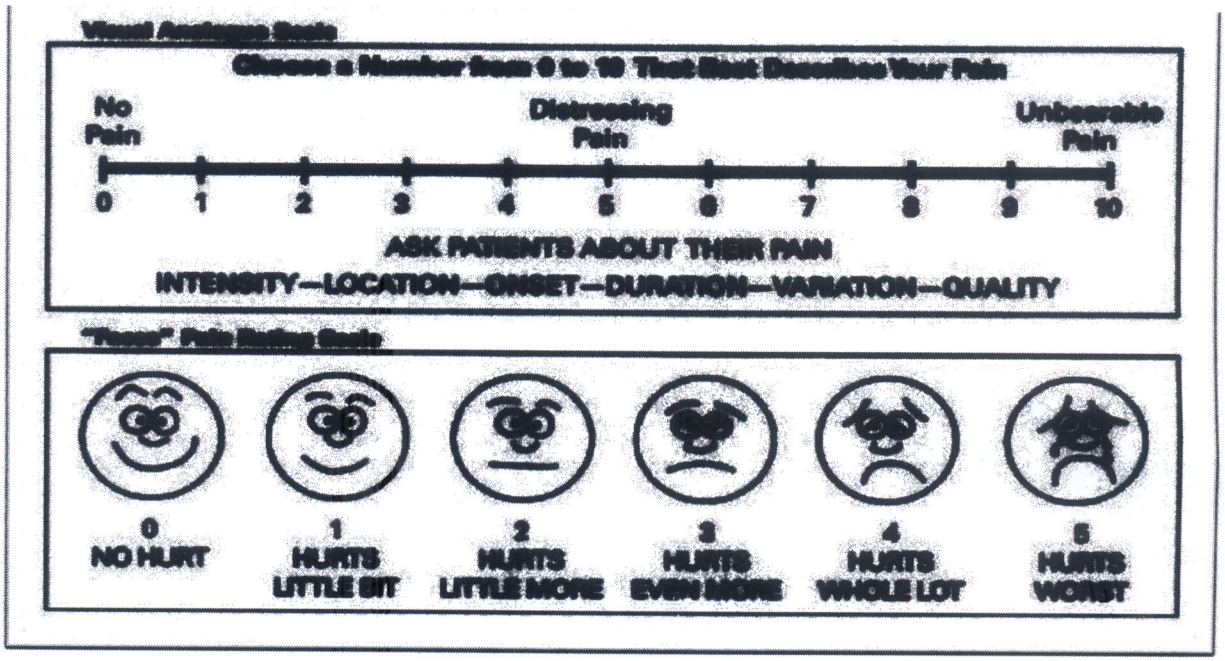

Figure No. 4 : Tools Commonly Used to Rate Pain

Behavioral Pain Scale (BPS)

ITEM	DESCRIPTION	SCORE
FACIAL EXPRESSION	Relaxed	+1
	Partially tightened (e.g., brow lowering)	+2
	Fully tightened (e.g., eyelid closing)	+3
	Grimacing	+4
UPPERLIMB MOVEMENT	No movement	+1
	Partially bent	+2
	Fully bent with finger flexion	+3
	Permanently retracted	+4
COMPLIANCE WITH MECHANICAL VENTILATION	Tolerating movement	+1
	Coughing but tolerating ventilation for most of the time	+2
	Fighting ventilator	+3
	Unable to control ventilation	+4

BPS score ranges from 3 (no pain) to 12 (maximum pain)

N. Bundles for the prevention of central line-associated bloodstream infections (CLABSI)

Insertion Bundle:

- Perform hand hygiene before insertion.
- Adhere to aseptic technique.
- Use maximal sterile barrier precautions (i.e., mask, cap, gown, sterile gloves, and sterile full body drape).
- Choose the best insertion site to minimize infections and noninfectious complications based on individual patient characteristics.
- Avoidance of the femoral vein for central venous access in adult patients; use of subclavian rather than jugular veins.
- Prepare the insertion site with >0.5% chlorhexidine with alcohol.
- Place a sterile dressing a preferably sterile transparent, semi permeable dressing over the insertion site.
- Dedicated staff for central line insertion, and competency training/assessment.
- Standardized insertion packs.
- Availability of insertion guidelines (including indications for central line use) and use of checklists with trained observers.
- Use of ultrasound guidance for insertion of internal jugular lines.

Maintenance Bundle:

- Perform hand hygiene before and after handling central line.
- Daily review of central line necessity.
- Prompt removal of unnecessary lines.

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- Minimal use of tubes / connectors/ 3 way cannulas.
- Disinfection prior to manipulation of the line.
- Disinfect catheter hubs, ports, connectors, etc., before using the catheter.
- Change dressings and disinfect site with alcohol-based chlorhexidine every 5-7 days and change earlier if soiled.(gauze dressing needs to be changed every alternate day)
- Replace administration sets within 96 hours and immediately if used for blood products or lipids.
- Ensure appropriate nurse-to-patient ratio in ICU preferably 1:1.

	CLASBSI BUNDLE	Yes	No	Remarks
INSERTION BUNDLE	Hand hygiene			
	Aseptic technique			
	Use of Maximal sterile barrier protection			
	Checklist			
	Insertion Site selection			
	Preparation of site with >0.5% chlorhexidine with a lcohol			
	Sterile transparent dressing,			
MAINTENANACE BUNDLE	Hand hygiene before handling			
	Use of 2% chlorhexidine for dressing			
	Use of transparent sterile dressings			
	Alcohol hub decontamination before handling			
	Any sign of infection			
	Dressing changed			
	CVC still required			

Refer CDC checklist of CLABSI bundle in annex IV

O. Bundle for the prevention of catheter-associated urinary tract infections (CAUTI)

- Avoiding the use of urinary catheters by considering alternative methods for urine collection.
- Methods include: condom catheters, intermittent catheterization, use of nappies.
- Using an aseptic technique for insertion and proper maintenance after insertion.
- Following evidence-based guidelines and implementing catheter insertion policies at the institution.
- Daily assessment of the presence and need for indwelling urinary catheters.
- Perform a daily review of the need for the urinary catheter.
- Check the catheter has been continuously connected to the drainage system.
- Ensure patients are aware of their role in preventing urinary tract infection.
- Perform routine urinary meatus hygiene.
- Regularly empty urinary drainage bags as separate procedures, each into a clean container.
- Perform hand hygiene and wear gloves and apron prior to each catheter care procedure; on procedure completion, remove gloves and apron and perform hand hygiene again.

S.N	CAUTI BUNDLE		Yes	No	Remarks
1.	Hand hygiene				
2.	Specific indication				
3.	Meatal/perineal care using aseptic technique	6am			
		6pm			
4.	Closed drainage system				
5.	Empty bag when half full into a clean container				
6.	Secure Catheter to thigh				
7.	Drainage bag above Floor and below bladder Level				
8.	Daily review of catheter need				

Give patient A Fast Hug In Each Shift (FAST HUG SBID)

S.N	Procedures	Yes	No	Remarks
1.	**F:** Feeding/fluids			
2.	**A:** Analgesia			
3.	**S:** Sedation holiday			
4.	**T:** Thromboprophylaxis			
5.	**H:** Head up position to 35 to 40 degrees			
6.	**U:** Ulcer prophylaxis			
7.	**G:** Glycemic control			
8.	**S:** Spontaneous breathing trial			
9.	**B:** Bowel care			
10.	**I:** Indwelling catheter removal			
11.	**D:** Deescalation of antibiotic			

P. Bundles of Care and Bundle of interventions for the prevention of Ventilator Associated Pneumonia (VAP)

- Elevation of head of bed (30°–45°).
- Oral care with Chlorhexidine 4-6 hrly.
- Continuous subglottic secretion drainage (desired suction pressure-20 mm of Hg)
- ET tube Cuff pressure 20-30 cm of H2O
- Closed suction system.
- Peptic ulcer prophylaxis.
- Venous thrombo-embolism prophylaxis.
- Avoidance of scheduled ventilator circuit changes.
- Spontaneous Awakening Trial.
- Spontaneous Breathing Trial.

Assessment and Monitoring of Patients on Mechanical Ventilation

Assessment and monitoring of patients on mechanical ventilation is essential to ensure the goals of mechanical ventilation are achieved. At the same time, potential harms from the use of mechanical ventilation are prevented.

Goals of mechanical ventilation

1. To help the patient in oxygenation.
2. To help the patient in ventilation.
3. Finally to wean and extubate before any complications occur.

Potential complications of mechanical ventilation

1. Pulmonary complication: barotrauma, volutrauma, atelectasis, tracheal damage, oxygenation toxicity, patient-ventilator dysynchrony, Auto-PEEP, inability to wean, hypercapnia, and hypocapnia.
2. Infection: VAP
3. Gastrointestinal: Peptic Ulcer
4. Neurological: agitation, distress, delirium, somnolence
5. Fluid balance: fluid retention, dehydration

Steps of Assessment and Monitoring of Patients on Mechanical Ventilation

A. Assessment of the Respiratory ystem

Patients with respiratory issues should have a thorough exam of their respiratory system.
The healthcare provider should review:

- Inspection of the chest
- Percussion of the chest
- Auscultation of breath sounds
- Analyzing respiratory rate & interpretation of pulse oximetry (instant feedback on oxygenation)
- Interpretation of end-tidal CO2 monitoring
- Interpretation of ABG

B. Assessment of airway/interface

1. Patient with noninvasive face masks
   - Check for the conscious level and ability to communicate
   - Check for the tolerance by the patient
   - Check for the proper fitting of the face mask (no or minimal leak)
   - Check for the proper fitting of the harness or strap (avoid too tight or too loose).

2. Patient with endotracheal intubation
   - Check for the Endotracheal tube placement in each shift
   - Mark the length of the ET tube fixed at the patient's lip
   - Check for the radiological marking of the ET tube in the Chest X ray after intubation and after adjustment of the length. The end of the tube should be 2-4 cm above the carina.
   - Check for the proper fixation of the tube

- Move ETT from one side of the mouth to the other side of the mouth at least daily.

3. Check for the endotracheal tube patency
   - Check for the kinking and biting of the tube
   - Check for the visible secretions inside the tube

4. Check the cuff pressure in each shift
   - The cuff pressure is to be maintained at 25 to 30 cm H2O (Higher pressure leads to tracheal ischemia, necrosis and erosion, low pressure leads to air leak).
   - The cuff pressure is to be measured between positive pressure breaths.
   - The cuff leak test has to be done before extubation after prolong intubation to rule out vocal cord edema.

5. Patient with tracheostomy tube
   - Check for the proper position, placement and fixation.
   - Care of the tracheostomy tube and stoma as per standard.
   - Check for the cuff pressure or deflate the cuff if applicable as advised.

C. Assessment of oxygenation

- Clinical assessment: Hypoxemic patients are restless, agitated, cyanotic, confused, somnolent, obtunded
- Monitoring by devices: Pulse oximetry (SpO2)
- Investigation
  ABG (PaO2, PA-a gradient, PaO2/FiO2, SaO2)
  VBG (ScvO2)

D. Assessment of ventilation

- Clinical assessment: Respiratory rate, depth, pattern, use of accessory muscles, sweating, fatigue or pain, anxiety. Hypercarbic patient shows flap tremor, warm periphery, drowsy, unconscious
- Monitoring by devices Capnograph, ETCO2
- Investigation ABG (PaCO2)

Clinical application of ETCO2

- Increases in ETC02,
- Sudden
- Sudden increase in cardiac output
- Sudden release of a tourniquet
- Bicarbonate administration
- Equipment malfunction (rebreathing, exhausted CO2 absorber)
- Gradual
- Hypoventilation
- Decreases in ETCO2
- Sudden
- Sudden hyperventilation
- Cardiac arrest
- Massive pulmonary embolism
- Air embolism
- Disconnection of the ventilator
- Equipment malfunction (endotracheal tube obstruction, circuit leak)

E. Monitoring of Ventilatory Parameters

A set mode and ventilator parameters should be documented and certain ventilator parameters should be measured and monitored as applicable.

Set Parameters:

Depending on the mode chosen one or more parameters are fixed:

1. Parameters which improve oxygenation
   - FiO2
   - PEEP/CPAP/EPAP

2. Parameters which improve ventilation
   - Patient trigger (Flow or Pressure trigger for assisted or supported breath)
   - Time trigger: Respiratory rate (Control breaths in Control mode, Assist Control mode or SIMV mode)
   - Volume limit: Inspired Tidal volume
   - Pressure limit: Inspiratory Pressure above PEEP for control breaths
   - Inspiratory time or Inspiratory Flow or I:E ratio
   - Flow pattern: accelerating, decelerating, constant
   - Pressure support: Inspiratory Pressure above PEEP for supported breaths
   - Expiratory cycle percentage

3. Measured parameters:

   one or more of the parameters are measured and monitored as applicable
   - Respiratory rate: spontaneous rate and total rate
   - Expired tidal volume
   - Expired minute volume
   - Rapid shallow breathing index (f/VT)
   - Peak inspiratory Pressure
   - Plateau inspiratory Pressure (putting inspiratory pause or hold)
   - Inspiratory and expiratory ratio
   - Ineffective trigger or auto trigger
   - Auto PEEP (putting expiratory pause)
   - Resistance
   - Compliance: dynamic, static

F. Monitoring of ventilator alarms

Proper response and knowledge of ventilator alarms is imperative when working with intubated patients. All ventilator alarms should be responded to promptly and patient assessed. Most ventilators have audible alarm and visual alarm of different priority: yellow alarm (low priority) for warning and red alarm (high priority) for immediate action needed.

- When there is an alarm, always treat your patient first and the ventilator second! Look at the patient and assess vital signs.
- Review the ventilator display to review the type of alarm.
- If necessary, ventilate patient with manual resuscitation bag and call a senior nurse or a doctor for assistance.

Types of Alarms

1. High Pressure Limit : High-pressure limit is reached before volume is delivered.

Interventions:

- Assess ETT for kinks, reposition, and use a bite block; check for kinks or condensation in ventilator tubing.
- Assess oxygenation status, vital signs, breath sounds and suction airway as needed.
- Bronchodilators may be ordered to reduce bronchospasm.
- Assess the patient for pain, anxiety and synchrony with the ventilator; provide emotional support; sedative may be required (nursing before narcotics).
- Notify the physician with deterioration in patient status and/or unable to troubleshoot the cause of alarm.

2. Low Inspiratory Pressure : Not developing set pressure to deliver volume from circuit leak, disconnect, or change in compliance and resistance within the system.

Interventions:

- Check for a disconnect.
- Check the ETT for placement and cuff leak.
- Assess the patient for air leakage from the mouth or around the tube.
- Notify the physician with deterioration in patient status and/or unable to troubleshoot the cause of alarm.

3. Low Minute Volume Or Low Tidal Volume : Patient is not exhaling at least 80% of mandatory or normal volume.

Interventions:

- Leak in circuit (Cuff leak, wherever there are connections: Catheter mount, HME filter, Water traps, humidifier, Etc.)
- Disconnection
- High pressure limit reached

Troubleshooting Alarms

i. Apnea

- Ventilator does not sense a breath during set delay period.
- Over sedation, or neurologic changes.
- Cardiopulmonary arrest.
- Assess the need for change in ventilator mode.
- Alarm interval synchrony.
- Rate increase.
- Remove from the vent and AMBU breath for the patient as needed.

ii. High Respiratory Rate

- Respiratory rate higher than set limit.
- Change respiratory rate limits, mode of ventilation, or sedate patient.

iii. Low O2 Inlet Pressure:

- Loss of oxygen pressure.
- Call the maintenance or connect new oxygen cylinder. Monitor patient and bag patient if needed.

Approved.

iv. Low Battery or No AC Power:

- Battery for audible alarms weak.
- Plug in ventilator. If problem does not resolve, call the maintenance or use new ventilator.
- Stay with patient and remove from ventilator and bag, if needed.

v. Heater Alarm:

- Overheated humidifier.
- Exchange water container or adjust settings.

G. Monitoring of ventilator graphs

i. Scalar graphs

- Pressure versus time
- Flow versus time
- Volume versus time

ii. Loops

- Pressure Volume Loop
- Flow Volume Loop

H. Assessment of circulation

- Clinical: Pulse rate, volume, rhythm, capillary perfusion, blood pressure, urine output
- Monitors: Heart rate, noninvasive/invasive blood pressure, ECG, SpO2, CO
- Investigations: ScvO2, Lactate

The details of mechanical ventilation alarms, trouble shoot and its management is given on Annex V

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Awakening Trial of Ventilator Patient

Weaning trial (Extubation, Post extubation care)

Weaning

Weaning from mechanical ventilation is the process of abruptly or gradually withdrawing ventilator support. Weaning from mechanical ventilation usually implies **two** separate but closely related aspects of care.

1. Discontinuation of mechanical ventilation
2. Removal of any artificial airway (ET or TT tube) and removal of O2 therapy.

Process of weaning

Weaning process start from assessing readiness to maintain spontaneous breathing via trial of unassisted breathing. Removal of artificial airway is based on

1. The patient's mental status.
2. Airway protective mechanism.
3. Ability to cough and Character of secretions.

Factors that can lead to weaning failure

1. Factors that increases the load
2. Factors that result in decreased neuromuscular competence

Factors that increases the load

1. Restrictive load eg- bronchospasm, airway edema, secretion, upper airway obstruction, circuit kinking etc.
2. Increased chest wall elastic load eg –pleural effusion, pneumothorax, flail chest, obesity, ascites, abdominal distention etc.
3. Increased lung elastic loads eg- Hyperinflation, alveolar edema, infection, atelectasis, interstitial inflammation and edema.

Factors that result in decreased neuromuscular competence

1. Decreased drive e.g. - Drug overdose, sleep deprivation, hypothyroidism, malnutrition/ starvation, brain stem lesion etc.
2. Muscle weakness e.g. - electrolyte imbalance, malnutrition, myopathy, hyperinflation, drugs steroids, sepsis etc.
3. Impaired neuromuscular transmission e.g.-Critical illness polyneuropathy, neuromuscular blockers, Guillain-Barre syndrome, myasthenia gravis, Phrenic nerve injury, Aminoglycosides

Types of trial used before extubation of tube

1. Spontaneous Awakening Trial (SAT)

The SAT consists of two parts, a safety screen and the trial (Figures 1 and 2). The safety screen checks for contraindications. A patient passes the screen unless the following factors are present. Contraindication of SAT:

1. Receiving a sedative infusion for active seizures or alcohol withdrawal.
2. Receiving escalating doses of sedative for agitation.
3. Receiving neuromuscular blockers.
4. Evidence of active myocardial ischemia in prior 24 hours.
5. Evidence of increased intracranial pressure.

If the patient passes the safety screen, all sedatives and analgesics used for sedation are stopped. Analgesics

used for pain are continued as necessary. The goal is that the patient can do three out of four simple tasks on request: open their eyes, look at their caregiver, squeeze the hand, or put out their tongue[3] or can go without sedation for 4 hours or more without the following:

1. Sustained anxiety, agitation, or pain.
2. Respiratory rate of 35 breaths/minute for at least 5 minutes.
3. Oxygen saturation (SpO_2) of less than 88% for at least 5 minutes.
4. Acute cardiac dysrhythmia.

Signs of respiratory distress (two or more):

- Tachycardia.
- Bradycardia.
- Use of accessory muscles.
- Abdominal paradox.
- Diaphoresis.
- Marked dyspnea.

If a patient fails the SAT, sedatives are started at half the prior dosage and titrated up as needed.

2. Spontaneous Breathing Trial

If a patient passes the SAT, the patient is assessed for the SBT safety screen. A patient fails the safety screen if any of the following conditions are met:

1. Inadequate oxygenation ($SpO_2 < 88\%$ or a F_iO_2 of $\geq 50\%$ and a positive end-expiratory pressure [PEEP] ≥ 8 cm H_2O).
2. No spontaneous inspiratory effort in a 5-minute period (Consideration of the set respiratory rate is recommended).
3. Agitation.

Significant use of vasopressors or inotropes (patients may be on dopamine or dobutamine at ≤ 5 µg/kg/min or norepinephrine ≤ 2 µg/min, but may not be receiving any vasopressin or millrinone)[8]

Evidence of increased intracranial pressure.

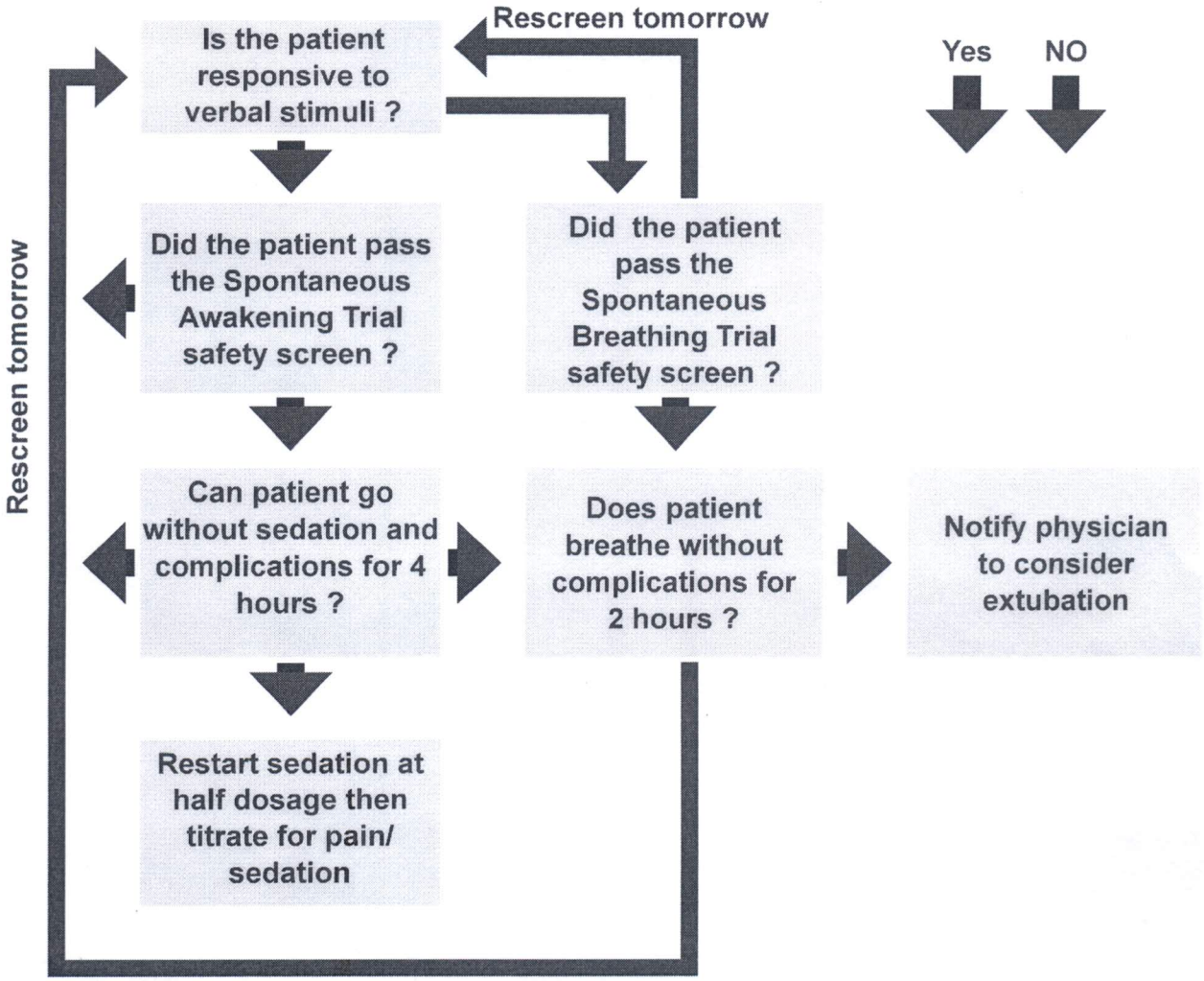
If a patient fails the safety screen, sedatives are started at half the prior dosage and titrated up as necessary. The patient is then reassessed for SAT the following day. If the patient passes the safety screen, he or she undergoes the SBT ventilator support is removed. The patient is allowed to breathe through either a T-tube circuit or a ventilator circuit with continuous positive airway pressure of 5 cm H_2O or pressure support ventilation of less than 7 cm H_2O. A patient passes the trial if he or she avoids developing any of the following failure criteria within 120 minutes:

1. Respiratory rate of either fewer than 8 breaths per minute (bpm) or more than 35 bpm for 5 minutes or longer.
2. Hypoxemia ($SpO_2 < 88\%$ for ≥ 5 minutes).
3. Abrupt change in mental status.
4. Acute cardiac arrhythmia.

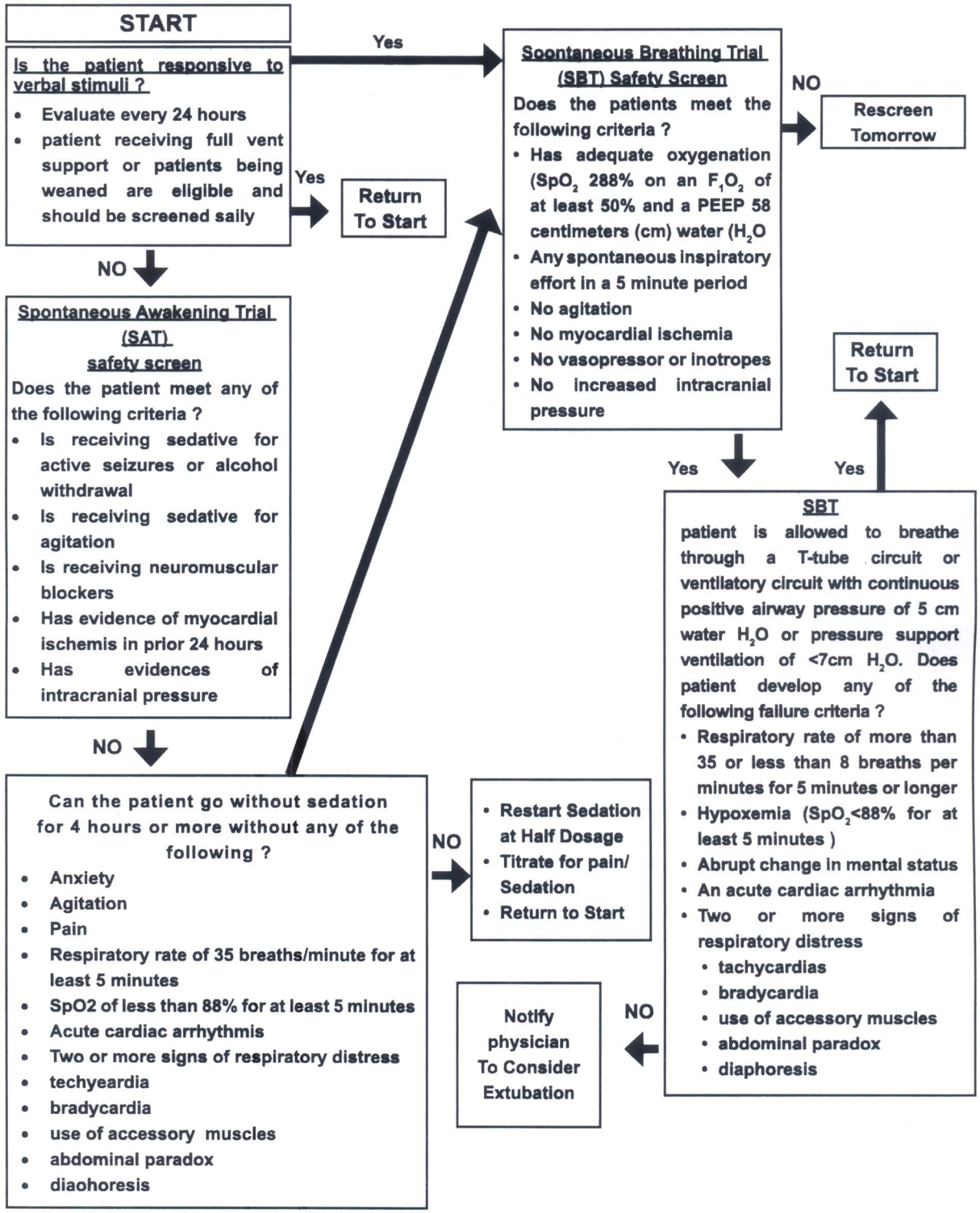
Signs of respiratory distress (two or more):

- Tachycardia.
- Bradycardia.
- Use of accessory muscles.
- Abdominal paradox.
- Diaphoresis.
- Marked dyspnea.

If a patient fails the SBT, he or she is reassessed for SAT and SBT the following day. If a patient passes the SBT, the patient's physicians are notified for possible extubation.



Flow Chart No. 4 : Summary of Coordinated SAT and SBT



Flow Chart No. 5 : Protocol on Coordinated SAT and SBT

Sedation and Analgesia

Sedation is the process of reliving anxiety and establishing a state of calm. This process includes general supportive measures (like frequent communication with patient and families), and drug therapy.

- Sedation is the depression of a patient's awareness to the environment and reduction of his or her responsiveness to external stimulation
- Sedative agents also have varying degrees of associated effects, which may be dose-dependent, such as:

1. Anxiolysis – Relief of apprehension or agitation with minimal alteration of sensorium
2. Amnesia – memory loss for a period of time
3. Analgesia – relief of pain without an altered sensorium
4. Anaesthesia – loss of sensation

- Sedation is commonly used in ICU and sedation protocols are in widespread use and are considered best practice

According to Jacobi et.al (2002), Summerised from clinical practice guidelines:

- Maintaining light levels of sedation in adult ICU patients is associated with improved clinical outcomes
  -shorter duration of mechanical ventilation
  -shorter ICU length of stay
- Maintaining light levels of sedation increases the physiologic stress response, but is not associated with an increased incidence of myocardial ischemia
- The association between depth of sedation and psychological stress in lightly sedated patients is unclear
- The Richmond Agitation-Sedation Scale (RASS) (see Annex II page No.....) and Sedation-Agitation Scale (SAS) are the most valid and reliable sedation assessment tools for measuring quality and depth of sedation in adult ICU patients
- Nonbenzodiazepine sedatives (either propofol or dexmedetomidine) may be preferred over sedation with benzodiazepines (either midazolam or lorazepam) to improve clinical outcomes in mechanically ventilated adult ICU patients

Uses

- allows patients to tolerate painful/distressing procedures (e.g. endotracheal intubation, invasive lines)
- optimize mechanical ventilation (e.g. tolerate permissive hypercapnea)
- used to decrease O2 consumption (e.g. sepsis)
- decrease ICP in neurosurgical patients
- facilitate cooling (e.g. therapeutic hypothermia)
- control agitation

Monitoring

- Richmond Agitation-Sedation Score (RASS) is the most-validated and most widely-used tool to assess depth of sedation (the Sedation-Agitation Scale (SAS) is a reasonable alternative)
- Views sedation and agitation as a continuum
- Not useful in patients receiving neuromuscular blocking agents
- Titrate almost all patients to a RASS score of -2 or higher (no more than light sedation); very ill or agitated patients (e.g., severe ARDS, raised ICP) may "rarely" require RASS -3 or -4

Procedure for RASS Assessment

- Observe patient
  Patient is alert, restless, agitated or combative (score 0 to +4)
- If not alert, state patient's name and say to open eyes and look at speaker

1. Patient awakens with sustained eye opening and eye contact >10 sec. (score –1)
2. Patient awakens with eye opening and eye contact <10sec., but not sustained(score -2)
3. Patient has any movement in response to voice but no eye contact (score –3)

- When no response to verbal stimulation, physically stimulate patient by shaking shoulder and/or rubbing sternum

1. Patient has any movement to physical stimulation (score –4)
2. Patient has no response to any stimulation (score –5)

An Approach to Sedation in ICU

- Sedative medications should be titrated to maintain a light rather than a deep level of sedation in adult ICU patients, unless contraindicated
- Keep patients comfortable and safe using the minimum possible amount of sedation
- Use protocolised care with sedation score monitoring
- Propofol is widely used as it usually allows rapid, predictable recovery
- Daily sedation interruptions may not be necessary in ICUs with protocolised sedation
- Review infusion rates at least daily, and after any procedures
- Treat pain with boluses of analgesics (e.g. IV morphine or fentanyl), only make minor increases in basal infusion rates
- Avoid prolonged deep coma whenever possible
- Use caution in renal and liver failure
- Use spontaneous breathing, unless contra-indicated
- Dexmedetomidine is increasingly preferred in delirious patients requiring ongoing sedation

Delirium Monitoring and Management

- Every patient admitted to an adult ICU will undergo routine sedation and delirium assessment using standardized, validated assessment tools.
- A nurse will perform and record the results of the Richmond Agitation and sedation scale (RASS) every 2 hours with Vital Signs.
- A Nurse will perform and record the results of the Confusion Assessment Method-ICU (CAM-ICU) (see Annex VI page No .....) twice a day and whenever a patient experiences a change in mental status.
- Each day during rounds, the team will set "target" RASS score for the patient to be maintained at for the following 24 hours.
- Each day during interdisciplinary rounds, the nurse will inform the team of the:

1. Patient's "target" RASS score
2. Patient's actual RASS score
3. Patient's CAM-ICU status

Non-pharmacologic methods for Prevention of Delirium

1. Ensure Daily Awakening Trials performed
2. Continually reorient patient to environment/surroundings
3. Perform Early mobilization

a) Out of bed and Wheel Chair Mobilization for All
b) Ambulation if OFF Inotropes AND Low Ventilator Settings i.e. PEEP<8 and FiO2<50%

4. Promote effective sleep/awake cycles
5. Perform timely removal of catheters/physical restraints
6. Ensure the use of eyeglasses, hearing aids
7. Minimize continuous noise/stimulation at night
8. Daylight exposure and orientation to day and night
9. Minimize benzodiazepine for sedation- Consider Alcohol Withdrawal States in Chronic Alcohol Consumers

Pharmacologic treatments of Delirium:

Consider Using Medications for management of Delirium

- **Haloperidol:**

1. IV 5 mg Bolus, Repeat every 3-5 minutes till agitation settles down.
2. Calculate the total dose required and divide into q6 hourly standing dose for few days

- **Quetiapine:** Tab. Quetiapine 25 mg BD/TDS and Increase dose as required
- **Olanzapine**: Tab. Olanzapine 10 mg BD/TDS

Sedatives and Analgesic in ICU

Propofol:

- 25-50 mcg/kg/min and titrate in increments of 25mcg/kg/min till desired level of sedation is achieved
- More appropriate for targeting deep sedation (RASS=-2/-3)
- Check Triglycerides after 72 hours
- Watch for lactic acidosis and rhabdomyolysis
- Should be used in Increment of 5ml/hour

Fentanyl:

- 50-100 mcg IV bolus, followed by 25- 50 mcg/hr
- Reassess in 15 minutes
- If inadequate pain relief, re-bolus fentanyl 50-100 mcg and increase drip by 50%
- Re-evaluate again in 3o mins and increase or decrease dose by 50% if inadequate or over sedation
- USE FOR SEDATION in patients planning to be weaned and extubated early

Morphine:

- 2-5 mg IV then either 1-5 mg q 1 hr. prn or continuous infusion at 1-5 mg/hr
- Reassess after 30 mins
- If inadequate pain relief then re-bolus Morphine 1-5 mg and increase drip by 50%
- Re-evaluate again in 30 mins and increase or decrease dose by 50% if inadequate or over sedation

gesia **Midazolam:**

- Should not be used for ICU sedation, Used only for Anticonvulsant, and for Procedural Sedation or Amnesia.
- 2 mg IV bolus followed by 1-2 mg q hr. prn titrated in increments of 1-2 mg IV after reassessing every 30 mins till desired level is achieved
- Maintenance: Use 25% of total drug used to achieve level prn q 1 hr
- If over sedated hold drug.

Demedetomidine:

- Bolus Dose: 0.5 mcg/ Kg to 1 mcg / Kg IV
- Maintenance: Continuous infusion at 0.2 -1 mcg /Kg/hour
- Side Effect: Bradycardia, Hypotension
- STOP if HR<60 / min OR MAP < 70 mm Hg

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Preparation:

- Currently available: 1 ml= 100mcg
- Give IV Bolus: 0.5 ml- 1 ml
- Add 2 ml Dexmedetomidine with 48 ml NS in 50 ml Syringe pump, so 50 ml= 200mcg, 1 ml= 4mcg
- Start infusion at 0.2 mcg/Kg/hr. = 3ml / hour for 60 Kg (12 mcg)
- Reassess over 5 mins and Increase Infusion by 3 ml / hour
- Maximum infusion rate : 1mcg/Kg / hr. = 20 m /hour for 60 kg (60 mcg)
- Doses Used: 3/ 6/ 9/ 12/ 15 ml/hour
- Titrate down the infusion rate and maintain a that rate when target RASS is achieved

Side effects

- hypotension
- respiratory depression
- arrhythmias
- drug specific effects
- sleep disturbance
- withdrawal
- delirium

Extubation

Extubation refers to the removal of the endotracheal tube/ artificial airway. This procedure is done if there is evidence of no longer need of mechanical ventilation to maintain ventilation and oxygenation. It is final step in liberating patient from mechanical ventilation.

Prior extubation, following conditions must be addressed.

Presence of airway protective reflex. It is the ability to protect airway from aspirated secretion. This is determined by presence of gag and cough reflex which can be assessed during endotracheal suctioning. Cough reflex can also be assessed by holding a piece of paper 1-2 cm from the end of the endotracheal tube and asking the patient to cough. If wetness appears on the paper, cough strength is considered adequate.

Assessment of laryngeal edema. Laryngeal edema causes upper airway obstruction in the patient intubated for longer than 36 hours. Cough leak test is done to identify presence of laryngeal edema. This test measures the volume of inhaled gas that escapes through the larynx when the cuff of the ET tube is deflated. Absence of air leak indicates the high risk of laryngeal edema and presence indicates low risk of edema. Pretreatment with steroids (methyl prednisolone, 20 -40 mg 4-6 hourly 3 dose) can decreases the chance of laryngeal edema.

Cough leak test

Keep the patient in semi fowler's position

Keep the ventilator on assist control mode.

When the cough is inflated, measure the maximum occlusion volume of mechanically exhaled volume and record it.

After then, deflate the cough and record the mechanically exhaled tidal volume of six respiratory cycle than average of three lowest three exhaled volume is recorded.

Compute the difference between exhaled tidal volume with cough inflated and deflated. If the difference is more than 110mL, indicates the no sign off laryngeal edema.

Assessing the patient's readiness for extubation

The objective criteria for assessing patient readiness include the rapid shallow breathing index, blood gases, muscle strength and general cardiopulmonary signs. A patient is ready for extubation who have airway reflex and showing non sing of cardiopulmonary distress. Strong productive cough, small amount of secretion, acceptable blood gas level, infrequent need for suction (more than 4 hour), being alert, SaO2 >95% are the good conditions which guide in deciding extubation.

Rapid shallow breathing index (f/V_T) is measured to evaluate successful extubation. It can be achieved by breathing frequency in minute divided by average tidal volume in litre. Highly predictive of successful extubation outcome if f/V_T is <100min/L

Criteria for extubation

1. Optimal fluid balance
2. Adequate ventilation and oxygenation; Fio2<0.5, Vital capacity of>10ml/kg, Tidal volume>5ml/kg and Respiratory rate <25 BPM.
3. ABG; pco2<45, po2>80 on Fio2 of 40% and PEEP -5 and PH normal range
4. Other: Sedating agents must be stopped
5. Paralyzing agents stopped >24 hrs
6. Normal metabolic status

7. Electrolyte balance
8. Neurologically intact
9. Intact gag and cough reflex

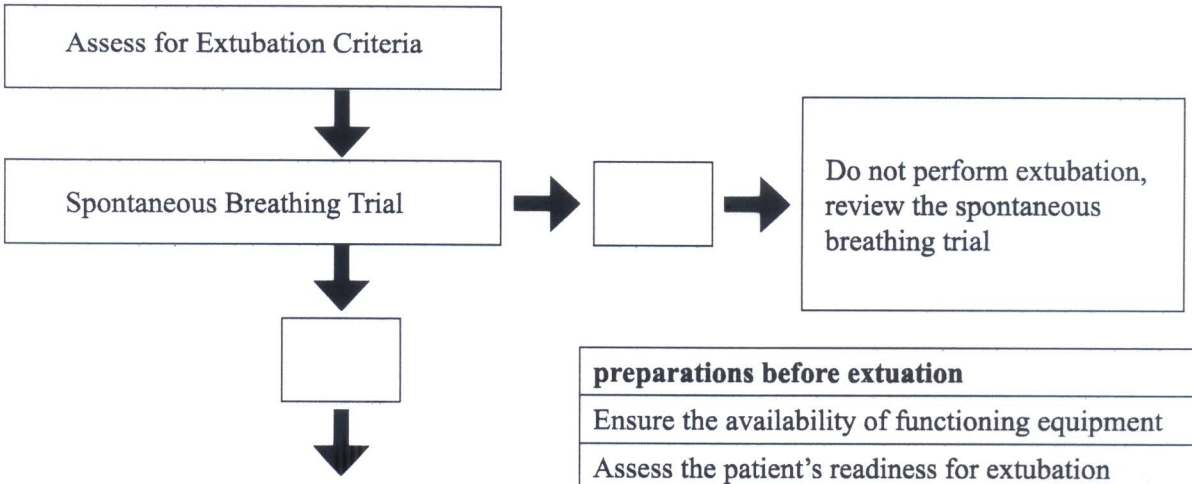
Complication of extubation

Following complication may arise after extubation so one should be ready to manage them.

Immediate complications may be aspiration, laryngospasm, hoarseness and laryngeal and subglottic edema.

More severe complications are mucosal injuries, laryngeal stenosis, tracheal inflammation, dilation or stenosis, vocal cord parasysis.

Extubation



preparations before extuation
Ensure the availability of functioning equipment
Assess the patient's readiness for extubation
Be sure that skilled person for intubation is available

S.N	Extubate The Patient By Following Steps
1.	Explain the procedure to the patient
2.	Collect necessary equipment (see equipments)
3.	Ensure the privacy of patient
4.	Pre-oxygenate the patient with 100%O2 for 2 minutes (manual resuscitator can be used)
5.	Perform endo-tracheal suctioning and than oropharyngeal suctioning
6.	Position the patient in Fowler's position
7.	Remove the ET fixer (tape)/ET fixing system
8.	Deflate the ET cuff completely
9.	At peak inspiration, remove the tube, Suction the airway through the tube as it is pulled out.
10.	Administer high humidity oxygen by face/ventury mask
11.	Document the procedure

Equipments For Extubation
• Suctioning equipment
• Sterile suctioning catheter
• AMBU bag with tube
• Oxygen source
• Disposable syringe (10mL)
• Yankauer suction
• Sterile gloves
• Emergency cart (refer intubation)
• A tray setup for intubation (refer intubation)

Flow Chart No. 6 : Steps for Extubation

Provide Following Post-Extubation Care	
1.	**Assess:** Heart rate, respiration rate, blood pressure, oxygen saturation air entry and breathing sounds, presence of stridor for laryngeal edema, amount of secretion
2.	Encourage the patient for cough and deep breathing along with the use of incentive spirometry
3.	Nebulize the patient with the asthalin: Ipravent :NS (1:1:2). If stridor occurs, nebulize with 0.5 mL adrenaline in 3 mL NS.
4.	**Assess** for the sigh of post extubation failure: RR > 25 breaths/min for 2 hour, HR>140 beats/min or sustained increased or decreased by 20%, use of accessory respiratory muscles SaO2<90%, Pao2 <80 mmHg, paco2> 45mmHg or more than 20% from pre intubation rapid shallow breathing
5.	Obtain ABG with in next hour.
6.	Remain with the patient to determine stability.
7.	Keep NPO or give only ice chips for next few hours and provide mouth care

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Non-Invasive Ventilation

Non-invasive ventilation means providing the mechanically assisted breaths without using artificial airways. NIV works best for the patients with COPD or cardiogenic pulmonary edema
The objective of NIV in the management of acute respiratory failure is.

- To reduce the need of invasive ventilation.
- To decrease the need of prolonged ventilation.
- To improve the patient outcome.
- To reduce hospital and ICU length of stay.
- To reduce mortality and morbidity in those with acute on respiratory failure.

A. Indications

- Acute exacerbation of COPD.
- Cardiogenic pulmonary edema.
- Hypoxemic respiratory failure.
- Asthma.
- Post extubation patients who have weak respiratory muscles.

B. Exclusion Criteria

- Respiratory arrest
- Medically unstable
- Unconscious, unable to protect airways
- Significant vomiting
- Agitated or uncooperative
- Excessive secretions
- Facial trauma burns, or anatomic abnormalities interfering with mask application.

C. Modes of NIV

Non-invasive ventilation can be given by:

- Bilevel positive –airway –pressure (BIPAP)
- Continuous positive airway pressure (CPAP)

I. BIPAP

Respiratory effects of Bi-PAP

a. EPAP

- Stands for expiratory positive airway pressure.
- Provides PEEP
- Increases the Functional residual capacity.
- Reduces FiO2 required to optimise SaO2.

a. IPAP

- Stands for Inspiratory positive airway pressure.
- Decreases work of breathing and oxygen demand
- Decreases the spontaneous tidal volume.

Settings in BIPAP

- Recommended initial settings for BiPAP machines in the non-invasive support of patients

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are IPAP of 8 cm H2O and EPAP of 3 cm H2O, for a pressure support (IPAP minus EPAP) of 5cm H2O.

- The level of supplemental oxygen flowing into the circuit should be governed by goal pulse oximetry and collaborated by ABG results as necessary; it is appropriate initiate therapy with 2 to 5 L/minute, but this amount should be adjusted with each titration of IPAP or EPAP.

Initial Setting

- Start at EPAP=10 cm water/ IPAP = 5 cm of water.
- Pressures less than 8 cm water/4 cm water not advised as this may be inadequate
- Initial adjustments to achieve tidal volume of 5-7 mL/kg.

Subsequent adjustments based on arterial blood gas values are as follows:

- Increase IPAP by 2 cm water if persistent hypercapnia
- Increase IPAP and EPAP by 2 cm water if persistent hypoxemia
- Maximal IPAP limited to 20-25 cm water (avoids gastric distension, improves patient comfort)
- Maximal EPAP limited to 10-15 cm water
- Back up respiratory rate 12-16 breaths/minute

II. CPAP

- Constant positive pressure throughout the cycle.
- Improves oxygenation
- Decreases work of breathing by decreasing the elastic work of alveoli.
- Decreases hypoxia and reduces intra pulmonary shunt.
- Initially supply 3 to 5 cm H2O of CPAP with supplemental oxygen.
- Sequentially increase the CPAP pressure by 2 to 3 cm H2O increments according to (ABG-Pulse oximetry).

Procedure

1. Check the non-invasive ventilator
   - Function
   - Battery backup
   - Settings
   - Mask Size
2. Check the alarm setting and oxygen supply(some machines can operate in room air even when oxygen supply is disconnected)
3. Give reassurance and adequate explanation to patients and assess the patient (Airway, Breathing, Circulation and Disability).
4. Check if patient has NG tube and artificial denture.
5. Explain to the patient the reasons and purposes of the therapy because a high flow is expected during therapy and it can be difficult to tolerate in the beginning.

Non- Invasive Positive Pressure Interfaces

Non-invasive positive pressure interfaces include nasal masks, full-face masks, nasal mask, oral interfaces or the helmet, and are crucial to the success of NIV as the choice of ventilation. Ideally, discuss with the patient the choices of mask available to them, as any discomfort to the patient will reduce their tolerance of the NIV.

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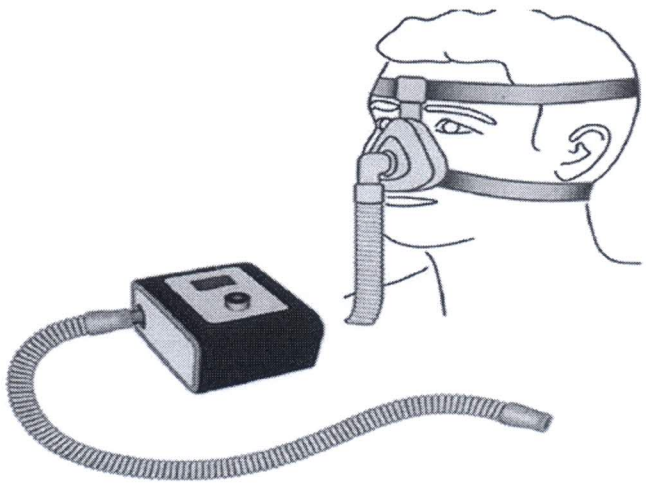

Figure No. 5 : Nasal Mask

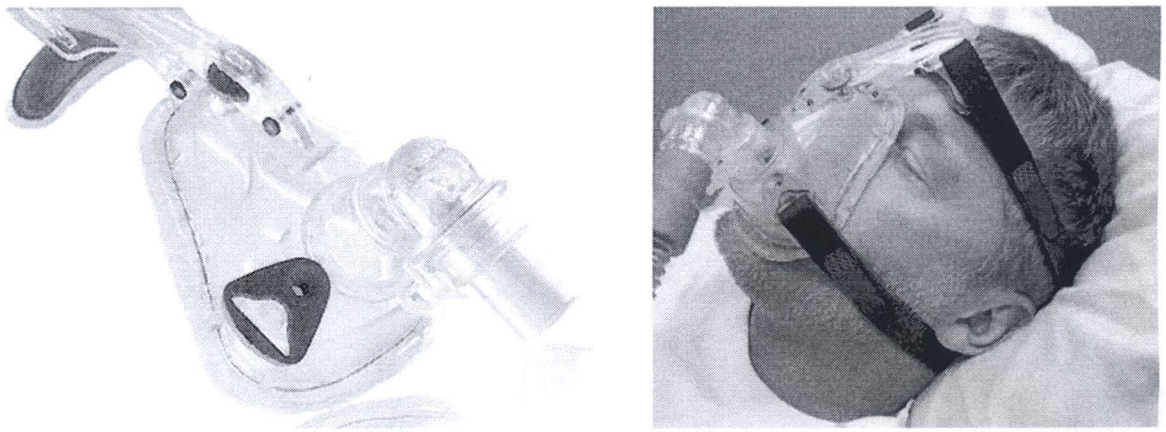

Figure No. 6 : Full Face Mask

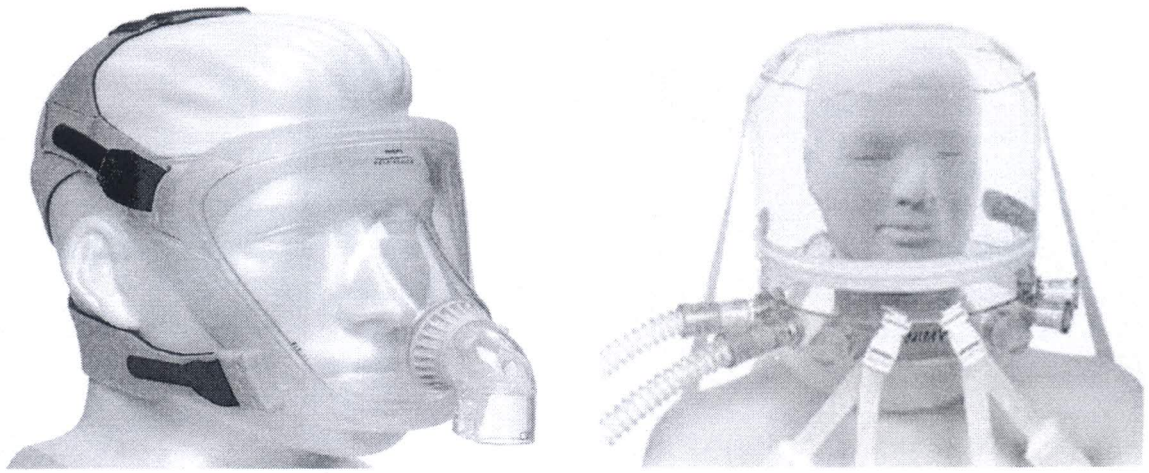

Figure No. 7 : Total Face Mask

Advantages and disadvatages of different types of masks

Interfaces	Advantages	Disadvantages
Nasal mask	• Good for long-term use in adults	• Problems in patients with mouth leaks or nasal pathology
Full face mask	• Can solve problems with mouth leak • Useful in confused patients and children	• Can be claustrophobic
Nasal plugs	• No pressure over nasal bridge • Helpful for claustrophobic individuals • Can be used easily by patients wearing spectacles	• Can be unstable and slip off face • Not available in small enough sizes for young children
Total face mask	• Small functional deadspace reduced leaks • Helpful in some claustrophobic patients • Useful in preventing sores formation when compare with use of nasal or full face mask	• Limited sizes and none yet suitable for children • Designed for short-term use • Expensive
Helmet	• No contact with face or head • May have infection control advantages • Helpful for short-term emergency application	• Greater likelihood of rebreathing • Intended for short-term use • Not easy to sleep in device

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S.N	Practical Checklist for NIPPV
1.	Check the alarm setting and oxygen supply (some machines can operate on room air even when oxygen supply is disconnected).
2.	Initial settings are based upon the clinical decision of the prescribing doctor. Start with low pressure and increase as and when the patient is comfortable.
3.	Give reassurance and adequate explanation to patients: a. Explain to the patient the reasons and purposes of the NIPPV therapy. Because a high flow of NIPPV is expected during therapy and its use is difficult to tolerate in the beginning, patient cooperation is crucial to the success of the therapy. b. Select a mask that fits the patient and hold it in place to allow patient to sense the "high flow" of the machine. c. When starting NIPPV, hold the mask over the patient's face and allow a few minutes for the patient to get used to the high flow and pressure before securing the mask in place. d. Secure the mask in place with straps or headgear and observe the patient's tolerance.
4.	Ventilator settings and monitoring of patient vital signs: a. Check for adequate ventilation and oxygenation. Correct any problems of respiratory failure and make sure the patient is comfortable and tolerating the mask and settings. b. Look for any evidence of leaking around the mask that may lead to a decreased tidal volume and oxygen desaturation. c. For settings, focus on: i. Achieving adequate tidal volume, 6 to 8 ml/kg ii. Decrease RR <25 breaths per minute d. Alter the oxygen to achieve SpO2>90%. e. Monitor ABG's and make necessary adjustments.
5.	Emergency action: a. If the patient vomits, it is important to remove the mask quickly to prevent aspiration. Masks usually have a rapid release mechanism. Make sure you are familiar with how to remove your patient's mask quickly. b. Teach the patient how to remove the mask and how to ask for help. This may include providing them with communication aids, watching them carefully and providing with a call bell.

Weaning plan: _____

Time/date
NIV ceased: _____

Reason: _____

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Tracheostomy

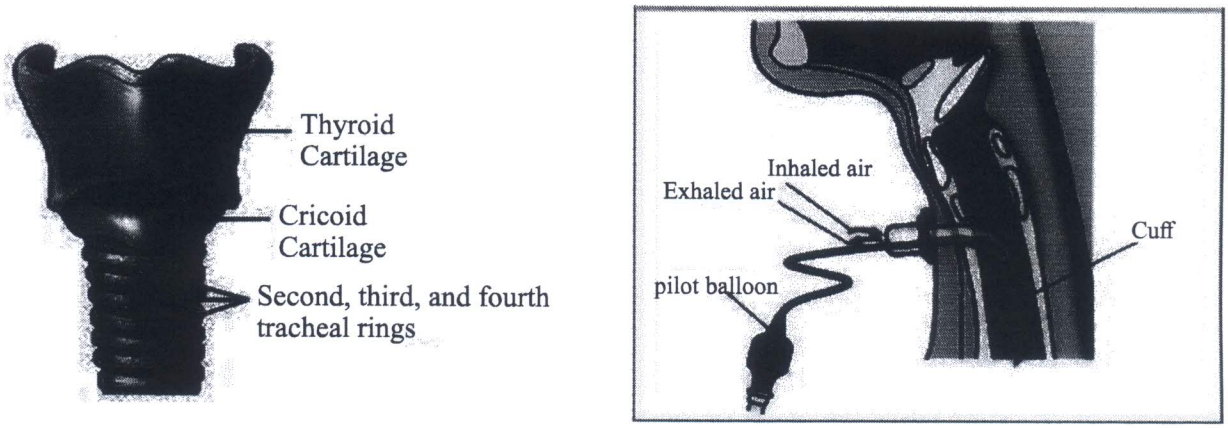

Fig. A *Fig. B*

Figure No. 8 : Tracheostomy site (Fig. A) Tracheostomy tube in situ (Fig. B)

Anatomy

Trachea lies in the middle of the neck extending form cricoid cartilage (C6) superiorly to the tracheal bifurcation at the level of sternal angle (T5) . Comprises 16-20 C shaped cartilage rings. Become intra thoracic at 6th cartilaginous ring

- Length : 10-12 cm
- Diameter : 15-20 mm

Tracheostomy

A surgical procedure to create an opening between 2-3 (3-4) tracheal rings into the trachea below the larynx to facilitate ventilation. The opening is usually maintained by use of tracheostomy tube performed either surgically or by percutaneous method

Indication

To relieve acute upper airway obstruction cause may be due to :
Infection : Iaryngeal infection Neoplasm carcinoma of larynx and pharynx
Trauma : Iaryngeal-tracheal injuries
Foreign body in larynx

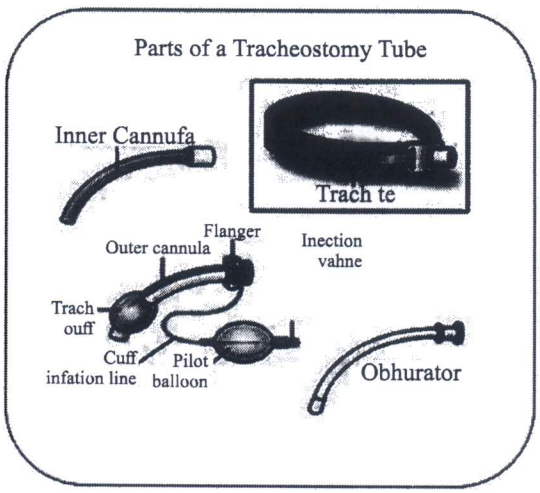

Figure No. . 9 : Different Parts of Tracheostomy Tube

Checklist for tracheostomy tube care

S.N	Daily Assessment of Tracheostomy	Yes	No	Remarks
Oxygen Therapy & Humidification				
1	Ensure adequate humidification delivered (ventilated & non-ventilated patients)			
2	Saline Nebulizer (5-10ml) 0.9% N/S, mucolytic			
3	Mobilization, regular chest physiotherapy, encourage coughing			
Inner cannula				
1	Inner cannula should be removed, inspected & cleaned every 4 hours			
2	Spare inner cannula to be kept at bedside			
3	Dirty cannula cleaned with sterile water & left to air dry			
A blocked inner cannula= A blocked airway				
Secretions and suctioning				
1	Every 4 hours if fully ventilated or if any indication			
Stoma care and securing the tracheostomy				
1	Every shift inspect stoma site for infection, bleeding, swelling & skin breakdown			
2	Clean stoma with sterile gauze & normal saline			
3	One finger fit snugly under trachea ties.			
	Check that the trachea tube is patent, secured and in midline position.			
Cuff check				
1	Minimum once per shift			
2	Cuff pressure should be 20-30 cmH20			
3	Speaking valve only be applied when the cuff pressure is fully deflated*			
4	Loss of cuff pressure/cuff leak may indicate trache is incorrectly sited			
Oral care & assessment of swallowing				
1	Daily oral care			
2	Regular assessment of swallowing test			
Safety				
1	Emergency equipments must be at the bedside: ☐ AMBU bag connected to oxygen supply ☐ one extra trach tubes-one of the patient's current size or a smaller one ☐ tracheostomy mask ☐ an obturator of the correct size ☐ extra set of trach ties ☐ suctioning device and catheters			
Documentation				
	a) Respiratory status b) Dressing status c) Condition of stoma d) Any skin breakdown e) Secureness of the tube			

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Annex I-BRADEN Scale for Predicting Pressure Sore Risk

Patient's Name _____ **Evatuator's Name**_____ **Date of Assessment**

SENSORY PERCEPTION ability to respond meaningfully to pressure related discomfort	**1. Completely Limites** Unresponsive (does not mosn, finich or grasp) to painful stimuli, due to diminished level of consciousness or sedation OR limited ability to feel pain over most of body.	**2. Very Limited** Responds only to painful stimuli Cannot communicate discomfort except by moaning or restlessness OR has a sensory impairment which limits the ability to feel pain or discomfort over 1/2 of body.	**3. Slightly Limited** Responds to verbal command, but cannot always communicate discomfort or the need to be turned OR has some sensory impairment which limits ability to feel pain or discomfort in 1or 2 extremities.	**4. No Impairment** Responds to verbal commands. Has no sensory deficit which would limit ability to feel or voice pain or discomfort.
MOISTURE degree to which skin is exposed to moisture	**1. Constantly Moist** Skin is kept moist almost constantly by perspiration, urine, etc. Dampness is detected every time patient is moved oor turned.	**2. Very Moist** Skin is often, but not always moist Linen must be changed at least once a shift.	**3. Occasionally Moist** Skin is occasionally moist, requiring an extra linen change approximately once a day.	**4. Rarely Moist** Skin is usually dry, linen only requires changing at routine intervals.
ACTIVITY degree of physical activity	**1. Bedtast** Confined to bed.	**2. Chairtast** Ability to walk severely limited or non-existent. Cannot bear own weight and/or must be assisted into chair or wheelchair.	**3. Walks Occasionally** Walks occasionally during day, but for very short distance, with or without assistance Spends majority of each shift in bed or chair.	**4. Walks Frequently** Walks outside room at least twice a day and inside room at least once every two hours during waking hours.
MOBILITY	**1. Completely Immobile** Does not make even slight changes in body or extremity position without assistance.	**2. Very Limited** Makes occasional slight changes in body or extremity position but unable to make frequent or significant changes independently.	**3. Slightly Limited** Makes frequent though slight changes in body or extremity position independently.	**4. No Limitation** Makes major and frequent changes in position without assistance.
NUTRITION ability to change and control body position	**1. Very Poor** Never eats a complete meal, Rarely eats more than 1/2 of any food offered. Eats 2 servings or less of protein (meat or dairy products) per day. Take fluids poorly. Does not take a liquid dietary supplement OR is NPO and/or maintained on clear liquids or IVs for more then 5 days.	**2. Probably Inadequate** Rarely eats a complete meal and generally eats only about 1/2 of any food offered Protein intake includes only 3 servings of meat or dairy products per day. Occasionally will take a dietary supplement OR receives less than optimum amount of liquid diet or tube feeding.	**3. Adequate** Eats over half of most meals. Eats a total of 44 servings of protein (meat, dairy products) per day. Occasionally will refuse a meal, but will usually take a supplement when offered OR is on a tube feeding or TPN regimen which probably meets most of nutritional needs.	**4. Excellent** Eats most of every meal. Never refuses a meal. Usually eats a total of 4 of more servings of meat and dairy products. Occasionally eats between meals. Does not require supplementation.
FRICTION & SHEAR	**1. Problem** Requires moderate to maximum assistance in moving. Complete lifting without sliding against sheets id impossible. Frequently slides down in bed or chair, requiring frequent repositioning with maximum assistance Spasticity, contractures or agitation leads to almost constant friction.	**2. Potential Problem** Moves feebly or requires minimum assistance. During a move skin probably slides to some extent against sheets, chair, restraints or other devices. Maintains relatively good position in chair or bed most of the time but occasionally slides down.	**3. No Apparent Problem** Moves in bed and in chair independently and has sufficient muscle strength to lift up completely during move. Maintains good position in bed or chair.	

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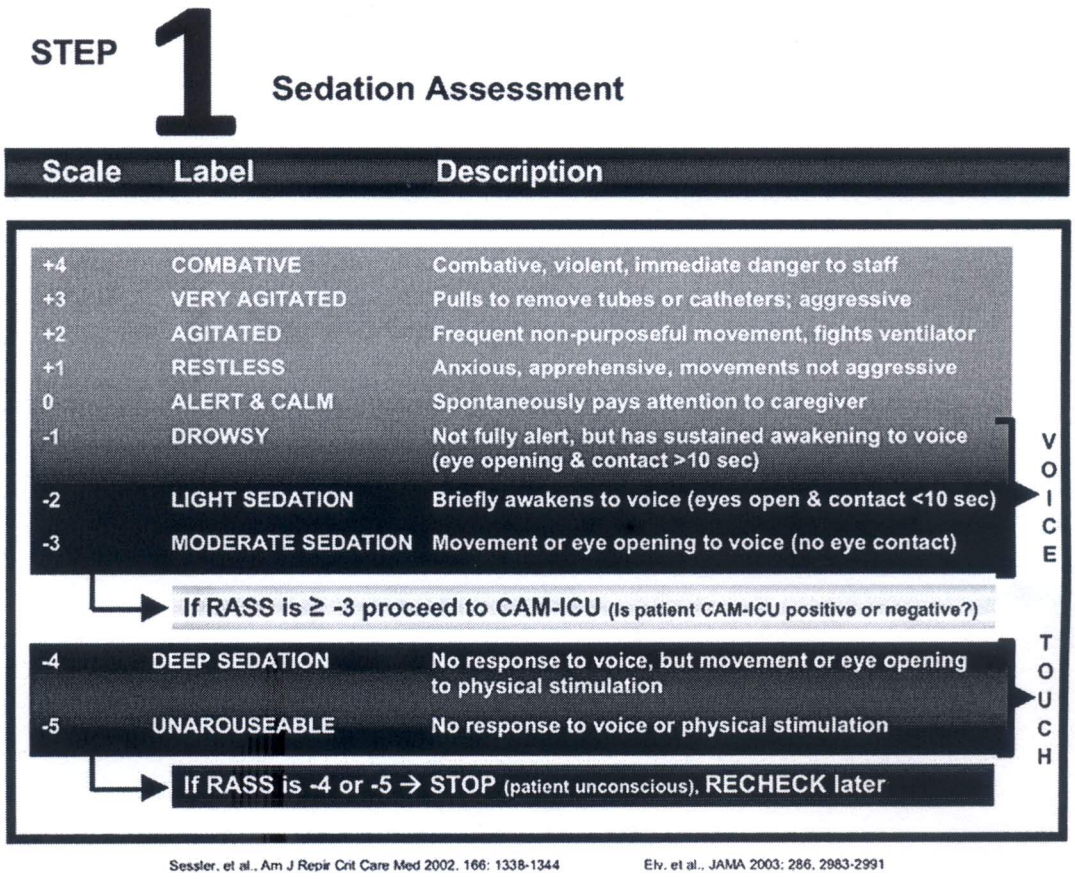
Annex II Richmond Agitation-Sedation Scale (RASS)



Sessler, et al., Am J Repir Crit Care Med 2002, 166: 1338-1344 Ely, et al., JAMA 2003; 286, 2983-2991

Annex III Assessment test for delirium & cognitive Impairment (4AT)

4AT

Assessment test for delirium & cognitive impairment

(label)

Patient name:

Date of birth:

Patient number:

Date: **Time:**

Tester:

CIRCLE

[1] ALERTNESS

This includes patients who may be markedly drowsy (eg. difficult to rouse and/or obviously sleepy during assessment) or agitated/hyperactive. Observe the patient. If asleep, attempt to wake with speech or gentle touch on shoulder. Ask the patient to state their name and address to assist rating.

Normal (fully alert, but not agitated, throughout assessment)	**0**
Mild sleepiness for <10 seconds after waking, then normal	**0**
Clearly abnormal	**4**

[2] AMT4

Age, date of birth, place (name of the hospital or building), current year.

No mistakes	**0**
1 mistake	**1**
2 or more mistakes/untestable	**2**

[3] ATTENTION

Ask the patient: "Please tell me the months of the year in backwards order, starting at December." To assist initial understanding one prompt of "what is the month before December?" is permitted.

Months of the year backwards	Achieves 7 months or more correctly	**0**
	Starts but scores <7 months / refuses to start	**1**
	Untestable (cannot start because unwell, drowsy, inattentive)	**2**

[4] ACUTE CHANGE OR FLUCTUATING COURSE

*Evidence of significant change or fluctuation in: **alertness**, cognition, other mental function (eg. paranoia, hallucinations) arising over the last 2 weeks and still evident in last 24hrs*

No	**0**
Yes	**4**

4 or above: possible delirium +/- cognitive impairment
1-3: possible cognitive impairment
0: delirium or severe cognitive impairment unlikely (but delirium still possible if [4] information incomplete)

4AT SCORE ☐

GUIDANCE NOTES Version 1.2. Information and download: **www.the4AT.com**

The 4AT is a screening instrument designed for rapid initial assessment of delirium and cognitive impairment. A score of 4 or more *suggests* delirium but is not diagnostic: more detailed assessment of mental status may be required to reach a diagnosis. A score of 1-3 suggests cognitive impairment and more detailed cognitive testing and informant history-taking are required. A score of 0 does not definitively exclude delirium or cognitive impairment: more detailed testing may be required depending on the clinical context. Items 1-3 are rated *solely on observation of the patient at the time of assessment.* Item 4 requires information from one or more source(s), eg. your own knowledge of the patient, other staff who know the patient (eg. ward nurses), GP letter, case notes, carers. The tester should take account of communication difficulties (hearing impairment, dysphasia, lack of common language) when carrying out the test and interpreting the score.

Alertness: Altered level of alertness is very likely to be delirium in general hospital settings. If the patient shows significant altered alertness during the bedside assessment, score 4 for this item. **AMT4 (Abbreviated Mental Test - 4):** This score can be extracted from items in the AMT10 if the latter is done immediately before. **Acute Change or Fluctuating Course:** Fluctuation can occur without delirium in some cases of dementia, but marked fluctuation usually indicates delirium. To help elicit any hallucinations and/or paranoid thoughts ask the patient questions such as, "Are you concerned about anything going on here?"; "Do you feel frightened by anything or anyone?"; "Have you been seeing or hearing anything unusual?"

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Annex IV Checklist for Prevetion of Central Line Associated Blood Stream Infections

Follow proper insertion practices

- ☐ Perform hand hygiene before insertion.
- ☐ Adhere to aseptic technique.
- ☐ Use maximal sterile barrier precautions (i.e., mask, cap, gown, sterile gloves, and sterile full body drape).
- ☐ Choose the best insertion site to minimize infections and noninfectious complications based on individual patient characteristics.
  - Avoid femoral site in obese adult patients.
- ☐ Prepare the insertion site with >0.5% chlorhexidine with alcohol.
- ☐ Place a sterile gauze dressing or a sterile, transparent, semipermeable dressing over the insertion site.
- ☐ For patients 18 years of age or older, use a chlorhexidine impregnated dressing with an FDA cleared label that specifies a clinical indication for reducing CLABSI for short term non-tunneled catheters unless the facility is demonstrating success at preventing CLABSI with baseline prevention practices.

Handle and maintain central lines appropriately

- ☐ Comply with hand hygiene requirements.
- ☐ Bathe ICU patients over 2 months of age with a chlorhexidine preparation on a daily basis.
- ☐ Scrub the access port or hub with friction immediately prior to each use with an appropriate antiseptic (chlorhexidine, povidone iodine, an iodophor, or 70% alcohol).
- ☐ Use only sterile devices to access catheters.
- ☐ Immediately replace dressings that are wet, soiled, or dislodged.
- ☐ Perform routine dressing changes using aseptic technique with clean or sterile gloves.
  - Change gauze dressings at least every two days or semipermeable dressings at least every seven days.
  - For patients 18 years of age or older, use a chlorhexidine impregnated dressing with an FDA cleared label that specifies a clinical indication for reducing CLABSI for short-term non-tunneled catheters unless the facility is demonstrating success at preventing CLABSI with baseline prevention practices.
- ☐ Change administrations sets for continuous infusions no more frequently than every 4 days, but at least every 7 days.
  - If blood or blood products or fat emulsions are administered change tubing every 24 hours.
  - If propofol is administered, change tubing every 6-12 hours or when the vial is changed.

Promptly remove unnecessary central lines

- ☐ Perform daily audits to assess whether each central line is still needed.

For Healthcare Organizations:

- ☐ Educate healthcare personnel about indications for central lines, proper procedures for insertion and maintenance, and appropriate infection prevention measures.
- ☐ Designate personnel who demonstrate competency for the insertion and maintenance of central lines.
- ☐ Periodically assess knowledge of and adherence to guidelines for all personnel involved in the insertion and maintenance of central lines.
- ☐ Provide a checklist to clinicians to ensure adherence to aseptic insertion practices.
- ☐ Reeducate personnel at regular intervals about central line insertion, handling and maintenance, and whenever related policies, procedures, supplies, or equipment changes.
- ☐ Empower staff to stop non-emergent insertion if proper procedures are not followed.
- ☐ Ensure efficient access to supplies for central line insertion and maintenance (i.e. create a bundle with all needed supplies).
- ☐ Use hospital-specific or collaborative-based performance measures to ensure compliance with recommended practices.

Supplemental strategies for consideration:

- ☐ Antimicrobial/Antiseptic impregnated catheters
- ☐ Antiseptic impregnated caps for access ports

Source : *Based on 2011 CDC guideline for prevention of intravascular catheter-associated bloodstream infections:* https://www.cdc.gov/infectioncontrol/guidelines/bsi/index.html
Strategies to Prevent Central Line–Associated Bloodstream Infections in Acute Care Hospitals: 2014 Update http://www.jstor.org/stable/10.1086/676533

Approved.

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Annex V- Mechanical ventilation Alarms and troubleshoot

Common alarm	Possible problems	Assessment	Problem solving
Whenever a ventilator alarm sounds start by assessing the patient Perform a rapid ABCD assessment. • Is the ETT in place? • Is there chest rise and fall? • Does the patient have an adequate BP? • Is the patient awake/ moving ?		➢ If the patient: - Does **not** have a patent airway -Does **not** have adequate chest rise and fall - Has haemodynamic instability **Call for help immediately !!** **And consider commencing airway management and/or BLS**	➢ If the patient is otherwise stable the next step is to check the ventilator: - What is the alarm? - Do you understand the alarm? - Do you know how to fix the alarm? ➢ If you cannot troubleshoot the alarm promptly or you are unsure of what to do, **call for assistance early**
	- High or low Peak Inspiratory Pressure (PIP) - High or low Tidal Volume (VT) - High or low Respiratory rate (f) - High or low Minute volume (MV) - Apnoea		

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High peak inspiratory pressure	• Patient - Biting, coughing, patient-ventilator dyssynchrony, bronchospasm, pulmonary oedema, pleural effusion, pneumothorax etc. • ETT - Kinked, blocked or displaced ETT • Ventilator - Ventilator circuit kinked, water condensation, inappropriate alarm settings, ventilator malfunction	• Assess the patient • Assess the alarm settings • Identify and treat simple causes of high PIP: - Patient Causes - ETT causes - Ventilator causes	➢ Start at the patient. Perform a rapid ABCD and call for help if required. ➢ If the patient is stable assess the alarm setting. What is the PIP? Is it high or has the alarm been inappropriately set? ➢ If the PIP is appropriately high, attempt to identify and treat simple causes of the alarm: ➢ Observe the patient to see if they are biting or coughing on the ETT or if the patient appear to have ventilator dyssynchrony (fighting the ventilator). Inform doctor to consider giving the patient a bolus of sedation if this is the cause. If the patient is biting on the tube inserting a bite block. ➢ If you cannot observe any obvious patient causes, perform ETT suctioning to check the patency of the tube and to remove sputum blockages, ➢ If the ETT is patent and there are no obvious sputum plugs in the tube, assess the ventilator circuit for kinks or water condensation. ➢ If the PIP is still high and you cannot identify or treat an obvious cause, call for assistance and consider manually ventilating ('bagging') the patient. This can also help to troubleshoot the cause of the alarm, if the patient is difficult to manually ventilate then the problem probably lies with the patient or ETT. If, on the other hand, the patient is easy to manually ventilate the problem probably lies with the ventilator or circuit. ➢ The patient may require a chest x-ray to look for other possible causes such as pulmonary oedema or a pneumothorax.

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Low Peak Inspiratory Pressure (PIP)	• ETT - ETT cuff deflation - ETT dislodgement • Ventilator - Circuit disconnectionorloose connection at catheter mount, Y-connection, Water traps, connection to humidifiers, capnography sample line opened, etc - Disconnected air or oxygen line	• Assess the patient • Assess alarm settings • Identify and treat simple causes of low PIP: - Listen for cuff leak (gurgling), - Check ETT cuff pressure - Check position of ETT at teeth level - Check breathing circuit for disconnectionor loose connection - Check air and oxygen are connected	If the PIP is truly low: ➢ Identify and treat simple causes of low PIP: • If the tube has become significantly dislodged or you cannot identify the cause of the alarm call for assistance and consider increasing the fi02 to 100% to maintain adequate oxygenation, **call for help immediately!!** • If the ETT is dislodged take the tube out and begin bag mask ventilation, **call for help immediately!!**
High Tidal Volume (VT) High Minute volume (MV) High Respiratory rate (f) (A change in MV must be due to a change in either TV or RR)	High MV is caused by a high RR, a high VT or both A high MV can lead to hyperventilation, hypocapnia and acute lung injury	• Patient - Pain, agitation or under-sedation - Improved lung compliance - Inappropriate ventilation mode patient on an assisted mode but taking a lot of spontaneous breaths	➢ Assess the patient ➢ Assess alarm settings (identify if it is the RR or the TV or both that are high) ➢ Identify and treat causes of high MV and high RR: - Assess the patients pain level and consider giving analgesia - Assess the patients agitation levels and consider increasing sedative medications OR - Reassess the mode of MV- consider whether they should be changed to a spontaneous mode
low Tidal Volume (VT) low Minute volume (MV) low Respiratory rate (f)	Low MV is caused by a low RR, a low VT or both A low MV can lead to hypoventilation and hypercapnia	• Leak in circuit (Cuff leak, wherever there are connections: Catheter mount, HME filter, Water traps, humidifier, Etc.) • Disconnection • High pressure limit reached	

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Apnoea	• Absence of respiratory effort • Commonly set to alarm >15 seconds • Should only alarm in spontaneous ventilation modes • Most spontaneous modes will alarm then switch to backupapnoea ventilationmode	• Patient - Respiratory arrest - Neurological deterioration - Over-sedation or use of muscle relaxant - Inappropriate ventilation settings • ETT - ETT dislodgement or circuit disconnection	➢ Assess patients respiratory effort (if the ventilator has automatically switched to apnoea ventilation you will need to change back to spontaneous mode to assess the patients respiratory effort) ➢ Change to mandatory mode if apnoea ongoing ➢ Identify and treat simple causes of apnoea: ➢ Check ETT placement ➢ Check ventilator tubing is connected ➢ Reduce sedative medications ➢ Consider manually ventilating ('bagging') the patient if apnoea cannot easily be resolved
Desaturation	Possible causes: • endobroncheal intubation • accidental extubation • pneumothorax • pulmonary embolus • any cause of increased intrapulmonary shunt any cause of hypoxic respiratory failure ventilator malfunction	• Check patient • Check SpO2 • Check ventilator • Turn FiO2 to 100% • Call for HELP • Attend endotracheal suctioning • Commence manual bagging	➢ Check patient- ABCD assessment ➢ Check SpO2 trace- is it accurate? ➢ Check ventilator- what is the patient RR, TV etc. ➢ Turn FiO2 100% ➢ Call for HELP ➢ Attend endotracheal suctioning - To clear airways - To check any blocking ➢ Commence manual bagging if saturations do not improve
Others possible problems	• Low O2 Inlet Pressure • Low Battery or No Ac Power: • Heater Alarm Overheated humidifier.		Low O2 Inlet Pressure: • Loss of oxygen pressure. Call the maintenance or connect new oxygen cylinder. Monitor patient and bag patient if needed. Low Battery or No Ac Power: Battery for audible alarms weak. • Plug in ventilator. If problem does not resolve, call the maintenance or use new ventilator. • Stay with patient and remove from ventilator and bag, if needed. Heater Alarm: Overheated humidifier. • Exchange water container or adjust settings.

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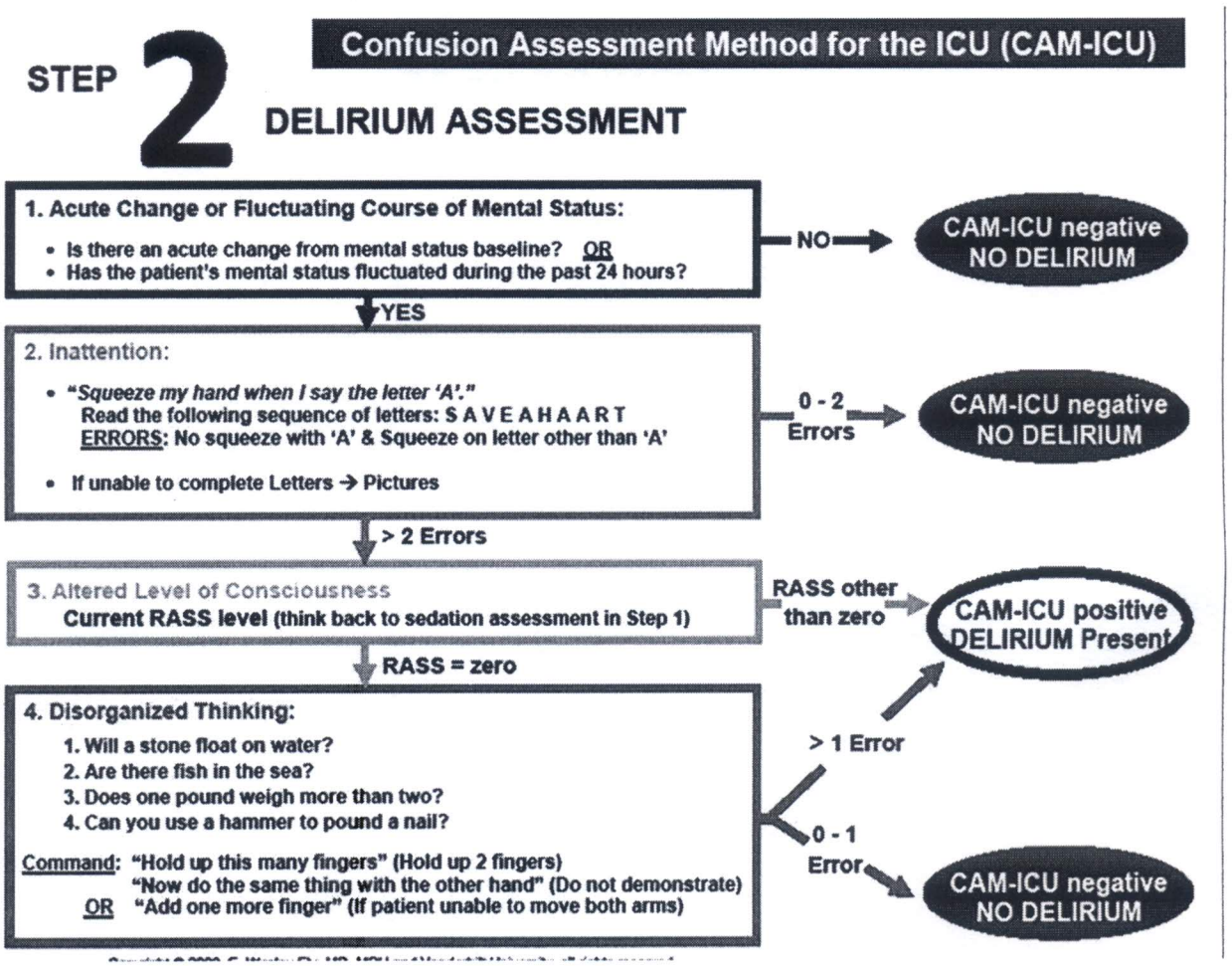
Annex VI Confusion Assessment Method for the ICU (CAM-ICU)



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