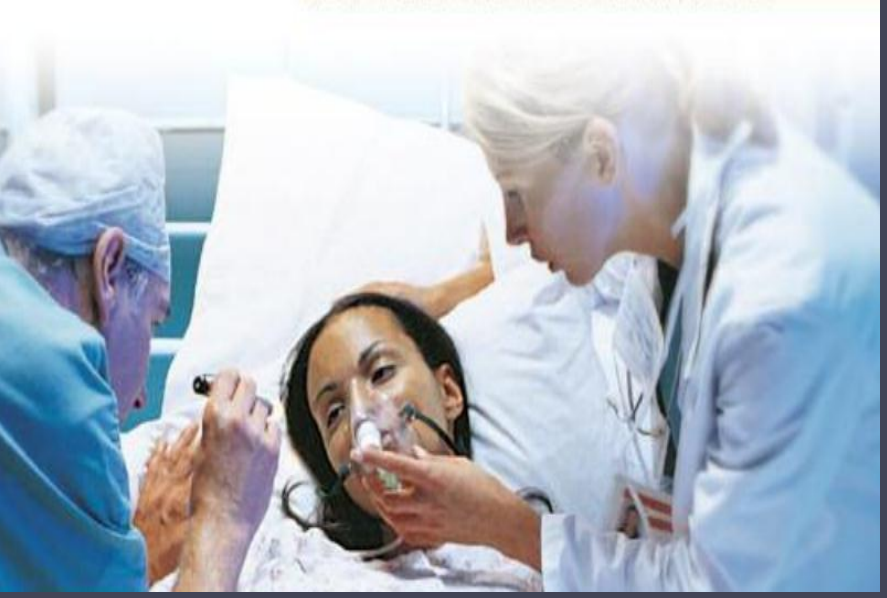

Approach to a patient in ICU

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- Patients in the ICU require complex care
- For acute illnesses and pre-existing conditions
- Innate complexity of the ICU
  - attractive quality measure and
  - target for performance improvement strategies

- ICU care requires a multidisciplinary team
- Consists of-
  - Intensivists
  - Pharmacists
  - Nurses
  - Respiratory care therapists
  - Other medical consultants
    - surgery, pediatrics, and anesthesiology

- The role of intensivists in managing ICU patients has shown a beneficial impact on patient outcomes
- So staffing ICU with intensivist is one of the recommended hospital safety initiatives

Practice model of ICU care

- Open ICU model
- Intensivist co-management model
- Closed ICU model
- Mixed ICU model and
- Intensivist model

High dependency unit (HDU)

- Level of care intermediate between that available on a general ward and that on an ICU
- Provide monitoring and support to patients with, or at risk of developing, acute or acute-on chronic single organ failure
- It should not manage patients requiring multiple organ support or mechanical ventilation
- HDU can act as a 'step-up' or 'step-down' facility between the general ward and intensive care unit

Admission criteria

ICU admission decision based on several models

- Prioritization model
- Diagnosis model and
- Objective parameters models

Prioritization Model

This system defines those that will benefit most from the ICU (Priority 1) to those that will not benefit at all (Priority 4) from ICU admission

Priority 1

- These patients are critically ill, unstable
- Need of intensive treatment and monitoring that cannot be provided outside of the ICU - ventilator support, continuous vasoactive drug infusions
  - Post-operative or acute respiratory failure patients requiring mechanical ventilatory support and
  - Shock or hemodynamically unstable patients

Priority 2

- These patients require intensive monitoring and may potentially need immediate intervention
- Patients with chronic comorbid conditions who develop acute severe medical or surgical illness

Priority 3

- These unstable patients are critically ill but have a reduced likelihood of recovery because of underlying disease or nature of their acute illness
- Examples include patients with metastatic malignancy complicated by infection, cardiac tamponade, or airway obstruction

Priority 4

- These patients are generally not appropriate for ICU admission
- Admission of these patients should be on an individual basis, under unusual circumstances
- Can be placed into two categories
  - too well to benefit from ICU care- hemodynamically stable diabetic ketoacidosis, mild congestive heart failure,conscious drug overdose, etc. and
  - too sick to benefit from ICU care- severe irreversible brain damage, irreversible multi-organ system failure etc.

Diagnosis Model

- This model uses specific conditions or diseases of different systems-

  Respiratory, CVS, Neurological, Renal, Endocrine, Gastroenterology, Haematology, Obstetrics, Surgical and Multisystem disorder

Objective Parameters Model

This model usage

- Vital signs
- Laboratory Values
- Radiography/Ultrasonography/Tomography
- Electrocardiogram and
- Physical Findings

Vital Signs

- Pulse < 40 or > 150 beats/min
- Systolic BP< 80 mm Hg or 20 mm Hg below the patient's usual pressure
- Mean arterial pressure < 60 mm Hg
- Diastolic arterial pressure > 120 mm Hg
- Respiratory rate > 35 breaths/min

Laboratory Values (newly discovered)

- Serum sodium < 110 mmol/L or > 170 mmol/L
- Serum potassium < 2.0 mmol/L or > 7.0 mmol/L
- PaO2 < 50 mm Hg
- pH < 7.1 or > 7.7
- Serum glucose > 45mmol/L
- Serum calcium > 15 mg/dl
- Toxic level of drug or other chemical substance in a hemodynamically or neurologically compromised patient

Radiography/Ultrasonography/Tomography (newly discovered)

- Cerebral vascular hemorrhage, contusion or subarachnoid hemorrhage with altered mental status or focal neurological signs
- Ruptured viscera, bladder, liver, esophageal varices or uterus with hemodynamic instability
- Dissecting aortic aneurysm

Electrocardiogram

- Myocardial infarction with complex arrhythmias, hemodynamic instability or congestive heart failure
- Sustained ventricular tachycardia or ventricular fibrillation
- Complete heart block with hemodynamic instability

Physical Findings (acute onset)

- Unequal pupils in an unconscious patient
- Burns covering > 10% BSA
- Anuria
- Airway obstruction
- Coma
- Continuous seizures
- Cyanosis
- Cardiac tamponade

Approach to a patient in ICU

- Recognition, initial assessment and resuscitation of critically ill patient
- Full clinical assessment
- Ongoing resuscitation/stabilisation
- Establishment of monitoring
- Review of medical and social history
- Communication with relatives
- Investigations to establish or confirm the definitive diagnosis
- Formulation and implementation of a management plan

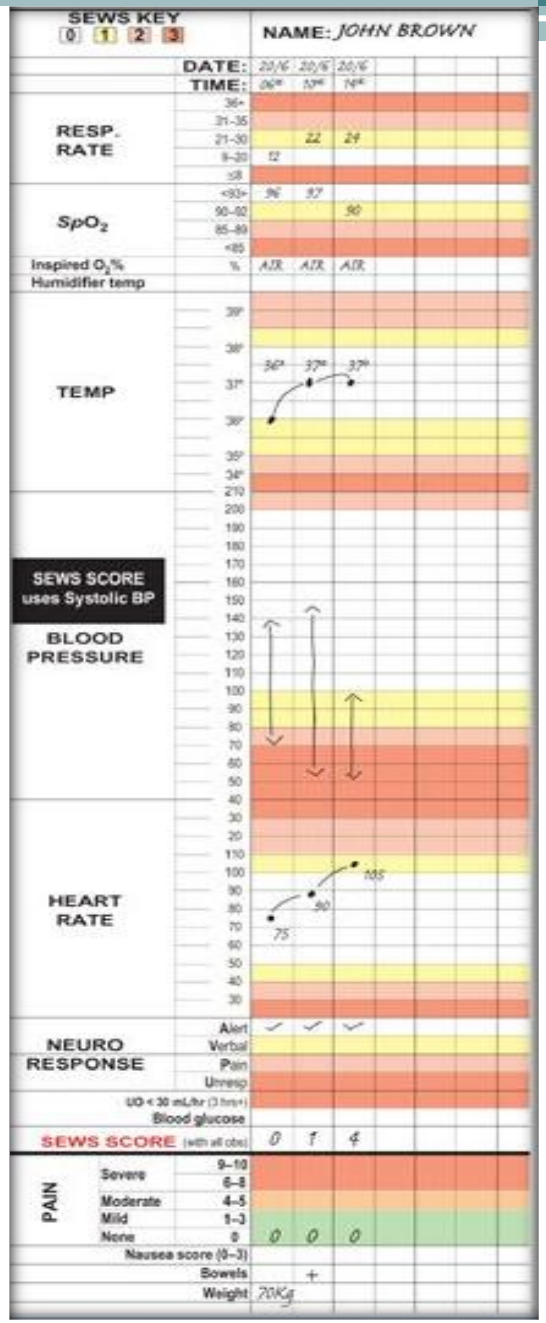
Recognition, initial assessment and resuscitation of critically ill patient

Patient may present with

- circulatory failure
- respiratory failure
- neurological failure
- renal failure
- multi-system failure
- septicemia or
- disseminated intravascular coagulation(DIC)

- So early recognition of severity of illness is crucial
- A number of approaches have been adopted to improve the recognition of critical illness

Standard Early Warning System (SEWS) chart


SEWS KEY
0 1 2 3
NAME: JOHN BROWN
DATE: 20/6 20/6 20/6
TIME: 06h 13h 14h
RESP. RATE
36+
31–35
21–30
9–20
≤8
22
24
12
SpO2
<93%
90–92
85–89
<85
96
97
90
Inspired O2%
Humidifier temp
%
AIR
AIR
AIR
TEMP
39°
38°
37°
36°
35°
34°
36°
37°
37°
SEWS SCORE uses Systolic BP
BLOOD PRESSURE
270
260
250
240
230
220
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
HEART RATE
110
100
90
80
70
60
50
40
30
105
90
75
NEURO RESPONSE
Alert
Verbal
Pain
Unresp
UO < 30 mL/hr (3 hrs+)
Blood glucose
SEWS SCORE (with all obs)
0
1
4
PAIN
Severe
Moderate
Mild
None
9–10
6–8
4–5
1–3
0
0
0
0
Nausea score (0–3)
Bowels
+
Weight
20Kg

SEWS chart

Recognition of critical illness: Standard early warning scores

- Record standard observations:
  - Respiratory rate
  - *Sp* O_2
  - Temperature
  - Blood pressure (BP)
  - Heart rate
  - Neurological response
- Note whether the observation falls in a shaded 'at-risk zone'
- Add the points scored and record total SEWS score on chart
- Do not add 'Pain' score to SEWS score

If SEWS score ≥ 6, doctor should assess the patient within 10 minutes

Assessment and initial resuscitation of the critically ill patient

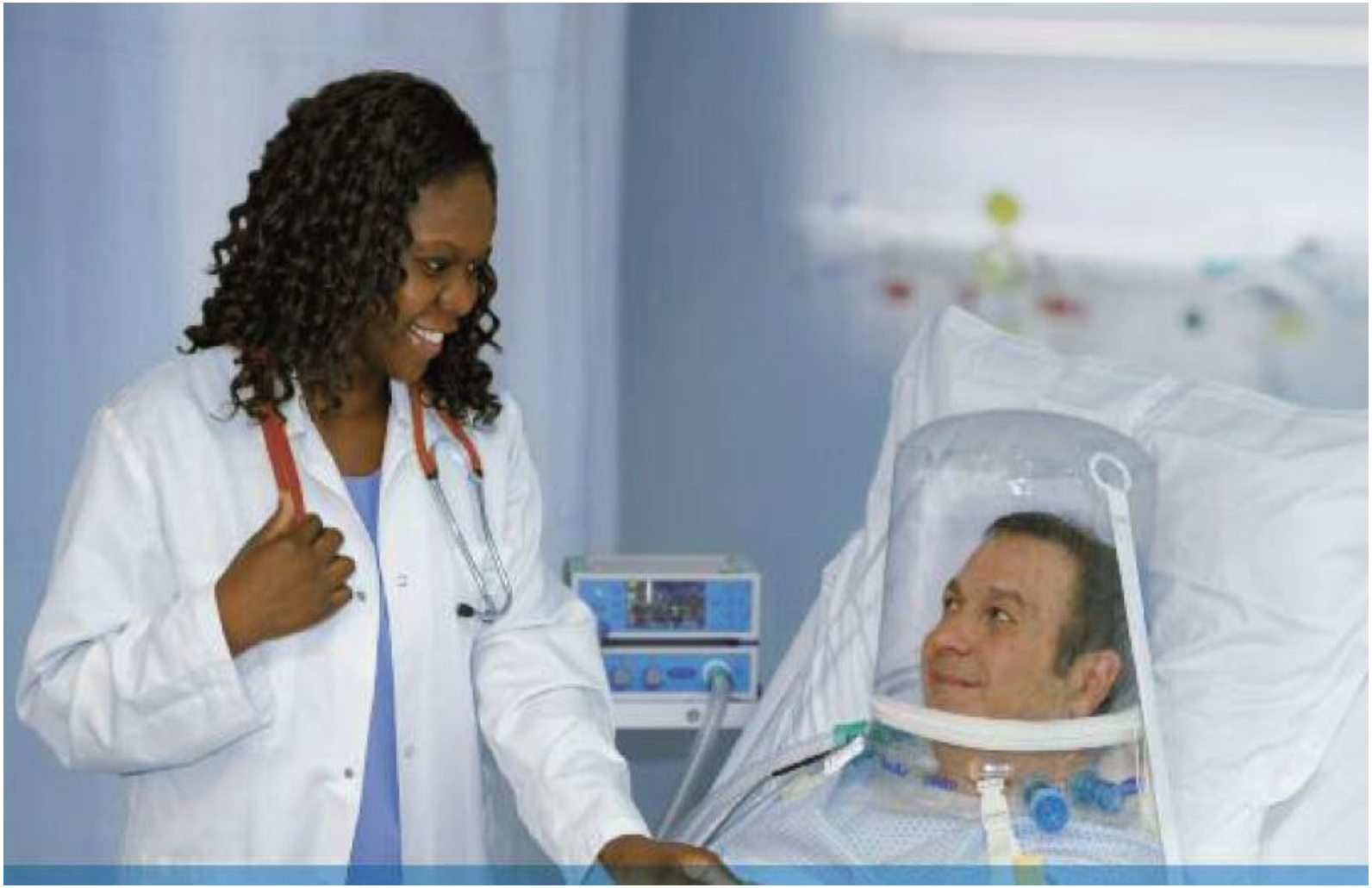
Airway and breathing

- If patient is conscious rapid history should be obtained
- Assessment of respiratory rate, volume, rhythm, character and symmetry.
- Look for accessory muscle use and sign of paradoxical chest/abdominal movement, manifest as a seesaw pattern of breathing.

Oxygen Supplement should be given to patients with

- Breathlessness
- Tachypnoeic or bleeding
- Chest pain
- Reduced conscious level.

- Critically ill should receive at least 60% oxygen initially
- High-concentration oxygen is best given using a mask at 15 L/min
- Oxygen Helmet can be used
- Arterial blood gases (ABG) should be checked to assess oxygenation, ventilation and metabolic state
- Pulse oximeter is ideal for monitoring
- Intubation and mechanical ventilation may be indicated



Conscious level

- Conscious level should be assessed using the Glasgow Coma Scale
- A score of 8 or less denotes coma and necessitates intervention
- Focal neurological signs, abnormal pupil size, symmetry or reaction to light should be assessed

Circulation

- Carotid and peripheral pulses should be palpated
- Venous access for the administration of drugs and/or fluids with 16 G cannula

Features of circulatory failure

hypovolaemia, cardiogenic shock

- Rapid, shallow respiration
- Cold, clammy skin
- Tachycardia
- Hypotension
- Drowsiness, confusion, irritability
- Oliguria
- Multi-organ failure

Vasodilated shock

- Rapid, shallow respiration
- Warm peripheries
- Tachycardia
- Hypotension and disproportionately low diastolic BP-early
- Drowsiness, confusion, irritability
- Oliguria
- Multi-organ failure

Assessment of Severity of Illness

- Numerous severity-of-illness (SOI) scoring systems have been developed and validated over the last two decades
- Most commonly utilized scoring systems
  - APACHE (acute physiology and chronic health evaluation) and
  - SAPS (simplified acute physiology score)

Common variables that include

- Age
- Vital signs
- Assessments of respiratory, renal, and neurologic function and
- Evaluation of chronic medical illnesses

APACHE II score is the sum of the

- Acute physiology score
  (vital signs, oxygenation, laboratory values) and
- Glasgow coma score, age, and chronic health points

- Worst values during first 24 h in the ICU should be used

- Updated versions of the APACHE scoring system now available (APACHE III and APACHE IV)
- APACHE III is derived from a larger database and utilizes a daily clinical update protocol to provide daily modification of predicted mortality
- APACHE IV uses a modified statistical model of logistic regression

The Saps Scoring System

- The SAPS II score, used more frequently in Europe
- This score is not disease-specific
- Incorporates three underlying disease variables (AIDS, metastatic cancer and hematologic malignancy)
- Severity of illness scoring systems cannot be used to predict survival in individual patients
- These tools should be used as important data to complement clinical bedside decision-making

INVESTIGATIONS AND MICROBIOLOGICAL SURVEILLANCE

Basic investigations on admission

- Full blood count
- Serum creatinine, blood urea and electrolytes (including Na, K, Cl, Ca, Mg, Phosphate)
- Liver function test
- Prothrombin time (PT)
- Activated partial thromboplastin time (APTT)
- Coagulation screening
- Arterial blood gas
- Blood glucose level

Additional tests on admission when indicated

- Septic / microbiology screen as indicated
- CXR
- ECG

Tests ordered daily

- FBC: Hb, TC, DC, platelet count
- Blood Urea
- Serum creatinine
- Serum Electrolytes
- Other tests only when indicated

Microbiological Surveillance

MRSA screening (nasal swab only)

- Patients who have been admitted for > 5 days in the ward
- Patients with previous positive cultures for MRSA either in the blood, tracheal aspirate or urine
- Patients admitted from other hospital
- Patients admitted from long-term care institutions e.g. nursing homes
- Patients on chronic renal dialysis

Tracheal aspirate for C&S

- May be done once a week in intubated patients

(not all positive cultures on routine surveillance are infective)

Management protocol in ICU

- Ongoing monitoring
- Continuous intravenous sedation
- Enteral feeding
- Inotropic and vasopressor support
- Intensive insulin therapy
- Lung protection strategy
- Stress related mucosal disease(SRMD) prophylaxis
- Weaning from mechanical ventilation

Ongoing monitoring

Monitoring the circulation

- Electrocardiogram (ECG)
- Blood pressure -MAP
- Central venous pressure (CVP)
- Pulmonary artery catheterisation and pulmonary artery 'wedge' pressure (PAWP)
- Cardiac output
- Urine output-lower limit of normal is 0.5 mL/hr/kg body weight
- Peripheral skin temperature
- Blood lactate, hydrogen ion and base excess/deficit

Monitoring respiratory function

- Oxygen saturation (SpO_2)
- Arterial blood gases (ABGs)
- Lung function
- Capnography
- Transcutaneous PCO_2

Continuous intravenous sedation

- Patients are to be assessed for sedation and agitation based on the revised Riker Sedation and Agitation scale every 4 hours
- Precaution
  - head injury
  - severe sepsis on high inotropic support
  - ARDS on high ventilatory support
  - tetanus
- midazolam and morphine
- Fentanyl may be used in
  - a. renal failure
  - b. hepatic failure

ENTERAL FEEDING

- Recommended energy intake of 25 kcal/kg/day and at least 1.2-1.5 g/kg/day of protein
- Blenderised diet should not be used
- All ventilated patients must receive nasogastric or orogastric tube
- Preferable to use 12FG in adults
- Early enteral feeding should be commenced within 24-48 hours after ICU admission
- Patients should preferably receive feeding continuously during the acute phase

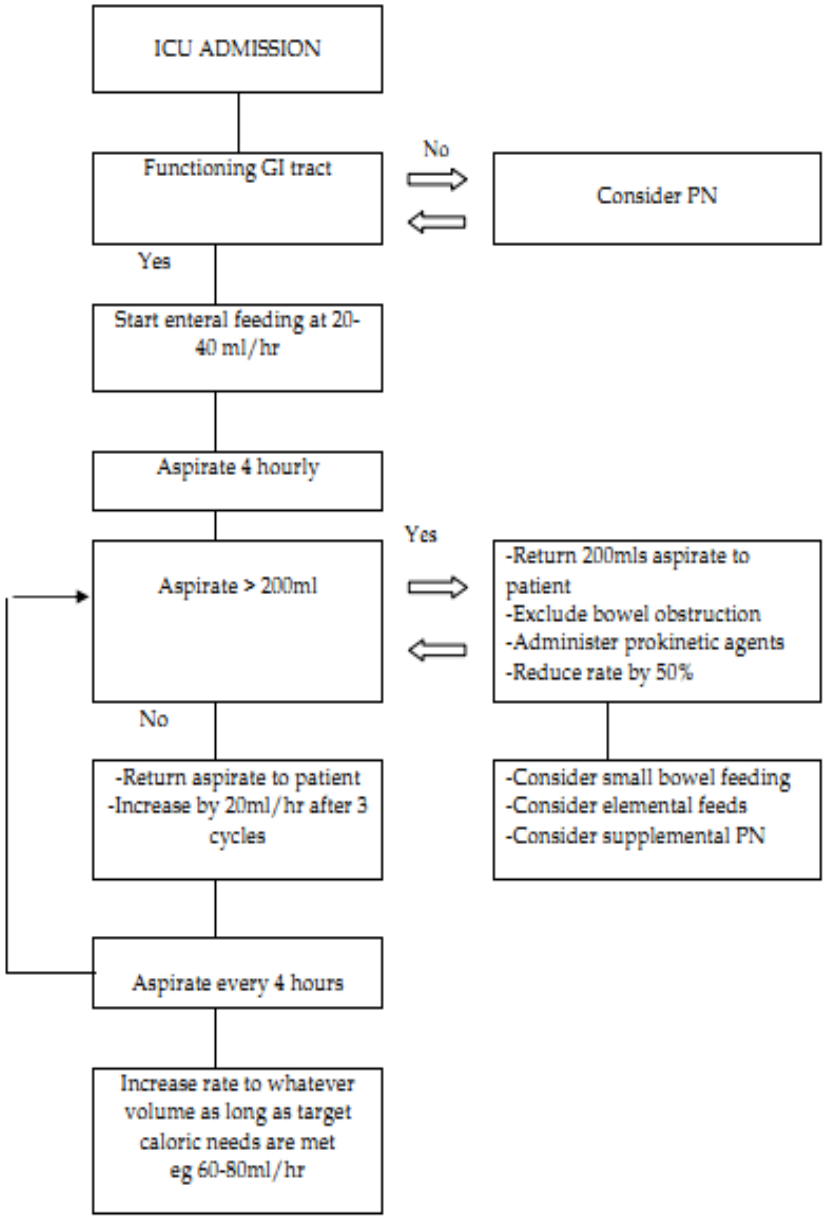
Continuous feeding

- Start at 20-40ml/hr continuously. Aspirate the feeding tube every 4 hours
- If aspirate < 200ml, return all aspirate. Increase rate by 20ml/hr every 3 cycles till a flow rate that meets the caloric needs of the patient
- If aspirate >200ml, return 200ml aspirate to patient and reduce rate by 50% of initial rate. Exclude bowel obstruction first. If there is no clinical evidence of bowel obstruction, administer prokinetic agents

Intermittent bolus feeding

- Start with 50ml every 3 hours. Aspirate before every feed.
- If aspirate < 200ml return aspirate to patient. Increase by 50ml after every 4 feeds. Increase by 100 ml/feed every 24 hr till caloric needs are met.
- If aspirate >200ml, return 200ml aspirate to patient and reduce by 50ml per feed

ALGORITHM FOR ENTERAL FEEDING (CONTINOUS METHOD)



INOTROPIC AND VASOPRESSOR SUPPORT

Inotropic and vasopressor support in Septic Shock

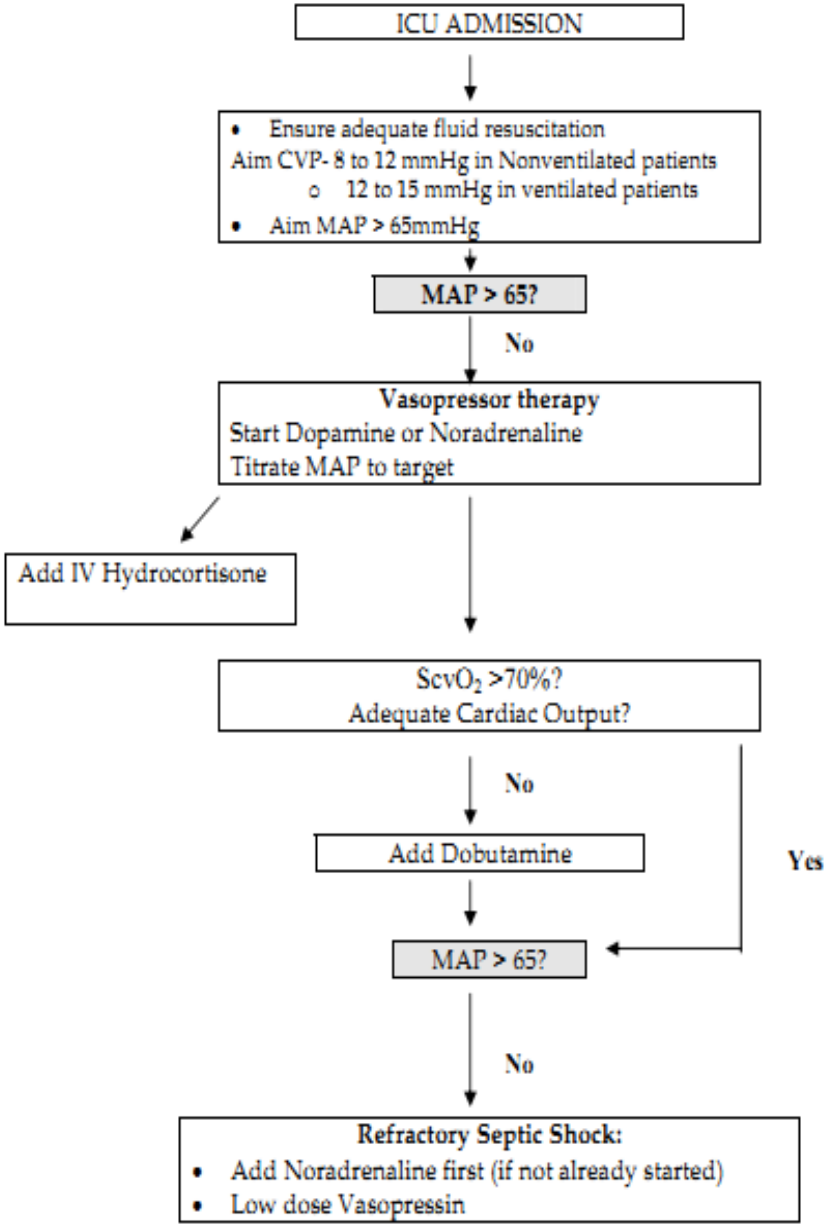
- Ensure adequate fluid resuscitation.
- Target CVP – for non ventilated patients is 8-12 mmHg and for ventilated patients is 12-15mmHg.
- Target MAP > 65mmHg

- Dopamine (200mg diluted in 50mls 0.9% NS or D5%)
  Dosage range 5-20mcg/kg/min

- IV hydrocortisone 50mg QID or 100mg TDS

- Noradrenaline (4mg diluted in 50mls 0.9% NS or D5%)
  Dosages range 0.02-1.5mcg/kg/min

INOTROPIC AND VASOPRESSOR SUPPORT IN SEPTIC SHOCK



Inotropic and vasopressor support in Cardiogenic Shock

- Dobutamine: 1st line drug

  dilute 250mg in 50mls of 0.9% NS or D5%

  to be used when MAP↓ (<65mmHg)

- Noradrenaline infusion if MAP drop (<60mmHg)
- Infusion adrenaline (3mg in 50mls of 0.9%NS or D5%) at 0.02-1.0 mcg/kg/min.
- use of inotropes is guided by cardiac output monitoring.
- consider intra aortic balloon pump and cardiac consult.

INTENSIVE INSULIN INFUSION

- To maintain tight control of blood glucose in critically ill patients
- In mechanically ventilated adults, intensive insulin therapy reduced mortality to 4.6% compared with a conventional treatment group which had a mortality rate of 8%.
- The greatest reduction in mortality involved deaths due to multi-organ failure with a proven septic focus.

AIM TO MAINTAIN BLOOD GLUCOSE LEVEL(BGL) 5.1-8.0 MMOL/L

ICU ADMISSION

Monitor BGL 2 hourly. Can be monitored less frequently when patient is stable.
(Minimum – 1/day)

If BGL > 8.0 mmol/l check again in 1 hour.
IF BGL STILL > 8.0 START INSULIN INFUSION

INITIAL INSULIN INFUSION RATE

BGL (mmol/l)	Infusion rate (U/h)
5.1-8.0	0
8.1-11.0	2
11.1-15.0	3
>15.1	4

- START or maintain 10% Dextrose infusion at 25ml/h until EN tolerated (i.e. 40 ml/hr with < 200 ml aspirate) or TPN started
- Check BGL HOURLY and adjust infusion rate until 2 consecutive hours require no rate change, then check BGL 2-4 hourly. If adjusting the insulin infusion rate or changing between dextrose/Enteral Nutrition/TPN, revert to hourly BGL monitoring.

ONGOING INSULIN INFUSION RATES
WHAT IS LATEST BLOOD GLUCOSE?

< 3.5

STOP INSULIN

Give 20-50 mls of 50% Dextrose

Check BGL in 15 min.
When BGL > 5.0 mmol/l, halve previous infusion rate

3.6-5.0

How much BGL changed since last value?

BGL ↓ by < 0.5 mmol/l	BGL ↓ by ≥ 0.5 mmol/l	Increasing trends
↓ infusion rate by 0.5 U/h	Halve infusion rate	No rate change

5.1-8.0

No rate change

8.1-11.0

How much BGL changed since last value?

Decreasing trends	Increasing ≥ 0.5 mmol/l
No rate change	↑ by 0.5 U/h

11.1-15

How much BGL changed since last value?

BGL ↓ by > 1.0 mmol/l	BGL ↓ by < 1.0 mmol/l	Increasing trends
No rate change	↑ infusion rate by 1U/h	

> 15

(Check ketone)

How much BGL changed since last value?

BGL ↓ by > 1.0 mmol/l	BGL ↓ by < 1.0 mmol/l	Increasing trends
No rate change	↑ infusion rate by 1U/h	

BGL is not ↓ after 2 increments of infusion rate in 2 hours

- To maintain serum glucose levels between 5 to 8 mmol/l in all ICU patients.
- Continuous intravenous insulin infusion (CIVII) through a pump is preferred
- Dilute 50 units of soluble insulin in 50 ml of normal saline in a syringe and deliver it by an infusion pump.
- Start CIVII with scale 1 or 2 initially.
- Blood glucose level (BGL) should be monitored at 2 h intervals.

Continuous intravenous insulin infusion

Blood glucose (mmol/l)	Scale 1 (U/h)	Scale 2	Scale 3	Scale 4	Scale 5	Scale 6	Scale 7	Scale 8
≥ 22	3.0	4.0	5.0	6.0	7.0	8.0	10.0	11.0
18-	2.5	3.5	4.0	5.0	6.0	6.0	8.0	9.0
14-	2.0	3.0	3.0	4.0	5.0	5.0	6.0	7.0
12-	1.5	2.5	2.5	3.0	4.0	4.0	4.0	5.0
10-	1.0	2.0	2.0	2.0	3.0	3.0	3.0	4.0
8-	1.0	1.5	1.5	1.5	2.0	2.0	2.5	3.0
6-	0.5	1.0	1.0	1.0	1.5	1.5	2.0	2.0
5-	0.5	0.5	0.5	0.5	1.0	1.0	1.5	1.5
< 5	***Stop IV insulin infusion and inform doctor***							

LUNG PROTECTIVE STRATEGY

Principles:

1. Minimise atelectrauma (under-recruitment injury)
- open up alveoli with recruitment manoeuvre
- keep alveoli open (prevent de-recruitment) by applying optimal PEEP

2. Minimise volutrauma (over-distension injury)
- keep plateau pressure < 30cm H_2O
- use low tidal volume ventilation 6ml/kg IBW

3. Minimise O_2 toxicity
- maintain FiO_2 below 0.6

4. Accept physiologic target outside normal range
- permissive hypercapnia
- permissive hypoxemia

Choose one of the 2 options:

- Step-wise incremental PEEP
- PCV with PEEP method

STRESS RELATED MUCOSAL DISEASE (SRMD) PROPHYLAXIS

Specific risk factors for SRMD

- mechanical ventilation (more than 48 hours)
- coagulopathy
- shock states (septic, haemorrhagic, cardiogenic, anaphylactic)
- severe head injury and neurosurgical patients
- severe burns (more than 30%)
- multiple organ failure

Prophylactic therapy for SRMD

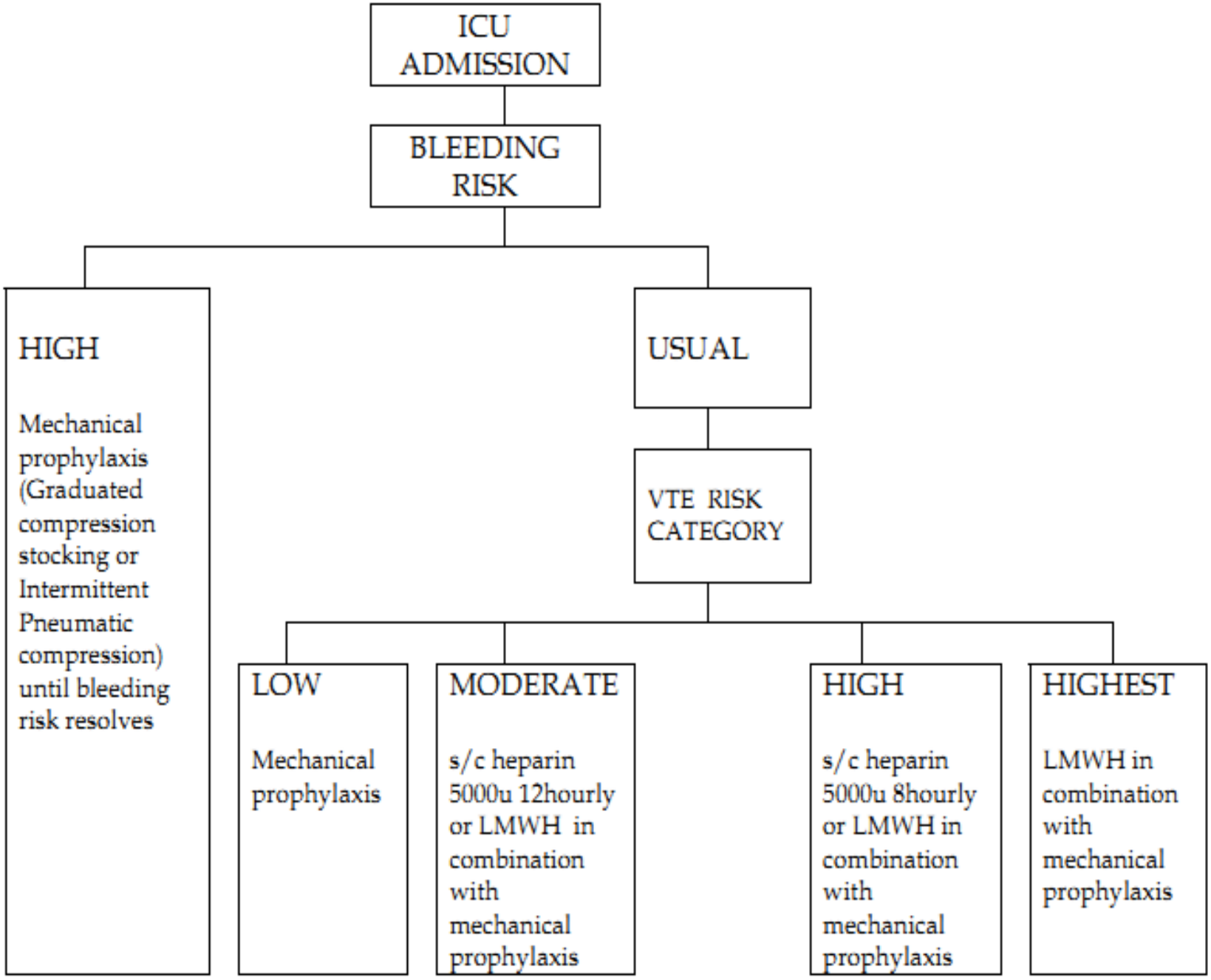
- IV Ranitidine 50 mg 8 hourly. Reduce dose to 50 mg 12 hourly in patients with renal failure
- IV Omeprazole or IV Pantoprazole 40 mg daily

VENOUS THROMBOEMBOLISM PROPHYLAXIS

- All patients should be assessed for their risk of venous thromboembolism (VTE)
- Accordingly, most patients should receive thromboprophylaxis
- If high risk of bleeding (eg. upper GIT bleeding, liver laceration etc.) use mechanical prophylaxis
- Combined pharmacologic and mechanical prophylaxis may provide greater protection

ABSOLUTE RISK FOR VTE

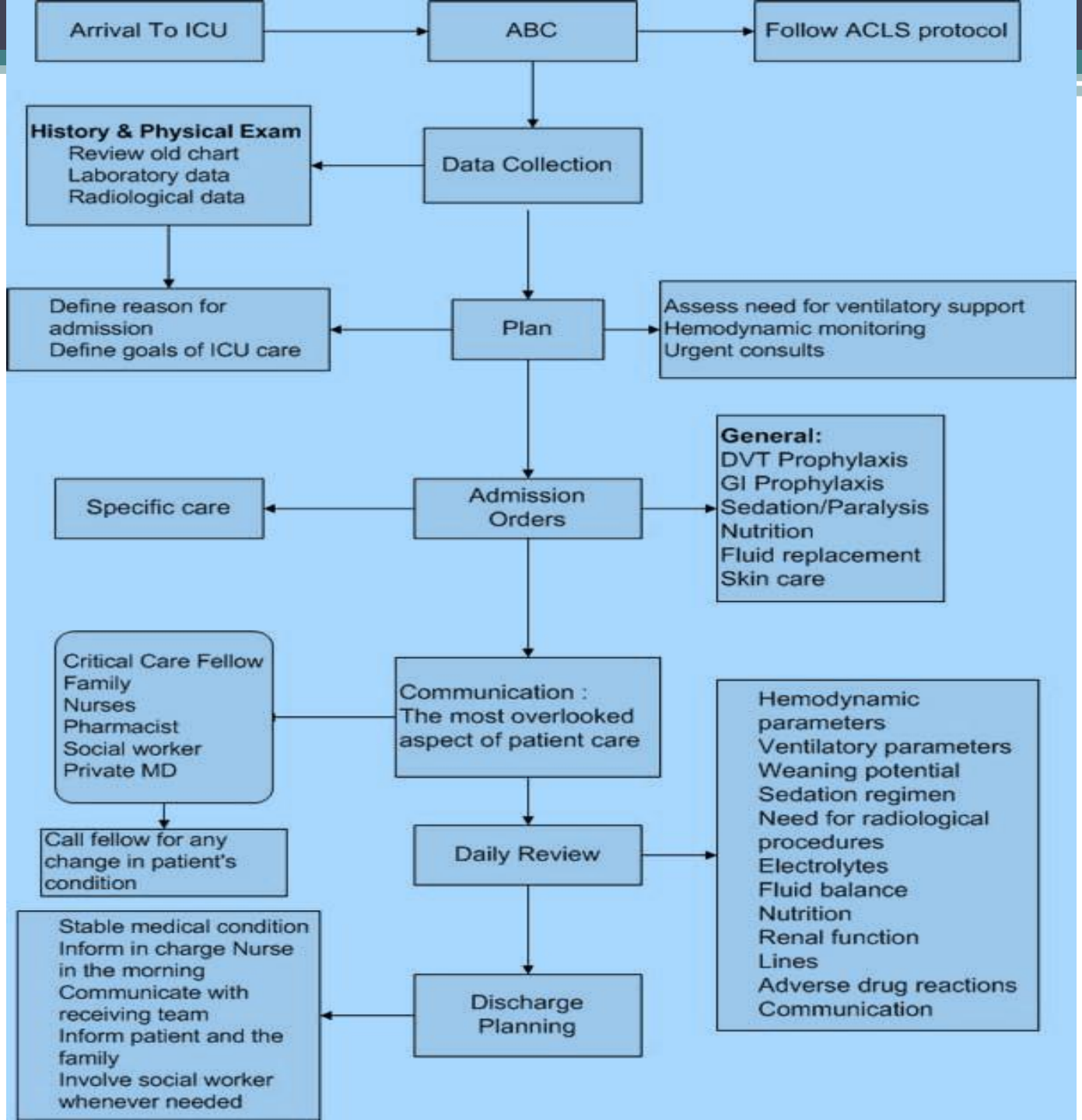
Patient category	Recommendation
Low risk eg. medical patients, immobilization, use of pharmacologic paralysis or sedation, heart failure	Mechanical prophylaxis
Moderate risk eg. general surgery, major gynecologic surgery, major urologic surgery, sepsis, vasopressor use, active medical condition	LMWH or s/c Heparin 5000 units 12 hourly in combination with mechanical prophylaxis
High risk eg. stroke, neurosurgery, previous VTE	LMWH or s/c Heparin 5000 units 8 hourly in combination with mechanical prophylaxis
Highest risk eg. spinal cord injury, major trauma hip/knee arthroplasty, hip fracture surgery	LMWH in combination with mechanical prophylaxis


ICU ADMISSION
BLEEDING RISK
HIGH
Mechanical prophylaxis (Graduated compression stocking or Intermittent Pneumatic compression) until bleeding risk resolves
USUAL
VTE RISK CATEGORY
LOW
Mechanical prophylaxis
MODERATE
s/c heparin 5000u 12hourly or LMWH in combination with mechanical prophylaxis
HIGH
s/c heparin 5000u 8hourly or LMWH in combination with mechanical prophylaxis
HIGHEST
LMWH in combination with mechanical prophylaxis

WEANING OR DISCONTINUATION FROM MECHANICAL VENTILATION

Start with assessment of readiness to wean:

- Initial problem has improved or resolved, improvement of respiratory failure
- $SpO_2 \geq 90\%$ or $PaO_2 \geq 60$ mmHg and $FiO_2 \leq 0.5$, $PaO_2/FiO_2 \geq 200$, and PEEP ≤ 8 cm H_2O, PS < 10, MV < 15 l/min, RR < 30/min
- Intact ventilatory drive and patient has spontaneous breathing effort
- Cardiovascular stability (no active cardiac ischemia, none or low dose of vasopressors/inotropes)
- Normal electrolytes (including Mg, Phosphate)
- Normal body temperature
- Adequate nutritional status
- Absence of major organ system failure


Arrival To ICU
ABC
Follow ACLS protocol
History & Physical Exam
Review old chart
Laboratory data
Radiological data
Data Collection
Define reason for admission
Define goals of ICU care
Plan
Assess need for ventilatory support
Hemodynamic monitoring
Urgent consults
General:
DVT Prophylaxis
GI Prophylaxis
Sedation/Paralysis
Nutrition
Fluid replacement
Skin care
Specific care
Admission Orders
Critical Care Fellow
Family
Nurses
Pharmacist
Social worker
Private MD
Communication : The most overlooked aspect of patient care
Hemodynamic parameters
Ventilatory parameters
Weaning potential
Sedation regimen
Need for radiological procedures
Electrolytes
Fluid balance
Nutrition
Renal function
Lines
Adverse drug reactions
Communication
Call fellow for any change in patient's condition
Daily Review
Stable medical condition
Inform in charge Nurse in the morning
Communicate with receiving team
Inform patient and the family
Involve social worker whenever needed
Discharge Planning

the Perfect ICU