

## (A) INTRODUCTION

### Definition

Intensive Care Medicine (ICM) is a medical subspecialty concerned with the prevention, diagnosis and management of patients who are critically ill and are under imminent threat of severe morbidity or mortality, due to the derangement of critical physiologic and organ system(s). An Intensivist is a specialist who is an expert in the diagnosis and management of all aspects of critical illness.

### Objective(s) of Training

This objective of this Training Programme is to produce specialists in ICM who are able to provide the total management required by critically ill patients, through administering management modalities appropriate to the patient's problems and needs, deployment and coordination of the ICU health care team, engaging health care professionals of other disciplines, and the management and organization of the physical environment. As such, the trainee should achieve the following during their formal period of training:

1. Acquire competencies in the prompt and effective management of urgent life threatening problems through systematic and prioritized approaches in problem identification, good grasp of the knowledge and concepts in pathophysiologies, developing practical skills in appropriate procedures and the prevailing recommended standards of management.
2. Acquire the knowledge and concepts, competency in skills and the use of equipment, systematic approach to problem identification, problem solving capabilities, attitudes towards the safe and effective management of the entire period of critical illness. These include the diagnosis and management of all pathological processes present, continuous life support, maintenance of basic physiological needs, ensuring comfort and alleviation of suffering, the prevention of hospital acquired complications, and the provision of end-of-life management.
3. Acquire the knowledge, concepts and communicative skills to facilitate appropriate psychological, emotional and social management of the patients' relatives, including end-of-life issues.
4. Acquire the knowledge and skills in other aspects of medicine, surgery, paediatrics, obstetrics, anaesthesiology, radiology and other specialties which are relevant in the treatment of critically ill patients.
5. Be conversant with the principles of medical ethics, with special emphasis on its application in critical illness and end of life issues.
6. Cultivate the attitude and skills to be a team player, either as a member or the leader, in the context of teams consisting of multidisciplinary personnel (ICM, other specialties, nursing, therapists etc).
7. Develop the clinical managerial competence to be the ICU "specialist in-charged", able to provide, lead and coordinate the overall management for patients, and where necessary to coordinate a team of other consultants for this purpose.
8. Develop the attitude and relational skills to facilitate coordinated inter-disciplinary care of patients, through amicable working relationships, effective communication processes, multi-disciplinary protocols and work processes.
9. Understand the organizational, administrative and managerial aspects of an ICU and how that would affect the prompt and effective delivery of care. Develop the ability to work within the limits of available resources and yet provide the best care for patients.

10. Develop capabilities to design and implement processes for clinical audits and quality improvement.
11. Be involved in research through participation in their design, implementation, data analysis and interpretation, and formal publication.
12. Understand the special concepts, requirements and processes for the provision of critical care in mass disaster situations (eg. epidemics, mass traumatic casualty events).
13. Acquire the capability to identify and modify the stresses and hazards that the ICU environment exerts on patients, their relatives and fellow healthcare providers, in order to facilitate the optimization of their wellbeing.
14. Develop and enquiring mind for clinical and scientific problems, and to adopt systematic and critical appraisal of available information.
15. Participate in educational activities of fellow healthcare providers of various disciplines (students, medical, nursing, respiratory therapy, physiotherapy, pharmacy, etc)
16. Develop the habit to constantly update oneself in the changes in Medicine, society and the world which requires adaptation of their practice.
17. Acquire a process of constant self-appraisal to improve one's areas of deficiencies in ICM.

## (B) PROGRAMME OVERVIEW

### Traineeship Duration For Advanced Specialty Training

Refer to Annex A for an overview of the traineeship duration and posting structure for Advanced Specialty Training in Intensive Care Medicine.

## (C) ADMISSION REQUIREMENTS

### Eligibility

#### C.1 Application for entry to programme

C.1.1 Candidates may apply for ICM AST programme with the JCST once they have either (1) exited from; or (2) have obtained appointment from JCST to be an AST, in one of the following base specialties:

- a) Anaesthesiology
- b) Internal Medicine
- c) Respiratory Medicine

C.1.2 The applicant must also provide evidence of having completed the Basic Specialist Training (BST) in one of the base specialties listed above, and have obtained one of the following postgraduate qualifications (or an approved foreign equivalent):

- a) Master of Medicine in Anaesthesiology, MMed(Anaes), or
- b) Mater of Medicine in Internal Medicine, MMed(Int Med), or
- c) Member of Royal College of Physicians, UK (MRCP(UK)), or
- d) Member of Royal College of Physicians, Ireland (MRCPI).

#### C.2 Process of AST appointment

C.2.1 Provisional ICM Trainee Successful candidates who are still undergoing AST and pending exit certification in their base specialties will be classified as "Provisional ICM Trainees" by the

SSTC (ICM). Successful candidates who have already exited from their base specialties will also be classified as “Provisional ICM Trainees” until they are performing their Core AST ICU Rotations (see D.2). Provisional ICM Trainees will submit a proposed plan for 12 months of Core ICU postings as part of the ICM AST rotations, to the JCST for approval.

C.2.2 Registered ICM Trainee Provisional ICM Trainees who have obtained exit certification from their base specialties will subsequently be appointed by JCST as “Registered ICM Trainees” for the period of their Core AST ICU rotations and training (exception for Trainees from Internal Medicine, see D.6 below).

### C.3 Exit requirement for ICM

The Registered ICM Trainee will be conferred the exit certification in ICM when all of the following have been fulfilled:

- a) Exit certification in one of the base specialties stated in C.1.1
- b) Completed 12 months of pre-requisite ICM-relevant postings (see D.1)
- c) Completed 12 months of Core ICU Postings (see D.2)
- d) Passed the ICM Exit Examinations organized by SSTC (ICM)/JCST (see section H)

### C.4 Other Base Specialties as entry requirements for ICM training

After the initial establishment of the ICM Training Programme, the SSTC (ICM) may consider the application of Specialist Training Committees (STC) of other Base Specialties (eg. Emergency Medicine, Cardiology, Surgery, etc) to be included as entry specialties. These Base Specialties may have to modify their programmes for BST and AST to include adequate components that are relevant to ICM. Until then, entry to the ICM AST is limited only for Anaesthesiology, Respiratory Medicine and Internal Medicine.

## (D) TRAINING SYLLABUS

### D.1 Pre-requisite ICM Relevant Postings (12 months)

#### D.1.1 Type of Postings

For Exit Certification, the trainees must provide evidence of having completed 12 cumulative months of ICM relevant postings. ICM relevant postings may be any one or a combination of the following:

- a) Anaesthesiology (minimum 3 months’ continuous postings)
- b) Respiratory Medicine (minimum 3 months’ continuous postings)
- c) Intensive Care Unit (minimum 3 months, continuously or in multiple shorter postings of at least 1 month each) – Trainee using ICU rotations as Pre-requisite ICM Relevant Postings would still need to complete 12 months’ Core ICU Postings (see D.2).

#### D.1.2 Combination of the Postings

For the postings stated in D.1.1, the trainee has the option of spending all 12 months in one type of posting, or have a combination of the different postings, subject to the minimum number of months stated for each type.

#### D.1.3 Relationship of Postings vs Base Specialty AST

For Trainees from the base specialties of Anaesthesiology and Respiratory Medicine, these posting must be done as part of their respective base specialty’s AST. For Trainees from the base specialty of Internal Medicine, at least 3 months of respiratory medicine must be done during their Internal Medicine AST, while the remaining 9 months of the ICM Relevant Postings may be done as a Registered ICM Trainee. (see D.6).

### D.2 Core ICU Postings (12 months)

D.2.1 The duration for this period of training is 12 months.

D.2.2 Approved Training Centres

This period must be spent entirely on clinical ICU work rotations, and in local or overseas units approved by the SSTC (ICM).

D.2.3 Adequate exposure to ICU Patient Types

To ensure good clinical experience with a wide spectrum of critically ill patients, the ICM Trainee must rotate to both Medical Type ICUs and Surgical Type ICUs to ensure good exposure to both “medical” and “surgical” types of critically ill patients. Such a requirement can also be achieved by the following possible combinations:

12 months of Core ICU Postings	
Possible Combination – 1	Possible Combination - 2
<ul style="list-style-type: none"> <li><u>12 months posting in a Multidisciplinary ICU unit</u>, of which up to 4 months may be spent in Subspecialty ICUs.</li> </ul> <p>The 4 months spent in subspecialty ICUs is limited to:</p> <ul style="list-style-type: none"> <li>maximum of 2 <u>Medical Type Subspecialty ICU</u> (maximum 1 month posting each)</li> <li>maximum of 2 <u>Surgical Type Subspecialty ICU</u> (maximum 1 month posting each)</li> </ul>	<ul style="list-style-type: none"> <li><u>6 months posting in MICU</u>, of which 2 months may be spent in <u>Medical Type Subspecialty ICU</u>:                             <ul style="list-style-type: none"> <li>Maximum of 2 Medical Type Subspecialty ICU (maximum 1 month posting each)</li> </ul> </li> </ul> <p><b>AND</b></p> <ul style="list-style-type: none"> <li><u>6 months posting in SICU</u>, of which 2 months may be spent in <u>Surgical Type Subspecialty ICU</u>:                             <ul style="list-style-type: none"> <li>Maximum of 2 Surgical Type Subspecialty ICU (maximum 1 month posting each)</li> </ul> </li> </ul>

- Approved Medical Type Subspecialty ICUs include (not exhaustive):  
Coronary Care Unit, Neurological ICU,
- Approved Surgical Type Subspecialty ICUs include (not exhaustive):  
Burns ICU, Cardiothoracic ICU, Neurosurgical ICU
- Definition The terms “MICU”, “SICU” and “Subspecialty ICUs” are defined based on the ICU structure in Singapore hospitals. Multidisciplinary ICUs are defined as ICUs that cater to all critically ill patients in the hospital without categorization based on surgical vs medical disciplines (eg. in Australia, New Zealand and Canada).

D.2.4 Time Period Requirements for completion of Core ICU postings

- These 12 months can be done continuously, or cumulatively in multiple shorter ICU postings, with each rotation lasting at least 1 month and consisting of at least 44 supervised hours per week.
- For trainees from Anaesthesiology and Respiratory Medicine, These 12 months must be completed within 3 years after obtaining Exit Certification from their base specialty.
- For trainees from Internal Medicine, these 12 months must be completed within 4 years after obtaining Exit Certification from their base specialty.

D.2.5 Supervisor

The ICM Trainee’s Core ICU Postings must be supervised by a JCST approved ICM Trainer from the Trainee’s home institution. If the posting is done outside the home institution, name(s) of the immediate supervisor at the training unit(s) must also be submitted to JCST through the SSTC (ICM) for approval prior to the commencement of the posting.

D.2.6 Submission of Proposed ICU Rotation Plan  
Provisional ICM Trainees must submit a proposed ICU rotation plan to SSTC (ICM) through JCST, for approval prior to commencement of their Core ICU training.

D.2.7 The structure of the Core ICU postings in relation to the base specialty AST programme will be different for the various base specialties of Anaesthesiology, Respiratory Medicine and Internal Medicine. The subsequent sections will describe these structures for each base specialty (D.4 to D.6).

### D.3 Competency Based Requirements

D.3.1 ICM Trainees must fulfill Competency Based Requirements during their period training. A portion of these may be obtained during their Pre-requisite ICM-relevant Postings (eg. specific technical skills), while the majority must be obtained during the Core ICU Postings (eg. specific pathophysiological conditions)

D.3.2 The fulfillment of these requirements must be verified and endorsed by the relevant training supervisors.

D.3.3 The details of these requirements will be specified in the Trainees' Log Books, and updates will be communicated with ICM Trainees.

### D.4 Posting Structure for Trainees from base specialty of Anaesthesiology (See Annex A for summary diagram)

D.4.1 Pre-requisite ICU Related Postings  
ICM Trainees from the base specialty of Anaesthesiology should complete their 12 months' pre-requisite ICM Relevant postings during their AST in Anaesthesiology.

D.4.2 Core ICU Postings  
Their 12 months' Core ICU Postings can only commence after obtaining Exit Certification in Anaesthesiology. The Trainee will be appointed by JCST as "Registered ICM Trainee" for these 12 months of training.

### D.5 Posting Structure for Trainees from base specialty of Respiratory Medicine (See Annex A for summary diagram)

D.5.1 Pre-requisite ICU Related Postings  
ICM Trainees from the base specialty of Respiratory Medicine should complete their 12 months' pre-requisite ICM Relevant Postings during their AST in Respiratory Medicine.

D.5.2 Core ICU Postings  
ICM Trainees from Respiratory Medicine have 2 options:

Option A The trainee may do the entire 12 months of Core ICU Postings after obtaining Exit Certification in Respiratory Medicine.

Option B For the compulsory 6 months of MICU Postings during the Respiratory Medicine AST, the trainee may structure it in a manner so as to exempt him/her from the 6 months' "Medical Type ICU postings" portion of the 12 months Core ICU Postings, through fulfilling the following:

- a) Proposed plans of these 6 months of MICU postings must be submitted to JCST and SSTC(ICM) for approval prior to commencement of the rotations.
- b) The MICU postings must be done in JCST approved training units.
- c) The trainee's MICU posting must be supervised by a JCST approved ICM Trainer.
- d) These 6 months can be done continuously, or cumulatively in multiple shorter ICU postings, with each rotation lasting at least 1 month and consisting of at least 44 supervised hours per week.

- e) The balance 6 months of “Surgical Type ICU Postings” must be done after the trainee has obtained Exit Certification in Respiratory Medicine.

D.5.3 The Trainee will be appointed by JCST as “Registered ICM Trainee” for the 12 months (as in D.5.2 Option A) or 6 months (as in D.5.2 Option B) of Core ICU Postings.

#### D.6 Posting Structure for Trainees from base specialty of Internal Medicine (See Annex A for summary diagram)

D.6.1 ICM Trainees from the base specialty of Internal Medicine must complete at least 3 months’ pre-requisite ICM Relevant Postings during their AST in Internal Medicine. It is ideal if they can complete the entire 12 months during their Internal Medicine AST, however, this is subject to the approval of STC (Internal Medicine) in consideration of training requirements for Internal Medicine, failing which, the balance period of ICU Relevant Postings would have to be done after the AST for Internal Medicine.

D.6.2 After obtaining Exit Certification in Internal Medicine, the trainee should then complete the balance period of pre-requisite ICM Relevant Postings and 12 months’ Core ICU Postings (total 12 to 21 months). The Trainee will be appointed by JCST as “Registered ICM Trainee” for these 12 to 21 months of training.

(Refer to Annex B for detailed training content and syllabus.)

### (E) INSTITUTIONAL REQUIREMENTS (FACILITIES & RESOURCES)

#### TRAINING DELIVERABLES

All training units must provide all trainees, except for SAF sponsored trainees, (irrespective of the specialties pursued) with the training deliverables, as follows:

- a) at least one session (half day) of protected time per week to be dedicated to pure training/learning activities.
- b) 12 days of study leave per year for their training activities (e.g. in-training exams and reviews).

#### TRAINING REQUIREMENTS

To achieve the objectives of training, all Training Programmes must ensure that each ICM Trainee receives the appropriate level of supervised exposure to an adequate number of critically ill patients, participates in an organized didactic program, develops and executes a guided research project, and is allowed to develop leadership and management skills in caring for the critically ill in an ICU. A graduated progression during the subspecialty training should lead the clinician to increasing responsibility and independent decision making. It is essential that this training and experience occur in appropriately staffed and equipped ICUs under the direction of certified critical care physicians. Since not all clinical problems will occur during the advanced training program, an exhaustive, detailed didactic curriculum must supplement the clinical experience. Each ICM Trainee has unique strengths and weaknesses, and it is the responsibility of the program to ensure that each trainee achieves these competencies. The program must evaluate its effectiveness in developing competent intensivists and make changes based on these evaluations.

### (F) SUPERVISION OF TRAINEES

All AST trainees will be supervised by a designated consultant/ supervisor but in general all the consultant staff will be duty bound to take an active part in teaching. Assessment of progress and log should take place at least 6 monthly.

The supervisors should be full-time and in full Intensive Care Medicine Practice.

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Associate Consultants/supervisor may supervise up to a maximum of 2 BSTs or 1 BST and 1 AST (with minimum of 2 years training gap. Ee.g. First year Associate Consultant may supervise 1<sup>st</sup> year AST)

## (G) ASSESSMENT AND FEEDBACK

### Logbook

All trainees are expected to keep a log book which will be reviewed on a monthly basis by the main supervisor. The log book will have a record of cases managed or consulted. Notes should be made regarding difficult or complicated cases. CME activities should also be recorded.

All other teaching experiences e.g. conferences, seminars, papers presented should also be recorded.

### Assessment

1. The trainee will be continuously assessed by the Training Supervisors during their clinical postings. Training assessment forms formulated by the SSTC (ICM) will be issued to the respective Training Supervisors and these forms must be submitted to the SSTC (ICM) after each clinical posting.
2. Trainees are required to repeat the particular posting(s) if they failed to obtain a satisfactory report. This implies that the training period might be extended.
3. Trainees need to log in the procedures and review by the SSTC (ICM) every 6 monthly.

### Feedback

Six-monthly interviews with the trainees should be conducted to ensure that the training objectives for each rotation have been adequately met, as well as to monitor for any difficulties in workload and training activities. Feedback forms should also be provided at the end of each posting, and the programme supervisor is responsible for collating the results and instituting the appropriate changes to the training programmes.

## (H) EXIT EXAMINATION

### Introduction

1. The Exit Examination will serve as the final independent evaluation of the trainee's adequacy in knowledge, concepts and clinical evaluation of patients.
2. The Panel of Examiners will be appointed by the Joint Committee for Specialist Training (JCST), with recommendations from the Subspecialist Training Committee (SSTC) for ICM.
3. Candidates will only be eligible to sit for the Exit Examination upon successful completion of all the sub-specialty postings and training requirements (acquired satisfactory reports from respective Training Supervisors) during the Advanced Specialist Training (AST) period.

### Examination Format

1. The examination will consist of 2 sections:
  - i) Multiple Choice Questions
  - ii) Viva/ Clinical Sections
2. Passing the entire examination requires a pass in all of the sections above.

## (I) OVERSEAS TRAINING

Approval for accreditation for training programmes conducted in overseas centres has to be sought prospectively from JCST through the SSTC.

## (J) SPECIALIST ACCREDITATION WITH MINISTRY OF HEALTH

Having satisfied the panel of Exit Examiners, candidates will be recommended to JCST for certification in Intensive Care Medicine, after which, applications for specialist accreditation in ICM may be submitted to the Ministry of Health.

## (K) APPOINTMENT AS ICM TRAINER BY JCST

Once accredited as a specialist in ICM by the SAB as per point 8, the candidate will be eligible to be appointed by JCST to assume the role of an ICM trainer in an approved local ICM Training Unit.

## (L) GENERAL GUIDELINES

Please refer to Annex 1 for General JCST Guidelines on the following:

- Leave Guidelines
- Training Deliverables
- Retrospective Recognition
- Changes to Training Period
- Part-time Training
- Overseas Training
- Withdrawal of Traineeship
- Exit Certification

**POSTING STRUCTURE FOR ADVANCED TRAINING IN INTENSIVE CARE MEDICINE**  
(Summary Diagram for sections D.4 – D.6)

	Type of Posting	ICM AST from Respiratory Medicine		ICM AST from Anaesthesiology	ICM AST from Internal Medicine		
		Option A	Option B		Option A	Option B	Option C
Period of AST for base specialty: Possible combinations of Pre-requisite ICM Relevant Postings:	Resp Med	12 mths	12 mths	0 mths	3 mth	6 mth	12 mth
	Anaesthesiology	0 mths	0 mths	12 mths	0 mth	0 mth	0 mth
	ICU	0 mths – if MICU postings don't fulfill ICM criteria	6 mth – must fulfill ICM Criteria	0 mths	0 mth	6 mth	0 mth
Status at Base Specialty Exit		Exit Respiratory Medicine	Exit Respiratory Medicine	Exit Anaesthesiology	Exit Internal Medicine	Exit Internal Medicine	Exit Internal Medicine
		Completed ICM relevant postings	Completed ICM relevant postings + waived 6 mths of core MICU posting	Completed ICM relevant postings	Lack 9 mths of ICM relevant postings	Completed ICM relevant postings	Completed ICM relevant postings
Period of AST for ICM: Required Core ICU Postings ± ICM relevant postings		12 mths ICU	6 mths ICU	12 mths ICU	12 mth ICU + 9 mth ICM relevant posting	12 mth ICU	12 mth ICU
Total period from beginning of Base specialty AST to end of AST ICM required postings		AST RM : 3 yr Core ICU: 1 yr Total : 4 yr	AST RM : 3 yr Core ICU : 0.5 yr Total : 3.5 yr	AST Anae : 2 yr Core ICU : 1 yr Total : 3 yr	AST IM : 2 yr Core ICU: 1 yr ICU relev: 0.75yr Total = 3.75 yr	AST IM : 2yr Core ICU: 1yr Total : 3yr	AST IM :2yr Core ICU: 1yr Total : 3yr

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## TRAINING CONTENT AND SYLLABUS

The following lists of credentials and cognitive and procedural skills are not intended to serve as a complete list of all topics that should or must be covered during ICM training. The lists are only intended to serve as guides for both programs and individuals participating in the educational process. Many unique illnesses may exist in particular patient populations that are less well represented in this list, and we again remind the reader that this list is in no way intended to be a complete list of all topics.

## 1.1 Specific Skills Courses

At the time of exit, each trainee must demonstrate current provider and/or instructor status in all of the following:

- i. Basic Cardiac Life Support
- ii. Advanced Cardiac Life Support (NRC Singapore)
- iii. Fundamentals of Critical Care Support (SCCM, USA) or BASIC Course– the trainee only needs provide evidence of previous attendance and having passed the Course test, currency is not required.

## 1.2 Cognitive and Management Skills in direct patient care delivery

Acquisition of the following cognitive skills by trainees could be ensured by the training supervisor through the use of any of a number of techniques, including didactic lectures, journal club sessions, and illustrative case reports.

## 1.2.1 Cardiovascular Physiology, Pathology, Pathophysiology, and Therapy

- a. Shock (hypovolemic, neurogenic, septic, cardiogenic) and its complications
- b. Myocardial infarction and its complications
- c. Cardiac rhythm and conduction disturbances
- d. Indications for and types of pacemakers
- e. Pulmonary embolism-thrombus, air, fat, amniotic
- f. Pulmonary edema-cardiogenic, noncardiogenic
- g. Cardiac tamponade and other acute pericardial diseases
- h. Acute and chronic life-threatening valvular disorders
- i. Acute aortic and peripheral vascular disorders, including arteriovenous fistulas
- j. Acute complications of cardiomyopathies and myocarditis
- k. Vasoactive and inotropic therapy
- l. Pulmonary hypertension and cor pulmonale
- m. Complications of angioplasty
- n. Principles of oxygen transport and utilization
- o. Hemodynamic effects caused by ventilatory assist devices
- p. Thrombolytic and anticoagulant therapy
- q. Perioperative management of patient undergoing cardiovascular surgery
- r. Recognition, evaluation, and management of hypertensive emergencies and urgencies
- s. Congenital heart disease and the physiologic alterations with surgical repair
- t. Noninvasive methods of cardiac output assessment (i.e., aortic Doppler, indicator dilution techniques, etc.)

## 1.2.2 Respiratory Physiology, Pathology, Pathophysiology, and Therapy

- a. Acute respiratory failure
  - i) Hypoxemic respiratory failure including acute respiratory distress syndrome
  - ii) Hypercapnic respiratory failure
  - iii) Acute on chronic respiratory failure
- b. Status asthmaticus
- c. Smoke inhalation, airway burns
- d. Aspiration
- e. Chest trauma (e.g., flail chest, pulmonary contusion, rib fractures)
- f. Bronchopulmonary infections including bronchiolitis
- g. Upper airway obstruction
- h. Near drowning
- i. Bronchopleural fistulas
- j. Pulmonary mechanics and gas exchange

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- k. Oxygen therapy
- l. Hyperbaric oxygenation
- m. Mechanical ventilation
  - i) Pressure and volume modes of mechanical ventilators
  - ii) Positive end-expiratory pressure, intermittent mandatory ventilation, continuous positive airway pressure, high-frequency ventilation, inverse ratio ventilation, pressure-support ventilation, volume support (airway pressure release ventilation, pressure-regulated volume control ventilation), negative pressure ventilation, differential lung ventilation, pressure control and noninvasive ventilation, split lung ventilation, one-lung ventilation
  - iii) Indications for and hazards of mechanical ventilation
  - iv) Barotrauma and volutrauma
  - v) Criteria for extubation and weaning techniques
  - vi) Extracorporeal membrane oxygenation
  - vii) Permissive hypercapnia
  - viii) Liquid ventilation
  - ix) Pulmonary surfactant therapy
  - x) High-frequency oscillatory ventilation
- n. Airway maintenance
  - i) Emergency airway management
  - ii) Endotracheal intubation
  - iii) Tracheostomy, open and percutaneous
  - iv) Long-term intubation vs. tracheostomy
- o. Ventilatory muscle physiology, pathophysiology, and therapy, including polyneuropathy of the critically ill and prolonged effect of neuromuscular blockers
- p. Pleural diseases
  - i) Empyema
  - ii) Pleural effusion
  - iii) Pneumothorax
  - iv) Hemothorax
- q. Pulmonary chylothorax, hemorrhage, and hemoptysis
- r. Nitric oxide and prostaglandin therapies
- s. Noninvasive ventilation
- t. Positional therapy (i.e., prone position, rotational therapy)
- u. Interpretation of chest radiographs and correlation with clinical status

### 1.2.3 Renal Physiology, Pathology, Pathophysiology, and Therapy

- a. Renal regulation of fluid balance and electrolytes
- b. Renal failure: Prerenal, renal, and postrenal
- c. Derangements secondary to alterations in osmolality and electrolytes
- d. Acid-base disorders and their management
- e. Principles of renal replacement therapy and associated methodologies (hemodialysis, peritoneal dialysis, ultrafiltration, continuous arteriovenous hemofiltration, and continuous veno-venous hemofiltration)
- f. Interpretation of urine electrolytes
- g. Evaluation of oliguria
- h. Drug dosing in renal failure
- i. Rhabdomyolysis
- j. Systemic diseases that involve the kidney (thrombotic thrombocytopenic purpura, hemolytic uremic syndrome)

### 1.2.4 Central Nervous System Physiology, Pathology, Pathophysiology, and Therapy

- a. Coma
  - i) Metabolic
  - ii) Traumatic
  - iii) Infectious
  - iv) Mass lesions
  - v) Vascular-anoxic or ischemic
  - vi) Drug induced
  - vii) Assessment and prognosis

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- b. Hydrocephalus and shunt function and dysfunction
- c. Psychiatric emergencies
- d. Perioperative management of patient undergoing neurologic surgery
- e. Brain death evaluation and certification
- f. Diagnosis and management of persistent vegetative states
- g. Management of increased intracranial pressure, including intracranial pressure monitors
- h. Status epilepticus
- i. Neuromuscular disease causing respiratory failure
  - i) Guillain-Barré
  - ii) Amyotrophic lateral sclerosis
  - iii) Myasthenia gravis
  - iv) Myopathies (Duchenne's, etc.)
  - v) Neuropathy of critical illness
- j. Traumatic and nontraumatic intracranial bleed
  - i) Subarachnoid
  - ii) Intracerebral
  - iii) Epidural
  - iv) Others (subdurals)
  - v) Traumatic brain injury
  - vi) Axonal shear injury
- k. Conscious and deep sedation
- l. Pain management: Intravenous, oral, transdermal, and regional and axial
- m. Neuromuscular blockade: Use, monitoring, and complications

#### 1.2.5 Metabolic and Endocrine Effects of Critical Illness

- a. Colloid osmotic pressure
- b. Nutritional support
  - i) Enteral and parenteral
  - ii) Evaluation of nutritional needs including indirect calorimetry
  - iii) Immunonutrition and specialty formulas
- c. Endocrine
  - i) Disorders of thyroid function (thyroid storm, myxedema coma, sick euthyroid syndrome)
  - ii) Adrenal crisis and insufficiency (primary and secondary)
  - iii) Disorders of antidiuretic hormone metabolism
  - iv) Diabetes mellitus
    - Ketotic and nonketotic hyperosmolar coma
    - Hypoglycemia
  - v) Pheochromocytoma
  - vi) Insulinoma
  - vii) Disorders of calcium, magnesium, and phosphate balance
  - viii) Inborn errors of metabolism
- d. Electrolyte disorders including Na, K, Mg, Ca, PO<sub>4</sub>.
- e. Glucose management

#### 1.2.6 Infectious Disease Physiology, Pathology, Pathophysiology, and Therapy

- a. Antibiotics
  - i) Antibacterial agents including aminoglycosides, penicillins, cephalosporins, quinolones, and newer emerging classes of antibiotics
  - ii) Antifungal agents
  - iii) Antituberculosis agents
  - iv) Antiviral agents
  - v) Agents for parasitic infections
- b. Infection control for special care units
  - i) Development of antibiotic resistance
  - ii) Universal precautions
  - iii) Isolation and reverse isolation
- c. Anaerobic infections
- d. Sepsis definitions (sepsis, severe sepsis, septic shock)
- e. Systemic inflammatory response syndrome

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- f. Tetanus
- g. Hospital-acquired and opportunistic infections in the critically ill
- h. Adverse reactions to antimicrobial agents
- i. ICU support of the immunosuppressed patient
  - i) Acquired immunodeficiency syndrome
  - ii) Transplant
  - iii) Oncologic
- j. Infectious risks to healthcare workers
- k. Evaluation of fever in the ICU patient
- l. Biological modifiers (activated protein C, tissue factor, etc.)
- m. Mechanisms of antibiotic resistance

#### 1.2.7 Physiology, Pathology, Pathophysiology, and Therapy of Acute Hematologic and Oncologic Disorders

- a. Acute defects in hemostasis
  - i) Thrombocytopenia/thrombocytopathy
  - ii) Disseminated intravascular coagulation
- b. Anticoagulation; fibrinolytic therapy
- c. Principles of blood component therapy
  - i) Packed red blood cell transfusions
  - ii) Fresh frozen plasma transfusions
  - iii) Platelet transfusions
  - iv) Cryoprecipitate transfusions
  - v) Specific coagulation factor concentrates
  - vi) Albumin, plasma protein fraction
  - vii) Hemoglobin substitutes
  - viii) Pharmacologic agents that modify the need for transfusion (i.e., aminocaproic acid, aprotinin)
  - ix) Erythropoietin
- d. Acute hemolytic disorders including thrombotic microangiopathies
- e. Acute syndromes associated with neoplastic disease and antineoplastic therapy
- f. Sickle cell crisis and acute chest syndrome
- g. Plasmapheresis
- h. Prophylaxis against thromboembolic disease
- i. ICU-acquired anemia

#### 1.2.8 Physiology, Pathology, Pathophysiology, and Therapy of Acute Gastrointestinal, Genitourinary, and Obstetrical-Gynecologic Disorders

- a. Acute pancreatitis with shock
- b. Upper gastrointestinal bleeding, including variceal bleeding
- c. Lower gastrointestinal bleeding
- d. Acute and fulminant hepatic failure
- e. Toxic megacolon and pseudo-obstruction syndromes (i.e., Ogilvie's)
- f. Acute perforations of the gastrointestinal tract
- g. Ruptured esophagus
- h. Acute inflammatory diseases of the intestine
- i. Acute vascular disorders of the intestine, including mesenteric infarction
- j. Obstructive uropathy, acute urinary retention
- k. Urinary tract bleeding
- l. Toxemia of pregnancy, amniotic fluid embolism, HELLP (hemolysis, elevated liver function tests, and low platelet count) syndrome, ovarian hyperstimulation
- m. Hydatidiform mole
- n. Perioperative management of surgical patients
- o. Stress ulcer prophylaxis
- p. Drug dosing in hepatic failure
- q. Acalculous cholecystitis
- r. Postoperative complications including fistulas, wound infection, and evisceration
- s. Placenta previa and abruption
- t. Peripartum cardiomyopathy

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### 1.2.9 Environmental Hazards

- a. Drug overdose and withdrawal
  - i) Barbiturates
  - ii) Narcotics
  - iii) Salicylates
  - iv) Alcohols
  - v) Cocaine
  - vi) Tricyclic antidepressants
  - vii) Acetaminophen
  - viii) Others
- b. Temperature-Related Injuries
  - i) Hyperthermia, heat shock
  - ii) Hypothermia, frostbite
- c. Envenomation
- d. Altitude sickness
- e. Decompression sickness
- f. Skin and wound care
- g. Biological and chemical terrorism
- h. Radiation exposure

### 1.2.10 Immunology and Transplantation

- a. Principles of transplantation (organ donation, procurement, preservation, transportation, allocation, implantation, maintenance of organ donors, national organization of transplantation activities)
- b. Immunosuppression
- c. Organ transplantation: Indications preoperative and postoperative care
- d. Transplant-related infectious disease

### 1.2.11 Trauma, Burns

- a. Initial approach to the management of multiple system trauma
- b. Central nervous system trauma (brain and spinal cord)
- c. Skeletal trauma, including the spine and pelvis
- d. Chest trauma, blunt and penetrating
- e. Abdominal trauma, blunt and penetrating
- f. Crush injury
- g. Burns
- h. Electrical injury

### 1.2.12 Monitoring, Bioengineering, Biostatistics

- a. Prognostic indexes, severity, and therapeutic intervention scores
- b. Principles of electrocardiographic monitoring, measurement of skin temperature and resistance, transcutaneous measurements
- c. Invasive hemodynamic monitoring
  - i) Principles of strain gauge transducers
  - ii) Signal conditioners, calibration, gain, adjustment
  - iii) Display techniques
  - iv) Principles of arterial, central venous, and pulmonary artery pressure catheterization and monitoring
  - v) Assessment of cardiac function and derived hemodynamic variables
- d. Noninvasive hemodynamic monitoring
- e. Electrical safety
- f. Thermoregulation
- g. Central nervous system brain monitoring (intracranial pressure, cerebral blood flow, cerebral metabolic rate, electroencephalogram, jugular venous bulb oxygenation, transcranial Doppler)
- h. Respiratory monitoring (airway pressure, intrathoracic pressure, tidal volume, pulse oximetry, deadspace/ tidal volume ratio, compliance, resistance, capnography, pneumotachography)
- i. Metabolic monitoring (oxygen consumption, carbon dioxide production, respiratory quotient, indirect calorimetry)

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- j. Use of computers in critical care units
- 1.2.13 Ethics, Legal issues and End-of-life care
- a. Ethical decision and consent issues
  - b. End-of-life decision making and care
  - c. Futility, foregoing life-sustaining treatment and Do-Not-Resuscitate Orders
  - d. Certification of brain death
  - e. Management of brain dead patients and organ procurement
  - f. Major ethical principles
  - g. Advanced Medical Directives, Living Wills, Power of Attorney
- 1.2.14 Administration and management
- a. Physical design, environment, organisation, standards and staffing models for the ICU
  - b. Effective record keeping
  - c. Patient triage and resource allocation
  - d. Team building and management
  - e. Patient safety, quality, workflow and systems improvement processes
  - f. Cost effectiveness in financial management
  - g. Information technology in the ICU
- 1.2.15 Disaster Management / Health hazards to staff
- a. Contagious diseases/bioterrorism
    - i) Personal + staff protection
    - ii) Hospital and ICU infection control processes
    - iii) Workflow, logistic deployment
  - b. Mass traumatic casualty situations
    - ii) Workflow, logistic deployment
    - iii) Priority in management, triage
  - c. Attacks using hazardous materials (HAZMAT)
    - i) Personal + staff protection
    - ii) Work processes
    - iii) Treatment issue for individual agents
- 1.3 Core Procedural Skills
- In addition to practical training in the following procedural skills, the resident must have an understanding of the indications, contraindications, complications, and pitfalls of these interventions. Due to the variability of individual training programs, practical experience may be limited for some procedures.
- 1.3.1 Airway Management and Respiratory System
- a. Maintenance of an open airway in the nonintubated patient
  - b. Ventilation by bag-mask
  - c. Administration of oxygen therapy and relevant equipment
  - d. Tracheal intubation and long term care of endotracheal tube
  - e. Cricothyrotomy
  - f. Tracheostomy – percutaneous tracheostomy, care/change of tracheostomy tube
  - g. Management of pneumothorax (needle, chest tube insertion, drainage system)
  - h. Management of Pleural Effusions, Haemothorax
  - i. Fiberoptic bronchoscopy, bronchoscopic removal of secretions and mucous plugs
  - j. Practical operation of mechanical ventilators (including non-invasive ventilation)
- 1.3.2 Circulation
- a. Arterial puncture and cannulation
  - b. Insertion of central venous catheters
  - c. Pericardiocentesis in acute tamponade
  - d. Dynamic electrocardiogram interpretation
  - e. Cardioversion and defibrillation
  - f. Pulmonary artery catheterisation and its clinical application
  - g. Transcutaneous pacing

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- h. Electrocardiographic monitoring
  - i. Operation of syringe and infusion pumps
  - j. Operation of intra-aortic assist devices
  - k. Use of rapid infusor devices for massive haemorrhage
- 1.3.3 Central Nervous System
- a. Lumbar puncture
  - b. Practical management of intra cranial pressure monitoring systems, ventricular drainage systems.
  - c. Insertion and practical operations of jugular venous catheter.
- 1.3.4 Renal System
- a. Insertion of haemodialysis catheters and its care
  - b. Practical management of Continuous Extracorporeal Blood Purification.
  - c. Practical management of peritoneal dialysis.
  - d. Practical management of intermittent haemodialysis
- 1.3.5 Gastrointestinal System
- a. Insertion of transoesophageal devices (eg. Nasogastric tube, tonometry)
  - b. Practical management of oesophageal variceal tamponade devices
  - c. Gastric tonometry.
- 1.3.6 Basic ultrasonographic Skills
- a. Ultrasound imaging guided insertion of intra-vascular catheters
  - b. Ultrasound assessment of Pleural effusions, cardiac function, pericardial effusion and intra-abdominal free fluid.
- 1.3.7 Infection Control skills
- a. Use of high filtration protective masks
  - b. Use of Power-air purifying respirators (PAPR)
- 1.4 Patient Care Experience
- Trainees must have at least 12 months of ICU clinical experience in which the trainee has significant responsibility for patient contact and management. Consultative experience alone does not provide the exposure necessary to train an intensivist. Trainees should have clinical experience with both surgical and medical critically ill patients, with exposure to a large proportion if not all of the clinical situations listed below:
- 1.4.1 Hemodynamic Instability
- a. Use of monitoring equipment, computer or calculators to determine derived parameters, including cardiac index and derived parameters, systemic and pulmonary vascular resistance, oxygen content, intrapulmonary shunt, alveolar-arterial gradients, oxygen transport, and oxygen consumption
  - b. Dynamic electrocardiogram interpretation
  - c. Infusion of epinephrine, dopamine, norepinephrine, nitroglycerin, dobutamine, isoproterenol, nitroprusside, and other vasoactive drugs, titrated to haemodynamic objectives with the aid of advanced haemodynamic monitoring.
  - d. Thrombolytic therapy
  - e. Fluid therapy.
  - f. Pacing
  - g. Cardioversion and defibrillation
- 1.4.2 Respiratory Insufficiency and Failure
- a. Indications, applications, techniques, criteria, and physiologic effects of positive end-expiratory pressure; intermittent positive pressure breathing; intermittent mandatory ventilation; continuous positive airway pressure; pressure-support ventilation; airway pressure release ventilation; pressure control; noninvasive ventilation
  - b. Use of intermittent positive pressure breathing therapy, bronchodilators, humidifiers
  - c. Weaning techniques

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- d. Sedation, analgesia, neuromuscular blockade
  - e. Acute exacerbation of severe restrictive airway disease – asthma, COPD
  - f. Acute Respiratory Distress Syndrome
  - g. Respiratory failure from lung infection
- 1.4.3 Acute Neurologic Insult Including Those With Increased Intracranial Pressure
- a. Management of raised intracranial pressure using intracranial pressure monitors
  - b. Severe Traumatic Brain Injury
  - c. Status epilepticus
  - d. Diagnosis of brain death
  - e. Anoxic brain injury
- 1.4.4 Acute Renal Insufficiency and Failure including renal replacement therapies
- 1.4.5 Acute Life-Threatening Endocrine and/or Metabolic Derangements
- 1.4.6 Drug Overdose and Poisonings
- 1.4.7 Coagulation Disorders
- 1.4.8 Serious Infections Including Sepsis and septic shock
- 1.4.9 Nutritional Inadequacy and Failure
- 1.4.10 Acute Trauma
- 1.5 Personal Scholastic and Professional Development
- 1.5.1 Scholastic development
- The trainee will aim to develop the following scholastic qualities:
- a. Develop and utilize a self-directed continuing education strategy.
  - b. The ability to acquire and critically appraise sources of medical information.
  - c. The ability to apply evidence based standards of care to patients.
  - d. Develop a questioning an inquisitive approach to medical information, and to learn the techniques in clinical research.
  - e. Contribute to the education of students, and other health professionals, and through these continue to improve in the instructional effectiveness.
- 1.5.2 Professional development
- The trainee will aim to continually develop a personal character that facilitates the following:
- a. Delivery of the highest quality of care to patients with integrity, honesty and compassion.
  - b. Understand and apply the basic principles of medical ethics including: informed consent, advanced medical directives, research ethics, patient autonomy, and justice.
  - c. Exhibit appropriate personal and interpersonal professional behavior thus avoiding interpersonal conflicts that may lower effectiveness of patient care
  - d. Practice medicine ethically and consistent with the professional and legal obligations of a physician.