

**DIPLOMA IN CRITICAL CARE MEDICINE**  
**POSTGRADUATE INSTITUTE OF MEDICINE**  
**UNIVERSITY OF COLOMBO**

**PROSPECTUS**

**In accordance with the decision of the Board of Study in Multi Disciplinary Study Courses and the approval of the Board of Management of the PGIM, this Prospectus, curriculum and training programme in Critical Care Medicine became effective from 01<sup>st</sup> November 2008.**

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## Background

Critical Care Medicine is an established specialty in most developed countries. In some countries specialists in other clinical disciplines undergo additional training to become intensivists. In some others it is considered a sub-specialty of Anesthesiology or Internal Medicine. In countries such as Australia critical care specialists are trained through a comprehensive program similar to that of any other clinical discipline.

Diploma in Critical Care Medicine can be considered the first step towards the development of critical care as a specialty in Sri Lanka. This degree program is offered over a one year period and is mainly designed to suit intermediate grade medical officers serving in the Intensive Care units of this country.

## Potential Benefits

Acquisition of this diploma is considered useful to;

- qualify for promotion to grade 1 medical officers in the Ministry of Health
- Improve standards of intensive care through improved knowledge and skills.
- help the private sector ICUs get their medical officers trained in Critical Care

## Overall Design

This diploma programme will be offered annually, conducted by PGIM, full-time, over a one year period, incorporating a hybrid of a competency based training programme and a credit point scheme for theory. The teachers shall constitute mainly specialists from Anesthesiology, Internal Medicine, Paediatrics, Obstetrics and Gynaecology and Surgery who has undergone specific training to become trainers or/are considered in-charge officers of a recognised ICU for training. There shall be a component of continuous assessment during hospital based training in the PGIM recognized units in addition to the end of course final assessment.

## Broad Objectives and Learning Outcomes

Students awarded this qualification should have demonstrated

1. A high level of understanding and knowledge in critical care medicine, together with an awareness of current subject developments, where appropriate
2. An understanding of subject methodology and the ability to use it in their studies and, where appropriate, in professional practice.

Typically, holders of a qualification at this level will be able to:

- 1 Deal with complex issues systematically, and in collaboration with colleagues, make sound judgments using incomplete data and communicate their conclusions clearly and confidently to a range of audiences
- 2 Demonstrate self-direction and self-confidence in problem solving and the ability to plan and implement tasks at a professional or equivalent level
- 3 Demonstrate the ability to advance their knowledge and understanding and to develop new skills;
- 4 Exercise initiative and personal responsibility;
- 5 Learn and work independently, when required for continuing professional development.

## Course Administration

The delivery of the course and evaluation shall be organized by the PGIM through its Board of Study in Multidisciplinary Study Courses (MDSC). MDSC is meant for initiation of courses that need multidisciplinary inputs – thus, its board members originate from many disciplines. The curricular development for Critical Care and Emergency Medicine shall be under one sub-committee of this Board of Study.

## Date of Commencement

September 2008.

## Target Group

Medical officers currently serving in Public and Private sector ICUs (priority) and those who have training/ experience in the said arena.

## Eligibility Criteria

Prospective applicants must satisfy the following requirements.

- (a) A medical degree registered \* with the Sri Lanka Medical Council.
- (b) Satisfactory completion of internship acceptable to the Sri Lanka Medical Council.
- (c) Satisfactory completion of one year of post internship in Medical/ Clinical practice in a university/public/private sector institution in Sri Lanka acceptable to the PGIM.
- (d) The criteria prescribed in paragraphs (a) to (c) must have been satisfied by the applicants as at the date of closure of applications, provided that where a short-fall has occurred due to any reasons including Sick, Maternity or Other leave, the doctor concerned should complete such shortfall in order to become eligible to apply for the Selection examination.
- (e) Any other requirement/s stipulated by the Board of Study relevant to a particular field of study concerned that has/have been approved by the Board of Management.

\* foreign nationals who seek to apply to register for selection examinations should possess a medical degree registrable with the Sri Lanka Medical Council. The decision of the Board of Management will be final in all such applications.

A quota for the private sector is presently available for most courses.

- (f) Pass the Screening test

## Screening Test

This shall be a 3 hour Multiple Choice Question paper consisting of 60 questions. Each question shall have 5 true/false responses. There shall be no carrying forward of negative marks from one question to another. Twenty candidates shall be selected annually to follow the diploma training programme based on merit of this test. There shall be no limitation on the number of attempts a candidate could participate in the screening test.

## Orientation Course

The selected candidates will follow an orientation course that shall incorporate courses in basic life support and emergency life support.

## Duration of the course

One year

## Maximum intake for a year

20

## Exceptions and equivalence

Would be considered later – currently not available

## Curriculum

A hybrid of (a) Competency based - US, Europe model (b) Credit scheme-UK model

## Proposed Syllabus

The syllabus outline is prepared based on the CoBaTrICE model (Competency-based training in Intensive Care Medicine in Europe). However, since there shall be many limitations in relation to competency assessment, modifications are proposed, based on the conventional model of training.

*The course shall adopt a credit system for theory (1 credit = 15 hours of lectures/tutorial). The full curriculum structure includes 40 weeks of clinical training and theory of 14 credits.*

Course (Module) coding: The first two letters indicate the degree course (CM= Critical Care Medicine) followed by a space, then the series level and course number (two digits).

Course Code	Course Description	Credits
CM 601	Resuscitation	01
CM 602	Applied Anatomy & Physiology	01
CM 603	Pharmacology	01
CM 604	Mechanical Ventilation	01
CM 605	Knowledge to Support Clinical Practice	01
CM 606	Clinical Management Planning	01
CM 607	Use of Equipment	01
CM 608	Physics and Measurement	01
CM 609	Specialist Diseases and Syndromes	02
CM 610	Patient Transport	01
CM 611	Imaging	01
CM 612	Information Technology	0.5
CM 613	Audit & Evidence Based Medicine	01
CM 614	Medical Ethics	0.5
<b>Total</b>		<b>14</b>

Clinical Training in Recognized ICUs (See **Appendix 1**)

40 weeks of clinical training (with 80% attendance) will have to be completed during the course, as a MO ICU in a recognized ICU as following.

*General ICU* 24 wks (Special periods in Renal, Endocrine, Metabolism, Toxicology including Portfolio)

*Paediatric ICU* 02 wks

*Anaesthesia* 04 wks  
*Neuro ICU* 02 wks  
*Cardiac ICU* 04 wks  
*Accident and Emergency Unit* 04 wks.

The ICUs intending to become training centres would have to apply for PGIM recognition on a pre prepared application form (See Appendix 1).

Assessment Procedure

In course continuous assessment 40% marks (based on modified CoBaTrICE log book)

Final Examination 60% marks (Best response question paper 20%, Short Essay Questions 20%, OSCE based Viva 20%)

In course Continuous Assessment 40% marks

This is a collated mark of scores given by each PGIM appointed supervisor for each segment of clinical training adjusted to the duration of each clinical appointment (Please see table below).

Final Examination 60% marks

1. Best response question paper 20%
  - 1.1. 2 hour paper, 40 questions
2. Short Essay Questions 20%
  - 2.1. 1½ hour paper – Answer 4 out of 6 questions
3. OSCE based Viva 20%
  - 3.1. 6 stations 10 minutes each
  - 3.2. Single viva examiner for each station

Allocation of marks for Continuous Assessment during Clinical Training

Marks will be allocated by PGIM recognized supervisors (in confidence) in each segment of clinical training with an indication of a breakdown score for each area detailed in the table below i.e. for knowledge, skills, attitudes and behavior.

<i>Clinical appointment and duration</i>	<i>Knowledge (100)</i>	<i>Skills (100)</i>	<i>Attitudes/ Behavior (100)</i>	<i>Total</i>
<i>General ICU 24 wks</i>	<i>K</i>	<i>l</i>	<i>M</i>	<i>X</i>
<i>Paediatric ICU 02 wks</i>				<i>Y</i>
<i>Anaesthesia 04 wks</i>				<i>Z</i>
<i>Neuro ICU 02 wks</i>				<i>A</i>
<i>Cardiac ICU 04 wks</i>				<i>B</i>
<i>A &amp; E Unit 04 wks</i>				<i>C</i>

Calculation of the overall mark for continuous assessment.

$$X = [ 2.5k + 2.5 l + m ] / 600$$

*Y, Z, A, B, C* to be calculated using the same formula.

Overall mark for continuous assessment

$$= [ X \times 0.24 ] + [ Y \times 0.02 ] + [ Z \times 0.04 ] + [ A \times 0.02 ] + [ B \times 0.04 ] + [ C \times 0.04 ]$$

Pass mark

The overall pass mark shall be 50%. However, the candidate should score a minimum of 40% from each component of the examination, i.e. from continuous and the final assessment.

A candidate shall be allowed a maximum of 4 attempts at the final examination.

Any candidate who has exhausted all four attempts at the final examination will have to face the screening test once again if he/she wishes to re-enter the training programme.

Competencies (modified CoBaTrICE to suit course objectives)

This syllabus is the aggregate of all the knowledge, skills, behaviors and attitudes required CoBaTrICE competencies. It is divided into 13 sections: 12 domains (see Appendix 2) plus basic sciences (see).

## Appendix 1 The recognition of ICUs for training

The Board of Study of Multi-Disciplinary Study courses shall recognize ICU suitable for training based on following features and this will be reviewed regularly.

The ICUs serving as training centres is expected to be capable of providing high standard of general intensive care including complex multi system life support such as mechanical ventilation, renal support services, invasive cardiac monitoring for several days. Following practices and features are favoured.

- Defined admission, discharge and referral policies
- Minimum of 6 beds
- The number of mechanically ventilated patients per annum
- Availability of an In charge Specialist (May be an anaesthesiologist, physician, paediatrician or a surgeon)
- 1:1 nursing
- Availability of suitable infection control and isolation procedures
- Availability of support staff as appropriate
- Ability to submit an audit of the previous year

## Appendix 2 Domains

### DOMAIN COMPETENCE STATEMENT

**Each domain will elaborate on the skills, knowledge, behavior and attitude required.**

#### 1. RESUSCITATION & INITIAL MANAGEMENT OF THE ACUTELY ILL PATIENT

- 1.1 Adopts a structured and timely approach to the recognition, assessment and stabilization of the acutely ill patient with disordered physiology
- 1.2 Manages cardiopulmonary resuscitation
- 1.3 Manages the patient post-resuscitation
- 1.4 Triage and prioritizes patients appropriately, including timely admission to ICU
- 1.5 Assesses and provides initial management of the trauma patient
- 1.6 Assesses and provides initial management of the patient with burns
- 1.7 Describes the management of mass casualties

#### 2. DIAGNOSIS: ASSESSMENT, INVESTIGATION, MONITORING AND DATA INTERPRETATION

- 2.1 Obtains a history and performs an accurate clinical examination
- 2.2 Undertakes timely and appropriate investigations
- 2.3 Describes indications for and assist echocardiography (transthoracic / transoesophageal)
- 2.4 Assist electrocardiography (ECG / EKG) and interpret the results
- 2.5 Obtains appropriate microbiological samples and interprets results

- 2.6 Obtains and interprets the results from blood gas samples
- 2.7 Interprets chest x-rays
- 2.8 Liaises with radiologists to organise and interpret clinical imaging
- 2.9 Monitors and responds to trends in physiological variables
- 2.10 Integrates clinical findings with laboratory investigations to form a differential diagnosis

### 3. DISEASE MANAGEMENT

#### ACUTE DISEASE

- 3.1 Manages the care of the critically ill patient with specific acute medical conditions

#### CHRONIC DISEASE

- 3.2 Identifies the implications of chronic and co-morbid disease in the acutely ill patient

#### ORGAN SYSTEM FAILURE

- 3.3 Recognises and manages the patient with circulatory failure
- 3.4 Recognises and manages the patient with, or at risk of, acute renal failure
- 3.5 Recognises and manages the patient with, or at risk of, acute liver failure
- 3.6 Recognises and manages the patient with neurological impairment
- 3.7 Recognises and manages the patient with acute gastrointestinal failure
- 3.8 Recognises and manages the patient with acute lung injury syndromes (ALI / ARDS)
- 3.9 Recognises and manages the septic patient
- 3.10 Recognises and manages the patient following intoxication with drugs or environmental toxins
- 3.11 Recognises life-threatening maternal peripartum complications and manages care under supervision

#### 4. THERAPEUTIC INTERVENTIONS/ SPECIFIC MANAGEMENT / ORGAN SYSTEM SUPPORT IN SINGLE OR MULTIPLE ORGAN FAILURE

- 4.1 Prescribes drugs and therapies safely
- 4.2 Manages antimicrobial drug therapy with advice
- 4.3 Administers blood and blood products safely
- 4.4 Uses fluids and vasoactive / inotropic drugs to support the circulation with advice
- 4.5 Describes the use of mechanical assist devices to support the circulation
- 4.6 Initiates, manages, and weans patients from invasive and non-invasive ventilatory support under supervision
- 4.7 Manages patients on renal replacement therapy
- 4.8 Recognises and manages electrolyte, glucose and acid-base disturbances
- 4.9 Co-ordinates and provides nutritional assessment and support

### 5. PRACTICAL PROCEDURES

#### RESPIRATORY SYSTEM

- 5.1 Administers oxygen using a variety of administration devices
- 5.2 Performs fiberoptic laryngoscopy under supervision
- 5.3 Performs emergency airway management

- 5.4 Performs difficult and failed airway management according to local protocols
- 5.5 Performs endotracheal suction along with chest physiotherapy
- 5.6 Describes fiberoptic bronchoscopy and BAL in the intubated patient
- 5.7 Describes percutaneous tracheostomy
- 5.8 Performs thoracentesis via a chest drain

#### **CARDIOVASCULAR SYSTEM**

- 5.9 Performs peripheral venous catheterisation
- 5.10 Performs arterial catheterisation
- 5.11 Describes a method for surgical isolation of vein / artery
- 5.12 Describes ultrasound techniques for vascular localisation
- 5.13 Performs central venous catheterisation
- 5.14 Performs defibrillation and cardioversion
- 5.15 Describes Cardiac pacing (transvenous or transcutaneous)
- 5.16 Describes how to perform pericardiocentesis
- 5.17 Demonstrates a method for measuring cardiac output and derived haemodynamic variables

#### **CENTRAL NERVOUS SYSTEM**

- 5.18 Performs lumbar puncture (intradural / 'spinal') under supervision
- 5.19 Manages and interpret Intracranial pressure monitoring

#### **GASTROINTESTINAL SYSTEM**

- 5.20 Performs nasogastric tube placement
- 5.21 Performs abdominal paracentesis
- 5.22 Describes indications for, and safe conduct of endoscopy

#### **GENITOURINARY SYSTEM**

- 5.24 Performs urinary catheterisation

### **6. PERI-OPERATIVE CARE**

- 6.1 Manages the pre- and post-operative care of the high risk surgical patient
- 6.2 Describes care of the patient following cardiac surgery
- 6.3 Manages the care of the patient following craniotomy under supervision
- 6.4 Describes the care of the patient following solid organ transplantation
- 6.5 Manages the pre- and post-operative care of the trauma patient under supervision

### **7. COMFORT, PAIN RELIEF & RECOVERY**

- 7.1 Identifies and attempts to minimise the physical and psychosocial consequences of critical illness for patients and families
- 7.2 Manages the assessment, prevention and treatment of pain and delirium
- 7.3 Manages the administration of analgesia via an epidural catheter
- 7.4 Manages sedation and neuromuscular blockade
- 7.5 Communicates the continuing care requirements of patients at ICU discharge to health care professionals, patients and relatives
- 7.6 Manages the safe and timely discharge of patients from the ICU

### **8. END OF LIFE CARE**

- 8.1 Manages the process of withholding or withdrawing treatment with the multidisciplinary team
- 8.2 Discusses end of life care with patients and their families / surrogates
- 8.3 Manages palliative care of the critically ill patient
- 8.4 Describes brain-stem death testing
- 8.5 Manages the physiological support of the organ donor

### **9. PAEDIATRIC CARE**

- 9.1 Describes the recognition of the acutely ill child and initial management of paediatric emergencies
- 9.2 Describes principles of neonatal and paediatric mechanical ventilation in contrast to that in adults

### **10. TRANSPORT**

- 10.1 Undertakes transport of the mechanically ventilated critically ill patient outside the ICU: with in the hospital and between hospitals
- 10.2 Describes the special considerations required during patient transport by air.

### **11. PATIENT SAFETY AND HEALTH SYSTEMS MANAGEMENT**

- 11.1 Joins daily multidisciplinary ward round
- 11.2 Complies with local infection control measures
- 11.3 Identifies environmental hazards and promotes safety for patients & staff
- 11.4 Identifies and minimizes risk of critical incidents and adverse events, including complications of critical illness
- 11.5 Organizes a case conference
- 11.6 Critically appraises and applies guidelines, protocols and care bundles
- 11.7 Describes commonly used scoring systems for assessment of severity of illness, case mix and workload
- 11.8 Demonstrates an understanding of the managerial & administrative responsibilities of the ICM specialist

### **12. PROFESSIONALISM**

#### **COMMUNICATION SKILLS**

- 12.1 Communicates effectively with patients and relatives
- 12.2 Communicates effectively with members of the health care team
- 12.3 Maintains accurate and legible records / documentation
- 12.4 Provides explanations and teaches multidisciplinary members of critical care team.

#### **PROFESSIONAL RELATIONSHIPS WITH PATIENTS AND RELATIVES**

- 12.4 Involves patients (or their surrogates if applicable) in decisions about care and treatment

- 12.5 Demonstrates respect of cultural and religious beliefs and an awareness of their impact on decision making
- 12.6 Respects privacy, dignity, confidentiality and legal constraints on the use of patient data

**PROFESSIONAL RELATIONSHIPS WITH PATIENTS AND RELATIVES**

- 12.7 Collaborates and consults; promotes team-working and respects different opinions
- 12.8 Ensures continuity of care through effective hand-over of clinical information
- 12.9 Supports clinical staff outside the ICU to enable the delivery of effective care
- 12.10 Appropriately supervises, and delegates to others, the delivery of patient care

**SELF GOVERNANCE**

- 12.11 Takes responsibility for safe patient care
- 12.12 Formulates clinical decisions with respect for ethical and legal principles with advice
- 12.13 Seeks learning opportunities and integrates new knowledge into clinical practice
- 12.14 Participates in multidisciplinary teaching
- 12.15 Participates in research or audit under supervision and quality assurance
- 12.16 Participates in the team approach with respect for team members

**13. BASIC SCIENCES (see Appendix 3)**

Appendix 3 Basic Sciences

**Applied ANATOMY**

**RESPIRATORY SYSTEM:**

Mouth, nose, pharynx, larynx, trachea, main bronchi, segmental bronchi, structure of bronchial tree:

differences in the child

Airway and respiratory tract, blood supply, innervation and lymphatic drainage

Pleura, mediastinum and its contents

Lungs, lobes, microstructure of lungs

Diaphragm, other muscles of respiration, innervation

The thoracic inlet and 1st rib

Interpretation of a chest x-ray

**CARDIOVASCULAR SYSTEM:**

Heart, chambers, conducting system, blood and nerve supply

Congenital deviations from normal anatomy

Pericardium

Great vessels, main peripheral arteries and veins

Foetal and materno-foetal circulation

**NERVOUS SYSTEM:**

Brain and its subdivisions

Spinal cord, structure of spinal cord, major ascending and descending pathways

Spinal meninges, subarachnoid and extradural space, contents of extradural space.

Cerebral blood supply

CSF and its circulation

Spinal nerves, dermatomes

Brachial plexus, nerves of arm

Intercostal nerves

Nerves of abdominal wall

Nerves of leg and foot

Autonomic nervous system

Sympathetic innervation, sympathetic chain, ganglia and plexuses

Parasympathetic innervation.

Stellate ganglion

Cranial nerves: base of skull: trigeminal ganglion

Innervation of the larynx

Eye and orbit

**VERTEBRAL COLUMN:**

Cervical, thoracic, and lumbar vertebrae

Interpretation of cervical spinal imaging in trauma

Sacrum, sacral hiatus

Ligaments of vertebral column

Surface anatomy of vertebral spaces, length of cord in child and adult

**SURFACE ANATOMY:**

Structures in antecubital fossa

Structures in axilla: identifying the brachial plexus

Large veins and anterior triangle of neck  
Large veins of leg and femoral triangle  
Arteries of arm and leg  
Landmarks for tracheostomy, cricothyrotomy  
Abdominal wall (including the inguinal region): landmarks for suprapubic urinary and peritoneal lavage catheters  
Landmarks for intrapleural drains and emergency pleurocentesis  
Landmarks for pericardiocentesis

#### **ABDOMEN:**

Gross anatomy of intra-abdominal organs  
Blood supply to abdominal organs and lower body

## **PHYSIOLOGY & BIOCHEMISTRY**

### **GENERAL:**

Organisation of the human body and homeostasis  
Variations with age  
Function of cells; genes and their expression  
Mechanisms of cellular and humoral defence  
Cell membrane characteristics; receptors  
Protective mechanisms of the body  
Genetics & disease processes

### **BIOCHEMISTRY:**

Acid base balance and buffers Ions e.g. Na<sup>+</sup>, K<sup>+</sup>, Ca<sup>++</sup>, Cl<sup>-</sup>, HCO<sub>3</sub><sup>-</sup>, Mg<sup>++</sup>, PO<sub>4</sub><sup>-</sup>  
Cellular and intermediary metabolism; variations between organs  
Enzymes

### **BODY FLUIDS:**

Capillary dynamics and interstitial fluid  
Oncotic pressure  
Osmolarity: osmolality, partition of fluids across membranes  
Lymphatic system  
Special fluids: cerebrospinal, pleural, pericardial and peritoneal fluids

### **HAEMATOLOGY & IMMUNOLOGY:**

Red blood cells: haemoglobin and its variants  
Blood groups  
Haemostasis and coagulation; pathological variations  
White blood cells  
Inflammation and its disorders  
Immunity and allergy

### **MUSCLE:**

Action potential generation and its transmission  
Neuromuscular junction and transmission  
Muscle types  
Skeletal muscle contraction  
Motor unit  
Muscle wasting  
Smooth muscle contraction: sphincters

### **HEART & CIRCULATION:**

Cardiac muscle contraction  
The cardiac cycle: pressure and volume relationships  
Rhythmicity of the heart  
Regulation of cardiac function; general and cellular  
Control of cardiac output (including the Starling relationship)  
Fluid challenge and heart failure  
Electrocardiogram and arrhythmias  
Neurological and humoral control of systemic blood pressures, blood volume and blood flow (at rest and during physiological disturbances e.g. exercise, haemorrhage and Valsalva manoeuvre)  
Peripheral circulation: capillaries, vascular endothelium and arteriolar smooth muscle Autoregulation and the effects of sepsis and the inflammatory response on the peripheral vasculature  
Characteristics of special circulations including: pulmonary, coronary, cerebral, renal, portal and foetal

### **RENAL TRACT:**

Blood flow, glomerular filtration and plasma clearance  
Tubular function and urine formation  
Endocrine functions of kidney  
Assessment of renal function  
Regulation of fluid and electrolyte balance  
Regulation of acid-base balance  
Micturition  
Pathophysiology of acute renal failure

### **RESPIRATION:**

Gaseous exchange: O<sub>2</sub> and CO<sub>2</sub> transport, hypoxia and hyper- and hypocapnia, hyper- and hypobaric pressures  
Functions of haemoglobin in oxygen carriage and acid-base equilibrium  
Pulmonary ventilation: volumes, flows, dead space.  
Effect of IPPV and PEEP on lungs and circulation  
Mechanics of ventilation: ventilation/perfusion abnormalities  
Control of breathing, acute and chronic ventilatory failure, effect of oxygen therapy  
Non-respiratory functions of the lungs  
Cardio-respiratory interactions in health & disease

### **NERVOUS SYSTEM:**

Functions of nerve cells: action potentials, conduction, synaptic mechanisms and transmitters  
The brain: functional divisions  
Intracranial pressure: cerebrospinal fluid, blood flow  
Maintenance of posture  
Autonomic nervous system: functions  
Neurological reflexes Motor function: spinal and peripheral  
Senses: receptors, nociception, special senses  
Pain: afferent nociceptive pathways, dorsal horn, peripheral and central mechanisms, neuromodulatory systems, supraspinal mechanisms, visceral pain, neuropathic pain, influence of therapy on nociceptive mechanisms  
Spinal cord: anatomy and blood supply, effects of spinal cord section

## **LIVER:**

Functional anatomy and blood supply

Metabolic functions

Tests of function

## **GASTROINTESTINAL:**

Gastric function; secretions, nausea and vomiting

Gut motility, sphincters and reflex control

Digestive functions and enzymes

Nutrition: calories, nutritional fuels and sources, trace elements, growth factors

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## **METABOLISM AND NUTRITION:**

Nutrients: carbohydrates, fats, proteins, vitamins, minerals and trace elements

Metabolic pathways, energy

production and enzymes; metabolic rate

Hormonal control of metabolism: regulation of plasma glucose, response to trauma

Physiological alterations

in starvation, obesity, exercise and the stress response

Body temperature and its regulation

## **ENDOCRINOLOGY:**

Mechanisms of hormonal control: feedback mechanisms, effect on membrane and intracellular receptors

Central neuro-endocrine interactions

Adrenocortical hormones

Adrenal medulla: adrenaline (epinephrine) and noradrenaline (norepinephrine)

Pancreas: insulin, glucagon

and exocrine function

Thyroid and parathyroid hormones and calcium homeostasis

## **PREGNANCY:**

Physiological changes associated with a normal pregnancy and delivery

Materno-foetal, foetal and neonatal circulation

Functions of the placenta: placental transfer

Foetus: changes at birth

## **PHARMACOLOGY**

### **PRINCIPLES OF PHARMACOLOGY:**

Dynamics of drug-receptor interaction

Agonists, antagonists, partial agonists, inverse agonists

Efficacy and potency

Tolerance

Receptor function and regulation

Metabolic pathways; enzymes; drug: enzyme interactions; Michaelis-Menten equation

Enzyme inducers and inhibitors.

Mechanisms of drug action Ion channels: types: relation to receptors.

Gating mechanisms.

Signal transduction: cell membrane/receptors/ion channels to intracellular

molecular targets, second

messengers

Action of gases and vapours

Osmotic effects

pH effects

Adsorption and chelation

Mechanisms of drug interactions:

Inhibition and promotion of drug uptake.

Competitive protein binding.

Receptor inter-actions.

Effects of metabolites and other degradation products.

### **PHARMACOKINETICS & PHARMACODYNAMICS**

Drug uptake from: gastrointestinal tract, lungs, nasal, transdermal, subcutaneous, IM, IV, epidural and

intrathecal routes

Bioavailability

Factors determining the distribution of drugs: perfusion, molecular size, solubility, protein binding.

The influence of drug formulation on disposition

Distribution of drugs to organs and tissues:

Body compartments Influence of specialised membranes: tissue binding and solubility

Materno-foetal distribution

Distribution in CSF and extradural space

Modes of drug elimination:

Direct excretion

Metabolism in organs of excretion: phase I & II mechanisms

Renal excretion and urinary pH

Non-organ breakdown of drugs

Pharmacokinetic analysis:

Concept of a pharmacokinetic compartment

Apparent volume of distribution

Orders of kinetics

Clearance concepts applied to whole body and individual organs

Simple 1 and 2 compartmental models:

Concepts of wash-in and washout curves

Physiological models based on perfusion and partition coefficients

Effect of organ blood flow: Fick principle

Pharmacokinetic variation: influence of body size, sex, age, disease, pregnancy, anaesthesia, trauma,

surgery, smoking, alcohol and other drugs

Effects of acute organ failure (liver, kidney) on drug elimination Influence of renal replacement therapies on clearance of commonly used drugs

Pharmacodynamics: concentration-effect relationships: hysteresis

Pharmacogenetics: familial variation in drug response

Adverse reactions to drugs: hypersensitivity, allergy, anaphylaxis, anaphylactoid reactions

### **SYSTEMIC PHARMACOLOGY**

Hypnotics, sedatives and intravenous anaesthetic agents

Simple analgesics

Opioids and other analgesics; Opioid antagonists

Non-steroidal anti-inflammatory drugs

Neuromuscular blocking agents (depolarising and non-depolarising) and anti cholinesterases  
 Drugs acting on the autonomic nervous system (including inotropes, vasodilators, vasoconstrictors, antiarrhythmics, diuretics)  
 Drugs acting on the respiratory system (including respiratory stimulants and bronchodilators)  
 Antihypertensives  
 Anticonvulsants  
 Anti-diabetic agents  
 Diuretics  
 Antibiotics  
 Corticosteroids and other hormone preparations  
 Antacids. Drugs influencing gastric secretion and motility  
 Antiemetic agents  
 Local anaesthetic agents  
 Immunosuppressants  
 Principles of therapy based on modulation of inflammatory mediators indications, actions and limitations  
 Plasma volume expanders  
 Antihistamines  
 Antidepressants  
 Anticoagulants  
 Vitamins A-E, folate, B12

## PHYSICS & CLINICAL MEASUREMENT

### MATHEMATICAL CONCEPTS:

Relationships and graphs  
 Concepts of exponential functions and logarithms: wash-in and washout  
 Basic measurement concepts: linearity, drift, hysteresis, signal: noise ratio, static and dynamic response  
 SI units: fundamental and derived units  
 Other systems of units where relevant to ICM (e.g. mmHg, bar, atmospheres)  
 Simple mechanics: Mass, Force, Work and Power

### GASES & VAPOURS:

Absolute and relative pressure.  
 The gas laws; triple point; critical temperature and pressure  
 Density and viscosity of gases.  
 Laminar and turbulent flow; Poiseuille's equation, the Bernoulli principle  
 Vapour pressure: saturated vapour pressure  
 Measurement of volume and flow in gases and liquids.  
 The pneumotachograph and other respirometers.  
 Principles of surface tension

### ELECTRICITY & MAGNETISM:

Basic concepts of electricity and magnetism.  
 Capacitance, inductance and impedance  
 Amplifiers: bandwidth, filters  
 Amplification of biological potentials: ECG, EMG, EEG.  
 Sources of electrical interference  
 Processing, storage and display of physiological measurements

Bridge circuits

### ELECTRICAL SAFETY:

Principles of cardiac pacemakers and defibrillators  
 Electrical hazards: causes and prevention.  
 Electrocution, fires and explosions.  
 Diathermy and its safe use  
 Basic principles and safety of lasers  
 Basic principles of ultrasound and the Doppler effect

### PRESSURE & FLOW MONITORING:

Principles of pressure transducers  
 Resonance and damping, frequency response  
 Measurement and units of pressure.  
 Direct and indirect methods of blood pressure measurement; arterial curve analysis  
 Principles of pulmonary artery and wedge pressure measurement  
 Cardiac output: Fick principle, thermodilution

### CLINICAL MEASUREMENT:

Measurement of gas and vapour concentrations, (oxygen, carbon dioxide, nitrous oxide, and volatile anaesthetic agents) using infrared, paramagnetic, fuel cell, oxygen electrode and mass spectrometry methods  
 Measurement of H<sup>+</sup>, pH, pCO<sub>2</sub>, pO<sub>2</sub>  
 Measurement CO<sub>2</sub> production/ oxygen consumption/ respiratory quotient  
 Colligative properties: osmometry  
 Simple tests of pulmonary function e.g. peak flow measurement, spirometry.  
 Capnography  
 Pulse oximetry  
 Measurement of neuromuscular blockade  
 Measurement of pain

## RESEARCH METHODS

### DATA COLLECTION:

Simple aspects of study design (research question, selection of the method of investigation, population, intervention, outcome measures)  
 Power analysis  
 Defining the outcome measures and the uncertainty of measuring them  
 The basic concept of meta-analysis and evidence based medicine

### DESCRIPTIVE STATISTICS:

Types of data and their representation  
 The normal distribution as an example of parametric distribution  
 Indices of central tendency and variability

### DEDUCTIVE & INFERENCE STATISTICS:

Simple probability theory and the relation to confidence intervals  
 The null hypothesis.  
 Choice of simple statistical tests for different data types  
 Type I and type II errors  
 Inappropriate use of statistics

## REFERENCES

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6. P.D.Davis, G.D.Parbrook, G.N.C.Kenny, 1995. Basic Physics and Measurement in Anaesthesia. 4th edition. Butterworth Heinemann.
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