SYLLABUS

FOR THE BASIC SCIENCES IN

INTENSIVE CARE MEDICINE

A Guide to the CICM First Part Examination

THIRD EDITION 2017

FOREWORD

This is the third edition of the Syllabus for the Basic Sciences in Intensive Care Medicine.

This edition has evolved from the components of the previous editions. Significantly, this edition has also been more closely integrated with the College of Intensive Care Medicine Fellowship Objectives of Training and the overall Training Program.

There have been important changes made since the first edition with a broader outline of the required topics, the inclusion of a rating system for each topic, and the Pharmacopeia. These have been refined in this third edition to help guide Trainees towards the depth and breadth of knowledge required to successfully complete the CICM First Part Examination.

The Syllabus review panel has made every effort to ensure the overall content of the Syllabus has not increased with some topics removed to make way for new material.

Topics are listed under major systems, which include relevant physiology, pharmacology and anatomy.

The First Part Examination continues to emphasize an integrated approach to the learning and assessment of the Basic Sciences as they apply to Intensive Care Medicine. The intention continues to be to review this document every five years.

Finally, the strengths and value of this document would not have been attained without the contribution of all those involved with the previous editions, candidates who have sat the CICM First Part Examination, past and current CICM First Part Examiners, and all those listed within this document.

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LEARNING OBJECTIVES FOR THE FIRST PART EXAMINATION IN INTENSIVE CARE MEDICINE

INTRODUCTION

The purposes of the learning objectives for the Basic Sciences in Intensive Care Medicine are to provide a:

- guide to Trainees in preparation for the First Part Examination
- guide to Supervisors of Training, Tutors and Teachers
- guide to Examiners

This will ensure that Trainees, Tutors and Examiners can work from a common base. These learning objectives are designed to outline the minimum level of understanding required for each topic.

All examination questions are based around this Syllabus. The accompanying texts are recommended on the basis that the material contained within them provides a clear indication of the minimum level of understanding that will be expected.

Trainees are strongly encouraged to explore the existing, and evolving, body of knowledge of the Basic Sciences as they apply to Intensive Care Medicine by reading widely.

LEVEL OF UNDERSTANDING

Throughout the document, each topic has been assigned a Level of Understanding. This rating is a guide to Trainees, Tutors, Teachers and Examiners as to the level of knowledge and assessment that can be expected for that topic.

Level of Understanding (L1)
These topics are core areas of the Basic Sciences as they apply to Intensive Care Medicine. A detailed knowledge and comprehension of the principles and facts that relate to these areas will be expected. As such, they will be eligible to be assessed in depth and are considered essential knowledge.

Level of Understanding (L2)
These topics are important and relevant to Intensive Care Medicine. A good understanding of the key concepts and facts that relate to these areas is expected. They will be eligible to be assessed in some depth, and are considered important knowledge.

Important to note:

For all sections of the Syllabus an understanding of normal physiology, and physiology at the extremes of age, obesity, pregnancy (including foetal) and disease (particularly critical illness) is expected. Similarly for pharmacology, Trainees are expected to understand a drug's pharmacology in the context of normal physiology, extremes of age (i.e. neonates, paediatrics and the elderly), obesity, pregnancy (including foetal) and disease. An understanding of potential toxicity and relevant antidotes is also expected.

Throughout the document specific wording has been used under the required abilities to indicate the level of knowledge and understanding expected, and a glossary of these terms is provided.

Definitions:

- **Classify** Divide into categories; organize, arrange
- **Define** Give the precise meaning
- **Describe** Give a detailed account of
- **Explain** Make plain, interpret, and account for
- **Interpret** Explain the meaning or significance
- **Outline** Provide a summary of the important points
- **Relate** Show a connection between
- **Understand** Appreciate the details of; comprehend

RECOMMENDED TEXTS

We encourage candidates to use the most recent version of each of the following texts.

GENERAL PHYSIOLOGY:

A good introductory text book:

“Principles of Physiology for the Anaesthetist” by Kam and Power

OR

“Textbook of Medical Physiology” by Guyton and Hall

OR

“Ganong’s Review of Medical Physiology” by Barrett et al.

RESPIRATORY PHYSIOLOGY:

“Nunn’s Applied Respiratory Physiology” by Lumb

AND

“Respiratory Physiology – the essentials” by West

CARDIOVASCULAR PHYSIOLOGY:

“Cardiovascular Physiology” by Pappano and Wier

RENAL PHYSIOLOGY:

“Vander’s Renal Physiology” by Eaton and Poole

PHARMACOLOGY

“Pharmacokinetics made easy” by Birkett and Australian Prescriber

“Drugs in Anaesthesia and Intensive Care” by Smith et al (provides brief monographs of many common drugs)

“Basic and Clinical Pharmacology” by Katzung et al.

MEASUREMENT:

“Basic Physics and Measurement in Anaesthesia” by Davis and Kenny

OR

“Physics in Anaesthesia” by Middleton et al.

ANATOMY:

“Anatomy for Anaesthetists” by Ellis and Lawson

BLOOD:

"Australian Red Cross Blood Service" (http://www.transfusion.com.au/) and "New Zealand Blood Service" (http://www.nzblood.co.nz/)

SECTIONS of the following texts maybe useful:

"Stoelting's Pharmacology and Physiology in Anesthetic practice" by Shafer et al.

"Pharmacology for Anaesthesia and Intensive Care" by Peck and Hill

"Anaesthesia Pharmacology Basic Principles and Clinical Practice" by Evers and Maze

"Medical pharmacology at a glance" by Neal

"Immunology at a Glance" by Playfair and Chain) – (a useful reference text for some topics – you are not expected to read it all.)

"Therapeutic Guidelines" – Antibiotics

"Miller's Anaesthesia" (a good reference text for some topics – you are not expected to read it all.)

"Mims' Medical Microbiology" by Goering et al. No need to read it all. The main syllabus content is covered in chapters 1 to 5 (basic microbiology) and chapter 33 (antimicrobial agents and chemotherapy). Other sections of the book may provide useful insights for the syllabus (e.g. the chapter on immune defences in action).

"Goodman and Gilman's the Pharmacological Basis of Therapeutics" by Hardman et al (this is a good reference text – you are not expected to read it all.)

PLEASE NOTE: online non peer reviewed sources may not be reliable.

SECTION A: PHARMACEUTICS

Abilities

i. A more detailed knowledge would be expected for more commonly used drugs. L1

ii. Describe the pharmaceutics and formulation of drugs including packaging, formulation, isomerism, compatibility and excipients (additives) as they pertain to drugs. L2

SECTION B: PHARMACOKINETICS

Objective

An understanding of the fate of drugs in the body, including dosage, and how it is affected by **extremes of age, obesity**, **pregnancy** (including foetal) and **disease (particularly critical illness)**.

Abilities

i. Explain the concept of pharmacokinetic modeling of single and multiple compartment models. L1

ii. Describe absorption and factors that will influence it. L1

iii. Describe factors influencing the distribution of drugs. L1

iv. Describe the mechanisms of drug clearance and metabolism. L1

v. Explain the concepts of intravenous bolus and infusion kinetics. To describe the concepts of effect-site and context sensitive half time. L1

vi. Explain clinical drug monitoring with regard to peak and trough concentrations, minimum therapeutic concentration and toxicity. L1

vii. Describe the pharmacokinetics of drugs in the epidural and subarachnoid space. L2

SECTION C: PHARMACODYNAMICS

Objective

A general understanding of how drugs work, how their actions may be modified, including adverse effects and drug interactions, as they apply to **normal physiology**, **extremes of age**, **obesity**, **pregnancy** (including foetal) and **disease (particularly critical illness)**.

Abilities

i. To define and explain dose-effect relationships of drugs, including dose-response curves with reference to:
   - graded and quantal response
   - therapeutic index
   - potency and efficacy
   - competitive and non-competitive antagonists
   - partial agonists, mixed agonist-antagonists and inverse agonists L1

ii. To explain the concept of drug action with respect to receptor theory. L1

iii. To explain the concept of drug action with respect to:

- enzyme interactions
- physico-chemical interactions L2

iv. To explain receptor activity with regard to:
- ionic fluxes
- second messengers and G proteins
- nucleic acid synthesis
- regulation of receptor number and activity
- structural relationships for receptors and ligands L2

v. To explain the Law of Mass Action and describe affinity and dissociation constants. L2

SECTION D: VARIABILITY IN DRUG RESPONSE

Abilities

i. Classify and describe adverse drug reactions. L1

ii. Classify and describe mechanisms of drug interaction. L1

iii. Describe alterations to drug response due to physiological change, with particular reference to neonates/infants, the elderly, pregnancy and obesity. L1

iv. Describe alterations to drug response due to pathological disturbance with particular reference to cardiac, respiratory, renal and hepatic disease. L1

v. Define tachyphylaxis, tolerance, addiction, dependence and idiosyncrasy. L2

vi. Describe mechanisms of tolerance. L2

vii. Outline genetic variability. L2

viii. Explain the mechanisms and significance of pharmacogenetic disorders (e.g. malignant hyperthermia, porphyria, atypical cholinesterase and disturbance of cytochrome function). L2

ix. Describe and give examples of the clinical importance of isomerism. L2

SECTION E: CELLULAR PHYSIOLOGY

Abilities

i. Explain mechanisms of transport of substances across cell membranes, including an understanding of the Gibbs-Donnan effect. L1

ii. Describe the cell membrane and cellular organelles and their properties. L2

iii. Outline the role of cellular receptors and the function of secondary messengers. L2

iv. To describe the composition and control of intracellular fluid and the mechanisms by which cells maintain their homeostasis and integrity. L2

SECTION F: RESPIRATORY SYSTEM

F1: Anatomy of the Respiratory System

Abilities

i.	Describe the function and structure of the upper, lower airway and alveolus.	L1
ii.	Understand the differences encountered in the upper airway for neonates, children and adults.	L1
iii.	Describe the structure of the chest wall and diaphragm and to relate these to respiratory mechanics.	L1
iv.	Outline the anatomy of the pulmonary and bronchial circulations.	L1

F2: Control of Ventilation

Abilities

i.	Describe the control of breathing.	L1

F3: Mechanics of Breathing

Abilities

i.	Describe the inspiratory and expiratory process involving the chest wall, diaphragm, pleura and lung parenchyma.	L1
ii.	Define compliance (static, dynamic and specific), its measurement, and relate this to the elastic properties of the respiratory system.	L1
iii.	Explain the concepts of time constants.	L1
iv.	Describe the pressure and volume relationships in the respiratory system.	L1
v.	Describe the pressure flow and flow volume relationships of the lung.	L1
vi.	Describe the properties, production and regulation of, surfactant and relate these to its role in influencing respiratory mechanics.	L1
vii.	Explain the significance of the vertical gradient of pleural pressure and the effect of positioning.	L1
viii.	Explain the relationship between resistance and respiratory gas flow.	L1
ix.	Describe the factors affecting airway resistance, and its measurement.	L1
x.	Describe the work of breathing and its components.	L1

F4: Pulmonary Gas Volumes

Abilities

i.	Explain the measurement of lung volumes and capacities and factors that influence them.	L1
ii.	State the normal values of lung volumes and capacities.	L1

iii. Define closing capacity, the factors that alter it, its clinical significance and measurement. L1

F5: Pulmonary Circulation

Abilities

i. Describe the anatomical and physiological features of the pulmonary circulation. L1

ii. Understand pulmonary vascular resistance and the factors that affect this. L1

iii. Understand the differences between the pulmonary and systemic circulation. L1

F6: Ventilation-Perfusion Relationships

Abilities

i. Describe the concepts of global and regional ventilation and perfusion and the factors that affect these. L1

ii. Describe West's zones of the lung and explain the mechanisms responsible for them. L1

iii. Explain ventilation-perfusion matching and mismatching. L1

iv. Define dead space and its components. Explain how these may be measured and describe the physiological impact of increased dead space. L1

v. Explain the concept of shunt, its physiological effects and its measurement. L1

vi. Explain venous admixture, its relationship to shunt and ventilation-perfusion (V/Q) mismatch. L1

vii. Explain the effect of ventilation-perfusion mismatch on oxygen transfer and carbon dioxide elimination. L1

viii. Outline the methods used to measure ventilation-perfusion mismatch. L1

F7: Diffusive Transfer of Respiratory Gases

Abilities

i. Describe and explain the oxygen cascade. L1

ii. Describe the movement of carbon dioxide from the cell to the atmosphere. L1

iii. Explain perfusion-limited and diffusion-limited transfer of gases. L1

iv. Define diffusing capacity and its measurement. L1

F8: Gas Transport in the Blood

Abilities

i. Describe the carriage of oxygen in blood. L1

ii. Explain the oxyhaemoglobin dissociation curve and factors that may alter it. L1

iii. Describe the carbon dioxide carriage in blood including the Haldane effect and the chloride shift. L1

iv. Explain the carbon dioxide dissociation curve. L1

v. Describe the oxygen and carbon dioxide stores in the body. L1

vi. Describe physiology and consequences of foetal haemoglobin. L1

vii. Describe physiology and consequences of abnormal haemoglobin. L2

F9: Pulmonary Function Tests and Equations

Abilities

i. Describe the measurement and interpretation of pulmonary function tests. L1

ii. Describe the carbon dioxide and oxygen response curves and how these may be used to assess the control of breathing. L1

iii. Interpret normal and abnormal blood gases. L1

iv. Understand the common respiratory equations. L1

F10: Applied Respiratory Physiology

Abilities

i. Describe the physiological consequences of intermittent positive pressure ventilation and positive end-expiratory pressure. L1

ii. Explain the physiological effects of hyperoxia, hypoxaemia, hypercapnia and hypocapnia. L1

iii. Explain the effect of changes in posture on ventilatory function. L1

iv. Define humidity and give an outline of the importance of humidification. L1

v. Explain the pathways and importance of the cough reflex. L1

vi. Outline the non-ventilatory functions of the lungs. L1

F11: Respiratory Pharmacology and Therapeutic Gases

Abilities

i. Describe the pharmacology of anti-asthma drugs. L1

ii. Describe the pharmacology of oxygen. L1

iii. Outline the pharmacology of drugs used to treat acute pulmonary hypertension. L2

F12: Respiratory Measurement

Abilities

i. Describe the principles of pulse and tissue oximetry, co-oximetry including calibration, sources of errors and limitations. L1

ii. Describe the principles of capnography, including calibration, sources of errors and limitations. L1

iii. Describe the methods of measurement of oxygen and carbon dioxide tension in blood. L1

iv. Describe the principles of measuring oxygen concentration. L2

SECTION G: CARDIOVASCULAR SYSTEM

G1: Structure and Function of the Heart

Abilities

i. Describe the structure and functional significance of the excitatory, conductive and contractile elements of the heart . L1

ii. Describe the anatomy of the heart, including valves, chambers and the pericardium and coronary circulation. L1

iii. Describe the normal pressure and flow patterns (including velocity profiles) of the cardiac cycle. L1

iv. Describe the fetal circulation. L1

v. Describe the circulatory and respiratory changes that occur at birth. L1

G2: Electrical Properties of the Heart

Abilities

i. Explain the ionic basis of spontaneous electrical activity of cardiac muscle cells. L1

ii. Describe the normal and abnormal processes of cardiac excitation and electrical activity. L1

iii. Explain the physiological basis of the electrocardiograph. L1

iv. Correlate the mechanical events of the cardiac cycle with the physical, electrical and ionic events. L1

G3: Determinants and Control of Cardiac Output

Abilities

i. Explain the Frank-Starling mechanism and its relationship to excitation-contraction coupling. L1

ii. Define the components and determinants of cardiac output including the effects of positive pressure ventilation. L1

iii. Describe myocardial oxygen demand and supply, and the conditions that may alter each. L1

iv. Describe and explain cardiac output curves, vascular function curves and their correlation. L1

v. Describe the pressure-volume relationships of the ventricles and their clinical applications. L1

vi. Describe the cardiac reflexes . L2

G4: The Peripheral Circulation

Abilities

i. Describe the essential features of the micro-circulation including fluid exchange (Starling forces) and control mechanisms present in the pre- and post-capillary sphincters. L1

ii. Describe the distribution of blood volume and flow in the various regional circulations and explain the factors that influence them, including autoregulation. These include, but not limited to, the cerebral and spinal cord, hepatic and splanchnic, coronary, renal and utero-placental circulations. L1

iii. Explain the factors that determine systemic blood pressures and their regulation. L1

iv. Describe the physiological factors that may contribute to pulse variations in blood pressure. L1

v. Describe total peripheral vascular resistance and the factors that affect it. L1

vi. Describe the factors that affect venous oxygen saturation. L1

G5: Control of Circulation

Abilities

i. Describe the role of the vasomotor centre and the autonomic nervous system in the regulation of cardiac output and venous return. L1

ii. Describe the function of baroreceptors and to relate this knowledge to common clinical situations. L1

iii. Explain the role of the autonomic nervous system in controlling systemic vascular resistance and redistribution of blood volume. L1

iv. Explain the humoral regulation of blood volume and flow. L1

G6: Applied Cardiovascular Physiology

Abilities

i. Explain the response of the circulation to changes in posture, haemorrhage, hypovolaemia, anaemia and exercise. L1

ii. Explain the physiological consequences of intermittent positive pressure ventilation, positive end-expiratory pressure (see also F10 i.) and the Valsalva manoeuvre. L1

iii. Explain the systolic pressure-volume relationships of the ventricles and their clinical applications. L1

iv. Explain the cardiovascular consequences of obesity. L2

v. Describe the classification of shock. L2

G7: Cardiovascular Measurement

Abilities

i. Describe the principles behind the electrocardiogram (ECG). L1

ii. Describe the principles of measurement, limitations, and potential sources of error for pressure transducers, and their calibration. L1

iii. Describe the invasive and non-invasive measurement of blood pressure, including limitations and potential sources of error. L1

iv. Describe the methods of measurement of cardiac output including calibration, sources of errors and limitations L1

v. Explain the derived values from common methods of measurement of cardiac output including transpulmonary thermodilution and pulse contour analysis devices (e.g. variables such as EVLW, GEDV, SVV in addition to CI, SVI, SVRI, LVSWI etc.). L2

vi. Outline methods and principles used to measure regional blood flow. L2

G8: Cardiovascular Pharmacology

Abilities

i. Understand the detailed pharmacology of inotropes and vasopressors. L1

ii. Understand the pharmacology of adrenoreceptor blocking drugs. L1

iii. Understand the pharmacology of anti-hypertensive drugs. L1

iv. Understand the pharmacology of antiarrhythmic drugs. L1

v. Understand the pharmacology of anti-anginal drugs. L2

SECTION H: RENAL SYSTEM

H1: Renal Physiology

Abilities

i. Describe the functional anatomy of the kidneys and renal blood flow. L1

ii. Describe glomerular filtration and tubular function. L1

iii. Explain the counter-current mechanisms in the kidney. L1

iv. Outline the endocrine functions of the kidney. L1

v. Describe the role of the kidneys in the maintenance of acid/base balance. L1

vi. Describe the role of the kidneys in the maintenance of fluid, osmolality and electrolyte balance. L1

vii. Describe the role of the kidney in the handling of glucose, nitrogenous products and drugs. L1

viii. Describe the physiological effects of renal dysfunction. L1

H2: Renal Pharmacology

Abilities

i. An understanding of the pharmacology of diuretics. L1

H3: Applied Renal Physiology

Abilities

i. Describe the principles of dialysis and renal replacement fluid. L2

H4: Renal Measurement

Abilities

i. Describe the principles of measurement of glomerular filtration rate and renal blood flow. L2

ii. Describe the utility of measurement of serum Creatinine and estimation of Creatinine Clearance. L2

SECTION I: BODY FLUIDS AND ELECTROLYTES

I1: Physiology of Body Fluids and Electrolytes

Abilities

i. Explain the distribution and movement of body fluids and their measurement. L1

ii. Define osmosis, colloid osmotic pressure and reflection coefficients and explain the factors that determine them. L1

iii. Describe the function, distribution, regulation and physiological importance of sodium, chloride potassium, magnesium, calcium and phosphate ions. L1

iv. Outline the composition and functions of lymph. L2

I2: Intravenous Fluids

Abilities

i. An understanding of the pharmacology of colloids and crystalloids (used in Intensive Care Medicine). L1

I3: Measurement of Body Fluids

Abilities

i. Describe the measurement of osmolality and the mechanisms involving the regulation of osmolality. L1

ii. Describe the measurement of body fluid compartments. L1

SECTION J: ACID BASE

J1: Acid Base Physiology

Abilities

i. Describe the chemistry of buffer mechanisms and explain their relevant roles in the body. L1

ii. Explain the principles underlying acid-base chemistry. L1

iii. Explain the physiological basis to clinical acid – base disturbance. L1

iv. Explain the Henderson-Hasselbach (traditional) and the Stewart (physico-chemical) approach to acid-base. L2

J2: Acid Base Measurement

Abilities

i. Be able to interpret normal and abnormal arterial blood gases. L1

ii. Describe the methods of measurement of pH in blood. L2

SECTION K: NERVOUS SYSTEM – INCLUDING PAIN

K1: Physiology of the Nervous System

Abilities

i. Describe the anatomy of cranial nerves relevant to brainstem reflexes. L1

ii. Explain the factors affecting and control of intra-cranial pressure. L1

iii. Describe the physiology of cerebrospinal fluid. L1

iv. Explain the basic electro-physiology of neural tissue, including conduction of nerve impulses and synaptic function. L2

v. Describe the major sensory and motor pathways (including anatomy). L2

vi. Describe the major neurotransmitters and their physiological role, with particular reference to GABA, excitatory and inhibitory amino acids, acetylcholine, noradrenaline, dopamine and serotonin and NMDA receptor. L2

vii. Describe the physiology of sleep. L2

K2: Pharmacology Related to the Nervous System

Abilities

i. Understanding of the pharmacology of sedating drugs. L1

ii. Understanding of the pharmacology of local anaesthetic drugs, including their toxicity. L1

iii. Understand the pharmacology of anti-convulsant drugs. L1

iv. Understand the pharmacology (including toxicology) of anti-depressant and anti-psychotic drugs. L2

K3: Pain Physiology

Abilities

i. Describe the physiology of pain, including peripheral nociception, conduction, mediators and pathways, spinal cord modulation, central processing of pain, changes in the older patient. L1

ii. To describe peripheral and central sensitization, gate control theory, preemptive and preventive analgesia. L2

iii. Describe the physiology of opioid and NMDA receptors. L2

K4: Pain Pharmacology

Abilities

i. Describe the classes of drugs used to treat pain. L1

ii. Describe the pharmacology of opiates as a class. L1

iii. Describe the pharmacology of Nonsteroidal anti-inflammatory drugs as a class. L2

K5: Nervous System Measurement

Abilities

i. Describe the measurement of intracranial pressure. L1

ii. Describe the principles behind the electroencephalogram (EEG) and evoked potentials. L2

SECTION L: MUSCULOSKELETAL SYSTEM

L1: Musculoskeletal System Physiology

Abilities

i. Describe the anatomy and physiology of skeletal, smooth, and cardiac muscle. L1

ii. Describe the physiology of the neuromuscular junction and its receptors. L1

iii. Describe the mechanism of excitation-contraction coupling. L1

iv. Describe the relationship between muscle length and tension. L1

v. Explain the concept of motor units. L2

vi. Describe the monosynaptic stretch reflex, single twitch and tetanus. L2

L2: Musculoskeletal System Pharmacology

Abilities

i. Understanding of the pharmacology of neuromuscular blocking drugs. L1

ii. Understanding of the antagonism of neuromuscular blocking drugs. L2

L3: Neuromuscular Measurement / Monitoring

Abilities

i. Describe the monitoring of neuromuscular blockade. L2

SECTION M: AUTONOMIC NERVOUS SYSTEM

M1: Physiology of the Autonomic Nervous System

Abilities

i. Describe the autonomic nervous system, including anatomy, receptors, subtypes and transmitters (including their synthesis, release and fate). L1

M2: Pharmacology of the Autonomic Nervous System

Abilities

i. Understanding of the pharmacology of drugs acting upon the autonomic nervous system. L1

ii. Describe the structure activity relationships of adrenergic and cholinergic drugs. L1

iii. Outline the mechanisms by which drugs may affect neurotransmission and noradrenaline effect at the sympathetic nerve terminal. L2

SECTION N: LIVER

N1: Liver Physiology

Abilities

i. Describe the storage, synthetic, metabolic, immunological and excretory functions of the liver. L1

ii. Describe the physiology and anatomy of the hepatic and portal blood flow and the biliary tract. L1

iii. Describe the physiology of bile and its metabolism. L2

N2: Liver Measurement

Abilities

i. Describe the interpretation of laboratory assessment of liver function (Albumin, Glucose, Bilirubin, Coagulation profile, Ammonia). L1

SECTION O: GASTROINTESTINAL SYSTEM

O1: Gastrointestinal Physiology

Abilities

i. Describe the composition, volumes and regulation of gastrointestinal secretions. L2

ii. Describe the control of gastrointestinal motility, including sphincter function. L2

iii. Outline the digestion and absorption of fat, protein, carbohydrates and the absorption of water, electrolytes and vitamins. L2

iv. Outline the gastrointestinal blood supply. L2

O2: Gastrointestinal Pharmacology

Abilities

i.	Describe the pharmacology of aperients, laxatives and other drugs that affect gastrointestinal motility.	L1
ii.	Describe the pharmacology of drugs that influence gastric fluid pH and volume.	L1
iii.	Describe the pharmacology of drugs with anti-emetic activity.	L1
iv.	Describe the pharmacology of the octreotide.	L2
v.	Describe the pharmacology of terlipressin.	L2

SECTION P: NUTRITION & METABOLISM

Abilities

i.	Describe the physiology and biochemistry of fat, carbohydrate and protein metabolism.	L1
ii.	Describe anaerobic metabolism and ketone production.	L1
iii.	Describe the normal nutritional requirements.	L1
iv.	Describe the normal requirements for vitamins and trace elements.	L2
v.	Describe basal metabolic rate and its measurement.	L2
vi.	Outline the factors that influence metabolic rate.	L2
vii.	Describe the pharmacology of enteral and parenteral nutrition.	L1

SECTION Q: HAEMATOLOGICAL SYSTEM

Q1: Physiology of Haematological System

Abilities

i.	Outline the physiological production of blood and its constituents.	L1
ii.	Explain the major blood groups and process of cross matching.	L1
iii.	Outline the constituents and functions of plasma.	L1
iv.	Describe the process and regulation of haemostasis, coagulation and fibrinolysis.	L1
v.	Describe the mechanisms of preventing thrombosis including endothelial factors and natural anticoagulants.	L1
vi.	Explain the physiological consequences of acute and chronic anaemia.	L2

Q2: Pharmacology of Haematological System

Abilities

i. Understanding of the pharmacology of anti-coagulants, anti-platelet drugs, thrombolytic drugs and anti-fibrinolytic drugs. L1

Q3: Measurement of Haematological System

Abilities

i. Outline the methods for assessing coagulation (including TEG, ROTEM). L1

ii. Outline the methods for assessing platelet function and fibrinolysis. L2

Q4: Blood and Blood Products

Abilities

i. Understanding of the pharmacology of blood and its components, including individual factor replacement. L1

ii. Understanding the adverse consequences of blood transfusion, including that of massive blood transfusion. L1

iii. Understand the process of collection and production of blood and its components. L2

SECTION R: THERMOREGULATION

R1: Temperature Physiology

Abilities

i. Define heat and temperature. L1

ii. Outline the mechanisms for heat transfer between the body and its environment. L1

iii. Explain the mechanisms by which normal body temperature is maintained and regulated. Including mechanisms for the loss of heat produced in metabolism, and the generation of additional heat. L1

iv. Explain the physiological responses when a person is subjected to hypothermia and hyperthermia. L1

v. Explain temperature regulation specific to the neonate. L2

R2: Temperature Measurement

Abilities

i. Describe the measurement of temperature. L1

SECTION S: IMMUNOLOGY & HOST DEFENCE

S1: Physiology of Immunology & Host Defence

Abilities

i.	Explain anaphylaxis.	L1
ii.	Explain the immunological basis of hypersensitivity.	L2
iii.	Describe the factors involved in the process of inflammation and the immune response, including innate and acquired immunity.	L2
iv.	Outline the non-immune host defenses used to defend against infection.	L2

S2: Pharmacology Related To Immunology

Abilities

i.	Understand the pharmacology of the drugs used in the treatment of anaphylaxis.	L1

SECTION T: MICROBIOLOGY

T1: General Microbiology

Abilities

i.	Describe the classification bacteria.	L1
ii.	Describe the principles of anti-microbial resistance.	L1
iii.	Broadly outline the classification of viruses and fungi.	L2

T2: Anti-Microbial Drugs

Abilities

i.	Describe the classification and pharmacology of antibacterial agents.	L1
ii.	Describe the classification and pharmacology of antiviral and antifungal agents.	L2
iii.	Outline the pharmacology of antiseptics and disinfectants.	L2

SECTION U: ENDOCRINE SYSTEM

U1: Endocrine Physiology

Abilities

i.	Describe the exocrine and endocrine functions of the pancreas.	L1
ii.	Describe the physiology of insulin, glucagon and somatostatin.	L1
iii.	Explain the control of blood glucose.	L1
iv.	Describe the control, secretions and functions of the pituitary and the hypothalamus.	L1

v.	Describe the control, secretions and functions of the thyroid.	L1
vi.	Describe the control, secretions and functions of renal and adrenal hormones.	L1
vii.	Describe the control of plasma calcium.	L1

U2: Endocrine Pharmacology

Abilities

i.	Understand the pharmacology of glucocorticoids.	L1
ii.	Understand the pharmacology of insulin preparations.	L1
iii.	Understand the pharmacology of oral hypoglycaemic drugs.	L2
iv.	Understand the pharmacology of thyroid hormones.	L2
v.	Understand the pharmacology of mineralocorticoids.	L2
vi.	Outline the pharmacology of glucagon.	L2
vii.	Understand the pharmacology of vasopressin and its analogues.	L2

SECTION V: OBSTETRICS

V1: Obstetric Physiology

Abilities

i.	Explain the physiological changes during pregnancy, and parturition.	L1
ii.	Outline the functions of the placenta, and determinants of placental blood flow.	L2
iii.	Describe the transfer of nutrients, drugs and gases between mother and fetus including the double Bohr and Haldane effects.	L2
iv.	Describe the transition from foetal to neonatal circulation and the establishment of ventilation.	L2
v.	Describe the physiological consequences of changes in posture during pregnancy including the consequences of aorto-caval compression.	L2

V2: Obstetric Pharmacology

Abilities

i.	Understand the changes in pharmacokinetics and pharmacodynamics during pregnancy.	L1
ii.	Describe the pharmacology of oxytocic drugs with special reference to oxytocin derivatives, ergot derivatives and prostaglandins.	L2
iii.	Describe the pharmacology tocolytic drugs with particular reference to beta 2 agonists, calcium antagonists and magnesium.	L2

SECTION W: PRINCIPLES OF MEASUREMENT AND EQUIPMENT

See individual sections for specific measurement related to each sections of the syllabus.

Abilities

i.	Describe the laws governing the behavior of gases and liquid.	L1
ii.	Describe the physical principles of ultrasound and the Doppler Effect.	L1
iii.	Explain the electrical concepts of current, potential difference, resistance, impedance, inductance, capacitance, frequency and amplitude as they relate to biological signals and biomedical apparatus.	L2
iv.	Describe the measurement of flow, pressure and volume of gases.	L2
v.	Describe the principles of flow as they relate to the function and classification of oxygen delivery devices.	L2

SECTION X: PROCEDURAL ANATOMY

Abilities

i.	Describe the anatomy relevant to central venous access (including femoral, internal jugular, external jugular, subclavian and peripheral veins).	L1
ii.	Describe the anatomy relevant to the insertion of an arterial line into a brachial, axillary, posterior tibial, dorsalis pedis, radial or femoral artery.	L1
iii.	Describe the anatomy relevant to the insertion of an intercostal catheter.	L1
iv.	Describe the anatomy relevant to the performance of endotracheal intubation, a cricothyroidotomy and a tracheostomy.	L1
v.	Describe the anatomy relevant to the performance of a lumbar puncture.	L1

PHARMACOPEIA

The following is intended to provide a guide as to the minimum breadth and depth of knowledge required for certain drugs or Classes of drugs that are considered relevant to the CICM First Part Examination.

It is not an exhaustive list of all drugs relevant or important in ICU practice. For each drug or Class there is a level of the minimum required Detail of Understanding.

It is suggested for drugs from a particular Class, when an example is not given, to study a prototypical drug from each Class, as well as the relevant variations within each class and what major differences may exist between agents in that Class.

Trainees are expected to understand a drug's pharmacology in the context of **normal physiology**, **extremes of age** (i.e. neonates, paediatrics and the elderly), **obesity**, **pregnancy** (including foetal) and **disease.** An understanding of potential toxicity and relevant antidotes is also expected**.** Agents maybe listed in more than one section when they are used for different indications.

DETAIL OF UNDERSTANDING

Drugs or Classes of drugs have been assigned a Detail of Understanding level. This is a guide as to the minimum level of knowledge and assessment that can be expected for that drug.

Level 1 (1) – Represents drugs used almost every day in the ICU
For these drugs, a detailed knowledge and comprehension of their class, pharmaceutics, pharmacodynamics, pharmacokinetics, relevant structure activity relationships and adverse effects (including relevant toxicity and withdrawal syndromes) will be required. As such, they will be eligible to be assessed on all occasions, in depth and are considered essential knowledge.

Level 2 (2) – Represents drugs that may be used once a month or periodically in the ICU
For these drugs, a general understanding of the class, pharmacodynamics, pharmacokinetics and adverse effects (including toxicity and relevant withdrawal syndromes) will be required. They will be eligible to be assessed on most occasions, in some depth, and are considered important knowledge.

Level 3 (3) – Represents drugs only used occasionally in the ICU
For these drugs a working knowledge of the important points relating to class, pharmacodynamics, pharmacokinetics and adverse effects, as they relate to the practice of Intensive Care Medicine will be required. They will be eligible for assessment regularly and a broad understanding of the concepts the principals involved will be expected.

RESPIRATORY PHARMACOLOGY

Oxygen (1)

Bronchodilators:

- Beta agonists
  - e.g. Salbutamol (1)
- Antimuscarinic drugs
  - e.g. Ipratropium (1)
- Theophylline / Aminophylline (2)

Corticosteroids:

- Oral / intravenous (1)
- Inhaled (2)

Pulmonary vasodilators:

- Nitric oxide (1)
- Prostacyclin (2)

CARDIOVASCULAR PHARMACOLOGY

Adrenergic drugs:

- Adrenaline / Epinephrine (1)
- Noradrenaline / Norepinephrine (1)
- Dopamine (1)
- Dobutamine (1)
- Isoprenaline / Isoproterenol / (1)
- Metaraminol (1)
- Ephedrine (2)
- Phenylephrine (2)

Non-adrenergic drugs:

- Vasopressin (1)
- Phosphodiesterase III inhibitors (1) Milrinone
- Calcium Sensitisers (1) Levosimendin

Antihypertensive drugs:

- Centrally acting drugs
  - Clonidine (1)
- Adrenoreceptor antagonist
  - Alpha blockers
    - Prazosin (2)
  - Beta blockers (1)
  - Mixed Antagonist
    - e.g. Labetalol (1) / Carvedilol (2)
- Direct vasodilators
  - Calcium channel antagonist
    - Non-dihydropyridines (2)
    - Dihydropyridines (2)
  - Glyceryl Trinitrate (1)
  - Sodium Nitroprusside (1)
  - Hydralazine (2)
- ACE inhibitors (1)
- Angiotensin receptor blockers (2)

Antiarrhythmics:

- Sodium channel blocking drugs
  - Lignocaine (1)
  - Procainamide (2)

    - Flecainide (2)
- Beta blockers (1)
- Amiodarone (1)
- Digoxin (1)
- Adenosine (1)
- Magnesium (1)
- Atropine (1)
- Sotalol (2)
- Calcium channel blockers (2)

RENAL PHARMACOLOGY

Diuretics:

- Osmotic drugs
    - Mannitol (2)
- Drugs acting on the proximal tubule
    - Carbonic anhydrase inhibitors (2)
- Drugs acting on the Loop of Henle
    - Loop acting diuretics (1)
- Drugs acting on the distal tubule or collecting duct
    - Thiazides (2)
    - Aldosterone antagonist (2)

Renal Replacement Fluid (2)

INTRAVENOUS FLUID PHARMACOLOGY

Crystalloids (1):

- 0.9% saline
- Hypertonic saline solutions
- Hartmann's / Plasmalyte
- Glucose containing solutions

Colloids:

- Albumin (1)
- Gelatins (2)
- Starches (2)

Electrolytes and Buffers (1):

- Potassium
- Calcium chloride and gluconate
- Magnesium
- Sodium Bicarbonate
- Phosphate

NEUROPHARMACOLOGY

Sedative / Hypnotic drugs:

- Propofol (1)
- Benzodiazepines (1)
- Ketamine (1)
- Dexmedetomidine (1)
- Barbiturates (2)
    - Thiopentone
    - Phenobarbitone (see also neuropharmacology)

Analgesics:

- Opiates (1)
  - Morphine (1)
  - Fentanyl (1)
  - Oxycodone (1)
  - Alfentanil (2)
  - Remifentanil (2)
  - Methadone (2)
  - Pethidine (2)
  - Buprenorphine (2)
  - Hydromorphone (2)
  - Codeine (2)
- Paracetamol (1)
- Ketamine (1)
- Non-steroidal anti-inflammatory drugs (2)
- Tramadol (2)
- Gabapentin / Pregabalin (2)

Antidepressants (2):

- Tricyclics
- Selective serotonin reuptake inhibitors
- Serotonin-Noradrenalin reuptake inhibitors
- Monoamine oxidase inhibitors

Antipsychotics (2):

- First generation antipsychotics
  - Haloperidol
  - Chlorpromazine
- Second generation antipsychotics
  - Olanzapine
  - Risperidone
  - Clozapine
  - Quetiapine

Local Anaesthetics:

- Amides (1)
- Esters (2)

Anticonvulsants:

- Phenytoin (1)
- Midazolam (1)
- Levetiracetam (1)
- Sodium valproate (1)
- Carbamazepine (2)
- Clonazepam (2)
- Phenobarbitone (2)

Lithium (2)

Nimodipine (2)

NEUROMUSCULAR PHARMACOLOGY

Neuromuscular blockers (1):

- Depolarising
  - Suxamethonium
- Non-depolarising
  - Aminosteroids
    - Vecuronium
    - Rocuronium
    - Pancuronium
  - Isoquinolines
    - Atracurium
    - Cisatracurium

Dantrolene (2)

Sugammadex (2)

AUTONOMIC PHARMACOLOGY

Indirect Muscarinic stimulants:

- Neostigmine (2)

Antimuscarininc drugs:

- Atropine (1)
- Glycopyrrolate (2)

GASTROINTESTINAL PHARMACOLOGY

Acid suppression (2):

- H2-receptor blockers
- Proton pump inhibitors

Prokinetics (2):

- Metoclopramide
- Erythromycin

Antiemetics (as a class 1) – this list is not exhaustive:

- Serotonin antagonist (1)
- Metoclopramide (1)
- Droperidol (2)
- Prochlorperazine (2)
- Promethazine (2)

Octreotide (2)

Aperients and Laxatives (1)

Nutritional supplements:

- TPN solution (1)
- Intravenous Lipid solutions (specific brand details not required) (1)
- Enteral feed solutions (specific brand details not required) (1)
- Vitamins (2)
- Trace Elements (2)

HAEMATOLOGICAL PHARMACOLOGY

Anticoagulants:

- Heparin (1)
- Low molecular weight heparin (1)
- Warfarin (1)
- Dabigatran (2)
- Apixaban, Rivaroxaban (2)

Anticoagulant Reversal Agents:

- Idarucizumab (2)
- Protamine (2)
- Vitamin K (2)

Anti-platelet drugs:

- Aspirin (1)
- ADP receptor blockers (2) e.g. Clopidogrel, Ticagrelor, Prasugrel
- GPIIb/IIIa inhibitors (3) e.g. abciximab and tirofiban

Fibrinolytics (2):

- Alteplase
- Tenecteplase

Antifibrinolytics (2):

- Tranaxemic acid

Blood products (1):

- Red blood cells
- Fresh frozen plasma
- Platelets
- Cryoprecipitate

Fractionated plasma products:

- Albumin
- Factor concentrates (3)
    - Prothrombinex (2)
    - Fibrinogen concentrate
    - Factor VIIa
    - Factor VIII
    - Factor IX
    - Antithrombin III

Intravenous Immunoglobulin (3)

ANTIMICROBIALS

Antibiotics:

- Penicillins (1)
- Cephalosporins (1)
- Carbapenems (1)
- Glycopeptides (1)
- Aminoglycosides (1)
- Quinolones (1)
- Metronidazole (1)
- Macrolides (2)
- Lincosamides (2)
- Tetracyclines (2)
- Trimethoprim / Sulphamethoxazole (Bactrim) (2)

- Beta-lactamase inhibitors (2)

Antivirals (2):
- Acyclovir
- Neuraminidase inhibitors

Antifungals (2):
- Azoles
- Amphotericin

Antiseptics and disinfectants (2)

ENDOCRINE PHARMACOLOGY

Hypoglycemic drugs:
- Insulin (1)
  - Short (1) vs Long (2)
- Sulphonylureas (2)
- Biguanides (2)

Glucocorticoids (1)

Mineralocorticoids (2)

Thyroxine (2)

Glucagon (2)

Vasopressin analogues (Terlipressin / Desmopressin) (2)

OBSTETRIC PHARMACOLOGY

Oxytocics (2)

Tocolytics (2)

SPECIFIC ANTIDOTES FOR REVERSAL OF TOXICITY – not listed elsewhere (2)

Naloxone
Flumazenil
N-acetylcystine
Pralidoxime
Digoxin Antibodies

CONTRIBUTORS

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