COLLEGE OF INTENSIVE CARE MEDICINE
OF AUSTRALIA AND NEW ZEALAND

Syllabus of the First Part Examination for the Basic Sciences in Intensive Care Medicine

Fourth Edition (2023)

Forward

This is the fourth edition of the Syllabus of the First Part Examination for the Basic Sciences in Intensive Care Medicine.

Only minor content changes have been made from the previous edition. Every effort has been made to ensure the overall content of the Syllabus has not increased. The most significant change is the inclusion of further information in the 'Detail of Understanding' section of the pharmacopeia. Each drug or classes of drugs have been assigned a 'Detail of Understanding' level and the information expected for each level is clearly defined.

Topics remain listed under major systems, which include relevant physiology, pharmacology, anatomy, and measurement. The respiratory and cardiovascular sections include a list of subheadings as these are areas in which a more detailed knowledge and comprehension is expected.

The First Part Examination continues to emphasise an integrated approach to the learning and assessment of the Basic Sciences as they apply to Intensive Care Medicine. The intention is 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.

Dr Andrew Semark
Chair, First Part Examination Committee
College of Intensive Care Medicine

Dr Naomi Pallas
Deputy Chair, First Part Examination Committee
College of Intensive Care Medicine

September 2023

Contributors and Acknowledgements

The foundation that underpins the enormity, relevance, and value of this fourth edition of the Syllabus for the Basic Sciences in Intensive Care Medicine is the contribution made by each of the following individuals. It is important that they are listed. Doing so not only acknowledges their valued input, but also allows current and future trainees to have confidence in using this document to attain a high level of knowledge in the Basic Sciences, as they apply to Intensive Care Medicine.

The following individuals provided in depth review as the panel that has overseen this revision and provided comments and contributions in its development:

- Dr Andrew Semark
- Dr Naomi Pallas
- Dr Michael Clifford
- A.Prof Ross Freebairn
- First Part Examination Committee members

Acknowledgement to the College exams staff who have assisted in collating and reviewing the revised syllabus document – Adam Procter and Paisiri Subaram.

Contents

Learning objectives for the First Part Examination in Intensive Care Medicine

Introduction

The purposes of the learning objectives are to provide a guide for:

- trainees in preparation for the First Part Examination.
- supervisors of training, tutors, and teachers.
- examiners.

This will ensure that trainees, tutors, and examiners can work from a common base. All examination questions are based around this Syllabus. These learning objectives are designed to outline the minimum level of understanding required for each topic. The accompanying texts are recommended on the basis that the material contained within them provides sufficient information for trainees to meet the learning objectives.

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.

For all sections of the syllabus an understanding of normal physiology and physiology at 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 these contexts.

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

- **Calculate** Work out or estimate using mathematical principles.
- **Classify** Divide into categories; organise, arrange.
- **Compare and contrast** Examine similarities and differences.
- **Define** Give the precise meaning.
- **Describe** Give a detailed account of.
- **Explain** Make plain.
- **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

Candidates are encouraged to use the most recent version of each of the following texts.

General Physiology

Good introductory textbooks include:

- "Principles of Physiology for the Anaesthetist" by Kam and Power **OR**
- "Textbook of Medical Physiology" by Guyton and Hall **OR**
- "Medical Physiology" by Walter Boron and Emile Boulpaep **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
- "Basic and Clinical Pharmacology" by Katzung et al. **OR**
- "Applied Pharmacology in Anaesthesiology and Critical Care" by Milner and Welch

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)

Additional texts with useful sections

- "Anaesthesia Pharmacology Basic Principles and Clinical Practice" by Evers and Maze
- Antibiotic Chapter of "Therapeutic Guidelines" available online: https://tgldcdp.tg.org.au/index
- "Goodman and Gilman's the Pharmacological Basis of Therapeutics" by Hardman et al
- (a good reference text for some topics – you are not expected to read it all.)
- "Miller's Anaesthesia" (a good reference text for some topics – you are not expected to read it all)
- "Mims' Medical Microbiology and Immunology" by Richard Goering et al.
- "Pharmacology for Anaesthesia and Intensive Care" by Peck and Hill
- "Stoelting's Pharmacology and Physiology in Anaesthetic practice" by Shafer et al.

Please note:

Online non-peer reviewed sources may not be reliable and hence have not been included on the recommended reading list. Care should be taken to confirm the accuracy of any online material. The exam is prepared and marked using the recommended texts provided and as such these should be considered the definitive source material.

Section A: Pharmaceutics

i. Describe the pharmaceutics and formulation of drugs including packaging, formulation, isomerism, compatibility, and excipients (additives) as they pertain to level 1 drugs.

Section B: Pharmacokinetics

i. Explain single and multiple compartment models.
ii. Describe the absorption of drugs and factors that influence this.
iii. Describe the distribution of drugs and factors that influence this.
iv. Describe the mechanisms of drug metabolism and clearance.
v. Explain the kinetics of an intravenous bolus and infusion.
vi. Describe the concepts of effect-site concentration and context sensitive half-time.
vii. Explain clinical drug monitoring with regard to peak and trough concentrations, minimum therapeutic concentration and toxicity.
viii. Describe the pharmacokinetics of drugs in the epidural and subarachnoid space.

Section C: Pharmacodynamics

i. Explain the concept of drug action with respect to receptor theory.
ii. Define and explain dose-effect relationships of drugs, including dose-response curves with reference to:
    - graded and quantal response
    - therapeutic index
    - potency and efficacy
    - agonists, competitive and non-competitive antagonists, partial agonists, mixed agonist-antagonists, and inverse agonists
iii. Explain the concept of drug action with respect to:
    - enzyme interactions
    - physico-chemical interactions
iv. Explain receptor activity with regard to:
    - ion fluxes
    - second messengers and G proteins
    - nucleic acid synthesis
    - regulation of receptor number and activity
    - structural relationships for receptors and ligands
v. Explain the Law of Mass Action and describe the affinity and dissociation constants.

Section D: Variability in Drug Response

i. Classify and describe adverse drug reactions.
ii. Classify and describe mechanisms of drug interactions.
iii. Describe variability in drug responses due to physiological changes with reference to neonates/infants, the elderly, pregnancy, and obesity.
iv. Describe variability in drug responses due to critical illness.
v. Define tachyphylaxis, tolerance, addiction, dependence, and idiosyncrasy.

vi. Describe mechanisms of tolerance.
vii. Outline genetic variability, mechanisms, and significance of pharmacogenetic disorders. (e.g., malignant hyperthermia, porphyria, atypical cholinesterase, and disturbance of cytochrome function).
viii. Describe isomerism and outline the clinical importance of isomerism, providing examples.

Section E: Cellular Physiology

i. Describe the cell membrane, nucleus and cellular organelles and their properties.
ii. Explain mechanisms of transport of substances across cell membranes, including an understanding of the Gibbs-Donnan effect.
iii. Outline the role of cellular receptors and the function of secondary messengers.
iv. Describe the composition and control of intracellular fluid and the mechanisms by which cells maintain homeostasis and integrity.

Section F: Respiratory System

F1: Anatomy of the Respiratory System

i. Describe the structure and function of the upper airway, lower airway, and alveolus.
ii. Describe the structure of the chest wall and diaphragm and relate this to respiratory mechanics.
iii. Outline the anatomy of the pulmonary and bronchial circulations.

F2: Control of ventilation

i. Describe the control of breathing.

F3: Mechanics of Breathing

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

F4: Pulmonary Gas Volumes

i. State the normal values of lung volumes and capacities.
ii. Explain the factors that influence lung volumes and capacities.
iii. Explain the measurement of lung volumes and capacities.
iv. Define closing capacity, describe the factors that alter closing capacity, its clinical significance and measurement.

F5: Pulmonary Circulation

i. Describe the anatomical and physiological features of the pulmonary circulation.
ii. Understand pulmonary vascular resistance and the factors that affect this.
iii. Understand the differences between the pulmonary and systemic circulation.

F6: Ventilation-Perfusion Relationships

i. Describe the concepts of global and regional ventilation and perfusion and the factors that affect these.
ii. Describe West's zones of the lung and explain the mechanisms responsible for them.
iii. Explain ventilation-perfusion matching and mismatching. Explain the effect of ventilation-perfusion mismatch on oxygen transfer and carbon dioxide elimination.
iv. Define dead space and its components. Explain how these may be measured and describe the physiological impact of increased dead space.
v. Explain the concept of shunt, its physiological effects, and its measurement.
vi. Explain venous admixture, its relationship to shunt and ventilation-perfusion (V/Q) mismatch.

F7: Diffusive Transfer of Respiratory Gases

i. Describe and explain the oxygen cascade.
ii. Describe the movement of carbon dioxide from the cell to the atmosphere.
iii. Explain perfusion-limited and diffusion-limited transfer of gases.
iv. Define diffusing capacity and its measurement.
v. Describe the role of endogenous nitric oxide in ventilation and perfusion.

F8: Gas Transport in the Blood

i. Describe the carriage of oxygen in blood.
ii. Explain the oxyhaemoglobin dissociation curve and factors that may alter it.
iii. Describe the carriage of carbon dioxide in blood.
iv. Explain the carbon dioxide dissociation curve.
v. Describe the oxygen and carbon dioxide stores in the body.
vi. Describe the physiology of foetal haemoglobin.

F9: Pulmonary Function Tests and Equations

i. Describe the measurement and interpretation of pulmonary function tests.
ii. Describe the carbon dioxide and oxygen response curves and how these may be used to assess the control of breathing.
iii. Understand respiratory equations that describe ventilation, perfusion, blood flow and respiratory mechanics.

F10: Applied Respiratory Physiology

i. Describe the physiological consequences of intermittent positive pressure ventilation and positive end-expiratory pressure.
ii. Explain the physiological effects of hyperoxia, hypoxaemia, hypercapnia and hypocapnia.
iii. Explain the effect of changes in posture on ventilatory function.
iv. Define humidification, outline the mechanisms of humidification and its importance.
v. Explain the pathways and importance of the cough reflex.
vi. Outline the non-ventilatory functions of the lungs.

F11: Respiratory Pharmacology and Therapeutic Gases

i. Describe the pharmacology of oxygen.
ii. Describe the pharmacology of anti-asthma drugs.
iii. Outline the pharmacology of drugs used to treat acute pulmonary hypertension.

F12: Respiratory Measurement

i. Describe the principles of pulse and tissue oximetry, co-oximetry including calibration, sources of errors and limitations.
ii. Describe the principles of capnography, including calibration, sources of errors limitations.
iii. Describe the methods of measurement of oxygen and carbon dioxide tension in blood.
iv. Describe the principles of measuring oxygen concentration.

Section G: Cardiovascular System

G1: Structure and Function of the Heart

i. Describe the anatomy of the heart including the chambers, valves, pericardium, and the orientation of the heart.
ii. Describe the coronary circulation and its regulation.
iii. Describe the structure and functional significance of the excitatory, conductive, and contractile elements of the heart.
iv. Describe the normal pressure and flow patterns of the cardiac cycle.
v. Describe the foetal circulation.
vi. Describe the circulatory and respiratory changes that occur at birth.

G2: Electrical Properties of the Heart

i. Explain the ionic basis of spontaneous electrical activity of cardiac muscle cells.
ii. Describe the normal processes of cardiac excitation and electrical activity.
iii. Correlate the mechanical events of the cardiac cycle with the physical, electrical, and ionic events.

G3: Determinants and Control of Cardiac Output

i. Explain the Frank-Starling mechanism and its relationship to excitation-contraction coupling.
ii. Explain the measurement of central venous pressure, the components of its waveform and the factors that determine its magnitude.
iii. Define the components and determinants of cardiac output including the effects of positive pressure ventilation.
iv. Describe myocardial oxygen demand and supply and the conditions that may alter each.
v. Describe and explain cardiac output curves, vascular function curves and their correlation.
vi. Describe the pressure-volume relationships of the ventricles and their clinical applications.
vii. Describe the cardiac reflexes.

G4: The Peripheral Circulation

i. Describe the essential features of the micro-circulation including fluid exchange and its control mechanisms.
ii. Describe the distribution of the blood volume and flow in the various regional circulations and explain the factors that influence them, including autoregulation.
iii. These include but are not limited to the cerebral and spinal cord, hepatic, and splanchnic, coronary, renal, and utero-placental circulations.
iv. Explain the factors that determine systemic blood pressure and its regulation.
v. Describe the physiological factors that may contribute to pulse variations in blood pressure.
vi. Describe total peripheral vascular resistance and the factors that affect it.
vii. Describe the factors that affect venous oxygen saturation.

G5: Applied Cardiovascular Physiology

i. Explain the cardiovascular responses to changes in posture, hypovolaemia, a fluid bolus, anaemia, exercise, and aging.
ii. Explain the physiological consequences of intermittent positive pressure ventilation, positive end-expiratory pressure (see also F10 i.) and the Valsalva manoeuvre.

G6: Cardiovascular Measurement

i. Describe the principles behind the electrocardiogram (ECG).
ii. Describe the invasive and non-invasive measurement of blood pressure, including limitations, potential sources of error and the need for calibration.
iii. Describe the methods of measurement of cardiac output including limitations, potential sources of error, the need for calibration and the values obtained.

G7: Cardiovascular Pharmacology

i. Understand the pharmacology of inotropes and vasopressors.
ii. Understand the pharmacology of anti-hypertensive drugs.
iii. Understand the pharmacology of anti-arrhythmic drugs.
iv. Understand the pharmacology of anti-anginal drugs.

Section H: Renal System

H1: Renal Physiology

i. Describe the functional anatomy of the kidneys.
ii. Describe renal blood flow and its regulation.
iii. Describe glomerular filtration and tubular function.
iv. Explain the counter-current mechanisms in the kidney.
v. Describe the functions of the kidney.
vi. Describe the physiological effects of renal dysfunction.

H2: Applied Renal Physiology

i. Describe the principles of dialysis and filtration.

H3: Renal Pharmacology

i. Understand the pharmacology of diuretics.
ii. Understand the pharmacology of renal replacement fluid.

H4: Renal Measurement

i. Describe the principles of measurement of glomerular filtration rate and renal blood flow.
ii. Describe the utility of biochemical estimates of renal function (including but not limited to the measurement of serum creatinine, cystatin C and estimates of Creatinine Clearance such as eGFR).

Section I: Body Fluids and Electrolytes

I1: Physiology of Body Fluids and Electrolytes

i. Explain the composition, distribution, and movement of body fluids.
ii. Define osmosis, colloid osmotic pressure and reflection coefficients and explain the factors that determine them.
iii. Describe the distribution, regulation and physiological importance of sodium, chloride, potassium, magnesium, calcium, and phosphate ions.
iv. Outline the composition, circulation, and functions of lymph.

I2: Intravenous Fluids

i. Understand the pharmacology of colloids and crystalloids.

I3: Measurement of Body Fluids

i. Describe the regulation of osmolality and outline its measurement.
ii. Describe the principles of estimating body fluid compartments.

Section J: Acid Base

J1: Acid Base Physiology

i. Explain the principles underlying acid-base chemistry.
ii. Explain the physiological basis to clinical acid-base disturbances.
iii. Describe the chemistry of buffer mechanisms and explain their roles in the body.
iv. Explain the Henderson-Hasselbach (traditional) and the Stewart (physico-chemical) approach to acid-base.

J2: Acid Base Measurement

i. Interpret normal and abnormal arterial blood gases and differentiate arterial from venous blood gases.
ii. Describe the methods of measurement of pH in blood.

Section K: Nervous System – Including Pain

K1: Nervous System Physiology

i. Describe the anatomy of cranial nerves relevant to brainstem reflexes.
ii. Explain the determinants of intra-cranial pressure.
iii. Describe the anatomy and regulation of cerebral circulation.
iv. Describe the physiology of cerebrospinal fluid.
v. Describe the major sensory and motor pathways (including anatomy) from the periphery to cortex.
vi. Explain the basic electro-physiology of neural tissue, including conduction of nerve impulses and synaptic function.
vii. Describe the major neurotransmitters and their physiological role, with particular reference to excitatory and inhibitory amino acids (including those acting on the NMDA receptor), GABA, acetylcholine, noradrenaline, dopamine and serotonin.

K2: Pharmacology Related to the Nervous System

i. Understand the pharmacology of sedating drugs.
ii. Understand the pharmacology of local anaesthetic drugs.
iii. Understand the pharmacology of anti-convulsant drugs.
iv. Understand the pharmacology of anti-depressant and anti-psychotic drugs.

K3: Pain Physiology

i. Describe the physiology of pain, including peripheral nociception, conduction, receptors, mediators and pathways, spinal cord modulation and central processing of pain.

K4: Pain Pharmacology

i. Describe the pharmacology of drugs used to treat pain.
ii. Outline the classification, structure and distribution of opioid receptors and NMDA receptors.

K5: Nervous System Measurement

i. Describe the measurement of intracranial pressure.

Section L: Musculoskeletal System

L1: Musculoskeletal System Physiology

i. Describe the anatomy and physiology of skeletal, smooth, and cardiac muscle.
ii. Describe the physiology of the neuromuscular junction and its receptors.
iii. Describe the mechanism of excitation-contraction coupling.
iv. Describe the relationship between muscle length and tension.
v. Explain the concept of motor units.
vi. Describe the monosynaptic stretch reflex, single twitch, and tetanus.

L2: Musculoskeletal System Pharmacology

i. Understand the pharmacology of neuromuscular blocking drugs and reversal agents.

L3: Neuromuscular Measurement and Monitoring

i. Describe the monitoring of neuromuscular blockade.

Section M: Autonomic Nervous System

M1: Physiology of the Autonomic Nervous System

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

M2: Pharmacology of the Autonomic Nervous System

i. Understand the pharmacology of drugs acting upon the autonomic nervous system.
ii. Describe the structure activity relationships of adrenergic and cholinergic drugs.
iii. Outline the mechanisms by which drugs may affect neurotransmission and noradrenaline effect at the sympathetic nerve terminal.

Section N: Liver

N1: Liver Physiology

i. Describe the functions of the liver.
ii. Describe the functional anatomy of the liver.
iii. Describe liver blood supply and its regulation.
iv. Describe the physiology of bile.

N2: Liver Measurement

i. Describe the laboratory assessment of liver function.

Section O: Gastrointestinal System

O1: Gastrointestinal Physiology

i. Describe the composition, volumes, and regulation of gastrointestinal secretions.
ii. Describe the control of gastrointestinal motility, including (oesophageal) sphincter function.
iii. Outline the digestion and absorption of fat, protein, and carbohydrates.
iv. Outline the absorption of water, electrolytes, and vitamins.
v. Outline the gastrointestinal blood supply.

O2: Gastrointestinal Pharmacology

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

Section P: Nutrition and Metabolism

i. Describe the normal nutritional requirements, including vitamins and trace elements.
ii. Describe the physiology of fat, carbohydrate, and protein metabolism.
iii. Define basal metabolic rate and outline the factors that influence it.
iv. Describe the measurement of metabolic rate.
v. Describe anaerobic metabolism and ketone production.
vi. Describe the pharmacology of enteral and parenteral nutrition.

Section Q: Haematological System

Q1: Physiology of Haematological System

i. Outline the physiological production of blood and its constituents.
ii. Explain the major blood groups and the principles of cross matching.
iii. Outline the constituents and functions of plasma.
iv. Describe the process and regulation of haemostasis, coagulation, and fibrinolysis.

v. Describe the mechanisms of preventing thrombosis including endothelial factors and natural anticoagulants.
vi. Explain the physiological consequences of acute and chronic anaemia.

Q2: Pharmacology of Haematological System

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

Q3: Measurement of Haematological System

i. Outline the methods for assessing coagulation (including TEG and ROTEM).
ii. Outline the methods for assessing platelet function and fibrinolysis.

Q4: Blood and Blood Products

i. Understand the pharmacology of blood and its components, including individual factor replacement.
ii. Understand the adverse consequences of blood transfusion, including that of massive blood transfusion and storage lesions.
iii. Understand the process of collection and production of blood and its components.

Section R: Thermoregulation

R1: Temperature Physiology

i. Define heat and temperature.
ii. Outline the mechanisms for heat transfer between the body and its environment.
iii. Explain the mechanisms by which normal body temperature is maintained and regulated.
iv. Explain the physiological responses to hypothermia and hyperthermia.

R2: Temperature Measurement

i. Describe the measurement of body temperature.

Section S: Immunology and Host Defence

S1: Physiology of Immunology and Host Defence

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

S2: Pharmacology Related to Immunology

i. Understand the pharmacology of Human Immunoglobulin.

Section T: Microbiology

T1: General Microbiology

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

T2: Antimicrobial Pharmacology

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

Section U: Endocrine System

U1: Endocrine Physiology

i. Describe the exocrine and endocrine functions of the pancreas.
ii. Describe the physiology of insulin, glucagon, and somatostatin.
iii. Describe the control of blood glucose.
iv. Describe the control, secretions and functions of the pituitary and the hypothalamus.
v. Describe the control, secretions, and functions of the thyroid.
vi. Describe the control, secretions, and functions of renal and adrenal hormones.
vii. Describe the control of plasma calcium.

U2: Endocrine Pharmacology

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

Section V: Obstetrics

V1: Obstetric Physiology

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

V2: Obstetric Pharmacology

i. Describe the pharmacology of oxytocic drugs.
ii. Describe the pharmacology tocolytic drugs.

Section W: Principles of Measurement and Equipment

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

i. Describe the laws governing the behaviour of gases and liquid.
ii. Outline oxygen delivery devices (including high flow oxygen).
iii. Outline the physical principles of ultrasound including transducer properties, image resolution and the Doppler Effect.
iv. Explain the electrical concepts of current, potential difference, resistance, impedance, inductance, capacitance, frequency, and amplitude as they relate to biological signals and biomedical apparatus.

Section X: Procedural Anatomy

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

Pharmacopeia

This document is intended to provide a guide to the minimum breadth and depth of knowledge required for certain drugs or classes of drugs that are relevant to the CICM First Part Examination.

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 implications) and critical illness. An understanding of potential toxicity and relevant antidotes is also expected. Agents may be listed in more than one section when they are used for different indications.

This is not an exhaustive list of all drugs relevant to or important in ICU practice. Each drug or classes of drugs have been assigned a details of understanding level outlined below. This is a guide to the minimum level of knowledge expected for that drug.

For classes of drugs where examples are not specified, it is suggested a prototypical drug from the class be studied, as well as the relevant variations within the class exploring the major differences that exist between the agents in that class.

Details of Understanding

Level 1
For these drugs, a detailed knowledge and comprehension of:

- Class, indications, and dose
- Pharmaceutics
- Mechanism of action
- Pharmacodynamics and adverse effects
- Pharmacokinetics

Level 2
For these drugs a detailed knowledge of:

- Class, indications, and dose
- Mechanism of action
- Pharmacodynamics and adverse effects
- Important pharmacokinetic differences or considerations when using in the ICU.

Level 3
For these drugs a detailed knowledge of:

- Class, indications, and dose
- Mechanism of action
- Pharmacodynamics and adverse effects

Respiratory Pharmacology

<table>
<tr>
<td>Level 1
Oxygen</td>
<td>Level 2
Bronchodilators
Anti-muscarinic agents - ipratropium, theophylline (aminophylline)
Beta agonists – Salbutamol</td>
</tr>
<tr>
<td colspan="2">Level 3
Corticosteroids
Inhaled
Intravenous
Oral
Exogenous surfactant
Pulmonary vasodilators
Nitric oxide
Prostacyclin</td>
</tr>
</table>

Cardiovascular Pharmacology

<table>
<tr>
<td>Level 1
Adrenergic drugs
Adrenaline (Epinephrine)
Noradrenaline
Non-adrenergic drugs
Phosphodiesterase III inhibitors – Milrinone
Vasopressin
Antiarrhythmics
Amiodarone
Atropine
Magnesium
Sodium channel antagonists – Lignocaine</td>
<td>Level 2
Adrenergic drugs
Ephedrine
Metaraminol
Antihypertensive drugs
Beta Blockers - Esmolol
Glyceryl Trinitrate
Mixed Antagonist – Labetalol
Sodium Nitroprusside
Antiarrhythmics
Adenosine</td>
</tr>
<tr>
<td colspan="2">Level 3
Adrenergic drugs
Dopamine
Dobutamine
Isoprenaline/Isoproterenol
Phenylephrine
Antihypertensive drugs
ACE inhibitors
Alpha blockers – Prazosin
Angiotensin receptor blockers
Beta Blockers – not listed above.</td>
</tr>
</table>

- Calcium channel antagonists - Non-dihydropyridines and Dihydropyridines
- Centrally acting drugs – Clonidine
- Hydralazine
- Mixed Antagonists – Carvedilol

- **Antiarrhythmics**
  - Beta Blockers – not listed above.
  - Calcium channel antagonists - Verapamil
  - Digoxin
  - Sodium channel antagonists – Flecainide
  - Sotalol
- **Non-adrenergic drugs**
  - Calcium Sensitisers – Levosimendan

Renal Pharmacology

Level 1 • **Diuretics** • Drugs acting on the Loop of Henle - Frusemide/Furosemide	**Level 2**

Level 3
• **Diuretics**
  • Drugs acting on the distal tubule or collecting duct – Thiazides and Aldosterone antagonists.
  • Drugs acting on the proximal tubule – Carbonic anhydrase inhibitors.
  • Osmotic agents – Mannitol
• **Renal replacement fluid**	

Intravenous Fluid Pharmacology

Level 1
• **Crystalloids**
  • 0.9% saline
  • Glucose containing solutions.
  • Balanced Salt Solutions - Hartmann's, Plasmalyte
  • Hypertonic saline solutions
• **Colloids**
  • Albumin
• **Electrolytes and Buffers**
  • Magnesium
  • Potassium
  • Sodium Bicarbonate
	Level 2
	• **Electrolytes and Buffers**
	  • Calcium chloride
	  • Calcium gluconate
	  • Phosphate

Level 3	

Neuropharmacology

<table>
<tr>
<td>

Level 1

- **Analgesics**
  - Ketamine
  - Opioids – Oxycodone, Fentanyl, Morphine
  - Paracetamol
- **Local Anaesthetics**
  - Amides – Lignocaine, Bupivacaine, Ropivacaine.
- **Sedative/Hypnotic drugs**
  - Benzodiazepines – Midazolam, Diazepam
  - Dexmedetomidine
  - Ketamine
  - Propofol

</td>
<td>

Level 2

- **Analgesics**
  - Buprenorphine
  - Gabapentin/Pregabalin
  - Hydromorphone
  - Methadone
  - Remifentanil
  - Tapentadol
  - Tramadol
- **Anticonvulsants**
  - Phenytoin
- **Sedative/Hypnotic drugs**
  - Barbituates - Thiopentone
- **Other**
  - Nimodipine

</td>
</tr>
<tr>
<td colspan="2">

Level 3

- **Analgesics**
  - Alfentanil
  - Non-steroidal anti-inflammatory drugs
- **Antidepressants**
  - Monoamine oxidase inhibitors
  - Selective serotonin reuptake inhibitors
  - Serotonin-Noradrenaline reuptake inhibitors
  - Tricyclic anti-depressants
- **Antipsychotics**
  - **First generation antipsychotics**
    - Haloperidol
  - **Second generation antipsychotics**
    - Olanzapine
    - Quetiapine
- **Anticonvulsants**
  - Lamotrigine
  - Levetiracetam
  - Phenobarbitone
  - Sodium valproate

</td>
</tr>
</table>

Neuromuscular Pharmacology

Level 1
• **Neuromuscular blockers**
  • Aminosteroids – Rocuronium
  • Isoquinolines - Cisatracurium
  • Suxamethonium
	Level 2
	• **Neuromuscular blockers**
	  • Aminosteroids – Vecuronium, Pancuronium
	  • Isoquinolines - Atracurium

Level 3 • Dantrolene • Sugammadex	

Autonomic Pharmacology

Level 1
• **Antimuscarinic drugs**
  • Atropine
	Level 2
	• **Antimuscarinic drugs**
	  • Glycopyrrolate
	• **Cholinesterase Inhibitors**
	  • Neostigmine

• **Cholinesterase Inhibitors** • Organophosphates	

Gastrointestinal Pharmacology

Level 1	**Level 2**
	• **Nutritional supplements**
	  • Enteral feed solutions *(specific brand details not required).*
	  • TPN solution

Level 3
• **Acid suppression**
  • Proton pump inhibitors
• **Antiemetics**
  • Cyclizine
  • Droperidol
  • Metoclopramide
  • Ondansetron
  • Prochlorperazine
  • Promethazine
• **Aperients and Laxatives**
• **Nutritional supplements**
  • Vitamins and Trace elements
• **Octreotide**
• **Prokinetics**
  • Erythromycin
  • Metoclopramide	

Haematological Pharmacology

<table>
<tr>
<td>

Level 1

- **Anticoagulants**
  - Low molecular weight heparin
  - Unfractionated Heparin
  - Warfarin
- **Anti-platelet drugs**
  - Aspirin
- **Blood Products**
  - Cryoprecipitate
  - Fresh frozen plasma
  - Platelets
  - Red blood cells
- **Fractionated plasma products**
  - Albumin

</td>
<td>

Level 2

- **Anticoagulants**
  - Apixaban
  - Bivalirudin
  - Dabigatran
  - Rivaroxaban
- **Fractionated plasma products**
  - Fibrinogen concentrate
  - Prothrombinex

</td>
</tr>
<tr>
<td colspan="2">

Level 3

- **Anticoagulant Reversal Agents**
  - Idarucizumab
  - Protamine
  - Vitamin K
- **Anti-platelet drugs**
  - ADP receptor blockers – Clopidogrel, Ticagrelor, Prasugrel
  - GPIIb/IIIa inhibitors – Abciximab and Tirofiban
- **Fibrinolytics**
  - Alteplase
  - Tenecteplase
- **Antifibrinolytics**
  - Tranexamic acid
- **Fractionated plasma products**
  - Antithrombin III
  - Factor IX
  - Factor VIIa
  - Factor VIII
- **Intravenous Immunoglobulin**

</td>
</tr>
</table>

Antimicrobials

<table>
<tr>
<td>Level 1
Antibiotics
Aminoglycosides
Carbapenems
Cephalosporins
Glycopeptides (vancomycin)
Penicillins</td>
<td>Level 2</td>
</tr>
<tr>
<td colspan="2">Level 3
Antibiotics
Beta-lactamase inhibitors
Lincosamides
Macrolides
Metronidazole
Quinolones
Tetracyclines
Trimethoprim/Sulphamethoxazole (Bactrim)
Antivirals
Acyclovir
Ganciclovir
Oseltamivir
Antifungals
Amphotericin
Caspofungin
Fluconazole
Antiseptics and disinfectants
Alcohol
Chlorhexidine
Iodine</td>
</tr>
</table>

Endocrine Pharmacology

Level 1	Level 2

• **Hypoglycaemic drugs**
  • Insulin – Rapid and Short (1) acting
	• **Hypoglycaemic drugs**
	  • Insulin – Long Acting (2)
	• **Glucocorticoids**
	• **Vasopressin analogues**
	  • Desmopressin
	  • Terlipressin

Level 3
• **Hypoglycaemic drugs**
  • Biguanides
  • SGLT2 Inhibitors
  • Sulphonylureas
• **Mineralocorticoids**
• Glucagon
• Thyroxine	

Obstetric Pharmacology

Level 1	Level 2
Level 3 • Oxytocics • Tocolytics	

Specific Antidotes for reversal of toxicity (not listed elsewhere)

Level 1	Level 2
Level 3 • Digoxin Antibodies • Flumazenil • Intralipid • N-acetylcysteine • Naloxone • Pralidoxime	

Document details	
Document reference	CICM First Part Examination Syllabus
Document category	Training & Assessments
Date established	2005
Date reviewed/version	2023 (version 4)
Date of next review	2028
Version history	2005, 2011/2014, 2017, 2013