COLLEGE OF INTENSIVE CARE MEDICINE
OF AUSTRALIA AND NEW ZEALAND

REPORT OF THE
INTENSIVE CARE FIRST PART EXAMINATION

MARCH / MAY 2014

This report is prepared to provide candidates, tutors and their Supervisors of Training with information about the examination. Answers provided are not model answers. Candidates should discuss the report with their tutors so that they may prepare appropriately for the future examinations.

The exam included two, 2.5 hour written papers, each comprising of twelve short answer questions and twenty short fact questions. Candidates were required to perform at a satisfactory level in the written before being eligible to present for the oral part of the exam. The oral was comprised of eight, ten-minute Viva stations.

OVERALL STATISTICS

Total number of candidates presenting for the written examination:	38
Number of candidates scoring > 50% in the written:	18
Number of candidates scoring 45 – 50% in the written:	8
Number of candidates carrying a written score:	0
Total number invited to the Oral section based on written marks:	24
Total number of candidates successful at the CICM Primary:	22

38 candidates sat this examination. 26 candidates were invited to the viva examination based on their written paper performance. 24 attended and 22 were successful (57.9 % pass rate).

SUCCESSFUL CANDIDATES

Dr Cheyne Bester
Dr Rosalyn Boyd
Dr Andrew Clift
Dr Josine Dekker
Dr Hatem Elkady
Dr Jina Hanna
Dr Kerrianne Huynh
Dr Waleed Ali Fahmy Ali Ismael
Dr Angelo Justus
Dr Beatrice Hoi Ying Lai
Dr Stephen Morgan
Dr Ahmad Samir Marrey Sayed Nasser
Dr Shawn Kit Ng
Dr Minny Ojha
Dr Prashant Pruthi
Dr Sarfaraz Navaz Rahiman
Dr Prabhu Rajaraman
Dr Hayley Robinson
Dr Sandeep Singh Sethi
Dr Mark Shea
Dr Robert Tamblyn
Dr Kathleen Thomas

WRITTEN SECTION:

SHORT ANSWER QUESTIONS – PAPER 1 AND 2

1. Outline the motor and sensory pathways involved in withdrawing the lower limb from a painful stimulus.

26% of candidates passed this question.

It was expected that candidates would outline both motor and sensory pathways and mention a reflex arc and conscious pathways.

2. Classify calcium channel blockers, and give an example for each classification. (30% of marks) Describe the pharmacology of verapamil. (70% of marks)

61% of candidates passed this question.

Most candidates managed to provide a classification of calcium anatagonists. The pharmacology of verapamil was less well understood. The structure for answering a pharmacology question was often poor and there was commonly a lack of precision in pharmacokinetics. We suggest that candidates look at a general pharmacokinetic structure when answering these questions. One approach would be a structure that covers drug name and description, pharmaceutics (chemistry/ ampoule contents), Pharmacokinetics, Pharmacodynamics (Think CNS/CVS/Resp/GIT etc. if relevant), Dose and Side effects then Indications and Contraindications can help organize the information.

3. Describe the neural integration of vomiting. (60% of marks) Describe the pharmacology of ondansetron. (40% of marks)

58% of candidates passed this question.

Candidates who failed the question did not answer the actual question. They did not discuss the neural integration but instead listed various inputs into the CTZ and vomiting centre. It was expected candidates could detail the pathways involved (afferent and efferent limbs) and describe the relationship with the coordinating centres. For example, afferent pathways to the vomiting centre include stretch and chemoreceptors located throughout the GIT via vagal and sympathetic nerves, pharyngeal touch receptors via glossopharyngeal nerves etc. Again structuring pharmacology answers was often poor.

4. Describe the respiratory changes during pregnancy.

26% of candidates passed this question.

This question was variably answered, with a wide range of marks. Candidates often mentioned central regulation, anatomy, respiratory mechanics, static lung volumes or gas transfer, but did not provide comprehensive cover of all areas. Very few clearly described the

extent of any change (either as a percentage or actual amount relative to the non-pregnant state). A number of candidates presented information well in diagrammatic form (e.g. static lung volumes) however then repeated this same information in text, which was unnecessary.

5. Describe the pharmacological effects of paracetamol. (40% of marks) Outline its toxic effects and their management. (60% of marks)

63% of candidates passed this question.

This question was generally well answered with narrow variance; very few candidates discussed factors predisposing to hepato-toxicity or renal toxicity. Discussion of pharmacokinetics only gained marks when relevant to toxicity.

6. Outline the strength and weaknesses of the randomized control study design.

13% of candidates passed this question.

Very few candidates demonstrated an understanding of the randomized controlled study design and discussion of its strengths and weaknesses was limited. There was a significant knowledge deficit in this area. Some candidates spent time describing the types of blinding and other details of RCT. Unless related to the strength or weakness, these descriptions did not score marks**.**

7. Outline the principles underlying pulse oximetry. (80% of marks) Briefly describe the effect of an elevated level of the following upon pulse oximetry values. (20% of marks)

a) **Carboxyhaemaglobin**
b) **Methaemaglobin**

34% of candidates passed this question.

Explanation of several crucial principles was expected for a good answer. These would include that Haemoglobin can be measured and quantified with a light absorbance technique; based on the Beer Lambert law (a description of this was required). In addition, oxygenated haemoglobin must be distinguished from reduced haemoglobin (the 2 dominant species of Hb) and that the oximeter determines pulsatile from non pulsatile blood. The oximeter accounts for ambient light and that “R”, a ratio of absorbances during pulsatile and non pulsatile flow is calculated and compared within a computer algorithm to standardised values of SaO2 to deliver a final value.

Mention of limitations was not required except to answer the second part of question. Common omissions included failure to describe accurately the Beer Lambert Law, and no explanation of how pulsatile component was detected, or ambient light accounted for. Many candidates understood the clinical inaccuracy associated with CO and Met HB, but failed to identify the spectrophotometric reason and application of the R value for this discrepancy.

8. Describe the physiology of skeletal muscle cell contraction.

34% of candidates passed this question.

This question required a description of excitation- contraction coupling. Marks were gained for a brief outline of the structure of a sarcomere and how it facilitates shortening. An explanation of membrane processes, receptor interactions and the contraction processes was required. Mention of the role of ATP was also required and marks were gained for commenting on the mechanism of return to the relaxed state.

Most candidates wrote extensively on the nerve action potential and neuromuscular junction transmission, with minimal reference to events occurring within the skeletal muscle cell membrane. They could not gain marks for this. Few candidates demonstrated knowledge of the ATP dependent walk along processes of myosin heads during contraction.

9. Discuss the factors that may potentially influence the speed of onset of neuromuscular blockade.

16% of candidates passed this question.

Speed of onset is related to how quickly an effective dose reaches the neuromuscular junction, the type of interaction with the receptor and the margin of safety of the receptors. Examples of parameters that increase speed of onset include a high drug rate of delivery (high CO, high muscle group blood flow, and fast injection rate), high drug concentration (higher dose, low potency, higher ED 95, lower protein binding) or a depolarising block. A good answer would include a list of these factors, with a brief explanation. Mention of other factors such as electrolyte disturbances gained additional marks. It was expected that the direction of an effect would be clearly indicated (e.g. "potency" would not score a mark unless the candidate wrote – "low potency increases speed of onset", etc.). These drugs are charged molecules which do not cross cell membranes and have a low volume of distribution. Absorption from GIT, Lipid solubility, pKa, metabolism and clearance have minimal relevance to speed of onset.

10. Classify bacteria according to the Gram stain system and their shape. Give two examples for each classification. (40% of marks) List with examples the mechanisms of bacterial antibiotic resistance. (60% of marks)

63% of candidates passed this question.

Generally candidates provided an accurate classification of bacteria based upon Gram staining and shape. None or poorly staining organisms were often overlooked. Mechanism of resistance was also well covered, with examples. Areas of weakness were a lack of descriptive detail and/or omission of an example for each mechanism. Mechanisms such as metabolic blockade of essential pathways for antibacterial action and active removal of intracellular antibiotic were more commonly omitted.

11. Outline the formation, structure and function of the adult red blood cell.

19% of candidates passed this question.

Candidates generally provided detailed description of the cell lineage that led up to the production of the mature red blood cell (RBC), but often omitted to mention those aspects unique to the RBC that were essential to its functions (e.g. biconcave shape gives the RBC a greater surface area and shorter distance to central regions, thus optimising diffusion of gases; the RBC enhanced ability to change shape and travel through narrow capillaries; lack of organelles maximises space for Hb, etc.). Mention of RBC function often lacked detail (e.g. restricted to just mentioning "O2 carriage") or failed to mention, and describe, the RBC's role in acid base buffering and HCO3- production.

12. Describe autoregulation within peripheral circulations.

8% of candidates passed this question.

Most candidates failed to fully comprehend the question. Candidates displayed some difficulty in differentiating regulation at a local level (which is what the question asked for) from that of central regulation (e.g. sympathetic nervous system activity, cardiac output, etc.), which was not what the question asked for. Other omissions were a failure to define and explain autoregulation. Most candidates mentioned the myogenic and the metabolic theories, but failed to provide sufficient details as to their mechanisms. It was expected candidates would provide some detail as to locally acting factors. Adenosine and nitric oxide were mentioned on occasions but others such as endothelin and prostacyclin were often omitted.

13. Describe the cough reflex.

26% of candidates passed this question.

Many candidates struggled with this question. A good answer included a brief description of the role of the cough reflex, an outline of the sensory pathways, central integration and motor pathways of the reflex, and a description of the components of the cough reflex. Most candidates failed to accurately describe the sequence of events involved in the cough reflex. Very few gave sufficient detail on the nerve supply of the larynx

14. Using a diagram, explain the effect of PaO_2, $PaCO_2$ and MAP (Mean Arterial Pressure) on cerebral blood flow (CBF). (60 % of marks) Outline the effects of propofol and ketamine on CBF and cerebral metabolic requirement for oxygen ($CMRO_2$). (40% of marks)

74% of candidates passed this question.

This question was well answered. It is a structured question that guides candidates through exactly what is required. Well drawn graphs were a particularly effective means of scoring marks.

15. What is lung compliance and how is it measured?

34% of candidates passed this question.

There was a good understanding of the definitions of compliance but many candidates failed to clearly demonstrate an understanding of the difference between static and dynamic compliance. Many candidates had little knowledge of how compliance is measured. It was expected that descriptions of methods to measure static and dynamic compliance would be provided. There were frequent errors in descriptions that were provided.

16. Describe, with the aid of a diagram, the structure of the cell membrane, (40% marks) and transmembrane transport processes. (60% marks)

60% of candidates passed this question.

The structure of the cell membrane was generally well covered by most candidates. Many had difficulties structuring an answer for the transmembrane transport processes. Dividing this section into proteins (some receptors, channels etc.) and carbohydrates (some receptors, immune reactions etc) followed by a very brief discussion of each type of process would have aided candidates towards providing a good answer.

17. Classify local anaesthetic agents and give examples. (30% of marks) Describe the pharmacology of lignocaine. (70% of marks)

71% of candidates passed this question.

The first part of this question was answered well by most candidates.

Generally, the second part of the question was poorly organised by many candidates, the consequence being that many opportunities for picking up marks were lost. A brief statement as to what lignocaine is, its presentations and dose, some facts about PD and PK followed by a few lines on toxicity (CC/CNS ratio) was mostly what was required. Only a few candidates mentioned lignocaine toxicity.

18. Outline the anatomy of the internal jugular vein. (80% of marks) Describe the Doppler Effect. (20% of marks)

40% of candidates passed this question.

An overview of the Internal Jugular vein stating where it is formed and terminates would be a good start. The important surface anatomy of the vein (left and right) followed by mention of the important anatomical relationships was then required. Few candidates mentioned anatomical variations.

Many answers had no identifiable structure and went back and forth around the topic as information came to mind. A number of answers contained very rough diagrams that did not contain mark worthy information but took time to draw.

The second part of the question was generally well answered by those attempting it. Many candidates ignored or forgot about this part of the question. Some candidates wrote 2 or more pages of significant detail in stark contrast to what they had written for the first part of the question. The percentage of marks allocated is a good guide as to the level of detail required in the answer.

19. Define cardiac output. (10% of marks) Outline the factors that affect cardiac output. (60% of marks) Briefly describe the thermo dilution method of measuring cardiac output. (30% of marks)

58% of candidates passed this question.

This is a core question. It was expected candidates could provide a definition (heart rate x stroke volume) and then move on to outline factors that affect it (afterload, preload, contractility). Additional marks were awarded for descriptions of the relationship to mean systemic filling pressure and other influences beyond this.

Most candidates described a thermodilution cardiac output curve but almost all described the technique as based on the "Fick equation or method" (which is used to estimate cardiac output from oxygen consumption). Very few candidates correctly identified the Stewart Hamilton equation as the integration method used to relate cardiac output (flow) to temperature change as an example of indicator dye dilution.

Candidates seemed to lack depth and understanding on this topic.

20. Describe the factors affecting drug absorption from the gastrointestinal tract.

45% of candidates passed this question.

This is a very broad and open question. While a structured approach was useful, a sound knowledge of first principles or even being able to "think on the fly" would have provided candidates with enough opportunities to generate a pass.

21. Compare and contrast the mechanism of action, pharmacokinetics, adverse effects and monitoring of effect of dabigatran and warfarin.

29% of candidates passed this question.

Most candidates were able to provide some details about warfarin however dabigatran was less well known. The syllabus provides a guide to depth of knowledge required for listed drugs and so more detail was expected for Warfarin as a class "A" drug than was expected for dabigatran (a class "C" drug). It was however expected that candidates would provide more than just generalisations regarding "hepatic metabolism and renal excretion" when applied to both agents that actually have different modes of elimination.

22. What is a buffer? (10% of marks) Discuss the body's buffer systems and how they work. (90% of marks)

37% of candidates passed this question.

Candidates who described an overall view of the body's buffer systems scored well.

Most candidates could define buffer and could discuss the bicarbonate buffer system; however this was not sufficient to pass the question. To pass there had to also be a discussion of the other buffer systems including phosphate, protein (haemoglobin, plasma proteins and intracellular proteins), ammonia and bone.

Best answers included discussion of open versus closed systems and the relative contribution of the differing buffer systems in blood, intracellular fluid, extracellular fluid and urine.

23. What is the Glomerular Filtration Rate (GFR)? Discuss the physiological factors that can influence it.

40% of candidates passed this question.

Generally this question was well answered. Almost all answers gave the correct value for GFR and the correct formula for Starling's forces across the glomerular membrane.

Better answers discussed the physiological factors affecting each force (hydrostatic and osmotic) across the membrane in a stepwise logical manner.

Some answers discussed the control of renal blood flow; this was not expected and therefore was not rewarded.

24. Describe the mechanism of action of the analgesic effect of opiates. (70% of marks) Explain the mechanism by which morphine causes respiratory depression and constipation. (30% of marks)

11% of candidates passed this question.

This question was poorly answered with a low pass rate; which was unexpected for this core topic. In general, completed answers demonstrated good understanding of the analgesic mechanisms of opiates, but only superficial understanding of respiratory depression and constipation. Better answers explained the decreased responsiveness of the respiratory centre to CO_2, and the effects of opiates on the enteric nervous system and peristalsis.

SHORT FACT QUESTIONS – PAPER 1 AND 2

97% of candidates passed this section.

Cloze Questions	82% pass rate
Rank Questions	89% pass rate
Match Questions	95% pass rate

ORAL SECTION

24 candidates were invited to attend the oral section based upon their written marks.

VIVA 1

83.3% of candidates passed this question.

This Viva tested knowledge of hepatic physiology and aspects of cerebral physiology. It explored topics such as liver blood flow, the structural arrangement in the liver and moved on to determinates of intracranial pressure.

VIVA 2

95.8% of candidates passed this question.

This Viva tested knowledge of renal physiology and diuretic pharmacology. It explored nephron structure and function, sodium handling and diruretic pharmacology.

VIVA 3

62.5% of candidates passed this question.

This Viva tested knowledge on the pharmacology of propofol. It explored mechanism of action, pharmaceutics, basic pharmacokinetics for bolus dosing and infusions and side effects.

VIVA 4

79.2% of candidates passed this question.

This Viva tested knowledge on glucose and lipid metabolism and went on to explore daily nutritional requirements and aspects of insulin physiology.

VIVA 5

79.2% of candidates passed this question.

This Viva tested knowledge on the measurement of temperature, physical principles of flow and ionic changes across membranes.

VIVA 6

50% of candidates passed this question.

This Viva tested knowledge on oxygen. It explored an understanding of the physiological effects of oxygen, measurement of oxygen and principles around humidity.

VIVA 7

95.8% of candidates passed this question.

This Viva tested knowledge on respiratory physiology. It explored the spirogram, aspects of functional residual capacity, closing volume, the effects of obesity on respiratory function and alterations in pharmacology.

VIVA 8

79.2% of candidates passed this question.

This Viva tested knowledge on cardiovascular physiology. It explored the valsalva manoeuvre, determinates of venous return, cardiac function curves and the anatomy related to intercostal catheter insertion.

SUMMARY OF THE EXAMINATION

Candidates are reminded that all short answer questions are worth equal marks and so time should be apportioned accordingly.

The CICM First Part Examination explores the knowledge of the basic sciences that form the basis to Intensive Care practice. A detailed syllabus has been developed and clearly sets out the Level of Understanding expected for each listed topic and drug. It is important that Candidates follow the Syllabus in its entirety. All questions are sourced directly from that syllabus.

Candidates are expected to attain a level of knowledge that goes beyond just the listing of pure facts but to also be able to explain, describe, collate and synthesize that knowledge across different scenarios as they apply to intensive care practice. Sufficient depth of understanding and a structured approach to topics continues to remain an area of weakness for many candidates.

This is a challenging exam. Candidates must allow sufficient time to prepare (typically approximately 12 or more months to study). As a general rule we would suggest 1000 hours of study is required. Candidates are strongly encouraged to discuss their level of preparedness, and to trial written and oral questions, with their Supervisor of Training and other CICM Fellows, prior to undertaking the CICM First Part Examination.

A/Prof Peter Kruger
Chair
CICM First Part Examination Committee

Dr David Austin
Deputy Chair
CICM First Part Examination Committee

May 2014