



COLLEGE OF INTENSIVE CARE MEDICINE OF AUSTRALIA AND NEW ZEALAND

SECOND PART EXAMINATION

EXAM REPORT MARCH / MAY 2015

This report is prepared to provide candidates, tutors and Supervisors of Training with information regarding the assessment of candidates' performance in the CICM Second Part Examination. Answers provided are not necessarily model answers but a guide as to what was expected and for use as an educational resource. Candidates should discuss the report with their tutors so that they may prepare appropriately for future examinations.

The exam comprises a written section and an oral section. The written exam consists of two 2.5hr papers of 15 ten-minute short answer questions each. Candidates are required to score at least 50% in the written section to be eligible to sit the oral section. The oral exam consists of eight interactive vivas and two separate clinicals "hot cases".

The tables below provide an overall statistical analysis as well as information regarding performance in the individual sections. A comparison with data from the four previous exams is provided.

In all sections of the exam the candidate has to demonstrate performance consistent with that of a competent senior registrar / junior consultant, i.e. demonstrate he/she has the ability for safe, effective, independent practice as an Intensivist. Candidates who are not at this level are encouraged to defer their attempt at the exam.

Overall Performance	May 2015	October 2014	May 2014	October 2013	May 2013
Presenting for written (Including OTS)	35	53	35	53	27
Carrying a pass from a previous attempt	21	3	8	11	7
OTS Exempt	0	0	0	0	0
Total number presenting (written + carry + OTS)	56	56	43	64	34
Invited to orals (>50% in written section)**	27	40	15	28	18
Total number invited to oral section	48	43	23	39	25

Analysis of Performance in Individual Sections	May 2015	October 2014	May 2014	October 2013	May 2013	October 2012
Successful in the written section	27/35	40/53	15/35	28/53	18/27	29/43
	77%	75%	43%	53%	67%	67%
Successful in the Hot Case section	32/48	21/42	15/23	22/39	9/25	21/41
	67%	50%	65%	56%	36%	50%
Successful in both Hot Cases	17/48	12/42	6/23	10/39	7/25	10/41
	35%	29%	26%	26%	28%	24%
Successful in the Viva section	40/48	25/42	22/23	30/39	15/25	36/41
	83%	60%	96%	77%	60%	86%

Sectional Pass Rates	May 2015		October 2014		May 2014		October 2013	
	Pass rate	Highest individual mark	Pass rate	Highest individual mark	Pass rate	Highest individual mark	Pass rate	Highest individual mark
Hot Case 1	60%	80%	36%	88%	43%	70%	54%	80%
Hot Case 2	56%	88%	57%	85%	61%	85%	49%	90%
Viva 1	83%	90%	76%	95%	91%	85%	56%	70%
Viva 2	96%	95%	90%	92%	83%	90%	85%	90%
Viva 3	79%	100%	31%	78%	61%	89%	62%	90%
Viva 4	52%	88%	55%	90%	87%	85%	85%	95%
Viva 5	92%	90%	86%	100%	87%	85%	54%	80%
Radiology Viva	85%	90%	2%	61%	74%	90%	72%	100%
Communication Viva	65%	100%	24%	85%	61%	94%	49%	87%
Procedure Viva	46%	81%	48%	80%	78%	100%	79%	76%

Oral Section Pass Rates	May 2015	October 2014	May 2014	October 2013	May 2013	October 2012
Candidates who scored >50% in written section and passed the overall exam	19/27	20/40	15/15	18/27	11/18	24/29
	70%	50%	100%	67%	61%	83%
All candidates invited to oral section and passed the overall exam (written + carry + OTS)	37/48	22/42	19/23	28/39	13/25	31/42
	77%	52%	82%	72%	52%	74%
Overall Pass Rate	37/56	22/55	19/43	28/64	13/34	31/56
	66%	40%	44%	44%	38%	55%

EXAMINERS' COMMENTS

Written Paper

Nine of the thirty questions had an overall pass rate of less than 50%. Topics covered by questions with a pass rate of less than 30% related to bacterial meningitis, sodium homeostasis and factors affecting choice of antibiotic in a critically ill septic patient.

As in previous exams, candidates who failed questions did so for one or more of the following reasons:

- Insufficient knowledge of the topic in question.
- Insufficient detail and/or depth of the answer.
- Poorly structured answer.
- Inadequate reference to supportive evidence where relevant.
- Failure to answer the question as asked.
- Omission of all or part of the question.

It seems that candidates do not always read the questions carefully and thoroughly. It is noted that, in some instances, candidates give key words/terms/phrases with no further comment or explanation, showing a lack of depth of knowledge of the topic in question. Candidates should include in their answer only information that is relevant to the question. Candidates are reminded to make sure their writing is legible and to avoid using non-standard abbreviations.

Candidates who failed the written section passed an average of 10/30 questions compared with candidates scoring >50% and gaining an invitation to the oral section, passing an average of 20/30 questions.

This exam introduced an indication of the mark allocation for multi-part questions.

Hot Cases

This exam saw the inclusion of an extra two minutes at the start of the Hot Cases with the candidate given a written introduction to the case in question as well as verbal information. This is to give candidates more opportunity to take in the relevant information and to plan a focussed approach to examination of the patient.

The overall pass rate for the Hot Cases was higher than in recent exams.

The following comments are a guide to the expected standard for performance in the Hot Cases:

- Candidates should address and answer the question asked of them in the introduction to the Hot Case.
- Candidates should interpret and synthesise information as opposed to just describing the clinical findings.
- Candidates need to seek information relevant to the clinical case in question
- Candidates should be able to provide a sensible differential diagnosis and appropriate management plan. A definitive diagnosis is not always expected and in some cases may yet to be determined.
- Candidates should not rely on a template answer or key phrases but answer questions in the context of the clinical case in question
- Candidates must be able to describe, with justification, their own practice for specific management issues.

Candidates who performed well in the Hot Cases, as in previous exams, were able to demonstrate the following:

- A professional approach showing respect and consideration for the patient.
- Competent, efficient and structured examination technique and also able to appropriately adapt the examination to suit the clinical case in question.
- The seeking of information relevant to the case.
- Ability to interpret and synthesise their findings appropriately
- Presentation of their conclusions in a concise and systematic fashion, addressing the issue in question
- Listing of a differential diagnosis that is relevant to the clinical case in question
- Discussion of management issues in a mature fashion, displaying confident and competent decision-making
- Overall performance at the expected level (competent Senior Registrar / Junior Consultant)

Candidates who did not perform at the acceptable standard did so for reasons including the following:

- Missing or misinterpreting key clinical signs on examination and/or on review of imaging
- Asking a large number of questions at the start of the case, of which many are not relevant or necessary for the case in question
- Poor interaction with a conscious patient
- Incomplete or poor technique for examination of a system
- Poor synthesis of findings with limited differential diagnosis
- Poor interpretation of imaging and data
- Limited discussion as a consequence of missed clinical signs and incomplete differential diagnosis
- Inability to confidently answer the question “What would you do?”
- Inability to convey the impression that he/she could safely take charge of the unit

Concerns related to candidates’ performance expressed by the examiners included misinterpretation of standard findings on clinical examination, for example, ascribing dullness elicited on percussing over the heart to the presence of a left-sided pleural effusion.

Candidates are advised that they should not sit the Second Part Examination until they can confidently examine patients, present the relevant clinical findings and discuss management issues at the appropriate level, **i.e. demonstrate that they are capable of safe, effective, independent practice as a competent Senior Registrar / Junior Consultant.** Candidates are also encouraged to practise examination of individual systems.

Vivas

The pass rate for the vivas (88%) was the highest for all sections of the exam (written, clinical and vivas). Only one viva (Procedure viva) had a pass rate less than 50%. As in the discussion for the Hot Cases, candidates should not rely solely on generic statements, key phrases and template answers, and, instead, tailor their responses to the specifics of the question. Candidates must be able to give the rationale for their answers. Additional comments are included with the list of viva topics at the end of this report.

SECOND PART WRITTEN EXAMINATION

- (A) Write your answers in the blue book provided.
- (B) Start each answer on a **new page** and indicate the **question number**. It is not necessary to rewrite the question in your answer book.
- (C) You should aim to answer each question in **ten** minutes.
- (D) The questions are worth **equal** marks.
- (E) Record your **candidate number** and each **question number** on the cover of each book and hand in all books.

GLOSSARY OF TERMS

- Critically evaluate:** Evaluate the evidence available to support the hypothesis.
- Outline:** Provide a summary of the important points.
- List:** Provide a list.
- Compare and contrast:** Provide a description of similarities and differences (E.g. Table form).
- Management:** Generic term that implies overall plan. Where appropriate, may include diagnosis as well as treatment.
- Discuss:** Explain the underlying key principles. Where appropriate, this may include controversies and/or pros and cons

NOTE

Where laboratory values are provided, abnormal values are marked with an asterisk (*).

Please note that in this report all images from the SAQs have been removed.

Question 1

You are called to review a 29-year-old male with confirmed asthma in the Emergency Department. He has been unwell for 2 days with increasing cough, wheeze and shortness of breath. He has just been intubated.

- a) Describe what ventilator settings you will initially set and give the reasons for your answer. *(40% marks)*

Two hours later he has become increasing difficult to ventilate. You quickly assess and exclude all other causes except severe bronchospasm.

- b) Briefly outline your management of this situation. *(60% marks)*

Answer Template

a)

Ventilator settings	Rationale
FiO ₂ = 1.0	Correct/prevent hypoxia. Adjust as indicated from SpO ₂
PEEP = 0 or <3 cmH ₂ O	Gas trapping obviates need for PEEP in patients with no spontaneous respiratory effort. A school of thought that PEEP splints airways open and reduces airflow obstruction
Low Respiratory rate (<i>any reasonable rate accepted</i>)	Allow enough time for expiration and prevent gas trapping with adequate minute ventilation, accepting permissive hypercapnia
Tidal volume = 6-8 ml/kg IBW	Adequate Vt for minute ventilation but at 'safe' volumes to reduce risk of VALI
I:E = 1:4	Allow enough time for expiration and prevent gas trapping. Accept permissive hypercapnia
High inspiratory flow rate	Allow delivery of target Vt in relatively short inspiratory time. Accept high peak pressures
Reset airway pressure alarm limits	Peak pressures reflect airway resistance and high values are not a concern. Lung compliance in asthma is normal and so elevated plateau pressures represent gas trapping

b)

Ensure adequate sedation:

- Ketamine +/- propofol +/- analgesia
- Preferentially use non histamine releasing analgesia – fentanyl

Muscle relaxation:

- Non steroid/non histamine releasing agents – ideally cisatracurium

Bronchodilator therapy

- Regular inhaled salbutamol – MDI, nebuliser
- IV infusion salbutamol
- IV adrenaline infusion
- Anticholinergic therapy
- Ipratropium bromide inhaled regularly
- Magnesium infusion – aiming for Mg 1.5-2.5 mmol/L
- Methylxanthine therapy
 - Aminophylline infusion

Steroid therapy

- 100 mg 6 hrly hydrocortisone (*or any reasonable steroid / dose*)

Ventilation

- Confirm ventilator settings
- Tidal volume 6-8 mL/kg

- Check plateau (rather than peak) inspiratory pressure with inspiratory pause in volume control mode and paralysed patient
- Reduce respiratory rate if possible
- Minimise PEEP
- Check for evidence of dynamic hyperinflation with expiratory hold in paralysed patient
- Permissive hypercapnia

Other strategies

- Inhaled volatile anaesthetic agents
- Heliox if available
- Consider ECCO₂ removal / ECMO

Pass rate	71%
Maximum mark	8.8

Additional comments:

Common scenario and should be basic knowledge. Some candidates gave a poor explanation for their choice of ventilator settings in part a). Candidates who failed the question had knowledge gaps and inadequate detail in their answer.

Question 2

List the complications and their likely underlying mechanisms specifically related to cardiopulmonary bypass that may be seen in the ICU following cardiac surgery.

Answer Template

a)

Effects related to blood contact with non-biologic surfaces and blood-gas interfaces

- Activation of coagulation cascade- consumptive coagulopathy, thromboembolic phenomena, haemolysis, rarely TTP.
- Systemic inflammatory response syndrome due to leucocyte and complement activation, cytokine release and expression of adhesion molecules- vasodilatory shock, fever, acute lung injury, liver dysfunction, multiorgan dysfunction.
- Platelet dysfunction

b)

Effects related to non-pulsatile flow

- Renal dysfunction
- Cerebrovascular events, watershed infarcts, neurocognitive dysfunction
- Splanchnic ischaemia

c)

Effects related to haemodilution

- Dilutional coagulopathy, anaemia.
- Electrolyte abnormalities

d)

Effects of hypothermia

- Coagulopathy
- Decreased tissue oxygen delivery

- Insulin resistance and hyperglycaemia
- e)

Effects of heparin and protamine

- Residual heparinisation leading to bleeding
- Increased pulmonary vascular resistance and right ventricular dysfunction from protamine, allergic reactions to protamine

f)

Effects related to aortic manipulation (cross-clamping and proximal grafts)

- Systemic embolisation with potential for neurologic, mesenteric and renal dysfunction.
- Difficulty with myocardial protection resulting in postoperative myocardial dysfunction (especially right-sided) due to stunning or infarction

g)

Other

- Left phrenic nerve palsy (surgical injury, use of cold cardioplegia “slush”)
- Left lower lobe collapse (poor re-inflation post bypass, phrenic nerve injury)

Pass rate	63%
Maximum mark	8.8

Additional comments:

Candidates who failed did not address complications specific to CP bypass and/or did not describe the underlying mechanisms. Some answers were poorly structured with a tendency to repeat points.

The above answer template is not the only way to structure the answer, for example the complications could be classified by body system affected.

Question 3

3.1 The following data are from the arterial blood gas analysis of a 71-year-old male with necrotising fasciitis:

Parameter	Patient Value	Normal Adult Range
Barometric pressure	760 mmHg (100 kPa)	
FiO ₂	0.3	
pH	7.43	7.35 – 7.45
PCO ₂	23 mmHg (3.1 kPa)*	35 – 45 (4.6 – 5.9)
PO ₂	107 mmHg (14.3 kPa)	
Bicarbonate	15 mmol/L*	22 – 26
Standard Base Excess	-8.6 mmol/L*	-2.0 – +2.0
Lactate	23.0 mmol/L*	0.2 – 2.5
Sodium	147 mmol/L*	137 – 145
Potassium	6.7 mmol/L*	3.2 – 4.5
Chloride	95 mmol/L*	100 – 110

List the acid-base abnormalities.

(30% marks)

3.2 Inspect the following biochemical data:

Parameter	Patient Value	Normal Adult Range
Sodium	145 mmol/L	135 – 145
Potassium	4.0 mmol/L	3.2 – 4.5
Chloride	101 mmol/L	100 – 110
Bicarbonate	34 mmol/L*	22 – 26
pH	7.20*	7.35 – 7.45
pCO ₂	90 mmHg* (11.7 kPa)*	35 – 45 (4.6 – 5.9)

Describe the abnormalities and give an example of an associated clinical scenario. (20% marks)

3.3

The following data are taken from a 74-year-old female who has just been admitted to ICU following surgery for revision of an infected hip prosthesis.

Parameter	Patient Value	Normal Adult Range
Sodium	147 mmol/L*	135 – 145
Potassium	3.6 mmol/L	3.2 – 4.5
Chloride	124 mmol/L*	100 – 110
Haemoglobin	106 g/L*	115 – 155
FiO ₂	0.3	
pH	7.32*	7.35 – 7.45
PCO ₂	32 mmHg (4.3 kPa)*	35 – 45 (4.6 – 5.9)
PO ₂	63 mmHg (8.4 kPa)	
Bicarbonate	16.0 mmol/L*	22.0 – 26.0
Standard Base Excess	-9.0 mmol/L*	-2.0 – +2.0

- Describe the acid-base abnormalities. (20% marks)
- What is the likely cause of this disturbance? (20% marks)
- What is the underlying biochemical mechanism? (10% marks)

Answer Template

3.1

Lactic acidosis
 Anion gap elevation (37 mEq/L)
 Metabolic alkalosis
 Respiratory alkalosis

3.2

Acute respiratory acidosis with metabolic alkalosis
 Clinical scenario – acute respiratory failure in COAD (Acute on chronic respiratory failure)

3.3

a)

Normal anion gap metabolic acidosis with appropriate respiratory compensation.

b)

Resuscitation with large volume saline infusion.

c)

ECF dilution by fluid with strong ion difference of zero (*or any reasonable explanation.*)

Pass rate	100%
Maximum mark	10

Question 4

The following list refers to classes of oral anticoagulation regimens for use in chronic atrial fibrillation:

- i. Antiplatelet agents
- ii. Vitamin K antagonists
- iii. Antithrombin agents
- iv. Anti Xa agents

a) Give an example of a drug for each class of drug listed. (10% marks)

b) Compare and contrast these regimens specifically with respect to:

- The relative advantages and disadvantages
- The appropriate laboratory tests to assess coagulation status
- Management of life-threatening bleeding

(90% marks)

(You may tabulate your answer.)

Answer Template

Regimen / Agent	Advantages / Disadvantages	Assessment of coagulation status	Life-threatening bleeding
Anti-platelet agents Aspirin, clopidogrel, ticagrelor	A - Simple, no testing. D - Poor efficacy; prolonged action; limited reversibility, Minor increased risk of (non-traumatic) ICH	APTT, INR, platelets Bleeding time, TEG/ROTEM, Platelet function tests	Platelet transfusion
Vit K anatagonists Warfarin	A - Remains gold standard; easy reversibility. D - Requires frequent monitoring; multiple drug (and alcohol) interactions. 3-4% risk of (any) bleeding; 2-5x risk of ICH (absolute risk .3-0.8%)	APTT, INR, platelets	Vit K / Prothrombin complex concentrate (Prothrombinex / FFP

Direct antithrombin agents Dabigatran	A - No testing. D - Twice daily dosing; not suitable in severe renal impairment (80% renally cleared); no direct antidote; interacts with amiodarone. ICH risk lower than warfarin in some patient groups, but ischaemic stroke risk raised in prosthetic heart valves	No specific tests	Activated charcoal if recent ingestion Antifibrinolytic (tranexamic acid) Dialysis if co-existing renal impairment
Anti Xa agents Rivaroxaban, apixaban	A - No testing. D - Twice daily dosing for apixaban; no direct antidote (yet); dose modification in renal impairment (33% & 27% renally cleared)	Anti-Xa levels	Activated charcoal if recent ingestion Antifibrinolytic (tranexamic acid)

Pass rate	77%
Maximum mark	8.9

Additional comments:

Some candidates included agents given by intravenous or sub-cutaneous routes instead of focusing on oral agents as asked.

Question 5

You are supervising a registrar who suffers a needle stick injury during the insertion of a central line in a patient with a history of intravenous drug use.

Outline your approach to this problem.

Answer Template

Immediate Response:

- Stop the procedure
- Ensure patient is safe
- Takeover / delegate patient management as required

Further response:

- Wash the registrar's wound immediately with soap and water
- Express any blood from the wound
- Initiate injury-reporting system used in the workplace
- Patient may need to be consented and then tested for HIV, hepatitis B, Hepatitis C
- Refer registrar to designated treatment facility: Emergency Department / Infectious Disease Physician / Immunology as per hospital protocol
- With consent, registrar to be tested immediately and confidentially for HIV, hepatitis B and C
- Document the exposure in detail for your own record and for the employer
- If the patient is HIV positive, post exposure prophylaxis needs to be started within two hours of the exposure.

- For possible Hepatitis C exposure, no treatment is recommended but advice must be obtained from Infectious Disease Specialist
- If the source patient tests positive for HIV, hepatitis B, hepatitis C, get post-exposure prophylaxis in accordance with CDC guidelines and as per recommendations from Infectious Disease Specialist or other expert.
- Registrar to have follow up with post exposure testing
- Advise re: taking precautions (including safe sex) to prevent exposing others until follow up testing is complete.
- If exposed to blood borne pathogen, he/she should not donate blood for six months until cleared

Counselling:

- While definitive testing is essential, counsel the registrar that the risk factors for infection are: deep injury, visible blood on devices, and needle placement in a vein or artery, lower risk with solid suture needle.

Related to procedure:

- Review of registrar's technique, equipment used, unit policy for procedural training, assessment of competency, etc.

Pass rate	74%
Maximum mark	7.6

Additional comments:

Candidates who failed did not give enough detail, e.g. "take bloods" without specifying for which investigations.

Question 6

Outline the key issues in the management of **acute** right ventricular failure in an ICU patient with moderate to severe pulmonary hypertension.

Answer Template

Goal / Principle	Additional detail to be provided
Treat triggering factors	Infection, anaemia, arrhythmias, comorbidities, PE, MI, acidosis
Maintain oxygenation	Supplemental Oxygen to maintain sats >90% Avoid Intubation if possible. Consider Echo +/- PA Catheter risks
Establish adequate monitoring	ECG, Arterial line, Oxygen Sats, CVP, Echocardiography vs PA Catheter Kidney function: Urine Catheter, Serum Creatinine, Liver congestion: AST, ALT, Bilirubin, Lactate
Optimise fluid balance	Fluids if hypovolaemia is present , diuretics if excess fluid is present
Reduce RV afterload	IV Prostanoids: Epoprostinil, iloprost IV or Oral PDE-5 inhibitors (sildenafil) Inhaled vasodilators (nitric oxide) Endothelin receptor antagonists (ERAs) eg bosantan
Optimise Cardiac output	Milrinone, Levosimendan,

Optimise Systemic perfusion pressure	Norepinephrine or Vasopressin
Liaison with Pulmonary Hypertension Centre	Surgical options: Pulmonary thrombendarterectomy / balloon atrial septostomy / ECMO / Ventricular assist device / Heart/lung transplant / Palliation

Pass rate	60%
Maximum mark	7.9

Additional comments:

Candidates who scored well showed an in-depth understanding of the applied physiology and consequences of the various therapeutic options. Candidates who scored poorly omitted key points.

Question 7

A 26-year-old female is admitted to the ICU post operatively with faecal peritonitis as a result of multiple bowel perforations secondary to Crohn's disease. She has had the majority of her small bowel resected and is to be prescribed total parenteral nutrition (TPN).

- a) Describe the available methods to estimate total energy expenditure in critically ill patients and outline their advantages and limitations. *(70% marks)*

The basal energy expenditure of this patient is determined to be 2000 kcal (8400 kJ) / day and she weighs 50 kg.

- b) Describe how you would prescribe her TPN. *(30% marks)*

Answer Template

a)

- **Empiric:**
 - This may be based just upon weight or surface area – Most critically ill patients will have requirements of approx. 25 kCal/kg/day.
 - Advantages – quick, simple and cheap. Universally available
 - Disadvantages – may be inaccurate
- **Predictive equations:**
 - Many versions such as Harris-Benedict, PennState, Faisy etc., based upon various direct measurements.
 - Advantages – quick, simple and cheap. Universally available
 - Disadvantages - Inaccuracy, usually underestimate requirements. Need for multiple correction factors.
- **Indirect Calorimetry:**
 - Measures oxygen uptake and carbon dioxide production using the assumption that all of the oxygen uptake is used for oxidation of substrates.
 - Advantages: Most accurate method. Bedside monitor than can be integrated with ventilator.
 - Disadvantages: Expensive; requires technical expertise, limited availability. Inaccurate in the setting of high FiO₂ or PEEP, leaks in circuit, recent ventilator changes, changes in oxygen concentration, hemodynamic instability, temperature changes or haemodialysis.
- **Fick method**

- Determines oxygen consumption from indwelling pulmonary artery catheter, then uses caloric value for oxygen to calculate energy expenditure.
- Advantages: More accurate than predictive equations, cheaper and more available than indirect calorimetry.
- Disadvantages: Highly invasive. Does not account for pulmonary oxygen consumption.

b)

Standard TPN delivery 2 litre bags

If the total non-protein kCal required is 2000/day, ratio for CHO to fat is 70:30

Dextrose:

1400Kcal

824mls (412g dextrose at 50% solution at 3.4Kcal/gram and requiring 1400KCal)

Lipid:

600Kcal

Using 10% lipid (1.1kcal/ml), will need 545mls 10% lipid

Adjust if using propofol as sedation (approx. 1kcal/ml as fat)

Protein

1.5-2g/kg/day

2 x 50 = 100 grams/day of amino acids

Using 10% solution amino acid solution (100g/L)

1 Litre of 10% amino acid solution

Electrolyte, vitamins and trace elements are added to the solution in a standard fashion, but may be individually tailored to the patient's requirements.

Pass rate	69%
Maximum mark	7.8

Additional comments:

Other valid methods for measurement of energy expenditure were given credit. Detail on nutritional requirements was lacking in some answers

Question 8

A systematic review of the literature was undertaken comparing proton pump inhibitors with H2-receptor blockers for the prevention of gastro-intestinal bleeding in ICU patients.

The following figure was included: *(Figure removed.)*

- Name the type of graph illustrated in the above figure. *(10% marks)*
- What does it show? *(25% marks)*
- What are the benefits of this type of analysis? *(25% marks)*
- What are the disadvantages of this analysis? *(40% marks)*

Answer Template

- a) Forest plot
- b) Combining the trials together, PPI use results in an odds ratio of 0.35 or reduction in the risk of bleeding compared to H2RA. Alternatively, PPI use results in 65% reduction (1-0.35) in bleeding.
- c) Combines small studies with limited power, increasing the number and thus the ability to pick up a positive effect. Small studies with low power (due to small effect, small numbers) run the risk of a Type II error.
- d) Individual studies might have different patient populations (with different risk of bleeding) or different definitions of outcome.
- Individual studies might have been conducted with different degrees of rigour (blinding, etc.)
- There is publication bias to positive studies so that negative studies are not reported.
- Need full disclosure how the studies were selected, their scientific grading, subgroup analyses and assessment of heterogeneity.

Pass rate	83%
Maximum mark	8.0

Question 9

Critically evaluate the use of therapeutic hypothermia in intensive care practice.

Answer Template

Maintenance of a target temperature to provide neuroprotection. A range of different temperatures employed with 'mild hypothermia' traditionally 32-34°C; more recently 36°C post TTM trial.

Rationale:

Hypothermia may lessen the brain injury through a number of mechanisms:

- Cerebral metabolic rate decreases by ~6-10% per degree Celcius drop in temperature
- Reduced release of excitatory amino acids / glutamate which mediate neuronal injury
- Reduced ischaemia reperfusion induced reactive oxygen species release
- Reduced inflammation – both cellular response and cytokine expression
- Reduced apoptosis
- Preservation of blood brain barrier (reduced NO, aquaporin 4, metallo-proteinases)

Clinical utility and evidence:

Post cardiac arrest:

- Standard of care
- HACA and Bernard studies in 2002 cooled VF/VT patients to 32-34 for 12-24 hrs.
- TTM trial 2013 showed no difference between target 33 and 36 in patients with out of hospital arrest of presumed cardiac cause. Fever avoided for 72 hrs in TTM.

- Current ARC/ILCOR guideline remains 32-34 but either approach reasonable.
- Avoidance of hyperthermia may be more important than hypothermia.
- ILCOR draft guidelines for 2015 recommend 32-36 for all arrests with unresponsiveness post ROSC for 24 hours (weak recommendation, very low quality evidence.)
- Prehospital cooling with crystalloid confers no benefit with increased APO
- Studies that suggest benefit of TTM in patients with cardiac arrest post hanging
- HYPERION trial underway to evaluate TTM 32.5 – 33.5 in non-shockable cardiac arrest survivors

Traumatic brain injury:

- Multiple studies have looked at TH to treat severe TBI i.e. prophylaxis.
- Meta-analysis of trials spanning over 20 yrs suggests a beneficial effect on mortality and favourable outcome.
- When limited to higher quality trials no significant mortality benefit.
- BTF guidelines level III recommendation for prophylactic hypothermia with no significant decrease in mortality but association with higher GOS
- Cooling associated with lower ICP and higher incidence of pneumonia
- Most trials using 32-35 degrees for at least 48 hrs
- POLAR awaited – TH for severe TBI
- Eurotherm 3235 awaited – TH for Intracranial hypertension
- TH commonly used to treat intracranial hypertension rather than as prophylaxis.
- Contemporary data evaluating this practice is lacking

Other potential uses

Hepatic encephalopathy

- Intracranial hypertension common in grade III/IV encephalopathy related to ALF
- Some advocate cooling as a treatment of strategy to manage intracranial HT
- Controversial
- No RCTs

Meningitis

- Evidence of potential harm

Stroke

- Fever associated with two-fold risk of death after haemorrhagic or ischaemic stroke
- Pharmacologic methods of fever control have not shown improved outcome
- NINDS and European (EuroHYP-1) funded trials looking at induced hypothermia underway

Seizures

- Case reports with HYBERNATUS trial underway evaluating TH for refractory SE

SAH

- No good data to support the use of TH in SAH.
- Small studies have looked at TH in patients with intracranial HT
- Fever associated with worse outcomes

Neonatal encephalopathy

- Results of RCTs recommend cooling 33-34 for 72hr

Adverse effects:

- Bradycardia / Arrhythmias
- Increased SVR and venous return with cold diuresis
- Hypokalaemia during cooling and rebound hyperkalaemia during rewarming
- Immunosuppression / infectious Complications

- Coagulopathy
- Altered drug metabolism / reduced clearance sedative drugs
- Requirement for sedation +/- paralysis
- Concern regarding rebound intracranial hypertension during warming phase
- Challenge of achieving and maintaining target temperature

Practice:

- Reasonable statement of candidates practice re TH

Pass rate	51%
Maximum mark	7.5

Additional comments:

Candidates mentioned detail that was not requested, such as methods of cooling. Candidates also showed poor breadth of knowledge related to the potential use of hypothermia in conditions such as TBI / SAH / CVA.

Question 10

A two-week-old baby is brought to your general ICU in extremis pending transfer to a paediatric centre. Born at term, she had been discharged well on day 5 of life. For three days she has had progressive tachypnoea, lethargy and failure to feed, and has now presented after a seizure. She has been intubated in the Emergency Department.

Blood tests taken on air prior to intubation show:

Parameter	Patient Value	Normal Adult range
pH	7.04*	7.35 – 7.45
PCO ₂	14 mmHg (1.9 kPa)*	35 – 45 (4.6 – 6.0)
PO ₂	80 mmHg (10.5 kPa)	
Bicarbonate	5 mmol/L*	22 – 28
Lactate	8 mmol/L*	<2
Glucose	0.9 mmol/L*	3.5 – 6.1
White Cell Count	14.7 x 10 ⁹ /L*	4.0 – 11.0
Neutrophils	27%	
Lymphocytes	70%	
Alanine aminotransferase (ALT)	1600 U/L*	10 – 55
Aspartate aminotransferase (AST)	2200 U/L*	10 – 40

- List, in broad terms, the key differential diagnoses for this presentation. (20% marks)
- Outline your approach to differentiating between these diagnoses. (30% marks)
- Outline principles of early management pending transfer. (50% marks)

Answer Template

a)

Inborn error of metabolism Sepsis (viral likely) Cardiac disease- especially duct dependent disease Trauma (NAI) Drugs / Toxins

b)

History:

Exposure to ill persons including siblings and parents.

“Colds”, chicken pox and maternal herpes should be specifically solicited.

Maternal Group B Strep swab should be reviewed

Injury

Cyanotic spells

Apnoeas

Family history including infant deaths, inborn errors of metabolism (IEMs), cardiac disease, degree of consanguinity

Examination:

General exam - trauma, rash Liver edge (failure, hepatitis) Murmurs Femoral pulses

Investigations:

CXR

ECG

Ammonia

Urine amino and organic acids (if can't be processed, take while acidotic and store)

Cultures if not done

CMV, HSV PCR

Consider skeletal survey if any suggestion of injury

Cranial ultrasound (widely available)

Echo if available

c)

Ongoing liaison with receiving centre.

Restore then maintain BSL using 10% Glucose (2.5-5ml/kg 10% glucose bolus then 6mg/kg/min infusion.)

Restore intravascular volume (even post FEAST fluid bolus reasonable)

Direct therapy if specific pathology found- e.g. alprostadil infusion if evidence of duct dependent cardiac disease

Empiric antibiotics

Empiric antiviral given results above (acyclovir or ganciclovir)

Nil protein intake till initial metabolic results in- maintain on glucose as above

Lung protective ventilation

General ICU housekeeping.

Pass rate	34%
Maximum mark	7.0

Question 11

With respect to community-acquired bacterial meningitis in Australia and New Zealand:

- a) List two common pathogens encountered AND the empirical antimicrobial therapy of choice in EACH the following contexts:
- i) Neonate aged < 1month
 - ii) Immunocompetent adult aged 35 years
 - iii) Adult aged 48 years on steroids
 - iv) Immunocompetent adult aged 85 years

(70% marks)

- b) Briefly discuss the role of adjunctive corticosteroids in the management of meningitis.
(30% marks)

Answer Template

a)

Pathogens

Neonate aged < 1 month

- Gp B Strep (agalactiae)
- Ecoli
- Listeria.

Immunocompetent adult aged 35 years

- Strep. Pneumonia
- N. meningitidis

Adult aged 48 years on steroids

- Listeria
- Gram negative bacilli
- [TB]

Immunocompetent adult aged 85 years

- Strep pneumonia
- N meningitides
- Listeria
- Aerobic GNB

Antimicrobial Therapy

Neonate aged < 1 month

Amoxicillin/Ampicillin + 3rd generation cephalosporin
(OR Amox/Amp + aminoglycoside)

Immunocompetent adult aged 35 years

3rd generation cephalosporin + Vancomycin

Adult aged 48 years on steroids

Vancomycin + Ampicillin + either Cefepime or Meropenem

Immunocompetent adult aged 85 years

3rd generation cephalosporin + Vancomycin + Ampicillin
NB Some protocols substitute Rifampicin for Vancomycin.

b)

Multiple studies and meta-analyses conflicting results with mortality and neurological sequelae. Neurological sequelae seen in up to 50% of survivors of community-acquired meningitis.

Cochrane review 2013:

Overall -

- Trend to reduction in mortality
- Reduced rate of hearing loss
- Reduced rate of short-term neurological sequelae subgroup analyses -
- Reduced hearing loss in children with h influenza only
- Favourable effect on mortality with s pneumonia only
- No effect in low income countries, except possibly for tb meningitis

Approach to use of adjunctive steroids

- Adults in developed world – suspected or proven pneumococcus. Therefore commence steroids in all and discontinue if proven to not be pneumococcus.
- Children – suspected or proven H influenza, although many recommendations do include steroids for suspected pneumococcal or meningococcal as well. Given prior to, or with first dose of antibiotics. Continued for 4 days.

Potential side-effects of steroids

- Concern that steroids may reduce antibiotic penetration into CSF (esp Vancomycin) – controversial.
- Generic SEs – e.g. hyperglycaemia, GI bleed, immunosuppression etc.

Pass rate	9%
Maximum mark	5.9

Additional comments:

Overall candidates had poor knowledge about the causative organisms and appropriate antimicrobial agents in the setting of bacterial meningitis

Question 12

You are called to urgently review a 73-year-old female who is ventilated following admission with severe community-acquired pneumonia. She had a tracheostomy five days ago. She has now acutely desaturated and developed high airway pressures.

Outline your management of this problem.

Answer Template

This is an emergency situation with the risks of hypoxia, hypoventilation and/or barotrauma.

Management consists of concurrent resuscitation and focussed assessment to identify the underlying cause with definitive management as indicated.

The differential diagnosis includes:

- Ventilator malfunction
- Obstruction/kinking of circuit including filter
- Displacement/blockage trache tube
- Increased airway resistance e.g. bronchospasm
- Decreased lung or chest wall compliance e.g. pneumothorax, lung collapse, intra-abdominal hypertension

Stepwise response (*does not have to be in this order*)

- Increase FiO₂ to 1.0
- Assess patient for severity of insult – is there haemodynamic instability? Is the patient peri-arrest?
- Call for help and crash trolley / difficult airway trolley if indicated
- Disconnect patient from the ventilator and manually ventilate with FiO₂ 1.0 and assess resistance/compliance
- If resistance/compliance seems normal with reduction in airway pressures and improvement in saturations then cause is due to ventilator malfunction or inappropriate settings. Replace ventilator and/or review settings
- If resistance/compliance seems abnormal then systematic approach to look for cause
- Check circuit and filter for kinking/blockage and unkink/replace as indicated

- Assess trache for position and patency – remove inner cannula and pass suction catheter. If not patent and not cleared by suction or if displaced (may be evidence of subcutaneous emphysema) remove trache tube, occlude stoma and ventilate initially with bag-valve-mask and subsequently re-intubate with oral endotracheal tube
- If trache tube patent and correctly placed assess chest expansion and air entry to confirm/exclude bronchospasm, pneumothorax, lobar collapse, pleural effusion etc.
- Treat as appropriate – bronchodilators, thoracocentesis, physio, bronchoscopy, pleural drainage
- If decreased chest wall compliance consider sedation
- If increased intra-abdominal pressure, treat appropriately e.g. gastric decompression
- Re-assess patient after definitive management with investigations as indicated e.g. ABG and CXR.
- Review ventilator settings
- Be aware there may be more than one cause. If there is an obvious precipitating cause e.g. pneumothorax complicating difficult CVC insertion, tracheostomy displacement then treat this directly but then re-assess patient for resolution of hypoxia and high airway pressures

Pass rate	63%
Maximum mark	8.5

Additional comments:

Candidates were expected to describe a systematic approach and consider the possibility of multiple causes

Question 13

13.1

The following data refer to a 28-year-old male who is day 5 in ICU following a severe traumatic brain injury. He has no other injuries and has been heavily sedated with infusions of fentanyl, midazolam and propofol since admission. Over the last four hours he has become increasingly bradycardic and hypotensive, and has not responded to fluid loading or repeated doses of atropine.

Venous Biochemistry		
Parameter	Patient Value	Normal Adult Range
Sodium	138 mmol/L	135 – 145
Potassium	5.1 mmol/L*	3.5 – 4.5
Chloride	100 mmol/L	95 – 105
Bicarbonate	11 mmol/L*	22 – 26
Urea	29 mmol/L*	2.9 – 8.2
Creatinine	310 µmol/L*	70 – 120
Calcium (corrected)	1.71 mmol/L*	2.10 – 2.55
Phosphate	2.31 mmol/L*	0.65 – 1.45
Creatine Kinase	25,000 U/L*	0 – 270
Lactate	5.1 mmol/L*	< 2.0

Give the most likely diagnosis and the rationale for your answer.

(20% marks)

13.2

The following data refer to a 34-year-old male admitted to ICU twenty days after an allogeneic stem cell transplant for acute myeloid leukaemia. Over the last few days he had been

complaining of right upper quadrant abdominal pain, and observed to have gained several kilos in weight.

Venous Biochemistry		
Parameter	Patient Value	Normal Adult Range
Sodium	142 mmol/L	135 – 145
Potassium	4.8 mmol/L*	3.5 – 4.5
Chloride	97 mmol/L	95 – 105
Bicarbonate	22 mmol/L	22 – 26
Urea	11.2 mmol/L*	2.9 – 8.2
Creatinine	134 µmol/L*	70 – 120
Calcium	2.13 mmol/L	2.10 – 2.55
Phosphate	1.21 mmol/L	0.65 – 1.45
Total bilirubin	342 µmol/L*	0 – 25
Aspartate aminotransferase (AST)	175 U/L*	< 40
Gamma glutamyl transferase (GGT)	123 U/L*	< 40
Alanine aminotransferase (ALT)	87 U/L*	< 40

- a) Give the most likely diagnosis. (15% marks)
- b) How would you confirm this? (15% marks)

13.3

The following data refer to a 67-year-old male 8 days following initiation of treatment for acute leukaemia:

Parameter	Patient Value	Normal Adult Range
Haemoglobin	102 g/L*	130 – 180
White Cell Count	111 x 10 ⁹ /L*	4 – 11
Platelets	21 x 10 ⁹ /L*	150 – 350
Blasts	100 x 10 ⁹ /L*	0
Sodium	136 mmol/L	136 – 145
Potassium	6.1 mmol/L*	3.5 – 5.0
Chloride	95 mmol/L*	98 – 106
Bicarbonate	17 mmol/L*	23 – 28
Urea	21.8 mmol/L*	2.9 – 7.1
Creatinine	209 µmol/L*	60 – 120
Calcium (corrected)	2.48 mmol/L	2.20 – 2.60
Phosphate	2.76 mmol/L*	0.80 – 1.45
Magnesium	0.81 mmol/L	0.60 – 1.10
Urate	0.84 mmol/L*	0.20 – 0.42
Total protein	59 g/L*	60 – 78
Albumin	27 g/L*	35 – 55
Bilirubin	9 µmol/L	< 20
Alkaline phosphatase (ALP)	587 U/L*	36 – 92
Alanine transferase (ALT)	42 U/L*	< 35
Gamma glutamyl transferase (GGT)	110 U/L*	< 30
Lactate dehydrogenase (LDH)	7157 U/L*	60 – 100

- a) Give the underlying cause of the above abnormalities and give your reasoning to explain these findings. (20% marks)
- b) List the treatment options for this condition. (30% marks)

Answer Template

13.1

Propofol Infusion Syndrome.

Rationale: Biochemistry consistent with rhabdomyolysis. No other injuries to account for it. Refractory bradycardia and hypotensive suggestive. History of high dose propofol administration.

(Partial credit given for rhabdomyolysis, raised ICP and coning)

13.2

- a) Venous-occlusive disease of the liver (sinusoidal obstruction syndrome)
- b) Liver USS showing ascites and reversal of portal vein flow.

13.3

- a)
 - Tumour lysis syndrome
 - Renal impairment with hyperkalaemia, hyperphosphataemia, hyperuricaemia and increased LDH
- b)
 - Resuscitation – Adequate IV hydration
 - Treatment of hyperkalaemia – Calcium chloride, bicarbonate if ECG changes, dextrose-insulin, dialysis, resonium
 - Renal replacement therapy – metabolic acidosis, hyperkalaemia and hyperphosphataemia
 - Allopurinol
 - Rasburicase

Pass rate	66%
Maximum mark	9.3

Question 14

The images (Image A and Image B) below depict a mechanical / automated chest compression device. With respect to the use of these devices in cardiopulmonary resuscitation:

- a) What are the potential advantages of these devices over standard practice? *(40% marks)*
- b) What are the potential disadvantages associated with their use? *(30% marks)*
- c) Summarise the role of these devices in clinical practice. *(30% marks)*

(Images not depicted.)

Answer Template

- a)
 - Consistent quality CPR
 - Decreases number of personnel required to run the arrest (remote locations)
 - Reduced interruptions to chest compressions
 - Defibrillation can be administered during compressions

- Improves ability to perform procedures such as ECMO insertion, percutaneous coronary intervention.
- Improves ability to transport patient to definitive care while performing effective CPR.

b)

- Increased “hands-off” time due to delay in application of the device
- Visceral injuries- lung, liver, spleen, gastric
- Rib and sternal fractures
- Bleeding-mediastinal, epicardial, pericardial, aortic
 - (rate of injuries with mechanical CPR are probably higher than those seen with manual CPR)

c)

- Randomised controlled trials (CIRC , LINC, ParaMeDiC) have shown no improvement in outcome when comparing these devices to manual compressions
- May have a role in transporting patients, during procedures or in settings where there are limited personnel
- May contribute to good outcomes when used as part of an aggressive interventional bundle, including early reperfusion and ECMO in well-resourced settings (CHEER trial)

Pass rate	37%
Maximum mark	8.0

Question 15

With respect to pathological conditions of the spinal cord, for each of the following syndromes, list two causes and the clinical findings:

- Complete cord transection
- Cord hemisection
- Central cord syndrome
- Anterior cord syndrome (anterior spinal artery syndrome)
- Cauda Equina syndrome

(20% marks per syndrome)

(You may tabulate your answer.)

Answer Template

Syndrome	Aetiology	Clinical Findings
Complete Transection	Trauma, Infarction, Transverse myelitis, Abscess, Tumour	Complete loss of motor and sensory function below level of the lesion
Cord Hemisection	Trauma, Tumour, Multiple sclerosis, Abscess	Ipsilateral loss of motor and proprioception. Contralateral pain and temperature loss
Central Cord	Neck hyperextension, Syringomyelia, Tumour	Motor impairment greater in upper limbs than lower Variable sensory loss, bladder dysfunction
Anterior Cord	Hyperflexion, Disc protusion, Anterior spinal artery occlusion, Post AAA	Motor function impairment, Pain and temperature loss, proprioception spared.
Cauda Equina	Disc protusion, Tumour, Infection	Bladder/bowel dysfunction Altered sensation in saddle area, sexual dysfunction

Pass rate	97%
Maximum mark	9.5

Question 16

Critically evaluate the role of thrombolysis in pulmonary embolism.

Answer Template

Theory:

- Thrombolytic agents activate plasminogen to plasmin and can be used to accelerate clot lysis in pulmonary embolus.
- Can be given systemically or catheter directed via a pulmonary artery catheter.
- By reducing clot burden, aim is to decrease pulmonary hypertension, decrease right ventricular dysfunction and improve mortality
- Side effects of thrombolysis therapy can be devastating and include intracranial haemorrhage and massive GI or other bleeding.
- Potential benefits of thrombolysis weighed up against risks of haemorrhage.
- Usual contraindications to thrombolysis: recent intracranial haemorrhage, recent major surgery, active bleeding etc

Evidence:

Systemic Thrombolysis

- Large randomized controlled trials supporting the use of systemic thrombolytics in pulmonary embolus are lacking.
- Meta-analysis of thrombolysis revealed that in subgroup of haemodynamically unstable patients (n = 154) thrombolysis decreased the composite end point of death or recurrent pulmonary embolus.
- A commonly accepted indication is persistent hypotension (Massive PE) in a number of guidelines (Level of evidence not great – 2C)
- More controversial is the role of thrombolysis in haemodynamically stable patients.
- Recent meta-analysis: no difference in recurrent PE or mortality but increased major bleeding

In the following groups:

- **Submassive PE:**
 - Definition: pulmonary embolus with SBP >90 mmHg and right ventricular dysfunction or myocardial necrosis on echocardiography – worse prognosis than without pulmonary hypertension/r vent dysfunction.
- Evidence of mortality benefit is lacking.
- Recent NEJM article showed thrombolysis prevented deterioration in RV dysfunction with no mortality benefit. Increased haemorrhage and stroke rate vs heparin anticoagulation.
- **Cardiopulmonary resuscitation**
- Evidence of benefit is lacking from clinical trials – based on case reports and series
- **Large clot burden**
- Lower dose (“safe dose”) thrombolysis has been investigated in this group and found improvement in pulmonary hypertension (persisted until 28months) but no improvement in mortality and no increased risk of bleeding

Catheter directed thrombolysis:

- Can be directed via PAC.
- Can be used in patients where systemic thrombolytics have failed or risk of systemic thrombolysis considered too great.
- Evidence of mortality benefit is lacking but may be improved RV dysfunction

- Small studies

In practice:

- Usually thrombolysis for patients with massive PE (i.e. Persistent hypotension)
- Consider on a case by case basis patients with submassive PE (right ventricular dysfunction on echocardiography)
- Consider safe dose thrombolysis for patients with large clot burden.
- Consider thrombolysis in CPR
- Role of catheter directed thrombolysis uncertain.

Pass rate	54%
Maximum mark	7.5

Additional comments:

This is an area of enormous practical significance AND a common problem. Candidates were not expected to know the details of individual studies, but to be able to show a reasonable understanding of the state of play of the evidence.

A satisfactory answer was expected to include the following:

- *Rationale for using thrombolysis with risks and benefits*
- *Indications*
- *Discussion of use in sub-massive PE and cardiac arrest*
- *Reference to evidence*

In general, candidates who failed gave either clearly inaccurate statements or superficial answers.

Question 17

A 42-year-old primigravida, 30 weeks gestation, is admitted with abdominal trauma and hypotension, following a motor vehicle crash, to the Emergency Department of a hospital without an obstetric service.

Outline the management issues specific to the care of this patient.

Answer Template

In addition to management by a trauma team following EMST principles, this case requires additional early obstetric, neonatal and anaesthetic input. The operating theatre needs to be alerted to the possibility of the need for emergency Caesarian section. In an elderly primigravida this is likely to be a 'precious' pregnancy.

Other specific management issues include:

- High-flow oxygen to avoid maternal and fetal distress.
- Reduced maternal respiratory reserve with decreased FRC.
- Potential for relative difficulty in intubation
- Maternal compensation for blood loss is at the expense of utero-placental blood flow.
- Left lateral tilt to avoid aorto-caval compression.
- Transfusion should be Rhesus compatible and immunoglobulin should be given if she is Rhesus negative because of the immunological effects of minor feto-maternal haemorrhage.
- Physiological anaemia of pregnancy
- Minimise exposure to radiation – ultra-sound alternatives may be preferable. (DPL contra-indicated).

- Retroperitoneal haemorrhage, placental abruption or fetal distress may occur and premature labour may be precipitated.
- If pelvic fractures present, pelvic binders may not be suitable.
- Regular fetal monitoring is required.
- Bereavement issues in the event of an adverse fetal outcome

Pass rate	80%
Maximum mark	7.9

Additional comments:

Some candidates wrote about trauma management in general and/or did not address the issues of abdominal trauma and hypotension in a pregnant patient.

Question 18

18.1

The following data refer to a 65-year-old male admitted to ICU with septic shock on a background of active rheumatoid arthritis.

Parameter	Patient Value	Normal Adult Range
Haemoglobin	86 g/L*	125 – 180
Serum ferritin	298 µg/L	15 – 300
Serum iron	7 µmol/L*	9 – 27
Total Iron Binding Capacity (TIBC)	52 µmol/L	47 – 70
Transferrin Saturation (Iron / TIBC x 100)	28%	16 – 40
Erythropoietin level	15 U/L	4 – 28
C-reactive protein (CRP)	321 mg/L*	< 8

- What abnormality is demonstrated in this patient? Give your reasoning. (20% marks)
- What is the pathogenesis of these changes? (20% marks)
- What specific treatment strategy would correct the demonstrated abnormality? (10% marks)

18.2

The following data refer to a 48-year-old female admitted electively to ICU following extensive pelvic surgery for invasive endometrial carcinoma. The patient has remained in ICU for 22 days because of complications including acute kidney injury.

Parameter	Patient Value	Normal Adult Range
Haemoglobin	66 g/L*	125 – 180
Serum ferritin	14 µg/L*	15 – 300
Serum iron	3 µmol/L*	9 – 27
Total Iron Binding Capacity (TIBC)	86 µmol/L*	47 – 70
Transferrin Saturation	9%*	16 – 40
Erythropoietin level	41 U/L*	4 – 28
C-reactive protein (CRP)	60 mg/L*	< 8

- What abnormality is demonstrated in this patient? Give your reasoning. (20% marks)

b) Give two potential causative factors in this patient.

(10% marks)

c) Briefly outline the available treatment options to correct the demonstrated abnormality including any disadvantages / risks.

(20% marks)

Answer Template

18.1

a)

Anaemia of Inflammation demonstrated by:

- decreased haemoglobin
- decreased iron
- normal to high ferritin
- suppressed erythropoietin
- elevated CRP.

b)

Inflammation -> cytokines (IL6) -> increased hepcidin -> decreased iron release from bone marrow, decreased iron release from macrophages, decreased absorption of iron -> suppressed erythropoiesis

c)

Control inflammation, no value to iron replacement, no value to the use of erythropoietin.

18.2

a)

Iron deficiency anaemia as evidenced by:

- decreased haemoglobin
- decreased iron
- decreased ferritin
- increased erythropoietin
- increased TIBC.

b)

Blood loss

Pre-existing dietary deficiency

c)

IV iron replacement – no demonstrated benefit and risks of adverse effects (awaiting Ironman study)

Oral iron replacement

Erythropoietin – expensive and no demonstrated benefit

Blood transfusion – risks of transfusion including immunosuppression

Nil – may have reduced oxygen carrying capacity for some time until correction of Hb

Pass rate	46%
Maximum mark	6.7

Question 19

With respect to patients with HIV disease admitted to Intensive Care for a non-HIV related cause:

- a) What relevant information about the patient's HIV disease would you elicit from the history, examination and investigations to assist management? (50% marks)
- b) Discuss the issues associated with the administration of antiretroviral therapy in the Intensive Care Unit. (50% marks)

Answer Template

a)

History

- Duration of disease
- Treating physician
- h/o AIDS defining illnesses
- h/o opportunistic or other infections, Hep B/C status
- h/o IVDU
- h/o malignancy
- Weight loss
- Medication history
 - antiretrovirals, compliance
 - side effects with ART
 - prophylaxis against opportunistic infections

Clinical Examination

- Nutritional state/wasting
- Stigmata of IVDU
- Oropharyngeal candidiasis, herpes simplex lesions
- Assessment for cardiovascular risk and disease

Investigations

- recent CD4 & viral load
- nadir CD4 and peak viral load
- ART drug resistance tests
- Previous chest x-ray- old TB/MAC, chronic changes
- ECG- looking for ischaemic changes, (risk of accelerated atherosclerosis)

b)

No prospective studies evaluating safety, efficacy & timing of ART in the ICU

- 1) ART interruption- Difficulty with administering oral drugs in the critically ill especially with GI dysfunction. No parenteral preparations. Treatment interruption can lead to resistance mutations (effects seen up to 3 months after). Interruption also has HIV-specific and non-HIV specific risks (cardiovascular, renal, liver)
- 2) Toxicities and Side Effects- Dose adjustment required with organ failure (renal or hepatic). Specific toxicities and complications such as lactic acidosis, pancreatitis, liver failure, cardiovascular disease and hypersensitivity reactions.
- 3) Drug Interactions- With commonly used ICU drugs such as midazolam, PPIs, H2 blockers, amiodarone.(specific names of drugs not required)
- 4) Immune Reconstitution Syndrome- May complicate new initiation of ART in ICU. Worsens respiratory failure from PJP or TB. Worsens neurological status from

Cryptococcus or TB. Increased risk soon after commencement of ART and with low CD4 counts.

Pass rate	66%
Maximum mark	8.0

Question 20

Briefly discuss the information (including clinical features / investigations) that may help determine the prognosis of patients following cardiac arrest.

Answer Template

Prognostication after cardiac arrest may be very difficult and involve a number of modalities.

It involves consideration of:

History

- Underlying cause of the arrest
- Co-morbidities
- Use of therapeutic hypothermia
- Features of the arrest – down time, CPR, ROSC

Clinical assessment

Timing:

Neurological assessment timing will be determined by the use of therapeutic hypothermia and the duration and type of medication for sedation but is most reliably performed day 3 without therapeutic hypothermia – probably day 5 with TH. Suggestion is to wait 72 hours until return of normothermia.

With new TTM trial suggesting 36C then 72 hours post arrest may again be appropriate.

Examination:

Clinical – off sedation and neuromuscular blocking agents

Cranial nerve abnormalities – absence of pupillary response and corneal reflexes are bad prognostic indicators.

Best Motor response at 72 hours with absent or extensor response associated with poor outcome.

Status / Generalised and repetitive myoclonus (as opposed to sporadic myoclonus)

Biochemical parameters

Neurone specific enolase, > 33µg/L at days 1-3 indicates poor outcome

S100, CSF CKBB not accurate enough for prognostication

Electrophysiological features

EEG: generalised suppression, burst suppression or generalised periodic complexes strongly associated with poor outcome.

SSEPs: Bilateral absence of N20 component of SSEP with median nerve stimulation within 1-3 days is strongly associated with poor outcome.

Imaging

CT appearance – catastrophic changes with obvious pathology. Diffuse oedema has not been formally assessed as an indicator.

MRI may be more sensitive

Predictors of better outcome are:

Recovery of brainstem reflexes within 48 hours
Return of purposeful response within 24 hours
Hypothermia at the time of arrest
Young age

Pass rate	49%
Maximum mark	7.8

Question 21

21.1

List three causes of coma with bilateral miosis.

(15% marks)

21.2

A previously healthy 65-year-old female presents with headache, fever and altered level of consciousness. A CT Brain scan is normal and an LP is performed showing the following results:

Parameter	Patient Value	Normal Adult Range
Opening pressure	22 cm H ₂ O*	5 – 15
White Blood Cell Count	240 cells/μL* (75% mononuclear)	0 – 5
Red Blood Cell Count	1 cell/μL	0 – 5
Protein	800 mg/L*	150 – 400
Cerebrospinal Fluid Glucose	3.0 mmol/L	2.5 – 4.4
Serum Glucose	6.0 mmol/L	4.2 – 6.9

The patient is currently treated solely with Ceftriaxone 2g 12 hourly.

Give the three most likely infectious causes that would require additional specific treatment, and give the treatment of each of these conditions.

(40% marks)

21.3

A 46-year-old male from a foreign fishing vessel presents unconscious to the Emergency Department. He complained of visual disturbance prior to his deterioration. The following blood results are obtained:

Parameter	Patient Value	Normal Adult Range
Sodium	144 mmol/L	135 – 145
Potassium	4.0 mmol/L	3.5 – 5.0
Chloride	102 mmol/L	95 – 110
Bicarbonate	8.2 mmol/L*	22.0 – 30.0
Urea	6.4 mmol/L	3.0 – 7.0
Creatinine	127 μmol/L*	44 – 97
Glucose	5.0 mmol/L	3.5 – 7.8
Calcium (ionised)	1.10 mmol/L	1.03 – 1.23
Lactate	4.1 mmol/L*	0.6 – 2.4
Osmolality	324 mOsm/kg*	275 – 295

- a) What is the most likely diagnosis? (10% marks)
- b) What is the pathophysiology of the visual disturbance? (20% marks)
- c) List three specific treatments you would institute. (15% marks)

Answer Template

21.1

Pontine lesions
 Thalamic haemorrhage
 Metabolic encephalopathy
 Organophosphate
 Other cholinergic agents (e.g. donepezil for Alzheimers)
 Opioids, barbituates, GHB, clonidine
 Mushroom intoxication (cholinergic effect)

21.2

- Listeria Benzylpenicillin 2.4g Q4H or
 Ampicillin 2g ivi Q4-6H
- HSV Aciclovir 10mg/Kg Q8H
- Resistant pneumococcus Vancomycin load 25-35mg/kg and reasonable ongoing dosing
 regimen)
- TB Isoniazid plus rifampicin plus ethambutol plus
 pyrazinamide
- Cryptococcus Amphotericin

21.3

a)

Methanol toxicity

b)

Methanol -> formaldehyde -> formate which is neurotoxic (especially retina and basal ganglia)

c)

Sodium bicarbonate
 ADH inhibition with Ethanol (or fomepizole if available)
 Dialysis
 Cofactor therapy with either folic or folinic acid

Pass rate	80%
Maximum mark	9.0

Question 22

Regarding regional citrate anticoagulation for continuous renal replacement therapy (CRRT):

- a) What is the mechanism by which citrate provides anticoagulation? (20% marks)

- b) What is the metabolic fate of the citrate? (20% marks)
- c) What are the features of citrate toxicity? (20% marks)
- d) What conditions may increase the risk of citrate toxicity? (20% marks)
- e) What alternative(s) to citrate could you use in a patient with severe HITS? (20% marks)

Answer Template

a)

Forms a calcium – citrate complex which drops the serum ionized calcium level. Calcium is necessary for IX → IXa, X → Xa and PT → thrombin.

b)

Citrate complexed with calcium is partially removed by the filter, but some enters the circulation. Citrate is largely metabolized in the liver, entering the tricarboxylic acid pathway (Krebs cycle) generating NADH. Also generates bicarbonate (at a rate of 3 bicarb per 1 citrate).

c)

2 sorts of problems.

First (most commonly described), due to inadequate calcium replacement, are those of low ionized calcium, i.e. chilliness, anxiety, perioral paraesthesiae, carpopedal spasm, tetany, QT prolongation and arrhythmias. Associated with metabolic alkalosis from citrate metabolism, and possibly with sodium overload from the hypertonic sodium citrate.

Secondly (less common), due to citrate load in excess of hepatic ability to metabolise it, i.e. accumulation of citrate-calcium complex. Metabolic acidosis with high anion gap from citrate; raised ratio of total to ionized calcium from complexed calcium in circulation (normal total:ionized ratio 1.9-2.2:1, toxic ratio > 2.5:1).

d)

Hypocalcaemia
Liver failure
Low cardiac output (i.e. poor hepatic perfusion)

e)

At least 3 classes or 4 drug names for full marks
Prostacyclin (PGI₂)
Argatroban
Danaparoid
Bivalirudin
Fondaparinux
Lepirudin
No anticoagulation

Pass rate	86%
Maximum mark	9.3

Question 23

With respect to heat stroke:

- a) Outline the pathophysiology. (20% marks)

- b) List the factors that affect prognosis. (10% marks)
- c) List the expected changes on routine investigations in the presence of heat stroke. (20% marks)
- d) Outline the management of a patient with heat stroke. (50% marks)

Answer template

a)
 Uncoupling of oxidative phosphorylation
 Failure of enzyme systems
 Membrane permeability increased
 Na leak into cells
 ADP depleted
 Sweat gland damage from heat

b)
 Prognosis depends on core temp, duration of hyperthermia and presence of comorbidities.

c)
 Haemoconcentration (dehydration), haemolysis
 Hypernatremia
 LFT derangements (cholestatic, early sign),
 Renal impairment,
 DIC often delayed onset and a/w worse prognosis
 CK rise (exertional type),
 Lactate rise.
 During treatment: CXR pulmonary oedema (centralise fluid, ALI), low PO4, Ca, glucose,

d)
 ABC (Airway protection if GCS low etc.) & control of seizures if present

Remove from offending environment,

Rapid cooling to 39 C (duration of hyperthermia major determinant of outcome): remove clothing, sponge cold water, ice, fans, cooling blankets, cold intravenous fluids gastic lavage with cold solutions, immersion (young and military), cold dialysis, etc.

Monitor core temp closely

Volume and electrolyte resuscitation and close monitoring
 ABG,
 Eectrolytes. NB Risk of cerebral oedema
 CVC

Pass rate	31%
Maximum mark	7.4

Additional comments:

In general there was a knowledge deficit relating to the pathophysiology of heat stroke. Some candidates failed to address cooling and control of temperature in the management of heat stroke and did not recognise the need for initial rapid cooling and/ or the need for careful temperature monitoring.

Question 24

Outline the advantages and disadvantages of a CT scan, transoesophageal echocardiography (TOE), MRI and an aortogram for the evaluation of suspected aortic dissection.

Answer Template

CT

Advantages:

- Easy availability on an emergency basis
- High sensitivity and specificity
- Can pick up complications involving the branches (e.g. ischaemic gut) and extent of dissection into abdominal aorta
- Easier to monitor the patient than MRI
- Detects pericardial effusion.

Disadvantages:

- Have to move the patient
- Iodinated contrast
- Cannot assess for AR, LV function or coronaries

TOE

Advantages:

- Bedside test
- Can detect intimal flap, true and false lumen AR, tamponade
- Assess LV function
- No contrast needed

Disadvantages:

- Semi-invasive
- May need anaesthesia/intubation
- May cause undesirable hypertension
- “Blind spot” arising from left main bronchus
- Not widely available
- Special expertise required

MRI

Advantages:

- High sensitivity and specificity
- MR contrast (Gadolinium) has more favourable safety profile
- Can detect AR

Disadvantages:

- Not readily available
- Inconvenient (patient motionless for 30 minutes)
- Access and monitoring difficult, esp. for haemodynamically unstable patient on IV infusions
- Limited applicability (claustrophobia, pacemakers etc.)

Aortography

Advantages:

- Will detect intimal flap, AR
- Assess LV, tamponade, blocked coronaries (important for surgery in type A dissection)

Disadvantages:

- Not readily available

- Invasive
- Large contrast load

Pass rate	74%
Maximum mark	7.5

Question 25

Your intensive care unit has had a noticeable increase in the rate of ventilator-associated pneumonia (VAP). A number of cases involve multi-resistant organisms.

Outline the strategies you would recommend implementing in your unit in an effort to reduce the incidence of VAP.

Explain the rationale for each recommended quality improvement strategy in your answer.

Answer Template

Infection control procedures

Review routine infection control procedures e.g. hand washing, personal protection (gloving, gowning etc.), isolation policies for MDR organisms and airborne pathogens.

Benefits include a reduction in transmission of organisms from patient to staff and staff to patients hence reducing colonisation. Generally evidence of benefit exists for many of these strategies (e.g. hand washing) and there is also evidence of poor or less than perfect compliance.

Robust infection control governance and systems are also mandatory under new National Standards for Safety and Quality in Healthcare (Standard 3) including the need for regular audit and feedback.

Direct patient care strategies to prevent VAP

The presence of an endotracheal tube, micro aspiration and poor clearance of respiratory secretions is thought to be the key to pathogenesis of VAP. Therefore the implementation of a so-called 'VAP bundle' or similar is worth considering (although not all elements have a high level of evidence).

Strategies include:

- Remove tube at earliest possible time
- Elevate head of bed ≥ 30 degrees
- Daily mouth care (meticulous dental care and/or Chlorhexidine mouthwash)
- Minimise circuit manipulation
- Appropriate cuff pressures

May also consider:

- ETTs with subglottic suctioning
- Selective digestive decontamination
- Limiting the use of PPIs
- Weaning and sedation protocols

Antibiotic stewardship

Implement antibiotic stewardship including review of current prescribing practice, consideration of regular infectious diseases input, ICU and hospital specific antibiogram to guide antibiotic use and possible regulation of prescription of certain antibiotic classes.

No high level evidence of benefit for individual patients but generally considered to be important to avoid overuse of broad spectrum antibiotics in particular and limit the development of MDR pathogens. Good antibiotic stewardship may also increase the adequacy of empiric antibiotic cover, which is associated with improved mortality.

Environmental cleaning and decontamination

Review of cleaning procedures and compliance with Australian regulations regarding the surrounding environment is warranted.

For example:

- Staphylococcus remains viable on dry surfaces and be transmitted to staff and patients hence the entire bedspace including high surfaces must be cleaned regularly.
- Aspergillus may be transmitted via airborne spread of spores particularly to immunosuppressed patients in the setting of construction or renovation.
- Serratia has been linked to spread via sinks particularly if non-compliant with current design regulations.

Ongoing measurement and audit program

Ongoing measurement and feedback of clinically relevant processes and outcomes is a key to any quality improvement strategy and essential to demonstrate future improvement.

Problems exist with definitions for VAP including poor reliability and gaming of results. Even so review of existing data and data quality with appropriate statistical measures is important to be able to distinguish common cause from special cause variation.

It should not necessarily be assumed that the current increase in cases is based on reliable data or that it is statistically significant.

Equally important is allocation an appropriate clinician (nurse or doctor) with the responsibility and time to champion the cause and provide regular feedback to other staff.

This would likely be included in a wider quality and safety or infection control portfolio.

Pass rate	51%
Maximum mark	9.0

Additional comments:

Candidates were expected to give a clear statement of each strategy with a mature explanation of the rationale, not just state, for example, "VAP bundle"

Question 26

- a) Outline the clinical features and laboratory abnormalities likely to be found in a patient with envenomation due to an Australian snake-bite. (50% marks)
- b) Outline the management of a patient with confirmed snake envenomation. (50% marks)

Answer Template

a)

Clinical features

Local pain, swelling and bruising. This may be absent

Sudden collapse – associated with hypotension and loss of consciousness, rarely cardiac arrest and seizure (5%)

Non –specific systemic symptoms – nausea, vomiting, diarrhoea, headache, sweating.

Neurotoxicity – descending flaccid paralysis – starting with ptosis, diplopia, blurred vision, and then progressing to bulbar weakness, respiratory and limb muscle paralysis.

Myotoxicity – local and generalised myalgia and muscle tenderness.

Haemorrhage – rare – intracranial, gastrointestinal or from cannula sites

Laboratory abnormalities

Venom induced consumptive coagulopathy – characteristic of Australian snake bite – INR >3, APPT >100, fibrinogen < 1, raised D-dimers – can be 100 times assay cut off, Thrombocytopenia <100

CK – 1000 to over 100,000 u/L associated with myotoxicity

Acute renal failure – raised potassium, urea and creatinine.

Fragmented red cells in blood film – microangiopathic haemolytic anaemia.

b)

Management.

First aid – Pressure bandage with immobilisation of the limb and the patient, pressure similar to that for a sprained ankle.

Monitor the patient in critical care area with resuscitation facilities - ED, HDU, ICU - neurological state, HR, BP, respiration, bleeding

Resuscitation as appropriate with two large bore cannulas and collect blood for laboratory tests – Coags (INR, APTT, Fibrinogen, D-Dimers), platelets, Urea, creatinine, electrolytes, CK.

Identify the likely snake type; the site of the bite can be swabbed and a venom detection kit (VDK) used or urine but not blood, or consultation with a herpetologist. Administer anti-snake venom (ASV) only if clinical symptoms or signs or lab abnormalities such as prolonged INR. Current guidelines are for one vial ASV only and then correct subsequent coagulopathy with FFP

Release pressure bandage only after administration of ASV.

Type of ASV (monovalent or polyvalent) depends on clinical presentation, geography and VDK.

Monitor closely for anaphylactic reaction. Treat with adrenaline. Premedication with adrenaline, steroids or antihistamines not recommended.

Repeat lab investigations at 6, 12 and 24 hours to monitor response such as improvement in coagulopathy (INR).

Supportive treatment such ventilation for muscle paralysis and respiratory failure, dialysis for acute renal failure, inotropes for cardiovascular collapse and FFP for severe coagulopathy and bleeding complications

Pass rate	60%
Maximum mark	9.0

Question 27

Discuss the factors that may affect your choice of antimicrobial agent in a critically ill septic patient, giving examples where relevant.

Answer Template

Patient Factors

- History of current acute illness
- Allergies
- Previous antibiotic exposure
- Co-morbidities like immunocompetence, Diabetes.
- Social history e.g. nursing home resident, alcohol/drug abuse, occupation, contact with birds/animals, travel

Organism

- Sensitivity profile
- Inducible beta-lactamase producers (e.g. ESCAPPM)
- Tendency to develop resistance to antimicrobial during treatment course e.g. *Pseudomonas aeruginosa*
- Intracellular (e.g. aminoglycosides poorly active against strictly intracellular bacteria e.g. *Rickettsia*, *Chlamydia*, *Coxiella burnetti*)

Site of infection

- Organs with non-fenestrated capillaries (e.g. brain, prostate, anterior chamber of eye) – poor penetration of non lipid-soluble drugs
- Biliary and urinary sepsis – select drugs with hepatic (e.g. ceftriaxone) and urinary excretion (cefotaxime) respectively
- Lung – e.g. daptomycin inactivated by surfactant, vancomycin poor penetration

Organ dysfunction

- Renal or hepatic dysfunction may result in decreased elimination and increased toxicity

Toxicity

- Renal and ototoxicity of aminoglycosides
- Renal toxicity of vancomycin
- Neurotoxicity of imipenem

Drug interactions

- Synergy – beta lactams and aminoglycosides
- Pharmacodynamic interactions e.g. macrolides plus other agents causing prolongation of QT

Non anti-microbial effects of antimicrobial

- Anti-inflammatory effect of macrolides – may underlie outcome benefit when combined with beta lactams for bacteraemic pneumococcal pneumonia
- Inhibition of toxin synthesis in toxic-shock syndrome by clindamycin and linezolid

Hospital factors

- Local microbiology/ecology
- Ability of monitoring drug levels (TDM)
- Presence of an ID physician / Antibiotic Stewardship team in the hospital and their policies.

Route of administration

- Certain routes of administration may be unreliable in critically ill patients and drugs which can only be administered by that route are less desirable e.g. inhaled zanamivir

Cost

- Cost-effectiveness of the antibiotic

Bactericidal vs bacteriostatic

Theoretical benefit from bactericidal drugs. Controversial whether there is a clinical benefit

Pass rate	23%
Maximum mark	6.0

Additional comments:

Candidates were not expected to provide long lists of antimicrobial agents but to mention some examples where relevant. Overall, the question was poorly answered with superficial answers showing a lack of depth of understanding of the topic. Some wrote about dosing and dose adjustment but not about the choice of antimicrobial agent. Some candidates included key phrases e.g., “time dependent killing” without any demonstration of understanding of how that concept affected the choice of antibiotic.

Question 28

Critically evaluate the role of Early Goal Directed Therapy (EGDT) in septic patients.

Answer Template

Definition of EGDT –This is a protocolised approach to sepsis that refers to sequentially targeting a series of haemodynamic targets with the use of fluids, vasopressors/dilators, inotropes and blood within the first six hours of presentation. This follows early appropriate antibiotic therapy and source control where appropriate.

The 3 major trials:

Rivers (NEJM 2001) – single centre, randomised trial of 263 patients with severe sepsis or septic shock compared a protocol - including targeting ScVO₂ > 70%, CVP 8-12 mmHg, MAP > 65 mmHg and urine output > 0.5mL/kg/hour - to conventional therapy that targeted CVP, MAP and urine output only. Both groups initiated therapy (including antibiotics) within 6 hours of presentation. Mortality was lower in the group where all 4 targets were used (31% Vs 47%), suggesting that targeting SCVO₂, CVP, MAP and urine output was a superior strategy.

Critique - There was an emphasis on use of blood transfusion (haematocrit>30) and dobutamine in order to reach the ScVO₂ target, which is controversial. Results may not be generalisable due to inclusion of significant number of sick patients/late presentations with liver and heart disease that may have potentially biased the outcome favourably (resulting in very high mortality in control group as well as treatment group - higher than that seen in other settings). “Hawthorne effect” in intervention group patients who were managed by a senior, experienced clinician.

ProCESS (NEJM 2014) – multicentre, randomised trial of 1341 patients (U.S. based) with septic shock reported no mortality benefit with protocol-based therapies. The study had 3 arms – a protocol-based therapy that used all of the EGDT targets (ScvO₂, CVP, MAP, urine output,

central access required), a protocol-based standard therapy arm (MAP, urine output, central access not required) and a “usual care” (no protocol) arm.

ARISE (NEJM 2014) – multicentre, randomised trial of 1600 patients conducted in Australia and New Zealand. The study had 2 arms - the EGDT group and the usual-care group. Patients in the EGDT group received a larger mean volume of intravenous fluids in the first 6 hours after randomization than did those in the usual-care group and were more likely to receive vasopressor infusions, red-cell transfusions, and dobutamine. There was no significant difference in survival time, in-hospital mortality, duration of organ support, or length of hospital stay between the 2 groups.

Critique for ProCESS and ARISE – There are a number of proposed explanations for the negative results from ProCESS and ARISE. Antibiotics were administered early (70 to 100% before randomisation) in all randomisation groups. The trials were conducted in academic centres during an era of education and training regarding sepsis management. Central line placement was common in patients receiving protocol-based and usual care (>50%).

ProMISe due out soon

Conclusion

Conflicting evidence regarding the value of protocol-based therapy for sepsis with larger multi-centre trials not demonstrating the originally reported benefit.

Results of the ProMISe (UK) trial awaited.

Surviving Sepsis Guidelines still recommend central venous access for CVP/ScvO₂ measurement together with MAP and urine output in all patients with severe sepsis. The Guidelines were created before the publication of ARISE and ProCESS.

The optimal target to guide fluid management is unknown. However, it may be reasonable to aim for certain physiological targets when resuscitating patients with severe sepsis, rather than have no therapeutic targets.

OR any reasonable conclusion.

Pass rate	71%
Maximum mark	7.6

Additional comments:

Candidates were not expected to provide specific details of the trials, such as patient numbers.

(Note: ProMISe trial findings subsequently published in NEJM April 2015: 1260 patients with early septic shock randomised to EGDT or usual care did not show improved outcome in EGDT protocol group)

Question 29

Regarding sodium homeostasis in critically ill patients:

- a) Outline the pathophysiological mechanisms responsible for the hyponatraemia commonly seen in hepatic and renal failure. (20% marks)
- b) List the criteria essential for diagnosis of the syndrome of inappropriate antidiuresis (SIAD). (20% marks)
- c) List 4 drugs from separate classes that may cause SIAD. (20% marks)

- d) How would you distinguish SIAD from cerebral salt wasting syndrome (CSWS)? (20% marks)
- e) List two drugs that may be useful in the management of SIAD. (20% marks)

Answer template

- a)
- Hyponatraemia in the setting of **ECF volume expansion**.
 - Both however have **reduced effective circulating arterial volume** leading to increased AVP levels. In liver disease due to systemic vasodilatation and shunting and with CHF due to impaired cardiac output.
 - There is **impaired excretion of solute free water** caused in part by reduced GFR and reduced delivery of ultra filtrate to the diluting site in the nephron-renin angiotensin system is activated leading to sodium retention –overall water gain exceeds sodium gain
- b)
- Effective serum osmolality < 275mOsm/kg
 - Urine inappropriately concentrated(> 100mOsm/kg) in face of hypotonic plasma
 - Euvolaemic circulation
 - Urine sodium > 30mEq/l (accept any elevated value)
 - Absence of adrenal, thyroid or pituitary disease
- c)
- Antidepressants in particular SSRIs, TCA, MAOI
 - Anticonvulsants –carbamazepine, valproate, lamotrigine
 - Oncological agents- Vinca alkaloids, Melphalan, Methotrexate, and cyclophosphamide
 - Vasopressin analogues
 - Antidiabetics- chlorpromamide
 - Other- opiates, NSAID, MDMA, interferon, amidarone, proton pump blockers
- d)
- Difficult - key difference is that patients with CSWS are volume /blood volume deplete with low CVP.
 - Urine volume and sodium may be higher in CSWS than SIADH.
 - Serum uric acid may be lower in SIADH than CSWS but is not consistent.
- e)
1. Demeclocycline
 2. Tolvaptan / Conivaptan

Pass rate	29%
Maximum mark	6.3

Question 30

30.1

The following ECG (ECG 1) was recorded in a 25-year-old patient in ICU who was alert and conscious with a blood pressure of 100/50 mmHg.

What rhythm is demonstrated? Give the reasons for your answer. (40% marks)

30.2

The following ECG (ECG 2) was recorded in a 40-year-old female admitted with severe trauma.

- a) List the abnormalities
- b) What is the underlying diagnosis?
- c) List four pharmacological strategies for treatment of the demonstrated ECG abnormalities.

(40% marks)

30.3

The following ECG (ECG 3) was recorded from a 62-year-old woman presenting with syncopal episodes.

What are the abnormalities?

(20% marks)

Answer Template:

30.1

The ECG is consistent with a diagnosis of SVT with aberrant conduction for the following reasons:

There are no capture or fusion beats

There is no concordance in the chest leads

The QRS complexes are relatively narrow (under 160ms)

The patient's age makes the diagnosis of an atrial origin more likely.

30.2

- a) Irregular rhythm
Absent P waves
Bizarre widened QRS complexes
Peaked T waves
- b) Hyperkalaemia secondary to rhabdomyolysis
- c) NaHCO₃
CaCl₂
Dextrose/insulin
Frusemide
Salbutamol
(Resonium)

30.3

Type 2 (Wenckebach) second degree heart block

Slow transition across the chest leads (? Old anteroseptal infarct)

Pass rate	46%
Maximum mark	9.3

SECOND PART ORAL EXAMINATION

CLINICALS “HOT CASES”

- 26-year-old male day 4 ICU following fall from roof. He had sustained a severe head injury with extradural haematoma, contrecoup injury, SAH and temporal bone fracture extending to carotid canal. On examination there was a craniotomy scar and a pack in his left ear and he was waking up, localising with both upper limbs.
Candidates were asked to examine him with a view to assessing the severity of his head injury, and any other associated injuries likely to affect his recovery.
- 38-year-old female farmer day 8 ICU, admitted with severe sepsis and respiratory failure secondary to community-acquired pneumonia, and now with new-onset fever. Clinical signs included right-sided bronchial breathing, high minute ventilation, and a hyperdynamic circulation with a systolic murmur.
Candidates were asked to examine her and provide a summary of the clinical findings, differential diagnosis and management plan.
- 70-year-old female, day 10 in ICU, following an elective AAA repair, with on-going requirements for mechanical ventilation. Clinical signs included the presence of confusion but with no focal neurological deficits, normal cardiorespiratory examination, large NG aspirates and TPN, anuria and CRRT, ischaemic toe and new onset fever.
Candidates were asked to examine her and identify reasons for a difficult wean from ventilatory support.
- 56-year-old female, day 2 in ICU, admitted following a sub-arachnoid haemorrhage (WFNS grade 2 and Fischer grade 3). Clinical signs included the presence of an EVD, nor-adrenaline infusion and localising with right side.
Candidates were asked to evaluate the patient and describe their management plan for the day.
- 50-year-old male, day 7 ICU, admitted following out-of-hospital VF cardiac arrest secondary to STEMI, requiring multi-system support with VA ECMO, mechanical ventilation, vasopressor and inotropic support and CRRT.
Candidates were asked to assess him with a view to making a plan for that day and projecting forward for the subsequent few days.
- 69-year-old male, day 2 ICU following a fall from a standing height. Background history included hypercholesterolaemia, C-spine fusion and insulin dependent T2DM. His injuries included intracranial haemorrhage and base of skull fracture with blood in the right external auditory meatus.
Candidates were asked to examine him with a view to identifying his main injuries and any ongoing issues.
- 16-year-old male, day 3 ICU, admitted having been found unconscious after presumed high voltage electrocution and subsequent fall. Clinical signs included bilateral upper limb and gluteal fasciotomies with VAC dressings, GCS 15 and haemodynamic stability.
Candidates were asked to examine him and elucidate his clinical issues with particular reference to why he was still requiring ICU management.
- 35-year-old male, day 1 ICU, admitted following attempted suicide by hanging. He required 5 min CPR at the scene and GCS was 3/15 on presentation to hospital. Background included a history of IV drug use and alcohol abuse.

Candidates were asked to assess him, say which investigations they would perform and to give a management plan for the next 72 hours.

- 45-year-old man, day 3 ICU, admitted with fever and respiratory failure and left empyema. Background of long-term LVAD for cardiomyopathy. On examination he was awake and alert with an old sternotomy scar and a new left thoracotomy wound, three intercostal catheters in situ, and reduced breath sounds on the left side
Candidates were asked to assess him for the source of the fever.
- A 34-year-old with multi-trauma following a five storey fall onto a car, with respiratory failure and unstable haemodynamics. The patient had chest and spinal injuries and an unstable pelvic fracture awaiting surgical fixation.
Candidates were asked to examine him and describe why his haemodynamics were problematic.
- A 23-year-old man with a severe traumatic brain injury following a motor vehicle accident. Patient had poor conscious level with non-reactive pupils and a CSF leak.
Candidates were told the family wished to meet to discuss prognosis, and to examine the patient and present their findings.
- A 77-year-old male admitted two days ago, having fallen down the stairs. Found unconscious by his wife and intubated at the scene by paramedics. Underwent an emergency craniotomy.
Candidates were asked to examine him with an emphasis on neurology and injuries, and to present their plan of management for the day.
- A 59-year-old woman admitted twelve days previously with a WFNS Grade 4 subarachnoid haemorrhage.
Candidates were asked to examine her focussing on neurology and to present an ongoing plan of management.
- A 63-year-old man admitted four days previously following a laparotomy for small bowel resection, with a background of ulcerative colitis.
The patient had just returned from the operating theatre.
Candidates were asked to examine him and present their plan for weaning his ventilation.
- A 63-year-old man admitted 24 hours previously following an out of hospital cardiac arrest. Relevant background history included hypertension, Type 2 diabetes and rheumatic fever. He was in cardiogenic shock requiring inotropic support and IABP with clonus on neurological exam.
Candidates were asked to examine him and outline their management plan.
- A 74-year-old woman who had undergone a redo coronary artery grafting procedure the previous day. Relevant background included diabetes, hypertension and aortic valve replacement.
Candidates were asked if they would determine her suitability for extubation.
- A 31-year-old man who had been admitted to ICU eight days previously with limb weakness secondary to cervical epidural abscess. Clinical findings included sensory level at T2 with decreased power in upper limbs and absent motor function in his lower limbs with upgoing plantars; a weak moist cough with decreased air entry at the left base.
Candidates were asked if he was ready to be discharged to the ward.

- A 71-year-old man who had been admitted to the ICU six days previously with intra-abdominal sepsis.
Candidates were asked their approach to weaning his ventilation.
- 24-year-old male with a history of intravenous drug use and mitral valve endocarditis, which resulted in an embolic stroke. The patient subsequently had surgery for a mitral valve replacement from which he was recovering.
Candidates were directed to perform a neurological examination and a relevant general examination.
- 44-year-old female with acute liver failure and hypoxia on a background of alcohol excess and heavy smoking. Transferred from a peripheral hospital and intubated on arrival for hypoxia and delirium.
Candidates were directed to identify and discuss active issues and make a plan for the following week.
- 31-year-old female following re-do liver transplant. The patient had an actively discharging surgical wound, was jaundiced and was on CRRT.
Candidates were required to identify the current problems and formulate a plan of management.
- 70-year-old man 2 weeks following resection of a large mediastinal sarcoma that included oesophagectomy. His postoperative course was complicated by a bronchial injury and chyle leak. The patient was slow to wean from the ventilator - issues included potential sources of sepsis (including VAP and mediastinal), ongoing chyle leak, acute brain syndrome and neuromuscular weakness.
Candidates were directed to identify causes for the slow wean from ventilatory support.
- 81-year-old female who had suffered a cardiac arrest following an acute coronary syndrome, which was complicated by a stroke. The patient had undergone percutaneous intervention (PCI) and had an intra-aortic balloon pump in place.
Candidates were directed to assess the patient's progress and formulate a management plan.

VIVAS

Viva 1

A 55-year-old female is admitted to the ICU with a diagnosis of subarachnoid haemorrhage. She had 24 hours of severe headache, her CT and CTA showed subarachnoid haemorrhage, significant intraventricular blood and early hydrocephalus and a left middle cerebral artery aneurysm. The aneurysm has been confirmed with a formal angiogram and is not amenable to endovascular treatment, and she is admitted to the ICU pending surgical intervention.

On admission, she is alert and oriented with no focal neurological deficits. Her BP is 170/80 mmHg.

In detail, outline your initial assessment and management.

Additional comments:

Overall, well answered. Some candidates were formulaic in their approach to the initial assessment and management, stating "Resuscitation and ABC" and proposing intubation, rather

than considering aspects of the history, examination, investigations and specific treatment strategies in a stable patient with GCS 15.

Viva 2

Video loop of real-time US scan showing arterial puncture and post-procedure CXR showing malposition of dialysis catheter.

These images were taken during the insertion of a dialysis catheter.

What may have happened here?

Viva 3

A 42-year-old male is admitted to your intensive care day 4 post induction chemotherapy for acute promyelocytic leukemia (AML-M3). The patient was initially treated with idarubicin and all-trans retinoic acid (ATRA). He has progressively become more dyspnoeic in the ward. A Chest X-Ray demonstrates a bilateral, diffuse pulmonary infiltrate.

Initial examination reveals:

RR 40 breaths/min, SpO₂ 88% on 10 L/min O₂ by face mask.
GCS 14 (E4 M6 V4)
Temp 38.9°C
HR 144 beats/min, BP 95/50 mmHg

Full blood count is as follows on admission:

Parameter	Patient Value	Normal Adult Range
Haemoglobin	88 g/L*	(135 - 180)
White Cell Count	26 X 10 ⁹ /L*	(4.0 - 11.0) No differential
Platelets	22 X 10 ⁹ /L*	(150 - 400)

Comment: Blasts visible.

INR 3.2

Suggest a differential diagnosis.

Additional comments:

Some candidates gave a limited differential for respiratory failure in this patient, focussing on infective causes only, and some mentioned graft versus host disease although the patient had not had a bone marrow transplant.

Viva 4

A 27-year-old female presents to the Emergency Department after a collapse at work, followed by a brief tonic-clonic seizure. She is 30 weeks pregnant with no previous pregnancies or other significant medical history. She currently localises bilaterally to painful stimulus but does not open her eyes or vocalise. Her blood pressure is 170/50 mmHg, her urine analysis is unremarkable, and the CTG is 'reassuring'. The Emergency Physician and Obstetrician have asked for your assistance with her management.

What is your differential diagnosis for her current neurological state?

Viva 5

A previously well 20-year-old female presents to the ED with fevers. Questioning reveals a history of sore throat over the previous week, and ongoing right lateral thigh pain following a blow from a hockey stick during a weekend match. Pharyngeal examination reveals mild erythema only and examination of the right thigh reveals bruising, redness and soft tissue swelling but with no obvious skin breach. No other obvious focus of infection is apparent on systems review. She is treated with paracetamol and NSAIDs and discharged home.

Twelve hours later she represents with worsening thigh pain and exquisite tenderness, fever and hypotension. Plain XR of the thigh reveals no fracture, CXR and urinalysis are unremarkable and beta HCG testing is negative. She becomes increasingly shocked, receiving > 4L of intravenous fluid and intravenous opiates for pain.

What is your differential diagnosis?

Viva 6 – Procedure Viva

The first few minutes of this viva is a simulated environment. In the scenario, you are the ICU consultant covering the high dependency unit in a small metropolitan hospital. It is early on Saturday morning.

You are urgently called from your rounds to the ward to review a 70 year-old man who is day 1 post a total hip replacement. He has been perfectly stable overnight and has just received a single dose of intravenous Cephazolin. He now has obvious stridor at rest with a generalized urticarial rash and evolving swelling of his face and tongue. His BP is 105 systolic and oxygen saturation is 85% in room air.

On the ward you have a competent nurse and an inexperienced junior doctor available to help you (the examiners). They will be helpful, but not take initiative. Other senior help is at home and at least 30 minutes away. The operating room is closed and the staff is not expected for another hour. There is simple resuscitation equipment on the ward trolley. A range of airway equipment is available in your high dependency unit.

Please manage this situation.

Additional comments:

Some candidates were unable to appropriately manage anaphylaxis and/or were unable to describe a safe management approach for an airway emergency.

Viva 7 - Radiology Viva

This station contains 8 cases in total: 4 individual X-Rays and 4 CT scans (with a series of slides) displayed as a PowerPoint slide show.

Each case is preceded by a short clinical introduction.

Use the up/down arrows on the keyboard to scroll through the images

For each case please describe the relevant findings as you would to a colleague on the phone.

Viva 8 - Communication Viva

A 30-year-old haematology inpatient, Donna/David Smith was transferred to your intensive care unit with neutropenic septic shock 4 hours ago. She/he received induction chemotherapy 14 days ago for newly diagnosed Acute Lymphoblastic Leukaemia. She/he developed left leg pain 24 hours ago, which has rapidly progressed. Overnight she/he was assessed by junior medical staff who prescribed increasing doses of morphine. She/he has now been sedated, intubated and ventilated for shock requiring high and escalating doses of inotropic and vasopressor support. She/he is coagulopathic and thrombocytopenic. Initial clinical examination in ICU revealed crepitus up to the level of the knee, which has spread rapidly to the lower back. Following surgical assessment in theatre by consultant orthopaedic and plastic surgeons, your anaesthetic colleagues hand over to you that it was agreed that it is too late for operative intervention and the patient is returned to your ICU without debridement.

You are about to meet her husband David/his wife Donna. He/she has just arrived at the hospital having been informed by the ward staff that Donna/David was transferred to ICU. Prior to the meeting you review Donna/David, noting she/he is now on 100 mcg/min of adrenaline and 100 mcg/min of nor-adrenaline with a mean arterial pressure of 55 mmHg.

Additional comments:

Candidates who passed this station conveyed the key issues in simple language with appropriate non-verbal communication and with no misinformation, whilst listening to the actor and acknowledging his/her concerns.