



# COLLEGE OF INTENSIVE CARE MEDICINE OF AUSTRALIA AND NEW ZEALAND

## SECOND PART EXAMINATION

### EXAM REPORT AUGUST / OCTOBER 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 2.5 hour 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	October 2015	May 2015	October 2014	May 2014	October 2013
Presenting for written (Including OTS)	52	35	53	35	53
Carrying a pass from a previous attempt	12	21	3	8	11
OTS Exempt	0	0	0	0	0
Total number presenting (written + carry + OTS)	64	56	56	43	64
Invited to orals (> 50% in written section)	35	27	40	15	28
Total number invited to oral section	47	48	43	23	39

Analysis of Performance in Individual Sections	October 2015	May 2015	October 2014	May 2014	October 2013	May 2013
Successful in the written section	35/52 67%	27/35 77%	40/53 75%	15/35 43%	28/53 53%	18/27 67%
Successful in the Hot Case section	26/47 55%	32/48 67%	21/42 50%	15/23 65%	22/39 56%	9/25 36%
Successful in both Hot Cases	13/47 28%	17/48 35%	12/42 29%	6/23 26%	10/39 26%	7/25 28%
Successful in the Viva section	31/47 66%	40/48 83%	25/42 60%	22/23 96%	30/39 77%	15/25 60%

Sectional Pass Rates	October 2015		May 2015		October 2014		May 2014	
	Pass rate	Highest individual mark	Pass rate	Highest individual mark	Pass rate	Highest individual mark	Pass rate	Highest individual mark
Hot Case 1	45%	80%	60%	80%	36%	88%	43%	70%
Hot Case 2	62%	85%	56%	88%	57%	85%	61%	85%
Viva 1	53%	93%	83%	90%	76%	95%	91%	85%
Viva 2	45%	88%	96%	95%	90%	92%	83%	90%
Viva 3	77%	85%	79%	100%	31%	78%	61%	89%
Viva 4	79%	78%	52%	88%	55%	90%	87%	85%
Viva 5	66%	85%	92%	90%	86%	100%	87%	85%
Radiology Viva	40%	95%	84%	90%	2%	61%	74%	90%
Communication Viva	47%	78%	65%	100%	24%	85%	61%	94%
Procedure Viva	40%	90%	46%	81%	48%	80%	78%	100%

Oral Section Pass Rates	October 2015	May 2015	October 2014	May 2014	October 2013	May 2013
Candidates who scored >50% in written section and passed the overall exam	27/35 <b>77%</b>	19/27 <b>70%</b>	20/40 <b>50%</b>	15/15 <b>100%</b>	18/27 <b>67%</b>	11/18 <b>61%</b>
All candidates invited to oral section and passed the overall exam (written + carry + OTS)	32/47 <b>68%</b>	37/48 <b>77%</b>	22/42 <b>52%</b>	19/23 <b>82%</b>	28/39 <b>72%</b>	13/25 <b>52%</b>
Overall Pass Rate	32/64 <b>50%</b>	37/56 <b>66%</b>	22/55 <b>40%</b>	19/43 <b>44%</b>	28/64 <b>44%</b>	13/34 <b>38%</b>

## EXAMINERS' COMMENTS

### Written Paper

Seven 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 management of penetrating neck trauma, isolation practices for a patient with suspected Ebola and understanding of Standardised Mortality Ratios.

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.

The most common reasons for failing a question cited by the examiners were lack of knowledge, inadequate detail and a superficial answer not at consultant level.

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 13/30 questions compared with candidates scoring >50% and gaining an invitation to the oral section, passing an average of 21/30 questions.

### Hot Cases

The Hot Cases run for twenty minutes with an additional two minutes at the start of each case for the candidate to be given a written introduction to the case in question. 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 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
- Missing potentially life-threatening signs on review of imaging, e.g. cardiac tamponade
- Asking a large number of questions at the start of the case, of which many were 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
- Inability to construct an appropriate management plan for the case in question
- Limited time for discussion as a consequence of taking too long to present the clinical findings or to interpret basic data
- Inability to convey the impression that he/she could safely take charge of the unit

It was noted that some candidates were able to elicit and describe the clinical signs and data but were unable to synthesise all the information to come to a reasonable grasp of the issues and to formulate an appropriate management plan.

Candidates are advised that they should not sit the Second Part Examination until they can confidently examine patients, present the relevant clinical findings, synthesise all the information 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 encouraged to seek the opportunity in their daily practice to take charge of the unit and be responsible for management decisions. Candidates are also encouraged to practise examination of individual systems.

## Vivas

The pass rate for the vivas (66%) was equivalent to the pass rate for the written section. Vivas with an overall pass rate of less than 50% were Viva 2 (interpretation of the literature), Viva 6 (Management of cardiac arrest in an asthmatic), Viva 7 (Radiology) and Viva 8 (Communication Viva). 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 demonstrate confident and appropriate decision-making in specific clinical situations.

## 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

<b>Critically evaluate:</b>	Evaluate the evidence available to support the hypothesis.
<b>Outline:</b>	Provide a summary of the important points.
<b>List:</b>	Provide a list.
<b>Compare and contrast:</b>	Provide a description of similarities and differences (E.g. Table form).
<b>Management:</b>	Generic term that implies overall plan. Where appropriate, may include diagnosis as well as treatment.
<b>Discuss:</b>	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**

Critically evaluate the role of non-invasive ventilation (NIV) in critically ill patients.

#### **Answer Template**

##### Rationale

NIV provides ventilatory support for patients with respiratory failure via a sealed face-mask, nasal mask, mouthpiece, full face visor or helmet without the need for intubation. Ventilatory support may be with CPAP or bi-level modes and delivered by a range of ventilators from specifically designed devices to full-service ICU ventilators.

NIV decreases resource utilisation compared with invasive ventilation and avoids the associated complications.

Patient selection and a well-designed clinical protocol are important to avoid delaying intubation in patients who are not suitable for and/or failing NIV.

##### Indications

APO – alveolar recruitment, decreased afterload, decreased work of breathing

COPD – decrease work of breathing and unload respiratory muscles

Immunosuppressed

Planned strategy post extubation in selected patients

OSA / Obesity hypoventilation syndrome

Asthma

Patients with not for intubation/ treatment limitation orders who may qualify for HDU admission or admission to respiratory care units

Post-operative patients – in selected patients

Rib fractures

Cystic fibrosis as bridge to transplantation

#### Evidence for its use:

APO – studies show decreased intubation rate and faster time to resolution of respiratory failure and reduction in mortality and hospital length of stay

COPD – RCTs and Cochrane review (14 RCTs) showed significant improvement in intubation rates, complications, length of hospital stay and mortality rates for NIV compared with invasive ventilation

Immunocompromised - – 2 studies, one looking at solid organ transplant recipients and one looking at patients with haematological malignancy showed benefit with NIV, i.e. fewer intubations, complications and reduced ICU and hospital mortality

Asthma – probably beneficial but limited evidence

Rib fractures – fewer episodes of pneumonia but no mortality benefit and limited evidence

#### Evidence against its use:

- Use as rescue strategy for failed extubation – delays time to re-intubation. May be of benefit as part of weaning strategy and planned intervention post extubation especially in COPD patients
- ARDS – not recommended as first line therapy

#### Predictors of success

Younger age

Unimpaired conscious state

Moderate rather than severe hypercarbia

Rapid improvement in physiological parameters

#### Contra-indications

Coma

Cardiac / respiratory arrest

Cardiac instability – shock, ventricular dysrhythmias, severe acute myocardial ischaemia

GI bleeding

Intractable vomiting

Inability to protect airway – poor cough, excessive secretions, decreased conscious state

Upper airway obstruction

Following upper GI surgery (some debate about this)

#### Complications

Facial and nasal trauma and pressure sores

Gastric distension

Dry mucous membranes

Aspiration of gastric contents

#### Alternatives

Invasive ventilation

HFNP – may provide CPAP 5mm Hg

## Summary statement / My Practice

### Such as:

Role of NIV in critically ill includes APO and respiratory failure in COPD and immunosuppressed patients. In my practice I use NIV as a planned strategy post-extubation in selected patients and as ventilatory support for patients with respiratory failure and treatment directives limiting care. I do allow its use to delay or withhold intubation in those who need this.

Pass rate	60%
Highest mark	8.5

### Additional Examiners' Comments:

*NIV is a fundamental part of intensive care practice and the overall level of understanding was poor. Few candidates were able to demonstrate detailed knowledge of this core therapy.*

*Candidates were not expected to include as much detail to score good marks. Essential points included indications, some mention of evidence for and against, contra-indications and complications. Candidates were given credit if they included valid points not in the answer template.*

## **Question 2**

- a) List four assessments of the RIGHT ventricle that can be made on transthoracic echocardiography. (20% marks)
- b) List four clinical signs of right heart failure. (20% marks)
- c) Classify the causes of pulmonary hypertension with examples. (60% marks)

## **Answer Template**

- a)
- RV size: LV size on apical 4-chamber view
  - RV diameter
  - RV wall thickness
  - Tricuspid annular plane systolic excursion (TAPSE) or S-PRIME on apical 4-chamber view
  - Right ventricular systolic pressure gradient to right atrium using tricuspid regurgitation (TR) jet.
  - Ventricular septal motion (D-shaped septum) that can indicate pressure or volume overload
  - Tissue Doppler and E/E' ratios

- b)
- Elevated Jugular venous pressure
  - Right ventricular heave
  - Right ventricular third heart sound
  - Pleural effusion
  - Peripheral oedema
  - Enlarged liver edge
  - Ascites

c)

### 1. Pulmonary arterial hypertension (PAH)

Idiopathic PAH, Heritable-genetic disease, Drugs and toxins induced: appetite suppressants e.g. fenfluramine, Associated with systemic disease: Connective tissue diseases e.g. scleroderma, HIV infection, Porto-pulmonary hypertension

### 2. Pulmonary hypertension due to left heart disease

Systolic dysfunction, Diastolic dysfunction, Valvular disease: Mitral stenosis, Mitral Regurgitation, Congenital abnormalities

### 3. Pulmonary hypertension due to lung diseases and/or hypoxia

Chronic obstructive pulmonary disease, Interstitial lung disease, Sleep-disordered breathing, Alveolar hypoventilation disorders, Chronic exposure to high altitude

### 4. Chronic thromboembolic pulmonary hypertension

### 5. PH with unclear and/or multifactorial mechanisms

Hematological disorders: myeloproliferative disorders, Systemic disorders: sarcoidosis, vasculitis, Metabolic disorders: glycogen storage disease, Others: tumour obstruction, fibrosing mediastinitis, chronic renal failure on dialysis

Pass rate	65%
Highest mark	8.5

#### Additional Examiners' Comments:

*Some candidates provided more than four answers for parts a) and b) and it should be noted that only the first four answers are considered. Part c) in general was poorly answered and many candidates confused acute elevations in pulmonary pressure with the disease entity of pulmonary hypertension.*

### Question 3

3.1

A 35-year-old female with no known previous medical history presents to the emergency department with a decreased conscious level.

The following results are obtained

<b>Venous Biochemistry</b>		
<b>Parameter</b>	<b>Patient Value</b>	<b>Normal Adult Range</b>
Sodium	144 mmol/L	135 – 145
Potassium	4.0 mmol/L	3.5 – 4.5
Chloride	100 mmol/L	95 – 105
Bicarbonate	14 mmol/L*	22 – 26
Glucose	1.1mmol/L*	3.5 – 6.1
Urea	2.7 mmol/L	2.9 – 8.2
Creatinine	120 µmol/L	70 – 120
Albumin	46 g/L	35 – 55
Total bilirubin	90 µmol/L*	< 20
Alkaline phosphatase (ALP)	131 U/L*	36 – 92
Aspartate aminotransferase (AST)	2450 U/L*	< 40
Gamma glutamyl transferase (GGT)	50 U/L*	< 30
Alanine aminotransferase (ALT)	2750 U/L*	< 35
<b>Coagulation Tests</b>		
<b>Parameter</b>	<b>Patient Value</b>	<b>Normal Adult Range</b>
PT	45 sec*	12 – 16
APTT	46 sec*	25.0 – 37.0
Fibrinogen	0.2 g/ L*	2.20 – 4.30

- a) Give one diagnosis which will explain the clinical and laboratory findings. (10% marks)
- b) List six possible aetiologies. (20% marks)

## Answer Template

a) Acute liver failure

b)

- Toxins – paracetamol, alcohol, mushrooms.
- Viral hepatitis – hep A,B,C,D,E, EBV,CMV
- Idiosyncratic drug reaction
- Ischaemic hepatitis due to shock – cardiogenic, septic.
- Acute fatty liver of pregnancy.
- Congenital/genetic - Wilson's disease.
- Hyperthermia - Heat stroke.
- Autoimmune hepatitis.
- Budd-chiari syndrome.
- Malignant hepatic infiltrations – breast cancer, lung cancer, melanoma, lymphoma, myeloma.

3.2

The following data were obtained from a patient who had been observed overnight in the Emergency Department with minor fractures. The patient is otherwise well and currently asymptomatic.

Venous Biochemistry		
Parameter	Patient Value	Normal Adult Range
Sodium	131 mmol/L*	135 – 145
Potassium	>10 mmol/L*	3.5 – 4.5
Chloride	98 mmol/L	95 – 105
Bicarbonate	14 mmol/L*	22 – 26
Glucose	1.2 mmol/L*	3.5-6.1
Creatinine	70 µmol/L	70 – 120
Lactate dehydrogenase (LDH)	600 U/L*	60 – 100
Phosphate	2.10 mmol/L*	0.65 – 1.45
Lactate	4.3 mmol/L*	< 2.0

Give the most likely cause for the above biochemical abnormalities?

Justify your answer.

(40% marks)

## Answer Template

Artefact; – This blood sample was left longer than 6 hours before it was processed for above investigations. (Note to examiners - This is not just a haemolysed sample – haemolysis alone does not cause hypoglycaemia and lactic acidosis, though it will cause other abnormalities).

- 1) Potassium, phosphate and LD enter the serum from red cell due to haemolysis and Na/K pump dysfunction.
- 2) Low Na – shift into red cell in exchange for potassium.
- 3) RBCs consume glucose and generate lactate.

3.3

You are asked to review a 44-year-old male known epileptic following a prolonged generalised tonic-clonic convulsion. He is intubated and ventilated.

The arterial blood gas analysis is as follows:

Parameter	Patient Value	Normal Adult Range
FiO <sub>2</sub>	0.5	
pH	7.15*	7.35 – 7.45
pCO <sub>2</sub>	35 mmHg (4.6 kPa)	35 – 45 (4.6 – 6)
pO <sub>2</sub>	105 mmHg (14 kPa)	75 – 98 (10 – 13)
HCO <sub>3</sub> <sup>-</sup>	10.3 mmol/L*	22.0 – 26.0

List the abnormalities on the blood gas and give the most likely cause of each abnormality. (30% marks)

**Answer Template**

Metabolic acidosis – lactic acidosis secondary to prolonged seizures  
 Respiratory acidosis (or inadequate compensation) – central hypoventilation or  
 Inadequate mechanical ventilation  
 Increased A-a gradient - aspiration pneumonia

Pass rate	61%
Highest mark	9.5

**Question 4**

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, SpO<sub>2</sub> 88% on 10 L/min O<sub>2</sub> by face mask  
 Glasgow Coma Scale 14 (E4 M6 V4)  
 Temperature 38.9 °C  
 Heart rate 144 beats/min  
 Blood pressure 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 <sup>9</sup> /L* ( no differential)	4.0 – 11.0
Platelets	22 x 10 <sup>9</sup> /L*	150 – 400
Comment: Blasts visible		
International normalised ratio (INR)	3.2	

- a) Give your differential diagnosis for his respiratory failure. (40% marks)
- b) What are the major issues in this patient and how would you manage them? (60% marks)

## Answer Template

a)

Sepsis in a patient with immune compromise secondary to leukaemia.

Nosocomial pneumonia

- Bacterial –Gm negative –E.coli, Pseudomonas, Klebsiella
- Gm positive: Strep, Staph epi
- Fungal: Aspergillus, Candida, Cryptococcus
- Atypical: Legionella, mycoplasma
- Viral: CMV, HSV, RSV, Influenza, H1N1, VZV
- PCP: Toxoplasmosis
- TB (depending on background)

Non- infective

- Idiopathic pneumonia syndrome
- Cardiac failure (cardiotoxicity due to induction chemo)
- Diffuse alveolar haemorrhage
- Non cardiogenic capillary leak syndrome
- Chemo induced ALI / pneumonitis
- Retinoic Acid Syndrome

b)

Major issues are:

1. Hypoxic respiratory failure

- Probable nosocomial pneumonia now requiring respiratory support and is likely to be progressive
- Problem with invasive respiratory support carrying very high mortality and complications including barotrauma, further nosocomial infections
- Management - Non-invasive respiratory support commencing with CPAP progressing to BiPAP using the lowest FiO<sub>2</sub> to maintain PaO<sub>2</sub> above 60 mmHg. Attempt to avoid invasive respiratory support if possible.

2. Possible Sepsis

- May rapidly progress to septic shock in this patient
- Possible unusual infective agent
- Early commencement of Broad cover (Cefepime / Ceftazadime / Tazocin and Vancomycin + Voriconazole / caspofungin / liposomal amphotericin + acyclovir + Bactrim.) Discussion with ID and haematology specialists for prior antimicrobial therapy, CMV status, previous aspergillus infection etc
- Removal of indwelling intravenous catheters that are in anyway suspicious for infection
- Central access (with platelet cover), consideration of inotropes after transfusion of blood products and IV fluids preferentially using Albumin containing solutions.
- Steroids.

3. Prognosis from acute promyelocytic leukemia (AML-M3).

- Management is to liaise early with treating haematologist to ascertain likely outcome from primary disease and also discuss with family and patient the significant risk of deterioration and mortality.

4. Other

Treatment of coagulopathy- Vit K, Platelets, FFP

Difficulties in making definitive diagnosis

- Possible atypical infection with low yield probable from cultures
- Significant other non-infective differential diagnosis.

Management includes having a high degree of suspicion for resistant or unusual organism and managing with broad cover.

Pass rate	37%
Highest mark	8.3

Additional Examiners' Comments:

Candidates were expected to give some indication of treatment strategies e.g. antibiotics, reversal of coagulopathy rather than just writing D/W ID, haematology etc.

**Question 5**

- a) Define "Open Disclosure" in the healthcare setting. (10% marks)
- b) Outline the general steps involved in Open Disclosure? (50% marks)
- c) Discuss the importance of Open Disclosure. (40% marks)

**Answer Template**

a)  
Open Disclosure is the process of communicating with a patient and/or their support person(s) about a patient-related incident or harm caused during the process of healthcare.

- b)
- Acknowledge the incident and its impact
  - Explain the known clinical facts
  - Apologise for what has occurred
  - Reassure and agree on a plan for ongoing care
  - Investigate the incident to learn what has happened.
  - Feedback to patient and staff
  - Document by incident reporting tool and in the patient's medical record

c)  
Actively and openly managing such incidents, including through the exchange of timely and appropriate information, is important for:

- The recovery process of patients and next-of-kin
- Clinicians to manage their involvement in, and recovery from, adverse events
- Health service organisations to learn from errors.

Practising open disclosure can assist health service organisations develop a reporting culture as it supports clinicians managing unintended patient harm.

Effective and timely communication, transparency and establishing a rapport with the patient and/or family along with an apology when incidents occur might mitigate potential legal action.

Pass rate	62%
Highest mark	6.9

Additional Examiners' Comments:

Candidates who did not pass this question did not demonstrate an understanding of Open Disclosure with failure to offer an apology an important omission.

**Question 6**

You are called to review a 55-year-old female following difficult, prolonged surgery for clipping of a left middle cerebral artery aneurysm. She returned to the ICU intubated, ventilated and with an external ventricular drain (EVD) in situ three hours earlier.

She now has frank blood in the EVD. Her blood pressure is 180/100 mmHg, and her intracranial pressure has increased to 57 mm Hg.

Outline your approach to her initial management

## Answer Template

### Overview

- This is a very urgent situation
- Likely diagnosis is a surgical catastrophe
- Priorities
  - Resuscitate
  - Will need urgent CT +/- angiogram
  - Contact surgical team
  - Control ICP and defend CPP
  - Prepare for OT
  - Contact family once urgent situation settled

### Resuscitate

- PaO<sub>2</sub> >90 mmHg, O<sub>2</sub> sats >95%
- CO<sub>2</sub> 32 – 38 mmHg
- Check ETT ties
- Check BP for accuracy, probably allow BP to be a bit on the high side initially (SBP 150 – 170) but not excessively. Avoid hypotension. Treat hypotension carefully (probably noradrenaline rather than metaraminol boluses) to prevent large swings in BP

### Urgent CT +/- Angiogram

- Get junior to call CT
- Start packing, obtaining equipment, medications

### Contact Surgical Team

### Control ICP

- Check reading; level, zero, draining
- ETT ties not tight
- Head up 45 degrees
- Mild hyperventilation (CO<sub>2</sub> 34 – 38 mmHg)
- Sedation
  - Thiopentone bolus 2 – 5 mg/kg
  - Opiate/benzodiazepine/propofol
- Paralysis
- Lower drain (5 – 10 cm above foramen magnum) and drain CSF
- Consider osmolar therapy
  - Mannitol (100 mL 20%)
  - Hypertonic saline (dose)
  - Target osm 320
- Maintain CPP if able
  - Probably target CPP of 50-60
- Prepare for OT
  - Check G+H
  - Check coags
  - Contact anesthetic/OT co-ordinator
  - Cease feeds

.Pass rate	87%
Highest mark	6.9

### Additional Examiners' Comments:

*Some candidates failed to recognise this as an emergency situation and treat appropriately in collaboration with the neurosurgeon.*

## Question 7

You have been called to the Emergency Room to review a previously well adult male who has sustained a penetrating injury to the root of the neck.

- a) Describe the anatomy of the root of the neck on the left side describing the clinically important structures that may be injured. (50% marks)
- b) Outline the issues specific to management of a penetrating neck injury. (50% marks)

### Answer Template

- a)
- The root of the neck is the junction between the thorax and the neck. It opens into, and is the cervical side of, the superior thoracic aperture, through which pass all structures going from the head to the thorax and vice versa. The root of the neck is bound laterally by the first rib, anteriorly by the manubrium, and posteriorly by the T1 vertebrae.
  - From anterior to posterior, the major contents are:

#### Subclavian artery and branches

- vertebral artery
- internal thoracic artery
- thyrocervical trunk
- costocervical trunk

#### Subclavian vein and tributaries (EJV)

Trachea

Oesophagus

Vagus nerve

Recurrent Laryngeal nerve

Dome of pleura

Brachial plexus

Lymphatics and thoracic duct

Phrenic nerve

Sympathetic chain, stellate ganglion

Scalene muscle.

Clavicle

b)

Requires management at a trauma centre with appropriate expertise. May require multiple speciality input - interventional radiology, ENT, vascular, cardiothoracic.

Airway issues:

- The possibility of laryngeal/ tracheal injury and the risk of intubating the "false airway passage". Consider tracheostomy under local anaesthesia.

Urgent surgical exploration required for haemodynamic compromise, expanding or pulsatile haematoma, extensive subcutaneous emphysema, stridor, or neurological deficit with intra op bronchoscopy/ endoscopy/ angiography if available.

If no indication for urgent surgical exploration requires CT angiography (or equivalent) with close observation in ICU +/- flexible laryngoscopy +/- endoscopy +/- oral contrast swallow study.

Pass rate	27%
Highest mark	7.4

Additional Examiners' Comments:

Most candidates were not aware of the issues and management priorities associated with this type of trauma.

**Question 8**

Note: The images have been omitted from this question.

With respect to thromboelastography and haemostasis:

The image depicted in Figure 1 represents a normal thromboelastogram.

With reference to the parameters labelled in Figure 1:

- i. CT (or R)
- ii. CFT (or K)
- iii. Alpha angle
- iv. MCF (or MA)
- v. LI30 (or LY30 or CL)

a) Explain what each parameter represents and what it measures. (60% marks)

Review the following thromboelastograms labelled A – E.

Diagram A represents a normal coagulation profile

b) Describe the coagulation status indicated by diagrams B – E. (40% marks)

**Answer Template**

a)  
R (reaction time or clotting time) is the time elapsed until first measurable clot forms (amplitude of 2mm) and indicates the initiation of haemostasis and is dependent on presence of clotting factors.

K (kinetics or clot formation time) is the time taken to achieve a certain level of clot firmness (amplitude of 20mm) and indicates amplification of the clotting process. Dependent on fibrinogen.

Alpha angle reflects the speed of fibrin accumulation. Dependent on fibrinogen.

MA/MCF is the maximum amplitude or maximum clot firmness and is the highest vertical amplitude of the TEG tracing. Dependent on platelets and fibrin.

LY30 /CL (clot lysis) is the percentage of amplitude reduction 30 min after maximum amplitude and is a measure of fibrinolysis.

- b)  
B – Anticoagulant therapy or factor deficiency  
C – Platelet dysfunction or thrombocytopenia or fibrinogen deficiency  
D – Fibrinolysis e.g. use of t-PA  
E – Hypercoagulable state

Pass rate	69%
Highest mark	9.3

## Question 9

A 42-year-old male is admitted to ICU following a cadaveric orthotopic liver transplant for end-stage liver disease secondary to alcohol-induced cirrhosis.

- a) List the important management principles for the first 24 hours specific to this patient. (70% marks)
- b) Despite weaning sedation he remains unresponsive 12 hours after ICU admission. What are the possible causes? (30% marks)

### Answer Template

a)  
Haemodynamic stabilization – optimize cardiac output and tissue perfusion and avoid fluid overload as ventricular function may be impaired. Close haemodynamic monitoring. Vaso-active agents as indicated.

Correction of anaemia and coagulopathy – maintain haemocrit 0.25 – 0.3 to keep blood viscosity low. INR  $\leq$  2, APTT  $\leq$  50 secs, Fibrinogen above 0.5 g/L and Platelets above  $30 \times 10^9/L$ .

Fluid and electrolyte management – appropriate negative fluid balance day 1 decreases risk of pulmonary complications. Fluid overload may aggravate graft congestion and oedema caused by ischaemic-reperfusion. Electrolyte imbalances are common and need to be corrected.

Correction of metabolic abnormalities – hypoglycaemia is an ominous sign of compromised liver recovery, hyperglycaemia also may occur, acid-base abnormalities also occur

Early weaning from mechanical ventilation – associated with better outcome but not feasible in patients with respiratory failure, haemodynamic instability, pulmonary oedema, primary graft dysfunction, encephalopathy etc. Unsuccessful early extubation may result in impaired oxygen delivery to transplanted liver

Monitoring of graft function LFTs, lactate, BSL, coagulation, hepatic artery doppler

Early detection of surgical complications - bleeding

Immunosuppressants

Infection prophylaxis

Housekeeping including analgesia (PCA) and appropriate nutrition plan

Other – ICP monitoring if decompensated CLD pre-op

- b)  
Delayed metabolism of sedative / anaesthetic drugs  
Metabolic derangements – hypoglycaemia, hyponatraemia, hyperosmolar syndrome  
Hepatic encephalopathy  
Hypoxic-ischaemic cerebral injury  
Seizures  
Intracerebral haemorrhage

Pass rate	58%
Highest mark	8.0

## Question 10

Outline how the pathophysiological changes in septic shock affect the pharmacokinetics and pharmacodynamics of commonly used antimicrobials.

### Answer Template

The major changes in pharmacokinetic parameters of critically ill patients include alterations in volume of distribution ( $V_d$ ) and clearance (Cl). Subsequently, these alterations affect the concentrations of antimicrobials in the body and the extent to which they are cleared.

The  $V_d$  is the volume in which the total amount of drug would have to be evenly distributed in to equal the same concentration as in the plasma. The toxins produced by various bacteria often lead to endothelial damage and result in increased capillary permeability. This leads to the phenomenon of “third spacing” where fluid shifts into the interstitial space from the intravascular space. These fluid shifts will increase the  $V_d$  of hydrophilic antimicrobials. Generally speaking, hydrophilic antimicrobials have a low  $V_d$  and therefore are greatly affected by these fluid shifts. Since lipophilic antimicrobials have a larger  $V_d$ , they typically distribute further into tissues and are less affected by these fluid shifts.

Patients in the ICU often have hypotension as a result of septic shock, which requires the administration of fluid boluses. Additionally, heart failure and renal failure lead to more oedematous states where patients can retain large amounts of fluid. These situations also lead to increases in  $V_d$  of hydrophilic drugs.

Changes in protein binding can also have a substantial effect on the  $V_d$ , especially for drugs that are highly protein bound. Only unbound or free drug is microbiologically active. Hypoalbuminemia in critically ill patients can result in decreased binding of drugs and subsequently higher free concentrations of drugs. While free drug will distribute into tissues, critically ill patients often have greater amounts of fluid in the interstitial space causing the antimicrobial concentrations in the tissues to remain low.

The administration of large volumes of fluid and use of vasopressors leads to a hypermetabolic state in which cardiac output and glomerular filtration rate are increased. The term often used to describe this enhanced elimination is augmented renal clearance. These physiological changes affect the clearance of drugs and can lead to sub-therapeutic levels of antimicrobials that are typically cleared by the kidneys. In contrast, decreased organ perfusion in the presence of end organ damage can lead to kidney and/or liver failure in which concentrations of these antimicrobials would be increased. Inadequate clearance or metabolism of these drugs would lead to accumulation and potential toxicity. Typically, equations such as Cockcroft-Gault are used to estimate renal function; however, these are often not good predictors of renal function in critically ill patients due to the acute and rapid changes such patients often experience. Since many antimicrobials are dosed based on renal function it is even more challenging to ensure adequate doses are being administered. The most accurate way to calculate renal function is the use of 8- or 12-hour creatinine collections. In situations where renal replacement therapy is utilized, careful consideration of timing and supplemental dosing post-dialysis would be needed depending on the antimicrobial agent

Pass rate	44%
Highest mark	7.5

## Question 11

- Define pulsus paradoxus and describe the mechanism by which this occurs in acute pericardial tamponade. (20% marks)
- List four methods by which pulsus paradoxus may be elicited clinically. (20% marks)
- List four other clinical signs of acute pericardial tamponade. (20% marks)
- List four electrocardiographic findings suggestive of pericarditis with cardiac tamponade. (20% marks)

e) List four echocardiographic features of cardiac tamponade.

(20% marks)

### Answer Template

a)

Pulsus paradoxus is an exaggeration (> 12 mmHg or 10%) of the normal inspiratory decrease in systemic blood pressure.

Decreased intrathoracic pressure with inspiration results in increased venous return to right heart and bulge of IVS to left. Because the ventricle can normally also expand outward, this septal shift is usually small, and the difference in the blood pressure is therefore small between inspiration and expiration (<10 mmHg). With tamponade, the left ventricle cannot expand outward, so the septal shift is exaggerated and the difference in BP is larger. Also, the relatively higher negative pressure in the pulmonary circulation compared to the left atrium in patients with pericardial pathology pooling of blood in pulmonary veins during inspiration resulting in decreased LV stroke volume.

b)

- Palpation of pulse- disappears in deep inspiration
- Sphygmomanometer- Korotkoffs sounds first heard in expiration only and then in inspiration with progressive deflation
- Pulse Oximeter-particularly useful in paediatrics
- Arterial pressure trace- exaggerated fall of systolic pressure in inspiration

c)

- Hypotension
- Elevated JVP (neck vein distension with inspiration- Kussmaul's sign)
- Muffled heart sounds
- Tachypnoea
- Exaggerated drop in diastolic CVP (Friedrich's sign)
- Absent y descent on CVP trace
- Clinical signs of shock- decreased peripheral perfusion, slow capillary refill, oliguria, confusion.

d)

- Tachycardia
- Low QRS voltage trace
- Electrical alternans
- Global concave ST elevation
- PR depression

e)

- Visible pericardial effusion
- Diastolic collapse of Right Atrium and Right Ventricle
- Respiratory variation in left and right sided volumes. Atrial and ventricular septa move leftward during inspiration and rightward during expiration
- Mitral and Tricuspid flow velocities are increased and out of phase. Mitral flow is increased on the first beat of inspiration and tricuspid flow is increased on expiration.
- The IVC is distended and does not collapse on inspiration

Pass rate	44%
Highest mark	7.4

## Question 12

Outline the strengths and limitations of the current Surviving Sepsis Campaign Guidelines, using examples to illustrate your points.

### Answer Template

Strengths:

- The guidelines are formulated by an international panel of experts reviewing and grading the evidence.
- Use of the Grading of Recommendations Assessment Development and Evaluation (GRADE) for guideline development.
  - GRADE separates the assessment of the quality of the evidence from the ultimate strength of the recommendations (allows for strong recommendations when the quality of evidence is weak or weak recommendations when the quality of evidence is strong, particularly when patient values and preferences may strongly factor into the equation).
- Intensivists may use as a decision-making tool in their practice as:
  - Information to aid practice
  - An established source of references
- Reduce variations in clinical practice
- The current recommendations may generate areas for future research and consensus statements for this high-risk and high-cost patient group.

Limitations

- The GRADE system, although transparent, is still subjective. Recommendations depend greatly on the values and preferences of the committee members.
- Guidelines attempt to include nearly every aspect of critical care potentially related to sepsis, thereby losing focus in the process and becoming a general ICU guideline.
- A narrower guideline dedicated to sepsis-specific management might be more useful.
- Complexity and diversity of sepsis may defy a single guideline for all cases.
- Guidelines may rapidly become out-dated

E.g. the 2012 guidelines on prone positioning for patients with PaO<sub>2</sub>/FiO<sub>2</sub> ratios < 100 despite such manoeuvres (Grade 2C). This would now potentially be (1B)

Recommends use of proton pump inhibitors over histamine-2 receptor antagonist for stress ulcer prophylaxis (grade 2C), although the emerging consensus suggests that this approach may not be beneficial and indeed may even be harmful.

- There are recommendations that may be considered controversial

E.g. Conservative fluid strategy in patients with sepsis-induced adult respiratory distress syndrome in the absence of evidence of tissue hypo perfusion (grade 1C)

- The guidelines emphasize 'bundles' of care for sepsis resuscitation, although the evidence behind some of the bundled recommendations is not strong, for example using central venous pressure readings to guide volume resuscitation.
- Significant risk that bundles will be utilised as quality measures with which Intensivist (who may validly disagree with some of the recommendations) treating sepsis will be assessed/benchmarked.

Pass rate	52%
Highest mark	8.1

### Question 13

Outline the key issues in the post-operative management of a super-obese (BMI 59) patient with type 2 diabetes following sleeve gastrectomy.

#### Answer Template

##### Maintain ABCs

- Monitoring of vital signs
- SpO<sub>2</sub> and ABGs for PCO<sub>2</sub>
- Use of CPAP post op if required. May use patient's own CPAP device but issues with leak, need for oxygen supplementation, etc. may require ICU machine usage
- Monitor electrolytes especially K<sup>+</sup>, urine output

##### Maintain hydration

- Appropriate fluids can be Hartmanns, 5% glucose, dextrose saline all of which will provide an energy substrate and avoid starvation ketosis

##### Maintain euglycaemia (BSL 4-10)

- Insulin either as an intravenous infusion or intermittent sub-cut bolus to maintain BSL 4-10. No evidence even in this group to support tight BSL control

##### Avoid starvation ketosis

- Post-operative oral fluids or diet should be discussed with surgical team and appropriate diet commenced as soon as practical

##### Housekeeping

- Adequate analgesia avoiding opioids
- DVT prophylaxis- mechanical prophylaxis for all with low molecular weight heparin if no contraindications.

##### Positioning

- Ensure appropriate posture/positioning in bed to optimize respiratory function and minimize gastro-oesophageal reflux and for pressure care
- Early mobilization is essential. Goals should be set in conjunction with physiotherapy staff including, for example, sitting out of bed within 18 hours, walking within the next 24 hours.
- Special bariatric beds required and may also need large chairs so patients can be sat out of bed.
- Hoists etc. / manual handling training for staff

##### Surgical

- Test for leak as per surgical protocol e.g. ice water test, gastrograffin swallow.

Pass rate	75%
Highest mark	8.3

#### Additional Examiners' Comments:

*Candidates who scored well mentioned specific challenges and considerations (rather than just generic "ABCs") and suggested strategies to address these.*

### Question 14

*Note: All ECGs have been omitted.*

#### 14.1

The following ECG (ECG 1) is from a 35-year-old male who presents with paroxysmal tachycardia.

- a) Describe this ECG. (30% marks)
- b) What would be the possible pharmacological options if his tachycardia were to recur? (20% marks)

**Answer Template**

- a)  
 Wolf-Parkinson-White syndrome
- short PR interval, less than 3 small squares (120 ms)
  - slurred upstroke to the QRS indicating pre-excitation (delta wave)
  - broad QRS
  - secondary ST and T wave changes
- b)  
 IV procainamide or amiodarone is preferred, but any class Ia, class Ic, or class III antiarrhythmic can be used (Digoxin, Verapamil contraindicated)

14.2

Review the following ECG (ECG 2).

- a) Describe the abnormalities. (15% marks)
- b) List the potential complications of this condition. (15% marks)

**Answer Template**

- a)  
 ST elevation in leads II, III and aVF  
 Q waves II, III and aVF  
 Reciprocal ST depression in aVL, V5-6
- Consistent with inferior STEMI
- b)  
 Bradycardia and heart block (2<sup>nd</sup> and 3<sup>rd</sup> degree)  
 Posterior infarction  
 Right ventricular infarction

14.3

A 65-year-old truck driver, with a history of COPD, has the following ECG (ECG 3).

Describe the ECG. (20% marks)

**Answer Template**

Atrial flutter: ventricular response of around 150 bpm (*atrial fibrillation acceptable but less marks*)  
 Left Axis Deviation  
 Poor R wave progression  
 Partial intra ventricular conduction defect

Pass rate	75%
Highest mark	8.8

### Question 15

- a) Describe the ultrasound features that help differentiate the internal jugular vein and the carotid artery? (70% marks)
- b) List the complications of central line insertion. (30% marks)

### Answer Template

a)

The IJ vein:

- Has an elliptical shape
- Is larger
- More collapsible with modest external surface pressure than the carotid artery (CA), which has rounder shape, thicker wall, and smaller diameter
- A Valsalva manoeuvre will further augment their diameter
- The IJ vein diameter varies depending on the position and fluid status of the patient and is particularly useful in hypovolemic patients.
- Adding Doppler, if available, can further distinguish whether the vessel is a vein or an artery. Colour flow Doppler demonstrates pulsatile blood flow in an artery in either SAX or LAX orientation.
- A lower Nyquist scale is typically required to image lower velocity venous blood flows. At these reduced settings, venous blood flow is uniform in colour and present during systole and diastole with laminar flow, whereas arterial blood flow will alias and be detected predominantly during systole (Figure 5) in patients with unidirectional arterial flow (absence of aortic regurgitation).
- A small pulsed-wave Doppler sample volume within the vessel lumen displays a characteristic
- Veins are thin walled and compressible and may have respiratory-related changes in diameter. In contrast, arteries are thicker walled, not readily compressed by external pressure applied with the ultrasound probe and pulsatile during normal cardiac physiologic conditions.

b)

- Pneumothorax
- Air embolus
- Haematoma
- Haemorrhage
- Thrombosis
- Stenosis
- Arterial puncture / catheterisation
- Incorrect catheter tip position
- Central vein perforation
- Tamponade
- Cardiac arrhythmia
- Embolised, fractured or irretrievable guide wires
- Infection

Pass rate	62%
Highest mark	7.3

### Question 16

You have been asked to assess a previously healthy 32-year-old male who has presented following a high-speed motorbike accident.

He has a Glasgow Coma Score of 15, a distended abdomen and a bleeding left leg wound. His current vital signs are as follows:

Heart rate 120 beats/min  
Blood pressure 74/38 mmHg  
Core temp 34.7°C.

The trauma surgeon plans to perform exploratory laparotomy and open reduction and fixation of a left proximal femur fracture.

The results of blood parameters are as follows:

Parameter	Patient Value	Normal Adult Range
Haemoglobin	61 g/L*	115 – 160
White Cell Count	13.2 x 10 <sup>9</sup> /L*	4.0 – 11.0
Platelets	46 x 10 <sup>9</sup> /L*	150 – 400
International Normalised Ratio (INR)	1.9*	0.8 – 1.2
Activated Partial Thromboplastin Time (APTT)	43 seconds*	22 – 27
Fibrinogen	1.1 g/L*	2.0 – 4.0

Arterial Blood Gas values are:

Parameter	Patient Value	Normal Adult Range
FiO <sub>2</sub>	0.21	
pH	7.29*	7.35 – 7.45
pCO <sub>2</sub>	25 mmHg* (3.3 kPa)*	35 – 45 (4.6 – 6.0)
PaO <sub>2</sub>	80 mmHg (10.5 kPa)	
HCO <sub>3</sub>	12 mmol/L*	22 – 27
Lactate	3.7 mg/L*	< 1.5
Base Excess	-11 mmol/L*	-2 – +2

- a) Describe your strategies to control the bleeding in this patient. (70% marks)
- b) What evidence is there for the use of tranexamic acid in this setting? (30% marks)

### Answer Template

a)  
Expedite surgery

#### Medical Measures to control bleeding

- Activate Massive Transfusion Protocol as per local hospital guidelines. Close liaison with surgeon and haematologist is warranted.
- Local pressure including adjunctive tourniquet use to control bleeding from the left leg wound.
- Target lower systolic blood pressure (e.g. 80 mmHg) until major bleeding has been stopped (absence of brain injury permits the same). Permissive hypotension is tolerated and has shown survival benefits in some studies.
- Correct hypothermia and acidosis.
- Packed cells transfusion to target haemoglobin concentration 70 – 90 g/L to achieve adequate tissue perfusion.
- Fresh Frozen Plasma to maintain INR & APTT < 1.5 x mean control. Usual dose 15 mL/kg.
- Cryoprecipitate to maintain Fibrinogen levels > 1.5 g/L. Usual dose is 3-4 g or 50 mg/kg. (Fibrinogen concentrate is also allowed).
- Platelet transfusion to keep platelets > 50 x 10<sup>9</sup>/L. With multiple injuries and suspicion of micro-vascular bleeding; platelet count can be aimed at > 100 x 10<sup>9</sup>/L.
- Supplemental Calcium to maintain ionised calcium > 1.1 mmol/L
- Fluid Resuscitation with warmed crystalloid solutions. Aggressive fluid resuscitation is no longer recommended due to risk of pulmonary oedema, worsening of thrombocytopenia and coagulopathy due to haemodilution.
- Use of ROTEM/TEG targets
- Tranexamic Acid (see below)
- Recombinant Factor VIIa: Not indicated at this stage (prior to surgery).

b)

**Tranexamic Acid (TXA)** is a synthetic lysine analogue that is a competitive inhibitor of plasminogen. TXA is distributed throughout all tissues with plasma half-life of 120 minutes.

**Evidence:** Recently published CRASH 2 trial; a multi-centre randomised, controlled trial examined the role of TXA against placebo in trauma patients, with, or at risk of significant haemorrhage. In more than 20,000 patients; TXA demonstrated a significant reduction in all-cause mortality at 4 weeks after injury (14.5% vs. 16%; RR = 0.91, P = 0.0035) and risk of death from bleeding (4.9% vs. 5.7%; RR=0.85, p=0.00077).

The risk of precipitated thrombosis with the use of the lysine analogues has been of major theoretical concern; however, CRASH-2 showed that the rate of thrombosis, especially myocardial infarction, was lower with the use of TXA. No adverse events were described with the use of TXA in CRASH-2, although an increased rate of seizures has been described in patients receiving a high dose of TXA when undergoing cardiac surgery.

A further analysis of CRASH-2 data showed that early treatment ( $\leq$  1 hour and 1-3 hour from injury) significantly reduced the death rate of bleeding but treatment administered after 3 hours; increased the risk of death due to bleeding. Hence, TXA should be administered within 3 hours of injury.

TXA should be considered as adjunctive therapy in patients with traumatic haemorrhage in the setting of overall patient management; including strict attention to the control of bleeding, physiological and metabolic parameters, coagulation and temperature maintenance.

Pass rate	67%
Highest mark	7.0

**Additional Examiners' Comments:**

*Most candidates answered this question well although knowledge relating to the evidence for tranexamic acid was overall limited. Some gave a reasonable discussion of the medical management of bleeding but omitted surgical strategies.*

**Question 17**

A 45-year-old male is admitted to the Emergency Department after ingesting an unknown quantity of "headache tablets". His initial complaints are nausea, vomiting, shortness of breath and tinnitus. Fluid resuscitation has been commenced. You are asked to assess him as he is getting more dyspnoeic.

His serum biochemistry and arterial blood gas profile are as follows:

Parameter	Patient Value	Normal Adult Range
Sodium	138 mmol/L	135 – 145
Potassium	3.2 mmol/L*	3.4 – 5.0
Chloride	108 mmol/L	100 – 110
Bicarbonate	10 mmol/L*	22 – 27
FiO <sub>2</sub>	0.3	
pH	7.32*	7.35 – 7.45
PO <sub>2</sub>	125 mmHg (16.4 kPa)	
PCO <sub>2</sub>	20 mmHg (2.6 kPa)*	35 – 45 (4.6 – 6.0)
Base Excess	-10 mmol/L*	-2 – +2
Salicylate level	105 mg/dL*	3 – 10
Paracetamol level	< 20 mg/L (< 130 µmol/L)	< 20 (< 130)

- a) Describe the acid-base status. (20% marks)
- b) What are four severe complications of this toxidrome? (20% marks)
- c) What coagulopathy may be present in this toxidrome and what is the treatment? (10% marks)

d) What are the treatment options for severe toxicity, and what is their rationale? (50% marks)

### Answer Template

a)

Acid-base status:

Increased anion gap metabolic acidosis

Concomitant normal anion gap metabolic acidosis

Respiratory alkalosis

Decreased delta ratio

b)

Hypoglycaemia

Pulmonary oedema

Cerebral oedema

Arrhythmias

Hyperpyrexia

c)

Hypoprothrombinaemia

Vitamin K

d)

Forced alkaline diuresis. Renal excretion of salicylates becomes important when the metabolic pathways become saturated. There is a 10-20 fold increase in elimination when the urine pH increased from 5 to 8.

Haemodialysis. Most of the drug is protein-bound, and is concentration dependant. The volume of distribution is small, and binding site saturation leads to large levels of free drug, which is easily dialyzable.

Multiple-dose charcoal. Many aspirin forms are slow release and after ingestion they clump together in the GI tract, forming a large slow release preparation. It is also poorly soluble in the stomach leading to delayed absorption.

Pass rate	64%
Highest mark	9.3

### Additional Examiners' Comments:

*Most candidates understood the acid-base abnormalities but not all were able to provide cogent answers relating to the complications and management. Few were able to describe all the treatment options for severe toxicity with the rationale for these strategies.*

### Question 18

a) List and briefly describe the different mechanisms by which an ICU ventilator may detect (and thus is triggered by) a spontaneous inspiratory effort.

Include in your answer the utility and potential disadvantages of each mechanism. (60% marks)

b) Outline the mechanisms by which an ICU ventilator may cycle from inspiration to expiration.

(40% marks)

## Answer Template

a)

*Pressure triggering:* the ventilator triggers in response to a fall in pressure by a user defined value below set PEEP or CPAP.

Requires a respiratory muscle contraction against a static load (closed inspiratory limb) to generate a negative pressure below the threshold set value before fresh gas flow can occur. The imposed work of triggering is high, and may exceed the patient's reserve, resulting in missed triggers. Working against a static load may cause patient distress. There is significant delay between the initiation of respiratory effort and the onset of any fresh gas flow.

*Flow triggering:* the ventilator triggers in response to a user defined change in flow during the expiratory phase. The exact mechanism is ventilator specific and differs between ventilator types.

Obviates some of the disadvantages of pressure triggering. A constant fresh gas flow is available for any inspiratory effort, eliminating patient effort against a static load. However there still remains a delay between inspiratory effort and the onset of support. Auto triggering and cardiac triggering can occur if the  $\square$  flow is too sensitive.

*Neural Assistance, (NAVA):* specific to Maquet Servo ventilators, diaphragmatic EMG is detected by a specific nasogastric tube with an array of bipolar electrodes positioned across the oesophago-gastric junction when the tube is placed correctly.

NAVA improves patient-ventilator synchrony when compared with commonly used PSV.

Patients ventilated with NAVA do not experience the increased tidal volumes and reduced ventilatory frequency seen at higher levels of PSV.

NAVA prevents dynamic hyperinflation which has been implicated as the major factory in asynchrony.

NAVA eliminates 'wasted efforts' where a patient makes inspiratory effort but fails to trigger the ventilator.

Requires specific nasogastric tube

b)

*Time cycled.*

Once the time programmed for inspiration (inspiratory flow time plus inspiratory pause time) is completed, the ventilator automatically cycles to expiration. This occurs independent of any patient effort or other variables.

*Flow cycled.*

Once flow has decreased to a pre-determined minimum value, (eg 25% maximum flow rate), the ventilator cycles to expiration. In lungs with poor compliance, the cycling threshold will be reached more quickly, resulting in a shorter time for inspiration and a smaller tidal volume. Used more in spontaneous modes

*Pressure cycled.*

Once a set pressure is reached, the ventilator will cycle to expiration. Non-compliant lungs will have smaller tidal volumes than compliant lungs. The most common application for this mode is as an alarm setting as a safety feature to prevent sustained or excessive high pressures.

*Volume cycled*

Once a set volume is reached, the ventilator will cycle to expiration (or inspiratory pause).

Pass rate	77%
Highest mark	8.5

Additional Examiners' Comments:

Overall there was a lack of knowledge on the core topic of ventilator triggering and cycling and inadequate explanation of basic concepts. Some candidates confused pressure with volume and/or flow. Most answers were incomplete and few candidates scored well

**Question 19**

Note: The images have been omitted.

- a) Interpret the three pharmacodynamic (PD) profiles, labelled Scenario 1, Scenario 2 and Scenario 3, shown below. (40% marks)
- b) For each PD profile, describe how you would optimise the dose and/or frequency of antibiotic if prescribing:
- i) a beta lactam
  - ii) an aminoglycoside
- (60% marks)

**Answer Template**

a)

Comments:

Scenario 1

Drug concentration does not reach MIC  
Ineffective dose

Scenario 2.

Drug concentration is well above MIC.

Repeat dose maintains the concentration above MIC but increases the AUC: MIC ratio.

Scenario 3

Peak drug concentration is well above MIC

Significant period of interval between doses where drug level is below MIC

b)

Methods to optimise:

(i) Beta Lactam agents:

Scenario 1

- Increase dose
- More frequent dosing
- Consider continuous infusion after an appropriate loading dose

Scenario 2

- Decrease dose
- Less frequent dosing intervals
- Continuous infusion

Scenario 3

- More frequent dosing interval
- Continuous infusion

(ii) Aminoglycosides

Scenario 1

- Increase dose

Scenario 2

- Prolong dosing interval
- Therapeutic drug monitoring to avoid drug toxicity

Scenario 3

- No change
- Could consider higher dose.

Pass	75%
Highest mark	8.0

**Question 20**

20.1

A 50-year-old male with a history of chronic pancreatitis presents with several days of nausea and vomiting. His biochemistry profile is as follows:

Parameter	Patient Value	Normal Adult Range
<b>Arterial Blood Gas</b>		
FiO <sub>2</sub>	0.4	
pH	7.62*	7.35 – 7.45
PCO <sub>2</sub>	62 mmHg* (8.2 kPa)*	36 – 45 (4.6 – 6.0)
PO <sub>2</sub>	133 mmHg (17.5 kPa)	
Bicarbonate	65 mmol/L*	21 – 28
Base Excess	> 30 mmol/L*	-3 – +3
Sodium	149 mmol/L*	135 – 145
Potassium	3.3 mmol/L*	3.5 – 5.2
Chloride	53 mmol/L*	95 – 110
Calcium ionised	0.74 mmol/L*	1.12 – 1.32
Lactate	2.7 mmol/L*	< 1.3
<b>Venous biochemistry</b>		
Urea	34.9 mmol/L*	3.0 – 8.0
Creatinine	431 micromol/L*	60 – 110

Interpret the abnormalities in the above results and give likely underlying causes. (30% marks)

**Answer Template**

Severe metabolic alkalosis (raised SID)  
 Respiratory compensation (incomplete)  
 High anion gap (approx. 31) metabolic acidosis  
 Profound hypochloraemia

Gastric losses and fluid depletion causing chloride loss and metabolic alkalosis  
 Metabolic acidosis secondary to renal failure (acute? Acute on chronic?) +/- sepsis from pancreatitis and/or gastro-enteritis  
 CO<sub>2</sub> retention as compensation for severe metabolic alkalosis

20.2

A 28-year-old previously fit male presents with a two-day history of fever, headache and a widespread rash.

Results of investigations are as follows:

<b>Arterial Blood Gas</b>		
Parameter	Patient Value	Normal Adult Range
FiO <sub>2</sub>	0.3	
pH	6.99*	7.35 – 7.45

PCO <sub>2</sub>	26* mmHg (3.4 kPa)*	35 – 45 (4.6 – 6.0)
PO <sub>2</sub>	78 mmHg (10.3 kPa)	
SpO <sub>2</sub>	96%	95 – 100
Base Excess	-27.5 mmol/L*	-3.0 – +3.0
Bicarbonate	6 mmol/L*	22 – 27
Sodium	126 mmol/L*	135 – 145
Potassium	5.1 mmol/L*	3.5 – 4.5
Creatinine	186 micromol/L*	60 – 110
Glucose	2.4 mmol/L*	3.6 – 7.7
Lactate	16.0 mmol/L*	0.2 – 2.0

Blood cultures show Gram-negative cocci.

- List the abnormalities shown by the ABG. (10% marks)
- Give the most likely diagnosis. (5% marks)
- What complication of this condition may have occurred? (5% marks)

### Answer Template

- Severe lactic acidosis with inadequate respiratory compensation and acute renal impairment and hypoglycaemia.
- Meningococcal septicaemia
- Waterhouse Friderichsen syndrome.

*Multi-organ failure with liver and renal dysfunction is a reasonable answer and was given some credit.*

20.3

The following arterial blood gas result was obtained from a 65-year-old lady with exacerbation of chronic obstructive pulmonary disease (COPD), day 7 in ICU following intubation and ventilation for respiratory failure.

Parameter	Patient Value	Normal Adult Range
FiO <sub>2</sub>	0.3	
pH	7.48*	7.35 – 7.45
PCO <sub>2</sub>	42 mmHg (5.5 kPa)	35 – 45 (4.6 – 6.0)
PO <sub>2</sub>	104 mmHg (13.7 kPa)	
Total haemoglobin	122 g/L	115 – 165
SpO <sub>2</sub>	98%	95 – 100
Base Excess	7.0 mmol/L*	-3.0 – +3.0
Bicarbonate	31 mmol/L	22 – 32

- Interpret the arterial blood gas. (10% marks)
- Give four possible reasons for the acid-base disturbance seen. (10% marks)

### Answer Template

- Metabolic alkalosis  
Raised A-a gradient

- b)
- Diuretics
- Steroids
- NG losses
- Post hypercapnia

20.4

The following biochemical profile is from a 65-year-old male who has been admitted to your Intensive Care Unit with a diagnosis of pancreatitis of unknown aetiology.

Parameter	Patient Value	Normal Adult Range
Sodium	124 mmol/L*	135 – 145
Potassium	4.3 mmol/L	3.2 – 4.5
Chloride	106 mmol/L	100 – 110
Bicarbonate	23 mmol/L	22 – 27
Urea	15.0 mmol/L*	3.0 – 8.0
Creatinine	340 µmol/L*	70 – 120
Glucose	5.8 mmol/L	3.0 – 7.0
Lipase	562 IU/L*	< 220
Total Calcium	2.3 mmol/L	2.15 – 2.6
Phosphate	1.25 mmol/L	0.70 – 1.40
Albumin	26 g/L*	33 – 47
Globulins	35 g/L	25 – 45
Total Protein	61 g/L	60 – 83
Total Bilirubin	20 µmol/L	4 – 20
Conjugated Bilirubin	4 µmol/L	1 – 4
γ-Glutamyl transferase (GGT)	6 U/L	0 – 50
Alkaline phosphatase (ALP)	100 U/L	40 – 110
Lactate dehydrogenase (LDH)	380 U/L*	110 – 250
Aspartate aminotransferase (AST)	210 U/L*	< 40
Alanine aminotransferase (ALT)	100 U/L*	< 40
Measured Osmolarity	290 mOsm/kg	280 – 300

What blood test would you now order?

Give your reasoning.

(30% marks)

**Answer Template**

Lipid profile.

The patient has low serum sodium but a normal measured osmolarity and hence has pseudohyponatraemia. His glucose and protein levels are not elevated. He therefore is likely to have hypertriglyceridemia, which may be the underlying cause of his pancreatitis.

Pass rate	71%
Highest mark	8.9

Additional Examiners' Comments:

20.4 was the least well answered section with many candidates failing to recognise pseudohyponatraemia.

## Question 21

Compare Continuous Venovenous Haemofiltration (CVVHF), Sustained Low Efficiency Dialysis (SLED) and Intermittent Hemodialysis (IHD) with respect to:

- Mechanism of solute clearance
- Advantages
- Disadvantages

### Answer Template

	CVVH	SLED	IHD
Mechanism of solute clearance	Solvent removal occurs as a consequence of a pressure gradient across a semi permeable membrane. Solute removal occurs only by convection (solvent drag).	Solute removal occurs predominantly by diffusion down a concentration gradient created by dialysate fluid on the other side of the semi permeable membrane.	Solute clearance by diffusion
Advantages	Achieves better clearance of middle molecules (< 15 Kd) than CVVHD/IHD, fluid management easier and flexible, lesser hemodynamic instability as compared to IHD.	Can be done at night so patient can be mobilized during the day. Period of anticoagulation reduced. Possible cost savings by using online water and ability for one machine to deliver 2 treatment episodes per day.	Shortest treatment time, anticoagulation often not required, cost savings by using online water
Disadvantages	Patient immobilized, need for continuous anticoagulation, higher nursing requirement	Inferior clearance of middle molecules, reduced fluid management flexibility. Higher risk of disequilibrium syndrome	Least clearance of middle molecules, least flexible fluid management, highest risk of disequilibrium syndrome. Possible greater haemodynamic instability

Pass rate	40%
Highest mark	7.2

### Additional Examiners' Comments:

*Candidates' knowledge and understanding of a core topic was overall poor. Some candidates were not able to describe the mechanisms involved. Many described CVVHDF rather than CVVHF.*

## Question 22

A health care worker, recently returned from West Africa, presents to the Emergency Department with fevers, vomiting and diarrhoea. Her vital signs are normal on presentation. Blood tests have not been taken, and venous access has not been established.

Your state and hospital's Ebola response plan has been activated, and the patient is due to be transferred to the state quarantine hospital. For logistic reasons this cannot occur for 24 hours, and you (with approval

from ICU medical and nursing directors) have agreed to admit the patient to your ICU as this is the site of your hospital's only suitable isolation rooms.

Outline your management for this first 24-hour period.

**Answer Template:**

Ensure appropriate isolation prior to transfer:

- negative pressure room with appropriate venting activated checked, and operational
- ante-room with facilities for donning and doffing of PPE,
- separate toilet and hygiene facilities,
- adequate PPE supplies
- ideally staffed by an "opt-in" model
- rehearse donning and doffing procedures with observed and guided doffing

Ensure appropriate staff safety:

- intervention and observations to a minimum,
- blood tests are contraindicated unless sent to a designated laboratory with appropriate containment facilities

Specific Patient Management:

- focussed clinical examination to determine both physiologic disturbance and to look for other diagnoses (malaria, typhoid)
- empiric antibiotics for typhoid etc. and antimalarials
- strategy to maintain adequate fluid intake (oral, or iv with appropriate precautions)
- active symptom management of nausea & vomiting, diarrhoea (often profuse), pain
- no blood tests unless logistics allow

Other:

- staff welfare and de-brief
- family support

Pass rate	8%
Highest mark	6.5

Additional Examiners' Comments:

*Most answers were very superficial, lacking consideration of the detail needed to describe adequate isolation practices and were not at specialist level*

**Question 23**

A 70-year-old male presents to the ED with a 2-week history of increasing dyspnoea, cough with altered sputum and fever. Past history includes chronic obstructive airways disease (COPD), lung cancer seven years ago treated with chemotherapy and radiation therapy with no sign of recurrence since.

Examination findings included RR 30 breaths/min, BP 110/70mmHg, HR 145 bpm, Temp 37.4°C, anxious and distress but tired and peripherally cold and cyanosed.

CXR shows findings consistent with COPD and right lower lobe infiltrate.

The following arterial blood gas is taken one hour after receiving 2 litres of fluid resuscitation, antibiotics and bi-level non-invasive ventilation (NIV), at  $FiO_2 = 1.0$ .

Parameter	Patient Value	Normal Adult Range
$FiO_2$	1.0	
pH	7.16*	7.35 – 7.45
$PCO_2$	33 mmHg* (4.3 kPa)*	35 – 45 (4.6 – 6.0)
$PO_2$	272 mmHg (38.5 kPa)	
Bicarbonate	11 mmol/L*	22 – 30
Base Excess	-17 mmol/L*	-3 – +3
Sodium	138 mmol/L	135 – 145
Potassium	4.3 mmol/L	3.5 – 5.0
Chloride	121 mmol/L*	95 – 110
Glucose	13.1 mmol/L*	3.5 – 7.8
Lactate	6.4 mmol/L*	0.6 – 2.4
Haemoglobin	131 g/L*	135 – 175
Creatinine	150 micromol/L*	70 – 120

a) Give your interpretation of the arterial blood gas and outline potential causes. (40% marks)

Six hours later the patient remains on NIV, is conscious, reports feeling slightly better, feet remain cyanosed, BP 105/72 mmHg, HR 108 bpm, RR 30 breaths/min, urine output 10 – 20 mL/hr and the following biochemistry profile is obtained:

Parameter	Patient Value	Normal Adult Range
Sodium	139 mmol/L	135 – 145
Potassium	5.5 mmol/L*	3.5 – 5.2
Chloride	110 mmol/L	95 – 110
Bicarbonate	12 mmol/L*	22 – 32
Urea	20.0 mmol/L*	2.7 – 7.8
Creatinine	220 $\mu$ mol/L*	70 – 120
Estimated glomerular filtration rate (eGFR)	25 mL/min/1.73 m <sup>2</sup> *	> 90
Anion gap	22 mmol/L*	8 – 18
Total protein	57 g/L*	60 – 80
Albumin	27 g/L*	35 – 50
Total bilirubin	24.9 $\mu$ mol/L	< 25
Alkaline phosphatase (ALP)	81 IU/L	30 – 110
Alanine transaminase (ALT)	6138 IU/L*	< 65
Aspartate transaminase (AST)	10122 IU/L*	< 50
$\gamma$ -Glutamyl transferase (GGT)	88 IU/L	< 90
C-reactive protein (CRP)	22.5 mg/L*	< 8

b) Give your interpretation of these findings. Include likely aetiologies. (40% marks)

The patient's haematology results are as follows:

Parameter	Patient Value	Normal Adult Range
Haemoglobin	87 g/L*	130 – 180
White cell count	$2.1 \times 10^9/L$	4 – 11
Platelets	$54 \times 10^9/L$	140 – 440
International normalised ratio (INR)	2.4	0.8 – 1.2
Activated partial thromboplastin time (APTT)	38 sec*	25 – 35

c) What is your interpretation of these findings? (20% marks)

## Answer Template

a)

ABG:

Metabolic acidosis, normal anion gap however mixed cause (hyperchloremic predominant), high lactate and renal impairment.

Respiratory compensation but less than expected (superimposed respiratory acidosis).

Impaired oxygenation with moderate shunt  $PaO_2:FiO_2$  272 – A-a  $DO_2$  400.

Hyperglycemia (stress response).

Dx.

Type 1 respiratory impairment secondary to pneumonia on background of COAD.

Inadequate respiratory compensation due to fatigue and reduced respiratory reserve (COAD).

Metabolic acidosis due to:

Chloride excess - fluid resuscitation

Lactate elevation – sepsis plus inadequate cardiac output.

Renal impairment

b)

Increasing anion gap due to worsening renal impairment and possibly increasing lactate.

LFTs deranged with predominant finding of transaminitis. (This is likely to be associated with an increase in lactate).

### Aetiologies

Liver ischaemia due to hypoperfusion

- cardiac failure (poor output +/- liver congestion)
- severe sepsis with profound hypotension
- other shock states e.g. obstructive
- thrombo-embolic disease

Drug related e.g. paracetamol (inadvertent or deliberate)

*(NB Acute alcoholic hepatitis is unlikely with such a high AST)*

c)

Acute anaemia, acute or chronic leucopaenia, acute or chronic thrombocytopenia, coagulopathy with raised INR

- No unifying diagnosis
- Acute drop in haemoglobin over 2 hours is most likely due to haemorrhage or massive fluid infusion. Massive haemolysis is less likely given the bilirubin is not raised
- Sepsis most likely cause of leucopaenia, thrombocytopenia and raised INR
- Acute liver failure may explain raised INR
- Bone marrow failure would explain leucopaenia and thrombocytopenia if they are chronic.

*Any cause of bone marrow failure also accepted.*

Pass	50%
Highest mark	7.5

## Question 24

As part of a nationwide quality improvement program, the standardised mortality ratio (SMR) of your Intensive Care Unit was compared to other similar Intensive Care Units using a funnel plot.

You are ICU “A”

a) What does the graph show about your ICU “A”?

(20% marks)

b) Explain how the SMR is calculated. (20% marks)

c) Give the causes of an increased SMR. (60% marks)

**Answer Template**

- a)
  - The SMR of ICU A is above the upper 99% CI indicating the SMR is significantly higher than similar hospitals. Your ICU has significantly more deaths than expected compared to similar hospitals.
  - The overall SMR for the group is less than 1 and the SMR for ICU A is less than 1
- b)
  - $SMR = O/E$  O= observed number of deaths, E = expected number of deaths
  - E is derived from the average of the sample/ population.
  - Usually a risk adjustment model is used to calculate and account for severity of illness.
- c)
  - Can be “apparent” or “real”.
  - Data quality
  - Incomplete or errors in data submission causing underestimated expected risk
  - Widely different casemix of this ICU compared to others.
  - Statistical model (risk adjustment) may no longer well calibrated
  - True increase in mortality which can be due to
    - i. Factors internal to ICU: very high occupancy, poor processes,, inadequate staffing,
    - ii. Factors external to ICU; problems in services that are high users of ICU e.g. surgery, system issues

Pass rate	27%
Highest mark	6.5

Additional Examiners’ Comments:

*Many candidates showed a significant knowledge gap relating to this commonly used quality indicator with insufficient details and structure in their answers.*

**Question 25**

You are called to assist with a 12-year-old child, brought in to the Emergency Department unconscious, following near drowning at a local beach.

Outline your immediate management.

**Answer Template**

*Difficult to give exact template, as style may vary, but should include:*

Initial Assessment/Primary Survey

Assess for signs of life and if absent commence CPR, check underlying rhythm and treat appropriately following APLS guidelines

Airway and breathing

Administer 100% oxygen

Intubation for airway protection and suction with ETT cuffed size 7 (ILCOR guidelines – cuffed ETTs acceptable in children) (age/4 +4) (half size bigger and smaller available) with C spine precautions

Ventilate with appropriate settings (Vt 6-8ml/kg, RR 15-20, PEEP > 5cm H2O)

SpO<sub>2</sub> and ETCO<sub>2</sub> monitoring, ABG and CXR

*May get some discussion re management of ARDS*

### Circulation

Assess pulse rate and volume, blood pressure and capillary return, Doppler may be helpful if hypothermic  
Secure IV and arterial access  
If inadequate circulation fluid bolus of 20 ml/kg 0.9% Saline – avoid hypotonic intravenous fluids  
Consider vasopressor support early  
Blood glucose, FBE, U & E

### Cerebral support

Avoid any further episodes of hypoxia and hypercarbia. Avoid hyperoxia  
Optimise circulation  
BSL control

### Temperature

Actively rewarm to core temperature of 34°C  
Passively rewarm over 34°C  
*If post cardiac arrest – maintain hypothermia 32.5 – 33.5°C for > 24 hours*  
*Could allow a normothermia strategy, but fever must be controlled*

### Other

Primary and secondary survey for associated trauma  
Look for precipitating cause (hypoglycaemia, epilepsy, toxin ingestion, marine envenomation)  
Antibiotics not indicated routinely  
Collateral history – immersion time, resuscitation at scene, medical history  
Admit to ICU with appropriate paediatric expertise

Counsel family regarding likely outcomes.

Pass rate	63%
Highest mark	9.0

### Question 26

A 27-year-old female presents to the Emergency Department after a collapse at work that was 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 cardiotocogram (CTG) is 'reassuring'. A CT brain scan shows a sigmoid and transverse venous sinus thrombosis, with some temporal lobe parenchymal haemorrhage.

- a) List the major risk factors, other than pregnancy, for this condition. (30% marks)
- b) Briefly outline the management priorities for this patient? (70% marks)

### Answer Template

- a)
- Prothrombotic conditions – genetic or acquired
  - Oral contraceptive
  - Malignancy
  - Parameningeal Infection e.g. ear, sinus
  - Head trauma
  - Surgery
  - Mechanical precipitant
  - Autoimmune disease e.g. SLE, antiphospholipid
  - Other drugs e.g. androgens

b)

• **Resuscitation:**

- Consider intubation
- Check gas exchange (expect slight respiratory alkalosis)
- BP currently a bit on the high side, maybe careful hydralazine to SBP 140-160?

• **Specific therapy for cerebral venous sinus thrombosis**

- Therapeutic anticoagulation
- Can use LMWH or UFH
- Intracranial haemorrhage with CVT is not a contraindication to anticoagulation
- Continued for remainder of pregnancy and usually for further 6-12 weeks postpartum
- Aspirin – no evidence of benefit. Occasionally used as alternative if firm CI to therapeutic anticoagulation
- Potential therapies include thrombolysis (systemic or catheter-directed), mechanical clot extraction, decompressive craniectomy
- Assess for underlying cause that may require specific therapy e.g.,
  - Antiphospholipid syndrome
  - Sinus or parameningeal infection
- May need an anticonvulsant; consider neurology input

• **Pregnancy related:**

- Involvement of obstetric service, regular CTG, ultrasound
- ? steroids to allow for early delivery if needed
- Shielding for X-ray and CT limit as able
- Blood conservation given physiological anaemia of pregnancy
- Need to keep family up to date

Pass rate	67%
Highest mark	8.8

**Question 27**

A 60-year old male with no significant past medical history has been treated in your ICU for 21 days for severe staphylococcal sepsis and multi-organ failure, for which he is receiving linezolid.

He requires continuous renal replacement therapy (CRRT) and, despite therapeutic heparin to facilitate this, his filter keeps clotting. His platelet count has reduced from  $154 \times 10^9/L$  to  $56 \times 10^9/L$  from day 18 to day 21.

- a) List the four most likely differential diagnoses for the thrombocytopenia. (20% marks)
- b) Discuss your investigation for the thrombocytopenia. (40% marks)
- c) Outline your immediate management of this problem. (40% marks)

**Answer Template**

- a)
  - i. Linezolid
  - ii. Consumption coagulopathy (from clotting on renal replacement therapy)
  - iii. Pseudothrombocytopenia (i.e., platelet clumping)
  - iv. Sepsis induced including DIC
  - v. Heparin induced (HIT or HITTS)
  - vi. TTP/HUS (*less likely*)

b)

Exclude pseudothrombocytopenia

*Increased consumption*

- i. Repeat blood count and request for film to determine platelet clumping, evidence of haemolysis (schistocytes)
- ii. Coagulation testing to include D-dimers, fibrinogen
- iii. Blood cultures
- iv. HITTS screen
  - a. ELISA test for anti-platelet factor 4 antibody
  - b. More specific but more technically difficult - platelet aggregation test
- v. Autoimmune screen (dsDNA)
- vi. ADAMTS13 screening for TTP

*Decreased production*

- i. Bone marrow aspiration (+/-bone marrow biopsy)
  - 1. Urea / creatinine for HUS
  - 2. 'HIT screen'
  - 3. Miscellaneous
    - a. Drugs, sepsis, alcohol, bone marrow suppression

c)

- i. Reassess need for linezolid but it will need to be ceased and commenced on less bone marrow toxic anti-microbial to cover Staph aureus (vancomycin/teicoplanin)
- ii. No need to provide platelet support unless bleeding actively
- iii. Minimise need for renal support while trying to understand thrombocytopenia, if urgently needed will need to consider safety of anti-coagulating circuit in view of low platelet count.
- iv. Consider alternative strategies for circuit maintenance
  - a. No anticoagulation
  - b. Citrate
  - c. Prostacyclin
  - d. Thrombin antagonists
  - e. LMWH
  - f. Increased systemic heparinisation (if HITTS unlikely)

Pass rate	89%
Highest mark	8.8

*Additional Examiners' Comments:*

*Most candidates passed but there was overall a knowledge gap on the management of this clinical problem.*

**Question 28**

A 76-year-old female is admitted to the ICU following elective aortic and mitral valve replacement. Trans-oesophageal echo assessment at the end of surgery showed an ejection fraction of 20%. Her preoperative creatinine was 340  $\mu\text{mol/L}$ . Total bypass time was 240 minutes. On arrival in Intensive Care Unit the patient has the following indices:

Temperature	35°C
Atrial pacing (AAI)	80/min
Systemic blood pressure	85/55 mmHg
Pulmonary artery pressure	60/30 mmHg
Cardiac index	1.5 L/min/m <sup>2</sup>
Systemic vascular resistance indexed (SVRI)	1700 dyn.sec.cm <sup>-5</sup>
Pulmonary artery wedge pressure	10 mmHg
Central venous pressure	8 mmHg

The patient is currently on adrenaline 4 $\mu\text{g/min}$  by infusion.

- a) List the specific clinical and haemodynamic issues for this patient on admission to ICU. (30% marks)
- b) Outline your management of these issues. (70% marks)

### Answer Template

a)

The main clinical and haemodynamic issues identified are:

- Elderly female patient post double valve surgery.
- Pre-existing renal impairment.
- Long bypass time.
- Systemic hypotension (MAP 65 unlikely to be adequate for this patient).
- Low output state (CI, EF post bypass).
- Increased afterload / vascular impedance (SVR).
- Probable fluid responsiveness (PAWP, CVP).
- Moderate pulmonary hypertension.
- Low core temperature.

b)

This patient is high risk (female, age, long bypass time, pre-existing renal impairment, low EF).

Management consists of:

- Re-warming.
- Judicious fluid replacement as she re-warms.
- Improved volume state may augment CI but given poor EF unlikely to be sole intervention needed.
- Titration of adrenaline infusion, aiming for CI > 2.2
- Bedside echo to evaluate effect of fluid and increased adrenaline, exclude tamponade and check valve function (mitral regurgitation can increase PAP and decrease cardiac output).
- Consideration of other vasoactive agents (dobutamine, milrinone, levosimendan) or IABP insertion if persisting low output state.
- Assess adequacy of pacing and consider changing mode to A-V pacing (heart block common after AVR) and /or increasing rate to 90 bpm.
- Correct post-op coagulopathy and replace blood losses to maintain Hb > 80 G/L. Surgical review if significant blood loss via drains.
- Evaluation of any other cause of low output state e.g. tension pneumothorax, dynamic hyperinflation.
- Close monitoring of renal function and early institution of renal replacement therapy if oligo-anuric or rising creatinine.
- Consideration of inhaled nitric oxide to reduce pulmonary hypertension and RV afterload.

Pass	94%
Highest mark	9.5

### Additional Examiners' Comments:

*Some answers for the management plan were very superficial with generic statements with inadequate detail e.g. "consider changing pacemaker settings", "order bedside echo" and lacking a consultant level approach.*

## Question 29

You are the Intensivist looking after a 30-year-old male, with no significant past medical history, who has been in the Intensive Care Unit for eight days with severe community acquired pneumonia and septic shock.

Although there are no overt signs of bleeding, his haemoglobin has slowly dropped and is now 65 g/L. He has been recommenced on low dose noradrenaline and you have decided to transfuse one unit of packed cells.

His wife has concerns about the “safety” of this and refuses to consent until she speaks to you.

Outline the key points of your discussion with the patient’s wife, including the pros and cons of, and alternatives to blood transfusion in this context.

### Answer Template

Discussion should cover:

- Involving patient If competent
- Ensure wife appropriate patient advocate
- Listening to and clarifying wife’s concerns including religious / cultural objections
- Patient’s wishes if known
- Pros and cons of transfusion in this situation
- Non-transfusion strategies

Pros:

- Transfusion at this low threshold is evidence based i.e. consistent with a restrictive approach as advocated by the National Guidelines. Transfusion is probably appropriate given the information available, but is not mandated.
- Administration of a single unit followed by reassessment is consistent with the National Guidelines.
- May improve oxygen delivery, enable cessation of noradrenaline, and potentially positively affect organ function and outcomes.
- Red cell transfusion is safe, with risks of viral transmission (HIV & HCV), CJD and fatal haemolytic reactions being less than 1 in 1 million.

Cons:

- There is insufficient evidence to suggest that transfusion in this situation will have a positive effect on mortality.
- This young man is relatively well compensated (although on noradrenaline), not actively bleeding and is unlikely to have significant ischaemic heart disease. Discussions with the family should weigh up the pros and cons of transfusion, and time devoted to hearing and clarifying their worries and concerns.
- There is some evidence that transfusion is associated with increased rates of VAP and other infections.
- Real risk of circulatory overload (up to 1 in 100 or Calman rating high), but probably less likely in this patient.
- Risk of TRALI (said to be 1 in 5000 to 1 in 190000, or low to minimal)
- Anaphylaxis or non-fatal haemolytic reactions (very low)

In the event of a blood transfusion being administered, consent will be needed

It is also reasonable to wait

- Set a trigger for transfusion (absolute Hb, clinical parameters) with the family)
- A second opinion or even a substitute decision maker/legal opinion may need to be sought if clear harm or death is likely to result in the future without transfusion and consent is not likely to be forthcoming.
- Non-transfusion strategies should be employed
  - Maximising nutrition

- Minimising haemodilution
- Consideration of haematinics / EPO
- Minimising blood volume for tests by using paediatric tubes etc.
- Haematology input if necessary.

Calman scale of risk useful in this context:

**Negligible** (less than 1 in a million or dying of lightning strike)

**Minimal, Very low, Low** (1 in a thousand to 1 in 10000 or dying in a road accident)

**High** (>1 in 1000)

Additional Examiners' Comments:

Candidates were not expected to give this much detail and were given credit for valid points not included in the answer template

Pass rate	77%
Highest mark	8.0

**Question 30**

Note: Image depicting a Minnesota tube has been removed.

- a) What is the tube in the image above used for? (10% marks)
- b) Describe the steps for insertion of this tube. (40% marks)
- c) What are the contraindications for its insertion? (20% marks)
- d) What are the complications of its use? (30% marks)

**Answer Template**

- a)
  - Minnesota tube (*Sengstaken-Blakemore or gastro-oesophageal balloon tamponade device acceptable*) for balloon tamponade of bleeding oesophageal varices.
- b)
  - Intubate patient to protect airway and simplify insertion.
  - Check balloon for leaks & lubricate tube.
  - Pass via nares (or mouth if severe coagulopathy present) and guide under laryngoscopic control into oesophagus, until 50cm inserted.
  - Slowly inflate gastric balloon: 250ml air.
  - Gently withdraw tube until resistance felt (~30-35cm) as balloon engages with gastro-oesophageal junction.
  - Aspirate both ports. Check volume of fresh blood: reducing?
  - If bleeding has ceased (~80%) then leave oesophageal balloon deflated.
  - Apply traction to tubing (as below)
  - If bleeding from mouth or oesophageal aspiration port continues, then inflate oesophageal balloon with air to 25-30mmHg (max 40).
  - Deflate oesophageal balloon for 10 min every 2-hrs.
  - Apply traction to tubing by tying 500ml bag of fluid over pulley.
  - Check position on CXR: identify gastric balloon below diaphragm & radio-opaque marker along course.

Or any acceptable technique

- c)
- Oesophageal stricture
  - Recent oesophageal surgery
  - Hiatus hernia
  - Unknown cause of GI bleed
- d)
- Trauma to nose, pharynx, oesophagus
  - Incorrect placement or dislodgement of gastric balloon in pharynx or oesophagus (may result in acute upper airway obstruction if airway not secured)
  - Oesophageal tear or rupture
  - Failure to control bleeding.
  - Aspiration pneumonitis.
  - Secondary infection: pneumonia, sinus
  - Nasal or oral mucosal ulceration & necrosis from traction.

Pass rate	79%
Highest mark	9.3

## SECOND PART ORAL EXAMINATION

### Clinicals “Hot Cases”

- 77-year-old female with Wegener’s granulomatosis, admitted the previous day with difficulty swallowing and drooling secondary to lateral pharyngeal wall cellulitis. On examination she had a bull neck but no clear signs of external swelling, was intubated with a size 6.0 ETT and requiring minimal ventilatory support. The ETCO<sub>2</sub> trace showed a pattern of obstruction.

Candidates were directed to assess her suitability for extubation.

Discussion points also included management of upper airway obstruction.

- 75-year-old female, day 2 post emergency coronary artery grafting for severe left main disease and NSTEMI with persisting low cardiac output state. Background included type 2 diabetes and hypertension. She was intubated and ventilated with cardiovascular support including an intra-aortic balloon pump, nor-adrenaline and milrinone.

Candidates were directed to review her and outline their plan of management for the day.

Discussion points also included management of the IABP and weaning and extubation.

- 59-year-old male admitted to ICU 2 weeks earlier with cardiorespiratory failure secondary to unknown bronchial adenocarcinoma causing obstruction of right upper lobe bronchus and pleural and pericardial effusions with tamponade. He had been extubated 10 days earlier but readmitted 2 days later for respiratory failure and started chemotherapy whilst ventilated. Past history included liver transplantation for cirrhosis one year ago. Findings on examination included left cervical lymphadenopathy, LLL collapse, liver transplant surgery scar, indications of chemotherapy in progress and minimal respiratory support.

Candidates were asked to assess his suitability for extubation.

Discussion points also included interpretation of imaging including the initial echo findings and the issues surrounding chemotherapy in a ventilated patient.

- 80-year-old woman day 2 in ICU following presentation with haematemesis and aspiration pneumonitis, intubated for endoscopy that was negative. Background history included atrial fibrillation and short bowel

syndrome on home TPN. Findings on examination included an awake patient on minimal respiratory support, raised JVP, atrial fibrillation with a displaced apex beat, and a Hickman line in situ.

Candidates were directed to assess her suitability for extubation.

Discussion points also included differential diagnosis for her presentation and further investigation and management of the GI bleed.

- 72-year-old male, day 1 ICU with respiratory failure following a respiratory illness for five days. Findings on examination included morbid obesity, signs of obstructive sleep apnoea and left pleural effusion with ICC

Candidates were directed to assess his current status and make a management plan.

Discussion points included management of underwater seal drain and interpretation of pleural fluid biochemistry.

- 62-year-old female, day 5 ICU, admitted with decreased level of consciousness from hepatic encephalopathy, secondary to decompensated liver disease with acute renal failure and haematemesis. Findings on examination included signs of decompensated chronic liver disease and hepatic encephalopathy, intubated on minimal ventilatory support and haemodynamic stability.

Candidates were directed to provide a differential diagnosis for her decreased level of consciousness and to provide a management plan.

Discussion points included interpretation of investigations, precipitants of hepatic encephalopathy and prognostication.

- 35-year-old female, three weeks in ICU post re-do MVR with peri-operative multi-organ failure, complicated post-operative course and slow ventilatory wean. Background included ESRF on dialysis. Findings on examination included tracheostomy, high sputum load, old ICC site, small tidal volumes on moderate level of pressure support ventilation, low vasopressor requirement, prosthetic heart valve, signs of right heart failure, general deconditioning and global weakness, presence of AV fistula in left forearm, and evidence of melaena in faecal management system.

Candidates were directed to identify the major issues with a plan for their management.

Discussion points included causes of failure to progress.

- 75-year-old male, day 2 ICU, admitted with respiratory failure. Findings on examination included the presence of droplet precautions, poor peripheral perfusion, the presence of a pacemaker/ICD and coarse crackles throughout all lung fields.

Candidates were directed to provide a differential diagnosis for his respiratory failure based on the findings on examination.

Discussion points included interpretation of imaging and echo findings and further assessment of his cardiac function.

- 67-year-old male, one month in ICU, transferred from SE Asia following a prolonged acute illness with liver abscess, sepsis and multi-organ failure. Background included CNS lymphoma. Findings on examination included tracheostomy, old craniotomy scar, breathing spontaneously on humidified oxygen with decreased breath sounds on the right, deconditioning and critical illness weakness syndrome with significant proximal weakness.

Candidates were directed to examine him and outline a management plan.

Discussion points included interpretation of the neuromuscular signs, respiratory weaning and interpretation of abnormal liver function tests.

- 73-year-old male day 1 ICU admitted following a MET call for decreased conscious state that required intubation. He had been admitted with shortness of breath, fever, headache and collapse and found to have meningococcal meningitis. Background included ischaemic heart disease on dual anti-platelet therapy and COPD. Findings on examination included ecchymoses, bronchial breathing left lung, right upgoing plantar and the absence of meningism.

Candidates were directed to determine the likely cause for the decrease in conscious state.

Discussion points included interpretation of the CSF results, management of meningitis and the role of steroids.

- 54-year-old female, day 5 ICU, admitted with massive haematemesis from oesophageal varices on a background of Child's B cirrhosis secondary to auto-immune hepatitis. Other co-morbidities included biventricular failure, atrial fibrillation, hypothyroid disease and polycythaemia. Findings on examination included generalised oedema, bilateral crackles on auscultation with decreased breath sounds at the bases, distended abdomen and neurological signs with brisk reflexes and ankle clonus.

Candidates were told that she had presented with upper GI bleeding that had been treated and were directed to examine her focussing on the neurological system and provide a differential diagnosis for her current clinical status.

Discussion points included interpretation of biochemistry, causes of encephalopathy and management of bleeding oesophageal varices.

- 68-year-old male day 3 ICU admitted with respiratory failure and septic shock secondary to pneumonia complicated by acute kidney injury. Background included type 2 diabetes and alcohol dependence. Findings on examination included mechanical ventilatory support with relatively high ventilatory requirements, bilateral chest signs and vasopressor dependent shock.

Candidates were told he had presented with dyspnoea increasing over several days and were directed to provide a differential diagnosis for his initial presentation and make a management plan.

- 78-year-old male, day 2 ICU, admitted following a MET call for altered conscious state and hypoxaemia. He had been admitted to hospital for management of melaena and falls. Background included significant cardiovascular disease and limited mobility. Clinical findings included sedated patient with loud aortic stenotic murmur and left hemiplegia with upgoing plantar reflex

Candidates were directed to examine him and comment on the major current issues.

Discussion points included interpretation of arterial blood gas and imaging, the clinical dilemma of thrombotic stroke in a patient who is a bleeding risk and the implications of aortic stenosis in this patient.

- 30-year-old male, day 5 ICU, admitted with 55% scald burn from the shower. Background of epilepsy. He had just returned from debridement. Clinical findings included sedated and ventilated, oliguric on CVVHDF, abdominal distension and the presence of a scalp haematoma.

Candidates were directed to assess him and make a management plan.

Discussion points included weaning of sedation and ventilation and the use of renal replacement therapy.

- 26-year-old male, day 4 ICU following a high-speed motorcycle accident. On presentation there was no sensation below the waist. Clinical findings included the presence of a tachycardia, left below-knee amputation, right external fixator, dark urine with an IVC filter and would not obey commands.

Candidates were directed to assess him and make a management plan.

Discussion points included weaning of sedation and ventilation and the role of DVT prophylaxis.

- 66-year-old male, day 15 ICU, admitted following a 2m fall from a truck. Clinical findings included a patient who was febrile, delirious, oedematous with rapid shallow breathing, no movement in his legs and hyper-reflexia.

Candidates were directed to examine with a view to identifying his major management issues.

Discussion points included his neurological findings, fever, ventilatory status and fluid balance.

- 60-year-old male, ICU day 9, presented following a seizure at work secondary to a sub arachnoid haemorrhage, with an initial GCS of 6. The aneurysm was clipped on day 1 and he subsequently failed extubation. Clinical findings included hypertension, the presence of an EVD wound scar, GCS E1 M2-3 VT, hypotonia, no response to facial pain and upgoing plantars bilaterally.

Candidates were directed to assess and explain his neurological status.

Discussion points included causes for deterioration after sub-arachnoid haemorrhage, investigation and management of vasospasm, and the causes of fever.

- 58-year-old male, day 3 ICU, who had undergone thoracic surgery three days earlier and suffered an intraoperative arrest.

Candidates were directed to examine the patient and discuss a management plan.

Discussion points included the causes of intra operative arrest and the complications of pneumonectomy.

- 59-year-old male, day 25 ICU, having presented with pneumonia on a background of COAD, anxiety and alcoholism. Clinical findings included an alert and co-operative patient with evidence of muscle wasting with preserved strength, an in situ tracheostomy with subglottic suction and reduced breath sounds at the bases.

Candidates were directed to assess the patient and formulate a management plan including the consideration for decannulation.

Discussion points included the management of pulmonary haemorrhage, and the significance of pseudomonas colonisation.

- 64-year-old male, day 6 ICU, having presented to a regional hospital six days earlier with infected left foot ulcer and Hb 67 g/l. He was transfused one unit of packed red cells and rapidly developed respiratory failure. He was transferred later that day for respiratory support and was intubated on arrival at the second hospital. Background included diabetes, peripheral vascular disease and coronary artery grafts. The patient had been extubated the previous day, requiring BIPAP overnight.

The candidates were directed to assess his current respiratory status and postulate causes of his initial respiratory failure.

- 60-year-old male, day 31 ICU, admitted to hospital, one month earlier with severe respiratory failure secondary to legionella pneumonia, mechanically ventilated since with increasing O<sub>2</sub> requirements over the previous 36 hours. Clinical findings included fever, tachycardia with atrial flutter, peripheral oedema, palpable liver edge and hyper-reflexia.

Candidates were directed to examine him for potential causes of his ongoing ventilatory requirement and for the deterioration in the past 36 hours.

Discussion points also included the management of elevated creatinine, and the significance of a positive blood culture for candida.

- 31-year-old female, day 27 ICU, having presented with a 4-week history of infective respiratory symptoms. She had an in hospital cardiac arrest with a brief period of CPR before return of spontaneous circulation. In ICU, treatment strategies included VV ECMO, dialysis and tracheostomy for weaning.

Candidates were directed to comment on her readiness for weaning and to give a further management plan.

Discussion points included interpretation of chest CT scan, the microorganisms likely to cause cavitating lung lesions, as well as criteria for readiness to wean.

- 44-year-old female, day 45 ICU, who presented with fever, shortness of breath and cough seven weeks earlier. Clinical findings included right-sided pleural effusion, a thoracostomy wound, ECMO scars in the groin, a recent decannulated tracheostomy site, a tender abdomen and significant muscle weakness.

Candidates were directed to examine her with respect to readiness for the ward and management plans for ongoing intensive care problems.

Discussion points included the differential diagnosis and investigation plan of muscle weakness in this setting, as well as the management of the patients respiratory function and rehabilitation.

- 43-year-old male, admitted to ICU one week earlier with septic shock and respiratory failure, intubated 2 days later and developed seizures. Background included active IV drug use. Clinical findings included sedated and intubated, splinter haemorrhages, Janeway lesions, injection sites in the groin and mitral regurgitant murmur.

Candidates were directed to examine him to determine the cause of his septic shock.

Discussion points included antibiotic therapy, contra-indications to surgery and prognosis.

- 44-year-old male admitted to ICU 2 weeks earlier having been found collapsed in the dialysis unit car park with a GCS 3, heart rate 30 bpm and temp 41.7°C. CPR was started in the ambulance with ROSC in ED 10 minutes later following treatment for  $K^+$  8.1 mmol/L. Background included IDDM and end-stage kidney disease on haemodialysis 3x /week. Clinical findings included GCS 4 with roving eye movements, increased tone with extensor response to pain and upgoing plantar reflexes and the presence of an A-V fistula in his forearm.

Candidates were directed to examine him with a view to assessing his neurological prognosis and possible causes of the cardiac arrest

Discussion points included management of the initial arrest, neurological prognostication, pros and cons of tracheostomy and family discussion re prognosis

## **Vivas**

### **Viva 1**

A 55-year-old female with no reported comorbid conditions has been admitted unexpectedly to your tertiary intensive care unit from the operating theatre. She had an uneventful general anaesthetic for a total hip replacement.

Forty-five minutes later, she was found unrousable by the attending nurse. An arterial blood gas showed the following:

Parameter	Patient Value	Normal Adult Range
pH	7.01	7.35 – 7.45
PaCO <sub>2</sub>	110 mmHg (14.5 kPa)	35 – 45 (4.6 – 6.0)
PaO <sub>2</sub>	100 mmHg (13.1 kPa) (15 L/min oxygen via non-rebreather mask)	
Base excess	+2 mmol/L	-2 – +2
Lactate	1.1 mmol/L	< 1.5

She was urgently reintubated and transferred to your ICU. She is hemodynamically stable.

Give the most likely differential diagnoses.

## Viva 2

The focus of this viva is Evidence Based Medicine.

Please read this modified abstract.

### High-Flow Nasal Oxygen vs Noninvasive Positive Airway Pressure in Hypoxemic Patients After Cardiothoracic Surgery

**OBJECTIVE:** To determine whether high-flow nasal oxygen therapy (HFNO<sub>2</sub>) was not inferior to BiPAP for preventing or resolving acute respiratory failure after cardiothoracic surgery.

**DESIGN:** Multicenter, randomized, non-inferiority trial

**PARTICIPANTS:** 830 of 3217 eligible patients who had undergone cardiothoracic surgery with acute respiratory failure (failure of a spontaneous breathing trial or successful breathing trial but failed extubation) or were deemed at risk for respiratory failure after extubation due to preexisting risk factors.

**INTERVENTIONS:** Patients were randomly assigned to receive HFNO<sub>2</sub> delivered continuously (flow 50 L/min, FiO<sub>2</sub> 0.5) or BiPAP delivered with a full-face mask for at least 4 hours per day (PSV 8 cm H<sub>2</sub>O, PEEP 4 cm H<sub>2</sub>O, FiO<sub>2</sub> 0.5)

HFNO<sub>2</sub> was delivered continuously through a nasal cannula. The initial flow rate was 50 L/min and the initial FiO<sub>2</sub> was 0.5, adjusted to maintain SpO<sub>2</sub> at 92% to 98%. Bilevel positive airway pressure (BiPAP) was delivered with a full-face mask and either a specific BiPAP ventilator or an ICU ventilator in pressure-support mode with added PEEP.

What are the strengths and weaknesses of the design of this study?

## Viva 3

You are working as a Locum Intensive Care Specialist in a regional hospital with no tertiary paediatric service. You are called as part of the trauma team to the Emergency Department to assist with the management of an 8 year old child with burns.

The paramedics report the child was found semi-conscious and breathing in the downstairs hallway of a home on fire less than an hour ago.

Describe your initial assessment and monitoring priorities for this child.

#### **Viva 4**

A 59-year-old male presents to an outer metropolitan hospital, supported by a non-tertiary ICU, with severe respiratory failure.

He gives a history of a week of cough, myalgia, fevers and increasing shortness of breath.

What is your differential diagnosis?

#### **Viva 5**

A 50-year-old farmer with a history of alcohol abuse and depression is brought to the Emergency Department having been found collapsed in his garage.

He is semi-conscious and unable to move.

What is your differential diagnosis?

#### **Viva 6 – Procedure Viva**

As the duty locum Intensivist you have been called to urgently review a patient on the medical ward of a small private hospital. The patient, Jane, is a 32-year-old female who was admitted to the ward yesterday with shortness of breath.

She presents with shortness of breath often, and has recently been started on a bronchodilator.

A local GP registrar was on the ward reviewing another patient and noticed that Jane was working very hard to breathe. The registrar emergently intubated her prior to your arrival.

You arrive on the ward 10 minutes post intubation. The registrar and a ward nurse are hand-ventilating Jane, who is hypoxic – O<sub>2</sub> saturations 85% - and hypotensive – BP 75/50 mmHg.

The registrar and nurse are with the patient and you have been called to assist.

#### **Viva 7 – Radiology Viva**

*This station contained 8 cases in total: 4 individual X-Rays and 4 CT scans displayed as a PowerPoint slide show.*

*Candidates spend the two-minute reading time reviewing the images as they wish.*

#### **Viva 8 – Communication Viva**

Zachary is a previously well 19-year-old male admitted to your ICU three days ago with refractory status epilepticus. No infective cause has been found and the working diagnosis is auto-immune encephalitis.

Zachary has been intubated and sedated. He continues to have frequent seizures despite adequate treatment with phenytoin, midazolam and levetiracetam and so propofol sedation has been increased to induce burst-suppression on continuous EEG monitoring.

The neurologist responsible for Zachary is considering immunosuppressive therapy, which you agree is appropriate treatment for this condition.

Zachary's parent has asked to meet with you, the Intensivist on duty. This is your first meeting with them. The nurse caring for Zachary has already been told by his parent that he will only receive immunosuppressive therapy "over my dead body!"