



COLLEGE OF INTENSIVE CARE MEDICINE OF AUSTRALIA AND NEW ZEALAND

PAEDIATRIC FELLOWSHIP EXAMINATION REPORT

AUGUST / OCTOBER 2012

This report is prepared to provide candidates, tutors and their Supervisors of training with information about the way in which the Examiners assessed the performance of candidates in the Examination. Answers provided are not model answers but guides to what was expected. Candidates should discuss the report with their tutors so that they may prepare appropriately for the future examinations

The Examination included two 2.5 hour written papers, each comprising 15 ten-minute short answer questions. Candidates were required to score at least 50% in the written paper to be eligible to sit the oral component of the Examination. The oral component comprised 8 interactive vivas and two separate clinical hot cases.

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

In all sections of the Fellowship Examination the candidate is expected to perform at the level of a competent senior registrar or junior consultant, i.e. to demonstrate the capacity for safe, effective, independent practice as an Intensivist. Candidates who are not at this level are encouraged to defer the Examination.

The Written section of the Examination was held in Brisbane, Melbourne, Perth, Sydney, and Auckland. The Clinical and Viva sections of the examination were held in Melbourne at the Royal Children's Hospital.

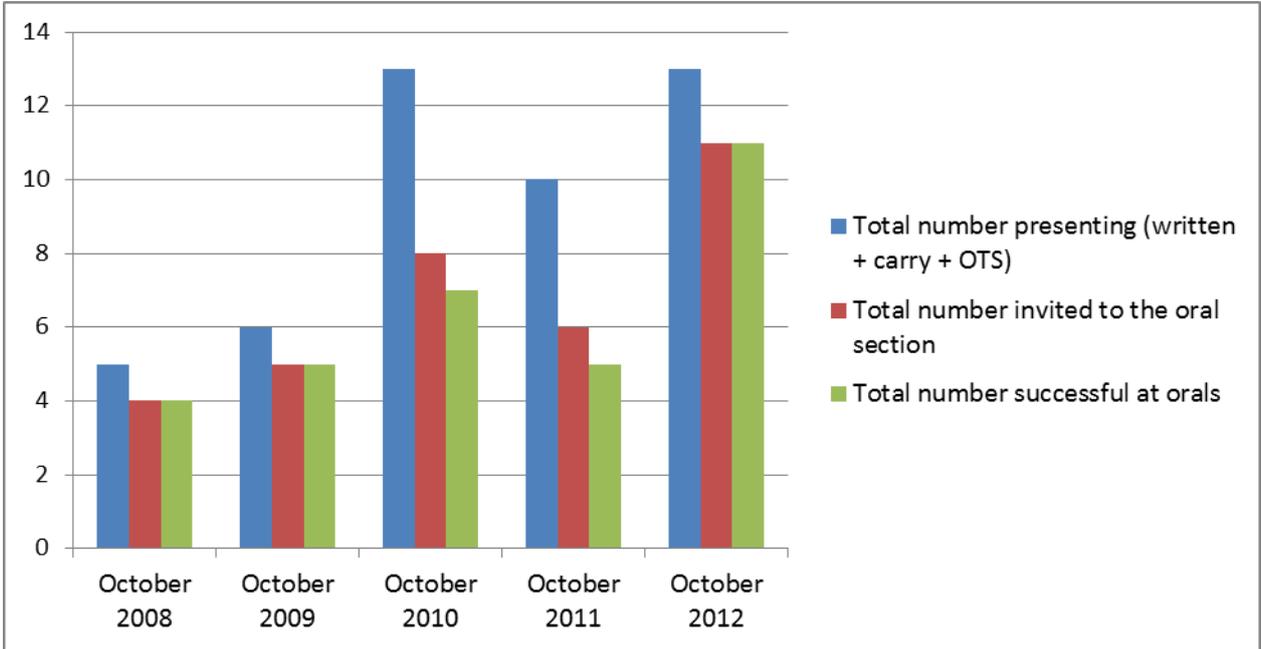
STATISTICAL REPORT

Overall Pass Rates	October 2008	October 2009	October 2010	October 2011	October 2012
Total number presenting (written + carry + OTS)	5	6	13	10	13
Total number invited to the oral section	4	5	8	6	11
Total number successful at orals	4	5	7	5	11
	100%	100%	88%	83%	100%
Overall pass rate	4/5	5/6	7/13	5/10	11/13
	80%	83%	54%	50%	85%

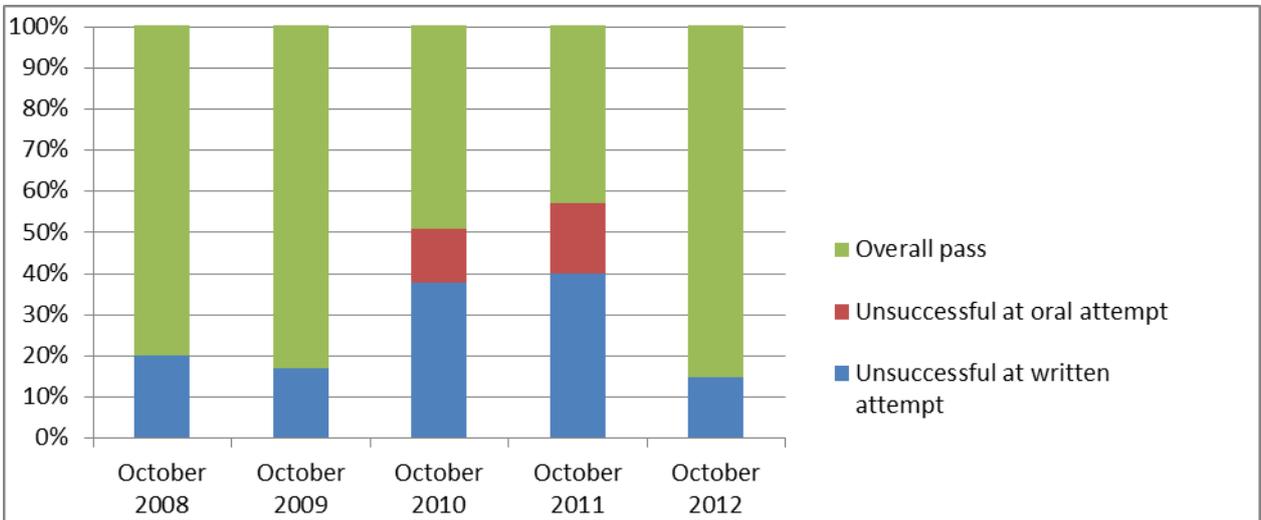
Clinical Pass Rates	October 2010		October 2011		October 2012	
	Pass rate	Highest individual mark	Pass rate	Highest individual mark	Pass rate	Highest individual mark
Hot Case 1	75%	77%	83%	90%	100%	83%
Hot Case 2	75%	87%	50%	67%	100%	87%
Total number successful in the Hot Case section	6/8		5/6		11/11	
Overall Hot Case pass rate	75%		83%		100%	

Vivas Pass Rates	October 2010		October 2011		October 2012	
	Pass rate	Highest individual mark	Pass rate	Highest individual mark	Pass rate	Highest individual mark
Viva 1	63%	90%	83%	75%	100%	90%
Viva 2 – Procedure Station	88%	90%	100%	68%	82%	80%
Viva 3	63%	75%	100%	95%	82%	80%
Viva 4 – Radiology Station	88%	90%	33%	65%	100%	90%
Viva 5	100%	90%	33%	88%	82%	100%
Viva 6	100%	100%	67%	72%	91%	90%
Viva 7 – Communication Station	88%	100%	17%	50%	100%	90%
Viva 8	100%	90%	33%	80%	64%	63%
Total number successful in the Viva section	8/8		5/6		11/11	
Overall Viva pass rate	100%		83%		100%	

Overall Performance



Overall Performance



EXAMINERS' COMMENTS

Written Section

Eleven of the thirty short answer questions had a pass rate of 50% or less. Candidates failed questions when answers were poorly structured, lacked sufficient detail or displayed inadequate knowledge of the topic. It is a persistent observation that candidates occasionally fail to answer the question being asked; candidates are reminded to read the question carefully and answer it specifically.

Candidates who failed the written section passed an average of 14/30 questions compared to an average of 21/30 for those who passed and were invited to the oral section.

Oral Section

The standard in this year's oral Examination was high. Candidates were well prepared and this was particularly evident in the hot cases. 100% of candidates passed both hot cases.

Performance at the viva section was also of a high standard, with all candidates being successful in this section.

WRITTEN EXAMINATION REPORT

Note

Allocations of marks within each question are shown on the SAQ papers to help candidates apportion time appropriately.

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

Images from the SAQ papers are not shown in this report.

Instructions to Candidates

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

Glossary of Terms

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

Question 1

A six week old baby presents in cardiogenic shock with a heart rate of 210 beats per minute and poor pulses. The child has been intubated and is securely on mechanical ventilation.

Echocardiogram shows severe biventricular failure in a structurally normal heart. You suspect myocarditis.

- a) Outline your initial management.**
- b) Nasopharyngeal aspirate result is positive for Parvovirus. Outline the role of immunosuppressive therapy.**
- c) The child remains in a critically low output state. Outline the role of extracorporeal membrane oxygenation (ECMO) in this child.**

75% of candidates passed this question.

Answer Guide

- a)
 - Ensure sinus rhythm - discuss other tachycardia
 - Access – central, arterial
 - Inotropes – which, why
 - Antibiotics
 - Carnitine
 - IVIG for myocarditis
 - Investigations – NPA, other viral cultures, cardiomyopathy screen
 - Biopsy
- b)
 - Limited data

- Should know basis on which IVIG is recommended, and weaknesses of this.
- Dose of IVIG
- Other immunosuppressants? When?

c)

- Recovery, bridge to transplant?
- ELSO registry data? Survival? Causes of death?
- Recommendation – reasonable to try, time frames, bridge etc.

Reference

<http://www.uptodate.com/contents/treatment-and-prognosis-of-myocarditis-in-children>

Question 2

A five day old term male infant is admitted from another centre with a three day history of refractory seizures. He is intubated and ventilated.

The following blood results are obtained:

Parameter	Value	Normal Range
Na+	133 mmol/L*	134 – 148 mmol/L
K+	4.3 mmol/L	4.5 – 6.0 mmol/L
Urea	1.7 mmol/L	1.0 – 4.0 mmol/L
Creatinine	35 umol/L	20 – 50 umol/L
Glucose	14.7 mmol/L*	3.5 – 5.4 mmol/L
Albumin	30 g/L	30 – 45 g/L
Ammonia	1174 umol/L*	0 – 70 µmol/L
Lactate	2.6 mmol/L*	0.5 – 2.2 mmol/L

- What is the likely diagnosis and what investigations will you request?**
- Outline management of this child.**
- Outline what you will tell the family.**

100% of candidates passed this question.

Answer Guide

a)

- urea cycle defect
- urinary organic acids, urinary amino acids, serum organic acids, serum amino acids
- (liver and skin biopsy, gene testing also correct but not first line)

b)

- ABC
- Treat seizures – how?

- High dose haemofiltration / CVVHDF – which, how?
- Alternative pathways - nitrogen scavengers: which?
- Replace intermediates - arginine, citrulline
- Treat catabolic state with calories:
- Reduce nitrogen load:
- Metabolic team
- Investigate neurology: MRI/EEG

c)

- May not survive
 - Prolonged period of hyperammonaemia and seizures; if survives brain damage is likely
- Genetic condition, will need discussion of recurrence risk
- Long term prognosis likely to be poor
- (Liver transplant?)
- Needs emergency plan for illness

Reference

<http://www.ncbi.nlm.nih.gov/books/NBK1217/>

Question 3

NB: Images removed from this question.

An eleven year old boy presents after a minor fall with vomiting and Glasgow Coma Score (GCS) of 15. The following Computed Tomography (CT) head scan is obtained:

- List the important findings on this CT picture.**
- What potential causes will you consider?**
- Outline your immediate management.**
- Discuss the signs you would see if this condition were to progress.**

100% of candidates passed this question.

Answer Guide

a)

- Large right temporal elliptical haemorrhage
- Acute: different densities of haemorrhage
- Significant midline shift
- Good grey white differentiation maintained
- No fracture but scalp swelling
- Good sized ventricles

b)

- Trauma; NAI; Clotting disorder, vWf deficiency; Leukaemia

- c)
 - Time critical emergency
 - Immediate intubation – outline approach, ventilation targets
 - Urgent neurosurgery and anaesthesia
 - Mannitol
- d) Description of Cushing's triad; sequence of pupillary changes; progressive loss of consciousness; coma; death

Question 4

- a) **What is the definition of massive transfusion in children?**
- b) **List six potential complications of massive transfusion.**
- c) **List six supportive measures which must be considered during a massive transfusion.**
- d) **Discuss your approach to Factor VII use in massive transfusion.**

83% of candidates passed this question.

Answer Guide

- a)
 - Transfusion of more than 40 mls/kg (blood volume of children older than a neonate is approximately 80 mls/kg)
- b)
 - hyperkalaemia
 - hypocalcaemia
 - Acid base derangement and lactic acidosis
 - Citrate load
 - Dilutional thrombocytopenia
 - disseminated intravascular coagulation
 - Systemic hypothermia
 - Hypoxia from low DPG levels with reduced release of O₂
 - Transfusion reactions
 - TRALI: transfusion related acute lung injury
- c)
 - Minimize hypothermia – how?
 - Prevent acidaemia - ph > 7.2
 - Use rapid transfuser
 - Strict compliance with product/recipient identification procedures
 - Track laboratory values and amount of products administered
 - Communication with transfusion service – progress, changing needs/location
 - Transfuse with type specific and cross matched blood
 - Ensure adequate monitoring: IAL, CVP
 - Transfuse FFP and platelets - ratios to red cells?

d)

- Lack of evidence to support use in trauma patients – outcomes?
- Potential for adverse outcomes
- high cost
- All other support must be optimised:
 - normalization of fibrinogen
 - normothermia (temp > 35°C), and
 - not acidosis (pH > 7.15), and
 - expectation patient will survive
- Consider under these circumstances only

Reference

- <http://www.blood.gov.au/pbm-module-1>

Question 5

In table form, compare and contrast the features of a transport ventilator with a state of the art PICU ventilator.

100% of candidates passed this question.

Answer Guide

Feature:	Transport ventilator	ICU ventilator
Similarities		
Modes	Major modes	Wide Array of modes
Variable FiO2	Yes	Yes
Continuous tidal volume	Yes	Yes
Simple to operate	Yes	Yes
Versatile for different sizes	Yes	Yes
Responsive demand valve or continuous flow	Yes	Yes
Non-invasive ventilation	Some	Yes
Differences:		
Sensitive alarms	Yes	No
Trend capabilities	No (desirable /not available)	Yes
Compensate for change in compliance or airway resistance	No (desirable / not available)	Yes
Battery life	Variable, some hours	Minimal
Power source	Pneumatic / battery /power	Wall power
Portability/Dropability	Robust and portable	May be dockable, not robust
Light weight	Yes	No
Minimal gas consumption	Yes	No

Question 6

A five-month old male presents to your emergency department two weeks after an uncomplicated complete repair of Tetralogy of Fallot.

He is tachypnoeic and grunting with SpO₂ 89% in room air. He is pale with a heart rate of 170 beats per minute, non-invasive blood pressure 120/80 mmHg and his peripheral pulses are felt intermittently.

A pericardial effusion is found on echocardiography.

- a) Define pericardial tamponade.
- b) List three clinical features of pericardial tamponade differentiating it from other causes of low cardiac output.
- c) List two echocardiographic features of pericardial tamponade (in addition to an effusion).
- d) Outline your immediate management plan for anaesthesia and pericardial drainage in ICU.

83% of candidates passed this question.

Answer Guide

- a) Clinical diagnosis of inadequate cardiac output (with exaggerated respiratory variability) secondary to phasic obstruction to venous return.
- b)
 - Evidence of venous congestion – describe features
 - Exaggeration of phasic cardiac output by variable obstruction - describe features
 - Muffled heart sounds

(Clinical features supporting the diagnosis but not cardinal are those of inadequate cardiac output – tachycardia, hypotension, pallor, sweating, tachypnoea, grunting, somnolence, collapse.)

- c)
 - Early diastolic collapse of RV free wall
 - Late diastolic atrial collapse
 - Respiratory variation in diastolic filling
 - exaggerated increase in tricuspid valve flow (>25% increase)
 - exaggerated decrease in mitral valve flow (>15% reduction)
 - Respiratory variation in Velocity Time Integral over the Aortic Valve
- d)
 - Preparation
 - High risk intervention - anticipate collapse
 - Patient (monitoring) and team (communication)
 - ? cardiology/cardiac surgery

- IV access ,volume, resuscitation drugs
- Vasopressor vs inotrope – which and why?
- Sedation
 - What, how much? +/- local anaesthesia
 - Address supplemental oxygen therapy / role for CPAP / intubation
 - Discuss echocardiography / fluoroscopic guidance
- Procedure
 - Positioning, preparation, equipment, approach, landmarks
 - Aspiration drainage+/- Pigtail catheter+/- proceed to pericardial window (loculated)
 - Sample for culture, differentiating ventricular blood (will clot) from pericardial blood

References

- Rogers Textbook of Pediatric Intensive Care 4th edition
- Chapter 25 Invasive procedures p363-364
- Chapter 70 A Postoperative care of the pediatric surgical patient p1168
- Oh's Intensive Care Manual 6th Edition Echocardiography in the Intensive Care p308

Question 7

You are called to the Emergency Department to review a 14 year old female with severe spastic cerebral palsy complicated by epilepsy and percutaneous jejunostomy feeds. Scoliosis surgery was performed last year. She has had multiple recent admissions to PICU for pneumonia and has been intubated during some of these.

On examination:

**Temp 38°C
Heart Rate 160 beats per minute, BP 110/70 mmHg
Respiratory rate 30 breathes per minute
SpO₂ 92% in 10 L/minute of oxygen via Hudson mask
Crackles in right lower zones**

Her parents do not want her to be intubated but wish her to have “everything else”.

- a) Discuss your options for oxygen delivery (therapy) and non-invasive support (ventilation).**
- b) Given the parental request, outline your approach to managing the non-respiratory components of her care.**

100% of candidates passed this question.

Answer Guide

- a) Issues for the candidates to consider and discuss are:
 1. FIO₂

2. Flow rates of gas delivery systems
3. Humidification
4. Measures to increase mean airway pressure.

b)

- Difficult – what limits to therapies, diagnostics and monitoring
- Clear communication with family, treating team, nursing staff (ward) and PICU
- Method of escalation and limits – where this will occur
- “Goal posts” –SpaO₂ target – mindful of chronicity and “normal” for her
- Role(s) for other modalities and invasive therapies if not proceeding to mechanical ventilation
 - arterial line, central venous catheters, inotropes, urinary catheters
 - antibiotics and specimen collection (blood vs sputum) bronchodilators, mucolytics
 - physiotherapy and cough assist
 - ultrasound for pleural effusion +/- aspiration (diagnostic) vs drainage
- What to do for “acute deterioration” vs “chronic slow slide”
- If palliation to occur how this will be managed, by whom, where (PICU, ward, hospice) and what are the indications for initiation
- Documentation of discussion and plan

Reference

- Rogers Textbook of Pediatric Intensive Care 4th edition Chapter 34 Mechanical Ventilation
- Oh’s Intensive Care Manual 6th Edition Chapter 24 Oxygen therapy, Chapter 28 Humidification, chapter 33 non-invasive ventilation

Question 8

- a) Describe the manifestations and aetiology of paediatric intensive care unit induced delirium.
- b) Discuss your approach to the diagnosis and management of this problem.

67% of candidates passed this question.

Answer Guide

a)

Manifestations:

ICU encephalopathy with behavioural disorder emerging 5-7 days post admission. Agitation, restlessness, confusion – fluctuates, often worse at night. Hypoactive “coma like” syndrome also described.

Aetiology

Multifactorial – difficult to diagnose younger child. Associations: prolonged ventilation, sleep deprivation, loss of day night cycling, noisy bright environments, organ dysfunction (hepatic and renal), sedatives and their metabolites (toxicities and withdrawal), underlying neurologic effects of disease.

b) Diagnosis

One of exclusion

Exclude specific encephalopathies - biochemical, nutritional, hormonal, CNS inflammatory and infective conditions, seizures, drug toxicity/withdrawal syndromes

Some mention of investigations electrolytes, thyroid and adrenal function, CSF examination, EEG +/- video, MRI (MRA), drug levels, trial of medication withdrawal.

Management

Include prevention i.e. avoiding night light and noise, Active management (parental presence, stimulus control), day-night plans, sedation holidays, avoid certain medications (e.g. benzodiazepines), ? melatonin, nocte antidepressants with sedative side effects, tranquilizers (which ones), mechanisms for safety include pharmacologic restraint (older agents – haloperidol and chlorpromazine, newer agents – quetiapine, risperidone) or soft restraints

Reference

- Rogers Textbook of Pediatric Intensive Care 4th edition
- Chapter 60 Metabolic encephalopathies
- Oh's Intensive Care Manual 6th Edition The confused/encephalopathic patient in the ICU p537-8

Question 9

NB: Images removed from this question.

A three-month old girl with trisomy 21 is admitted to the PICU following uncomplicated repair of an atrioventricular septal defect.

Post-operative inotropic support:

**Milrinone 0.5 µg/kg/minute
Dopamine 7.5 µg /kg/minute**

Observations on admission:

**Temperature Core 37.1°C, peripheral 32.0°C
Heart rate 200 beats per minute
Blood pressure 50/30 mmHg
CVP 14 mmHg**

Arterial Blood Gas:

Parameter	Value	Normal Range
pH	7.23*	7.35 – 7.45
PaCO ₂	46 mmHg*	31 – 42
PaO ₂	95 mmHg	80 – 105
HCO ₃	15 mmol/L*	22 – 26
Base Excess	-10 mmol/L*	-2 to +2
Lactate	6.0 mmol/L*	1.0 – 1.8

You are shown the following rhythm strip:

- a) What is the most likely rhythm disturbance? List the reasons for your answer.**
- b) Outline your approach to immediate investigation and management.**

92% of candidates passed this question.

Answer Guide

- a) Junctional ectopic tachycardia
 - Narrow complex tachycardia
 - Regular
 - p-waves not seen – therefore not helpful
 - Associated with signs of poor cardiac output
 - Common post-operative dysrhythmia in infants
 - Association with AVSD repair
- b)
 - Diagnose JET definitively:
 - ECG and atrial ECG – need to see AV dissociation
 - Role of adenosine to confirm diagnosis
 - Recognise degree of haemodynamic compromise
 - Eliminate/minimize contributing factors – what and how?
 - Management options
 - Cooling – how much, how quickly?
 - Electrolyte replacement and targets
 - External pacing once rate control achieved – how?
 - Other options if required (and how do you assess?)
 - Amiodarone - dose?
 - ECLS – why?
 - Other drug suggestions
 - Echocardiography - Function, effusion; residual shunt, AVVR

References:

- Perry et al. Pediatric use of intravenous amiodarone: efficacy and safety in critically ill patients from a multicentre protocol. J Am Coll Cardiol 1996
- Walsh et al. Evaluation of a staged treatment protocol for rapid automatic junctional ectopic tachycardia after operation for congenital heart disease. J Am Coll cardiology 1997

Question 10

Outline strategies to optimise antimicrobial usage in the PICU.

75% of candidates passed this question.

Answer Guide

1. Directed antibiotics use
 - Frequent micro surveillance

- Early microbiological opinion
 - Defined endpoints
 - Directed therapy
2. Patient review
 - Microbiologist on rounds
 - Specific daily antibiotic review
 3. Evidence based antimicrobial use
 - Use of hospital antibiogram
 - Cost effective use of alternative drug delivery modes.
 - Role of antimicrobial restriction
 - Role of hospital drug committee
 - Establish antibiotic protocols
 - Surgical prophylaxis needs to be evidence based/limited
 4. Formal antibiotic stewardship programme
 - coordination between microbiology/infectious diseases/pharmacy/high prescribing specialties

Reference

- Antibiotic Stewardship in the Intensive Care Unit, Lawrence KL and Kollef MH. Am J Respir Crit Care Med;179: 434-438
- Impact of antimicrobial stewardship in critical care: a systematic review. Kaki r et al. J Antiimicrob Chemother 2011;66:1223-1230
- Antimicrobial Stewardship in Australian Hospitals 2011. Editors: Margaret Duguid and Marilyn Cruickshank. Australian Commission on Safety and Quality Healthcare

Question 11

A three year old girl with newly diagnosed acute lymphoblastic leukaemia is referred to ICU 24 hours after commencement of induction chemotherapy.

Initial blood results are listed below.

Parameter	Value	Normal Range
Sodium	143 mmol/L	135 – 145
Potassium	6.1 mmol/L*	3.5 – 5.4
HCO ₃	19 mmol/L	18 – 24
Urea	21 mmol/L*	1.3 – 5.7
Creatinine	300 µmol/L*	10 – 60
Glucose	5.6 mmol/L*	3.6 – 5.4
Haemoglobin	85 g/dL*	125 – 170
WCC	150 x 10 ⁹ /L*	4.5 – 13.0
Platelets	25 x 10 ⁹ /L*	150 – 400
Calcium	0.8 mmol/L*	2.0 – 2.7
Phosphate	2.8 mmol/L*	1.1 – 1.8
Uric acid	1.1 mmol/L*	0.13 – 0.4

- a) **What complication of chemotherapy has occurred?**
- b) **What management strategies might have prevented this from occurring?**
- c) **Outline your management of this complication.**

83% of candidates passed this question.

Answer Guide

- a) Tumour lysis syndrome with renal impairment
- b)
 - Hyperhydration
 - How, why, aims
 - Rasburicase
 - How does it work, who should get it?
- c)
 - Describe the problem.
 - Overarching principles of monitoring and management
 - Specifics of
 - Fluids – what, why, aims
 - Hyperkalaemia – therapies, aims
 - Hyperuricaemia – approach, therapy, aims
 - Hyperphosphataemia – as above
 - Hypercalcaemia – as above
 - Acute renal failure – management to include indications for RRT. Approach and mode.

Question 12

You are asked to prescribe chloral hydrate to sedate a child with bronchiolitis on continuous positive airway pressure (CPAP).

- a) **Outline the pharmacology of chloral hydrate.**
- b) **What dose regimen will you use?**
- c) **List five reasons why chloral hydrate is useful clinically.**
- d) **List five important side effects or issues to consider in use of chloral hydrate.**

58% of candidates passed this question.

Answer Guide

- a)
 - Mechanism of sedative effect

- Onset of action
 - Sites of metabolism
 - Active metabolite trichloroethanol
 - later trichloroacetic acid
 - long half life
- b)
- Initial dose vs subsequent doses
 - Max doses per age group
 - Frequency of dosing
- c)
- Excellent (oral or rectal) absorption
 - Sedative hypnotic
 - Rapid onset
 - Effective in 80 to 90% of patients
 - Mild adverse effect profile
 - minimal effects on respiration
 - Readily available
- d)
- No analgesic properties
 - Bitter taste
 - unpredictable onset
 - long duration of action
 - no reversal agent
 - Prolongs QT interval
 - airway obstruction
 - apnea
 - bradycardia and hypotension
 - multiorgan failure with chronic use – why?
 - jaundice as less binding of bilirubin
 - potentiates anticoagulants
 - rapid development of tolerance

Reference

- The use of chloral hydrate in infants and children, Buck, Paediatric Pharm. 2005; 11(9) © 2005 Children's Medical Center, University of Virginia

Question 13

NB: Images removed from this question.

An 11 year old boy is referred for a pre-surgical intensive care consult prior to lung biopsy.

The patient has proteus syndrome with extensive lipomata and hamartomata over his abdomen and trunk. Over the last 3-6 months he has become increasingly dyspnoeic on minimal exertion (walking 10 metres) and when recumbent.

His chest is clear to auscultation; pulse oximetry is 99% in room air. Respiratory rate is 30 breaths per minute at rest.

Spirometry (pre and post bronchodilator therapy) and selected high resolution CT chest images are shown below.

- a) What does the spirometry demonstrate?
- b) What are the salient CT findings?
- c) What is the likely cause of the spirometry abnormalities?
- d) The patient undergoes a lung biopsy and returns to the ICU intubated and ventilated with a cuffed 6.0 endotracheal tube:

Ventilation:

SIMV PC at pressures of 20/10 cm H₂O
Inspiratory time 0.9 seconds
FiO₂ 0.25
Rate 10 breaths per minute

He is breathing above the ventilator to a total respiratory rate of 18 breaths per minute. SpO₂ 99%, end-tidal CO₂ 38 and there is a right pleural drain in situ which is not bubbling.

He is alert but uncomfortable and indicating he would like the endotracheal tube removed.

Briefly outline your approach to weaning and extubation.

75% of candidates passed this question.

Answer Guide

- a)
 - Mixed restrictive/obstructive pattern
 - Not bronchodilator responsive
- b)
 - R&L bronchi compressed in AP dimension
 - Normal parenchyma (probable air trapping in RML, some volume loss in L lung)
 - Large anterior mediastinal mass (probable lipoma)
 - Large soft tissue masses encasing anterior chest wall
- c)
 - Restrictive deficit because of soft tissue abnormalities in chest wall
 - Obstructive deficit caused by airway compression

d)

- Discuss extubation sitting up. Should you trial on lower CPAP prior to extubation? Would you extubate to NIV immediately? Readiness for reintervention.

Question 14

A 3 week old female infant presents to the Emergency Department with a 48 hour history of low grade fever and rhinorrhoea and a 24 hour history of repeated vomiting and increasing lethargy. She has been previously well and weighed 4.5 Kg at the maternal and child health nurse visit 4 days ago.

Her mother reports an episode of limb twitching and loss of responsiveness lasting 1-2 minutes on her way to hospital. She is breast fed and has not been interested in feeds for the last 6 hours. She has not passed urine in the last 12 hours.

On examination:

Weight 4.0 Kg
Pale and poorly perfused
Temp 36.5°C
Heart rate 185 beats per minute
BP 60/25 mmHg in all 4 limbs
Capillary refill > 5 seconds
Glasgow Coma Score 9
Abdomen is soft with no masses
Labia are fused

Arterial Blood Gas and electrolyte results are shown below:

Parameter	Value	Normal Range
pH	7.34*	7.35 – 7.45
pCO ₂	29 mmHg*	35 – 45
pO ₂	87 mmHg	75 – 100
Bicarbonate	15.4 mmol/L*	21 – 27
BE	-9.2*	-3.0 to +3.0
Na	116 mmol/L*	135 - 145
K	7.3 mmol/L*	3.7 – 5.7
Cl	95 mmol/L*	98 – 110
iCa	1.2 mmol/L	1.19 – 1.29
Mg	1.0 mmol/L	0.7 – 1.2
Lactate	3.5 mmol/L*	1.0 – 1.8
Glucose	5.0 mmol/L	3.6 – 5.4

- Describe the blood gas abnormality.
- What are the strong ion difference and the anion gap in this patient?
- What is the likely cause of this presentation and the key diagnostic test?
- Quantify the deficits of water and sodium.

e) Describe your fluid management to address these deficits over the next 24 hours.

58% of candidates passed this question.

Answer Guide

- a) Compensated metabolic acidosis.
- b) 27 mEq/l; 12.9 mEq/l
- c) Congenital adrenal hyperplasia
Blood or urine 17-OH-progesterone
(Store blood for genetics)
- d) Expect definition of water deficit using weight loss, and sodium deficit using ideal weight, body water and (target Na – current Na). Rounded answer is OK. (Some leeway in target Na and TBW for newborn).
- e) Question states 'address' not 'correct': must note full correction of serum Na over 24 hours is too fast. Deficit plus maintenance for 48 hour correction. Expect calculation with answer ~29ml/hr.

0.9% NaCl with 10% dextrose (no added K) expected, but could use 0.45% saline (with appropriate justification). Define plan for monitoring and reassessment. Aim to raise serum Na by ~0.5mmol/L/hour.

Question 15

A 10 year old boy has been admitted following repair of coarctation of the aorta, which was found following a routine medical examination. His preoperative blood pressure was 140/95 mmHg and preoperative echocardiography shows a severely thickened left ventricle with good systolic function.

Outline the potential post-operative complications specific to this operation and their management.

50% of candidates passed this question.

Answer Guide

Hypertension

Likely.

Acute risks associated with HTN. Which drugs to use, what pressure to aim for

Ischaemia

Risk of ischaemia with thickened ventricle – perfusion pressure. Blood pressure management

Post-coarctectomy syndrome

Description of syndrome.

Potential for gut infarction.

Mesenteric ischaemia, more common in older patients.
Manage hypertension, rest the gut. General surgeons

Spinal ischaemia

Rare.
Older patients again.
More likely if inadequate collateral circulation.
Probably not related to cross-clamp duration.

Inadequate repair – residual gradient

Examination, investigation, indications for intervention

Recurrent laryngeal nerve palsy

Unmasking of aortic valve gradient

Bicuspid valve

Reference

- Chapter 16.3 in Pediatric Cardiac Intensive Care. Eds Chang, Hanley, Wernovsky, Wessel

Question 16

- a) What are the practical restrictions or preconditions that must be met to perform indirect calorimetry in a mechanically ventilated patient in PICU?**
- b) Define the Respiratory Quotient (RQ).**
- c) Outline the consequences of overfeeding the critically ill child.**

42% of candidates passed this question.

Answer Guide

- a)
 - Steady metabolic state: No change in temp/haemodynamics/ventilation
 - No gas leaks: circuit/ETT/patient
 - $FiO_2 < 60\%$
 - No other gases (iNO)
 - No other source of CO_2 removal (PD/HD/ECMO)
- b) Ratio of CO_2 produced to O_2 consumed
- c)
 - Excess CO_2 production - association with prolonged ventilation
 - Lipogenesis
 - Fatty infiltration of liver
 - Hyperglycaemia - association with infection and prolonged ICU stay

References

- Paediatric Critical Care Med 2011; 12:398-406

Question 17

NB: Images removed from this question.

A 3 month old boy presents with a 2-day history of cough and wheeze on a background of irritability, poor feeding and poor weight gain. He is intubated for severe respiratory distress and poor peripheral perfusion and transferred to the PICU. His Chest X-ray and ECG are shown below.

- a) List the abnormal findings on the Chest X-ray.**
- b) Describe the ECG.**
- c) What are the differential diagnoses?**

33% of candidates passed this question.

Answer Guide

- a)
 - ETT – position OK
 - NGT deviated (L atrial enlargement)
 - Cardiomegaly
 - LLL collapse
 - L lung hyperinflation
 - Probable LMB compression by LA
- b)
 - Rate 130, Sinus rhythm
 - ST elevation anterolateral chest leads
 - Q waves I, aVL, V5, V6
 - Abnormal R/S progression
- c)
 - ALCAPA
 - Other coronary anomaly/MI
 - (Cardiomyopathy/myocarditis)

Question 18

A 15 month old girl with Spinal Muscular Atrophy (SMA) and a viral respiratory tract infection has been intubated and mechanically ventilated for 10 days in your ICU. She has been extubated onto continuous BIPAP after 2 failed attempts and is now comfortable and stable. She has had 2 previous similar admissions in the last 6 months.

She has no other major organ failure and has not suffered any neurologic injury. Her parents state that they wish her to receive all necessary active treatment for survival. They are members of an online SMA support group and are aware of home ventilation options. You have organised a meeting with them to discuss ongoing management.

- a) Outline how you will approach this discussion.**
- b) What management strategies will you discuss with the family?**
- c) What are the potential benefits and harm of these strategies and associated treatments?**

58% of candidates passed this question.

Answer Guide

- a) Candidate should:
 - explore what parents know and how
 - find out parents' expectations about lifespan and life
 - ensure they understand clinical situation and natural history
 - keep discussion focussed on the big picture, rather than day to day management
 - realise that home ventilation is an option for SMA in some centres
- b) Candidate should be prepared to discuss a wide range of potential strategies with the family. Discussing only a 'wait and see' approach is insufficient. Different services are available in different areas, but the range of options from one-way weans to tracheostomy and ventilation should be mentioned, even if some are not practical options in the candidate's region.
- c) Candidate should focus on benefits and harm to patient and family (rather than society and resource allocation).

References

- Arch Dis Child 2003; 88:848-850
- Paediatric Respiratory Reviews 2005;6:209-214
- Chest 2000;117:1100-1105

Question 19

You are called by a regional hospital for advice and retrieval of an infant male born at 26 weeks of gestation who is now term plus 2 weeks. The child weighs 2.9 kilograms and has been home for 3 weeks. In the neonatal period there had been two days of ventilation and then 2 weeks of CPAP. The child had been off supplemental oxygen for 6 weeks and there was a record of a grade 1 intra-cerebral bleed, but no other significant sequelae of prematurity.

The child has presented with a 2 day history of an upper respiratory tract illness and decreasing oral intake.

Due to concern about work of breathing and increasing oxygen requirement the child has been orally intubated with a 3.0 uncuffed endotracheal tube and is being ventilated in an adult ICU.

Ventilation:

Pressure control
30/3 cmH₂O
Rate 50 breaths per minute
Inspiratory time 0.45 seconds
FiO₂ 1.0

Observations:

Heart rate 160 beats per minute
SpO₂ 80-85%
Blood pressure 55/35 (mean 42) mmHg (non-invasive).

Due to inclement weather the child cannot be retrieved to your ICU until the following day.

- a) What further information do you require from the treating team?
- b) What advice will you give to the treating team?

75% of candidates passed this question.

Answer Guide

a)

Airway / Breathing

Details about tube, adequacy of ventilation and means to maintain it overnight

Circulation

Perfusion, access, IV fluids, feeding, urinary catheter

Treatment

Sedation/paralysis, Antibiotics

Investigations

What has been done, what is the minimum?

Parents' expectations and understanding

Local medical, nursing and technological capacity

b)

Airway/ ventilation

ETT management, ventilator and circuit management, ventilation advice.
Complications and management
Arterial line helpful – target

Circulation

Access and alternatives. Fluid management – specifics. Transfusion
Consider transfusion if Hb < 100 g/L.

Sedation/other treatment

Drugs and dosing. Use of paralysing agents.
Paralysis not essential but may assist with ventilation at times.
Cultures. Rationale for antibiotic advice.

Support

Frequent communication, open lines. Seek feedback about progress.
Encourage senior staff availability
Ensure parents understand clinical condition and reasons for delay.

Question 20

A six month old infant is admitted following repair of Tetralogy of Fallot. There has been significant right ventricular outflow tract resection and a long cardiopulmonary bypass time. The operation was otherwise uncomplicated.

The child is stable on 7.5 µg/kg/min of dopamine and 0.5 µg/kg/min of Milrinone, with moderate ventilation settings. You wish to keep this child ventilated overnight with a view to weaning the following day. Analgesia is being provided by a morphine infusion.

In table form compare the advantages and disadvantages of the following sedative agents in this setting:

- Midazolam
- Dexmedetomidine
- Propofol

33% of candidates passed this question.

Answer Guide

Question addresses clinical use; advantages and disadvantages. A 3x2 table is expected addressing clinically important pharmacokinetics, efficacy, cost, cardiovascular effects and side effects, other major side effects, concerns about neural apoptosis

Question 21

An 8 month old infant is admitted with severe meningococcal sepsis. The child is intubated and ventilated and is receiving 7.5 µg/kg/min dopamine and 0.1 µg/kg/min of noradrenaline. Fluid resuscitation of 50 ml/kg (0.9% NaCl and 4% Albumin) has been given:

Blood pressure:	62/35 mmHg
Heart rate:	165 beats per minute
Capillary refill time	4 seconds

Urine output has been negligible in the last 2 hours.

- a) Outline your approach to investigation of oliguria in this child.**
- b) Describe the factors that would influence your decision to initiate renal replacement therapy (RRT) in this child.**
- c) Outline the potential practical difficulties in initiating RRT in this patient.**

50% of candidates passed this question.

Answer Guide

- a) Systematic approach required. Outline investigations by category of cause of renal dysfunction, with comments. Good candidate may introduce classification/scoring of AKI or discuss biomarkers
- b) Cause of oliguria, likelihood of rapid recovery. Utility of CRRT for fluid management / electrolyte management. Ability to add nutrition? CRRT as immunomodulator in sepsis.
- c) Complications associated with all modes and specific to each. Answer expected to cover PD, CVVH, Haemodialysis.

Question 22

A two week old term infant presents with poor feeding for 2 days and is noted to have a heart rate of 240 beats per minute. Clinically she has an enlarged liver and some crackles on chest auscultation. Electrocardiogram shows a narrow complex tachycardia with p waves difficult to identify. Echocardiography reveals a structurally normal heart with moderately depressed ventricular function.

Compare and contrast in table format the following agents for the management of supraventricular tachycardia in this setting:

- **Adenosine**
- **Propranolol**
- **Verapamil**

Specifically address mechanism of action, pharmacodynamics, safety and utility.

33% of candidates passed this question.

Answer Guide

	Adenosine	Propranolol	Verapamil
Mechanism of action	Xanthine analogue Rapid Atrio-ventricular node blockade (A1 receptor)	Non-selective beta blocker slows the conduction velocity and automaticity in SA and AV nodes.	Ca Channel blocker decreases impulse conduction through AV node
Pharmacodynamics	Short acting (T _{1/2} <10secs) Metabolised by red cell adenosine deaminase	T _{1/2} 3-4 hours extended by active metabolite with longer T _{1/2} . Variable bioavailability orally significant first pass metabolism	Peak effect IV 1-2 mins duration of effect 20 mins prolonged T _{1/2} of elimination in infants
Safety	Beware prolonged block. (dipyridamole) Resuscitation readiness Vasodilation, hypotension	Slow onset relatively safe hypotension, bradycardia	Highly dangerous in this setting and should not be used as it causes cardiovascular collapse
Utility	Useful for initial reversion but will not have sustained effect	May not revert but is good choice for chronic therapy	Not to be used in this setting

Question 23

Tabulate the physiological principle, method of measurement, and disadvantages for the following methods of cardiac output monitoring in PICU:

- **Indicator Dilution Method**
- **Doppler Ultrasound**
- **Arterial Pulse Contour**

58% of candidates passed this question.

Answer Guide

	Principle	Method	Disadvantage
Indicator Dilution Method	Cardiac output measured by change in indicator concentration over time at a point downstream from injection	Thermodilution (utilised saline injection at room temperature) via pulmonary artery catheter (Swan Ganz). Dye Dilution also used	Thermo requires PA catheter Dye requires large systemic artery. Not accurate if cardiac shunt.

Doppler ultrasound	Doppler signal (velocity-time integral) multiplied by area of aortic valve (stroke volume) multiplied by heart rate to get cardiac output.	Typically aortic signal measured via transoesophageal probe Also measurable via transthoracic probe.	Accuracy depends on correct placement of oesophageal probe and alignment with blood flow. Aortic valve abnormal geometry another possible error source.
Arterial Pulse Contour	A relationship exists between stroke volume and arterial pulse contour.	Complex analysis of pressure waveform (PICCO). Complex calculations and assumptions of aortic impedance, aortic compliance, and systemic vascular resistance.	Requires alternative method for static CO measurement for calibration.

Question 24

A 20 day old male term infant with confirmed *Bordetella pertussis* is in PICU with progressive hypoxic respiratory failure. He is receiving high frequency oscillatory ventilation, with settings of FiO₂ 0.8 and mean airway pressure of 32 cmH₂O.

His white cell count had risen to 92.2 x 10⁹/L (RR 5.0 – 20.0 x10⁹/L). Chest X-ray shows bilateral diffuse opacification and no pneumothorax. His vital signs include heart rate of 210 beats per minute (sinus rhythm) and blood pressure 52/28 (mean 36) mmHg. He has received 60ml/kg normal saline, and is on infusions of dopamine 15 µg/kg/minute and noradrenaline 0.4 µg/kg/minute.

Arterial blood gas is shown below:

Parameter	Value	Normal Range
pH	7.07*	7.35 – 7.45
PaCO ₂	72 mmHg*	35 – 45
PaO ₂	42 mmHg*	75 – 100
HCO ₃	13 mmol/L*	21 - 27
Base Excess	-22*	-3.0 to +3.0
Lactate	7.2 mmol/L*	0.7 – 2.5
Hb	98*	100 – 205

- List the complications of pertussis that are likely to be occurring.
- List the possible mechanisms of cardiovascular compromise.
- Outline potential treatments.

92% of candidates passed this question.

Answer Guide

a)

- Pertussis syndrome multiorgan failure
- bronchopneumonia, possibly necrotising pneumonia
- pulmonary hypertension

b) *Toxin mediated*

- hyperleukocytosis; leukocyte thrombi in pulmonary capillary bed
- G protein inhibition α_2 and D2 adrenergic receptors
- peripheral vasoplegia, myocardial dysfunction

c)

- iNO / sildenafil: comment on efficacy
- PDE inhibitors(milrinone:) no evidence of effect on pulmonary hypertension
- Exchange transfusion leukodepletion, leukapheresis:– statement of evidence for use (and limits)
- ECLS: Extremely poor prognosis – unrecoverable necrotising pneumonia

References

- Romano et al Exchange Transfusion Paediatrics 2004; 114:2 264-266
- McEniery et al Mechanisms J Paed Child Health 2004; 40: 230-232.
- Burr et al Overview PCCM 2011; 12: 387-392

Question 25

Outline your approach to prevention and treatment of venous thrombosis in PICU.

92% of candidates passed this question.

Answer Guide

Expect these topics to be covered with rationale for practice in specific populations and situations:

<u>Prophylaxis</u>	Unfractionated heparin low dose infusion Enoxaparin prophylactic dose Heparin coated CVCs CVC stewardship Sequential compression devices Compression stockings Early ambulation IVC filter
<u>Treatment</u>	CVC removal Unfractionated heparin infusion - goals Enoxaparin subcut injection bd - goals Warfarin po daily after stabilisation - goals Lytic therapies, Thrombectomy – indications, risks

Reference

- Higginson et al PCCM 2011; 12:6, 628-634

Question 26

An eleven year old bicyclist has an isolated splenic laceration on abdominal CT scan. In the emergency department he has received 3 intravenous fluid boluses of 20ml/kg 0.9% NaCl for tachycardia and hypotension and one packed red blood cell transfusion of 20ml/kg. He has been reviewed by the paediatric surgical trauma team consultant who has recommended conservative management.

In PICU his vital signs are as follows:

Heart rate	136 beats per minute
Blood pressure	88/48 mmHg
Respiratory rate	25 breaths per minute
Capillary refill time	4 seconds

Arterial Blood Gas is shown below:

Parameter	Value	Normal Range
pH	7.32*	7.35 – 7.45
PaCO ₂	32 mmHg*	35 – 45
PaO ₂	268 mmHg*	75 – 100
HCO ₃	15 mmol/L*	21 – 27
Base Excess	-8*	-3.0 to +3.0
Lactate	3.9 mmol/L*	0.7 – 2.5
Hb	62*	100 – 205

Outline your management with regard to the following:

- Immediate priorities (assume airway and breathing are stable and satisfactory).
- Conservative versus non-conservative treatment options, risks and benefits.

75% of candidates passed this question.

Answer Guide

- monitoring & vascular access
 - coagulation profile including fibrinogen, CBC, other results (ELFT, lipase etc), regularly check acid base status, lactate, ionised calcium, patient temperature
 - regular communication with surgeon, alert OR, anaesthesia team
 - avoid hypothermia, avoid further excessive crystalloid
 - continue blood product administration, liaise with laboratory / blood bank and alert them to possibility of activate massive transfusion
 - regular communication with family
- Could be answered with a table:
 - Continued conservative management

- Risks: bleeding not yet stabilised; rebleeding may recur even after stabilisation; likely to need significant blood product exposure to stabilise
- Benefits: benefit of retaining spleen; avoids risks of laparotomy
- Interventional radiology – splenic artery embolisation
 - Risks: procedural complications; may be unsuccessful; post procedure fever and pain common
 - Benefits: less invasive than laparotomy; potential for regeneration of splenic tissue
- Emergency laparotomy and splenectomy
 - Risks: procedural risks; post splenectomy infection risk
 - Benefits: lifesaving if exsanguinating or not manageable conservatively

Reference

- Bellingham et al Splenic Art Embolisatn PCCM 2009; 10:1-4
- Massive tx nba 2011.pdf Massive transfusion:
http://www.transfusion.com.au/disease_therapeutics/transfusion

Question 27

Randomised Controlled Trials are considered the gold standard method to judge the efficacy of an intervention.

Outline the challenges of performing an RCT in the Australian and New Zealand PICU population.

25% of candidates passed this question.

Answer Guide

Need the candidate to think about this, with good answers coming from knowledge and perspective. Some anticipated responses:

- Clinical equipoise may not be present with regard to the intervention.
- Many critical care syndromes of interest do not have robust diagnostic methods
- Many critical care syndromes of interest are devastating but rare, making it difficult to recruit sufficient number of eligible patients.
- Children are going through various developmental stages and their response to drugs and interventions are not consistent.
- Some interventions are impossible to blind, introducing the potential for outcome measurement bias.
- Practice variability may make design difficult and treatment compliance and standardisation difficult to achieve.
- Excessively tight eligibility criteria or treatment standardisation may limit generalisability to the wider population at risk.
- Geographic distribution of the paediatric population and the high incidence of inter- hospital transfer to the tertiary PICU may separate the guardian from the child and delay consent.
- Critical illness necessitates immediate therapeutic decisions which may preclude the time needed for assessment of eligibility, randomisation and consent.

- Interventions in PICU are expected to have a modest or small effect. This markedly increases sample size.
- Paucity of accepted important measurements of outcome. Mortality infrequent
- Evaluation of functional outcomes/quality of life difficult (fewer validated scores, issue of assessment of preverbal dependant young child etc.)
- Inability of the child to give informed consent.
- Emotional / subjective views of guardian may limit consent and recruitment.
- Institutional review boards view children differently from adults; more challenging to get approval for research.
- PICUs may have inadequate resources to conduct RCTs.

Reference

- Randolph et al PCCM 2002; 3:102-106

Question 28

Frusemide use in PICU commonly produces distinctive metabolic abnormalities. Describe these and explain the mechanisms by which they occur.

25% of candidates passed this question.

Answer Guide

Metabolic abnormalities

- Metabolic alkalosis
- Hypokalaemia
- Hypochloraemia
- Hyponatraemia
- Hypocalcaemia
- Hypomagnesaemia
- Hyperuricaemia

Mechanisms

- Effect on TAL of the loop of Henle. Inhibition of Na⁺-K⁺-2Cl⁻ symporter in the TAL. markedly increases Na and Cl excretion: hyponatraemia and hypochloraemia
- Blocking of Na & Cl reabsorption in TAL abolishes transepithelial potential difference which leads to increased excretion of Ca and Mg: hypomagnesaemia and hypocalcaemia
- Increased delivery of Na to the distal tubule and collecting duct enhance K and H excretion: hypokalaemia and alkalosis

Question 29

- Briefly describe the clinical situations in which you would choose to utilize high frequency oscillatory ventilation (HFOV) in your paediatric patients.**
- List six mechanisms by which gas transfer occurs during HFOV.**

- c) A 2 year old girl with adenovirus-positive pneumonitis is becoming increasingly more difficult to support with conventional mechanical ventilation and has been commenced on HFOV.

Initial settings are:

FiO₂	60%
Bias Gas Flow	20 Lpm
Mean Airway Pressure	22 cmH₂O
Frequency	8 Hz
Amplitude	40

15 minutes after commencing HFOV, an arterial blood sample shows:

Parameter	Value	Reference Range
pH	7.12*	7.35 - 7.45
paCO ₂	78 mmHg*	35 - 45
paO ₂	49 mmHg*	75 - 100
HCO ₃	33 mmol/L*	21- 27
Base Excess	+2.6*	-3.0 to +3.0

- d) Briefly describe your initial management of this clinical situation.

100% of candidates passed this question.

Answer Guide

- a)
- Respiratory failure requiring invasive mechanical ventilation with one or more of the following:
 - high Peak Airway Pressure PAP (> 30cm H₂O)
 - hypoxaemia unresponsive to high PEEP (e.g. > 10cm H₂O)
 - hypercarbia with severe acidosis
 - Bronchopleural fistula difficult to ventilate with conventional ventilation
 - Clinical conditions at risk of Ventilator induced lung injury (VLI) – use HFOV as rescue therapy (ARDS, Congenital diaphragmatic hernia).
- b)
- Diffusion
 - Asymmetric inspiratory and expiratory velocity profiles
 - Bulk flow/convection
 - Turbulence
 - Pendelluft
 - Taylor dispersion
 - Cardiogenic mixing
- c) Areas to cover:
- Adequate sedation and paralysis; CXR; reduce frequency to 6 -7 Hz vs increase amplitude – assessment; increase mean airway pressure – how high? How to reduce? Increase FiO₂; ongoing reassessment and adjustment.

Reference

- High frequency oscillatory ventilation: Mechanisms of gas exchange and lung mechanics. Pillow J. Crit Care Med 2005; 33 (3 suppl.): S135-S141

Question 30

A 6 year old girl has been intubated and ventilated in Paediatric Intensive Care unit with refractory status epilepticus. Clinical seizures were controlled with a high dose midazolam infusion and intravenous phenytoin. Enteral feeds were introduced within 24 hours of admission to PICU and because of limited intravenous access phenytoin was administered by the nasogastric route.

On Day 3 of PICU admission, continuous EEG recording revealed presence of non-convulsive status epilepticus. Phenytoin level was measured at 6 µg/dl (normal 10-20) at this time.

- a) List the possible reasons for the measured phenytoin level in this patient.**
- b) Outline a strategy for achieving a therapeutic phenytoin level in this patient.**
- c) List the potential complications of intravenous phenytoin administration.**

42% of candidates passed this question.

Answer Guide

- a)
 - Inadequate dose
 - Dosing error
 - Adsorbed to plastic
 - Binds to enteral formulation
 - Low serum albumin (should measure free phenytoin levels)
 - Pharmacogenomics- (MDR1CC genotype) gene to explain low serum levels
- b)
 - Increase dose
 - Withhold feeds for 2 hours before and after dosage administration (in reality difficult to achieve with continuous feeds)
 - Measure free Phenytoin levels
- c)
 - Nausea vomiting dizziness sedation
 - Anticonvulsant hypersensitivity syndrome:
 - Skin rash, fever, hepatitis, lymphadenopathy, haematological abnormalities
 - High pH (11.5 -12.1) – extravasation causes tissue damage
 - Beware rapid infusion in prolonged QT syndrome.

ORAL SECTION

Clinical Section

The Clinical Section (2 clinical cases – 20 minutes per case) was conducted in the Paediatric Intensive Care Unit at The Royal Children's Hospital, Melbourne.

Candidates who approach the clinical examination of the patient and presentation of findings in an organized manner will impress the examiners. Candidates should approach the case discussion in a consultant-like manner. 30% of the overall marks are allocated to the two clinical cases. Candidates should bear this in mind when preparing for the examination.

Candidates should listen carefully to the introduction given by the examiners and direct their examination accordingly. Cases are usually presented as problem solving exercises. For maximal marks, candidates should demonstrate a systematic approach to examination, clinical signs should be demonstrated, and a reasonable discussion regarding their findings should follow. The twenty minutes available for each case provides ample opportunity to discuss investigations and plans of management. Some candidates waste valuable time at the start of the case by spending more than a couple of minutes around the bedside before they actually commence examining the patient. Exposing the patients should be limited to those areas that are necessary for that component of the examination. Candidates must show appropriate courtesy and respect to patients and their families if present during the examination.

Cases encountered in the clinical component of the examination included:

- A 3 day old child with transposition of the great arteries on central VA ECMO. Candidates were asked to examine the patient to assess the adequacy of haemodynamic support and to discuss a plan for definitive management.
- A 17 year old boy with severe cerebral palsy on non-invasive ventilation for respiratory failure. Candidates were asked to examine the respiratory system and formulate a management plan.
- A 6 year old boy with septic shock on central VA ECMO and haemofiltration. Candidates were asked to examine the patient and discuss management of extracorporeal therapies.
- A 4 month old girl with previous repair of Hypoplastic aortic arch and recent mitral valvuloplasty. Candidates were asked to examine the patient and discuss readiness for extubation.

Viva Section

There are 8 stations of ten minutes each for structured vivas. Two minutes are provided to read an introductory scenario (which includes the initial question) outside each viva room. This same information is also provided inside the viva room.

Candidates should be able to demonstrate a systematic approach to the assessment and management of commonly encountered clinical problems. Candidates should also be

prepared to provide a reasonable strategy for management of conditions that they may not be familiar with.

The following are the introductory scenarios and questions provided to the candidates:

Viva 1

NB: Images removed from this question.

A 12 month old, 10 kg child with respiratory failure secondary to pneumonia has been placed on veno-venous ECMO. A single double lumen internal jugular vein cannula has been placed on the right side

A Chest X ray taken immediately prior to ECMO cannulation is shown below:

Discuss the expected arterial saturations on VV ECMO in this patient.

100% of candidates passed this question.

Viva 2 – Procedure

A 6yr old boy has suffered a severe traumatic brain injury in a motor vehicle accident. He has been on the PICU for 4 days with unsuccessful attempts to control ICP with medical therapies. Overnight his pupils have become fixed and dilated.

His parents have spontaneously raised the possibility of organ donation with the PICU team and are keen for this outcome if he cannot survive. One set of clinical brain death tests have been performed by the consultant neurologist (Dr Stephens) and he has documented a clinical diagnosis of brain death in the notes.

You are the PICU senior registrar, have > 5yrs as a medical practitioner and are able to perform the tests in this state. You will be asked to perform the tests on a manikin.

You will be expected to manage this scenario in a simulated environment. There is one PICU nurse in the room who can assist you.

82% of candidates passed this question.

Viva 3

NB: Images removed from this question.

A 10 month girl has been brought to the emergency department with irritability and increasing head circumference.

Selected images from a CT brain scan are shown below

What is the most important immediate management priority?

82% of candidates passed this question.

Viva 4 - Radiology

NB: Images removed from this question.

A 3 year old boy has been brought in by ambulance having been struck by a car travelling at 50km/hour. He was intubated at the scene, where he was described as “bradycardic and not breathing”. Morphine and midazolam have been commenced on route

Currently he has a heart rate of 95 beats per minute and a systolic blood pressure of 55 mmHg.

His CXR is available on the screen inside.

100% of candidates passed this question.

Viva 5

NB: Images removed from this question.

A 9 year old girl presents with a 3 day history of fever, cough and respiratory distress. She is requiring 6L/min via Hudson mask to keep O₂ sats > 90%. She has a respiratory rate of 40 breaths per minute with moderate intercostal and subcostal recession.

The following chest X-ray is taken

Describe the findings on this X-ray and list differential diagnoses

82% of candidates passed this question.

Viva 6

A dysmorphic 1 year old child has been in your PICU for 12 hours with increasing respiratory distress and a clinical diagnosis of bronchiolitis (NPA sent but not yet processed). They have increasing work of breathing and are desaturating into the 70s on humidified high flow oxygen.

Describe your initial approach and priorities.

91% of candidates passed this question.

Viva 7 – Communication Station

Shay is a 6 year old boy with a severe head injury which has been managed with intubation and ventilation, sedation, analgesia and cooling for the last 4 days. Overnight he has developed fixed and dilated pupils. Clinical testing has confirmed that he is not brain dead.

You have been looking after Shay since admission. You and have already told his parents, Chris and Jo, that Shay is not dead, but has a severe head injury and is likely to die in the next few days or when the ventilator assistance is stopped. If Shay were to survive it would

be with severe disability. Neurosurgery and neurology concur that the outcome will be very poor.

You have come to talk to Chris and Jo about stopping invasive support and end of life management.

100% of candidates passed this question.

Viva 8

A four year old girl has been urgently admitted to your PICU. She has acute lymphoblastic leukaemia diagnosed 6 months earlier and has been undergoing maintenance chemotherapy delivered via a port-a-cath central venous access device.

She presented today to the Oncology outpatient department in your hospital with symptoms of fever, rapid breathing and lethargy. On examination she was tachycardic and hypotensive. Her port was accessed to sample a blood culture, an urgent full blood count examination, and to have administered the protocol IV antibiotics (piperacillin/tazobactam and teicoplanin) and two intravenous fluid boluses each of 20 mL per kg of normal saline.

During this she had a rigor. Her hypotension did not improve.

Her vital signs upon PICU admission are:

- respiratory rate 50 breaths per minute
- pulse oximetry 89% in face mask oxygen (high concentration reservoir mask)
- heart rate 185 beats per minute
- blood pressure 58 / 30 mmHg
- central capillary refill 5 seconds
- skin colour pale / grey
- glasgow coma scale 10 (eyes 3, speech 2, motor 5)
- pupils small, equal and reactive to light
- tympanic membrane temperature 40.2°C

Her full blood count result shows:

- Haemoglobin 81 G/L
- White Cell Count 2,100 /mm³
- Neutrophil count 0.0 /mm³
- Platelet count 17,500 /mm³

Describe your management priorities over the next 30 minutes.

100% of candidates passed this question.