



COLLEGE OF INTENSIVE CARE MEDICINE OF AUSTRALIA AND NEW ZEALAND

SECOND PART PAEDIATRIC EXAMINATION

EXAM REPORT

AUGUST / NOVEMBER 2019

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. Candidates should discuss the report with their tutors so that they may prepare appropriately for future examinations.

The Examination included two 2.5 hour written papers, each composed of 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 clinical hot cases.

The tables below provide an overall summary, as well as information regarding performance in the individual sections. A comparison with the previous five examinations is also provided.

The written section of the Examination was held in Auckland, Brisbane, Melbourne, Singapore and Sydney. The clinical section of the examination was held in Brisbane, Australia at Queensland Children's Hospital, and the vivas were held at the Brisbane Convention and Exhibition Centre.

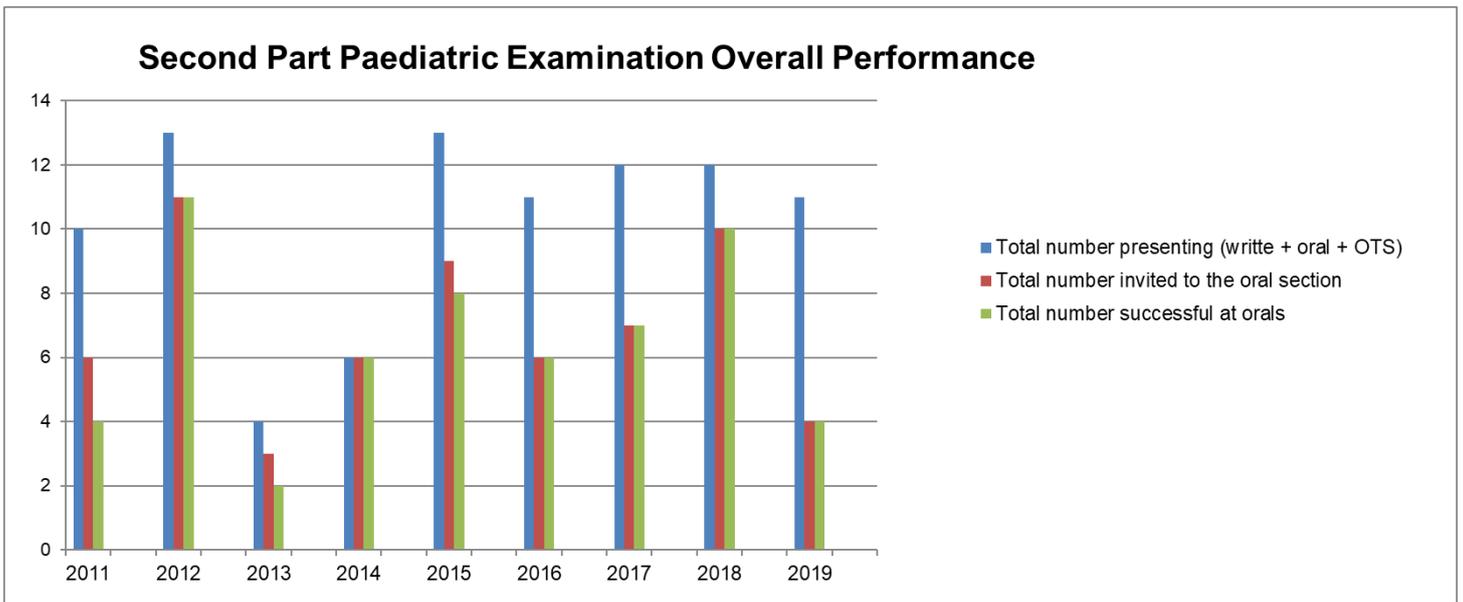
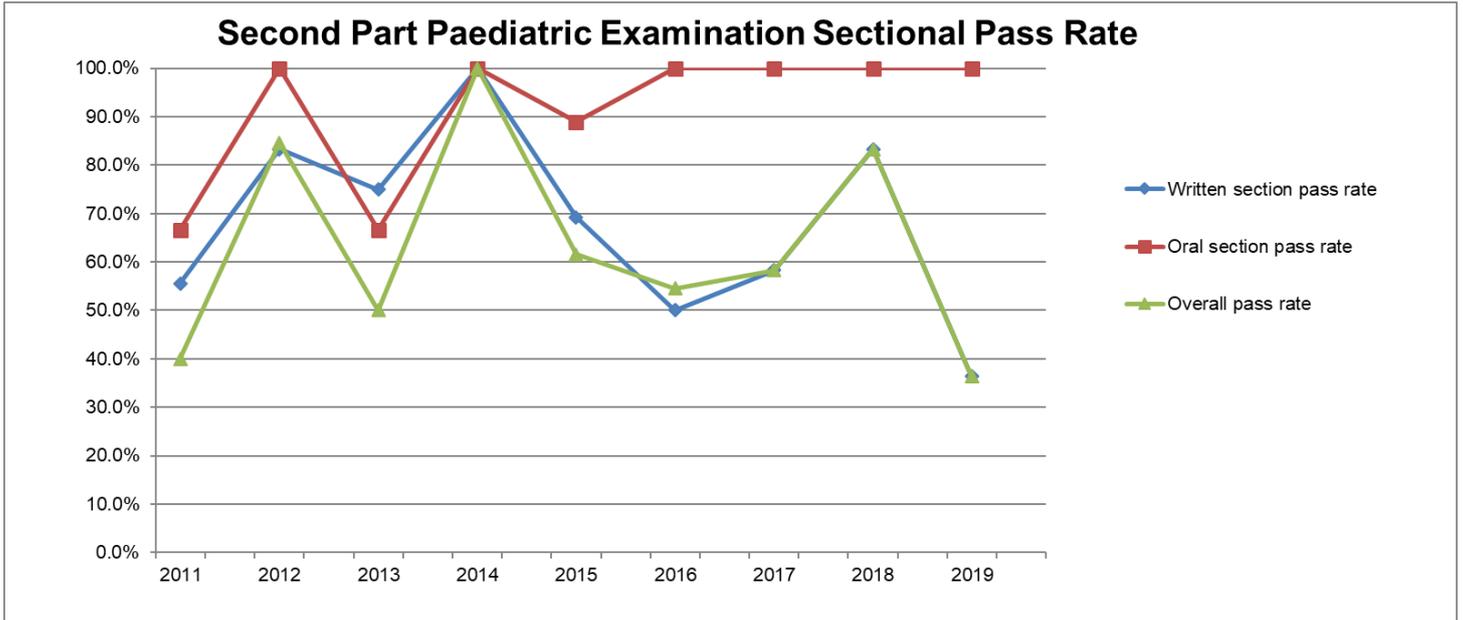
STATISTICAL REPORT

Overall pass rates	2019	2018	2017	2016	2015	2014
Total number presenting (written + carry + OTS)	11	12	12	11	13	8
Total number invited to the oral section	4	10	7	6	9	6
Total number successful at orals	4	10	7	6	8	6
	100%	100%	100%	100%	89%	100%
Overall pass rate	4/11	10/12	7/12	6/11	2/4	6/8
	36%	83%	58%	55%	62%	75%

Clinical Pass Rates	2019		2018		2017		2016		2015		2014	
	Pass rate	Highest individual mark										
Hot Case 1	75%	78%	50%	73%	71%	75%	100%	80%	78%	80%	83%	90%
Hot Case 2	50%	70%	70%	78%	86%	76%	100%	95%	56%	85%	83%	80%
Total number successful in the Hot Case section	3/4		6/10		6/7		6/6		8/9		5/6	
Overall Hot Case pass rate	75%		60%		86%		100%		89%		83%	

Vivas Pass Rates	2019		2018		2017		2016		2015		2014	
	Pass rate	Highest individual mark										
Viva 1	25%	54%	70%	75%	100%	70%	67%	80%	44%	60%	100%	80%
Viva 2	50%	60%	70%	85%	86%	78%	100%	85%	44%	70%	67%	88%
Viva 3	75%	70%	60%	83%	86%	85%	0%	49%	33%	85%	100%	85%
Viva 4	100%	88%	80%	59%	86%	78%	67%	90%	67%	83%	50%	54%
Viva 5	75%	69%	80%	73%	43%	76%	100%	88%	67%	80%	67%	70%
Radiology Viva	100%	65%	100%	90%	100%	70%	100%	83%	89%	80%	83%	73%
Communication Viva	25%	58%	70%	75%	86%	85%	83%	80%	89%	95%	100%	90%
Procedure Viva	75%	88%	80%	83%	57%	90%	83%	95%	100%	95%	100%	85%
Total number successful in the Viva section	4/4		10/10		6/7		6/6		8/9		6/6	
Overall Viva pass rate	100%		100%		86%		100%		89%		100%	

Overall Performance



EXAMINERS' COMMENTS

Written Paper

Eighteen of the thirty short answer questions had a pass rate of less than 50%. Topics covered by questions with a pass rate of 30% or less related to clinical trial design, bronchiolitis, capnography, end-of-life ethics, measles, ECMO decannulation, CVVH, post-immersion prognostication and cardiac tamponade.

The most common reasons for candidates to fail questions were:

- Insufficient knowledge of the topic
- Insufficient detail or incomplete answer
- Failure to answer the question asked
- Answer not at consultant level

Once again, candidates are reminded that it is crucially important to write legibly; examiners need to be able to read written answers.

Candidates are reminded to read the questions carefully and thoroughly, and to include in their answer only information that is relevant to the question. The allocation of marks in multipart questions is shown to allow candidates to organise their answers appropriately. The glossary of terms is provided to help candidates to understand the type of information and structure required in the answer. These terms are used in the questions to convey the level of detail required in each answer; it is very important that candidates understand their meaning.

Hot Cases

Hot cases run for twenty minutes, with an additional two minutes at the start of each case for the candidate to read a written introduction. The written introduction is to allow candidates greater opportunity to plan a focused approach to the case.

The following comments are a guide to the expected standard for performance in the hot cases:

- Candidates should address and answer the question asked in the introduction.
- Candidates should interpret and synthesise information, rather than just describing the clinical findings.
- Candidates need to seek information relevant to the 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 specific context of the 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 were able to demonstrate the following:

- A professional approach, showing respect and consideration for the patient and family.
- Competent, efficient and structured examination technique and an ability to appropriately adapt the examination to suit the case.
- Pursuit of information relevant to the case.
- An ability to interpret and synthesise their findings appropriately.
- Presentation of conclusions in a concise, targeted and systematic fashion.
- Listing of a differential diagnosis that is relevant to the clinical case.
- 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 the following reasons:

- Missing or misinterpreting key clinical signs on examination.

- Asking a large number of questions at the start of the case, many of which were not relevant or necessary.
- 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.

Some candidates were able to elicit and describe the clinical signs and data but were unable to synthesise all the information and to formulate an appropriate management plan.

The overall pass rate was comparable to previous examinations. Comments noted by the examiners when candidates failed cases included:

- Too slow with initial assessment.
- Spent too long at bedside.
- Missed clinical signs / important abnormalities.
- Unfocussed / hesitant examination.
- Lack of clarity and depth in discussion.

Candidates are advised that they should not sit the Second Part Paediatric Examination until they can confidently examine patients, present the relevant clinical findings and discuss management issues at the appropriate level (senior Fellow/Junior Consultant). This aspect of the examination requires specific and frequent practice.

Vivas

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.

WRITTEN EXAMINATION 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. 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.

Notes

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

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

Question 1

A 6-month-old boy with pulmonary atresia, who had a modified Blalock-Taussig shunt as a newborn, is admitted from theatre following a bidirectional cavopulmonary shunt.

The anaesthesia and operation were uncomplicated, but there have been problems with hypoxia since separation from cardiopulmonary bypass.

Current observations are:

Temperature: 37.5°C
SpO₂ 66%
Heart rate: 130 beats/minute
Blood pressure: 89/43 mmHg (mean 61 mmHg)
SVC pressure: 14 mmHg

He is on infusions of dobutamine (5 µgrams/kg/min) and morphine (20 µgrams/kg/hr).

Current ventilator settings are:

Time cycled, pressure limited ventilation
FiO₂ 0.7
Respiratory rate: 18 breaths/minute
Pressures: 18/5 cmH₂O
Inspiratory time: 1 second

Results for an arterial blood gas analysis are shown below:

Parameter	Patient Value	Normal Range
pH	7.45	7.35 – 7.45
PaCO ₂	31 mmHg (4.13 kPa)	31 – 42 (4.13 – 5.60)
PaO ₂	40 mmHg (5.33 kPa)*	80 – 105 (10.67 – 14.00)
HCO ₃	18 mmol/L*	22 – 26
Base Excess	-2 mmol/L	-2 to +2
Lactate	2.0 mmol/L*	1.0 – 1.8

- a) Outline the potential causes for hypoxia in this patient. (60% marks)
- b) Outline your management over the next 12 hours. (40% marks)

Maximum Score	8.5
Percentage Passed	64%

Examiners' comments:

This question required a structured approach to hypoxia that took into account current haemodynamics and considered pulmonary blood flow, surgical or anatomical problems, ventilation and oxygen consumption. Poor answers conveyed a misunderstanding of bidirectional Glenn physiology or did not provide a logical sequential approach to identifying the cause of hypoxia or to optimizing cardiac output, ventilation and oxygenation.

Question 2

- a) Outline the pathophysiology of acute cardiac tamponade. (30% marks)
- b) List four ECG features of cardiac tamponade. (20% marks)

- c) Outline the physiology of pulsus paradoxus in cardiac tamponade in a spontaneously breathing patient. (20% marks)
- d) Outline the principles of management of a non-ventilated patient with acute pericardial tamponade. Do not describe the technique of pericardiocentesis in your answer. (30% marks)

Maximum Score	7.1
Percentage Passed	9%

Examiners' comments:

This question required detailed knowledge of tamponade physiology and its evolution from simple pericardial effusion, with particular reference to cardiac, pericardial and intrathoracic pressures, and identifiable clinical signs. Candidates needed to demonstrate an understanding of how changes in intrathoracic pressure during respiration influence intracardiac pressures in tamponade, and the clinical consequences of this. This was a straightforward question on an important topic, which was poorly answered.

Question 3

A 9-year-old Pacific Islander boy presents with 3 days of vomiting, cough with blood-stained sputum, dyspnoea and abdominal pain. He has tachycardia and tachypnoea without fever. SpO₂ is 86% in room air, corrected with oxygen to 90%, but he has severe dyspnoea. Blood pressure is 85/50 mmHg. He has hepatomegaly and a pansystolic murmur at the apex. He was intubated in the Emergency Department after a fluid bolus.

His chest X-ray is shown below (Figure 3.1):

(Image removed from report.)

- a) List your differential diagnosis. (20% marks)
- b) List the key investigations. (25% marks)
- c) Outline your treatment plan. (35% marks)
- d) List potential complications specific to this disease and their management. (20% marks)

Maximum Score	8.5
Percentage Passed	64%

Examiners' comments:

Some candidates did not identify the most likely diagnoses in this patient and did not therefore treat or investigate appropriately. A range of differentials including rheumatic fever and endocarditis should have been considered, and investigations and treatments pertinent to these scored highly. Applying first principles to management would have benefited candidates who failed to identify likely diagnoses.

Question 4

- a) In table form, list five multidrug resistant organisms (MDROs) relevant to Australian and New Zealand PICU practice. For each organism, state the mechanism of acquired resistance and the antibiotic you would typically use to treat it empirically. (50% marks)
- b) Outline your approach to minimising MDRO infections in the PICU. (50% marks)

Maximum Score	7.0
Percentage Passed	73%

Examiners' comments:

Some candidates omitted an entire column of information in the table. Candidates could have scored more highly by having a broader, more structured approach to minimising multidrug resistant organisms, covering aspects of prevention, surveillance, identification, and treatment. Candidates are again reminded that 'Outline' requires a more detailed answer than a simple list.

Reference(s):

1. Preventing Transmission of Multidrug-Resistant Pathogens in the Intensive Care Unit *Infect Dis Clin North Am.* 2017 Sep; 31(3): 535–550.
2. Australian Commission on Safety and Quality in Healthcare – NSQHS Standard 3, 2017 <https://academic.oup.com/cid/article/46/1/120/335857>.

Question 5

Outline mechanisms of (40% marks), clinical manifestations of (20% marks), and management strategies for (40% marks) gut dysfunction in the critically ill paediatric patient.

Maximum Score	7.2
Percentage Passed	55%

Examiners' comments:

Many candidates had too narrow a focus throughout this question. Strong answers considered the wide-ranging effects of critical illness (stress response, gut hormonal dysregulation, alterations in gut perfusion, drug administration, gut flora alteration) as well as repeated fasting, direct gut injury, etc. in their answer. Many answers lacked sufficient breadth of thinking and depth of detail. Candidates need to demonstrate their ability to think widely about such questions to maximise potential scores.

Reference(s):

1. Martinez EE, Douglas K, Nurko S et al. Gastric Dysmotility in Critically Ill Children: pathophysiology, diagnosis and management. *Pediatr Crit Care Med* 2015;16:828-836
2. Blaser AR, Jacob SM and Starkopf. Gastrointestinal failure in the ICU. *Curr Opin Crit Care* 2016; 22:128-141
3. Lyons JD and Coppersmith CM. Pathophysiology of the gut and the microbiome in the host response. *Pediatr Crit Care Med* 2017;18: S46-S49.

Question 6

Discuss the pharmacology and the use of ketamine by infusion in PICU.

Maximum Score	6.0
Percentage Passed	64%

Examiners' comments:

This drug is commonly used in ICU and candidates should have a high level of knowledge and a structured approach to answering questions relating to drugs and their pharmacology, incorporating

benefits, harms, pharmacokinetics and dosing. Some answers lacked detail regarding the mechanisms of action of ketamine, and few described the pharmacology adequately. When asked to Discuss, candidates should remember that any controversial issues should be addressed; doing so conveys a detailed understanding of the topic.

Question 7

As a new specialist, you are keen to enhance trainee welfare in your PICU. List aspects you will focus on which are:

- a) Individual: aspects concerning the individual trainee's engagement and responsibility for their own well-being while in your unit. (60% marks)
- b) Systemic: organisational aspects at unit and College level to support and help trainees. (40% marks)

Maximum Score	6.8
Percentage Passed	64%

Examiners' comments:

This question is based on the CICM college statement paper "Welfare of intensive care trainee". Candidates should be aware of college papers and guidelines in general and have an understanding of maintaining trainee welfare both at a personal and systemic level.

Reference(s):

CICM document IC-5: STATEMENT ON THE HEALTH AND WELLBEING OF FELLOWS AND TRAINEES

Question 8

You attend a trauma call to the Emergency Department for a 6-year-old boy involved in a motor vehicle accident. The car was struck at 30 km/hr, and the patient was restrained in the back seat. The patient is in a hard collar, on a backboard, with his head taped down. He is alert, is able to move all extremities, and has minor abrasions on his arms. You are told that the patient had no loss of consciousness at the scene and complained only of the abrasions on his arms.

- a) List seven key differences between the paediatric and adult spine that increase the susceptibility of children to cervical trauma. (35% marks)
- b) List five high risk criteria for suspicion of cervical spine injury patients less than 18 years old (the paediatric NEXUS criteria). (25% marks)
- c) How would you investigate this patient's cervical spine? (10% marks)
- d) Discuss the relative merits of plain X-ray, CT scan and MRI in imaging a patient at risk for spine injury. (30% marks)

Maximum Score	7.9
Percentage Passed	45%

Examiners' comments:

Most candidates demonstrated a good understanding of differences between adults and children. The NEXUS criteria are important and should be considered core knowledge; however, only a few candidates knew these. Some candidates provided long answers for the brief and lowly-weighted question about

investigation of a patient who did not require imaging. The relative merits of different imaging techniques required a simple, structured answer, which several candidates did surprisingly poorly.

Reference(s):

Slaar A et al. Triage tools for detecting cervical spine injury in pediatric trauma patients (review). Cochrane database of systemic reviews 2017; 12.

Question 9

- a) List factors that have been shown to predict poor outcome after drowning:
 - i. At the scene.
 - ii. On presentation to hospital.
 - iii. 24 to 48 hours after PICU admission. (50% marks)
- b) For each factor, define the value, range or description associated with poor outcome. (50% marks)

Maximum Score	5.8
Percentage Passed	18%

Examiners' comments:

This question exposed a lack of knowledge of prognostic factors following immersion injury on the part of many candidates. Candidates fared better with the hospital factors associated with poor outcome, but generally had a poor understanding of factors relevant to scene and presentation (eg duration of submersion, time to BLS, initial rhythm, requirement for CPR, initial GCS). Many answers were poorly structured and not well set out. Some candidates listed prognostic factors but no details on values/ranges, which restricted their ability to pass.

Reference(s):

UpToDate: Drowning (submersion injuries)

Question 10

- a) Outline the mechanism of action, pharmacokinetics, ECG effects, and side effects of amiodarone. (70% marks)
- b) List three indications for amiodarone in PICU. (15% marks)
- c) List three ECG contraindications to amiodarone. (15% marks)

Maximum Score	8.5
Percentage Passed	73%

Examiners' comments:

This was generally well done, as would be expected for important core information about a commonly used drug. Some candidates demonstrated excellent knowledge in well-constructed answers, although others missed sections, such as the ECG effects.

Question 11

- a) Outline the important features of the paediatric index of mortality (PIM) score that distinguish it from the paediatric risk of mortality (PRISM) score. (50% marks)
- b) What is the standardised mortality ratio (SMR)? (10% marks)
- c) How is the SMR calculated? (10% marks)
- d) What are the potential reasons for an increase in annual SMR in a particular PICU? (30% marks)

Maximum Score	6.8
Percentage Passed	36%

Examiners' comments:

Most candidates had some knowledge of PRISM and PIM, although answers were not well set out, and the differences between the two were generally poorly described. Candidates were expected to be aware of which data were collected, and at what time, for these scoring systems, along with accessibility and validation of the scores. Most candidates understood the SMR and answered the second half of the question well.

Reference(s):

Randolph. Intensive Care Medicine 1997;23:141-142.

Question 12

Revised evidence-based guidelines for managing paediatric severe traumatic brain injury were published earlier this year by the Brain Trauma Foundation. According to these guidelines, outline the recommended management of paediatric traumatic brain injury for the following:

- a) Threshold for the treatment of intracranial pressure.
- b) Threshold for the treatment of cerebral perfusion pressure.
- c) Use of hyperosmolar therapy.
- d) Role of cerebrospinal fluid drainage.
- e) Use of barbiturates.
- f) Use of temperature management and hypothermia.
- g) Role of decompressive craniectomy.

Maximum Score	8.9
Percentage Passed	82%

Examiners' comments:

Most candidates had a good core knowledge of traumatic brain injury, were aware of the relevant guidelines. Candidates who did well understood the recent changes and clearly articulated these.

Reference(s):

1. Kochanek, P.M., Tasker, R.C., Carney, N., Totten, A.M., Adelson, P.D., Selden, N.R., Davis-O'Reilly, C., Hart, E.L., Bell, M.J., Bratton, S.L. and Grant, G.A., 2019. Guidelines for the management of pediatric severe traumatic brain injury: update of the brain trauma foundation guidelines. *Pediatric Critical Care Medicine*, 20(3S), pp.S1-S82.

Question 13

- Describe the three main surgical elements of the two types of Norwood operations commonly undertaken. (10% marks)
- Based on the physiological differences between the classic and modified Norwood, outline the theoretical advantages and disadvantages of each operation. Include both the immediate post-operative period as well as longer term. (30% marks)
- In table form, list any differences in the eight following outcomes and complications for the two surgical approaches: post-operative cardiac arrest, post-operative ECMO, 30-day mortality, interstage (between Stage I and Stage II surgery) mortality, 1-year mortality, 6-year mortality, catheter reinterventions, neurodevelopmental outcome at 14 months. (40% marks)
- List known risk factors for 30-day mortality following a Stage I repair. (20% marks)

Maximum Score	6.4
Percentage Passed	27%

Examiners' comments:

To score highly in this question, candidates needed to clearly articulate the principles underlying both variations of the Norwood operation (removing interatrial restriction, construction of a neo-aorta, and providing secure pulmonary blood flow) and to have a clear understanding of the physiological differences between a Sano and mBTS, and the implications for post-op management. This was surprisingly poorly done by some candidates. The outcomes section of the question required knowledge of the results of the single ventricle reconstruction trial, and most answers to this were poor. In fact, some candidates were unable to answer this section at all.

Question 14

A 5-day-old baby weighing 3.0 kg is transferred to your PICU from a regional hospital with decreased consciousness, suspected seizures and hyperammonaemia. He has two peripheral intravenous cannulae and is not on any respiratory support.

On examination:

No obvious seizure activity
Some spontaneous movements, pupils reactive to light
Heart rate: 165 beats/minute
Blood pressure: 55/31 mmHg (mean 41 mmHg)
Respiratory rate: 80 breaths/minute
SpO₂ 95% in room air

Initial blood test results are shown below:

Parameter	Patient Value	Normal Range
Activated partial thromboplastin time (APTT)	83 sec*	27 – 69
International normalised ratio (INR)	1.6*	0.8 – 1.5
Fibrinogen	2.3 g/L	1.5 – 4.0
Sodium	134 mmol/L*	135 – 145

Potassium	5.5 mmol/L	3.7 – 5.6
Glucose	5.3 mmol/L	3.6 – 5.4
Creatinine	64 µmol/L	53 – 97
Alanine aminotransferase (ALT)	96 IU/L*	7 – 40
Alkaline phosphatase (ALP)	459 IU/L*	100 – 350
Bilirubin (unconjugated)	191 µmol/L*	0 – 155
Bilirubin (conjugated)	5 µmol/L	0 – 10
Ammonia	700 µmol/L*	0 – 65

Metabolic workup is proceeding to identify an inborn error of metabolism. Arginine, benzoate, carnitine, biotin, and phenobarbitone have all been commenced at appropriate doses.

A decision is made to commence continuous veno-venous haemofiltration (CVVH).

- a) Outline the challenges in instituting CVVH in this patient. (40% marks)
- b) Provide a comprehensive prescription for CVVH in this patient. (30% marks)
- c) After two hours of CVVH the serum ammonia is 650 µmol/L. Outline the options to enhance extracorporeal removal of ammonia, including the mechanism by which each option would do this. (30% marks)

Maximum Score	4.6
Percentage Passed	0%

Examiners' comments:

Candidates were expected to describe the practical difficulties of urgent CVVH institution in a 3kg spontaneously breathing, obtunded newborn. This question was disappointingly poorly answered. Topics to be covered included securing the airway, obtaining access for the haemofilter as well as additional monitoring and drug administration, and anticipation of haemodynamic instability. Candidates were generally unable to write a prescription that covered all aspects of CVVH (blood and filtrate flows, replacement fluid, anticoagulation, catheter and filter size, etc.). In addition, candidates were unable to come up with strategies for increasing ammonia clearance, betraying a lack of understanding of the principles involved.

Question 15

You are the specialist taking over responsibility for the PICU. There is a newborn infant who has been on VA ECMO for 5 days because of meconium aspiration. You receive handover from the night staff that they believe that this patient is ready for decannulation.

- a) Outline how you will assess whether or not to proceed with decannulation. (70% marks)
- b) Outline the various methods of reducing ECMO support immediately prior to decannulation. (30% marks)

Maximum Score	5.0
Percentage Passed	9%

Examiners' comments:

This question tested whether candidates understood the process and practicalities of weaning from ECMO. Some candidates did not consider the big-picture, non-clinical factors that senior staff need to consider, such as staffing, timing and unit acuity. Many candidates demonstrated poor understanding of the use of VA ECMO for meconium aspiration (as opposed to post-op cardiac surgery) and therefore gave generic answers. Candidates needed to be able to describe assessment of resolution of the underlying condition and any associated complications prior to weaning from ECMO. A range of

decannulation strategies was expected in response to the second part of the question, including the use of a bridge with recirculation and pump-controlled retrograde flow.

Question 16

A previously well, fully immunized 4-year-old girl presents to the Emergency Department with a 5-day history of cough, fever and increasing dyspnoea.

Examination reveals the following:

Temperature: 39.5°C
Respiratory rate: 35 breaths/minute, with slightly increased effort
Oxygen saturation 92% in room air, 96% in 2 L/min of nasal prong O₂
Heart rate: 150 beats/minute
Blood pressure: 75/35 mmHg (mean 55 mmHg)

Her chest X-ray is shown below (Figure 16.1):

(Image removed from report.)

- a) Describe the salient features of the X-ray (Figure 16.1 shown on page 2). (20% marks)
- b) What are the likely organisms and what antibiotics would you administer to this patient? (20% marks)
- c) In tabular form, compare the advantages and disadvantages for the following treatment modalities:
 - i. Antibiotics alone.
 - ii. Antibiotics and chest drain.
 - iii. Antibiotics, chest drain and fibrinolysis.
 - iv. Antibiotics and video assisted thoracic surgery (VATS). (40% marks)
- d) Discuss the evidence supporting fibrinolysis and VATS in patients with empyema. (20% marks)

Maximum Score	8.8
Percentage Passed	100%

Examiners' comments:

This question required a good general knowledge base and a structured approach. Most candidates did well, and some had an excellent understanding of different treatments and approaches.

Question 17

In table form, compare and contrast malignant hyperthermia and neuroleptic malignant syndrome, with respect to the following features:

- a) Drug triggers.
- b) Genetics.
- c) Timing of onset.

- d) Clinical features.
- e) Treatment.
- f) Mortality.
- g) Specific diagnostic tests.

Maximum Score	8.0
Percentage Passed	82%

Examiners' comments:

Although neuroleptic malignant syndrome is uncommon, most candidates had a good understanding and answered this question well. Tables were well set out and structured.

Question 18

A 5-day-old boy, who is post-operative day 2 following repair of interrupted aortic arch and VSD, has had seizures overnight. An emergency CT scan shows subtle changes suggestive of an acute left-sided ischaemic infarct. A neurologist has been consulted and suggests an urgent brain MRI.

The patient is intubated, ventilated and sedated. He remains on dobutamine and low-dose adrenaline infusions. He is paced AAI, with an underlying junctional rhythm of 160 beats/minute.

Discuss the risks of transporting this patient to the MRI suite and performing the scan.

Maximum Score	8.5
Percentage Passed	45%

Examiners' comments:

Many candidates misinterpreted this question, answering 'how to prepare' or 'what equipment to use', rather than discussing the risks involved, and answers were often poorly structured. Candidates who scored well not only described the risks involved, but also expressed a mature opinion relating to the balance of risks and benefits.

Question 19

Outline the complications of measles relevant to PICU practice.

Maximum Score	6.3
Percentage Passed	27%

Examiners' comments:

This is highly topical and should have been well understood. Candidates were asked to outline complications, but many instead focused on management and infection control measures rather than answering the question. Candidates were generally narrow in focus and did not describe systemic complications other than pneumonia.

Question 20

You are caring for a 4-month-old infant with known spinal muscular atrophy (SMA) type 1, who has been intubated and ventilated for acute respiratory failure associated with RSV-positive bronchiolitis.

The parents initially agreed to treatment with regular intrathecal nusinersen. However, they state that they now wish to stop ventilation and allow their child to die peacefully.

During your discussion with the parents regarding end-of-life care, they ask whether medications can be administered to hasten the dying process, to ensure that the duration of any suffering is as short as possible. They say that they do not want to watch him struggling for breath once he has been extubated.

- a) How will you respond to the parents' request to 'hasten' the dying process? (35% marks)
- b) What is the difference between 'withdrawal of life-sustaining therapy with comfort measures only' and euthanasia? (25% marks)
- c) What is the 'doctrine/principle of double effect'? (20% marks)
- d) List four ethical conditions that must be satisfied for the application of the principle of double effect. (20% marks)

Maximum Score	5.5
Percentage Passed	18%

Examiners' comments:

Responses needed to describe the nature of discussion around this end of life request. The differences between withdrawal of life sustaining therapy and euthanasia were appreciated but the "principle of double effect" less so, and confused with other ethical considerations around autonomy, maleficence and beneficence. Few described ethical conditions specific to the application of this case such as parental request, ethical concerns and legal issues raised. Many candidates demonstrated a thoughtful approach to the family, but a more limited understanding of the ethical and legal principles underpinning the actions of most intensivists in this setting.

Question 21

- a) Draw and label a normal capnograph. (30% marks)
- b) List eight clinical uses of capnography. (20% marks)
- c) Outline the principles of function and limitations of a modern capnography device. (20% marks)
- d) Outline reasons for the difference between arterial and end-tidal CO₂ in health and disease. (30% marks)

Maximum Score	6.8
Percentage Passed	18%

Examiners' comments:

A correctly labelled diagram produced by most candidates. Clinical use of capnography was generally well appreciated. Principles of spectrophotometry, side stream and in-line methodologies and their limitations were, however, not well described. Few candidates provided adequate detail explaining the differences between arterial and end-tidal CO₂. Candidates should have an understanding of how equipment functions and an understanding of gas equations. This is core knowledge which should be well understood, and candidates should present well organised reasons for monitoring and what affects the parameter being monitored.

Question 22

A 10-year-old girl has been admitted to your PICU with increasing weakness. She has a long history of myasthenia gravis which has been difficult to control despite multiple different therapies.

- a) Outline the pathophysiology of myasthenia gravis in children. (40% marks)
- b) List the treatment categories used in myasthenia gravis and state how they are proposed to work. (40% marks)
- c) List four causes of myaesthetic crisis. (20% marks)

Maximum Score	8.3
Percentage Passed	36%

Examiners' comments:

Candidates were expected to describe the nature of the anti-Ach receptor antibody mediated weakness, and to make mention of other myasthenic syndromes in children (non AChR receptor antibodies, transient neonatal myasthenia, congenital myasthenia). Acetylcholinesterase inhibition, immunosuppression and immunomodulation, and surgery were expected in response to the section on therapies. Candidates who did well described these therapies, causes of myaesthetic crises and specific medical treatments. Many responses were unable to correctly identify the pathophysiology and provided a very superficial description of therapy.

Reference(s):

1. Uptodate – Overview of treatment of myasthenia gravis
2. Oh's Intensive Care Manual, Eighth Edition, pp 725-727

Question 23

You are phoned for advice by the paediatric retrieval team regarding stabilisation of a 3-day-old term infant, who has presented from home in a collapsed state to a regional hospital.

Resuscitation so far has included fluid boluses, appropriate antibiotics, intubation and ventilation, sedation, prostaglandin E1 (alprostadil) infusion 0.05 µgram/kg/min, and dopamine infusion.

The retrieval team reports the following examination findings: chest excursion good, skin colour pale and mottled, all pulses are difficult to feel, liver edge is palpable 7 cm, ECG shows sinus tachycardia.

A chest X-ray was obtained prior to intubation (see Figure 23.1 shown below):

(Image removed from report.)

Following resuscitation, observations are:

Heart rate: 202 beats/minute
Blood pressure:
 (right arm) 43/27 mmHg (mean 32 mmHg)
 (right leg) 42/26 mmHg (mean 31 mmHg)
SpO₂ 85% (right hand)

Ventilator settings:

FiO₂ 1.0
PEEP 5 cmH₂O

Peak Inspiratory Pressure: 25 cmH₂O
 Respiratory rate: 40 breaths/minute
 Tidal volume: 38 ml

Venous blood gas results are shown below:

Parameter	Patient Value	Normal Range
pH	7.13*	7.35 – 7.45
pCO ₂	34 mmHg (5.0 kPa)*	35 – 45 (5.1 – 5.6)
pO ₂	21 mmHg (2.8 kPa)	
Base deficit	-16*	-2 to +2
Lactate	11.4 mmol/L*	0.5 – 2.0
Glucose	4.2 mmol/L	3.8 – 6.0
Haemoglobin	192 g/L*	135 – 180

- a) List your differential diagnoses and the pathophysiology of each. (40% marks)
- b) What practical advice will you give the retrieval team? Include a brief outline of pathophysiologic rationale for each. (60% marks)

Maximum Score	7.2
Percentage Passed	36%

Examiners' comments:

Some candidates did well in providing a differential and a rationale for the therapeutic interventions; however, others had a very limited approach to what is a common clinical scenario. Some did not consider obstructive left-sided cardiac lesions in their answer, and others listed resuscitative endeavours or goals without providing any rationale. Candidates who did well identified which lesions would be helped / harmed by interventions.

This is a common problem which requires a structured approach. Candidates were asked to provide practical advice to the transport team; however, some candidates provided advice that was not clear or specific enough and did not demonstrate an understanding of the pathophysiological basis for interventions.

Question 24

In table form, outline the route of administration, mechanism of action, half-life, mode of excretion and side effects of nitric oxide, epoprostenol, sildenafil and bosentan for the treatment of pulmonary hypertension in children.

Maximum Score	7.8
Percentage Passed	82%

Examiners' comments:

This question was generally answered well, and content knowledge was high. Common mistakes were mode of excretion of sildenafil and bosentan, half-life of both, as well as superficial answers that did not mention modes of action, but rather just wrote "cAMP" or "cGMP"; candidates are reminded that when asked to outline, more than a list of single words is expected.

Question 25

Bronchiolitis remains the most common admission diagnosis in Australian and New Zealand PICUs.

- a) Outline the anatomical, physiological and immunological factors that make infants prone to severe bronchiolitis. (40% marks)
- b) Outline the features of RSV that make it a significant cause of bronchiolitis in infants. (20% marks)
- c) List the risk factors for severe bronchiolitis associated with RSV infection. (10% marks)
- d) Outline the disease-specific options for the management and prevention of RSV bronchiolitis. Do not include general supportive measures. (30% marks)

Maximum Score	6.0
Percentage Passed	18%

Examiners' comments:

Although RSV is a very common pathogen, this question was not answered well. Most candidates provided some information on the anatomical and physiological factors that predispose infants to bronchiolitis, but the immunological aspects were poorly understood and innate and adaptive immune system responses to RSV rarely listed. Few candidates were able to give any information on the mechanisms by which RSV causes bronchiolitis.

Despite specifically asking candidates not to list general supportive measures, many did so anyway.

Reference(s):

Borchers A.T, Chang C, Gershwin M.E, Gershwin L.J. Respiratory Syncytial Virus- A Comprehensive Review Clin Rev Allerg Immunol (2013) 45: 331-379

Question 26

- a) Outline the reasons that traditional large randomised controlled trials are difficult to perform in PICU. (40% marks)
- b) Discuss the principles of adaptive clinical trial design. (60% marks)

Maximum Score	3.8
Percentage Passed	0%

Examiners' comments:

Candidates gave many reasons why trials can be difficult to perform, but many reasons were non-specific, and did not apply specifically to PICU. Some expected responses specific to PICU were the small number of patients, patient heterogeneity, ethical and practical problems with consent, and lack of appropriate endpoints. Knowledge about adaptive trials was particularly poor, and answers often did not address the actual question.

Reference(s):

1. van Werkhoven CH Adaptive designs in clinical trials in critically ill patients: principles, advantages and pitfalls. *Int Care Med* 2019;45(5):672-682

2. <https://intensivecarenetwork.com/adaptive-trial-design/>

Question 27

Your registrar calls you to see a 4-year-old boy with a single right ventricle who was admitted to PICU one hour ago following Fontan completion. He has had an uneventful lateral tunnel Fontan with a 4 mm fenestration.

Post-operative transesophageal echocardiogram showed mildly reduced systolic contractility, mild AV valve regurgitation and unobstructed flow in the Fontan pathway.

His observations are:

SpO₂ 82%
Heart rate: 165 beats/minute
Arterial blood pressure: 73/30 mmHg
Central venous pressure (SVC line): 12 cmH₂O

Ventilator settings:

SIMV / PS
FiO₂ 0.75
Respiratory rate: 16 breaths/minute
Pressures: 18 (total) / 5 cmH₂O

Results of an arterial blood gas analysis are shown below:

Parameter	Patient Value	Normal Range
pH	7.23*	7.35 – 7.45
PaCO ₂	52 mmHg (6.93 kPa)*	31 – 42 (4.13 – 6.00)
PaO ₂	51 mmHg (6.80 kPa)*	80 – 100 (10.67 – 13.33)
Base excess	-7	-5 to +5
Lactate	3.9 mmol/L*	< 2.0
Haemoglobin	155 g/L	115 – 155

Outline your initial approach to and principles of management of this patient.

Maximum Score	8.0
Percentage Passed	45%

Examiners' comments:

Candidates who did well showed clear physiological reasoning, including a discussion about pulmonary venous desaturation, inadequate pulmonary blood flow, and systemic venous desaturation - and the causes of all three. Poor answers did not show this structured approach to the problem. The answer asked for "initial approach" and "management" which included more than just differential considerations to score high marks. Several candidates suggested early extubation with a high lactate. This would have needed a qualification and justification, rather than simply suggesting it as a strategy.

Reference(s):

1. Fuhmann and Zimmerman *Pediatric Critical Care 5th Ed Chapter 29 and Chapter 38*
2. Rogers *Textbook of Pediatric Intensive Care 5th Ed Chapter 79*

Question 28

Critically evaluate a restrictive red blood cell transfusion strategy in PICU. Do not include an extensive list of the risks of transfusion in your answer.

Maximum Score	6.0
Percentage Passed	45%

Examiners' comments:

Most candidates understood that 'critically evaluate' requires presentation and discussion of the evidence. Despite that, some candidates spent too long on the physiology of transfusion, oxygen delivery and indications for transfusion. While mentioning the TAXI guidelines of 2018 was relevant, these only synthesise the evidence rather than providing any original data. Knowledge of TRIPICU, the most important study, was thin. Candidates who did well also discussed evidence relating to cyanotic heart disease.

Reference(s):

1. Hébert P, Wells G, Blajchman Mea. A multicenter, randomized, controlled clinical trial of transfusion requirements in critical care. *Transfusion Requirements in Critical Care Investigators, Canadian Critical Care Trials Group. N Engl J Med.* 1999;Feb 11;340(6):409-17.
2. Lacroix J, Hébert P, Hutchison Jea. *Transfusion Strategies for Patients in Pediatric Intensive Care Units. New England Journal of Medicine.* 2007;356(16):1609-19.
3. Cholette JM, Willems A, Valentine SL, Bateman ST, Schwartz SM. *Recommendations on RBC Transfusion in Infants and Children With Acquired and Congenital Heart Disease From the Pediatric Critical Care Transfusion and Anemia Expertise Initiative. Pediatric Critical Care Medicine.* 2018;19(9S):S137-S48.
4. Willems A, Harrington K, Lacroix J, Biarent D, Joffe AR, Wensley D, et al. *Comparison of two red-cell transfusion strategies after pediatric cardiac surgery: A subgroup analysis. Critical Care Medicine.* 2010;38(2):649-56.
5. Cholette JM, Rubenstein JS, Alfieris GM, Powers KS, Eaton M, Lerner NB. *Children with single-ventricle physiology do not benefit from higher hemoglobin levels post cavopulmonary connection: results of a prospective, randomized, controlled trial of a restrictive versus liberal red-cell transfusion strategy. Pediatric Critical Care Medicine.* 2011;12(1):39-45.
6. Blackwood J, Joffe AR, Robertson CM, Dinu IA, Alton G, Penner K, et al. *Association of hemoglobin and transfusion with outcome after operations for hypoplastic left heart. The Annals of thoracic surgery.* 2010;89(5):1378-84. e2.
7. Willems A HK, Lacroix J et al for the Canadian Critical Care Trials Group and the Pediatric Acute Lung Injury and Sepsis Investigators (PALISI) Network. *Comparison of two red-cell transfusion strategies after pediatric cardiac surgery. . Crit Care Med.* 2010;38(2):649-56.
8. de Gast-Bakker DH, de Wilde RB, Hazekamp MG, Sojak V, Zwaginga JJ, Wolterbeek R, et al. *Safety and effects of two red blood cell transfusion strategies in pediatric cardiac surgery patients: a randomized controlled trial. Intensive Care Med.* 2013;39(11):2011-9.
9. Cholette JMMD, Swartz MFP, Rubenstein JMD, Henrichs KFMT, Wang HP, Powers KSMD, et al. *Outcomes Using a Conservative Versus Liberal Red Blood Cell Transfusion Strategy in Infants Requiring Cardiac Operation. The Annals of Thoracic Surgery.* 2017;103(1):206-14.

Question 29

- a) What is Airway Pressure Release Ventilation (APRV) and what is it used for? (20% marks)
- b) Draw a labelled pressure-time waveform of APRV. (20% marks)
- c) What are the similarities and differences between APRV and synchronised intermittent mandatory ventilation with pressure support (SIMV / PS)? (40% marks)
- d) What are the potential advantages and disadvantages of APRV? (20% marks)

Maximum Score	8.2
Percentage Passed	45%

Examiners' comments:

APRV is infrequently used but has been discussed in the literature and candidates should be aware of this mode of ventilation. Candidates should consider first principles in trying to answer questions where their knowledge is limited.

Reference:

Oh's intensive care manual Eighth Edition p407

Question 30

With regard to retrieval services for critically ill children and neonates:

- a) State three benefits of a centralised or stand-alone paediatric and neonatal retrieval service e.g. NETS in NSW, Australia. (30% marks)
- b) State three benefits of a paediatric and neonatal retrieval service based within an existing PICU. (30% marks)
- c) Describe the benefits of pre-transport consultation and advice when large delays / distances are involved. (30% marks)
- d) Explain the need for complete documentation of the patient's clinical condition prior, during and post transport. (10% marks)

Maximum Score	7.5
Percentage Passed	55%

Examiners' comments:

This question required a structured consultant level approach incorporating a global overview. Although some knowledge was required, candidates could do well by applying first principles. Candidates are reminded that concise bullet point answers addressing the question often score more highly than rushed longer answers.

Reference(s):

Hancock S, Harrison C. Establishing a combined Neonatal and Paediatric Transport System from Scratch. Curr Treat Options Peds (2018) 4: 119-128.

ORAL SECTION

The Clinical Section

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

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

Candidates were given a written introduction to the hot cases, which they studied for 2 minutes prior to commencement. This allowed candidates time to think about how best to approach the case, what information to seek and how to structure the examination. These two minutes are in addition to the 20 minutes taken to perform the hot case.

Cases are usually presented as problem solving exercises. For maximum marks, candidates should demonstrate a systematic approach to examination, clinical signs should be demonstrated, and a reasonable discussion regarding their findings should follow.

Some candidates waste valuable time at the start of the case by spending more than a couple of minutes around the bedside before actually examining the patient. Exposing the patient 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.

The twenty minutes available for each case provides ample opportunity to discuss investigations and plans of management. Candidates are reminded that a large proportion of the marks are allocated to coherent presentation and synthesis, discussion and reasoning. Candidates should approach the case discussion in a consultant-like manner.

Cases encountered in the clinical component of the examination included:

- A 4-week-old girl, ventilator dependent 16 days post hypoplastic arch repair and VSD closure
- A 7-day-old boy 3 days post truncus arteriosus and arch repair with delayed sternal closure
- An 11-day-old girl with obstructed TAPVD on ECMO from day one
- A 2-year-old girl with progressive weakness and respiratory failure

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.

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

Viva 1

A 4-month-old male infant was admitted to your PICU 8 hours ago following repair of a peri-membranous ventricular septal defect (VSD).

He is mechanically ventilated and has atrial and ventricular epicardial pacing wires and a mediastinal drain in situ.

His ECG is shown below.

What does the ECG show?

(Image removed from report.)

Viva 2

This viva will explore your understanding of humidification and oxygen therapy in PICU.

How does this device work?

(Image removed from report.)

Viva 3

You are looking after a 3-year-old previously well girl (14 kg) who has been transferred from a regional centre after being intubated for severe hypoxia.

She presented to the regional centre earlier today with acute respiratory distress after a 3-day history of cough and fever.

She has been given IV ceftriaxone.

Her initial chest X-ray on arrival is shown below.

Her initial ventilator settings following arrival are below:

SIMV (VC): FiO₂ 0.7
Tidal volume 80 mls
PEEP 6 cmH₂O
Rate 25 breaths/min
(MAP 18, PIP 32)

Please describe the chest X-ray.

(Image removed from report.)

Viva 4

You are the weekend consultant on call in a 6-bedded PICU in a tertiary level hospital.

At 8am this morning, you cancelled two planned admissions because the unit is full with no expected discharges.

As the unit is quiet, you have returned home for the afternoon, however, your PICU nursing shift coordinator has just informed you that 30 children are being assessed in the Emergency Department for smoke inhalation following a gas explosion at a local primary school fair.

There are unconfirmed reports of more casualties of all ages on their way to the hospital.

What constitutes a mass casualty incident?

Viva 5

You receive a night-time call from a remote GP at a remote hospital (250 km away) wishing to transfer a previously well 4-month-old girl with dyspnoea and shock.

The GP has given oxygen, has inserted an IV and given ceftriaxone and a 20 ml/kg fluid bolus.

You are the sole intensivist on duty in the PICU.

What questions would you ask?

Viva 6 – Procedure Viva

Ben is a 9-month-old child with a body weight of 10 kg.

He had congenital cardiac surgery for an atrioventricular septal defect 3 weeks ago. Post-cardiac surgery he suffered a cardiac arrest and was commenced on ECMO.

He was weaned from ECMO 2 weeks ago, with good cardiac recovery. He has ongoing renal dysfunction for which he is on CVVHDF with a vascath positioned in the neck.

He is intubated and ventilated. His ventilation settings are shown below:

Tidal volume 8 ml/kg

Rate 30 breaths/min

PEEP 10 cmH₂O

The inspired fraction of oxygen is 0.6

The measured peak inspiratory pressure is 30 cmH₂O

His cardiovascular support includes:

Milrinone: 0.5 mcg/kg/min

Fluid: Maintenance fluid with 0.9% saline mixed with 5% dextrose is running at 10 ml/hr

Sedation: Morphine 20 mcg/kg/hr. Dexmedetomidine at 0.5 mcg/kg/hr.

You are called by the bedside nurse to review him because his arterial saturations have dropped to the low 90s (they were 98% previously) and he has required 20 ml/kg of 4% albumin to keep his mean arterial blood pressure above 45 mmHg.

Viva 7 – Radiology Viva

Candidates were shown a series of radiological investigations and asked to describe the important findings in each.

Viva 8 – Communication Viva

Jayden is a 4-month infant with a large VSD. He was admitted with moderate heart failure requiring ventilation, a central line has been placed by the PICU registrar who thought Jayden would need inotropes. He improved with ventilation and intravenous diuretics and did not need inotropes after all. The plan is for Jayden to have his VSD operation brought forward to the next one or two days. On preoperative CXR today, it appears that at least some of the guide wire for the CVL has been retained.

The wire is now sitting beyond the cannula and in the RA. The surgeon does not want to intervene tonight because the child is stable. She will review the situation in the morning and decide whether to take a surgical approach with VSD repair, or an interventional approach to retrieve the wire first.

The surgeon has spoken to one of the parents about the VSD operation before the wire was found and has left the department. The parents have been waiting anxiously to come in to see Jayden.

You are to undertake a Clinician Disclosure of the retained guide wire to the parents, Leslie and Ash.