FRCPath Clinical Biochemistry

Part 2, Module 2, Oral Exam

Practice Questions

The following oral questions were the ones used in the autumn 2022 exam (unchanged). They have been retired from the cases question bank and will not appear again in their exact current format. The topic areas remain very much in scope for future exams (all parts) however.

Dr Bernie Croal – FRCPath Clinical Biochemistry Panel Chair

February 2023

The Oral examination comprises two sections, each with a pair of examiners. In the first, candidates are given two questions, one on a managerial topic and the other on either a clinical problem (for medically-qualified candidates) or analytical issue (for scientifically-qualified candidates). Candidates are allowed 30 minutes before the oral examination to review these questions and prepare their answers to them. The second section comprises 4 questions covering patient and laboratory safety and two more clinical problems; candidates are not allowed to review the questions in this section before the oral.

The Royal College of Pathologists
Pathology: the science behind the cure

Part 2 Oral Examination

Clinical Biochemistry

Autumn 2022

Candidates will have 30 minutes with the enclosed material in which to prepare their responses for the first half of the oral examination. **Please write your notes in the enclosed answer book.** All candidates will answer question 1; for question 2 ensure that you answer the correct question for whether you are medically or scientifically qualified.

The oral examination will be conducted by two pairs of examiners; you will see each pair for 20 minutes.

Question papers and answer books will be collected following the oral examination but are not used for marking purposes. Please ensure that you have handed your question paper and answer book either to the examiners or an invigilator before you leave.

Candidates must not communicate with other candidates about the content of the examination during the hours of the examination day.

Oral 1

Question 1 Management (All candidates)

You are a senior consultant working in a large District General Hospital in a relatively remote setting. At 11pm on a Friday evening, you are called by the hospital to inform you that there has been a serious fire within the hospital centred on the Laboratory block. As such, the entire block has been effectively destroyed.

As on-call consultant and head of department, ***outline what immediate, medium and long term action you would take.***

Additional Information

- Hospital size – 350 beds
- Services – A&E, maternity unit, cancer services, paediatric ward, small ITU and HDU. Large rural GP network.
- Laboratory Staff (Biochem) – 1 Consultant Medic, 1 Consultant Clinical Scientist, 2 Clinical scientists (band 7 and 8a), 12 biomedical scientists, 14 Admin/reception staff.
- Workload – 200,000 samples per year (50% from Primary Care). Large send away workload, mainly to large teaching hospital 90 miles away.
- Analysers – 3 large automated chem/immunoassay analysers – stand alone. Additional equipment for protein electrophoresis, CSF (Hb Breakdown Products), HbA1c and a HPLC set up used mainly for Catecholamines.
- POCT – 5 blood gas analysers (including basic chemistry) and 19 blood glucose meters distributed around the hospital.

Answers to consider/additional areas for questioning.
Main task is to ensure candidates are aware of the seriousness of this situation to patient care and that they can map out a logical, informed strategy to deal with immediate, medium and long term planning and decision making to re-establish a service.

Immediate Action

- Go to the hospital site. Consult Lab contingency plan for this kind of incident if available.
- Communicate with senior hospital management/Major Incident likely to be declared.
- Assess the whereabouts and safety of staff working that evening.
- Assess the feasibility of any undamaged equipment/areas being usable (in this case none)
- Communicate (informally as unlikely to be on call officially) with other senior staff in department and request assistance.
- Meet with senior hospital management and clinical leads to determine what level of service can be established in the next 24-48hrs. Draw up an action plan based on urgent samples only.
- Likely to be based upon maximising POCT use and linking with nearest hospitals for sample transport.
- Set up ad-hoc new sample reception to deal with receipt (another part of the hospital), data entry and packaging of samples. Likely to be paper based as Lab LIMS likely to have been affected.
- Communicate with on-call teams at nearest hospitals for assistance and to explore capacity for sample transfer.
- Likely that Hospital capacity and scope will be severely affected – especially if BTS also impacted – No trauma, major surgery, obstetric complications, etc.

- Implement demand optimisation strategy to cope with this setting and the likely extremely limited capacity.

Medium Term Action

- Likely to involve setting up an interim laboratory while a long term solution is worked through/delivered.
- Premises – another space is required – other part of the hospital or short term Porta cabin facilities.
- Analysers - Liaise with nearest hospitals and Equipment suppliers re stand alone analyser availability. Max out POCT options and ensure kit supply can keep up.
- Aim for general chemistry plus Troponin/HCG as a minimum panel.
- IT – Liaise with suppliers to establish if basic LIMS can be set up ASAP and linked to hospital and GP EPRs for reporting. Establish if LIMS back up was held offsite (cloud).
- Staff – reorganise and allocate tasks as needed to fit new structure. Likely more admin tasks if paper based ordering and reporting.
- Send-away likely to become a major part of the interim service to cover all testing not re-established.
- Importance about good comms with users in primary and secondary care.
- Consider draconian demand optimisation policy to keep samples to a minimum.

Long Term Action

- Will involve a permanent lab rebuild, IT set up and equipment implementation.
- Don’t look to simply re-build what was there before or copy the previous service – opportunity to build better.
- Opportunities to evaluate services required and base procurement of IT and Analytical equipment on that basis.
- Consider scope of tests needed onsite.
- Consider permanent send aways to larger hospital in network.
- Building – better processes – blood sciences set up.
- Environment and sustainability – again look to build into plan for physical building, analyser procurement, sample flow and processes.
- Build in better fire safety and contingency planning for such episodes of future critical service failure.

Question 2 Clinical (for medically qualified candidates only)

You are the on-call consultant for Clinical Biochemistry when you are called by the on-call Biomedical Scientist around midnight with the following results on a 3 day old male neonate. The clinical information on the request is: “Sick neonate – poor feeding to seizures to cardiac arrhythmia in a few hours - ?sepsis ?metabolic condition.”

Sodium	136 mmol/L	(133 – 146)
Potassium	5.5 mmol/L	(3.4 – 6.0)
Chloride	104 mmol/L	(95 – 108)
Urea	2.9 mmol/L	(0.8 – 5.5)
Creatinine	70 µmol/L	(27 – 81)
Ammonia	2919 µmol/L	(<100)
Haemolysis	+ (slightly haemolysed)	
Lipaemia	–	
Icteric	++	

- What immediate action would you take?
- What further biochemical investigations should be arranged?
- What treatments are likely to be initiated?

Notes for examiners

The key thing required of candidates is for them to indicate that this grossly increased plasma ammonia concentration is a critical result that must be immediately communicated by phone to the responsible clinician. I would expect candidates to indicate that they would personally phone the result, and that this should be to a responsible clinician. The candidate should indicate that they would seek to have a conversation with the clinician about the critical urgency of instituting immediate management of this severe hyperammonaemia.

Points that might be discussed:
Although this sample is slightly haemolysed, haemolysis will not account for this severe hyperammonaemia.
If the candidate asks, tell them that the sample arrived in the lab 27 minutes after the sample was taken, and it was transported on ice. However, candidates should be aware that even if sample receipt had been delayed or the sample had not been delivered on ice that neither of those factors would account for an ammonia result of this level.

Candidates should indicate that they would:
Request an urgent repeat sample to confirm the result – this must be sent immediately and absolutely cannot wait until the morning.
Advise that at this level of hyperammonaemia it is extremely likely that an inherited metabolic condition is responsible for the hyperammonaemia.

Further investigations are detailed in the relevant MetBioNet guideline: https://metbio.net/wp-content/uploads/MetBio-Guideline-PERE918546-10-12-2018.pdf:

Blood gases, urea, liver function tests, glucose, lactate, calcium, ketones
Plasma amino acids, urine organic acids including orotic acid, blood spot or plasma acylcarnitines.

Ideally, samples should be collected before initiation of treatment. However, it is essential to note that treatment in this case must be initiated immediately. The relevant guideline is the

BIMDG guideline on Undiagnosed hyperammonaemia: Diagnosis and immediate management: https://www.bimdg.org.uk/store/guidelines/Hyperammonaemiaand_manage_2016_415469_09092016.pdf.

Key points:

The clinician must be advised to contact the relevant metabolic centre immediately for advice regarding management and potential transfer. Unless the candidate is a specialist working in such a centre, clinical management of a condition such as this will be outwith their expertise. However, good candidates are likely to know the principles of management: i.v. glucose, sodium benzoate, sodium phenylbutyrate and arginine, and that overdose can be associated with fatal cerebral oedema and metabolic acidosis. A non-specialist should not initiate these drugs without expert advice.

If candidates get through all of the above, they could be given the results of plasma amino acid analysis:

Glutamine 1766 mmol/L (100-700)
Alanine 2071 mmol/L (200-600)
Citrulline 1658 mmol/L (10-60)
Ornithine 20 mmol/L (50-200)
Arginine 18 mmol/L (20-140)
No argininosuccinic acid detected

Urine orotic acid 268.5 mmol/mmol creatinine (0-3)

The diagnosis was citrullinaemia type 1 (argininosuccinate synthetase deficiency). However, it is to be emphasised that candidates are not expected to get to the diagnosis, and the point of this question is for them to demonstrate that they understand the urgency of severe hyperammonaemia and would ensure that the clinician is advised appropriately as above.

Question 3 Science (for Clinical Scientist candidates only)

You are a consultant in a large teaching hospital. The gastroenterologists are interested in the diagnosis and treatment of bile acid diarrhoea. NICE recently released guidance on using SeHCAT (tauroselcholic [75 selenium] acid) for this purpose, but concluded that there was not enough evidence to justify its routine adoption. One of the gastroenterologists has asked whether you could set up an assay for plasma bile acids, using a published liquid chromatography mass spectrometry method that was in use where they previously worked. At present, patients either have a SeHCAT scan or are started empirically on bile acid sequestrants. In the NICE guidance, plasma bile acids were not considered because measurement of bile acids is not generally available in the National Health Service. Your laboratory has suitable equipment for the proposed assay.

Describe the factors that you would take into account in deciding whether to set up the assay.

If you decided to set up the assay, how would you validate and introduce the service?

Note to examiners: This isn't about the specific assay and no knowledge about SeHCAT or bile acid measurements is assumed. It's a test of the general approach to deciding whether/how to introduce a new test and some of the factors that might be considered.

1. Deciding whether to set up the assay
    1. Clinical evidence:
        - What published evidence of measurement of bile acids being able to help the diagnosis of bile acid diarrhoea?
        - Are there any RCTs or meta-analyses, and if so, what is the comparator?
        - What is the sensitivity and specificity of the assay?
    2. Assay characteristics
        - How easy is the assay to set up?
        - Is there a laboratory that routinely performs the assay?
    3. Laboratory considerations
        - Who will run the assay?
        - Cost per sample and cost recovery
        - Turnaround time
        - Likely sample numbers
        - Would referring samples be a better option
2. Validation and introduction
    1. Sample type?
    2. Equipment, reagents, calibrants, controls
    3. Any extraction?
    4. See if the assay measures what you think it should, using purified substances
    5. If there are other laboratories providing the assay, do sample exchange
    6. EQA scheme (unlikely for a niche assay)
    7. Talk to clinicians

8. Arrange for it to be able to be requested on electronic systems (?hidden, demand management to control access to requesting)
9. Audit against SeHCAT, whatever the clinicians are using at present
10. Review usage after a predetermined time (e.g., 1 or 2 years) and discuss with clinicians

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Part 2 Module 2
Oral Exam Questions 3-6

Oral 2
Q3 Laboratory Safety

Following a prolonged heat spell, temperatures in the analytical labs of your department frequently rise to reach levels well in excess of 30°C. You are made aware of a significant detrimental impact on analytical errors and analyser breakdown. In addition, significant unrest is growing amongst staff. One particularly hot afternoon, a Biomedical Scientist within the lab becomes very unwell with possible heat exhaustion.

Outline your immediate action at this time.
What assessments do you make and what mitigation could you put in place.

Examiner Comments
This question deals with the candidate's ability to deal with the immediate incident involving the member of staff and also to establish via a risk assessment mechanism how to avoid or mitigate against the underlying issue – in this case, high working temperatures in the lab.

Immediate

- The immediate well-being of the staff member is paramount.
- The staff member should be taken to a cooler area of the lab or hospital – air-conditioned area or even outside in the shade. A walk in freezer should be avoided.
- They should be given a cool drink or fan.
- If not improving within 30 minutes, further formal medical assessment should be considered.

Risk assessment

- A formal risk assessment should be undertaken – this should be suggested if not volunteered.
- NB There is no UK law that governs whether it is safe to work above or below a certain temperature. The concept of "thermal comfort" is to be aimed for but this is ill-defined.
- Mitigations to reduce the impact of very hot working temperatures would be air-conditioning (installed and maintained), electric fans, blinds, opening windows, relaxation of restrictive clothing where possible, more frequent breaks, provision of adequate fluids and altering shifts to possibly avoid the hottest parts of the day.
- Include in the risk assessment, the impact on the analytical safety and the knock-on risks for patient care.
- The findings of the risk assessment should lead to the application of mitigation where possible and requests to hospital management for urgent implementation of other solutions requiring funding and/or estates work.
- It is likely that requests that mitigate against patient errors are more likely to be sanctioned rather than those purely aimed to improve the thermal comfort of staff.
- Candidates may mention the importance of an environmental and sustainability strategy for Lab Services.

Oral 2
Q4 Patient Safety

You receive a phone call from an irate surgeon one afternoon, complaining that his POCT U&Es machine is frequently producing results that don't match the lab results. This has led in some instances to delay or cancellation of surgical procedures and/or treatment being changed due to discordant results. This is the first time you have become aware of the existence of such an analyser. How do you respond?

Examiner Comments
Candidates should recognise the potential seriousness of this situation with respect to clinical risk. As such, a strong recommendation should be made that the POCT analyser is immediately taken out of use and any clinical incident is formally recorded (Datix).

An urgent meeting with the surgeon concerned and the relevant management should be called to discuss the incident and the importance of good governance with regards to POCT. The following should be considered:

- The actual clinical need for such a POCT service – alternative central lab solutions.
- The importance of lab involvement in POCT services and the associated costs involved.
- The need for lab informed analyser procurement, selection and safe implementation.
- The need for adequate lab maintenance.
- The need for on-going staff training.
- The need for adequate IQC and EQA.
- The need for adequate record keeping and result storage – ideally electronic to the lab LIMS and EPR.
- The need for UKAS Accreditation if possible and the potential changes to ISO 15189:2022 to incorporate POCT.

Oral 2
Q5 Clinical Case-1

Your department provides a comprehensive intravenous parenteral nutrition (PN) feeding service. A surgical resident phones you up requesting urgent PN, as his patient is very malnourished, oedematous with an albumin of 12 g/L and is not eating much.

Recent bloods:

Na	136 mmol/L	(133-146)	
K	4.2 mmol/L	(3.5-5.3)	
Urea	7.2 mmol/L	(2.5-7.8)	
Creat	82 umol/L	(45-84)	
Tot Prot	39 g/L	(60-80)	*
Albumin	12 g/L	(35-50)	*
Bilirubin	18 umol/L	(0-20)	
ALT	28 U/L	(5-55)	
Alk Phos	39 U/L	(30-130)	
CRP	249 mg/L	(0-4)	*

a) What information do you want to know about the patient?
b) What are the possible causes of his low albumin
c) Is PN indicated in this patient?

Examiner Comments
This question deals with the candidate's ability to interpret a very low albumin level in the context of a request for PN feeding. Some knowledge of options for nutritional support should be expected, especially from the medical candidates.

a) What information do you want to know about the patient?
Patient age, weight, BMI, PMH, history of malnutrition, able to eat?
- Age 29 yrs, 80kg, BMI 27, admitted with appendicitis 2 days ago, operated – appendix removed yesterday. No history of malnutrition or weight loss. Patient is able to eat but taking in very little.

b) What are the possible causes of his low albumin
- Prolonged Malnutrition – unlikely given the history, lack of weight loss or lack of a prolonged period without nutrition.
- Inflammatory state – highly likely given the post-surgical nature, recent appendicitis and the very high CRP level.
- Other causes but unlikely in this patient – liver disease, kidney disease, heart failure, malabsorption, protein losing enteropathy.
- Suggest measuring urine protein and albumin loss.

c) Is PN indicated in this patient?
- No – based on the information provided, the increased risks and expense of PN in this patient is not justified. Normalisation of albumin can be very slow and not until the inflammatory state resolves.
- The patient should be encouraged to eat +/- enteral supplement drinks. If prolonged course (> 1 week) then enteral tube feeding should be considered before PN.

Oral 2
Q6 Clinical Case-2

A Cardiology colleague phones your department for some advice on a 46 year male patient admitted a week ago with a brief episode of chest pain lasting 3 hours. He was found to have an elevated Troponin I level on admission of 1453 ng/L (Ref Range <34 ng/L) but both a normal ECG and subsequent coronary angiogram. He has no other symptoms, signs or past medical history of note. He has recently had his COVID-19 booster vaccination.

Since then he remains well but daily Troponin I levels remain elevated:

Admission	1453 ng/L
Day 1	1529 ng/L
Day 2	1252 ng/L
Day 3	1736 ng/L
Day 4	958 ng/L
Day 5	1487 ng/L
Day 6	1421 ng/L
Day 7	1162 ng/L

a) What other disorders except myocardial infarction can cause an elevated troponin?
b) What chemical phenomena and interferences can produce a chronically elevated troponin level.
c) Can this patient be safely discharged?

Examiner Comments
This question deals with the uncommon presentation of a chronically elevated troponin in a patient with no other evidence of acute myocardial infarction.

a) What other disorders except myocardial infarction can cause an elevated troponin?
- Cardiac: Inflammation, cardiomyopathies, arrhythmias, drug cardiotoxicity, cardiac amyloid.
- Non Cardiac: Pulmonary embolism, stroke, SAH, renal failure, rheumatoid, sepsis.

b) What chemical phenomena and interferences can produce a chronically elevated troponin level.
- Heterophilic antibodies, Rheumatoid factor, Biotin, rare anti-troponin antibodies, macro-troponin* - well-read candidates may mention the recent case series published in Clin Chem of macro-troponin being identified in 3 cases associated with COVID-19 infection or vaccination. Further investigations – blocking agents, measure by alternative assay, etc.

c) Can this patient be safely discharged?
- Not a call for the lab to make – up to the clinicians to exclude other non AMI causes of an elevated troponin, and then for the lab to investigate the possibility of interference with heterophillic antibodies, RhF interference or the existence of a macro-troponin.
- Discharge risk would seem low.