



**Higher Specialist Diploma**

**Medical Microbiology**

**Examination – September 2021**

Short-answer questions

60 minutes

**Attempt all four questions**

Instructions to candidates

1. Record your candidate number and HSD discipline on the front sheet of the answer booklet
2. Record your candidate number, the question number and the page number in the spaces provided on the answer sheets
3. Begin each new answer on a new page
4. Each question is worth 25 marks

1. Your laboratory has recently verified the use of a rapid PCR technique that detects the 'big five' carbapenemase genes. Explain how this might fit into your current working practice and make a case for or against its use as a primary test directly on specimens.
2. There has been an ESBL producing *K.pneumoniae* outbreak in the paediatric intensive care unit of your hospital and the infection control team have highlighted a need to rapidly introduce a screening method. Describe the process you would go through to enable this.
3. Following a run of the quality control samples through the urine analyser you notice the 10m Westgard rule has been breached. Explain this rule and suggest likely causes of the breach and any actions that should be taken.
4. During the processing of orthopaedic joint revision samples, it is noticed that there has been an increase in culture contaminants, causing difficulty with interpretation. The current process deployed is inoculation onto solid culture media plus Fastidious anaerobe broth. Identify potential sources of contamination and describe measures that can be implemented to reduce this.



**Higher Specialist Diploma**

**Medical Microbiology**

**Examination – September 2021**

**Essay Paper**

120 minutes

**Attempt 2 out of 5 questions**

Instructions to candidates

1. Record your candidate number and HSD discipline on the front sheet of the answer booklet
2. Record your candidate number, the question number and the page number in the spaces provided on the answer sheets
3. Begin each new answer on a new page
4. Each question is worth 100 marks

1. Critically review the following statement. 'The diagnosis of syphilis is difficult'.
  
2. Evaluate the significance of invasive fungal infections in the immunocompromised patient. Within your answer, highlight the problems associated with their laboratory diagnosis.
  
3. Why do UK laboratories need to retain and develop their expertise in the investigation of diseases caused by *Clostridium* species?
  
4. Critically evaluate the following statement. 'UK diagnostic microbiology laboratories must retain their capacity for using manual microscopy for the diagnosis of parasitic infections'.
  
- 5a. Construct a table showing the 'big five' carbapenemase families found in the UK, showing name, Ambler class, activity spectrum and example host organism species. (20%)
  
- 5b. Outline the SMI recommendations for the detection of bacteria with carbapenem-hydrolysing  $\beta$ -lactamases (carbapenemases) from stool or rectal swab samples. *NB: This information can be presented in tabular form or prose.* (40%)
  
- 5c. Discuss non-culture methods available for the detection of carbapenemases, commenting upon their advantages and disadvantages. (40%)



## **Higher Specialist Diploma**

### **Medical Microbiology**

**Examination - September 2021**

Case studies

120 minutes

### **Attempt all case studies**

#### Instructions to candidates

1. Record your candidate number and HSD discipline on the front sheet of the answer booklet
2. Record your candidate number, the question number and the page number in the spaces provided on the answer sheets
3. Begin each new answer on a new page
4. Each question is worth 100 marks
5. For these case study questions you are strongly advised to answer the questions as they arise during the case study to avoid later information impacting adversely on your answers to the earlier questions by presuming an “outcome”.

## SEEN CASE STUDY

1.

Elizabeth a 45 year old black woman from Zimbabwe where she works a nurse. During the COVID pandemic, a call is put out to temporarily offer NHS jobs to international nurses along with appropriate incentives to recruit additional staff. Elizabeth submits an application to work in the local hospital. She is shortlisted and the PR staff contact her existing employer in Zimbabwe for a reference. Her referee states that ‘Elizabeth is an excellent ICU nurse with 20 years’ experience’. She has a faultless record, is up to date in her training but, over the last two years, she has taken 30 days of self-certified sick leave, which is unusual for her’.

Elizabeth is subsequently given a three-month temporary work contract. She is granted an emergency work visa and arrives in the UK two weeks after being offered the role. The usual processes of screening international workers and temporary residents is not followed due to the emergency situation. She arrives in the UK on her own, having left her children in the care of a relative. Her husband died three years previously aged 50, cause unknown.

Elizabeth reports two days late for her first training shift. She says she was very fatigued by the long flight and is suffering from a lingering cold. She is tested for SARS-CoV-2 as a matter of course for all emergency workers and shown to not currently be infected. On her 5<sup>th</sup> day of working she asks to go home feeling unwell. She is fatigued, coughing and has a temperature. She returns to work the following week and collapses in the car park. She is rushed to A and E for further assessment but is noncommunicative, she does however have her staff card on her and her ward is contacted. The nurse in charge reports that Elizabeth had previously reported symptoms of:

- Generally feeling unwell
- Fatigue
- Coughing
- Raised temperature
- They also confirm her nationality

- a. Given **all of the above information** discuss any possible diagnoses that can be suggested at this point and your reasons why? (30 marks)

Table 1 below summarises the initial observations by the A and E registrar.

**Table 1: initial observations of the patient assessed in A and E**

Physical observations	Further observations
Enlarged lymph nodes and spleen	Pulse oximetry reading: 88%
Sweaty, temp of 37.9C	Pulse: 125 bpm
Disorientated, altered state of consciousness	Blood pressure: 80/44 mm Hg
Decreased breath sounds in left lung with regular, productive coughing	Respiratory rate: 28 breaths per minute
Severe headache and tingling sensation in extremities	Incidental suspected oral candidiasis upon inspection of oral cavity

- b. Comment upon the information in the above table and what this might suggest in relation to the cause of her illness; what microbiological samples would you suggest at this point and why? (20 marks)

She is given IV fluids and supportive oxygen treatment. Alongside microbiology samples the registrar orders a white blood cell count and a lactate and coagulopathy tests. She is immediately given an intravenous injection with 2.4 g of benzylpenicillin and moved to ICU. Overnight, her condition stabilises but does not improve and she is still reliant on the oxygen therapy to maintain her latest oximetry reading of 94%.

The microbiology laboratory reports no clinically significant bacterial isolates found from the samples cultured on blood agar. Overnight, her lactate and coagulopathy tests show 1.8 mmol/L lactate and normal clotting function, respectively however her white blood cell counts are significantly below the normal range especially the lymphocyte and neutrophil counts. She also has a significantly elevated C-reactive protein test result. There is a reasonable suspicion that Elizabeth may be HIV positive.

Further tests reveal:

- No response to antibiotics
  - Continued lower oxygen saturation levels
  - Elevated lactate levels
  - Low WBC levels despite signs of infection
  - Normal coagulopathy
  - No culturable microbes detected on routine media
  - Elevated C-reactive protein
- c. What can be taken from the above results and how might this aid the diagnosis, what further tests would you suggest at this stage? (35 marks)
- d. What major organism do you suspect is the cause of Elizabeth's infection, and detail the course of action for Elizabeth in terms of infectious disease-specific management of her condition? (15 marks)

## UNSEEN CASE STUDIES

2.

A 43 year old man presented with fever, swollen joints and diarrhoea after returning from a two week business trip in South East Asia. The symptoms had begun 5 days earlier while he was still on his travels. He had noticed pain in his right thigh, followed by fever, sweats and rigors. His right knee and both wrists were swollen and he also complained of mild pharyngitis. Before returning to the UK he was commenced on ciprofloxacin.

- a. Based only on the information above, evaluate the symptoms, possible infection(s) present and devise an investigative strategy. (20 marks)

On examination in the UK his temperature was 38.8°C, both wrists and his right knee had a faint rash and were swollen and hot to touch. The diarrhoea had resolved at this stage but the pharyngitis had worsened. A blood sample revealed an elevated white blood cell count and a C-reactive protein value of 152 mg/L and later this rose to 344 mg/L. Blood cultures were taken and currently were negative. Over the next 24 hours the swelling in the knee worsened and was aspirated. Turbid synovial fluid was sent to the laboratory for investigation. The ciprofloxacin was discontinued at this point.

- b. Explain how the synovial fluid would be processed in the microbiology laboratory. (20 marks)

No organisms were isolated from the synovial fluid and the blood cultures remained negative. No pathogens were detected from a throat swab. A 16S rDNA (broad range) PCR was performed on nucleic acids extracted from the synovial fluid deposit.

- c. Briefly explain the principle of 16S rDNA PCR in the detection and identification of bacteria. (20 marks)

- d. Why was 16S rDNA PCR not performed on the throat swab? (5 marks)

The 16S rDNA PCR produced a single product, which was sequenced, and analysis of this sequence showed a 100% similarity to *Neisseria gonorrhoeae* 16S rDNA sequence. Following this result the patient was reviewed by the GUM team where he admitted unprotected orogenital but protected genital contact with a sex worker while in South East Asia.

- e. What is the final diagnosis and what further actions are required at this point? (20 marks)



Nucleic acids extracted from the throat swab were subjected to PCR using *N. gonorrhoeae* specific primers. A positive result was observed and sequence analysis of PCR products revealed a 94% similarity to *N. gonorrhoeae* sequence and 82% similarity to *N. lactamica*.

- f. Comment on the significance of this result and any further actions required, if any. (15 marks)

3.

A 71-year-old male attended a London based A&E complaining of a weeklong history of a dull aching pain in his right testicle that had increased in severity the previous day following doing some manual work. The male was found to have a past medical history of untreated hepatitis C, erectile dysfunction (treated with vardenafil bought online), hypothyroidism and hypotension.

He stated there had been no erythema or pain in his other testicle or penile discharge. He reported haemospermia 4 times in the preceding 3 weeks, plus urinary urgency and frequency the night prior to attending hospital, but had no dysuria, difficulty initiating a stream or haematuria. He reported protected regular intercourse with a healthy single female partner. He reported a remote history of unspecified but treated sexually transmitted infection.

- a. What further tests should be performed, what if any conditions might you expect given the above scenario and what microbiology samples might be taken at this point? Which organisms might be suspected and what if any treatment might be started? Justify all of your choices? (30 marks)

On examination the patient was seen to be tachycardic, his right testicle swollen and tender but with no abnormal masses. There was no penile discharge. He had a raised WBC count with predominance of neutrophils. Urinalysis showed low WBC numbers and culture  $10^4$  normal flora. A testicular ultrasound showed right epididymitis and orchitis. The patient also developed a fever of  $39^{\circ}\text{C}$ .

- b. Comment on the above results and whether they support your previous suspicions and any actions you might take at this point? (15 marks)

PCR tests returned negative results for both *N. gonorrhoeae* and *C. trachomatis*. Despite antibiotics the patient remained febrile. 2 days post incubation blood cultures showed Gram positive cocci in both bottles, with culture showing white colonies, surrounded by a zone of Beta haemolysis. An immediate staph latex test undertaken proved negative.

- c. What is the most likely identity of this organism? What further tests are available to help with a full identification of this organism? What changes should now be made to the treatment regime? (30 marks)

The patient recovered following two weeks of antibiotics with repeat blood cultures negative. A repeat ultrasound prior to discharge demonstrated continued evidence of right epididymo-orchitis which resolved on follow up ultrasound three weeks after discharge.

- d. Comment on the findings in this case and the significance of the causative organism. What organisms are more often isolated in this type of infection and why? What then are the normal risk factors? (25 marks)