Higher Specialist Diploma

Medical Microbiology

Examination – September 2022

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. There has been a technical issue with your blood culture instruments and the capacity of the instruments has reduced by approximately 50%. This reduction means that you no longer have enough capacity to incubate all blood culture bottles.

   Describe the actions would you take to manage this scenario.

2. The daily disc diffusion IQC performed as per EUCAST methodology has demonstrated that co-trimoxazole has been too large for two days running.

   Explain the possible causes of this.

3. There has been hospital transmission of *Candida auris* amongst intensive care patients.

   Explain why this is of concern and suggest a method to screen other patients to identify if transmission has occurred.

4. Your Microbiology department is becoming overwhelmed due to a resurgence of Covid-19 and is unable to support all its services.

   Outline with reasons the services you would reduce or halt to help deal with the situation.

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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. Evaluate, with reference to named infectious disease examples, how useful global surveillance and the study of epidemiology can be in helping to prevent and control infection.

2. Explain, with examples, how prion proteins can cause infectious disease in humans and how specimens suggestive of an infectious prion infection are dealt with in the lab. You should include critical discussion of prion transmission routes in your answer.

3. 'All UK diagnostic microbiology laboratories should be providing a 24-hour routine service instead of an on-call system for out-of-hours working'. Critically evaluate this statement, giving examples of potential benefits and drawbacks of a 24-hour routine microbiology service from both a laboratory and patient pathway perspective.

4. MALDI-TOF has emerged as a powerful tool for the identification of pathogenic organisms within the clinical setting. Describe the scientific principle behind the MALDI-TOF methodology and compare and contrast the benefits and disadvantages of using this technique within the clinical laboratory.

5. Critically discuss the range of tests available for the detection of COVID-19. Within your answer, please consider the value of these methodologies and, the results generated from them, as we start to live with the virus. Apply how the introduction of these techniques could be used if there is a worldwide outbreak of a bacterial pathogen.

Higher Specialist Diploma

Medical Microbiology

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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 case study 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.

In July 2016, environmental health officials were called to investigate an outbreak of food poisoning at a village in Derbyshire, UK. The village comprises 3625 inhabitants and is located next to a nature reserve which includes several flooded gravel pits that are now used for water sports activities. There is also a forest which has numerous trails for horse riding and cycling. It is therefore a popular destination for visitors. As a consequence of these attractions, the village built a camp site near the reserve to accommodate visitors.

During the food poisoning outbreak, 45 people reported symptoms comprising 10 residents from the village and 35 visitors. Adjacent to the nature reserve is a farm that produced a wide range of organic fruits, vegetables and ice cream made from milk produced at the farm that were sold at a local Farmers' Market. This was very popular with the local inhabitants and visitors in the camp.

For one week in July 2016, commencing on Saturday 23rd July, a special festival was organised where local produce from the farm was sold. An epidemic curve was constructed (Fig. 1) and suggests that the outbreak may have coincided with the festival.

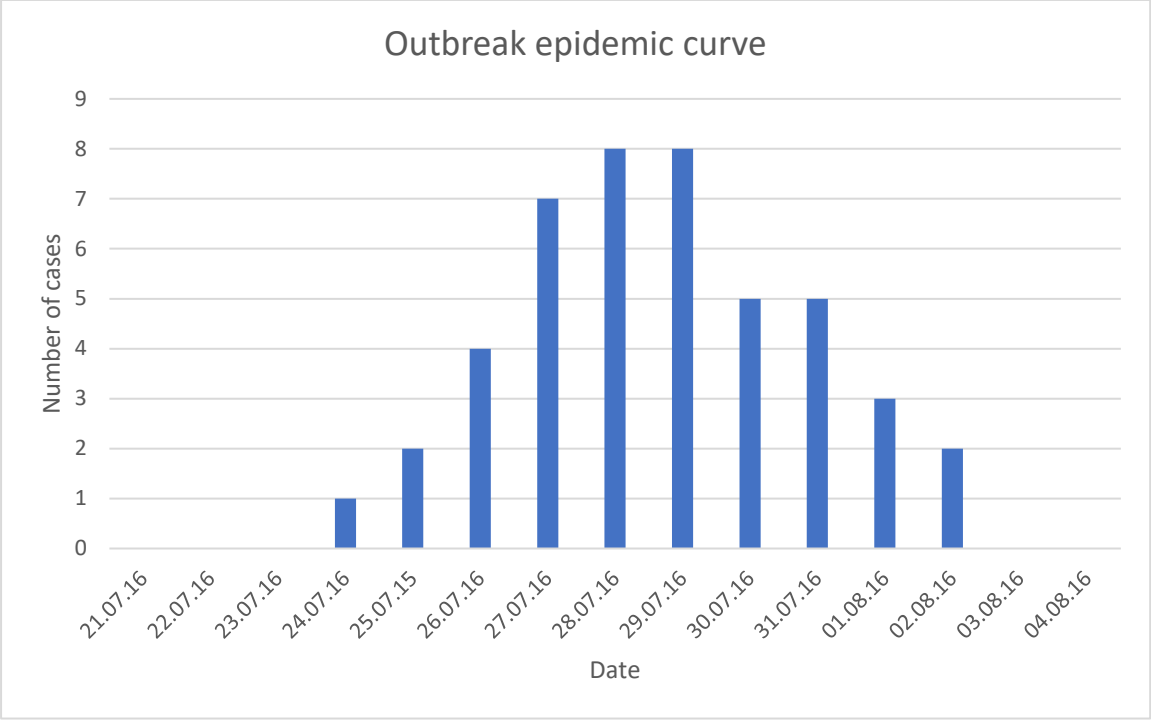

Fig 1. Outbreak curve commencing 21/07/2016, showing the number of cases of food poisoning on each day.

Symptoms experienced by people suffering from food poisoning comprised: watery diarrhoea (100%), abdominal cramping (88%), nausea (68%), fever (54%), vomiting (24%) and bloody diarrhoea (20%).

The patient age range was 7 to 79 years.

The median duration of symptoms was 8 days (range 2 – 14 days). Three patients were hospitalised as a precaution, but all made a full recovery.

a. From the information given above, which bacterial causative agents of gastroenteritis can be ruled out and which bacterial agent do you implicate in this outbreak case? Justify your decision for each bacterium named. (25 marks)

Following the outbreak, a food consumption questionnaire was sent for completion to as many traceable attendees as possible. Table One summarises the responses received. It shows the foods consumed and the numbers of people who ate the food who became ill and who did not eat the food but became ill. This information was used to calculate the Odds Ratio.

Table One

	Ate the food			Did not eat food			
Raw fruit & vegetables	No. ill	No. not ill	% ill	No. ill	No. not ill	% ill	Odds Ratio
Lettuce	33	11	75	66	23	74	1.05
Spinach	13	32	29	24	66	27	1.12
Tomatoes	30	15	67	62	28	69	0.90
Cucumber	25	19	57	36	54	40	1.97
Celery	11	34	24	38	50	43	0.43
Broccoli	12	33	27	28	60	32	0.78
Sprouts	3	42	7	8	80	9	0.71
Other food							
Raw or undercooked eggs	10	35	22	16	74	18	1.32
Strawberry ice cream	30	15	67	15	75	17	10.00
Hamburger	24	17	59	67	20	77	0.42
Rare or undercooked chicken	2	41	5	1	86	1	4.20
Rare or undercooked beef	10	34	22	24	62	28	0.76
Cans of lager	1	44	2	16	73	17	0.10
175ml bottles of red wine	19	25	43	55	35	61	0.48
330ml bottles of orange	31	14	69	56	32	64	1.27

b. Using the data from the table above discuss, which foods can be excluded as the carrier of the causative agent, and which is the most likely source of the infection? Justify your decision, including some explanation of how some of the food properties could allow for the exclusion as potential sources of infection. (25 marks)

c. What specific preventative measure could be implemented to prevent this outbreak happening again? (10 marks)

d. For some of the foods that can be excluded as carriers of the causative agent, their odds ratio was elevated. Explain from the detail given in the case study how this may have occurred. (10 marks)

e. Outline how you would isolate and confirm the identity of the organisms you have implicated to the level required for fulfilment of the UK minimum standard and indicate what reference activity would be required for the isolate (if appropriate). (15 marks)

f. Briefly describe the treatment options to patients infected with the organism you have implicated as being responsible for the outbreak. (15 marks)

UNSEEN CASE STUDIES

2.

A 12-year-old female school pupil reports a 2-year history of pain in her lower thoracic spine. Originally residing in Northeast Brazil, having travelled to the United Kingdom in the last six months, the patient reported presenting to the healthcare services in her home town on several occasions, receiving treatment with analgesics and/or anti-inflammatory medications.

During the physical examination the 12-year-old appeared in good health. She was afebrile, weighed 38.2kg and had a blood pressure of 120/80mmHg. Auscultation of the lungs and heart revealed no abnormalities and no hepatosplenomegaly was identified. Postural alterations were observed, the patient walked with a limp and found it difficult to flex her lumbodorsal area. She reported pain in the thoracolumbar region and during her examination pain was experienced when palpating the paravertebral fossa's.

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

Due to the initial symptoms observed, a blood sample and blood cultures were collected. Chest and spinal x-rays and a spinal MRI were performed. The results revealed an elevated white blood cell count with the white blood cell deferential indicating increased neutrophils.

The erythrocyte sediment rate was also increased and the C-reactive protein level was 85 mg/L. Blood culture results were negative at 48 hours and the chest x-ray was normal. The

spinal x-ray showed thoracolumbar kyphosis and collapse of the T11 and T12 vertebrae. A reduction in the corresponding distal space was also noted. An image of the MRI revealing the same problems can be seen below.

b. Discuss how the joint fluid would be analysed within the microbiology laboratory. (20 marks)

No organisms were observed or isolated in the joint fluid and the blood cultures remained negative. Further discussion with the patient and her mother revealed that she attended school in her home town and travelled daily using the school bus. No trauma or surgery were reported however, it was revealed that the school bus driver was diagnosed with pulmonary TB during the time of the patients attendance and no screening or prophylaxis was offered to the children regularly using the bus.

c. Based only on the new information provided, evaluate the possible infection present, which samples could be collected to confirm this diagnosis and how would the patient management differ. (20 marks)

d. What health and safety considerations should be taken into consideration considering the new information? (5 marks)

e. How will the samples that you have listed in question c be analysed within the laboratory? (20 marks)

f. In addition to routine TB analysis, the sample was also sent for PCR, discuss the importance of this investigation and the results that will be generated. (15 marks)

3.

A 43 year old male presented to his local Emergency Department with severe swelling along the length of his left arm. It was reddish in colour and hot to touch. The patient is tachycardic and has high blood pressure.

a. Based on the symptoms suggested alone suggest with justification, what would be included in the differential diagnosis. (10 marks)

A venogram is conducted and rules out deep vein thrombosis. The patient continues to have swelling and inflammation along his arm, with signs or worsening. The patient is started on flucloxacilin as empirical antibiotic treatment.

b. Explain what diagnostics tests would be performed and how will they help a diagnosis to be reached. (15 marks)

Some of the patient's blood tests have come back and the patient has a CRP of 120, WBC 32x10^9 with a neutrophil count of 31x10^9 and an ALT of 900.

c. Based on the information provided so far, describe what conclusions can be made including the likely pathogens and explain what, if any, additional tests should be performed. (15 marks)

Further patient history identifies that the patient consumes a high excess of alcohol (approx. 30 units per day) engages in frequent marijuana use, suffers from depression and as a result has low self-care.

A detailed examination of the arm identifies puncture marks consistent with a bite. The patient is reluctant to disclose the circumstances of how the bite was acquired.

d. Which additional pathogens should be included based on this information and which animal are they related to? (15 marks)

The patient deteriorates clinically, and the CRP increases to 179 and his ALT reaches 3300. Wound swabs of the bite area isolate skin flora only and blood cultures are negative at 48 hours. At day five the blood cultures flag positive and long slender Gram negative bacilli are seen in the Gram stain. There is no growth on the subcultures at 48 hours.

e. Based on this information describe what is the most likely causative organism and justify your answer. (5 marks)

An aliquot of the blood is tested by 16s PCR. The report indicates a likely match to *Capnocytophagia canimorsus*.

f. Describe which animal is likely to have caused this infection. (5 marks)

g. Describe the usual risk factors for *Capnocytophagia canimorsus* infection. (20 marks)

h. The patient deteriorated whilst in care. Discuss how the antibiotic selection may have contributed to this and the antibiotic regime that should be considered for dealing with a *Capnocytophagia canimorsus* infection. (15 marks)