# Sample FRCPath Part 2 Exam questions (Medical Microbiology) – March 2024

## SAQ 1

A 53 year-old woman with type 2 diabetes developed suspected osteomyelitis associated with a chronic ulcer.
The organism described below was isolated from a bone biopsy taken in theatre:

*Escherichia coli*

| Antibiotic | MIC (mg/L) | S /I /R | Breakpoint (mg /L) * |
|---|---|---|---|
| Amikacin | 4 | S | (8) |
| Gentamicin | >32 | R | (2) |
| Tobramycin | 32 | R | (2) |
| Ampicillin | >64 | R | 8 |
| Cefepime | 16 | R | 1 & 4 |
| Cefotaxime | 128 | R | 1 |
| Cefotaxime/ clavulanate | <=0.06 | X | |
| Cefoxitin | 4 | - | 8 (ECOFF) |
| Ceftazidime | 8 | R | 1 & 4 |
| Ceftazidime/ clavulanate | 0.25 | X | |
| Ertapenem | 0.25 | S | 0.5 |
| Imipenem | 2 | S | 2 & 4 |
| Imipenem / EDTA | 1 | X | |
| Meropenem | 0.125 | S | 2 & 8 |
| Piperacillin/ tazobactam | 16 | R | 8 |
| Cefepime/ clavulanate | <=0.06 | X | |
| Temocillin | 4 | I | 0.01 & 16 |
| Cefotaxime/ cloxacillin | 64 | X | |
| Colistin | <=0.25 | S | 0.25 & 0.5 |
| Ciprofloxacin | 4 | R | 0.5 & 1 |
| Tigecycline | 0.5 | S | 0.5 |

* When two breakpoints are provided, the lower is for categorising as sensitive and the upper, as resistant.

**Question 1** (2 marks)
What is the most likely primary mechanism of β-lactam resistance in this organism? Specify this as precisely as possible.

ESBL
CTX-M type ESBL most likely

**Question 2** (5 marks)
Describe the features of this antibiogram that are in support of your answer to question 1

Potentiation of cefotaxime, cefepime and ceftazidime by clavulanate
Greater potentiation for cefotaxime

No cefotaxime-cloxacillin potentiation
No imipenem-EDTA potentiation

Temocillin activity
Cefoxitin susceptibility

**Question 3** (2 marks)
Suggest TWO appropriate antimicrobial treatment regimens

Any Carbapenem (+/- amikacin)
Tigecycline (+/- amikacin)

Colistin & colistin-combinations – require justification
Newer B-lactam/inhibitor combinations –require justification

**Question 4** (1 mark)
Give TWO further antimicrobials that may be useful for treatment and could be tested if required.

FOSFOMYCIN or AZTREONAM or COTRIMOXAZOLE

or CEFTOLOZANE-TAZOBACTAM
or CAZ-AVI
or CEFIDEROCOL

**SAQ 2**

A 74-year old man developed diarrhoea. He had been admitted with a stroke 6 weeks previously and had received multiple courses of antibiotics for recurrent pneumonia.
On examination, his temperature was 38.5ºC; his abdomen was distended and generally tender.

Investigations

| | |
|---|---|
| white cell count | 17.2 x $10^{9/}$L (4.0–11.0) |
| neutrophil count | 14.1 x $10^{9}$/L (1.5–7.0) |
| platelet count | 113 x $10^{9}$/L (150–400) |

Faeces specimen:

| | |
|---|---|
| C difficile PCR | positive |
| C difficile toxin | negative |
| Norovirus PCR | negative |
| Routine culture | negative |

What is the most likely diagnosis? Explain your answer in terms of the faeces results

**Question 1** (2 marks)

Severe C difficile infection

Toxin likely to be false negative.

*Max 2 marks*

**Question 2** (3 marks)
What initial management would you recommend?

IPC: Isolation and barrier nurse

Treatment: oral vancomycin or fidaxomicin

Repeat test/re-sample

Assess: for life-threatening infection by AXR/other imaging, BP / ?ileus

Consider Treatment escalation: eg Surgical input /rectal vancomycin/ IV metronidazole, immunoglobulins

**Question 3** (2 marks)
Give FOUR alternative treatment options, apart from treatments given in Q2, that may be considered for recurrent, refractory or severe disease

Faecal transplant
Fidaxomicin OR tapering vanc (depending on answer to Q2)
IVIG
Rectal vancomycin
Accept Human Monoclonal antitoxin antibody – bezlotoxumab

NOT probiotics, cholestyramine

**Question 4** (3 marks)
A further 3 patients developed diarrhoea on the same ward. List SIX infection prevention and control actions that should be taken

Isolate/barrier nurse symptomatic patients,
Cohort if required
Close bay or ward
Stool culture/C diff/noro testing on symptomatic patients
Ribotype if C diff positive
Cleaning/environmental audit
Environmental screening
Independent hand hygiene audit
Antibiotic audit
RCAs for cases

**OSPE Sample question 1**

**A 21-year-old woman, who was taking infliximab and azathioprine for Crohn's disease, had blood samples sent to the laboratory for the investigation of abnormal liver function tests.**

Investigations:

| | | | |
|---|---|---|---|
| white blood cells | 26.5 | $x10^9$/L | (4.2–11.2) |
| lymphocyte count | 21.2 | $x10^9$/L | (1.1–3.6) |
| neutrophil count | 4.5 | $x10^9$/L | (2 –7.1) |
| eosinophil count | 0.3 | $x10^9$/L | (0–0.5) |
| | | | |
| bilirubin | 49 | µmol/L | (0–21) |
| alanine transaminase | 695 | IU/L | (0–40) |
| alkaline phosphatase | 374 | IU/L | (30–130) |

S/CO = signal/cut-off

| | | |
|---|---|---|
| cytomegalovirus IgG | negative | S/CO: 0.08 |
| cytomegalovirus IgM | positive | S/CO: 1.31 |
| | | |
| Epstein-Barr virus VCA IgG | positive | S/CO: 5.87 |
| Epstein-Barr virus VCA IgM | positive | S/CO: 26.88 |
| Epstein-Barr virus EBNA-1 IgG | negative | S/CO: 0.15 |
| | | |
| hepatitis A virus IgG | positive | S/CO: 12.30 |
| hepatitis A virus IgM | negative | S/CO: 0.14 |
| | | |
| hepatitis B virus core total (IgG/IgM) | positive | S/CO: 6.36 |
| hepatitis B virus core total IgM | negative | |
| hepatitis B virus e Ab | positive | S/CO: 0.1 |

*(**Please note that this assay is a competitive immunoassay**)*

| | | |
|---|---|---|
| hepatitis B virus e Ag | negative | S/CO: 0.7 |
| hepatitis B virus surface Ab | 97 mIU/mL | |
| hepatitis B virus surface Ag | negative | S/CO: 0.17 |
| | | |
| hepatitis C virus Ab | positive | S/CO: 15.64 |
| | | |
| hepatitis E virus IgG | negative | S/CO: 0.1 |
| hepatitis E virus IgM | negative | S/CO: 0.2 |

**Question 1** (13 marks)
For each virus listed in the serological profile above, write an interpretive comment for the laboratory report. Also indicate what further testing is required (if any) to clarify the infection status for each virus.

**1a Cytomegalovirus (2 marks)**

Interpretive comments:

CMV IgM likely to represent cross-reaction from EBV
OR
CMV IgM positive, CMV IgG negative. Repeat CMV IgG testing in 1 to 3 weeks to further investigate possible CMV infection (*UK SMI*).
(1 mark)

What further testing (if any) should be undertaken?

None

OR

Repeat serology in 1-3 weeks (1 mark)

**1b Epstein-Barr virus (2 marks)**

Interpretive comments:

Consistent with recent / acute EBV infection (1 mark)

(*full mark for either "recent" or "acute"*)

What further testing (if any) should be undertaken?

None (1 mark)
(EBV PCR not required)

**1c Hepatitis A (2 marks)**

Interpretive comments:

Consistent with past infection or immunisation
OR
No evidence or recent HAV infection
(1 mark)

What further testing (if any) should be undertaken?

None
(1 mark)

**1d Hepatitis B (3 marks)**

Interpretive comments:

| | |
|---|---|
| Consistent with past hepatitis B infection. | (1 mark) |
| Hepatitis B may reactivate in patients who are immunocompromised. | (1 mark) |

What further testing (if any) should be undertaken?

| | |
|---|---|
| None | (1 mark) |

**1e Hepatitis C (2 marks)**

Interpretive comments:

| | |
|---|---|
| Consistent with HCV infection at some time. | (1 mark) |

What further testing (if any) should be undertaken?

| |
|---|
| HCV RNA<br>OR<br>HCV Antigen |

**1f Hepatitis E (2 marks)**

Interpretive comments:

| | |
|---|---|
| No serological evidence of HEV infection. | (1 mark) |

What further testing (if any) should be undertaken?

| | |
|---|---|
| HEV RNA | (1 mark) |

**Question 2** (1 mark)
Based on the information available, what is the most likely cause of this patient's deranged liver function tests?

| | |
|---|---|
| Primary / acute / recent EBV infection | (1 mark) |
| OR | |
| EBV (*without stating 'primary OR acute OR recent' infection*) | (0.5 marks) |

**OSPE Sample question 2**

There was a nationwide shortage of media plates due to a fire in a national warehouse. Other laboratories were also unable to offer additional supplies and alternative manufacturers were unable to meet the extra demand.

**Question 1** (2 marks)
Identify FOUR distinct individuals or groups who you think should be notified about this situation.

Clinical lead/ clinical director (Pathology)
Medical Director
Lab manager
Executive Nurse Director
Local Medical Committee - (GP Liaison group)
User Groups
IPC team
Public health

**Question 2** (4 marks)
It became clear that some media plates are in shorter supply than others. You are asked about how best to substitute media plates used in certain circumstances. How could substitute agar plates be used in place of each of the following:

a) **chromogenic agar for carbapenem resistance screening**
b) **MRSA chromogenic agar**
c) **Xylose-Lysine-Desoxycholate (XLD) agar**

a) CLED (or similar) Agar with carbapenem disc

b) Mannitol Salt Agar or Staph/Strep selective agar [– may need additional biochemical tests]

c) DCA agar or Salmonella Selective chromogenic agar

**Max 4 marks**

**Question 3** (5 marks)
Susceptibility testing media were in limited supply. List FIVE factors (both clinical and laboratory) that you would consider when deciding how to prioritise use of limited susceptibility testing media?

Prioritise sterile site specimens (eg blood,CSF)

Prioritise specimens that are difficult to repeat (eg BAL)

Prioritise high risk patients (eg ITU, immunosuppressed)

Prioritise specimens/organisms of medico-legal or public health importance

Expected duration of media shortage

Organisms likely to survive storage pending reinstatement of supply

Access to alternative sens testing/inference methods (eg VITEK, PCR, latex tests)

Other sensible options accepted

**Complex Scenario sample question**

A 26-year-old man is referred by his GP to the Acute Admissions Unit (AAU) with a 3-day history of nausea, vomiting and profuse diarrhoea.

He is a veterinary student from the local agricultural college and a competitive open water swimmer. Prior to this admission he was previously fit and well. The patient is documented as having travelled to the USA and Mexico several weeks previously, returning back to the UK 5 days ago. He reports no past medical history or allergies.

On assessment, he is found to be acutely confused and has generalised abdominal pain.

Observations are:

- Temperature 38.6oC
- Heart rate 118 bpm
- BP 92/68

A CT abdomen and pelvis reports severe inflammation of the large bowel and distal ileum. Appearances are reported to be of uncertain aetiology in keeping with either an infective or inflammatory process.

He is reviewed by the Gastroenterology team and commenced on IV (Intravenous therapy) co-amoxiclav 1.2g TDS.

His bloods on admission are:

| **Blood test** | **Result** | **Units** | **Reference range** |
|---|---|---|---|
| C- reactive protein | 274 | mg/L | 0-10 |
| | | | |
| Haemoglobin | 133 | g/L | 130-170 |
| White Cell Count | 4.1 | $x10^9$/L | 4.0 - 11.0 |
| Neutrophils | 4.9 | $x10^9$/L | 2.0 – 7.5 |
| Platelet count | 222 | $x10^9$/L | 150-400 |
| | | | |
| Sodium | 105 | mmol/L | 133 - 146 |
| Potassium | 5.1 | mmol/L | 3.5 - 5.3 |
| Urea | 17 | mmol/L | 2.5-7.8 |
| Creatinine | 154 | µmol/L | 40-130 |
| | | | |
| Total Bilirubin | 82 | µmol/L | <20 |
| ALT | 95 | IU/L | <50 |
| AST | 90 | IU/L | <40 |
| Alkaline Phosphatase | 101 | IU/L | 30-130 |
| Albumin | 23 | g/L | 35-50 |

**Question 1 (2 marks)**

Provide two appropriate additional laboratory tests (non-routine screening tests), including at least one supplementary media-based test, you would request to be set up on the faeces specimen.

For each answer you should include the target organism.

Thiosulphate citrate bile salts sucrose agar (TCBS) agar
Targets: V. cholerae V. parahaemolyticus
(1 mark)

PLUS

Non-media answers
Microscopy for cysts or trophozoites; Testing for intestinal Amebiasis or Cyclospora
(1 mark)
OR
Specimen to be sent to Parasitology Reference Laboratory for microscopy/ stool antigen testing and/or PCR testing for Entamoeba (1 mark)

No marks for stating testing for Cryptosporidium species and Giardia species
No marks for CT-SMAC agar, XLD, Campylobacter selective agar
(Above is routine testing & recommended nationally as per UK SMI)

**Question 2 (2 marks)**

List two specific pathogens (causes of gastrointestinal infection) implicated in freshwater leisure activities/swimming.

Plesiomonas shigelloides
Leptospira
Aeromonas
Cryptosporidium

On day 2 of admission, blood cultures become positive with Gram-negative bacilli being seen on microscopy (aerobic and anaerobic bottles).

MALDI-ToF (Matrix-assisted laser desorption ionization–time-of-flight mass spectrometry) identification and antimicrobial susceptibility testing is performed on the blood culture isolate. Note the laboratory performs antibiotic susceptibility testing using the EUCAST methodology.

A faeces specimen taken on admission is also processed for this patient.

The blood culture and stool culture results are as follows.

INVESTIGATION: Blood Culture SPECIMEN TYPE: Blood culture

Aerobic Bottle: POSITIVE
Anaerobic Bottle: POSITIVE

CULTURE RESULTS: FROM BOTTLE:

a) E.coli Both

| **Antibiotic** | **Result; MIC (mg/L) or disc diffusion zone diameter (mm)** | **EUCAST breakpoint/ interpretation*** |
|---|---|---|
| Amoxicillin | 32mg/L | S </= 8 |
| Amoxicillin-clavulanic acid | 8mg/L | S </= 8 |
| Piperacillin-tazobactam | 8mg/L | S </= 8 |
| Ceftazidime | 32mg/L | S </= 1 |
| Cefoxitin | 22mm | S >/= 19mm |
| Perfloxacin | 20mm | S >/= 24mm |
| Ciprofloxacin | 0.125mg/L | S </= 0.25 |
| Gentamicin | 0.5mg/L | S </= 2 |

*As per Enterobacterales EUCAST Clinical Breakpoint Table v. 12.0, valid from 2022-01-01

SPECIMEN TYPE: Faeces

Appearance: Diarrhoeal
Cryptosporidium: OOCYSTS OF CRYPTOSPORIDIUM NOT SEEN

Salmonella culture: NEGATIVE Shigella culture: POSITIVE
Campylobacter culture: NEGATIVE E.coli 0 157 culture: NEGATIVE

C.difficile screening test negative

CULTURE RESULTS:

a) Shigella sonnei Isolated

| **Antibiotic** | **Result; MIC (mg/L) or disc diffusion zone diameter (mm)** | **EUCAST breakpoint/ interpretation*** |
|---|---|---|
| Trimethoprim-sulfamethoxazole | 10mm | S >/= 14mm |
| Azithromycin | 256mg/L | Epidemiological breakpoint 16mg/L |

**Question 3 (2 marks)**

What is your interpretation of the blood culture result in light of the faeces report?
Briefly discuss the most likely hypotheses.

Concern of BC isolate mis-identification, comment on the limitations of MALDI-Tof ID- current inability to reliability discriminate E.coli from Shigella spp

Potential gut translocation of E.coli /transient E.coli bacteraemia in the context of severe Shigella infection (Albumin noted)

**Question 4 (3 marks)**

What further routine laboratory testing; **culture-based/non-molecular technique**, would you request on the blood culture isolate? Your answers should include a brief comment/ explanation why.

Identification with an alternative method warranted (MALDI-tof not reliable)
Serotyping/ Serological identification/agglutination tests with diagnostic antisera
And/or Vitek 2 GN ID or API 20E

PLUS
Supplementary/ phenotypic testing/screening for ESBL production, BC isolate ceftazidime resistant, which is an indicator cephalosporin
OR
Additional ASTs; example provided Mero, Temocillin, Colistin

**Question 5 (1 mark)**

Describe the characteristic colonial appearance of a *Shigella sonnei* isolated from primary culture on selective media. Your answer should include the named selective media.

Accept either of the following as per UK SMI
(1 mark for a complete answer; agar with correct description)

XLD – Red colonies with no black centre
DCA – Colonies are colourless (*S. sonnei* may form pale pink colonies because of late lactose fermentation).
MAC – transparent or colourless colonies
HE – Colonies appear blue green.
SS- Colonies appear colourless

**Question 6 (1 mark)**

What reference laboratory test would you request on the blood culture and stool isolates as follow-up and why?

Candidate comments/ highlights awareness of outbreak strain of multi-drug resistant Shigella sonnei cluster (CTX-M-27); outbreaks in multiple states have been reported in the USA, cases linked with MSM. Isolates to be sent to reference laboratory for WGS

**Question 7 (2 marks)**

Describe the likely mechanisms of resistance exhibited phenotypically by the stool culture isolate?

Macrolide resistance conferred by genes erm(B) and mph(A)

Trimethoprim/sulphonamide resistance (sulfamethoxazole-resistant) due to changes in target enzymes dihydropteroate synthase and dihydrofolate reductase
or acquired resistance by drug-resistant target enzymes, e.g dfr or *sul* genes
Accept target site modification (1/2 mark)

**Question 8 (4 marks)**

Assuming no other causative pathogens are isolated, pending confirmatory testing, which of the following would you recommended as being the most appropriate treatment regime for this patient?

a) Ceftriaxone
b) Ciprofloxacin
c) Meropenem
d) Fosfomycin

Provide the rational for your chosen antibiotic regime and a brief explanation why the other listed regimes would not be advised.

**(Maximum 4 marks)**
1 mark for correctly identifying regime c) Comment that a), b) & d) considered sub-optimal

BC isolate ceftazidime resistant, which is an indicator cephalosporin for ESBL production as such Ceftriaxone not advised

Pefloxacin screen has detected clinical fluoroquinolone resistance; Strains with single gyrA mutation have a suboptimal response to treatment with ciprofloxacin

Fosfomycin would be off label/unlicensed, could be an option for treating uncomplicated cases such as prolonged diarrhoea out with a bacteraemia. Due to a lack of evidence of their efficacy in severe infections fosfomycin should NOT be used in immunocompromised patients or cases of sepsis or colitis; consideration should be given to intravenous agents like ertapenem or temocillin. As per PHE guidance.

**Question 9 (3 marks)**

On further questioning, you are informed that the patient reports unprotected sex with a man within the last month.

Based on this information, what should be considered and form part of the clinical assessment/follow-up.

Provide a brief comment detailing the further management advice you would offer to the patient and the clinical team.

? Potential outbreak, identification of contacts/ contact notification

Further spread may be reduced by control measures to reduce sexual transmission etc

MSM with shigellosis may be at risk of other sexually transmitted infections including HIV
Opportunity to provide sexual health advice and testing for other STIs/HIV etc

Accept additional appropriate answers
(Maximum 3 marks)

**Question 4** (3 marks)
Alternative agar plates for susceptibility testing were sourced from a neighbouring laboratory that produced media in-house. When these plates were quality-controlled by disc testing using an appropriate reference strain of E. coli, the observed zone diameters of all antibiotics tested were consistently greater than the acceptable upper limit.

Give THREE possible explanations for this quality control finding that relate to the media used.

Agar depth too shallow (1 mark)

*(0.5 marks for "agar depth")*

Agar formulation incorrect (inhibitor present OR nutrients absent) (1 mark)

Agar degraded over time / past expiry date (1 mark)

Alternative plausible reason (1 mark)

**Max 3**