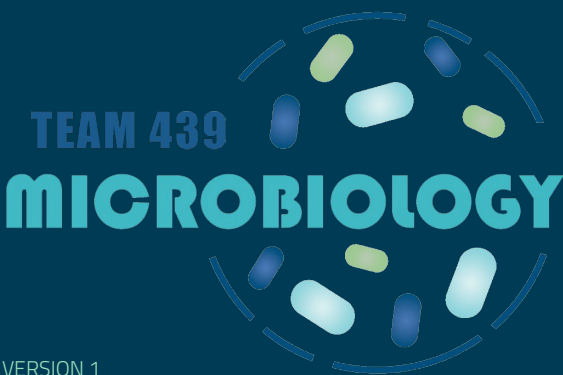
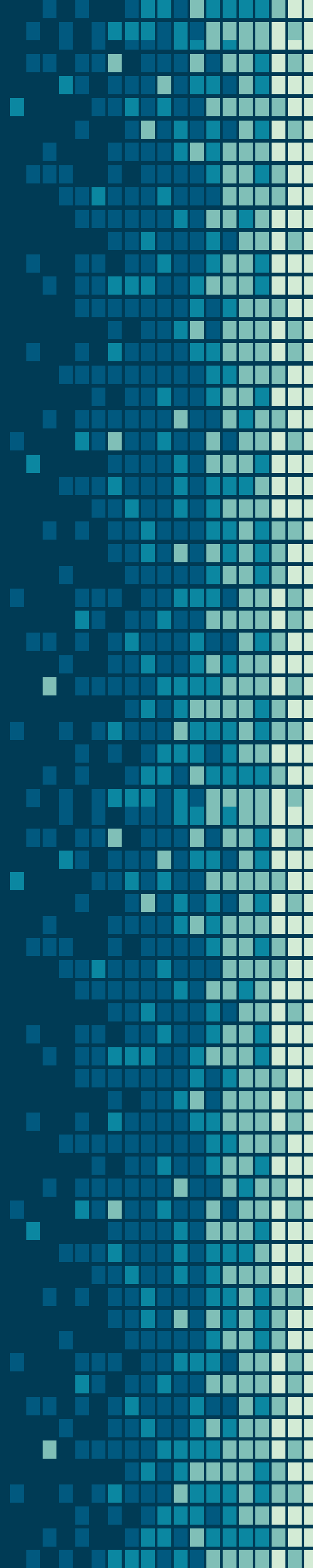


# Joints and Bone Infections



# Objectives

- ❖ Support the best team in the world Al Nassr FC
- ❖ Recognize the difference between osteomyelitis and arthritis
- ❖ Recall the route of infection of bone and joint
- ❖ Describe how infections reach the bone or joint
- ❖ Discuss the epidemiology, risk factors and pathogenesis of both osteomyelitis and arthritis
- ❖ Recall the commonest causative organisms of acute and chronic osteomyelitis and arthritis
- ❖ Recall the differential diagnosis of both conditions
- ❖ Describe the laboratory diagnosis and investigation of osteomyelitis and arthritis
- ❖ Recognize the management and treatment of both osteomyelitis and arthritis
- ❖ Recall the complications of both osteomyelitis and arthritis
- ❖ Discuss the causative organisms, diagnosis, management and treatment of infection of the joint and prosthetics

## Colour index:

**Red: Important .**

**Grey: Extra info & explanation.**

**Purple: Only in girl's slides.**

**Green: Only in boy's slides.**

Any future corrections will be in the editing file, so please check it

frequently.

Scan the code  
Or click [here](#)



# Introduction

- ❖ Bone and joint infections may exist separately or together.  
(Depending on the site, whether they are close together or not)
- ❖ Generally, both are common in infants and children.
- ❖ Usually caused by blood borne spread, but also can result from local trauma, or spread from other contiguous soft tissue infection.
- ❖ They are often associated with foreign body at the primary wound site.
- ❖ If not treated, they can lead to devastating effects.

## What will be covered:

1

Acute Osteomyelitis

2

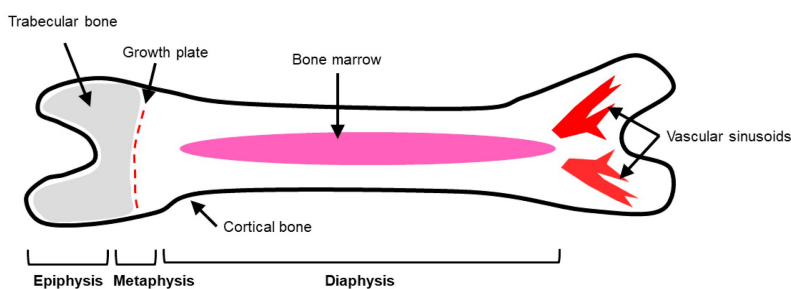
Chronic Osteomyelitis

3

Septic Arthritis

4

Infections of Joint Prosthesis



---

## Check Our Summary

By Clicking [Here](#)

# 1) Acute Osteomyelitis

<b>Definition</b>	Acute osteomyelitis is an acute infectious process of the bone and bone marrow.
<b>Duration</b>	Can be <b>short or long</b> : <ul style="list-style-type: none"> <li>- Short duration (few days for hematogenous acquired infection)</li> <li>- Lasts several weeks to months (if secondary to contiguous focus of infection)</li> </ul>

## How the pathogen reaches the bone?

- 1.Hematogenous route** (through blood)
- 2.Contiguous soft tissue focus** (from nearby infections)  
(post operative infection, contaminated open fracture, soft tissue infection, puncture wounds)
- 3.In association with peripheral vascular disease**  
(diabetes mellitus ,severe atherosclerosis, vasculitis)

## Causative Organism

<b>Infants / neonates</b> (Primary hematogenous)	<b>Staph. aureus, Group B Streptococcus, E.coli</b> (microbes comes from the mother)	<b>Site:</b> <b>Metaphysis</b> of long bones (tibia, femur, humerus...)
<b>Children</b> (Primary hematogenous)	<b>Staph. aureus, Group A streptococci, Haemophilus influenzae</b>	
<b>Adult</b>	<b>Most cases due to Staph. aureus</b> Hematogenous cases are less common due to <b>reactivation</b> of quiescent focus of infection from infancy or childhood	But in adults, it's usually in the back

## Special Clinical Situations (Etiology)

<b>Fist injuries, diabetic foot , decubitus ulcer patients</b>	Streptococci and anaerobes (Usually Polymicrobial)
★ <b>Sickle cell patients</b>	<b>Salmonella</b> or streptococcus pneumonia
<b>Immunocompromised (AIDs) patients</b>	<b>Mycobacterium tuberculosis</b> or mycobacterium avium

## Clinical presentation & Investigation (Usually abrupt rapid onset i.e symptoms appear quickly)

<b>Clinically</b>	<b>Limping, Fever, localized pain, heat, swelling, tenderness of affected site (one or more bones or joints affected in Hematogenous spread), local tissue infection (abscess or wound)</b>
<b>Blood test</b>	Leukocytosis, high ESR and C-reactive protein (it's non specific but indicator of inflammation)
<b>X-ray</b>	<b>Normal at early stages</b> , Swelling of soft tissues, elevation of periosteum ,demineralization and calcification of bone later
<b>Ultrasound</b>	Fluid collection (abscess) and surface abnormalities of bone are seen.
<b>CT scan</b>	Reveal small areas of osteolysis in cortical bone. <i>تفتت في العظم</i>
<b>MRI</b> (most sensitive imaging technique)	<b>Early detection</b> , helps in unclear situations. Defines bone involvement in patients with negative bone scan.

**Note:** Osteomyelitis shows lytic lesions (destroyed lesion) on imaging

# Diagnosis of Acute Osteomyelitis

Blood culture (**bacteremia common**) Most important test used for diagnosis

Biopsy of periosteum or bone, needle aspiration of overlying abscess  
**if blood culture is negative**

Blood test: complete blood and differential counts  
**Erythrocyte sedimentation rate ( ESR), C-reactive protein**

Imaging studies : **x-ray, MRI, CT-SCAN**

## Differential diagnosis of acute osteomyelitis includes:

## Complications of Acute Osteomyelitis Include:

Rheumatoid arthritis

Septic arthritis is common as the the infection reaches the diaphysis  
If the osteomyelitis site was close to a joint

Septic arthritis

Chronic osteomyelitis  
If acute osteomyelitis was not treated, might become chronic

Fractures

Metastatic infection to other bone or organ  
Spread through blood stream (bacteremia) to other bones.

Sickle cell crises

Pathological fracture

An antibiotic that covers staph and strep is preferred

## Management & Treatment

### Antimicrobial therapy:

**MSSA (methicillin sensitive S.aureus)**

**Cloxacillin**, or Clindamycin

**MRSA (methicillin resistant S.aureus)**

**Vancomycin** , Clindamycin, Linezolid, or TMP-SMX

**Polymicrobial infection**

(usually a **broad spectrum antibiotics** is used)

Piperacillin-Tazobactam or Quinolone with Metronidazole

Duration for 4-6 weeks to ensure cure and prevent progression to chronic osteomyelitis

Bed rest, splint (دعامة), and analgesia (painkillers) , **surgical drainage** (as needed) if there is local purulent process

## X-Ray of Acute Osteomyelitis



## 2) Chronic Osteomyelitis

### Definition

A chronic infection of the bone or bone marrow usually secondary to:

- 1) Inadequately (poorly) treated acute osteomyelitis
- 2) Relapse (انتكاسة) of acute osteomyelitis or foreign body

- Usually seen in elderly, diabetic patients, patients with chronic wounds.
- Most infections are secondary to a contiguous focus or peripheral vascular disease.

### Etiology

\* It can be caused either by **specific organisms that cause chronic infection** e.g. mycobacterium tuberculosis, or it can be related to **organisms that causes acute infection** that was not treated e.g. staph. aureus.

**Staphylococcus Aureus** (most common)

Other microorganisms: S.epidermidis, Enterococci, Streptococci, Enterobacteriaceae, Pseudomonas, and anaerobes

**Polymicrobial infection** common with decubitus (قرحة الفراش) ulcers and **diabetic foot**

**Tuberculosis** and fungal osteomyelitis: (details next)

- have a clinically **indolent** (chronic) course, they usually cause it in **immunosuppressed patients**

**Brucella** (الحمى المالطية): (comes from **unpasteurized dairy products**, like milk, cheese..) common in KSA especially in spring.  
عشان الناس تكشفت في الربيع و تشرب حليب ابل و غنم و الخ بدون بسترة. Causes vertebral osteomyelitis.

### TB & Fungal Osteomyelitis

#### Tuberculosis Osteomyelitis

- Primarily results from hematogenous spread from lung foci, or as an extension from a caseating lymph bone ( 50% in spine). It resembles Brucella osteomyelitis .
- Mycobacterium tuberculosis usually causes infection in lungs. However, it is also an important cause of chronic osteomyelitis
- Causes **osteomyelitis in vertebrae** (back), called **pott's disease**.

#### Fungal Osteomyelitis

- Hematogenous spread Eg. Candida species, Aspergillus species and other fungi may occur.

### Diagnosis of chronic osteomyelitis

#### Blood

- Blood culture is **not very helpful** because **bacteremia is rare**.
- WBC usually normal, ESR elevated but not specific.

#### Radiology

- MRI is very helpful for diagnosis and evaluation of the extent of disease.**
- Radiological changes are complicated by the presence of bony abnormalities

### Management & Treatment

Management is difficult, and prognosis is poor (Infection may not completely cure)

#### Surgical

Requires **surgical debridement** accompanied with antibiotic therapy for a long time.

#### Antimicrobial

- Parenteral antibiotics for 3-6 weeks followed by long term oral suppressive therapy.
- Some patients may require lifelong antibiotic ,others for acute exacerbations.
- MSSA: Cloxacillin
- MRSA & S.epidermidis: Vancomycin then oral Clindamycin or TMP-SMX.
- Other bacteria: treat as acute osteomyelitis.

- **Mycobacterium Tuberculosis (is treated with a combination of 4 drugs): .**

- First 2 months: INH+RIF +Pyrazinamide & Ethambutol.
- Additional 4 months: RIF + INH for additional 4 months.

أول شهرين نستعمل ٤ مضادات، والأربع شهور التالية نستعمل ٢ بس

INH = Isoniazid  
RIF = Rifampicin

-Brucella is treated with **Tetracycline & Rifampicin** for **2 to 3 months**.

Note that treatment of brucella and TB takes months, chronic osteomyelitis takes years, others take weeks.



# 3) Septic Arthritis (infectious arthritis)

<p><b>Definition</b></p> <p><small>How does it happen? When the joint space is blocked and there is contact of bones . Then Inflammation will take place and the synovial membrane will swell.</small></p>	<ul style="list-style-type: none"> <li>❖ Septic Arthritis is an acute inflammation of the joint space secondary to infection (i.e usually occurs due to another contiguous infection like osteomyelitis, gonorrhea, URTI).</li> <li>❖ Generally monoarthritis (<b>affects 1 joint</b>) &amp; results in suppurative inflammation (pus forming).</li> <li>❖ Mostly in very young (neonates) or very old (elders) people</li> <li>❖ Most common site is the knee</li> </ul>
<p><b>General Symptoms</b></p>	<p>Inability to bear weight, pain, swelling, limitation of movement. (esp; in children)</p>
<p><b>Mechanism of Infection</b></p>	<ul style="list-style-type: none"> <li>- <b>The most common MOI is by hematogenous seeding</b> of the joint. (Haematogenous seeding = Blood borne spread = transmitted by blood circulation).</li> <li>- Also it might be a result of <b>adjacent osteomyelitis</b>.</li> </ul>
<p style="text-align: center;"><b>Etiology (mostly bacterial but can be viral)</b> The same as acute osteomyelitis.</p>	
<p><b>Infants (neonates)</b></p>	<p><b>S.aureus, Group B strep</b>, Gram -ve rods (<b>E.coli &amp; Klebsiella, Proteus, Pseudomonas</b>)</p>
<p><b>Children</b></p>	<p><b>S.aureus, Group A streptococci, S.pneumonia, H.influenzae type b</b></p>
<p><b>Adult</b></p>	<p><b>S.aureus, Neisseria gonorrhoeae</b> (causes sexually transmitted infection)</p>
<p><b>Viral causes</b></p>	<p>Rubella, Hepatitis B, mumps, Parvovirus B19, Varicella, EBV (epstein barr virus), Adenovirus etc. These are self-limiting (usually don't require treatment)</p>
<p><b>Reactive arthritis</b> (antigen-antibody complex)</p>	<p>1- Campylobacter jejuni 2-Yersinia enterocolitica 3-Some Salmonella species</p>
<p><b>Non-infectious arthritis</b></p>	<p>1-Rheumatoid arthritis 2-Gout. 3-Traumatic arthritis. 4-Degenerative arthritis</p>
<p style="text-align: center;"><b>Risk Factors (increase the chance of septic arthritis)</b></p>	
<p>★ <b>Gonococcal Arthritis</b></p>	<ul style="list-style-type: none"> <li>- Most common in <b>young , sexually active adults</b></li> <li>- Caused by <b>Neisseria gonorrhoeae</b></li> <li>- Causes disseminated infection secondary to urethritis/cervicitis.</li> <li>- Patient Initially presents with polyarthralgia (joint pain), tenosynovitis (inflammation of synovium), fever, skin lesions.</li> <li>- If untreated leads to suppurative monoarthritis</li> </ul> <p style="text-align: center;">الـseptic arthritis غالبا يصيب الكبار في السن . لذلك لما يجي بيشتت مصاب فيه و عمره صغير بالعشرين أو الثلاثين (sexually active) لازم نفكر بالـ Gonorrhoeae</p>
<p><b>Procedures</b></p>	<ul style="list-style-type: none"> <li>- Occasionally results from direct trauma, <b>medical procedures (arthroscopy)</b>, or contiguous soft tissue infections.</li> </ul> <p>Patient has another type of arthritis, and if he had arthroscopy s. Aureus or other organism might be introduced during the procedure causing septic arthritis.</p>
<p><b>Nongonococcal (most common)</b></p>	<ul style="list-style-type: none"> <li>- Most common in older adults. It is caused by introduction of organisms into joint space as a results of bacteremia (bacteria in blood) or fungemia (fungi in blood) from infection at other body sites</li> <li>- Can lead to joint destruction if not treated quickly</li> </ul>
<p><b>Lyme disease</b></p>	<ul style="list-style-type: none"> <li>- Due to tick bite in endemic areas, uncommon in KSA, causes a skin rash.</li> <li>- Caused by Borrelia burgdorferi</li> </ul>
<p><b>Sickle cell disease</b></p>	<p style="text-align: center;"><b>Salmonella spp, S.aureus</b></p>
<p><b>Chronic Arthritis</b></p>	<p style="text-align: center;">Mycobacterium Tuberculosis (rarely), fungi</p>

## Diagnosis (it is considered as emergency)

<b>History / examination</b>	To exclude systemic illness. Note history of tick exposure in endemic areas.
<b>Arthrocentesis</b> (aspiration of synovial fluid)	<p>1-Synovial fluid is <b>cloudy and purulent</b></p> <p>2- Leukocyte count generally &gt; 25,000/mm<sup>3</sup> (i.e <b>elevated WBCs</b>),with predominant neutrophils (because it is acute inflammation).</p> <p>3- <b>Gram stain and culture are positive</b> in &gt; 90% of cases. (except in gonococcal the percentage is smaller)</p> <p>4-Exclude crystal deposition arthritis or noninfectious inflammatory arthritis.</p>
<b>Blood Culture</b> Prof: Always always always take a blood culture!!	<ul style="list-style-type: none"> <li>- If Gonococcal infection suspected, take <b>specimen</b> from <b>cervix, urethra</b>, rectum &amp; pharynx for culture or DNA testing for N.gonorrhoeae.</li> <li>- And for investigation for other sexually transmitted diseases</li> </ul>

## Management & Treatment

<b>Arthrocentesis</b>	- Drainage of infected synovial fluid. (Repeated therapeutic arthrocentesis often needed)
<b>Surgical intervention</b>	- Arthroscopic or surgical drainage/debridement are occasionally needed.
<b>Antimicrobial therapy</b>  Directed at the suspected organism and depending on the susceptibility results.	<p>1) Gonococcal Arthritis: IV Ceftriaxone (or ciprofloxacin or ofloxacin) then switch to oral quinolone or cefixime for 7-10 days</p> <p>2) <b>Non-gonococcal Arthritis:</b></p> <ul style="list-style-type: none"> <li>-MSSA: <b>Cloxacillin</b> or Cefazolin</li> <li>-MRSA: <b>Vancomycin</b></li> <li>-Streptococci: Penicillin or Ceftriaxone or Cefazolin</li> <li>-Enterobacteriaceae: Ceftriaxone or Fluoroquinolone</li> <li>-Pseudomonas: Piperacillin and Aminoglycoside</li> <li>-Animal Bite: Ampicillin-Sulbactam</li> </ul> <p>3) Lyme disease Arthritis: Doxycycline for one month</p>

## Prognosis

<b>Gonococcal Arthritis</b>	Excellent outcome and prognosis.
<b>Non-gonococcal Arthritis</b>	Can result in scarring with limitation of movement, ambulation is affected in 50% of cases <b>if not treated quickly.</b>

## Risk factors for long term adverse sequela

Age, prior rheumatoid arthritis, polyarticular joint involvement, hip or shoulder involvement, virulent pathogens and delayed initiation or response to therapy.



Scan or Click here



## 4) Infections of Joint Prosthesis:

- Occur in 1 - 5 % of total joint replacement.
- **Most infections occur within 5 years of joint replacement.** (chance of infection decreases with time)
- Result in significant morbidity and health care costs.
- Successful outcomes results from multidisciplinary approach.

### Etiology

- Can be caused by almost **any microorganism.**
- **Often caused by skin flora (staph. epidermidis)**

### Diagnosis by

<b>Aspiration and Surgical Exploration</b>	<p>Diagnostic aspiration of joint fluid necessary .</p> <ul style="list-style-type: none"> <li>-To obtain specimen for culture, sensitivity testing &amp; histopathology</li> <li>-Skin flora regarded as pathogens if isolated from multiple deep tissue cultures</li> </ul>
<b>Radiology</b>	<ul style="list-style-type: none"> <li>- Plain X-ray may not be helpful.</li> <li>- Arthrography may help define sinus tracts. (An arthrogram is a series of images of a joint after injection of a contrast medium)</li> <li>- Bone scan-not specific for infection.</li> </ul>
<b>Blood</b>	<ul style="list-style-type: none"> <li>-ESR and C-reactive protein( CRP ) may be high.</li> </ul>

### Management & Treatment:

<b>Surgery</b>	<p><b>Removal of prosthesis.</b> إزالته وتركيب واحد جديد</p>
<b>Antibiotics</b>	<ul style="list-style-type: none"> <li>- impregnated cement during reimplantation. تغطية وتغليف المفصل الجديد بالمضادات قبل عملية تركيبه</li> <li>- <b>Antimicrobial for 6 weeks</b></li> <li>- Begin empiric IV antibiotic to cover MRSA and Gram negative rods (Vancomycin, Cefepime, Ciprofloxacin, or Aminoglycoside)</li> <li>- Chronic therapy with oral drug if removal of prosthesis not possible. بعض المرضى يرفض تغيير المفصل الصناعي ممكن لأسباب مادية والخ.. في هذه الحالة تعطى له مضادات باستمرار</li> </ul>



# MCQs

**Q1:** A healthy 5 year old is brought to the A&E because of fever, irritability, malaise and left knee pain for 4 days. Four days ago, he fell off his bike and scraped his elbow. His temperature is 39.1C. The patient walks with a limp. An MRI of the left knee shows edema of the bone marrow and destruction of the medial metaphysis of the tibia. Which of the following is the most likely causative organism?

- A- Staphylococcus epidermidis
- B- Brucella melitensis
- C- Staphylococcus aureus
- D- Salmonella enterica

**Q2:** A 56 year old woman comes to the emergency department because of worsening pain and swelling in her right knee for 3 days. She underwent a total knee arthroplasty (replacement) of her right knee joint 5 months ago. Arthrocentesis of the right knee is performed and the patient was diagnosed with infectious arthritis. Which of the following is the most likely causal pathogen?

- A- Staphylococcus epidermidis
- B- Staphylococcus aureus
- C- Escherichia coli
- D- GAS

**Q3:** A 6 year old girl is brought to the physician for painful swelling of the left ankle for 2 weeks. She has no history of trauma to the ankle. She has a history of sickle cell disease. An MRI is performed and confirms a diagnosis of osteomyelitis. Which of the following is the most likely causative agent?

- A- H. influenzae
- B- N. gonorrhoea
- C- Salmonella enteritidis
- D- Pseudomonas aeruginosa

**Q4:** A 3 year old boy is brought to the doctor because of a 3 day history of fever. The mother reports that he has also been limping for 2 days. He has no history of trauma. Physical examination shows tenderness over his left leg. The range of motion of the leg is also limited due to pain. While walking he avoids putting weight on his left leg. An MRI is most likely to show abnormalities in which of the following regions?

- A- Lumbar vertebral column
- B- Proximal metaphysis of the femur
- C- Proximal epiphysis of the femur
- D- Acetabulum of the ilium

**Q5:** A 20 year old girl comes to the physician because of a 2 day history of pain in her right knee. Last week she had right wrist pain. She has no history of recent trauma. She recently returned from summer camp 2 weeks ago. She is sexually active with a male partner. Her temperature was 38C. Examination shows several painless skin lesions on her right foot. Which of the following is the most likely diagnosis?

- A- Staphylococcus aureus arthritis
- B- Lyme arthritis
- C- Acute rheumatic fever
- D- Disseminated gonococcal infection

**Q6:** A sexually active 51 year old male comes to the emergency department because of severe pain in his left knee. He has type 2 diabetes mellitus. On examination his temperature was 38.5C. His left knee was swollen and tender to palpation with significantly impaired range of motion. Which of the following will most likely help in establishing a diagnosis?

- A- MRI of the knee
- B- Arthrocentesis
- C- Measure rheumatoid factor
- D- CAT scan of the knee

## SAQ:

### CASE 1:

A 7 year old is seen with fever and an inability to bear weight on his right leg, xray shows a lytic lesion on the tibia, what is the most likely diagnosis? A blood culture shows gram -ve coccobacilli, what is the microbe?

### CASE 2:

A 60 year old man, with back pain, is found to have vertebral osteomyelitis, sample taken from bone and joint space shows gram + cocci in clusters, MSSA, what is the most likely microbe and what is the best treatment?

### CASE 3:

Someone with chronic symptoms for 6 weeks and night sweats, he reports that the symptoms appeared after a camping trip, where he drank unpasteurized milk, what is the microbe?

## Answer Key

1A: Acute osteomyelitis,  
1B: Haemophilus influenzae  
2A: S. aureus  
2B: Cloxacillin or Clindamycin  
3- Brucella

4-B  
5-D  
6-B

# Team Leaders

- Duaa Alhumoudi
- Manee Alkhalifah

# Team Members

- Sadem Alzayed
- Abdulaziz Alderaywsh
- Renad Alhomaidi
- Faisal Alomri
- Shahad Almezel
- Abdulaziz Alomar
- Raghad Albarrak
- Meshal Alhamed
- Noura Alsalem
- Ghadah Alsuwailem
- Noura Alshathri
- Reema Alowerdi



**Contact Us Through:**  
**[Microbiology439@gmail.com](mailto:Microbiology439@gmail.com)**