Original Research Article

Chronic osteomyelitis among children attending orthopedic services at Mbarara Regional Referral Hospital: Prevalence, etiological agents and their drug susceptibility Patterns.

ABSTRACT.

Background. This cross-sectional study was conducted to determine prevalence, causative agents and their drug susceptibility patterns of chronic osteomyelitis children among 766 children attending orthopedic services at Mbarara Regional Referral Hospital between October 2016 and June 2017.

Methods. Seventy-four consented patients were consecutively enrolled and their demographic characteristics, clinical and radiological data collected. Superficial and deep bone pus swabs were collected and processed as per standard operative procedures. Susceptibility testing was done using the Kirby Bauer disc diffusion technique. Data was analyzed using Stata version 13.0.

Results. The prevalence of children with COM was 9.7%. The female: male ratio was 1:1.2 with a mean age of 11 years. The most infected bone was the tibia followed by the femur. The common clinical presentations were chronic bone pain and discharging sinus tracts whereas the most imminent radiological features were sequestrum and involcrum. Pus swabs were taken off from both the discharging sinuses and the deep intra osseous abscesses for culture and sensitivity studies. The concordance rate of the microorganisms between the superficial and the deep swabs was 62.5 %. *Staphylococcus aureus* was the most predominant microorganism isolated (85%). All the microorganism isolates were sensitive to gentamycin. However, all *Staphylococcus aureus* isolated were resistant to penicillin.

Conclusion. Prevalence of Chronic osteomyelitis among children with orthopedic conditions presenting to MRRH is high. The isolated microorganisms are resistant to antibiotics we commonly use in our settings.

Key words. Osteomyelitis, Chronic, Children, Culture, Pus, Sensitivity, Resistance, Prevalence.

Background

Osteomyelitis is defined as infection of the bone by pyogenic organisms (Yeo and Ramachandran, 2014). Chronic osteomyelitis (COM) is a type of osteomyelitis that is relapsing and persistent characterized by low grade inflammation, presence of sequestrum, involcrum, brodies abscess and fistulous tracts (Cleland et al., 2006).

Chronic osteomyelitis (COM) is a major problem among children presenting with orthopedic conditions in low income countries and this has greatly constrained the resource limited systems

of these nations (Baldan et al., 2014). Its high prevalence in these countries is attributed to immune suppression, malnutrition and high incidence of trauma. It is still a major challenge faced by orthopedic surgeons (Marais et al., 2013).

Children and adolescents are the age groups commonly affected by COM (Peltola and Pääkkönen, 2014). In a Ugandan study by Stanley et al., 2010, 80% of the COM patients were below the age of 20 years. In another study carried out in Mityana hospital, peak age incidence was ranging between 10-19 ref years followed by 0-9 years contributing 37.5 and 12.5% respectively and thus it can be concluded that COM is the disease of children (Ibingira, 2004).

Globally prevalence of childhood osteomyelitis is low, ranging from 3-14/100,000 children (Ponio and Delos Reyes, 2013). In the United States, each year, 1 in 5000 children under the age of 13 years are diagnosed with osteomyelitis, accounting for 1% of all pediatric hospitalizations (Pugmire et al., 2014). However, in African setting, COM accounted for 7.8% of all pediatric surgical admissions and 15.4% of total pediatric inpatient days ranking second following burns in Gambia (Bickler and Sanno-Duanda, 2000). At the Beit cure Hospital - Malawi, COM accounted for 7.6% of total inpatient days and 6.7% of all operations on children (Stevenson et al., 2015). In Kenya surgical operation due COM accounted for 6% of all surgical interventions (Mantero et al., 2011). In a retrospective multicenter Ugandan Study, there was high prevalence of COM which accounted for over 8.3% of the total outpatients in one year (Stanley et al., 2010). Whereas 120 patients of COM were seen in Mityana hospital for a period of 5 years from 1996-2000, 38% of the patients presented beyond a period of 6 month of the disease (Ibingira, 2004).

Long bones are commonly affected in childhood COM, with tibia and femur being the commonest bones affected (Kumar and Singh, 2017). The hallmark of COM is bone necrosis which may or may not be accompanied by involcrum formation (Arube-Wani et al., 2008). Involcrum that forms help in structural support during recovery, but in instance it doesnot form then there is resultant segmental or focal bone loss (Zuluaga et al., 2006). Brodies abscess results from a persistent sub-acute infection leading to formation of radiolucent lesion with marginal sclerosis(Agrawal and Sobti, 2016). Another rare type of COM is Garre's sclerosing osteomyelitis and is characterized by massive focal thickening of bone periosteum, chronic non

suppurative infection and peripheral reactive bone (Zarrate et al., 2018). This comes as a result of inert stimulation of low grade attenuated infection (Gumber et al., 2016).

The Causative organisms of COM in children depend on the mechanisms by which they were acquired. *Staphylococcus Aureus* is the commonest isolated organism in all age groups. The method of isolation of isolation of etiological agent determines whether it's possible to determine the exact organism in question (Lima et al., 2014a). In chronic osteomyelitis, taking deep bone swabs or bone biopsy is the effective way of identifying organisms and increasing positivity rates of culture and sensitivity (Hatzenbuehler and Pulling, 2011). It is however prudent to note that since the skin surface and bone communicates through sinus tract the organisms cultured from bone biopsy may actually be affected by skin resident flora but not the true causative organisms (Fernandez et al., 2016). Polymicrobial organisms usually isolated when COM is secondary to contiguous spread (Baum, 1995). Other organisms which have been isolated include *Pseudomonas aeruginosa, Escherichia coli, Klebsiella pneumoniae, Enterobacter cloacae* and *Proteus mirabilis (Plummer et al., 2004).* Salmonella species have been linked to osteomyelitis in sicklers (Organization et al., 2012). Organisms isolated in mandibular and maxillary osteomyelitis are polymicrobial anaerobic and related to oral microbial flora. Common microorganisms often encouterd as causative agents of COM of the jaw include; actinomyces, fusobacterium, parvomonas and staphylococcus (Gaetti-Jardim Júnior et al., 2010).

Over the past decade there has been an emerging drug resistance to many microorganisms, for example methicillin resistant *Staphylococcus aureus* (MRSA) and extended spectrum beta lactamases in gram negative bacteria. This has in turn altered the antibiotic regimen used to treat COM (Wadekar et al., 2015). Vancomycin is being used for treatment of MRSA and ampicillin resistant Enterococcus but there is reported emerging vancomycin-resistant *Staphylococcus aureus* and vancomycin-resistant Enterococci which has left us with no choice of antibiotics to use (Mantero et al., 2011).

Chronic osteomyelitis has a far reaching impact on the patient, the health workers as well as the health facility. This is because COM is difficult to treat and most patients treated get recurrence of the disease. Central to treatment of COM is surgical debridement and antibiotic therapy. Treatment failure is thought to be caused by delay in presentation, misdiagnosis and drug

resistance among other contributing factors. In rural settings like Mbarara Regional Referral Hospital (MRRH), laboratory services to perform culture and sensitivity (C&S) are limited which contribute to poor antibiotic stewardship like empirical antibiotic usage in COM.

A review of records for a period of one year (1st September 2014 to 1st September 2015) in MRRH, Orthopedics outpatient's clinic, out of 1291 children who attended the clinic, 200 children (15.5%) had COM but the numbers were dominated by re attendances. Out of 200 children with COM, 43 patients were attending the clinic for the second time and nineteen patients had visited the clinic more than twice both constituting 31% of re attendances.

Chronic osteomyelitis is the disease of underdeveloped world. There are scanty prospective studies conducted in sub-Saharan Africa comparable to our setting which will guide us on the common causative organism of chronic osteomyelitis and choice of antibiotic which are effective in treatment of chronic osteomyelitis patients. This study will bridge this gap and help us to identify common causative agents and their susceptibility patterns.

Despite all this, the current prevalence of COM in MRRH is not documented and the commonest causative agents and their susceptibility patterns in MRRH are not known. This makes it a neglected condition over masked by trauma and maternal-child related conditions when it comes to logistics allocation. The current study sought to determine prevalence, causative agents and drug susceptibility patterns of COM in children attending orthopedic services in Mbarara Regional Referral Hospital.

METHODOLOGY.

This was a cross sectional study, conducted between October 2016 to June 2017 at orthopedic department in MRRH located in South western Uganda. The study involved children between xxx years of age and presented with orthopedic condition. A sample size of 74 was used as calculated according to Kish-Leslie formula (1965

Study procedures. Following admission of 74 children with COM, parents/ guardians for those children consented for them to participate in the study. They were subjected to a standard preset questionnaire. Data collected included; social demographics, co-morbid factors for COM, history of previous treatment, bones infected with COM, presenting complaints, physical findings and radiological features on x-ray radiographs.

Laboratory procedures. Pus swabs were either collected from superficial sinus tract or from bone/bone marrow intra-operatively following bone debridement procedures carried out by principal investigator under orthopedic surgeon's guidance. Strict aseptic technique was followed.

In addition to pus swabs, blood sample were corrected for HIV and Hepatitis B testing. Pus swabs together with blood samples were delivered to the laboratory by the research assistant immediately after collection in a suitable transport media and were received by the laboratory technician.

Glass slide smears were made from the pus swabs received in the laboratory and gram stain carried out. Gram stained smears were then read under microscope for morphological characteristics of causative agents.

In addition the pus swabs were cultured on chocolate plate agar, blood agar and MacConkey agar and incubated at 35-37^{o}C for 24-48 hours. Incubated plates were read thereafter for culture characteristics shown by organisms on respective culture media. Gram stain and biochemical tests were also performed on culture growth to further identify the causative agents.

Pure cultures from primary culture plates were emulsified into a sterile normal saline in a test-tube, vortexed for two minutes and inserted into densitometer to determine 0.5 McFarland standard turbidity. Sterile swabs were soaked in the suspension, excess drained off the walls of the test-tube. The swab was then used to smear evenly on the surface of muller hinton agar to obtain an evenly distributed growth of organisms. Selected antibiotic discs were placed at different positions on the surface of the medium and incubated at 35-37^{o}C for 24-48 hours.

Controls strains for *Staphylococcus aureus* and *E-coli* were prepared in the same way and similar antibiotics applied. Zones of inhibition of corresponding antibiotics were determined and interpreted as per CLSI guidelines for different organisms.

Antibiotics tested include; ceftazidime, ciprofloxacin, gentamycin, co tromoxazole, chloramphenicol, imipenem, tetracycline, erythromycin, penicillin G, oxacillin and ampicillin.

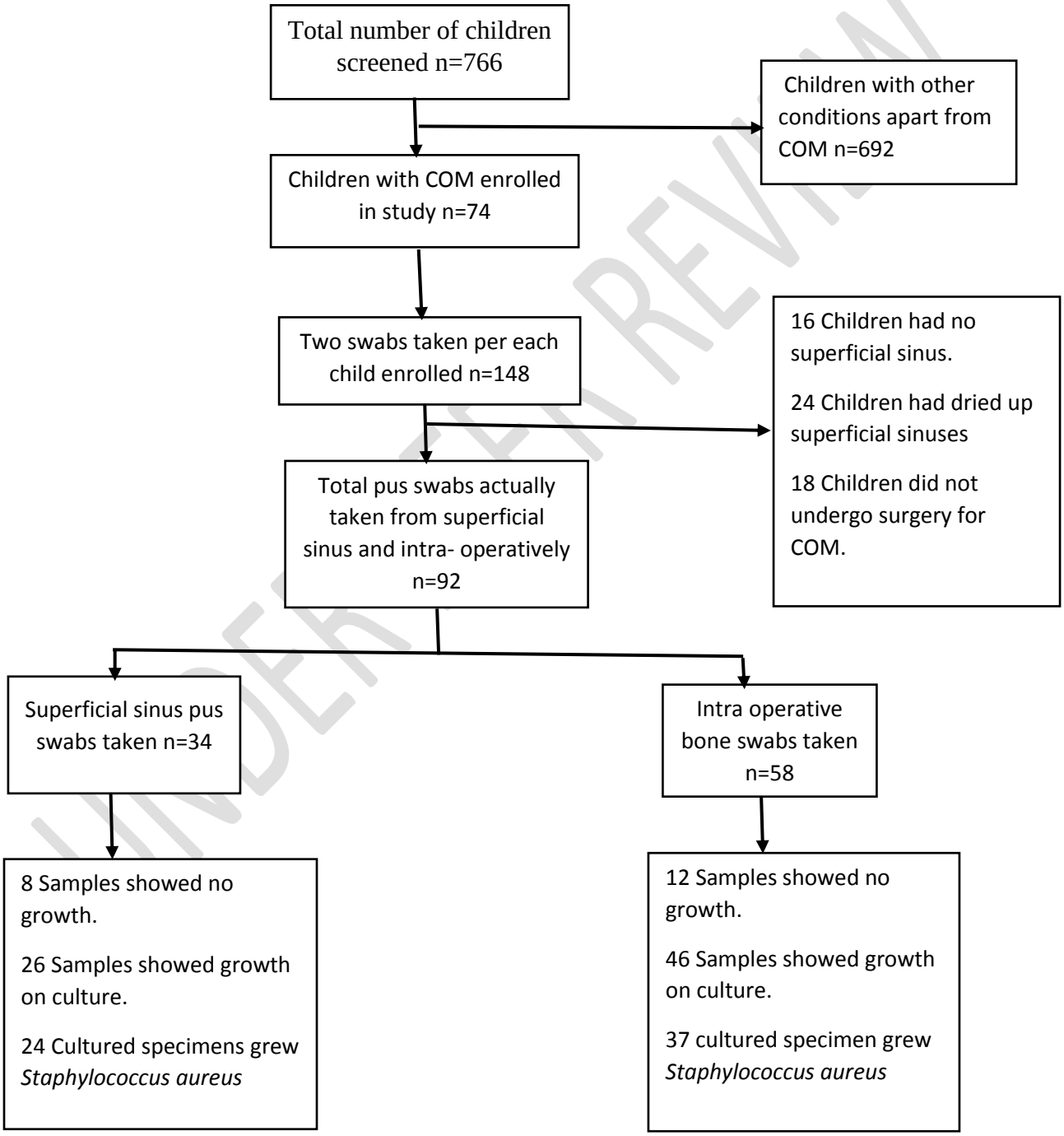
Data generated was entered into epi-info version 7.2 and exported to stata version 13 for cleaning and analysis. Demographic data, associated factors, etiology and susceptibility patterns

of microorganisms causing chronic osteomyelitis was presented by frequency distribution, percentages mean and standard deviation whereas prevalence of children with COM in proportion and percentages.

This study was approved by the Faculty of Medicine Research Committee (FRC), MUST Institutional Research Ethics Committee (IREC) and MRRH administration. Study procedures were explained to patients before asking them to participate. Informed written consent was sought from parent/guardian and assent also was obtained in all children with at least 8 years before enrollment into the study. All the information obtained was kept confidential.

Results.

Fig 1: Study Profile.



A total of 74 patients out of 766 children who attended orthopedic services at Mbarara Regional Referral Hospital had chronic osteomyelitis. The prevalence of chronic osteomyelitis was 9.7.

Table 1: Demographic characteristics of children with COM.

Characteristics	
Age in years, mean (SD)	10.9 (4.7)
Age categories, n (%)	
<5 years	9 (12.1)
5-9 years	17 (23)
10-17 years	48 (64.9)
Sex, n (%)	
Male	41(55.4)
Female	33(44.6)
District, n (%)	
Mbarara	25 (33.8)
Bushenyi	13(17.6)
Isingiro	9(12.1)
Others	27 (36.5)

A total of seventy four (74) patients were enrolled. Majority were males and Mean age of the participants was 11 years with standard deviation 4.7years. Children aged 10 years above were the predominantly affected age group.

Table 2: Medical characteristics of the children with COM. N=74.

Characteristics	
Referral status, n (%)	
Referral in	31 (41.9)
Self-referral	43 (58.1)
History of previous surgical treatment of COM before, n (%)	
No.	65 (87.8)
Yes.	9 (12.2)
Duration of symptoms in weeks, median [IQR]	52 [24-156]
Duration of symptoms categories, n (%)	
<6 months	17 (23)
6 months -1yr	16 (21.6)
1-2yrs	21 (28.4)
>2yrs	20(27.0)
History of antibiotic use, n (%)	
No antibiotic use	40(54.1)
Antibiotics used.	34(45.9)
Number of bones infected, n (%)	
single	63(85.1)
multiple	11(14.9)
HIV/AIDS test, n (%)	
Negative	71(96.0)
Positive	3 (4.0)
HepBsAg test, n (%)	
Negative	70 (94.6)
Positive	4 (5.4)

Eleven patients (14.9%) had multifocal chronic osteomyelitis (more than one bone affected). Of the eleven patients, three patients had both femur and tibia affected, five patients had both humerus and femur, two patients both femur and phalange and one humerus and tibia. Three patients were HIV positive.

Table 3: clinical and radiological characteristics of the children with chronic osteomyelitis. N=74.

Presenting complaints	**n (%)**
Chronic bone pain	69 (93.2)
Discharging sinus	63 (85.1)
Swelling	60 (81.1)
Fever	32 (43.2)
Protruding bone fragment	10 (13.5)
Complications of COM.	**n (%)**
Limited range motion	61 (82.4)
Muscle wasting	27 (36.5)
Soft tissue abscess	20 (27.0)
Malnutrition	9 (12.2)
Anaemia.	6 (8.1)
Affected bones	**n (%)**
Tibia	28 (37.8)
Femur	24 (32.4)
Humerus	13 (17.6)
Fibula	7 (9.5)
Ulna	4 (9.5)

Radius	3 (4.1)
Pharanx	3 (4.1)
Metatarsal	2 (2.7)
Radiological features	**n (%)**
Sequestrum	63 (85.1)
Involcrum	59(79.7)
Brodies abscess	18 (24.3)
Periosteal reaction	10 (13.5)
Pathological fracture	5 (6.8)
Examination features	**n (%)**
Tenderness	68 (91.9)
Scar / wounds	62 (83.8)
Bodily deformity	58 (78.4)
Irritability	14 (18.9)
Exposed bone	9 (12.2)

The most common presenting complaint was chronic bone pain discharging sinus and swelling the least being protruding bone fragment.

Limited motion presented as the most common complication of COM in children presenting to MRRH.

As shown in table 3 above, the tibia and femur were the most affected while the metacarpals were the least affected bones.

On examination majority of patients presented with tenderness while the least of patients had exposed bony fragment.

Most frequent radiological features found were sequestrum and involcrum and the least radiological feature was pathological fracture.

Fig 2: Pie chart showing Causative agents isolated on culture from pus swabs.

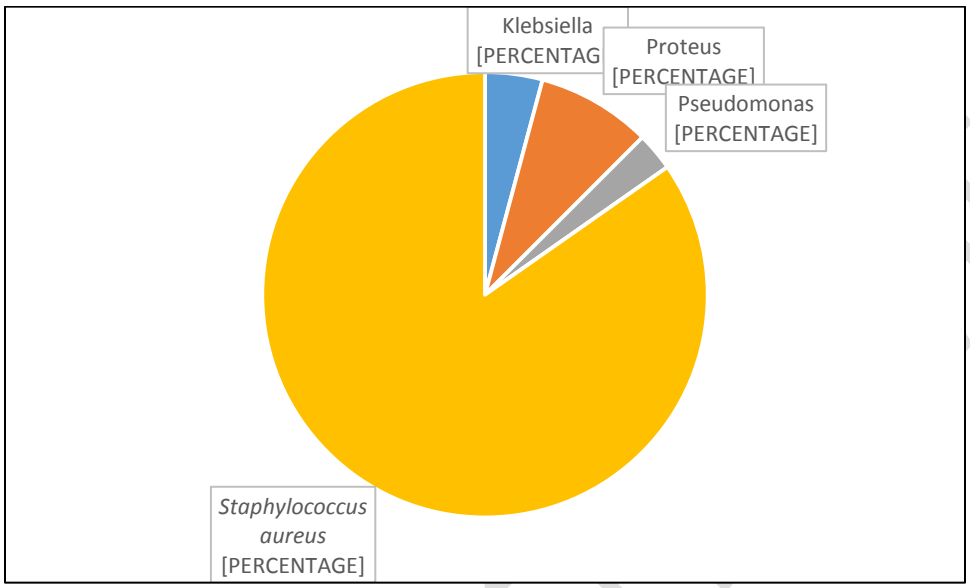


Table 4: Microbiologic concordance of superficial sinus swab with deep bone swab in children with COM. N=24.

Microorganisms isolated	Superficial sinus isolates	Deep bone swab isolates	Superficial sinus isolate agreeing with deep bone sample Isolate.	Concordance in percentages.
Staphylococcus aureus	12	11	7	46.7
Proteus	3	3	3	100
Klebsiella	1	0	0	0
No growth	7	5	5	50
Mixed growth.	3	0	0	0

Overall, cultured pus swabs that had similar isolated organisms from both sample showed 62.5 % concordance but Proteus and *Staphylococcus aureus* showed 100% and 46.7% respectively.

Fig 3: Graph showing Overall percentage drug resistance patterns for gram negative bacilli isolated.

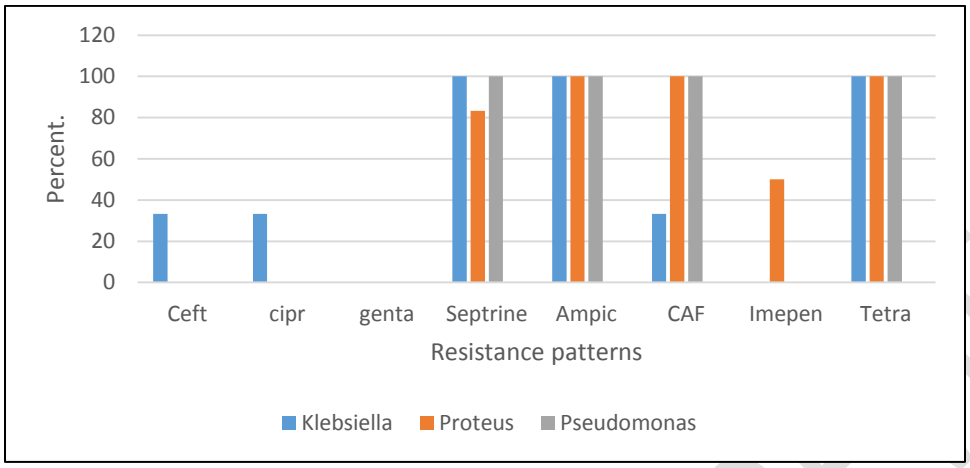
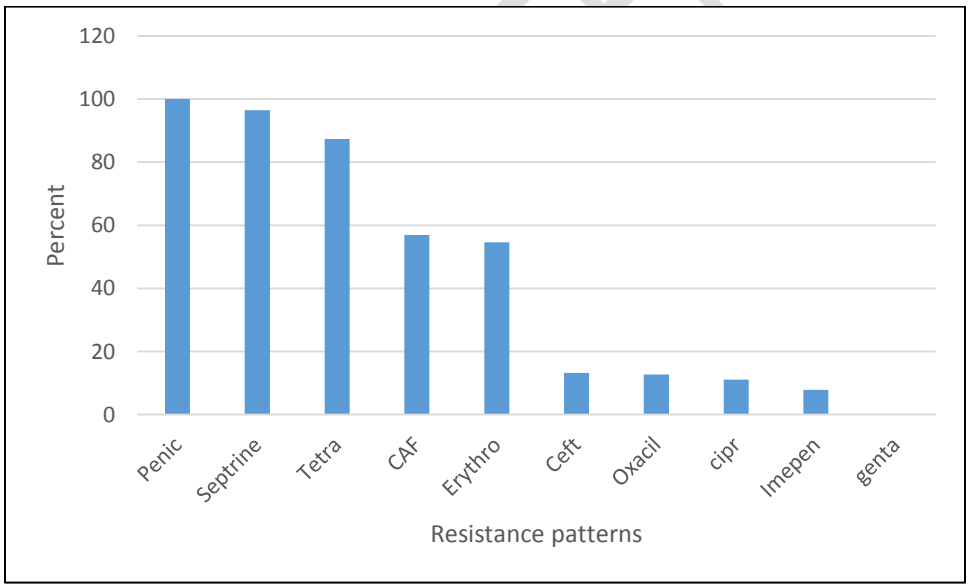


Fig 4: Graph showing overall percentage drug resistance patterns for gram positive cocci (*Staphylococcus aureus*) isolates.



All the gram negative organisms isolated were bacilli, no any cocci was isolated. They all showed total resistance to ampicillin and tetracycline but no any resistance against gentamycin.

The only isolated gram positive cocci were *Staphylococcus Aureus* and they were all resistant to penicillin G, but no any resistance to gentamycin.

DISCUSSION.

The prevalence of 9.7% for COM was observed in this study. This agrees with other studies conducted in Uganda (Stanley et al., 2010), Gambia (Bickler and Sanno-Duanda, 2000), Malawi (Beckles et al., 2010) and Togo (Abalo et al., 2010) which reported prevalence as 10%, 7.8%, 6.7% and 7.4% respectively .

In contrast a study conducted in Norway where prevalence of COM in children was 13/100,000 (Riise et al., 2008). The explanation here could be the fact that in developed world there is better health care system that in our setting and children with early signs of bone infection are treated early before it progresses to become COM and better health systems.

There were more males compared to females children with COM with F:M ratio of 1:1.2 The result is similar to that of studies conducted elsewhere which gave the F: M ratios as 1:1.4 in Nigeria (Akinyoola et al., 2009), 1:1.1 in Uganda (Ibingira, 2003) and 1:2.7 in Tanzanian (Ali et al., 2014) studies respectively. This could probably be because the above studies were conducted in geographical location similar to ours and that males participate in activities that predispose them to trauma compared to females.

These findings however are different from what was reported in Kenya (Mantero et al., 2011) and USA (Lazzarini et al., 2005) where males were slightly less than female in male : female ratio of 1:1.3 for both studies.

Mean age of the children with COM was 10.9 years and majority of the children were 10- 17 years of age. This is similar to that found in a prospective comparative study conducted in Nigeria (Akinyoola et al., 2009) and Kenya (Mantero et al., 2011) in which the mean age was 11 and 11.9 years respectively. This is an indication that COM is predominant in school going age. School going children are more prone to COM probably due to the fact that they are active and prone to trauma.

Nine patients (12%) still had COM despite previous surgical treatment of COM. This is similar to what was reported in a study conducted in Kenya that found a 12.2% relapse following a 12 month follow up (Mantero et al., 2011). The reason for persistence of symptoms following surgical treatment could be due to lack of follow up for such patients and failure to appropriately control local surgical site sepsis. Such infection may spread locally and affect already vulnerable bone tissue.

306 The findings are different from what was reported in a study conducted in Malawi which
307 reported that 16% of the COM patients required a second admission for surgery so as to control
308 infection (Beckles et al., 2010). This is a higher percentage compared to our study and this may
309 be due to the fact that Beit cure hospital in which the Malawi study was conducted is a
310 specialized orthopedic center and receives referral cases of complicated COM cases from
311 peripheral hospitals all over the country. More so COM is complex to treat despite combined
312 surgery and antibiotic use (Marais et al., 2014). In our setting recurrence of COM may be
313 attributed to poor adherence to long term antibiotic treatment and lack of follow up that leads to
314 neglected infected sites.

315 Additionally poor health seeking behavior where by patients present with advanced and
316 complicated disease involving more than one bone or even one bone but with multiple areas of
317 infection. This study found 15% of patients to have more than one bone to be affected.

318 The median time from disease onset to presentation was 13 month (range 6 -38 month) This
319 duration is higher than what was found in a Tanzanian study where median duration of
320 symptoms was 7 month (Ali et al., 2014). This could be because patients tend to first seek other
321 alternative traditional medicine before entering into formal health care system. Whereas others
322 prefer self-medication because of financial constraints which delays them from presenting to
323 hospital in time.

324 The median time from disease onset to presentation was less than what was found in the study
325 conducted in Germany on children admitted from Africa where mean duration of illness was 18
326 month (range 11-60 month) (Wirbel and Hermans, 2014). This may have resulted from delay that
327 occur from the time of identification of patient, transfer and arrival to German from where they
328 were treated.

329 Three patients (4%) were HIV positive. This is similar to study conducted in Malawi which
330 reported HIV/AIDS did not influence the prevalence of chronic in children (Jones et al., 2011).
331 The reason could be due to the fact that all children are started on antiretroviral therapy the
332 moment they are diagnosed with HIV infection and they don't develop immunosuppression
333 hence not at risk to develop COM compared to their counterpart.

334 This was different from what was reported in South African study where HIV test was positive in
335 30% of children with COM (Marais et al., 2015). More than a half of such children had CD4

count less than 336c/ul and not on antiretroviral therapy. This could be due the high prevalence of HIV infection in South Africa and also due to immunosuppression in those said children.

The majority of the patients with COM presented with chronic bone pain and discharging sinus. This is similar to what was reported in the systemic review which found pain and tenderness as classical diagnostic features (Grimbly et al., 2013) and in Germany where all patients recruited had discharging sinuses (Wirbel and Hermans, 2014). This is probably due to the fact that most of the patients don't go to the hospital until they develop persistent and unrelenting pain and unsightly pus oozing out of the sinus.

Tibia and femur were most affected bones accounting for 37.8% and 32.4% respectively. This is in agreement with the studies` done in Malawi (Beckles et al., 2010), Nigeria (Akinyoola et al., 2009) and Tanzania (Ali et al., 2014) in which the results indicated the tibia and femur as most frequently affected bones in frequencies 48.4%&29 %, 40&34 %, 40&24 % respectively. This could be because in children tibia and femur which the bones of the lower limbs are usually exposed because these children put on shorts (for the males) and dresses (females) so their legs as well as thighs are predisposed to trauma in active school going children which is the major risk COM. Additionally since the tibia and femur are in close proximity to each other, it is easy for the infection to spread from one bone to the other either hematogenously or locally.

To the contrary, the study by Ibingira found that phalanges were the most affected bone (Ibingira, 2003). This could be attributed to the fact that study included both children and adults. The adults were more involved in farming and pastoralism and may have had their fingers pricked by thorns and stick while in the farms and bushes.

Physical examination finding revealed that over 90% of children with COM had bony tenderness and scars/wounds/superficial sinuses. This is in agreement with what the patients came in reporting as their presenting complaints. The above finding is similar to studies in Nigeria (Ikpeme et al., 2010) and Switzerland (van Schuppen et al., 2012) that reported bony tenderness and fistulus sinus tract as the predominant physical findings in children with COM. This maybe the reason why patients after trying alternative care chose to seek orthopedic care.

On radiological findings, majority of the patients had sequestrum and involcrum accounting for 85.1 and 79.7 percent respectively. This is similar to a Germany study which noted that sequestrum and invocrum was the commonest feature of COM in children (Gerhard Walter et al

2012). The reason could be that progression to COM is marked by formation of necrotic bone which later stimulates new bone formation to engulf and support the dead bone.

Twenty four (24.3%) of the children with COM had Brodie's abscess on plain radiography this is different from a Nigerian study that reported 2.4% of the children with osteomyelitis who had Brodie's abscess (Olasinde et al., 2011). This gross difference could be attributed to the social economic status in our setting where many children walk bare footed and end up getting foot infection that is later propagated to develop Brodie's abscess.

Out of 94 cultured specimens collected from both sinus tracts and intra operative bone swab, 22% showed no growth. This finding is similar to what was reported in other studies conducted in Malawi (Beckles et al., 2010) and India (Khatoon et al., 2017) which showed that 29% and 16% respectively of the samples had negative growth. The reason behind this may be due to the fact that majority of patient presented when they had received antibiotics from peripheral health units. Also fastidious organisms like mycobacteria tuberculosis that don't grow on ordinary media may have brought about high rate of negative cultures since these were not taken care of. Additionally, in immunocompetent patients, pus is always composed of dead white blood cells and debris of dead microorganisms thus in such cases culture will turn out to be negative.

The microorganism predominantly isolated on culture was *Staphylococcus aureus* representing 85 percent of specimen cultured that showed growth. This is similar to what was found in studies conducted in Kenya (Mantero et al., 2011), Malawi (Beckles et al., 2010), Brazil (Jorge et al., 2010) and Germany (Wirbel and Hermans, 2014) which reported that *Staphylococcus aureus* was the commonest cause of COM. This could be because *Staphylococcus aureus* is the abundant normal flora on skin and mucus membranes and therefore easily access to the blood stream in case of trauma or breach in skin which commonly occur in trauma. Once in blood stream in combination with other factors like trauma can cause COM.

However, elsewhere in Oxford UK despite the fact that *Staphylococcus aureus* was a predominant microorganism a lower percentages (32%) was reported (Sheehy et al., 2010). This is a very low proportion compared to what was found in this study. This could be due to the fact that UK study was in a developed country which is a different geographical location when compared to our study.

The concordance for *Staphylococcus aureus* isolates between superficial sinus swabs and deep bone swab was 46.7% and that of all microorganisms was 62.5%. The results found in this study are not different from what was found in Nigeria (Akinyoola et al., 2009) and Columbia (Zuluaga et al., 2006) where overall concordance was 41.4 % and 30% respectively. The reason could be that on superficial sinus tracts other organisms different from the causative agent can colonize the open sinus tracts since it is exposed to the external environment but the deep bone pus swab does not contain colonizing skin or superficial sinus flora.

Staphylococcus aureus showed marked resistance to co trimoxazole (100%), penicillin (100%) and tetracycline (87.3%). This is similar to what was found in a retrospective study conducted in Moshi Tanzania where resistance against erythromycin, co timoxazole and tetracycline was noted (Ali et al., 2014). These are commonest available oral drugs over the counter cheap and accessible and they are not regulated in the community, therefore abused.

More than 80% of *Staphylococcus aureus* isolates were sensitive to gentamycin, ceftazidime, ciprofloxacin and imipenem. Gentamycin and ceftazidime are intravenous treatments which can only be accessed in the hospital setting hence not abused in communities and ciprofloxacin surprisingly is one of the drug that is cheap and easily accessible in our setting but still showed marked sensitivity. These findings are similar to those in Lubega et al study who also noted that gentamycin and ceftriaxone were 100% sensitive whereas ciprofloxacin was significantly sensitive (Lubega et al., 2017). These findings however differs from what was found in the study conducted in India where *Staphylococcus aureus* was resistant to gentamycin, erythromycin, ciprofloxacin and co trimoxazole in more than 50% of the isolates (Wadekar et al., 2015). This wide spread resistance could be due to higher proportion of MRSA and extended spectrum beta lactamase producers in developed nations. Further still ceftazidime together with other cephalosporin are commonly used empirically and could the reason behind the rise in resistance.

Imipenem was sensitive to more than 80% of isolated *staphylococcus aureus* a similar finding in study conducted in India (Khatoon et al., 2017). This could be due to the fact that imipenem is a new antibiotic on the drug market and has not developed resistance.

Gram negative bacilli were resistant to co trimoxazole, ampicillin and tetracycline and chloramphenicol and in more than 50 percent of isolates the finding that is similar to what was found in an Indian prospective study where all isolates were resistant to co trimoxazole

ampicillin and tetracycline when used as a single antimicrobial agent (Sheehy et al., 2010). These are drugs that have been in use in our setting for a long time, easy to access and cheap and hence abused by patients. They have developed resistance and no longer effective against gram negative bacilli.

Gentamycin, ciprofloxacin and ceftazidime were sensitive to gram negative bacilli in more than 50% of the patients this is different to what was found in Indian study where more than 50 % gram negative bacilli isolates were resistant to the above antibiotics (Khatoon et al., 2017). It is important to note that this study was conducted in a high income country which is experiencing extended spectrum resistance gram negative strains and that could be the reason for the discrepancy.

Fifty percent (50%) of Proteus isolates were resistant to imipenem but no resistance in other gram negative bacilli which was quite surprising as it's a new drug in use in our setting and only reserved for patients with persistent infections. this is quite different from what was found elsewhere in India where imipenem showed no resistance (Khatoon et al., 2017). This could be due to the how often patients is exposed to the antibiotics as this is a drug often used in our setting for severe gram negative sepsis. The number of gram negative isolates was small and this could affect the whole picture on imipenem resistance.

Conclusion

Chronic osteomyelitis accounted for 9.7% of all children attending orthopedic services at MRRH. Of the children who attended, common presentation was discharging sinus and bone pain. Tibia and femur were most commonly affected bones and *Staphylococcus Aureus* was the predominant isolated microorganism. Isolated organisms were resistant to penicillins, cotrimoxazole and tetracycline but sensitive to gentamycin, imipenem and ceftriaxone.

Competing Interests.

The authors declare no conflict of interests in the study.

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