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Prevalence of Wound Infections; Evaluation of its Growth Frequency and Antibiotic Resistance Pattern in Chennai Population

Edwina Jospiene M[1], Dr. S. Subramaniam[2], Dr. Shyama Subramaniam[3]

[1]Research Scholar, Regenix Super specialty laboratories Pvt., Ltd., (Affilated to University of Madras) No.42, Loganathan Nagar, 100 feet road, Choolaimadu (vadapalani), Chennai - 600 094, Tamil nadu, India
Phone number: 9600056014
Email ID: *edwina18[at]ymail.com*

[2]Lab director and Professor, Regenix Super specialty laboratories Pvt., Ltd., (Affilated to University of Madras), No.42, Loganathan Nagar, 100 feet road, Choolaimadu (vadapalani), Chennai - 600 094, Tamil nadu, India.
Phone number: 9841113331
Email ID: *subramaniam[at]regenix.in*

[3]HOD and Professor of biochemistry, Apollo Lab services, Chennai, Tamil nadu, India
Phone number: 9884213969
Email ID: *shyamasubramaniam[at]gmail.com*

Abstract: ***The prevalence of common wound infection occurrences in patients of selected population and evaluating the growth frequency including the infection rate followed by its antibiotic resistance pattern in Chennai population. Objective: The design of the study is to identify the cause of the common wound infection including post operative infection and identifying the bacteria analysing its frequency and its growth among Chennai population and also evaluating the antibiotic drug resistance pattern with the clinical correlation among the treatment available with the healthcare facilities. Materials and Methods: The samples were collected from the selected population with consent, cultured and differentiated based on morphological and interpretation based on biochemical tests. The frequency of the isolate causing infection and their antibiotic resistance were calculated using SPSS (version 21) at a significant level of P - value < 0.05. Results: Bacterial isolates were collected from the 300 clinical specimens, in which of 103samples are collected from male patients and 197samples are collected from female patients. The results showed that 38% were gram - positive and 62% were gram negative. In this study it is found that the Staphylococcus aureus was found frequently infecting the population and the drug resistance pattern was higher in the penicillin group of antibiotics. Conclusion: The effectiveness of the study is the identification of the bacteria quicker than the standard methods and enhance the use of effective antibiotic against the bacteria to reduce the risk of antibiotic drug resistance and proving effective healthcare to the patient.***

Keywords: Bacterial infection, Antibiotic resistance, Post Operative, Wound infection.

1. Introduction

One of the major problems faced in populated countries is maintaining and providing healthy lifestyle. Health has become a colossal task to balance and it has become a challenging task to the Government and its society to provide effective healthcare to its people. One of the colossal tasks healthcare providers face is the infection. Other than normal epidemic and the recent pandemic which was unknown to mankind has been successfully managed by the Ministry of Health and Family Welfare, Government of India and also the State Health Authorities organised by the Directorate of Public Health. During this outbreak it was a challenge to the healthcare providers for the diagnosis of the infection which was also supported by the Govt and Private laboratories. Likewise in normal cases the infection is not viewed seriously until it create a unease state to an individual. It is due to the ignorance of the patient to consider the infection and to approach a healthcare facility. This common wound infection can also become a life threatening to an individual unless it is identified timely before spreading the infection to the body creating acondition called as SEPSIS which eventually leads to death.

On the other hand, even after identifying the bacteria, drug resistance challenges the healthcare providers in their treatment plan to patients. It is due to the lack of early deduction of the cause for the infection where the patients are subjected with various antibiotics on trial before knowing the bacterial strain which caused a major problem among the medicalfraternity, antibiotic manufactures and the patients due to the development of the antimicrobial drug resistance by the bacteria. Antibiotic drug resistance islisted as the one of the top ten worldwide risks to humans, according to the WHO. Even the medical manufactures are worried about the antimicrobial resistance which has become the major concern to their R&D. [1]

Antibiotics used to treat the microbial infectionsin turn adverse when used frequently antibiotics leads to harmful side effects and also creates antimicrobial resistance (AMR). This AMR threatens the prevention and treatment of using antibiotics for a treatment of infections caused by bacteria, parasites, virus and fungi. [1, 2] These antibiotics are classified in to different groups and which has its own target potential and the classifications are listed as Aminoglycosides, Cephalosporins, Tetracyclins, Penicillins, Sulfonamides, Fluoroquinolones, Macrolides, Carbapenems,

Glycopeptides and Lincosamidesare the major classification of antibiotics used to bacterial infection.

AMR occurs when microscopic organisms do not respond to medicines which has been used for the line of treatment. When these drugs are administrated to the patient the drug has no effect on the infection and patient do not respond positively to the treatment and makethe diseases harder to treat and also spread the infection and create serious illness and in some cases mortality. [2, 4]

Antibiotics prevent millions of deaths each year and remains the primary and foremost treatment line for potentially lethal bacterial infections. Yet other challenge is the issue of inappropriate prescription rates which tend to administration of irrelevant antibiotic and frequent use of antibiotics have been led to resistance that has created a global health emergency and increased the mortality rate to 7, 00, 000 people per year. [11] In the U. S. over 6.5million individuals are infected and the Government spends around $25 billion every year in view of treating the infection. Septicaemia is a challenge in post operative patients for long time.

This study was designed to determine the bacterial pathogens isolated from infected septic wounds and post - operative wounds and their antimicrobial susceptibility patterns. Antimicrobial obstruction can raise confusions with the treatment and can cost expensive to the patient for the delay in the cure either in hospital or with the medicines. An infected wound changes the postoperative treatment course and result in extension of stay at hospital or if discharged home it may create unusual emergency situation to the patient to rush a healthcare facility. In general, our body has human Microbiome where microorganisms live on our epidermis layer, in the nasopharynx, gastrointestinal track and different parts of the body with a specific function to create and maintain a basic immunity and fight against infection guarding the body.

Surgical incisions, injury, sicknesses, sustenance are different variables influence these guards. The skin barrier is disturbed by skin incision and microbial contamination is inevitable despite the best clinical practices carried out at the skin prior surgery where it leads to infection and which is treated with antibiotics later. The increase of antibiotic resistance bacterial strains causing infection has become a big threat to this vulnerable population. Patients above 50 years of age with co - morbidities, particularly diabetes, obesity, venous insufficiency, peripheral artery disease, and immobility are at highest risk of developing chronic wounds. It has been predicted that by 2050 overall, 10 million peoplemight develop AMR, making it challenging to the healthcare facilities to treat. The aim this study was to recognize post - surgical bacterial diseases and general wound infection and to decide their potential antimicrobial protection from generally used antibiotic drugs. At present it is assessed that the mortality rate is about 7, 00, 000 each year around the world. [2, 3, 4]

Estimating the effect of medical intervention with antibiotics is at a significant stage in understanding the development of this issue and identifying arrangements to restrict the rise and spread of microbiological entities. Studies have begun on estimating the expanded cost, prolonged hospital stay and mortality rate in patients withvarious comorbidities due to the infection causing micro organisms. [7]

WHO's first reports on data relating to anti - microbial resistance uncovers higher degrees of protection from numerous genuine bacterial diseases in both developed and developing nations including low income generating nations. WHO's new GLASS (Global Antimicrobial Surveillance System) uncovers recent incidences of anti - infection obstruction among 5, 00, 000 individuals with suspected bacterial diseases across 22 nations. The most common microbes were Escherichia coli, Klebsiella pneumoniae, Staphylococcus aureus, and Streptococcus pneumoniae, trailed by Salmonella spp. [1, 4, 7].

In developing countries there is a crisis to access clean water, sanitation, and healthcare. These countries are often faced with ineffective infection control practices and disease control pattern. Here the only dependable and preventable source for disease control are low priced antibiotics are often not prescribedand the sale over the counter is prevalent. Primary health care can dramatically reduce AMR through simple, quick and economical interventions. [3, 6, 7] According to a study in 2019 about 42.6 %of countries develop AMRIn that 13 gram negative and 5 Gram positive bacteria were dominant and tested sensitive against 37 different varieties of antibiotics. Further 18/53 (34.0%) of *Haemophilus influenza* isolates were resistant to amoxicillin. Resistance of *Escherichia coli* to amoxicillin, trimethoprim and gentamicin was 88.1%, 80.7% and 29.8% respectively. Ciprofloxacin resistance in Salmonella Typhi was rare. No documented ceftriaxone resistance in *Neisseria gonorrhoeae* was reported, while the common resistance for quinolone was 37.5%. Carbapenem resistance was common in *Acinetobacter baumannii*and *Pseudomonas aeruginosa* but uncommon in *Enterobacteriaceae*. [1, 5, 7, 8]

Global impact of drug resistance:
About 4.95 million estimated deaths were associated to AMR in 2019. Measuring the impact of drug resistance is the principal step in understanding the magnitude of the problem and formulating policies to limit the emergence and proliferation of resistant organisms. Studies have focused on measuring the increased price, morbidity, and mortality in patients with infections due to resistant versus susceptible organisms. [7]

Increasing antibiotic resistance of pathogens associated with hospital acquired infections also becomes a major therapeutic challenge for medical industries. WHO's first release surveillance data in 2015 on antibiotic resistance reveals high levels of resistance to many serious bacterial infections in both high and low - income countries. WHO's new GLASS (Global Antimicrobial Surveillance System) reveals widespread occurrence of antibiotic resistance among 5, 00, 000 people with suspected bacterial infections across 22 countries. The most commonly reported resistant bacteria was*Escherichia coli*, *Klebsiella pneumoniae*, *Staphylococcus aureus*, and *Streptococcus pneumoniae*, followed by *Salmonella* spp. [1, 4, 7].

2. Materials and Methods

This cross - sectional review was directed on patients from August 2019 to January 2020 by questionnaire and followed for advancement of clinical signs and side effects on careful site and circulation system disease until the hour of release and post release. Wound swab and venous blood tests were gathered and handled for bacterial separation and antimicrobial weakness testing observing guideline bacteriological methods.

The samples from various collection centres of 'Regenix Super Speciality Laboratories Pvt. Ltd'. (NABL accredited) are collected from all over Chennai, Tamil Nadu, India from August 2019 to January 2020. The lab is accredited by the Quality Council of India. Regenix Super Speciality Laboratories Pvt. Ltd. is NABL accredited laboratory covering specialities from biochemistry, immunology, haematology, hormones, microbiology and molecular biology. All the data presented in this study are thevalues from the tests obtained from the lab. A detailed questioner and consent were collected and filed for future reference and for the knowledge of the history of the patients. The samples considered for this study were pus samples and wound swabs. These samples were cultured for growth and the samples with growth were further tested for anti - biotic sensitivity. The haematological and biochemical parameters for the samples with growth were correlated for the studies of comorbidities. Exclusion criteria for the study were neonates.

For examination of wounds, HI - Media sterile cotton swabs were used and the samples were collected. The samples were processed by experienced technician and the swabs were right away dropped into a sterile cylinder and was transported to Regenix Super Specialty Research facility in a separate cooler box at 2° C - 8° C. Then, the swabs were streaked as quadrant streak and incubated in inverted position in incubator forover night at 37°C. If the growth was seen the samples were further taken for Gram staining. Depending on the results of Gram staining further biochemical testing was carried out for confirmation of species and compared to the results of the ATCC strain. Further the colony was isolated, streaked by lawn streaking and the anti - biotic disks were placed and incubated overnight. After 24 hours the anti - biotic resistance patterns were seen and measured and reported as sensitive, moderate sensitive and resistant and colony count (CFU/g of tissue) was also reported.

Antimicrobial susceptibility testing was performed using Kirby Bauer agar disc diffusion method for the isolated pathogenic organisms. A loop full of bacterial organisms was taken from an unadulterated culture. province and was moved to a tube containing 5ml of phosphate cradle saline and blended tenderly until it framed a homogenous suspension and the turbidity of the suspension was changed in accordance with the turbidity of McFarland 0.5 norm in a cylinder. The normalized inoculums of each disengage were immunized on to Mueller - Hinton anti - infection awareness medium (Himedia Ltd.). Antimicrobial susceptibility testing was performed using Kirby Bauer agar disc diffusion technique for the isolated pathogen. Recognizable proof of refined segregates was finished by the standard bacteriological Techniques. [9]

Finally, all the disconnects were tried for these under recorded HI - Media drug plates: - Ampicillin (AP, 10µg), Amoxycillin (AMX), Penicillin G (P), Chloramphenicol (C), Gentamycin (GEN), Tetracycline (TE), Netillin (NET), Levoflax (LE), cloxacillin (COX), Clindamycin (CD), Azteram (AT), Imipenem (IPM), Teicoplanin (TEI), Meropenum (MRP) Ceftriaxone (CTB), Doxycycline (DO), Norfloxacin (NX), Ciprofloxacin (CIP), Erythromycin (E) and Nitrofurantoin (F). These antimicrobial medication plates were chosen in light of Clinical and Laboratory Standards Institute (CLSI), the accessibility and remedy recurrence of these medications in the review region.

The plates were incubated aerobically at 37°C for overnight (18 - 24) hours and the interpretation of the results of the antimicrobial susceptibility was made based on the CLSI The (Clinical and Laboratory Standards Institute) criteria as sensitive, intermediate and resistant by measuring diameter of inhibition of the zone. All transitional readings were taken as safe during information section. The standard reference strains, Staphylococcus aureus (ATCC25923), Escherichia coli (ATCC25922 and P. aeruginosa (ATCC 27853) were utilized to guarantee testing execution of the power of drug discs as well as the quality of culture media. The quantitative data was checked for completeness, coded and fed into SPSS version 21 and P - value <0.05 was considered statistically significant for association between variables. Approved by Hy - care Ethical Committee - 033/HYC/IEC/2019.

We have documented relatively higher drug resistance rates among gram negatives they are Amoxiclav Amoxycillin and Nalidic acid are top most antibiotics. Similarly, for Gram Positive bacteria Penicillin, Cefoxitin and cloxacillinshows increased resistance. In this study, Amikacin and Ciprofloxacin were found to be the most efficient antimicrobial agents against gram - negative bacterial isolates. However, Chloramphenicol and Ampicillin were found to be more effective against gram positives isolates. Moreover, majority of the isolates showed resistance to more than one drug. The predominance of *Staphylococcusaureus* infection was seen in this study. Infection with this organism may also be associated with contamination from the environment, surgical instruments or contaminated hands of the health care professionals. This is most likely associated with endogenous source as the organism is a member of the skin and nasal flora as explained by *Isbori et al.*,. The second most common source of infection is Klebsiella pneumonia. While E. coli was the third most commonly isolated bacteria from SSI (Surgical Site Infection). This could be because of the profound influence of endogenous contamination from the bowel and hollow muscular organs of patients where E. coli are present naturally. GPC's distribution in the study population is higher.

Among the antibiotics Penicillin group shows more resistant than other groups. The continuous use of Penicillin over the years can be attributed to this fact. Patients with diabetes and blood pressure showed more of GPC infections.

3. Results

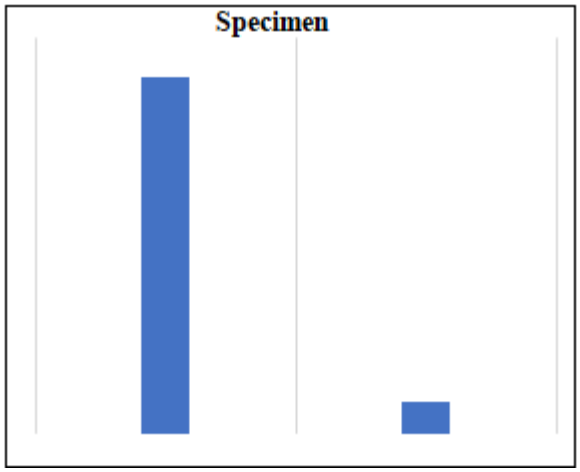

Figure 1: Distribution of specimen collected from the post operative infected Pus and wound swabs.

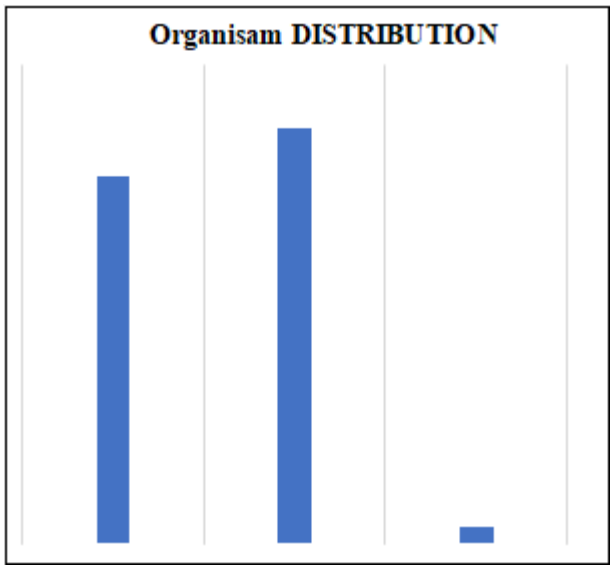

Figure 2: Distribution of Gram positive cocci (GPC), Gram - negative Bacillus (GNB) and Yeast.

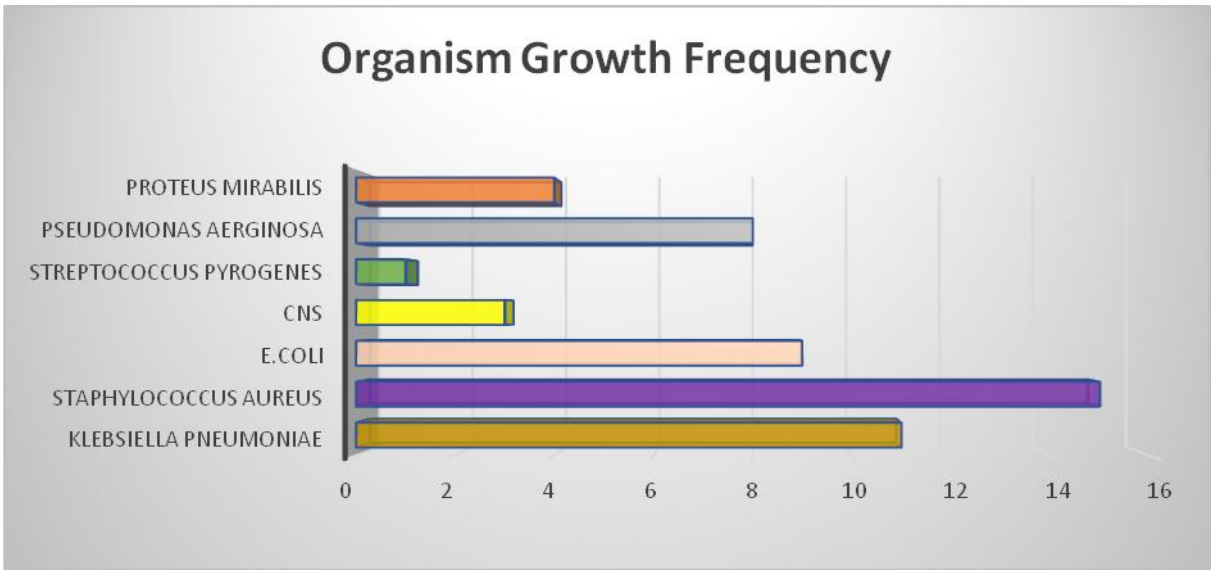

Figure 3: Organism growth Frequency, in this *Staphylococcus aureus* shows maximum number of growth among others followed by *Klebsiella pneumoniae, E. coli., Pseudomonas aerginosa and proteus mirabilis.*

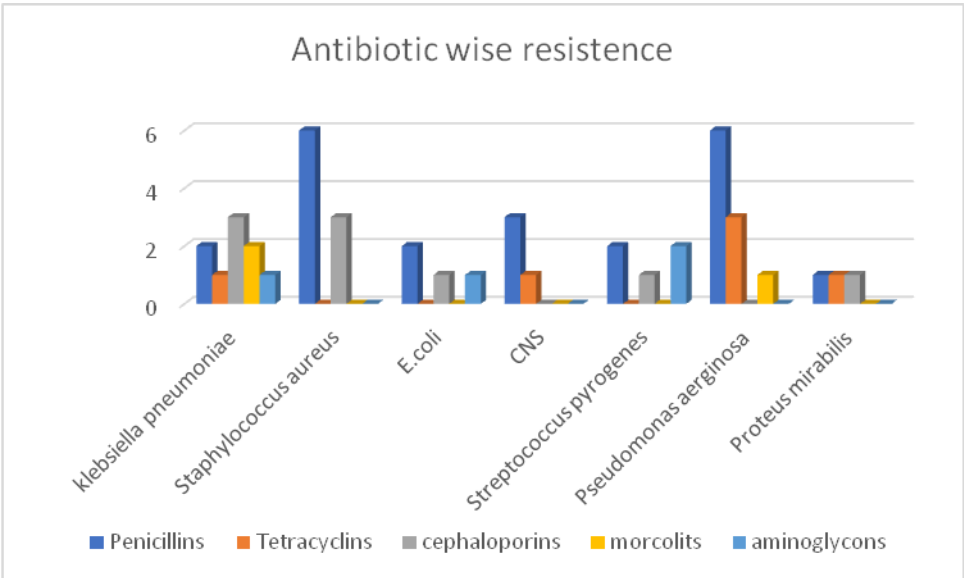

Figure 4: Major classification of Antibiotics showing Resistance: Penicillins shows high resistance in *Staphylococcus aureus* followed by Tetracyclines and Cephaloporins. *Klebsilla pneumoniae, Pseudomonas aerginosa, E. coli, and Proteus mirabilis.*

Penicilins shows highest resistance in all the organisms followed by Tetracyclines, Cephaloporins. Morcolits and Aminoglycons.

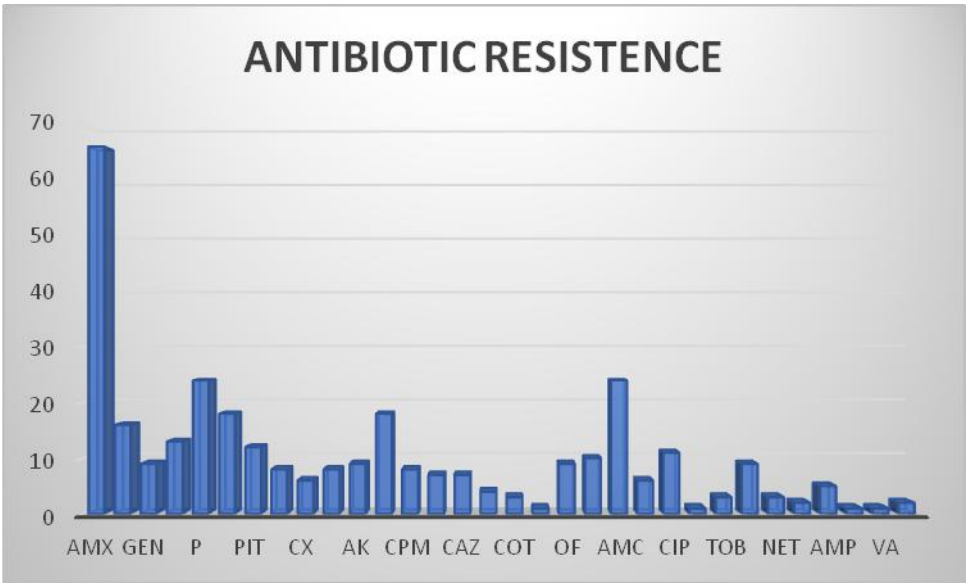

Figure 5: Antibiotic Resistence: Amoxicillin shows uppermost resistance among all the otherantibioticsfollowed by Ampicillin and Cephalosporins.

4. Discussion and Conclusion

The collection of specimens is of two categories pus and swab from the affected area. Among which the pus samples show more positive results then the wound swabs figure 1, similarly DagnachewMuluye et. al., also found Whilecomparing the culture positivity of the samples, pus or wound discharge samples were 2.38 times positive for bacterial isolates than wound swab samples. This shows the high probability of positive results obtained in pus samples them wound swabs. [29]

The isolated organism are Gram positive cocci (GPC), Gram - negative Bacillus (GNB) and yeast. The isolated organisms are widely distributed as 61% of GPC 37% of GNB and 2% of yeast. Likewise, Sulochana Khatiwada et., al. shoes Out of 152 pus and swab samples processed for culture, (64.5%) showed culture positivity. In total isolates (65.7%) were Gram negative bacteria and (34.3%) Gram positive bacteria. [30]

The understanding of the patterns of infection and the resistance is a key in the effective prevention of the AMR and consequent deaths. This is a pilot study that deals with the pattern of bacterial wound infections and resistance patterns in a post operative wound infected population in Chennai. [13] This study also provides information about antibiotics and the resistant pattern to each organism, Penicillin groups such as Amoxicillin, Ampicillin and Cephalosporins shows topmost resistant comparing to all the other antibiotics correspondingly C. Lee Ventola says the same and he also reports that AMR infections place a substantial health and economic burden in developed countries, health care system and population. Coordinated efforts to implement new policies, renew research efforts, and follow steps to manage the crisis are greatly needed to avoid this antibiotic resistance. This AMR occurs may be due to counter sale of pre - estimated antibiotics, poverty and lack of social awareness.

Organism growth Frequency highest rate of infections occurs in *Staphylococcus aureus* followed by *Klebsiella pneumonia, E. coli, Pseudomonas aerginosa and proteus mirabilis.* (Fig.1). In this study population. There is less or no similar work done in this population so comparing the obtained results with other similar studies done in different parts of the world, KemebradikumoPondeiet., al says at Nigeria Pseudomonas aeruginosa shows highest number of infection followed by *Staphylococcus aureus and E. coli.* SimilarlyP. G. BOWLER et, al at Arizona shows Staphylococcus aureus has the highest number infection growth frequency. This is purely based on the climatic condition of the study population, number antibiotics exposed, wound location, patients co - morbidities and poor sanitization.

Abebaw Bitew Kifilieet., al states that the predominant bacterial isolates were *S. aureus* (41.6%), *E. coli* (19.8%), *K. pneumoniae* (13.9%), *coagulase negative Staphylococcus* (12.9%), and *Enterobacter* spp. (4%). The majority of isolates were resistant to amoxicillin, ampicillin and tetracycline but susceptible to ceftriaxone,

amikacin and chloramphenicol. Lined up with the above study Antibiotic wise growth frequency penicillin shows highest resistance in all the bacteria increasingly in *Staphylococcus aureus* followed by *Klebsilla pneumoniae, Pseudomonas aerginosa, E. coli, and Proteus mirabilis.* Tetracyclines and Cephaloporins are the other two antibiotics shows highest resistance in the bacterial organisms.

5. Conclusion

Antibiotics endure the leading therapy for treating bacterial infections. However, by the unreasonable use of antibiotics, certain strains of multidrug - resistant pathogenic bacteria have emerged by selection pressure; consequently, bacteria that have been once sensitive, re - emerged as resistant to different antibiotics and create limited therapeutic options, increased risks of treatment failure and poor patient treatment management. Knowledge of proper antimicrobial prescription policy of a specific setting in addition to the investigation of causative agents and their antimicrobial susceptibility profile, is essential to improve the management and reduction of the rate of post operative infections.

In this study, the prevalence of antibiotic resistance was high in most common pathogenic organisms. Similarly, the results of this study demonstrated that antibiotics with a high resistance pattern must be less used for the treatment of bacterial contamination. Moreover, to prevent the spread of resistance among various strains and improve the effectiveness of antibiotics, it is suggested to establish a precise schedule for antibiotic use in each region based on their antibiotic resistance pattern. High occurrence of antimicrobial resistance to the commonly tested antibiotics isway more alarming. Therefore, effective infection control line - ups and rational antibiotic use policies should be conventional promptly.

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