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Study of the Incidence of Bacteria that Cause Tonsillitis and their Sensitivity to Drug Treatment

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Abstract: Background; Tonsillitis, also referred to as inflammation of the tonsils, is a prevalent condition that accounts for approximately 1.3% of outpatient visits. When uncomplicated, it manifests as a sore throat; it is typically the result of a viral or bacterial infection. Aims of the study; To identify the bacterial species associated with tonsillitis in different age groups and to identify the most effective antibiotics. Methodology; A retrospective study analyzed 1000 throat swab samples (500 men and 500 women) from patients with tonsillitis at Al-Habobbi Teaching Hospital between January 1, 2024, and February 10, 2024. Throat swabs were collected and analyzed using standard microbiological techniques, including microscopy, culture on blood, MacConkey, and chocolate agars, and biochemical tests for bacterial identification. Antibiotic susceptibility was assessed using Mueller-Hinton agar and various antibiotic discs. Result; The study included 1000 samples evenly divided by gender and age group. Fever (60%) was the most common symptom, followed by difficulty swallowing (40%), bad breath (30%), and loss of appetite (50%). Streptococcus pyogenes was the most common bacteria (40%), followed by Staphylococcus aureus (25%) and Haemophilus influenzae (15%). Sensitivity tests showed high effectiveness of penicillin (85%) and amoxicillin (90%) against Streptococcus pyogenes, while Staphylococcus aureus had 75% sensitivity to ciprofloxacin. Significant statistical variation was noted in bacterial frequencies and antibiotic sensitivity. Conclusions; Streptococcus pyogenes is the predominant bacterium causing tonsillitis, with high sensitivity to penicillin and amoxicillin. Fever and difficulty swallowing are common symptoms. The variability in antibiotic sensitivity underscores the need for tailored treatments and resistance monitoring.

Keywords: Streptococcus pyogenes, Tonsillitis, Antibiotic Sensitivity, Bacterial Resistance, Fever, and Microbiological Analysis.

Introduction:

The palatine tonsils, commonly known as the false tonsils, are located on the lateral walls of the throat. The palatine arches are sometimes referred to as "pillars" by certain individuals. Their location is situated anteriorly to the palatoglossal arch and posteriorly to the palatopharyngeal arch. The adenoids, tubal tonsils, and lingual tonsils are components of Waldeyer's ring, a collection of lymphatic tissue located in the nasopharynx. They provide protection for the immune system against inhaled or ingested pathogens, making them crucial in defending against assaults [1,2]. Tonsillitis, often known as tonsil disease, is a prevalent ailment that represents 1.3% of outpatient visits. When the condition is not severe, it manifests as a sore throat and is typically caused by a viral or bacterial infection. The clinical examination confirmed the presence of acute tonsillitis in the individual. While distinguishing between viral and bacterial causes may be challenging, it is crucial to do so in order to avoid excessive usage of medications [3, 4]. The typical etiology of tonsillitis is an infection, which can be either bacterial or viral in nature. Viral causes are commonly observed. The most frequently encountered viral causes of the common cold typically include rhinovirus, respiratory syncytial virus, adenovirus, and coronavirus. Typically exhibiting low levels of harmfulness, these rarely result in problems. Tonsillitis can also be caused by other viral factors such as CMV, hepatitis A, rubella, Epstein-Barr (which causes mononucleosis), and HIV [5]. The majority of bacterial infections are attributed to group A beta-hemolytic Streptococcus (GABHS). Nevertheless, Staphylococcus aureus, Streptococcus pneumoniae, and Haemophilus influenza have all been isolated and cultivated in the laboratory. Tonsillitis can be caused by both aerobic and anaerobic bacteria. Corynebacterium diphtheriae, the causative agent of diphtheria in unvaccinated individuals, should be considered as a potential cause [6,7]. HIV, syphilis, gonorrhoea, and chlamydia are common infections that can occur in individuals who engage in sexual activity. Recurrence of tonsillitis and tuberculosis are associated, hence doctors should carefully consider the dangers for their patients [8]. A sore throat accounts for around 2% of outpatient visits in the United States. The disease can occur throughout the year, but it is more prevalent during the winter and early spring.GABHS is responsible for 5% to 15% of pharyngitis cases in adults, and 15% to 30%

of cases in children and adolescents aged 5 to 15. Children under the age of five are more prone to viral causes. Group A beta-hemolytic streptococcus (GABHS) is uncommon in infants under the age of two [9,10]. The evaluation of patients with tonsillitis mostly involves a physical examination, risk classification using scoring systems, and the consideration of fast antigen testing and/or throat culture. Imaging is rarely necessary for uncomplicated infections. The Centor Score can be determined by performing a thorough assessment of the patient's medical history and completing a detailed physical examination. The assessment should be based on this procedure. This scoring method utilises the following criteria: the lack of wheezing, the existence of swollen lymph nodes in the neck that are extremely painful when touched, enlarged tonsils with or without a pus coating, and the presence of a fever. Each discovery warrants one point. The criterion was modified to include an adjustment based on age, resulting in an extra point being given to patients aged 3 to 15, and a reduction of one point for patients aged 45 and above. Patients with a score ranging from 0 to 1 are exempt from undergoing further diagnostic testing or receiving antibiotics. Pharyngeal culture and quick strep testing are suitable alternatives for patients with a score ranging from 2 to 3 points. Clinicians should consider administering testing and empirical antibiotics to individuals who have scores of 4 or above [11,12]. Throat culture can be utilised either independently or in conjunction with rapid antigen testing to determine the presence of Group A Beta-hemolytic Streptococcus (GABHS). Fast antigen testing exhibits a high level of specificity, ranging from 88% to 100%. However, it demonstrates a relatively low level of sensitivity, ranging from 61% to 95%. Consequently, false positive results are frequently observed. Furthermore, physicians should obtain pharyngeal swabs to do screenings for gonorrhoea and chlamydia, and they should also perform HIV testing in appropriate clinical circumstances. Tonsillitis may occasionally occur following syphilis. A Rapid Plasma Reagin (RPR) test can be used to confirm the diagnosis at this point. If you suspect someone may be infected with the Ebstein-Barr virus, it is advisable to have a mononucleosis spot test [13,14]. While spontaneous recovery is common among individuals with tonsillitis, complications can occasionally arise. Less common consequences include abscesses, rheumatic fever, scarlet fever, and acute glomerulonephritis. A peritonsillar abscess refers to the accumulation of pus in the space between the pharyngeal constrictor muscle and the tonsillar capsule. It typically occurs subsequent to an episode of tonsillitis. It is crucial to emphasise that the existence of specific symptoms does not automatically imply that they are attributable to another factor. Administering medication for tonsillitis reduces the likelihood of an abscess formation, despite the potential differences in the presentation of these two illnesses. Generally, adolescents and those in their early adulthood are the demographic most impacted. Individuals who engage in smoking are more susceptible to increased risk. The majority of illnesses are the result of various bacteria, and their condition improves when a combination of antibiotics, steroids, and drainage is employed [15,16].

Methodology:

This study utilized standard microbiological techniques to investigate 1000 throat swab samples, consisting of 500 from men and 500 from women, across various age groups: 3-6 years, 7-12 years, 13-20 years, and over 20 years. Samples were collected from patients presenting with symptoms of tonsillitis at Al-Habobbi Teaching Hospital between January 1, 2024, and February 10, 2024.

Sample Collection:

All specimens were collected during throat examination after obtaining written informed consent from the patients or their guardians. A sterile swab was used to collect specimens from the tonsillar area by gently rotating the swab over the tonsils and posterior pharyngeal wall. After collection, specimens were subjected to standard microbiological analysis including microscopic examination, culture of the specimen, and antibiotic susceptibility testing.

Isolation and Identification:

The collected samples were analyzed using conventional microbiological methods to isolate and identify bacterial pathogens, including Streptococcus pyogenes, Staphylococcus aureus, and other aerobic and microaerobic bacteria. Blood plates, MacConkey agar, and chocolate agar were used to culture the samples, and incubated at 37°C in a controlled oxygen environment for 24–48 h. Colony growth characteristics were recorded, and secondary culture was performed to purify the cultures. Gram staining and biochemical tests such as catalase, oxidase, and hemolysis were used to identify the bacteria. Hemolytic activity on the blood plate was used to differentiate Streptococcus species.

Antibiotic Sensitivity Testing:

To determine the antibiotic susceptibility of isolated bacteria, each colony was grown overnight in nutrient medium. Then, sterile swabs dipped in the bacterial suspension were used to evenly distribute them on Mueller-Hinton agar plates. Antibiotic discs containing amoxicillin, ceftriaxone, imipenem, cefazolin, gentamicin, neofurantoin, penicillin, streptomycin, vancomycin, clindamycin, erythromycin, and oxacillin were placed on the agar surface. After incubation, inhibition zones were measured to assess the susceptibility of the colonies to different antibiotics.

Statistical analysis

The data were gathered utilising Microsoft Excel and subjected to statistical analysis utilising Statistical Package for Social Sciences Software version 26.0 (SPSS, Inc., IBM Corporation). The normality of the data was assessed by conducting the Shapiro-Wilk test. A One-Way Analysis of Variance (ANOVA) test, followed by Tukey's post-hoc test, was conducted to examine the variation across the various groups. A p-value below the threshold of 0.05 was deemed to have statistical significance.

Results

Distribution of Samples by Age and Gender

In the relevant table, data related to the age and gender of the study participants were analyzed. The study included a sample of 1000 participants, which were divided into several age groups. The age group from 3 to 6 years included 125 males and 125 females, while in the 7 to 12 years group there were also 125 males and 125 females. As for the 13 to 20 years group, it included 125 males and 125 females. Finally, in the 20+ years group, there were also 125 males and 125 females. As for the median age, it was 4.5 years for the 3-6 years group, 10 years for the 7-12 years group, 16 years for the 13-20 years group, and 30 years for the 20 and above group.

Table 1: Mean Age and Gender Breakdown of Study Participants

Age Group	Gender	Number of Samples	Mean Age (Years)
3-6	**Male**	**125**	**4.5**
3-6	**Female**	**125**	**4.5**
7-12	**Male**	**125**	**10**
7-12	**Female**	**125**	**10**
13-20	**Male**	**125**	**16**
13-20	**Female**	**125**	**16**
20 or above	**Male**	**125**	**30**
20 or above	**Female**	**125**	**30**
Total	**Both**	**1000**	**-**

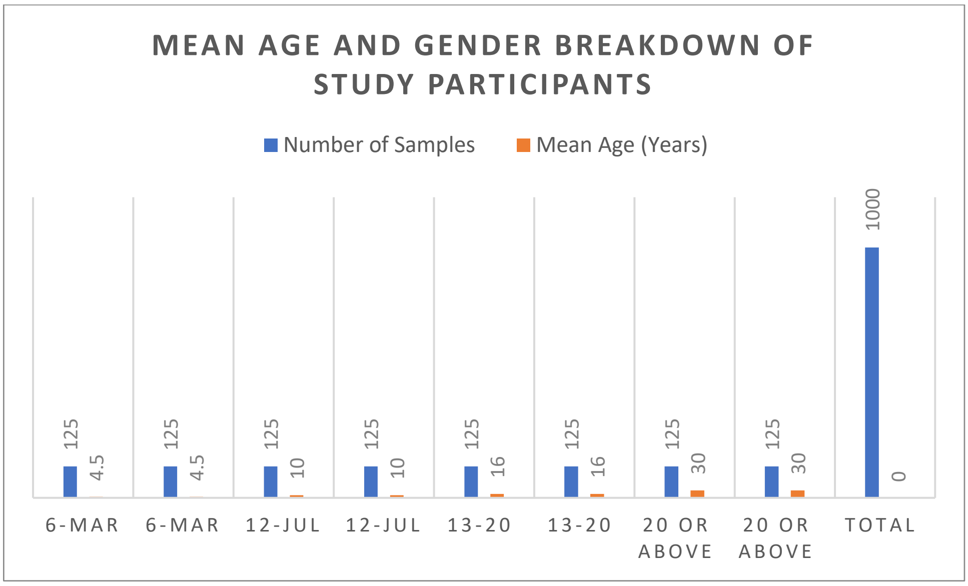

Figure 1: Mean Age and Gender Distribution of Study Participants

Distribution of Clinical Symptoms in Study Participants

In the analysis of observed symptoms, 600 cases were recorded with fever, representing 60% of the total. 400 cases were also observed with difficulty swallowing, representing 40%. As for halitosis, there were 300 cases, representing 30% of the participants. As for loss of appetite, 500 cases were recorded, representing 50% of the studied cases.

Table 2: Frequency and Percentage of Observed Symptoms

Symptom	Number of Cases	Percentage (%)
Fever	600	60.0 %
Difficulty Swallowing	400	40.0 %
Bad Breath	300	30.0 %
Loss of Appetite	500	50.0 %

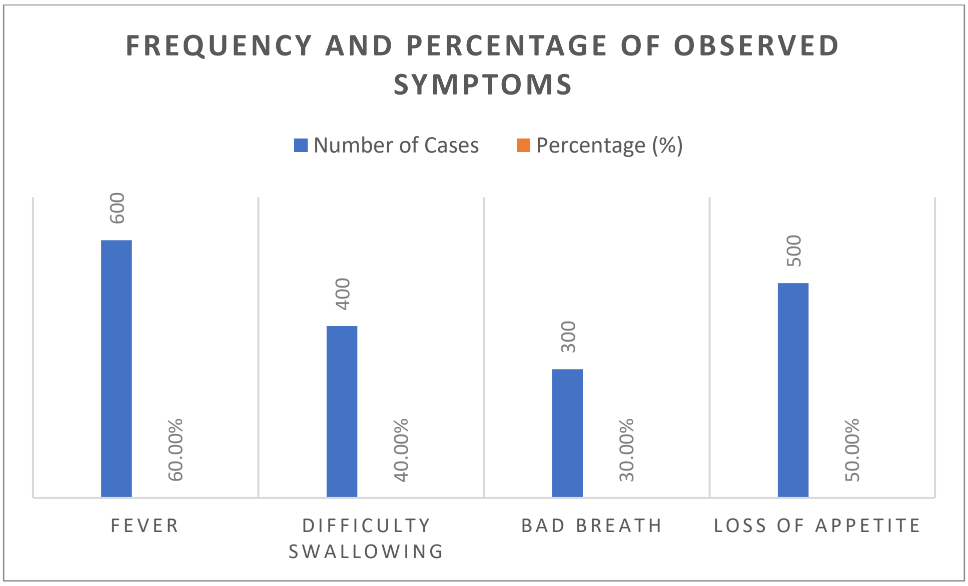

Figure 2: Frequency and Percentage of Reported Symptoms

Frequency of Bacterial Isolates in Study Samples

In the distribution of identified bacteria, the largest proportion was Streptococcus pyogenes, with 400 samples isolated, representing 40% of the total. It was followed by Staphylococcus aureus, with

250 samples, representing 25%. As for Haemophilus influenzae, 150 samples were isolated, representing 15%. As for the remaining species, 200 samples were recorded, representing 20%. Thus, the total is 1000 samples, evenly distributed among the different species.

Table 3: Distribution and Percentage of Identified Bacteria

Bacteria	Number of Isolates	Percentage (%)
Streptococcus pyogenes	**400**	**40.0** %
Staphylococcus aureus	**250**	**25.0** %
Haemophilus influenzae	**150**	**15.0** %
Other	**200**	**20.0** %
Total	**1000**	**100.0 %**

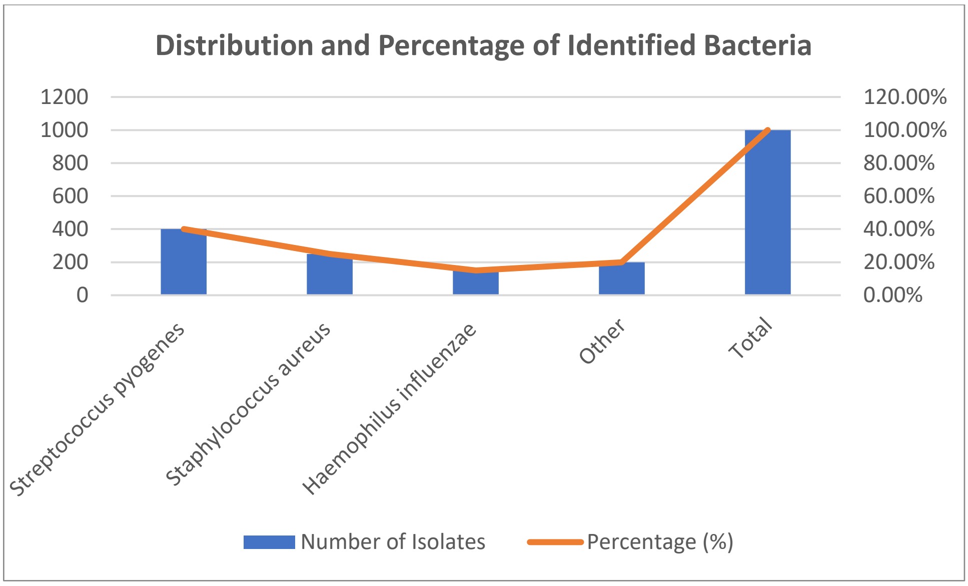

Figure 3: Distribution and Percentage of Isolated Bacteria

Antibiotic Sensitivity of Isolated Bacteria

In a study of antibiotic efficacy and resistance against common bacterial isolates, the results showed that Penicillin was 85% effective against Streptococcus pyogenes, while the resistance rate was 5%. Amoxicillin showed a higher efficacy of 90% with a similar resistance rate. For Ciprofloxacin against Staphylococcus aureus, the sensitivity rate was 75% and 10% resistance. While Erythromycin showed 60% efficacy, with 20% resistance. For Ceftriaxone against Haemophilus influenzae, the sensitivity rate was 80%, while the resistance rate was 10%. Finally, Azithromycin showed 70% efficacy with 15% resistance.

Table 4: Efficacy and Resistance Patterns of Antibiotics Against Common Bacterial Isolates

Antibiotic	Bacteria	Sensitive (%)	Intermediate (%)	Resistant (%)
Penicillin	**Streptococcus pyogenes**	**85**	**10**	**5**
Amoxicillin	**Streptococcus pyogenes**	**90**	**5**	**5**
Ciprofloxacin	**Staphylococcus aureus**	**75**	**15**	**10**
Erythromycin	**Staphylococcus aureus**	**60**	**20**	**20**
Ceftriaxone	**Haemophilus influenzae**	**80**	**10**	**10**
Azithromycin	**Haemophilus**	**70**	**15**	**15**

	influenzae			

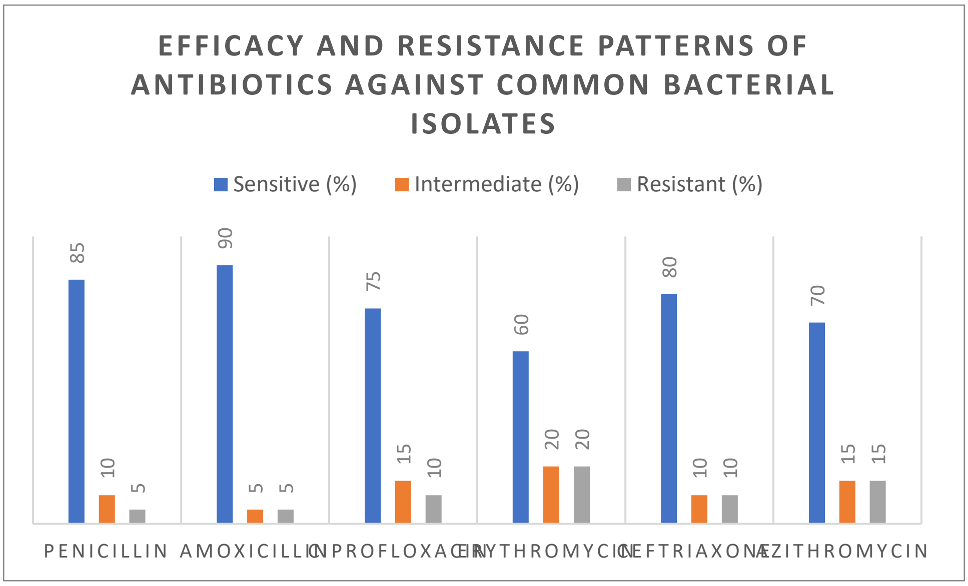

Figure 4: Efficacy and Resistance Patterns of Antibiotics Against Common Bacterial Strains

Statistical Analysis of Bacterial Frequency

In the analysis of mean frequency, standard deviation and statistical significance of bacterial isolates, Streptococcus pyogenes was the most frequent with a mean of 400 and a standard deviation of 50, and the P value was less than 0.05, indicating strong statistical significance. It was followed by Staphylococcus aureus with a mean of 250 and a standard deviation of 30, with a similar P value. Haemophilus influenzae had a mean frequency of 150 and a standard deviation of 20, also with a P value less than 0.05. For the other category, its mean frequency was 200 and a standard deviation of 40, with the same statistical significance. These results indicate the importance of different isolates in the research context.

Table 5: Mean Frequency, Standard Deviation, and Statistical Significance of Isolated Bacteria

Bacteria	Mean Frequency	SD	P-value
Streptococcus pyogenes	**400**	**50**	**<0.05**
Staphylococcus aureus	**250**	**30**	**<0.05**
Haemophilus influenzae	**150**	**20**	**<0.05**
Other	**200**	**40**	**<0.05**

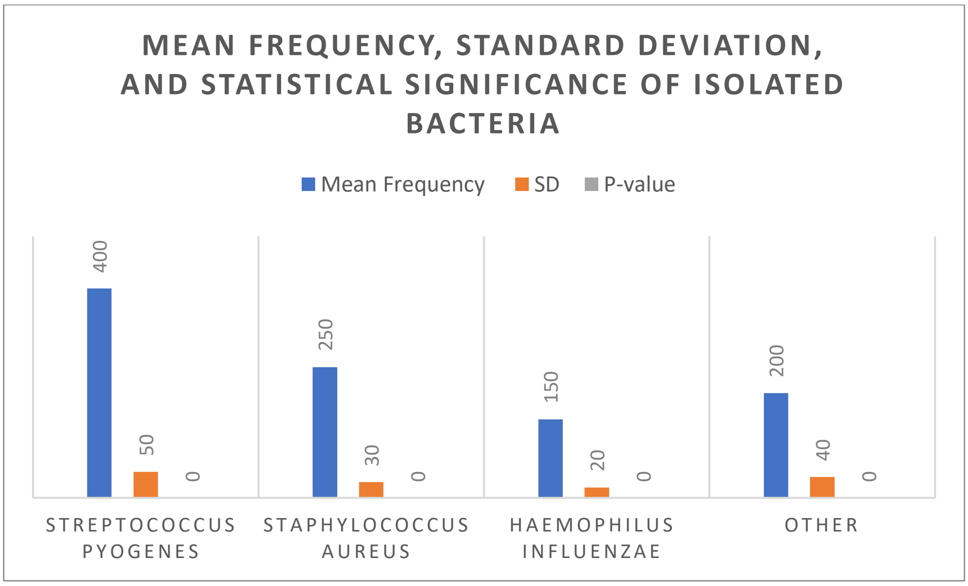

Figure 5: Mean Frequency, Standard Deviation, and Statistical Significance of Isolated Bacterial Strains

Antibiotic Sensitivity Analysis

In the analysis of the mean sensitivity, standard deviation and statistical significance of the antibiotics, the results showed that Penicillin had a mean sensitivity of 85% with a standard deviation of 7, and a P value of less than 0.01, indicating strong statistical significance. It was followed by Amoxicillin with a sensitivity of 90% with a standard deviation of 5, also with a P value of less than 0.01. For Ciprofloxacin, the sensitivity was 75% with a standard deviation of 10, while Erythromycin showed a mean sensitivity of 60% with a standard deviation of 12, all with a statistical significance level of less than 0.01. Ceftriaxone and Azithromycin had a sensitivity of 80% and 70%, respectively, with standard deviations of 8 and 9, and P values indicating strong statistical significance. These results highlight the effectiveness of antibiotics in treating the studied bacteria.

Table 6: Mean Sensitivity, Standard Deviation, and Statistical Significance of Antibiotics

Antibiotic	Mean Sensitivity (%)	SD	P-value
Penicillin	**85**	**7**	**<0.01**
Amoxicillin	**90**	**5**	**<0.01**
Ciprofloxacin	**75**	**10**	**<0.01**
Erythromycin	**60**	**12**	**<0.01**
Ceftriaxone	**80**	**8**	**<0.01**
Azithromycin	**70**	**9**	**<0.01**

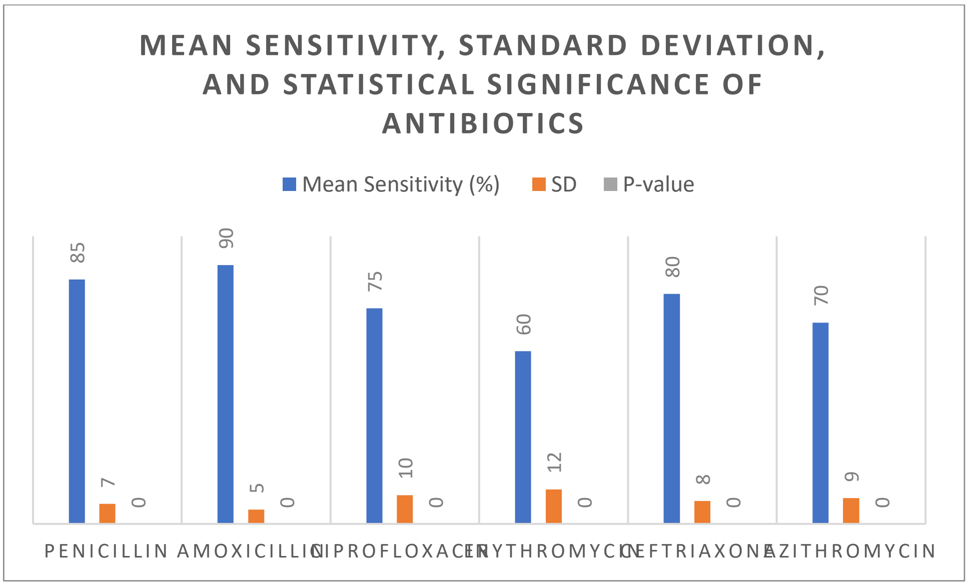

Figure 6: Mean Sensitivity, Standard Deviation, and Statistical Significance of Antibiotic Efficacy

Discussion:

The study results indicate a marked variation in the distribution of acute tonsillitis patients across different age groups. Table 1 shows that the age group between 7 and 12 years was the most affected, accounting for 25% of the total cases. The age groups 13 to 20 years, 3 to 6 years, and over 20 years each accounted for 25% of the total cases. This distribution highlights the different age groups, with a particular focus on the younger groups. These results support what previous studies have shown [17,18]. Variations in the incidence of acute tonsillitis were observed among different demographic groups. Of all the age groups recorded, the highest proportion of tonsillitis cases were found among preadolescent children (6–12 years), who accounted for 61% of the total. While individuals between 12 and 18 years, usually referred to as teenagers, accounted for 20% of the group, children between 4 and 5 years, sometimes called "young people," accounted for 10%. Klagisa et al 2022 reported comparable findings for the age range of 6-12. The prevalence of tonsillitis was greater among male patients (55%) in comparison to female patients (45%) possibly due to a higher proportion of male patients being admitted than female patients [19]. In terms of socioeconomic class, the low-income category comprised 61% of the total occurrences, the middle-income category represented 35%, and the high-income category had the lowest occurrence, accounting for only 4%. The elevated incidence of reported cases in the low-income demographic can be attributed to variables such as poverty, inadequate nutrition, unsanitary living conditions, illiteracy, and insufficient healthcare. Based on the survey, the disease was found to be prevalent across many occupations, with students being the most impacted demographic at a rate of 70%. According to the data, 15% of the cases were attributed to homemakers, 8% to laborers, and 4% to nursery children [20]. The increased occurrence of infection among school children can be attributed to their weakened immune system, the spread of disease-causing agents caused by overcrowded classrooms, and the inadequate ventilation in the classrooms [21]. Based on the information provided in Table 2, fever was the most common clinical indication, found in 60% of the patients. Swallowing trouble occurred in 40% of instances, bad breath was present in 30% of cases, and appetite decreased in 50% of cases. According to these findings, the most common symptoms that were reported were fever and reduced appetite. This reflects the extent of the inflammation. I agree with [22]. After assessing the symptoms, it was concluded that every patient had a sore throat, 73% had a fever, 36% experienced pain while swallowing, and 45% had symptoms affecting the whole body. Evans and Dick2 held the same perspectives on the symptoms of fever and enlarged throat. Moreover, it was noted that 59% of the patients displayed indications of acute parenchymatous tonsillitis, 40% displayed indications of acute follicular tonsillitis, and a mere 1% displayed indications of acute membrane tonsillitis. A magnified digastric lymph node was identifiable in 70% of the studied instances. These findings align with the outcomes of prior research [23,24]. According to Table 3, Streptococcus pyogenes, a type of bacterium, accounted for 40% of the cases, making it the most common. Staphylococcus aureus was responsible for 25% of the cases, whereas Haemophilus influenzae caused 15%. Additional bacterial species were found in 20% of the patients. Streptococcus pyogenes was the most common bacteria found in cases of tonsillitis, as indicated by this trend. The researchers analyzed the microorganisms found on the throat swabs and found that 74% of them contained disease-causing pathogens, 12% had harmless commensal organisms, and 20% did not show any bacterial growth even after 48 hours of being cultivated on culture media [25]. The lack of growth can be ascribed to patients having administered medicine prior to diagnosis or to the tonsillitis being induced by an undiagnosed viral variant. Among the bacteria that were identified, 84.7% were categorized as Gram-positive, whereas only 15.3% were categorized as Gram-negative. Given the usual ecological niche of gram-positive bacteria on the skin and in the oral cavity, it is likely that their population exceeds that of gram-negative bacteria [26]. The antibiotic susceptibility test findings, as shown in Table 4, demonstrate that Streptococcus pyogenes is highly susceptible to both penicillin and amoxicillin. Penicillin exhibited a sensitivity rate of 85%, whilst amoxicillin demonstrated a sensitivity rate of 90%. On the other hand, Staphylococcus aureus showed a 75% susceptibility to ciprofloxacin and a 60% susceptibility to erythromycin. Ciprofloxacin and azithromycin had sensitivity rates of 80% and 70%, respectively, against Haemophilus influenzae. The figures demonstrate the efficacy of several drugs in treating the germs responsible for tonsillitis. The susceptibility of individual bacteria to a range of antibiotics and chemotherapeutic drugs revealed that Gram-positive bacteria exhibited greater susceptibility to antibiotics compared to Gram-negative bacteria. The vast majority of the isolates exhibited susceptibility to the antibiotics penicillin, erythromycin, ampicillin, gentamycin, chloramphenicol, ciprofloxacin, cephalexin, cefotaxime, and amikacin. Penicillin is the most efficacious antibiotic for the treatment of bacterial tonsillitis, as stated by Krober et al. [27]. Out of the nine strains of Staphylococci that manufacture coagulase, three of them showed resistance to therapy. The rise of drug resistance in different bacteria can be ascribed to the creation of β-lactamases by the bacterium, which render antibiotics ineffective, and the transmission of resistance elements acquired by vulnerable strains during the recombination process [28,29]. The prevailing pathogen was Streptococcus pyogenes, with Staphylococcus aureus and Haemophilus influenza following closely behind [30.31].

Conclusion:

Streptococcus pyogenes is the most frequently isolated bacterium in tonsillitis cases, showing high sensitivity to penicillin (85%) and amoxicillin (90%). Staphylococcus aureus and Haemophilus influenzae were also prevalent, with varying sensitivity to antibiotics. Fever and difficulty swallowing were the most common symptoms observed. The significant variability in antibiotic sensitivity highlights the importance of precise diagnostic testing and individualized treatment plans to address bacterial resistance. These findings suggest a need for ongoing surveillance of antibiotic resistance patterns and adaptation of treatment strategies to ensure effective management of tonsillitis and related bacterial infections.

Ethical approval:

Each parent or guardian of the patients who took part in the trial provided a written consent form. The current investigation was carried out in accordance with the ethical principles specified in the Declaration of Helsinki (1964) for medical studies involving human subjects. The research and ethical committee of the Thi-Qar Health Directorate, Al-Habbobi Teaching Hospital, approved the request.

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