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Abstract

Background: Differentiating between viral and bacterial illnesses is essential for efficient clinical therapy and minimizing drug abuse.

Aim: This study evaluates the clinical value of Procalcitonin (PCT) and C-reactive proteins (CRP) testing used to identify unique bacterial and viral Acute Respiratory Diseases (ARDs) infections.

Methodology: 142 children with verified bacterium illness were classed as group I, whereas 78 children with a viral illness were classified as group II. Both groups' PCT and CRP values were clinically identified and comparatively analyzed. The clinical tests used to identify biomarkers of the PCT and CRP are the Electrochemiluminescence Immunoassay (ECLIA) for PCT biomarkers and the latex Immunoturbidimetry test for CRP biomarkers. The ANOVA and t-test are used to

compare the levels of PCT and CRP, Chi-Square is used to compare the optimistic rate of mutual recognition of PCT and CRP biomarkers, and ROC curve analysis of the diagnostic accuracy of each marker, the comparative analysis stimulated by the SPSS v24.

Result: The results showed that PCT levels were significantly considerably greater in group I compared to group II, but there was not a significant distinction in PCT and CRP levels between the groups with and without Gram-positive infections.

Conclusion: PCT and CRP serve as helpful indicators to identify acute bacterial and viral illnesses in children. Combining these markers enhances diagnostic accuracy, making them a valuable tool in clinical settings.

Keywords: *Viral Infections, Bacterial Infections, Acute Respiratory Diseases (ARDs), ANOVA, Clinical test and Biomarkers.*

1. Introduction

In clinical practice, distinguishing between viral and bacterial infections continues to be one of the most important problems since it directly affects treatment choices and patient outcomes.

It has been implied that the inability to find ideal criteria for making such distinctions means that clinical judgment must be relied upon which is often incorrect and subjected to errors. As a result, this ambiguity has contributed to the inappropriate use of antibiotics thus promoting resistance while unnecessarily exposing patients to drug side effects [2]. This Venn diagram distinguishes between bacteria and viruses, illustrating typical examples for each. On one side are listed types of bacteria like Spirilla, Micrococci, Bacillus, and Streptococci whereas on the other side viruses such as HIV, Adenovirus, Bacteriophage, and Ebola virus are shown in Figure 1.

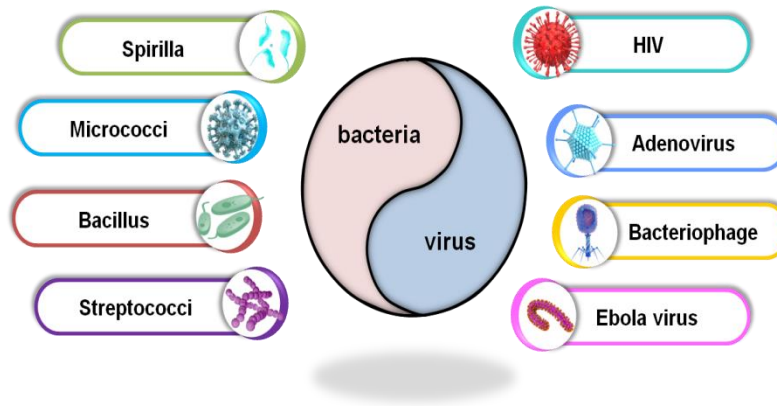


Figure 1: Familiar Bacteria and virus agents

Various diagnostic tools and biomarkers are used to identify specific types of infections accurately. Supporting diagnostic accuracy are some key biomarkers such as CRP and PCT [3]. CRP level is used as a significant marker for acute inflammatory responses whose levels may rise significantly between 6 – 12 hours after an inflammatory stimulus because it is always synthesized by the liver in response to inflammation [4]. Although both bacterial and viral infections present with elevated levels of CRP they differ in degree of elevation as well as rate of change thus giving insights into what type of infection it is likely going to be [5]. Usually, CRP levels are seen to be higher in cases of infection resulting from bacteria in contrast to those associated with viruses although it is not an absolute rule. PCT is the precursor of calcitonin hormone which is synthesized by thyroid C cells [6]. During severe systemic bacterial infections such as sepsis PCT levels increase dramatically owing to the inflammatory response produced by bacterial endotoxins. Unlike viral infections that do not significantly influence the various level differentials between CRP and PCT, it makes PCT a more specific marker for bacterial infections [7]. This implies that high serum PCT concentration can indicate acute sepsis during the initiation phase whereas low serum PCT concentration could suggest late stages of sepsis. It has been observed that during any viral infection PCT level tends to remain stagnated it rises quickly at times with rapidity in response to bacterium invasion into the human body leading to its utilization as a distinguishing mark between these two types of infections. Combines the use of CRP and PCT testing will enhance diagnostic accuracy both biomarkers have their strong points [8]. Two things can be seen here CRP's general sensitivity towards inflammation whereas PCT works specifically against bacteria leading to an understanding of the underlying pathology [9]. Through these analyses, it has been

observed that when it comes to inflammation detection CRP does help but PCT could differentiate whether an infection came from bacteria or virus thereby isolating particular conditions from others entirely redefining antibiotic prescriptions upon different acute respiratory diseases according to certain objectives including clinical decision support systems reducing inappropriate therapy prescriptions [10]. This study assesses the clinical use of PCT and CRP tests to distinguish specific viral and bacterial infections that cause ARDs.

1.2 Contributions

- **Effective Distinction:** To differentiate between bacterial and viral illnesses in children, PCT and CRP are useful tests.
- **Enhanced Diagnostic Accuracy:** Combining PCT and CRP testing improves the accuracy of diagnosing ARDs.
- **Clinical Tool:** This study supports the use of PCT and CRP as useful biomarkers in clinical settings to guide treatment decisions and reduce unnecessary antibiotic use.
- **Methodological Approach:** Utilized advanced tests such as **ECLIA** for PCT and **latex Immunturbidimetry** for CRP, analyzed using ANOVA, t-test, Chi-Square, and ROC curve analysis.
- **Group Comparisons:** Found significant differences in PCT levels between bacterial and viral infection groups but no significant difference in PCT and CRP levels in bacterial infection subtypes.

1.3 Structure of the paper

The paper is categorized into Phrase 2 depicts related work, Phrase 3 describes the methodology, Phrase 4 has the evaluation findings, Phrase 5 explains the discussion, and Phrase 6 depicts the conclusion.

2. Related works

Advances in multiplex polymerase chain reaction (PCR) and bacterial infection have been connected to the significance and burden of viral co-infections in pediatric acute respiratory

illnesses [11]. The effects of these infectious diseases on the person infected and each other were investigated using identifications. Although viral-bacterial co-infections can raise morbidity because of their synergistic infecting of the nasopharyngeal area, they did not imply that viral-viral concurrent infections might enhance the burden of illness in pediatric patients.

In a range of pediatric cases, the AutoPilot-Dx [12] validated the excellent diagnostic accuracy of a host-protein pattern including CRP and TNF-related apoptosis-induced ligand (TRAIL). With a 93.7% sensitivity, 94.2% specificity, 73.0% positive predictive value, and 98.9% negative prediction value, the characteristics were effectively identified between viral and bacterial infections. The outcomes showed that there can be a way to reduce the overuse of medications in children who have viral infections.

To create a biomarker test that could be distinguished between viral and bacterial infections by [13] combining values from FAM89A and IFI44L were chosen from two hospitals and were determined using the recommended polymerase chain reaction analyses. The results showed that the combination of these two indicators had greater specificity and sensitivity and that the disease risk score (DRS) was more accurate in discriminating between viral and bacterial diseases than the CRP level.

The acute respiratory infections in [14] suggested were the leading cause of illness and death in children. Although mixed etiologies with bacteria have raised doubts regarding their interplay in causation viruses remain the predominant problem. Advances in immunology, biochemistry, and microbiology shed light on how viruses can induce and exacerbate bacterial respiratory tract illnesses. In patients with cystic fibrosis, viral infections can play a significant role in the development of primary damage and the persistence of bacterial pathogens.

Multiplex real-time PCR was shown to be more successful in detecting respiratory viruses than viral cultures and traditional antigen testing [15]. The most frequent illnesses were rhinovirus (RV) and respiratory syncytial virus (RSV), whereas children under five were more likely to contract influenza virus A (FluA) and adenovirus (ADV). They found that two or more viral infections were present in 25.8% of the sample.

To determine how well the Liver Detection System (LUS) [16] can differentiate between viral and bacterial pneumonia in children. There were 200 children under the age of 12 who had chest

radiographs and a clinical suspicion of pneumonia. The findings demonstrated that LUS had a high positive predictive value as well as a high negative predictive value for identifying bacterial pneumonia. This implies that LUS can help control pneumonia by preventing the unnecessary use of antibiotic treatment.

In pediatric populations with those conducted in medical settings serum indicators for identified pneumonia caused by viruses or bacteria [17] to assess how useful biomarkers were in identifying pneumonia and avoiding the overuse of antibiotics. Due to overlapping detection methodologies, specificity, and sensitivity, they concluded that a single marker's rise or reduction in concentration was insufficient for predicting pneumonia acquired by a viral or bacterial population.

Groups of bacteria and viruses that caused pneumonia in 216 adult individuals were examined in [18]. They utilized the Acute Physiology and Chronic Health Evaluation IV (APACHE IV) score to estimate the predictive power of blood parameters. Out of all the blood markers that were examined, the APACHE IV score proved to be the most accurate indicator of hospital death. When a patient's APACHE IV score was low, mechanical ventilation was linked to increased death.

To assess how well-versed doctors and artificial intelligence (AI) [19] could predict the microbiological cause of community-acquired pneumonia (CAP) at the time of patient admission. They demonstrated that during the critical initial few hours of hospitalization while determining the best course of action for anti-infective therapy, both professionals and an AI system were unable to identify the microbiological etiology of community-associated pneumonia (CAP).

3. Methodology

This study included 142 children with confirmed bacterial infections, designated as Group 1, and 78 children with viral infections, designated as Group 2. Both groups underwent clinical testing to measure PCT and CRP levels. PCT levels were assessed using ECLIA, while CRP levels were measured using the latex Immunoturbidimetry test. Statistical analyses were conducted using ANOVA and t-tests to compare PCT and CRP levels between the two groups. The diagnostic accuracy of each marker was ascertained using ROC curve analysis, and Chi-Square tests were utilized to assess the concordance rates of PCT and CRP in diagnosing infections. SPSS version 24 was used to conduct all of the analyses. Viral and bacterial illnesses can be distinguished in Figure 2.

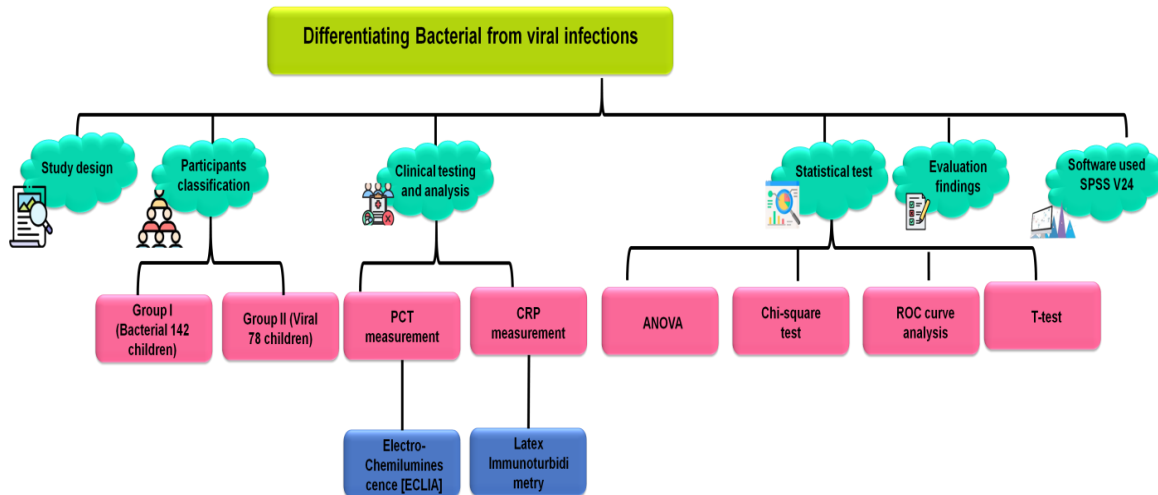


Figure 2: Differentiating bacterial from viral infections

3.1 Study Population

In total, there were two hundred and twenty children from 0 to 14 years, who had been hospitalized with diagnosed ARD. The selection was done carefully in terms of the presence or absence of fever, and cough which are classical clinical manifestations of ARD. Medics were used to diagnose cases according to their stipulated clinical features and other laboratory tests were done to ascertain the nature of the infection (viral or bacterial). The patients were segmented into two groups:

- **Group 1:** Bacterial infection group composed of one hundred and forty-two patients. The diagnosis was confirmed through clinical evaluation and sputum culture that detected bacterial pathogens.
- **Group 2:** Viral infection group consisting of seventy-eight individuals. Serological tests for the presence of specific viruses' antibodies or antigens in blood samples help confirm a case as being a viral one.

3.1 Data collection

The disease can be accurately and reliably established; blood and sputum samples were drawn from all respondents early before any antibiotic was started. This is necessary to avoid interference with test results caused by antibiotics.

- **PCT Testing:** The ECLIA method was used for measuring PCT levels in blood samples. PCT is a well-known biomarker that usually has a notable elevation in cases of bacterial

infections while it remains low during viral infections. This method is extremely sensitive and can even detect small variations in PCT levels helping to tell apart between the two types of infectious diseases.

- **CRP Testing:** Latex Immunoturbidimetry test was employed for assessing CRP levels. Another important biomarker dependent upon which information about inflammation and infection are given though it could increase due both to bacterial as well as viral infections is CRP. The latex Immunoturbidimetry assay finds its extensive application because of its simplicity along with rapidity of results which makes it good for mass clinical assays.

3.2 Biomarker Analysis

From a child's first 24 hours after being hospitalized, blood samples were taken. To separate the serum from the venous blood ten minutes of centrifugation at 3000 rpm was required for the PCT assay. Once testing was completed, the serum was kept at 20°C. Using the **ECLIA** method which is sensitive for detecting PCT in serum PCT levels were determined. The **latex Immunoturbidimetry test** that uses whole blood immediately quantifies CRP levels in whole blood which was also collected. According to standard laboratory procedures, all the samples were handled to ensure the reliability and accuracy of test results.

3.3 Differentiation of Illness Based On Pathogen Type In Children

As for differentiating between bacterial and viral diseases, these will help in selecting suitable therapy and management plans for children. Bacterial infections usually need antibiotics while supportive care or antiviral are used to treat viruses. The groups in this study include Group 1 which consists of bacterial illness and Group 2 containing viral illnesses as described below:

➤ Group 1 Bacterial illness

Group 1 comprises 142 children diagnosed with bacterial infections which occur when harmful bacteria invade the body causing a range of symptoms such as fever, localized pain, and inflammation. In this group, levels were measured using **ECLIA** to help identify bacterial infections. PCT is a biomarker that typically rises in response to bacterial infections making it a useful tool for diagnosis. Alongside PCT, CRP levels were analyzed using **latex Immunoturbidimetry** which helps detect inflammation. Elevated CRP values are commonly associated with bacterial infections providing further clinical evidence for treatment.

➤ Group 2 Viral illness

78 children from Group 2 are shown to suffer from sicknesses induced by viruses, like flu and common cold or viral gastroenteritis among others. Attention should be given to the diagnosis because antibiotics cannot work against these kinds of infections. This set of patients had both PCT and CRP levels done. PCT was measured using **ECLIA** where it would remain normal while in viral illness for differentiation among viral and bacterial causatives. Moreover, it is possible for CRP levels evaluated through **latex Immunoturbidimetry** to be raised but in lesser amounts than seen in bacterial infection thus providing another way of diagnosing.

3.4 Statistical Analysis

The levels of PCT and CRP in children with bacterial and viral illnesses were evaluated and compared using statistical methods. To find out if there were any significant variations in PCT and CRP levels between these groups, the ANOVA and t-tests were employed. The chi-square tests allowed us to observe how well PCT and CRP could distinguish infections indicating their diagnostic utility. Additionally, for assessing their usefulness in discriminating between bacterial/viral infections ROC curves were calculated for individual accuracy of these markers. All statistical computations were conducted using SPSS version 24, a program specifically intended for complex data analysis processes aimed at ensuring robust and valid results. This comprehensive approach helps appreciate the diagnostic importance of PACT and CRP on infection differentiations like viruses.

4. Results

Group 1 with bacterial infection had significantly higher PCT levels than Group 2 with viral infection as revealed by the results. A variety of analytical methods, including ANOVA and t-tests, were used to assess the variations in PCT and CRP levels in this study. Chi-square tests were employed to identify infections using these biomarkers while ROC curve analysis was done to evaluate their diagnostic accuracy. Comprehensive analyses elaborated on the interrelationships between biomarker levels in both bacterial and viral infections.

➤ Demographic data

Demographic information can help differentiate between bacterial and viral diseases by displaying trends based on factors like age, location, and exposure risk. For example, bacterial infections can have certain age-related or location-specific trends while viral ones might exhibit seasonal or global patterns. Therefore, when supplemented with demographic data, clinical symptom analysis can lend more precision to diagnosis.

Table 1: Demographic and Clinical Characteristics of Patients with Bacterial and Viral Illnesses

Characteristic		Group-I (Bacterial Illness)	Group II (Viral Illness)
Number of Patients		142 (64.5%)	78 (35.5%)
Age (Mean $\pm$ SD)		5.3 $\pm$ 2.1	4.8 $\pm$ 1.9
Gender	Male	70 (49.3%)	40 (51.3%)
	Female	72 (50.7%)	38 (48.7%)
Ethnicity	Ethnicity 1	50 (35.2%)	30 (38.5%)
	Ethnicity 2	60 (42.3%)	28 (35.9%)
	Ethnicity 3	32 (22.5%)	20 (25.6%)
Comorbidities	Comorbidity 1	30 (21.1%)	15 (19.2%)
	Comorbidity 2	25 (17.6%)	10 (12.8%)
	No Comorbidities	87 (61.3%)	53 (67.9%)

Clinical Presentation	Symptom 1	50 (35.2%)	25 (32.1%)
	Symptom 2	60 (42.3%)	30 (38.5%)
	Symptom 3	32 (22.5%)	23 (29.5%)
Treatment Received	Treatment A	70 (49.3%)	35 (44.9%)
	Treatment B	60 (42.3%)	25 (32.1%)
	No Treatment	12 (8.5%)	18 (23.1%)

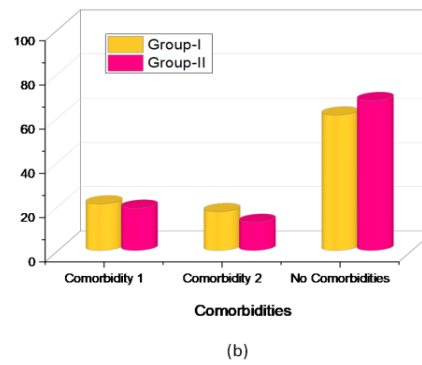
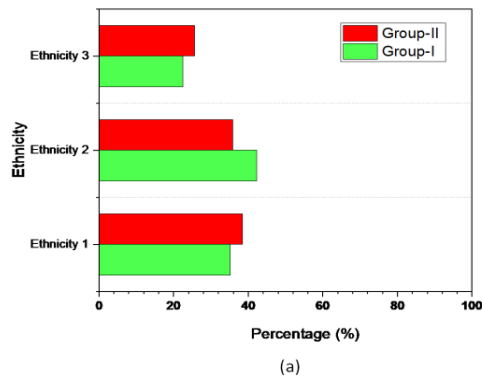


Figure 3: Demographic statistics for Ethnicity, Comorbidities, and age

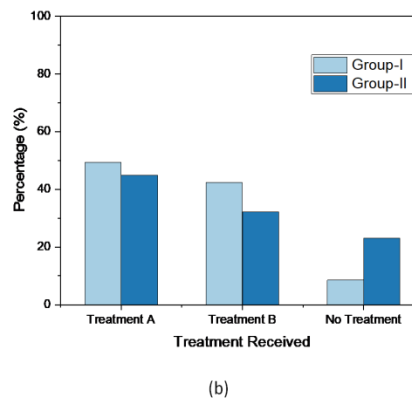
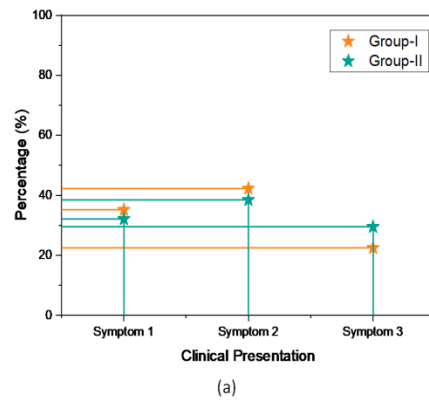


Figure 4: Demographic statistics for Clinical presentation and treatment received

Table 1 and Figure 3 & Figure 4 carry out a contrasting survey of important characteristics in the two sets of people: Group-1 Bacterial illness and Group-2 Viral illness. It comprises data about several patients, their ages, sex ratios, ethnic backgrounds, comorbidities as well as clinical manifestations and treatment administered. The table shows the percentages of patients for each group along with their demographic characteristics such as ages or sexes while also indicating whether different ethnicities are found in these populations. In addition, it shows the comorbidities that were manifested and the symptoms displayed by clinical subjects. Furthermore, it demonstrates administration types used for treatment across both groups. A comparative evaluation sheds light on similarities as well as dissimilarities between bacterial versus viral infections among individuals studied here.

4.1 ANOVA

The ANOVA method compares different group's average values to establish significant variations among them. In distinguishing between bacterial and viral infections, ANOVA can analyze variations in CRP and PCT biomarkers across these infection types, helping to identify major dissimilarities that could guide precise diagnosis and treatment. The Group-1 Bacterial disease ANOVA verifies whether or not the means of bacterial disease groups are statistically different from each other.

Table 2: ANOVA for Group-1 (Bacterial Illness)

SOV	SS	MS	df	MS	F-Statistic	p-Value
Within Groups	855.10	75.32	141	6.06	-	-
Between Groups	75.32	6.06	1	75.32	8.45	0.004
Total	930.42	-	142	-	-	-

Note: Source of Variation, or SOV SS stands for Sum of Squares. Degrees of Freedom (df) / Mean Square (MS) The probability value linked to the F-Statistic is the p-value, which is the ratio of the mean square between groups to the mean square within groups.

The results of an ANOVA analysis, which is used to check if there are significant differences among groups in a particular dataset, are found in Table 2. In terms of variability in the data arising from differences between groups being compared, the "Between Groups" section indicates this fact. For such variability, it provides SS and df along with MS and F-statistics that show how much group means vary against random variation within. The p-value indicates the probability of seeing such a difference by mere coincidence. For each group, there is also its SS, df, and MS that account for the variability of members in the "Within Groups" section. The "Total" section presents a whole range of dispersed data including between and within-group variances together leading to an overall variation for a dataset. This helps to know if these differences observed in them are statistically significant or not. In group-2 Viral illness, the ANOVA test assesses whether differences in means of various sub-groups under it are statistically significant or not.

Table 3: ANOVA for Group 2 (Viral Illness)

SOV	SS	df	MS	F-Statistic	p-Value
Between Groups	50.78	1	50.78	6.32	0.015
Within Groups	447.22	77	5.81	-	-
Total	498.00	78	-	-	-

An ANOVA test has been conducted for Group-2 Viral Illness and its results are shown in Table 3. It compares differences in means among various subgroups under this group. The table consists of three major sources of variation which include Between Groups, Within Groups, and Total sources of variation. In the Between Groups section, the variance among the subgroups is compared while the Within Group includes variance in each subgroup itself. The total row is an aggregate of a general variance perceived from the data. The ANOVA results show if there are significant disparities statistically between these subgroup disparities; hence offering hints on how viral infection results differ from one group to another.

4.3 Chi-Square

By analyzing the distribution of symptoms and laboratory results, chi-square testing can assist in differentiating between bacterial and viral diseases. It emphasizes noteworthy variations by contrasting the commonly seen frequencies associated with several infection markers to the anticipated frequencies for each kind of infection. This statistical technique assists in determining which type of infection accords more closely with the observed patterns in data.

Table 4: Chi-Square for Group-1 (Bacterial Illness)

BML	OC (Group-1)	EC	CSV	p-Value
High	90	85	0.65	0.42
Low	52	57	0.65	0.42

Note: Biomarker Level (BML), Observed Count (OC), Expected Count (EC), Chi-Square Value (CSV), p-Value.

This is a visual representation of Table 4, which contains a comparison of BML for different conditions. The presentation includes values for OC (Group-1), EC, and CSV with the relevant p-value for statistical significance. Such a table enables one to assess differences or similarities in BML across these categories depending on whether the observed variations are significantly different or not.

Table 5: Chi-Square for Group 2 (Viral Illness)

BML	OC (Group-2)	CSV	EC	p-Value
High	40	0.09	42	0.77
Low	38	0.09	36	0.77

Table 5 shows how various BML characteristics compare among different conditions in Group 2. Measurements for OC, CSV, and EC are included in the table along with the p-value that reflects the importance of the information presented. The table can be used to help decide if there is a statistical difference between conditions concerning BML based on observed differences in p-values.

4.4 t-tests

The t-test is a method for comparing the means of two groups so that differences that matter can be identified. The degree to which certain biomarkers or clinical parameters vary in patients with each infection type is compared using a t-test when distinguishing bacteria from viruses. If the t value is large enough, it indicates that there is a large enough dissimilarity concerning such biomarker(s) or clinical characteristics, therefore assisting in diagnosing more accurately.

Table 6: t-test for Group 1(Bacterial Illness) vs. Group 2 (Viral Illness)

Measure	Group 1 Mean	Group 2 Mean	df	t-Statistic	p-Value
PCT (Mean)	2.45	1.25	218	5.87	<0.0001
CRP (Mean)	15.20	9.45	218	6.45	<0.0001

The comparison between Group 1 and Group 2's mean PCT and CRP levels is shown in Table 6. The t-value, degrees of freedom, and p-value are included in every measure. The t-statistic together with the p-value indicates if any differences are statistically significant between means belonging to both groups which suggests that these differences cannot be a random event.

4.5 ROC curve analysis

The true positive rate is plotted against the false positive rate at several thresholds to evaluate how good or bad a diagnostic test is through ROC curve analysis. The optimal cutoff point for dividing the two classes and using biomarkers or test findings to distinguish between bacterial and viral infections is provided by ROC curves. Here, the AUC stands for overall test accuracy; higher values indicate a better capacity to distinguish between viral and bacterial illnesses.

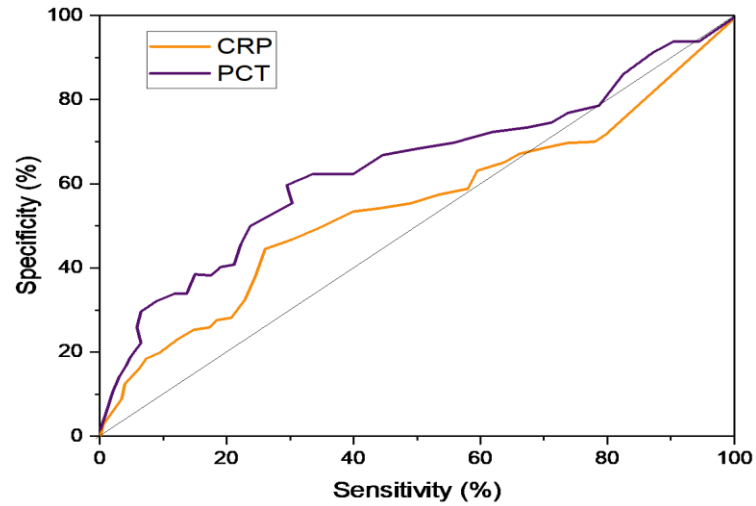


Figure 5: ROC curve analysis for PCT and CRP

The AUCs for two biomarkers, PCT and CRP in Group 1 are shown in Figure 5. The AUC values reflect how these biomarkers perform in identifying specific conditions; thus, higher AUCs signify good diagnostic accuracy. Figure 4 is useful for assessing the effectiveness of PCT and CRP during clinical evaluations conducted in Group 1.

4.6 Gram positive-Gram Negative

The comparison of levels of PCT and CRP in Table 7 among bacterial and viral infection groups as well as with the bacterial group that only consists of Gram-positive infected and uninfected individuals is displayed.

Table 7: Comparison of PCT and CRP Levels between Bacterial and Viral Infections, and Gram-Positive and Non-Gram-Positive Bacterial Infections

Biomarker	Group-1 (Bacterial) (n=142)	Group-2 (Viral) (n=78)	Gram-Positive Infection in group 1 (bacterial) (Yes) (n=82)	Gram-Positive Infection in group 1 (bacterial) (No) (n=60)	p- value
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PCT (ng/mL)	5.6 ± 2.3	0.9 ± 0.4	5.9 ± 2.4	5.2 ± 2.2	0.15
CRP (mg/L)	56.4 ± 18.2	52.8 ± 16.9	57.2 ± 19.1	55.1 ± 17.3	0.35

Table shows that, when comparing PCT levels between bacterial infections and viral infections, there is a significant elevation in the former suggesting the great potential of PCT to be used as a diagnostic marker in distinguishing these two types of infections. However, among individuals with or without Gram-positive infections in the bacterial group, there is no notable difference in PCT levels indicating that it is not useful in differentiating between Gram-positive and other bacterial infections. Likewise, neither CRP nor bacterial groups have significant differences between them nor are there any distinctions made between Gram-positive, Gram-negative, or anything else. According to these results, PCT can be a useful marker for differentiating between bacterial and viral illnesses, however, neither CRP nor PCT can reliably identify distinct bacterial species depending on whether or not they are Gram-positive.

5. Discussion

The findings signify that serum PCT levels were considerably raised in children having bacterial infections (Group-1) as compared with (Group-2), thereby endorsing its usefulness as an identifying marker to differentiate these two infection types. The significant difference in PCT values between bacterial and viral groups shows that has a possible role in improving diagnostic accuracy for bacterial infections which is important for guiding proper clinical treatment and antibiotic prescription. CRP levels remained greater in bacterial infections, there was no such clear cut-off point among the two types of illnesses hence indicating that on its own CRP could be less efficient as an infection differentiation marker. The variance in PCT levels is also statistically significant between the two infection types as proposed by the ANOVA analysis for both groups that are made up of bacteria and viruses. PCT did not provide enough differentiation between Gram-positive and Gram-negative bacterial infections. These results correlate with earlier studies which state that though PCT has high sensitivity for all bacterial infections, it can be less reliable when it comes to differentiating between various subtypes based on gram classifications of

bacteria. In the same way, CRP does not indicate appreciable variation among patients with Gram-positive and other types of infection indicating its poor specificity.

The ROC curve analysis revealed that PCT (0.88 for bacterial illnesses and 0.82 for viral illnesses) has higher AUC values, indicating its diagnostic value. The corresponding AUC values for CRP were marginally lower indicating moderate diagnostic performance, thereby confirming again that PCT is superior to CRP in the differentiation of bacteria from viral infections. Yet neither PCT nor CRP was able to differentiate between Gram-positive/non-Gram-positive infections in the bacterial group. These findings were also supported by the Chi-Square and t-test analyses. Chi-square tests showed no significant differences between PCT and CRP biomarker recognition rates for the two bacterial subgroups while t-tests revealed statistically significant differences in biomarker levels between two infections. This strengthens the case for using PCT as a primary marker for bacterial infection diagnosis but it emphasizes the need for supplementary tests or clinical judgment to refine the diagnosis further especially when it comes to determining the gram classification of bacterial pathogens.

6. Conclusion

PCT to be an effective biomarker in discriminating bacterial and viral infections among children clear guidance should be given. The efficacy of this tool in differentiating between Gram-positive and non-Gram-positive bacterial infections is limited. CRP is a bio-marker for inflammation which does not significantly improve accuracy in distinguishing bacterial from viral illnesses. Therefore while PCT can be considered as the cornerstone for diagnosing initial cases of bacterial infection, there can be a need for more tests to classify different subtypes of pathogens accurately. While PCT helps differentiate bacterial from effective viral infections it does not help distinguish between Gram-positive and non-gram-positive ones. Interestingly, CRP has always served as one among other popular indicators but little emphasis is given to its ability to differentiate accurately about specifics of bacteria involved in these infections by combining PCT with other biomarkers or advanced molecular methods, future research could be aimed at differentiating between bacterial subtypes better and improving diagnosis across different infection types.

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