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A Comparative Analysis of Amoxicillin and Cefuroxime

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ABSTRACT

This article is an examination of the Comparative analysis of Amoxicillin and Cefuroxime. The scientific development and subsequent analysis of antibiotics like Amoxicillin and Cefuroximd used to combat bacterial infections such as urinary tract infections, pneumonia, etc. continues to influence the researchers all over the globe today. This article examines the research done and published by researchers and scientists. Consideration of current trends and data in scientific queries and demonstrates further aspects of the comparative analysis of Amoxicillin and Cefuroxime. Additionally, this article explores options for different approaches and applications of Cefuroxime and Amoxicillin such as acute bronchitis, renal functions and tooth enamel defects, acute malnutrition, etc, respectively. This article also highlights the administration, dosages and the various advantages and disadvantages of both the antibiotics Cefuroxime and Amoxicillin, thus giving an in depth, overall comparison of the same.

Keywords : Amoxicillin, Cefuroxime, Antibiotics, Bacterial infections, Renal function.

I. INTRODUCTION

Antibiotics are antimicrobial substances that are effective against the activity of bacteria and play a crucial role in the treatment and prevention of bacterial infections, since they are the most common form of antibacterial agent. These compounds are extremely important as a wide range of bacteria can be killed or inhibited by these compounds and thus, also prevent the bacterial infections caused by them in various organisms. Scientists and researchers across the world are thoroughly studying the various antibiotics available in depth in order to gauge the safety, efficiency, long term effects and positives and negatives to find out which are the most suitable antibiotics. Amoxicillin is a modern, semisynthetic penicillin that is structurally comparable to ampicillin but has been found to be better absorbed and yields higher serum and urine concentrations. It has been shown to be effective against several bacterial infections such as pneumonia (infections caused in the chest), dental abscesses, UTIs (urinary tract infections) and is also often used in children, to treat ear infections as well. A comparable antibiotic to

Amoxicillin is Cefuroxime. Cefuroxime (Cefuroxime axetil) is a prodrug of cephalosporin, a second generation oral cephalosporin antibiotic. It is an antibiotic that only treats bacterial infections and is widely known for the same as it has demonstrated antibacterial activity in vitro against a number of gram-positive and gram-negative bacteria. This drug is an effective and well tolerated treatment in adult and paediatric patients as well with various infections, including pharyngitis, sinusitis, acute exacerbations of chronic bronchitis, amongst others. There has previously been rigorous research individually on both these antibiotics. Both have shown great promises, however there have been studies portraying their drawbacks as well. This review literature aims at giving a concise and accurate comparison of these two antibacterial compounds, highlighting various factors of efficacy, efficiency, administration, dosage, immediate and long term effects, side effects and tolerability of the drugs. This is done by analysing various research methods and techniques that have been carried out for Amoxicillin and Cefuroxime, on a diverse and wide range of patients suffering from these bacterial infections. This research paper is written having gathered information from a wide range of databases, over a wide time period, including the most recent advances. This paper aims to thoroughly compare Amoxicillin and Cefuroxime to devise better therapies and make the treatment robust for future medicinal healthcare.

II. METHODS

The study was conducted using four databases Google Scholars SAGE, DOAJ and PubMed. Selection of papers were done based on keywords and theme relevant to this review. Further the published papers from these databases were arranged in systematic order with respect to year of publication.

III. RESULTS AND DISCUSSION

1. Amoxicillin [1-12]

Sr. No	Title	Year of publication
1	Amoxicillin, a New Penicillin Antibiotic	1973
2	Comparative Therapeutic and Pharmacological Evaluation of Amoxicillin and Ampicillin Plus Probenecid for the Treatment of Gonorrhea	1974
3	Pharmacokinetics of Amoxicillin: Dose Dependence After Intravenous, Oral, and Intramuscular Administration	1977
4	Pharmacokinetics of Amoxicillin: Dosage Nomogram for Patients with Impaired Renal Function	1979
5	Comparison of Cefuroxime Axetil and Amoxicillin-Clavulanate Suspensions in Treatment of Acute Otitis Media with Effusion in Children	1994
6	Effect of Short-Course, High-Dose Amoxicillin Therapy on Resistant Pneumococcal Carriage	2001
7	HPLC determination of amoxicillin comparative bioavailability in healthy volunteers after a single dose administration	2003
8	Association of Amoxicillin Use During Early Childhood With Developmental Tooth Enamel Defects	2005
9	Pharmacokinetics of Amoxicillin in Maternal, Umbilical Cord, and Neonatal Sera	2009
10	Amoxicillin and amoxicillin plus clavulanate: a safety review	2009
11	Amoxicillin : A broad spectrum antibiotic	2011
12	Amoxicillin	2020

Amoxicillin, a New Penicillin Antibiotic

Amoxicillin is a modern semi-synthetic penicillin structurally similar but stronger than ampicillin. The drug was also evaluated in the treatment of 38

bacteriuria patients who received either 750 mg or 1 g/day doses for 10 days. The activity of amoxicillin was comparable to ampicillin in vitro. Amoxicillin was successful in eradicating bacteriuria but worked no better than a host of other medications currently available for the treatment of acute, uncomplicated bacteriuria for practical purposes. In vitro susceptibility of gram-negative pathogens to amoxicillin and ampicillin: The antibacterial activity of amoxicillin and ampicillin against approximately 30 isolates species is depicted which also demonstrate the effect of inoculum size on determination of the MIC. Amoxicillin or ampicillin inhibited 89 % of the strains of E.coli. Similarly, all 30 isolates of P. mirabilis were inhibited by. On the other hand high degrees of resistance to both drugs were encountered among strains of Klebsiella, Enterobacter, and indole positive Proteus species. It is obvious that amoxicillin has an antibacterial spectrum similar to that of ampicillin. The only benefit of amoxicillin is that it produces consistently higher levels of antibiotic in blood and urine than do equivalent doses of ampicillin, While in the present study amoxicillin was successful in eradicating bacteriuria due to susceptible species and was very well tolerated, the outcome of infection was most specifically linked to the diagnostic category of urinary tract infection. While amoxicillin has been shown to be better than ampicillin in the treatment of experimental infections in animals.

Comparative Therapeutic and Pharmacological Evaluation of Amoxicillin and Ampicillin Plus Probenecid for the Treatment of Gonorrhea (1974)

Amoxicillin and Ampicillin Plus Probenecid Comparative Clinical and Pharmacological Study for the Treatment of Gonorrhea. Single oral dose of 3.5 g Ampicillin with 1.0 g Probenecid or 3.0 g amoxicillin was given to participants with uncomplicated gonococcal infection. It was observed that 1.7 % Ampicillin with probenecide and 4.2% amoxilline failure rate for genital and anal infection or both. For most strains of N. gonorrhea , minimal inhibitory concentration. Periods of Gonorrhea up to 10 h after an oral dose of 3.0-g. Ampicillin was administered after 2.0 g with Probenecid, the serum levels exceeded those during the 5- to 12-h duration achieved and actually surpassed levels with 3.5 g of ampicillin plus probenecid attained with 3.0 g of amoxicillin administered alone over the same interval. Pharmacological studies: Amoxicillin peak concentrations were reached 1 h earlier than ampicillin and probenecid peaks, and amoxicillin serum concentrations also decreased more rapidly. By increasing the dosage of ampicillin administered with probenecid from 2.0 to 3.5 g, mean serum concentrations of ampicillin were not significantly increased from 4 to 12 h; and mean serum concentrations obtained after 2.0 g of ampicillin plus 1.0 g of probenecid were higher at all intervals from 5 to 12 h than those reached at the same intervals after 3.0 g of amoxicillin. Results of treatment: Gonococcal or both infections treated with 3.0 g oral amoxicillin had negative cultures when re-examined within 3 to 14 days of treatment. Of the 30 men and 30 women who received 1.0 g of probenecid plus 3.5 g of ampicillin, twenty-nine were cured of anal or genital infection, or both. In this review, the effectiveness of a single 3.0-g oral dose of amoxicillin alone in the treatment of uncomplicated gonococcal urethra, endocervix, and anal canal infections was not substantially different from that of a single 3.5-g oral dose of 1.0 g probenecid ampicillin, one of the latest U.S. approved treatment regimens.Single intramuscular doses of spectinomycin 2.0 to 4.0 g were also highly effective for anogenital gonococcal infection, but were unsuccessful for pharyngeal infection. Probenecid has been a useful adjunct for the single-dose treatment of ampicillin-containing gonorrhea, although it is not clear if this is mostly due to the transfer of ampicillin into the central body compartment by probenecid or the prolongation of the serum half-life of penicillin by inhibition of renal tubular secretion.Amoxicillin tends to be likely to be

even more effective than equivalent doses of ampicillin if administered with probenecid or in two divided doses separated by a 4- to 5-h period.

Pharmacokinetics of Amoxicillin: Dose Dependence After Intravenous, Oral, and Intramuscular Administration(1977)

Amoxicillin pharmacokinetics: dosage dependency following intravenous, oral and intramuscular administration. Amoxicillin was administered through intravenous, oral and intramuscular routes to determine the serum drug level by two-compartment open model, area under the curve (AUC) and urinary recovery the variation in the pharmacokinetics parameters was examine by three way analysis of variance and linear regression equation. This Amoxicillin study confirms the complete oral absorption. Complete and reliable absorption was observed in intramuscular administration with peak drug level, AUCs and urinary recovery was found to be equivalent to that of oral route. Pharmacokinetics parameters like peak serum level, time to peak and others were found to be identical for both oral administration and intramuscular injection. In this review the comparative dependency in intravenous, oral is determined and the bioavailability after intramuscular administration was observed that Amoxicillin if provided as a complete alternative for ampicillin then it will show complete reliable absorption. Statistical significance after i.m. injection, the 1,000-mg dose resulted in proportionately lower peak serum levels and AUCs. This relation is expressed in a regression equation. Similar results occur after p.o hence Amoxicillin was rapidly absorbed after i. m. Administration, producing equivalent serum levels, and should prove therapeutically bioequivalent to p.o. amoxicillin or i.m. ampicillin.

Pharmacokinetics of Amoxicillin: Dosage Nomogram for Patients with Impaired Renal Function(1979)

Amoxicillin pharmacokinetics: Dose Nomogram for patients with impaired renal function. Patients with normal renal function had an overall urinary recovery of 68 %. Serum half-life was strongly associated with body weight-corrected creatinine clearance (r = 0.967). For a corrected creatinine clearance of 100 ml/min per 70 kg and 16 h in the anephric patient, the estimated half-life was 71 min. The total half-life of hemodialysis amoxicillin was 3.6 h. A medication nomogram is provided to make reasonable changes to the loading dose based on patient weight and the maintenance dose based on the corrected clearance of creatinine. Distribution Volume- No effect of renal function on the volume parameters was predicted or observed, so all 19 subjects were examined as a single group. For both Vc and for Vss, with calculated weight, r = 0.617 and 0.674, respectively, is the highest correlation coefficient (r). The calculated weight, r= 0.646, is correlated to Vb, with an associated P value of 0.030. Therefore, even though the correlation coefficient for BSA and LBW is greater, weight is perhaps a simpler correction for Vbata. Half-life of amoxicillin, there is a strong decrease with declining Ccr in Ke and beta. When Ccr is corrected for measured weight, which we describe as the corrected creatinine clearance (CorCcr) as follows, and beta, the maximum correlation occurs: CorCc, = (Cc, x 70)/weight. The average beta for the four patients during hemodialysis was 0.195/h with a standard deviation of 0.140. Since the flow of the dialyzer is the same for all patients, the association of Ke and beta with inverse patient size measurements was examined. Amoxicillin tends to have a higher absorption rate than ampicillin and a greater penetration rate. Prediction of patient kinetics-Based on patient population, the best predictions of Vb and beta are given by the following: Vb (in liters) = 0.660 x weight (in kilograms); beta(/hour) = 0.0430 + 0.00545 x CorCr, (in milliliters per minute per kilogram). "Although the sample size of four did not reach the statistical significance of "magic P < 0.05," our best estimate of the rate of disappearance during dialysis, the spectrum is as follows-Beta(/hour)= -0.524 + 0.545 x 70/weight = 0.545 x 70/weight (in

kilograms). This suggests that for a 70 kg patient, 85 % of the medication will be absorbed during an 8-h dialysis. Recommendations on dosage - Dosage adjustment is not appropriate for a patient with moderately impaired renal function (CorCc, > 30 ml/min/70 kg). Our dose interval modification guidelines are summarized. In urinary tract infection, the active drug is concentrated such that a 12-h dose interval will be sufficient for the treatment of susceptible species.

Comparison of Cefuroxime Axetil and Amoxicillin-Clavulanate Suspensions in Treatment of Acute Otitis Media with Effusion in Children(1994)

Comparison of suspensions of Cefuroxime Axetil and Amoxicillin-Clavulanate in acute otitis media treatment with effusion in children: In the treatment of acute otitis media with effusion, 263 patients aged 3 months to 11 years, multicenter study comparing clinical and bacteriological efficacies and the safety of cefuroxime axetil suspension (CAE) with amoxicillin-clavulanate suspension (AMX-CL). Among 200 isolates from middle ear fluid pretreatment cultures, the primary pathogens were classified as follows: Haemophilus influenzae (39 % o), over a third of which were positive for P-lactamase; Streptococcus pneumoniae (34 %); and MoraxeLla catarrhalis (16%). In 81 % (95 of 118) and 76 % (50 of 66) of bacteriologically evaluable patients in the CAE and AMX-CL classes, pathogens were eradicated or believed to be eradicated. In 113 (77%) of 146 clinically evaluable patients in the CAE group and in 66 (74%) of 89 evaluable patients in the AMX-CL group, adequate clinical response (cure or change with or without effusion resolution) occurred. Drug-related adverse effects occurred in 18% of patients treated with CAE, compared with 39% of patients treated with AMX-CL (P < 0.001); diarrhea or loose stools were the most frequently recorded adverse events (CAE, 12%; AMX-CL, 31%; P < 0.0%; P < 0.001). These results suggest that CAE administered twice daily in pediatric patients is as successful as AMX-CL administered three times daily in the treatment of acute otitis media with elfusion, but CAE was associated with substantially less adverse drug-related events. Children have been treated with CAE and 98 have been treated with CL-AMX. Bacteriological data of 184 out of 263 patients (70%) could be analyzed for efficacy review. In 81% of patients who received CAE and 76% who received AMX-CL (P > 0.05), a "satisfactory" bacteriological outcome The bacteriological outcomes for the isolated primary pathogens (H. influenzae, M. catarrhalis, and S. pneumoniae). Of the 263 treatment-assigned patients, 235 (89 %) were evaluated as clinically evaluable. Satisfactory clinical results (cure and enhancement) were obtained by 77% of CAE group patients and 74 % of AMX-CL group patients (P = 0.7). To provide supporting evidence for the primary efficacy study, an intent-to-treat analysis was conducted. A pretreatment pathogen was identified in 207 patients (79%) of the 263 patients initially enrolled in the study; 95 out of 130 (73%) CAE-treated patients and 50 out of 77 (65%) AMX-CL-treated patients (P = 0.2) eradicated the pretreatment pathogen in these 207 patients. Similarly, 113 of the 165 (69 %) CAE-treated patients and 66 of the 98 (67 %) AMX-CL-treated patients (P = 0.9) achieved full resolution of the signs and symptoms present at the time of diagnosis. Adverse Events- One of the research drugs was administered by all 263 patients involved in the study and was included in the safety report. 18% of patients treated with CAE and 39 % of patients treated with AMX-CL experienced at least one adverse incident that the investigator judged to be drug-related (P < 0.001). In the treatment of AOME in infants and children, we announce the results of a comparison between two oral antibiotic suspensions, CAE and AMX-CL. The present research expands the earlier clinical trial by requiring the use of tympanocentesis to obtain bacterial culture middle ear aspirates, a technique not commonly conducted in clinical practice but considered the "gold standard" by which the antibiotic's effectiveness can best be

measured in the care of AOME patients. In summary, in the current study, twice-daily dosing of CAE in pediatric patients was as effective in both clinical and bacteriological parameters as triple-daily dosing of AMX-CL in the treatment of AOME. However, CAE was associated with markedly less adverse events.

Effect of Short-Course, High-Dose Amoxicillin Therapy on Resistant Pneumococcal Carriage(2001)

Impact on resistant pneumococcal carriage of short-course high-dose amoxicillin therapy. Emerging drug resistance is a challenge to the efficacy of current pneumococcal infection therapies. Modification of the antibiotic therapy dose and length can restrict the spread of resistant pneumococcal. The randomized trial was performed. Participants Children 6 to 59 months of age receiving prescription antibiotics for respiratory tract disease (n= 795). Intervention 1 of 2 twice-daily amoxicillin regimens is randomly allocated to children. Outcome Tests Non-susceptible penicillin Streptococcus pneumonia carriage, evaluated in nasopharyngeal specimens obtained on days 0, 5, 10 and 28; baseline risk factors for non-susceptible pneumococcal carriage; and protocol enforcement, relative to 2 classes was determined. At day 28 of the visit, the chance of penicillin-non-susceptible pneumococcal carriage was significantly lower in the short-term, high-dose group (24%) compared to the standard-course group (32%); relative risk (RR), 0.77; 95% confidence interval (CI), 0.60-0.97; p=.03; the risk of non-susceptibility of trimethoprim-sulfamethoxazole was also lower in the short-term, high-dose group (RR, RR, high-dose group). In households with 3 or more children, the protective impact of short-term, high-dose care was higher (RR, 0.72; 95 % CI, 0.52-0.98). In the short-course, high-dose category, adherence to care was higher (82% vs 74%; P=.02). As an intervention to minimize the effect of antibiotic usage on the spread of drug-resistant pneumococci, short-course, high-dose outpatient antibiotic therapy appears promising. Project Research-This was a randomized single-center prospective study. Since the clinical effectiveness of therapeutic regimens was previously known and was not an outcome factor, the research was not placebo-controlled. In blocks of 50 participants, randomization was performed. Children were randomly assigned to receive either amoxicillin 40 mg/kg daily (twice daily) for 10 days or amoxicillin 90 mg/kg daily (twice daily) for 5 days in 1 of 2 treatment groups. The US Food and Drug Administration recently approved a 90-mg/kg-per-day amoxicillin course and recommended the Drug-resistant Streptococcus pneumoniae Therapeutic Working Group for the treatment of acute otitis media in regions where pneumococcal resistance is prevalent. Adherence and Adverse Events-The amount of amoxicillin remaining in the participants' medicine bottles was assessed on the 5th and 10th visits. Parents were asked about adverse effects possibly associated with treatment (e.g., diarrhea, vomiting, rash) on the 5th, 10th and 28th visits, and participants were tested.

HPLC determination of amoxicillin comparative bioavailability in healthy volunteers after a single dose administration(2003)

HPLC determination of amoxicillin comparative bioavailability after a single dose administration in healthy volunteers. For the determination of amoxicillin in human plasma samples, a reliable, accurate and sensitive HPLC assay was created to compare the bioavailability of two amoxicillin capsule (500mg) formulations in 24 volunteers of both the sexes. Using combined reverse phase liquid chromatography and UV detection (λ=229 nm), amoxicillin concentrations were analyzed. By calculating individual peak plasma concentrations (Cmax) and area under the curve (AUC0-8h) ratios (test/reference), the bioequivalence between the two formulations was evaluated. As established by the US Food and Drug Administration Agency, the statistical interval proposed was 80-125 %. The assay showed excellent relationships between plasma

concentrations and peak height ratios (r2 ≥ 0.999). For pharmacokinetic, bioavailability, and bioequivalence studies, this simple, rapid and selective method is suitable. Since the 90% CI for both Cmax and AUC0-8h is within the 80-125% interval proposed by the Food and Drug Administration, it was concluded that in terms of both the rate and degree of absorption, Amoxicilina 500 mg capsules were bioequivalent to Amoxil® 500 mg capsules. Appropriate sensitivity, specificity and high sample throughout needed for pharmacokinetic studies are given by the alternative HPLC-UV method defined and used here for drug quantification. The retention times for AMO and the internal norm were 4.2 and 5.2min, respectively, under the chromatographic conditions defined. No endogenous interfering peaks emerged at the retention times of the compounds of interest. The LOD and the LOQ were 0.1 and 1μg/ml, respectively, for AMO. The calibration curve was linear between 1.0μg/ml and 50μg/ml, with a regression coefficient of 0.999 and an intercept that did not vary significantly from zero. The total variability (n=48) was respectively 11.0, 6.5, 5.2 and 4.8 %; and the accuracy was 102.8, 103.3, 103.0, 106.8 % . During this time, no significant degradation of AMO was observed under the storage conditions. At the administered dose, AMO was well tolerated, and no adverse effects were recorded. Other methods using HPLC in conjunction with UV detection have calculated AMO plasma levels. The lowest quantification limit obtained by UV detection was 50ng/ml, but both AMO and internal standard elution times were 31.8 and 32.8 min, respectively, far longer than those stated here in, respectively. Other more complex extraction procedures have also been documented, such as solid phase extraction (17, 18, 24-26). Solid-phase extraction methods, however, are laborious and involve SPE cartridges, raising the analysis cost. However, their assay, where the quantification limit was 10 ug/ml, was performed without an internal norm. Furthermore, because of the post column derivatization step, the method was complex. Their survival time for the analyte was also longer (about 10 minutes compared to our 4 minutes) and was also not used in a pharmacokinetic analysis in humans where a large number of samples were tested. AMO derivatization to a fluorescent compound showed comparable sensitivity and slightly longer retention time (4.5 min for AMO), but requires a complex system of chromatography, including electrochemical detection. The pharmacokinetic anaålysis was carried out within 8 hours and, as recommended by the regulatory agency, the resulting value of AUC 0-∞ was less than 20 % higher than that of AUC 0-∞for both formulations (12 and 13.9 % for Amoxicillin and Amoxil, respectively). Later samples (12 and 24 hours after drug administration) were taken and analyzed, but no better AUC 0-∞ estimate was observed and the variations between the values remained essentially the same.

Association of Amoxicillin Use During Early Childhood With Developmental Tooth Enamel Defects(2005)

Association of Amoxicillin Use because of Developmental Tooth Enamel Defects during early childhood: It has been suggested that the use of amoxicillin may be associated with defects in dental enamel. For fluorosis, the early-erupting permanent teeth of 579 subjects were tested using the Fluorosis Risk Index at approximately 9 years of age. Using relative risk (RR), Mantel-Haenszel stratified tests, and multivariable logistic regression, the relationships between fluorosis and amoxicillin usage were evaluated. The results of this study indicate a correlation between the use of amoxicillin during infancy and permanent teeth developmental enamel defects; further research is required. 75 % of subjects confirmed the use of amoxicillin after 12 months and 91 % after 32 months. Overall, on both maxillary central incisors, 24 % had fluorosis. The risk of fluorosis on the maxillary central incisors (RR = 2.04; 95 % confidence interval [CI], 1.49-2.78) was substantially increased by the use of amoxicillin from

3 to 6 months. The risk of fluorosis on maxillary central incisors from amoxicillin use over 3 to 6 months (Mantel-Haenszel RR = 1.85; 95 % CI, 1.20-2.78) was still statistically important following adjustment for fluoride consumption and otitis media. The increased risk of fluorosis from amoxicillin usage over 3 to 6 months was verified by multivariable logistic regression tests (odds ratio = 2.50; 95 % CI, 1.21-5.15); fluoride consumption was also statistically important. Data were collected as part of the Iowa Fluoride Study, a prospective study examining exposures to fluoride, biological and behavioral causes, and dental health of children. There were 698 subjects receiving primary dentition dental exams and 579 receiving early-erupting permanent teeth examinations. Therefore, the average annual attrition rate was 6.5% among the 1390 at 6 months of age. At 3- and 4-month intervals, from birth to 32 months of age, questionnaires were sent to parents evaluating fluoride consumption from different sources, antibiotic use, children's diseases, and breastfeeding habits. Fluoride intake in milligrams per kg body weight per day was calculated from water, beverages, and selected foods; dietary fluoride supplement; and fluoride dentifrice based on answers to a series of detailed questions. Parents reported whether the number of disease episodes for which antibiotics were used and the number of days of antibiotic usage during the reporting period were administered systemically, orally, or topically. Diffuse opacities of tooth surfaces have historically been referred to as "dental fluorosis" because the most common cause is excessive fluoride ingestion. All 12 early-erupting permanent teeth were examined for each subject: 4 mandibular incisors, 4 maxillary incisors, and 4 first molars. The examiners were bind to questionnaire data on fluoride consumption, childhood infections, and antibiotic usage. Fluorosis was distinguished based on Russell criteria 'from non fluorosis opacities Carious lesions based on colour, texture, demarcation, and gingival margin relationship.

Pharmacokinetics of Amoxicillin in Maternal, Umbilical Cord, and Neonatal Sera (2009)

Pharmacokinetics of Amoxicillin in Maternal, Umbilical Cord, and Neonatal Sera: In the prevention of neonatal group B streptococcus infection, the pharmacokinetics of amoxicillin were analyzed in umbilical cord and neonatal serum relative to maternal concentrations. The subjects were 44 pregnant women who were receiving amoxicillin as an intravenous infusion of 1 or 2 g. Blood samples were extracted from the patient, the arterial and venous umbilical cord, and the neonate to measure the concentrations. Using nonlinear mixed-effects (population) modeling, the pharmacokinetics were described by a five-compartment model. To simulate the concentration-time profiles in the maternal, venous umbilical cord, and neonatal serum, pharmacokinetic parameter estimates were used. The peak concentration was 18 % of the maternal peak concentration in the venous umbilical cord serum. 3.3 min after the maternal peak concentration was reached. The neonatal serum concentration time profile was calculated by the venous umbilical cord serum profile, which in turn relied on the maternal serum profile. In addition, for more than 90 % of the 4-h dosing period, the simulated concentrations in maternal, venous umbilical cord and neonatal serum surpassed the MIC for group B streptococcus. The 2-g infusion to the mother tends to be sufficient for the prevention of group B streptococcal disease in the first approximation. However, further studies of the interindividual variability of pharmacokinetics are suggested to examine the efficacy of prophylaxis. Out of 44 pregnant patients, a total of 53 umbilical cord blood samples were collected, consisting of 25 arterial and 28 venous cord blood samples. From 23 women, both arterial and venous cord blood samples were collected. From one twin birth, four umbilical cord samples were obtained. 904 maternal serum samples were obtained in total. Cord serum concentrations ranged in the arterial umbilical cord serum from 1.0 to 16.8 mg/liter and in the venous umbilical cord

serum from 1.1 to 18.0 mg/liter. Following the peak maternal concentration. Simultaneously with the maternal and arterial and venous umbilical cord serum concentrations, the few neonatal concentration data were analysed. The peak concentration reached in neonatal serum after infusion of 2 g into the mother was 8.0 mg/liter (while in venous umbilical cord serum it was 16.0 mg/liter). Similar concentrations were reached 1.1 h after the initiation of the infusion and neonatal serum concentrations surpassed the serum concentrations for the venous umbilical cord. For the prevention of neonatal GBS disease, an intrapartum dose of 2 g amoxicillin is widely used to try to achieve bactericidal concentrations in the fetus for a reasonable amount of time. In the case of GBS, concentrations of at least 0.25 mg/liter should be achieved, according to the clinical breakpoints defined by EUCAST. The simulations showed that amoxicillin concentrations surpassed MIC for more than 90 % of the dosing period after administration of a single 2-g dose in the maternal, venous umbilical cord and neonatal serum. The use of both arterial umbilical cord serum and neonatal serum samples was the best way to characterize the neonatal compartment. The peak concentrations were lower and delayed in the venous umbilical cord and neonatal serum compared with the peak concentration in the maternal serum. The concentration in the neonatal serum reached its peak level at approximately 1 h after the start of antibiotic administration and then surpassed the concentration in the venous umbilical cord serum. After administration of a 2-g dose, venous umbilical cord and neonatal sera surpassed the MIC for 90 % of the dosing interval. Specifically, nonlinear modeling of mixed effects (population) can be used to connect the sparse umbilical data. Fetal blood concentrations can be known as arterial cord blood concentrations. After passage of the antibiotic through the placenta, venous cord blood concentrations are reached. Those concentrations were then analyzed separately. Strictly speaking, it is therefore important to independently examine the arterial umbilical cord and neonatal serum concentrations, since there are many variations between the two. Antibiotics are removed from the fetus before clamping the umbilical cord by transplacental transport to the mother and by fetal renal excretion. The removal of amoxicillin from the neonate occurs only by neonatal renal excretion after cord clamping. In addition, several physiological changes occur in the neonate immediately after birth. These changes can affect the neonate's PKs and are more diverse than the variations in maternal PKs Studies of PKs in the serum of the umbilical cord are rare and are not differentiate, in general, between arterial and venous umbilical cord serum. Thus, our results can be contrasted with those from previous studies that did not differentiate between arterial and venous umbilical cord serum.

Amoxicillin and amoxicillin plus clavulanate: a safety review(2009)

Amoxicillin and amoxicillin plus clavulanate: an evaluation of safety: Amoxicillin, alone or in combination with clavulanic acid, is still among the most widely used antibacterial agents in recent decades. Although they are often considered twin drugs, both in terms of antibacterial activities and in terms of safety profile, they are distinct. It is well documented that adverse reactions can be caused by the clavulanate component alone, thus exposing patients to further, and sometimes undue, risks. Although amoxicillin/clavulanate should be considered only for the treatment of resistant bacteria as an alternative agent, evidence shows that it is also often used when a narrow-spectrum antibiotic would have been just as effective. In terms of patients, this prescription habit may have serious implications for safety, as well as in terms of bacterial resistance development. Some important variations were shown in the relative toxicity of AMX and AMC. The toxicity of the liver is closely linked to treatment with AMC, whereas AMX is only slightly involved. The involvement of the portion of the CA, which is

metabolized significantly through the liver, has been confirmed by several Case-reports and analysis on post marketing. There is still a controversy about the mechanism involved in such adverse reactions; a 'immunological idiosyncrasy' against the CA portion is the most frequently evoked one. These immunogenic properties also explain the higher level of SJS occurrence with AMC, at least partially, despite the higher overall number of AMX-related cutaneous adverse reactions. Mechanism of action- The synthesis of peptidoglycan, an essential component of Gram-positive bacteria cell walls, is interfered with by β-Lactams. Transpeptidation promotes the final transpeptidation stage in the synthesis of the peptidoglycan layer (penicillin binding proteins). The β-lactam nucleus permanently binds to the penicillin-binding proteins, stopping the linear peptidoglycan polymer from final crosslinking (transpeptidation). CA binds with β-lactamase irreversibly, saving β-lactam antibiotics from being inactivated. Consequently, when combined, the spectrum of AMX activity is expanded to include bacterial strains that are AMX-sensitive and β-lactamase-producing. This property has become increasingly essential for respiratory pathogens, especially H. M. and Influenzae. Safety: Gastrointestinal tolerability - AMX and AMC were associated with mild/moderate GI side effects, such as nausea, vomiting, cramping (prevalence 3-6%) or diarrhoea (4-15%). The strong oral absorption of AMX makes it better tolerated compared to other beta-lactams at the GI level. Liver tolerability- AMC is the one most commonly associated with liver injury among antibiotics, as well as the most frequently prescribed medication leading to drug-induced liver disease hospitalization. Overall, two known risk factors for AMC-induced liver injury tend to be advanced age and male gender. Allergic reactions: In 0.7-8% of treated patients, allergic reactions to β -lactams occur . For a long time, these effects have been linked to the sensitising effect of the benzylpenicilloyl moiety generated when the beta-lactam ring is cleft. This theory stems from the fact that CA-induced hepatitis, along with cutaneous adverse reactions, occurred in some studies and, in particular, one patient developed fatal SJS after extreme hepatotoxicity.

Amoxicillin : A broad spectrum antibiotic(2011)

Amoxicillin is used in the treatment of various diseases and bacterial infection hence its placed under class of broad spectrum antibacterial it was originally introduces in UK for oral use in early 1970s. Amoxicillin is more effective for gram positive then gram negative microorganisms. Amoxicillin was found to be more effective in treatment of middle ear (otitis media) , tonsils (tonsillitis & tonsillopharyngitis), throat, larynx (laryngitis) , pharynx (pharyngitis), bronchi (bronchitis), lungs (pneumonia), urinary tract (UTI), skin and to treat gonorrhea, also some recent suggested it is effective as prophylaxis against bacterial endocarditis, in patients with prosthetic joint replacements and in dentistry. Amoxicillin is a clinical effective antibacterial and found to be excellent to treat various infections; it is more effective for gram positive bacteria and less effective for gram negative bacteria. Official method of analysis- Liquid chromatographic method: The liquid chromatographic (LC) system for study of pure amoxicillin and amoxicillin assay in pharmaceutical dosage form was recommended by US Pharmacopoeia. Potentiometric titration method : Indian Pharmacopoeia (1996) suggested a buffer solution of the drug titrated with 0.02 M mercuric nitrate, potentiometrically evaluating the end-point with a platinum or mercury indicator electrode and a reference electrode for mercury-mercurous sulphate and ignoring any preliminary inflection in the titration curve. Subtract the % age content of the products of degradation from the Calculated %age of total penicillin content to determine the total penicillin content Amoxicillin sodium by %age content. Triple therapy - Amoxicillin 1 gram twice daily/clarithromycin 500 mg twice daily/lansoprazole 30 mg twice daily. Duel therapy -Amoxicillin 1 gram

three times daily/lansoprazole 30 mg three times daily. Drug- drug interaction-In combination with Allopurinol can develop skin rashes, Clavulanic acid (β-lactamase inhibitor) enhances the effect of amoxicillin and inhibits resistance production in β-lactamase generating micro-organisms. Amoxicillin reduces methotrexate's renal clearance, contributing to renal impairment/toxicity. Tetracyclines, chloramphenicol and other bacteriostatic medicines can interfere with amoxicillin's bactericidal impact. It has not been entirely clarified whether amoxicillin reduces the efficacy of oral contraceptives.

Amoxicillin(2020)

Amoxicillin is one of the most widely used antibiotics, with some additional gram-negative coverage similar to penicillin, covers a wide range of gram-positive bacteria. It covers most species of Streptococcus, close to penicillin. Amoxicillin is FDA approved for the treatment of infections of the genitourinary tract, ear, nose and throat infections, infections of the lower respiratory tract, infections of Helicobacter pylori, pharyngitis, tonsillitis, and infections of the skin and skin structure. It is recommended as a first-line treatment for acute bacterial rhinosinusitis. Its use for post-exposure prophylaxis for inhalation of anthrax. It also has other off-label applications, such as erysipeloid, Lyme disease and prophylaxis of infectious endocarditis, as well as prophylaxis in patients undergoing dental procedures with prosthetic joints. In conjunction with metronidazole, it can be beneficial in periodontitis and is one of the first-line therapies for streptococcus pharyngitis in group A. Amoxicillin is a common antimicrobial that nurse practitioners, primary care providers, and internists often prescribe. The drug is very effective, but before administering the medicine, it is always necessary to have a proper allergy history. Mechanism of action- Amoxicillin belongs to the class of antimicrobials of beta-lactam. By binding to penicillin-binding proteins, beta-lactams act by inhibiting a mechanism called transpeptidation, leading to the activation of autolytic enzymes in the cell wall of bacteria. This approach contributes to cell wall lysis, and hence the death of the bacterial cell. Bactericidal antimicrobials, such as amoxicillin, are also more "time-dependent" than "concentration-dependent" in their effectiveness. Time-dependent refers to the time when serum concentrations surpass the microorganism's minimum-inhibitor-concentration (MIC). Amoxicillin is an oral antimicrobial drug, while ampicillin can be administered orally, intravenously, or intramuscularly (which is structurally similar). Adverse effect - Amoxicillin is well-tolerated, but gastrointestinal (GI) symptoms, such as nausea, vomiting, and diarrhea, may be some common complaints. Hypersensitivity reactions are another substantial complication to be aware of. Type-I, II, III, or IV reactions can result from amoxicillin. Differentiating between a type-I and type-IV hypersensitivity reaction is critical because one may be more hazardous than the other. A type-I reaction is an IgE-mediated hypersensitivity to a sensitized patient that causes widespread release of histamine, leading to urticarial symptoms such as pruritic rash or even more serious systemic symptoms, such as anaphylaxis. A type IV reaction of hypersensitivity is not induced by the release of histamine and is more popular or morbilliform and sometimes not itchy. Contraindication- A major contraindication to amoxicillin is any prior anaphylactic reaction or severe skin reaction to amoxicillin or any other beta-lactam. These reactions may have cephalosporin or carbapenem crossover sensitivity. Another significant factor is deciding whether a type-I or type-IV hypersensitivity reaction is the patient's allergic rash. Patients will sometimes experience a childhood allergy to amoxicillin, which is actually a type IV-mediated hypersensitivity reaction, often at the stage of infectious mononucleosis; this is not a contraindication of prolonged amoxicillin administration. However, a type 1 induced hypersensitivity reaction is a

contraindication provided that prolonged exposure puts anaphylaxis at risk for the patient.

Clinical evidences: Extracted from clinicaltrials.gov

Bioavailability of Amoxicillin Dissolved in Human Milk(2020)
NCT01435824

Results -The researchers suggest a two-stage analysis of amoxicillin absorption that will, for the first time, yield information leading to paediatric pharmacology guidelines for the administration of amoxicillin dissolved in human milk to infants. Adult participants will be enrolled in the study as the number of blood extractions, volume of blood needed, and topic availability dictate. Since the number of blood extractions, volume of blood needed, and subject availability, among other issues, create a number of ethical and logistical constraints that make carrying out such an intensive sampling study in infants virtually impossible, the investigators' study will recruit adult volunteers.

2. Cefuroxime [13-17]

Sr no.	Title of the research paper	Year of publication
1	Cefuroxime: Human Pharmacokinetics	1976
2	Effect of dose and food on the bioavailability of Cefuroxime axetil	1987
3	Pharmacokinetics of cefuroxime axetil in patients with normal and impaired renal functions	1993
4	Comparative pharmacokinetics of new oral cephalosporins	1994
5	Cefuroxime axetil: a review of its antibacterial activity, pharmacokinetic properties and therapeutic efficiency	1996

Cefuroxime: Human Pharmacokinetics- 1976

A single dose of new parental cefuroxime was given at different quantities to 44 normal male subjects. Doses of 0.25, 0.5, 0.75 or 1.0 g were given through intramuscular injections to 33 volunteers. The serum at its mean peak concentration is assayed at 29 to 45 min. single rapid injection of doses 0.25,0.5 or 1.0 g were given to 9 of the volunteers, a mean levels were assayed at 3 min. The antibiotic has a half-life of 70 min. The doses were secreted through the volunteers, mean 95% was found in urinary recovery for all parental doses, antibiotic was also secreted through kidney tubules. Slight pain was experienced by some of the volunteers which disappeared after a few minutes. Physical laboratory investigation gave the result that cefuroxime had no adverse effects. There was also no evidence of absorption after oral Administration. The 44 volunteers are normal adult male of age 19-57 . physical test and laboratory tests are undertaken to exclude people with a history of allergy. These studies were made 2 days before and 1 day after each dose. Blood samples were tested. Urine is also examined for pH. First 33 volunteers are given single intramuscular injections; 8 were given 0.25, 0.5 0.74 and 1.0 g. 14 of the volunteers were given 0.5g of cephaloridine intramuscularly on separate occasions. The 6 volunteers are given 2 separate doses of 0.5 g of cefuroxime intramuscularly. Probenecid was given in 2 doses of 0.5g 2h before and 1h after intramuscular injections of cefuroxime. 9 of the volunteers are given intravenous injections. 2 of the volunteers are given 1g of cefuroxime by oral administration. The duration and the intensity of pain at the first site of injections are recorded. The blood of the volunteers is collected after each intramuscular injection at 30,60,90,120,180,240,360 and 480 min. After the intravenous injection the blood sample is collected from different arms at the end of bolus injection; 3, 10, 30,60, 120, 300, and 480 min. urine samples are collected from different hours after the intravenous injection. An interval of 1 week is given between the first and second part of the crossover study. Concentration of cefuroxime in specimens of serum and urine is determined. Serum samples are taken 1 h from the volunteers who had received 1.0 g of

intravenous injection. HPLC analysis is conducted . the pharmacokinetics is analysed by enabling pharmacokinetic Parameters. In the urinary recoveries and renal clearances , cefuroxime is rapidly excreted in high concentration through the kidney, and it's been recovered in urine after 6 h of injection. The renal clearance of cefuroxime is rapid and increases with increase of dosage. Renal clearance was found more rapid than measured creatinine clearance. Probenecid by mouth had effect and several pharmacokinetics parameters are studied. The renal clearance is delayed but not decreases the urinary excretion. Cefuroxime given by mouth , only 1% of dose is appeared in the urine and the serum concentration was not measurable. There were no clinical or laboratory evidence of toxicity in volunteers at any of the drug doses. The intramuscular injection was slightly painful for some volunteers , but the pain disappeared. Cefuroxime is the new antibiotic of cephalosporin. It appears to be very low toxic in lab animals. In particular it seems to have no toxic action on kidney These favourable pharmacokinetic properties with its good antibacterial activity suggests that cefuroxime is good and effective in treatment of bacterial infections in humans.

Effect of dose and food on the bioavailability of cefuroxime axetil - 1987

Cefuroxime sodium is a parental cephalosporin. Many ester derivatives have been synthesized of cefuroxime sodium, as oral absorption of cefuroxime sodium is very less. Cefuroxime axetil has been shown to have many oral bioavailability to use it clinically. Most oral antibiotics absorption reduces by co-administration with food. But in cefuroxime axetil absorption is enhanced when it is administered after a meal. The purpose of this study was to evaluate the dose proportionality of four different dose that were administered after standard meal. Also to determine the absolute bioavailability of cefuroxime axetil administered with and without food. 12 healthy male subjects of age between 21- 27 years, weight 70-90kg were subjected to 3-min intravenous infusion of cefuroxime sodium each and also five oral doses. One of the oral doses was administered after overnight fasting. Standard breakfast was given to subjects before the four oral doses. Blood samples were collected at 0.5, 1.0, 1.5, 2, 3, 4, 5, 6, 8, 10 and 12 hours after the dose. Some additional samples were also collected 5 to 15 min after the intravenous dose. Blood samples were separated in a refrigerated centrifuge at -70°C plasma is frozen. Subjects were instructed to empty their bladder just before each dose and urine was collected for 24 h after each dose. Plasma and urine samples are analysed by HPLC technique. Area under AUC curve is calculated. First order terminal deposition is calculated. From the individual plasma concentration-time profiles the peak concentration and time of the peak concentration were obtained. 3 subjects had experienced viral illness.The mean plasma concentration – time curve for each dose is drawn.For the peak plasma concentration coefficient of variation ranges from 17-28%. Plasma concentration is declined rapidly in a biexponential way, with mean terminal elimination rate constant of 0.55h -1 . Fasting and fed data for 500mg dose of CAE is compared. 36% of fasting and 52% of fed 500mg doses were absorbed. Urine samples are analysed for detection of cefuroxime. Cefuroxime was not detected in urine samples that were collected between 12 to 24 hours after the dose. Mean fraction of unabsorbed drug vs time is shown, absorption is relatively constant from 0.5 to 3h after dosing. For all the treatments between 1.5 to 2.0h approximately 50% of the drug was absorbed; and in 3h, 80% of the drug was absorbed. A plot of the mean fraction of unabsorbed drug vs time reveals that absorption is an apparent zero order process from 0.5 to 3h after dosing. Administration of cefaclor after meal reduces the peak serum concentration and extent of absorption. Administration of amoxicillin trihydrate with standard meal has no effect on absorption. In the presence of food there is an enhancement in 1g of oral

dose of cefuroxime axetil. This study also says that the effect of food occurs over an oral dose range of 125-1000 mg. These effects cannot be associated to food with an increase in gastric pH. Induced gastric alkalinity due to rancidity and sodium bicarbonate reduce the absorption of cefuroxime axetil . higher plasma concentrations are observed after food could not be attributed to a change in pharmacokinetics of the drug. Food may have some effect on the luminal esterase responsible for the de-esterification of cefuroxime axetil to the less absorbed cefuroxime. From this study it is recommended that cefuroxime axetil be administered immediately after meals.

Pharmacokinetics of cefuroxime axetil in patients with normal and impaired renal function- 1993

Cefuroxime axetil is a acetoxymethyl ester of cefuroxime.Cefuroxime is a drug with high intrinsic activity and great stability to beta lactamase from many gram-positive and gram- negative organisms. In normal volunteers and in patients pharmacokinetics of parentally administered cefuroxime has been studied with compromised renal functions. Pharmacological studies has been done with subjects with normal renal function, of oral administration of cefuroxime axetil. Objective of this study were to determine pharmacokinetics of cefuroxime axetil after oral administration in patients with normal and impaired renal function, also to determine dosage guidelines of this drug for patients with renal dysfunction. Total 28 adults (27 male and 7 female) ,age is between 20 years to 79 with different degrees of renal impairment. four groups were made and each was assigned to one of the groups. Group 1, >85mL/min?1.73m 2 (6subjects). Group 2, 50 to 84 mL/min/1.73m 2 (6subjects). The group 3 , 15 to 49 mL/min/1.73m 2 (7subjects) ; group 4 , <10mL/min/1.73m 2 (9subjects). Film coated tablets of cefuroxime axetil each having 300.75 mg of cefuroxime axetil were used. Each subject was instructed to take two tablets of cefuroxime axetil with 50mL of water after 15 min of breakfast. Blood samples were collected in heparinized tubes. Volumes were measured. Samples were frozen at -20 ° C until determination of cefuroxime concentrations. Serum and urine samples were collected during the study , they were also assayed for calculation of Cl cr . By vertical diffusion method plasma cefuroxime concentration was determined, using Streptococcus pyogenes IID697 as test organism. Using Bacillus subtilis ATCC 6633 urine cefuroxime concentration was determined. First order elimination rate constant (k el) is determined on log concentration- time curve with the weighing factor of 1/y 2 . The t 1/2 is determined by dividing 0.693 by k el . C max and T max are read from concentration-time curve.

The mean serum concentration of cefuroxime following oral administration of 500mg as the acetoxymethyl ester are noted. The C max and Tmax are -2+ 1-5 mg/L and 3-0 ± 1 1 h in group 1, 5-5 ± 14 mg/L and 3 0 + 1-3 h in group 2, 86 ±2-7 mg/L and 3-9 ± 1-2 h in group 3, and were

10-7 ±2-0 mg/L and 63 ±2-9 h in group4. The mean urinary recoveries during 48 h were 41- 9±9-3%, 32-9±7-9%, 340±5-2%, and 22-0± 114%, of the administered dose in groups 1, 2, 3, and 4. The values of pharmacokinetic parameters are summarized, there is no much difference between the four groups. The mean value for all subjects was 0-82 + 0-27 L/kg. The k el , T 1/2 and AUC 0-∞ were renal function dependent. T 1/2 value for group 1 is 1.4±0.33h , 2.4±0.65h in group 2, 4.6±2.32 h in group 3 and 16.8±10.2h in group 4. Loss of renal function results in progressive prolongation of the serum half life of cefuroxime administered orally as cefuroxime axetil. The correlation between Cl s /F versus Cl cr, reflecting differences in the bioavailability between the subjects. Cl s /F and Cl cr is linear , this indicates that there is probably no systematic dependence of the bioavailability upon renal function. The results enable us to suggest modifications in cefuroxime axetil dose schedules in patients with reduced renal function.

Comparative pharmacokinetics of new oral Cephalosporin- 1994

Comparative pharmacokinetics in healthy volunteers of new oral cephalosporin with carbacephem and loracarbef.. Single dose, multiple dose studies also elderly and oral agents are

noted and differences in pharmacokinetics has been observed and studied. Bioavailability of ester Cephalosporin with antacids is observed. Generally cephalosporin tends to be too hydrophilic to get easily absorbed by the intestinal mucosa. Number of oral cephalosporin agents have recently been found. The agents were divided into two groups the prodrug esters (cefetamet pivoxil, cefpodoxime proxetil and cefuroxime axetil) and the agents that are absorbed intact cefaclor, cefixime and ceftibuten). The absorption characteristics of cefetamet pivoxil is examined in an ascending dose study in healthy and fed volunteers. No significant differences were found between 500 to 1000 mg doses in rate or extent of absorption. Studies suggest that maximum serum concentrations (Cmax) were higher for loracarbef and ceftibuten and then cefprozil. Protein binding of loracarbef and the new oral Cephalosporins ranges from 22% for cefetamet pivoxil to 70% for cefixime. No significant differences are marked in pharmacokinetics values received after first and last study of doses. The bioavailability of cefetamet pivoxil and cefpodoxime proxetil were found similarly between the elder and young volunteers.When ester cephalosporin is administered after food it's bioavailability is enhanced compared to administration during fasting. There was a increase of 31 to 37% in Cmax and 41 to 78% increase in AUC also t1/2 was delayed by administration of cefetamet pivoxil or cefuroxime axetil after food.Antacids have great effect on absorption of quinolone antibacterial agents therefore any possible interaction with the new oral cephalosporins is of interest to the prescribing physician. There can be an increase in pH by altered absorption of this agent. There were small reductions evident in both the urinary recovery (23%) and AUC (6 to 12%) after co-administration with ranitidine or antacid with cefotiam hexetil. Single dose- Urinary recovery depends upon the enteral absorption, hepatic metabolism, and extra renal and renal elimination of the agent. With the exception of Cefixime , the new oral cephalosporins are characterised by moderate to high rates of urinary recovery indicating the predominant renal recovery. The low rate of urinary recovery and the high concentration of cefixime in the bile and gallbladder tissue indicate extensive hepatic elimination of the agent. According to the results of multiple dose studies, there was no evidence of accumulation of the new oral cephalosporins at the doses and regimens used.Metabolites were not detected in plasma or urine after administration of cefixime or cefprozil.Dosage adjustment of the new oral cephalosporins in elderly patients is unnecessary because the small pharmacokinetic differences observed are not clinically relevant. Food may prolong the period of contact between the drug and esterases in the intestinal mucosa as the result of delaying gastric emptying, contributing food effects are then observed. It is thus advisable to administer the ester cephalosporins after the meal. The absorption of cefpodoxime proxetil was reduced by co-administration of both H2 antagonists and antacids.Taking a C max to MIC90 ratio of 5 to 10 as being indicative of clinical efficacy, it summarises that all cephalosporins are highly active against Streptococcus pyogenes. Escherichia coli are highly susceptible to cefetamet pivoxil, ceftibuten, loracarbef and cefixime, with cefuroxime axetil, cefotiam hexetil.

Cefuroxime axetil : A review of antibacterial , pharmacokinetic properties and the therapeutic efficiency -1996

Cefuroxime axetil is an oral cephalosporin. It is rapidly hydrolysed to the active parent compound , cefuroxime. Cefuroxime has been evaluated in the treatment of upper and lower respiratory tract

infections , by its clinical traits. It is also an efficient antimicrobial agent. Cefuroxime axetil is associated with low incidence of adverse events, with gastrointestinal distributions being the most frequently observed. Hence, cefuroxime axetil is an effective and convenient treatment for a wide range of infections.Cefuroxime axetil can also become established as an oral component of sequential treatment regiments. Cefuroxime has good activity against gram-negative bacteria, both beta-lactamase positive and negative strains of the common respiratory pathogens. Cefuroxime is inactive against enterococci and Listeria monocytogenes. Cefuroxime is generally active against the common urinary tract pathogen Escherichia coli. Studies show that cefuroxime has good activity against P. mirabilis and variable activity against Klebsiella pneumoniae. Cefuroxime axetil undergoes hydrolysis by esterases in the gastrointestinal tract to yield the active parent compound. The absorption of cefuroxime axetil increases by presence of food. Cefuroxime is not significantly metabolized and it is eliminated by the kidneys and unchanged drug, this results in high urinary concentration of cefuroxime. In adults with acute sinusitis and acute exacerbations of chronic sinusitis, consistently high clinical response rates were achieved after treatment with cefuroxime axetil. 500 mg twice-daily dosage was more effective than 250mh twice-daily dosage. Single dose was effective in the treatment of adults with urinary tract infections.Gastrointestinal disturbances , and nausea, vomiting and diarrhoea were the most frequent. Toxic epidermal necrolysis, headaches , hypersensitivity reactions and pseudomembranous colitis is also observed occasionally during cefuroxime treatment.Cefuroxime is excreted in breast milk. Cefuroxime should be strictly administered with food. Dosage of cefuroxime axetil is not required to be modified for patients with mild to moderate renal impairment, but prolongation of the dosage interval is necessary for patients with creatinine clearance. Cefuroxime axetil is a well tolerated , broad spectrum antibacterial agent. When it is administered as a convenient twice-daily dosage regimen, it is proven to be effective treatment for various infections. Cefuroxime axetil can be considered as empirical therapy for a range of community- acquired infections, it includes infections of upper and lower respiratory tract, akin and the soft tissues, also the urinary tract. Cefuroxime axetil has been considered very useful for the treatment of infections with β-lactamase producing strains of the common respiratory pathogens , are identified as the causing pathogens. From the preliminary results of sequential treatment studies and pending results of further well-designed studies, cefuroxime axetil might be also established as an oral component of sequential regiments.

3. Amoxicillin[18-26]

Sr.No	Title of the Research Paper	Year of Publication.
1	Amoxicillin: in vitro and pharmacological studies	1972
2	Acute Renal Failure Following Amoxicillin Overdose	1993
3	Efficacy of Penicillin vs. Amoxicillin in Children with Group A Beta Hemolytic Streptococcal Tonsillopharyngitis	2003
4	Acute liver failure due to amoxicillin and amoxicillin/clavulanate	2005
5	Historical perspective and development of amoxicillin/clavulanate	2007
6	Common harms from amoxicillin: a systematic review and meta-analysis of randomized placebo-controlled trials for any indication	2015
7	Routine Amoxicillin for Uncomplicated Severe Acute Malnutrition in Children	2016

8	Amoxicillin Modulates ApoA-I Transcription and Secretion, Predominantly via PPARα Transactivation Inhibition	2019
9	Amoxicillin-Induced Crystalline Nephropathy Presenting as Ureteral Obstruction	2020

Amoxicillin: In vitro and pharmacological studies. (1972)

Amoxicillin is a new kind of semisynthetic penicillin, that is active in vitro against gram positive cocci. It's similar to penicillin and can kill a wide variety of bacteria including Streptococcus species, Listeria monocytogenes, Enterococcus, Haemophilus influenzae, some E.coli, Actinomycetes, Clostridial species, Shigella, Salmonella, and Corynebacteria. The Drug is found more effective than ampicillin for treating experimental infections in mice and resulting in substantially higher serum levels in humans. After a study was conducted ,it was found that only 28% of isolates of S.aureus resistant to 50µg of penicillin G per ml were susceptible to amoxicillin at this concentration or less , and none were susceptible to less than 12.5µg/ml. 76% of P.mirabilis isolates were susceptible to 1.56µg or less of amoxicillin per ml, but 20% were resistant to 12.5µg/ml or more, 57% of E.coli isolates were susceptible to 6.25µg/ml or less but most of the remaining were resistant to 50µg/ml or more. Only a few other gram negative bacilli were sensitive to amoxicillin (1). Amoxicillin and ampicillin are more similar against Proteus spp. and more active than cephalothin. It was found in the study Ampicillin was slightly more active than amoxicillin against E.coli and considerably more active against members of the Klebsiella-Enterobacter-Serratia group(1) . A comparison was done between serum levels observed after oral intake of 500mg of amoxicillin and 500 mg of ampicillin. With amoxicillin , mean peak serum level measured at 2 hr and was 6.75µg/ml. With ampicillin, mean peak serum level occurred at 3 hr and was 2.28 µg/ml (1). This study reveals that amoxicillin achieves its mean peak serum levels in lesser time and with more volume.

Acute Renal Failure Following Amoxicillin Overdose.(1993)

Amoxicillin and ampicillin are the drugs associated with relatively few side effects. Two children were found to be experiencing acute renal failure and macroscopic haematuria immediately after ingestion of supratherapeutic doses of amoxicillin. Patient 1, after physical examination his blood pressure was 123/85 mm Hg; heart rate, 82/bpm; temperature 37.3°C . He was mildly ill, urine was grossly dark maroon, with a specific gravity of 1.012. By dipstick urine contained +1 glucose, +3 haemoglobin, and 3+ protein, with a pH of 5.0 . Microscopic study showed 400 to 500 eumorphic rbc and occasional wbc without casts or crystals. Further questioning led the parents to notify that the child had ingested nearly an entire bottle of amoxicillin (250 mg/5ml) nearly 3 hours before the onset of his haematuria. Light microscopic examination of the renal biopsy showed a patchy interstitial inflammation and renal medulla with predilection to the collecting ducts. Patient 2 was a 2.5-year-old male child, accidentally chewed 30-40 amoxicillin tablets (250 mg/tablet) After developing abdominal cramps and vomiting without diarrhoea he started feeling restless. Being brought to the emergency room after 24 hours, the patient appeared ill and mildly dehydrated. Temperature 37.5°C , pulse 122/min , and blood pressure 110/60 mm Hg. A few drops of bloody urine were obtained for urinalysis. The specific gravity was 1.019 and pH was 6. Dipstick of the urine revealed 2+ protein and 4+ blood without glucose. Microscopic analysis of the uncentrifuged urine specimen showed 40 to 50 red blood cells per high-power field (hpf), 12 to 15 WBC/hpf, and no casts or crystals. Renal biopsy demonstrated focal edema and leukocytic inflammation of the interstitium, with occasional invasion of the tubules.

The above 2 patients shows that ingestion of such drugs in large amounts may result in oliguria, macroscopic haematuria, and azotaemia. Potential mechanisms of renal toxicity due to over dose of amoxicillin includes crystallisation of the drug within the tubular lumen, renal venules, or interstitium; direct cellular toxicity; vasoconstriction' or an immediately set hypersensitivity reaction. Therefore, we can conclude by imposing that one should consider the possibility of amoxicillin overdose in evaluation of the child with acute onset of macroscopic haematuria and acute renal failure.

Efficacy of Penicillin vs. Amoxicillin in Children with Group A Beta Haemolytic Streptococcal Tonsillopharyngitis. (2003)

The study was conducted to compare the bacteriologic and clinical efficacy of oral
penicillin versus amoxicillin as first-line therapy for group A beta-haemolytic streptococcal (GABHS) tonsillopharyngitis. This observational study was conducted over 18 months of period (January 2000-June 2001). Children enrolled in this study had acute onset of symptoms and signs and a laboratory documented GABHS tonsillopharyngitis illness. Follow-up examination and laboratory testing occurred 10 ± 4 days following completion of treatment. In total, 389 patients were enrolled (intent to-treat group): 195 received penicillin V and 194 received amoxicillin. Fifty-six of the penicillin treated and 57 amoxicillin-treated patients refused to take the drug, or were noncompliant, or did not return for the follow-up visit, leaving 276 patients in the per-protocol group: 139 penicillin-treated and 137 amoxicillin-treated. Bacteriologic cure for amoxicillin-treated children occurred in 76% versus 64% in the penicillin-treated children (p=0.04). The clinical cure rate for amoxicillin-treated children was 84% compared to 73% in the penicillin-treated children. Since treatment allocation was not randomized, logistic regression analysis was used to adjust for treatment group differences. The odds ratio (OR) estimates for cure for patients in the amoxicillin versus penicillin V treatment group remained significant (OR=1.84, 95% confidence interval 1.02-3.29); the same was true for clinical cure Amoxicillin is approximated to be superior to penicillin for bacteriologic and clinical cure of GABHS tonsillopharyngitis.

Acute Liver Failure Due to Amoxicillin and Amoxicillin/Clavulanate. (2005)

Ampicillin and Amoxicillin are usually associated with a very low rate of mild hepatocellular and cholestatic liver injury when used alone. Men above the age of 50 appear to be at increased risk of amoxicillin hepatotoxicity along with the patients who receive prolonged/repeated courses of treatment. Acute Liver Failure (ALF)is one of the rare but severe illnesses defined by the onset of coagulopathy and encephalopathy within 8 weeks of presentation in a patient without known underlying disease. A prospective study of 309 consecutive ALF patients demonstrated that acetaminophen (33%) and idiosyncratic drug-induced hepatotoxicity (13%) were the most commonly identified causes of ALF in the United States(2). To standardize the diagnostic criteria for drug -induced liver injury, several scoring systems have been proposed. The Council for international Organization of Medical Sciences (CIOMS) scale uses seven clinical criteria to generate a score that varies between -5 and +14 and is categorized into five levels of causality: >8 definite/highly probable, 6-8 probable, 3-5 possible, 1-2 unlikely and ≤0 excluded. The Clinical Diagnostic Scale(CDS) provides score between 6 and 20 that can be categorized into 4 levels of causality: >17 definite, 14-16 probable , 10-13 possible and 6-9 unlikely(5,6). A study was done involving 2 patients with life threatening ALF, due to amoxicillin and amoxicillin/clavulanate(7). A 59 -year old Caucasian male presented with ALF 34 days after intake of

amoxicillin/clavulanate. Despite intense support and care ,he died in hospital on day 10. A 42-year-old Caucasian female presented with ALF 21 days after receiving amoxicillin. She underwent liver transplantation on hospital day 19. Patient 1 was estimated to have a CIOMS score of 9 which indicates" definite/highly probable" and a CDS score of 13 which is "Possible". Whereas Patient 2 had a CIOMS score of 9 which is "definite/highly probable" and a CDS score of 9 which is "unlikely". Insight - Recently a genetic basis for amoxicillin/clavulanate hepatotoxicity has been identified with the linkage to human leukocyte antigen (HLA) haplotype particularly in patients with immunoallergic and cholestatic features.

Historical perspective and development of amoxicillin/clavulanate. (2007)

Infections were ranked as the leading global burden of disease and the leading cause of mortality in children, by the World Health Organization. Acute respiratory infections are the leading infectious cause of death in all ages. 50 years back, antibiotic resistance was a major problem. This problem still exists till today's date, selecting resistant strains of pathogenic bacteria is unavoidable and resistance to all classes of antibiotics has been identified. In the 1960's, a limited range of non-beta lactam antibacterials namely , sulphonamides, streptomycin and kanamycin, erythromycin, had certain limitations in terms of toxicity. In the period of 1960-70's challenging infections like meningitis, endocarditis, neonatal infections, penicillin resistant staphylococcus infections, new pathogens, and infections in immunocompromised patients, increased in number. This set of scenarios made an emergence in developing new Antibacterial agent fulfilling the requirements.A further objective at that time was to identify a broad-spectrum penicillin, which was realized in 1961 with the synthesis of ampicillin and later in 1970 ,with amoxicillin. Amoxicillin having a good oral absorption and broad-spectrum antimicrobial activity, was selected as the antibiotic to be co-administered with clavulanic acid and in tablet formulation was launched in Augmentin in the UK in 1981. In 2005, after 25 years of its initial launch ,the rationale for Amoxicillin/clavulanate remains the same and the development of new high-dose regimens and pharmacokinetically enhanced formulations ,has meant that it still has an important and unique role to play in the treatment of range of community-acquired infections.

Common harms from amoxicillin: a systematic review and meta-analysis of randomized placebo-controlled trials for any indication. (2015)

For this systematic review the resource searched are MEDLINE, Embase and the Cochrane Central Register of Controlled trials,for randomized participant-blinded ,placebo-controlled trials of amoxicillin or amoxicillin -clavulanic acid for any indication. The shared -opinion formation should not only just highlight the benefits , but also the possible harms of the antibiotics. Current knowledge of the harms from antibiotics are derived largely from observational analysis. In the given Meta analysis diarrhea was reported in 17 studies and was not significantly caused by Amoxicillin, except in combination form with clavulanic acid. The high heterogeneity was observed among all the studies except amoxicillin-clavulanic acid alone. Candidiasis reported in only 3 studies specifically caused by amoxicillin, with low heterogeneity. In addition to explicit candidiasis, a trial showed reports of diaper rash of about 50% among infants treated with amoxicillin-clavulanic acid. Rashes, nausea and vomiting were not reported significantly more frequently with antibiotics than placebo. Therefore in the meta analysis of randomized trials , a statistical significance of just 2 harms was found: diarrhoea from amoxicillin-clavulanic acid and candidiasis from amoxicillin with or without clavulanic acid.

Therefore this study highlights some new information about common harms of amoxicillin and amoxicillin-clavulanic acid that can contribute to better-informed discussions and decisions about the benefit-Harm trade=off for these antibiotics.

Routine Amoxicillin for Uncomplicated Severe Acute Malnutrition in Children.(2016)

To decrease the chances of death from severe acute malnutrition ,specialized nutritional and medical intervention is required . Bacterial infection can complicate advanced cases of severe acute malnutrition, and the risk of nosocomial infection in inpatient setting can be high. In 2007, WHO and the United Nations endorsed a community-based model for the management are treated at home with ready-to-use therapeutic food. A study was conducted at four health centres in rural health district of Madarounfa, Niger. All the childrens fitting certain given criterias were presented at the study centres. The study was randomized, double-blind, placebo controlled trial with sole purpose to examine the effect of routine antibiotic (Amoxicillin) use compared to placebo, on nutritional recovery from uncomplicated severe acute malnutrition. 1200 children were included in the analysis receiving placebo and 1199 included in analysis receiving amoxicillin.It was found that routine amoxicillin use has some benefits over placebo in terms of short term weight gain. However, without evidence of longer term effects on weight or height , the early growth promoting benefits of routine antibiotic use may be limited.

Amoxicillin Modulates ApoA-I Transcription and Secretion, Predominantly via PPARα Transactivation Inhibition.(2019)

In a recent human study, it was observed that amoxicillin treatment decreased HDL-C concentration. It was hypothesized that antibiotics lower the transcription and secretion of ApoA-I, the responsible protein for HDL production. HepG2 and Caco-2 cells were exposed to increasing dose of amoxicillin, penicillin, and streptomycin. Secreted ApoA-I protein and mRNA transcripts were analysed using ELISA and qPCR, respectively. Besides treatment of bacterial infections, antibiotics also influence the quantity and composition of the natural microbiota, which may be involved in a wide variety of physiological processes.. Relative PPARα transactivation in transfected HepG2 cells treated with different concentrations of antibiotics:
Increasing amoxicillin and the combination of penicillin and streptomycin concentrations showed a significant reduction in PPARα transactivation since the regression coefficient deviated from zero. ApoA-1 mRNA expression was observed to be higher in differentiated Caco-2 cells as compared to HepG2 cells. As for HepG2 cells, amoxicillin significantly ($p < 0.01$) and dose-dependently was lowered ApoA-I mRNA expression in Caco-2 cells. Recently, it was observed that amoxicillin treatment for 7 days significantly lowered serum HDL cholesterol in healthy subjects (15). Therefore, it was shown that amoxicillin treatment has direct effects by lowering ApoA-I secretion and transcription. Based on evaluating alterations in KEAP1, CPT1, and CHOP mRNA expression plus PPARα transactivation, it is tempting to suggest that a reduced PPARα transactivation is a potential mechanism behind the observed amoxicillin-induced effects on hepatic and intestinal ApoA-I expression.

Amoxicillin-Induced Crystalline Nephropathy Presenting as Ureteral Obstruction. (2020)

A 23-month-old male, having past medical history appropriate for imperforate anus status post ostomy placement and takedown, non-functional left kidney status post nephrectomy, partial urethrectomy, and persistent right sided grade 2 hydronephrosis, presented to the emergency department (ED) in April

2018 secondary to dehydration and decreased urine output. He began having diarrhoea 7 days prior to the ED visit. Two days prior to the ED visit, his diarrhea resolved but began having emesis. During hospital day 1, he was found to have oliguria(urine output 0.15 mL/kg/h) with repeated bladder scans showing <100 mL of urine. His net fluid balance was (+) 1.2 L with associated 0.8-kg weight gain. Within 12 hours following nephrostomy tube placement, the patient started spontaneously voiding and no longer had output from his nephrostomy. By 72 hours after initial ED presentation, his BUN/Cr improved to 23/0.5, HTN self-resolved, and weight returned to baseline admission weight. He was discharged home on hospital day 5 with removal of the nephrostomy tube 6 days after it was placed. Urine microscopy showed the significance for birefringent crystals with needle-shaped morphology. Crystalline nephropathy means renal injury followed with abundant crystals that are commonly found in tubules and interstitium. Amoxicillin is renally eliminated with majority (90%) through tubular secretion and the remaining (10%) via glomerular filtration. The risk of crystalluria increases with decrease in urine solubility of medication. There are several proposed mechanisms of amoxicillin- induced nephrotoxicity. The first is intrarenal precipitation with resultant medullary congestion and tubular damage leading to haematuria. Along with intratubular precipitation, crystallization can also occur in the renal pelvis causing obstructive uropathy (19). After discontinuation of the amoxicillin, crystalluria usually resolves within 24 hours, haematuria within 5 days, and renal failure within a couple weeks. Treatment is generally reserved for severe cases and consists of fluid rehydration and the consideration of urine alkalization to improve drug solubility. We can conclude by saying that, amoxicillin-induced crystal nephropathy is a rare finding followed by high-dose amoxicillin intake, especially in the pediatric population. The complication is usually mild and resolves following medication discontinuation.

Clinical evidences: Extracted from clinicaltrials.gov

Clinical Trial of the Treatment of Acute Sinusitis With Standard-dose Versus High-dose Amoxicillin/Clavulanate
NCT02340000

An interventional study was designed with randomized allocation. Standard dose: amoxicillin/clavulanate 875/125 mg + placebo tablet twice a day for 7 days . High Dose: Time Period I (November 18, 2014-January 5, 2016): extended-release amoxicillin/clavulanate 1000/62.5 mg 2 tablets (by different manufacturer) twice a day for 7 days Time Period 2 (February 6, 2016-February 27, 2017): immediate-release amoxicillin/clavulanate 875/125 mg plus standard immediate-release amoxicillin 875 mg twice a day for 7 days. The Primary outcome was a Subjective Improvement-Day 3(Rating of “a lot better” or “no symptoms”).

4. Cefuroxime [27-31]

SR.NO	TITLE	YEAR OF PUBLICATION
1	Review of the New Second-Generation Cephalosporins: Cefonicid, Ceforanide, and Cefuroxime	1985
2	Review of the Pharmacology, Pharmacokinetics, and Clinical Use of Cephalosporins	1990
3	Effectiveness of short-course therapy (5 days) with cefuroxime axetil in treatment of secondary bacterial infections of acute bronchitis.	1995
4	Formulation and characterization of Cefuroxime Axetil nanoemulsion for improved bioavailability	2012
5	Computer-Aided Design of Cefuroxime Axetil/Cyclodextrin System with Enhanced Solubility and Antimicrobial Activity	2019

Review of the New Second-Generation Cephalosporins: Cefonicid, Cefradine, and Cefuroxime - 1985

Cefuroxime is the most active new second-generation agent which is less active against gram-positive cocci than the first-generation cephalosporins for β-lactamase producing *Haemophilus influenza* with advantages of smaller doses and drug cost reduction. With documented effectiveness of cefuroxime in open trails and limited comparative studies got approval for the treatment of common paediatric bacterial meningitis infection. clinicians must be on alert for bacterial resistance development and decreased efficacy. Cefuroxime's chemical name is [(6R,7R)-3-carbamoylmethyl-7 -[Z-2 methoxyimino-2-(fur-2-yl)acetamido]- ceph-3-em-4-carboxylic acid].Its structure has two side chains attached to the 7-aminocephalosporanic nucleus. One side chain is a carbamate ester; the other is a combination of a furyl and a substituted oxime group. These chemical changes have provided improved β-lactamase stability and antibacterial activity over the first-generation cephalosporins. It is a monosodium salt with 42 mg of sodium (1.8 mmol) per 750 mg of active drug. Lower respiratory tract infections due to bacteria in a series of open studies have responded well to cefuroxime. In a randomized, double-blind study of 28 patients, cefuroxime was found to be as effective as parenteral amoxicillin with acute exacerbations of chronic obstructive pulmonary disease. Cefuroxime was also found to be equally effective as parenteral administration of trimethoprim-sulfamethoxazole among 40 patients with bronchopneumonia. With acute bacterial pneumonia, two groups have shown clinical improvement in paediatric patients who received cefuroxime. In the treatment of osteomyelitis (acute and chronic) and septic arthritis, several investigators have reported a positive clinical outcome in about 75 % of the patients with parenteral cefuroxime. Against many gram-negative bacteraemia Cefuroxime has been reported to be effective. With the administration of cefuroxime 200-250 mg/kg/d, successfully treated 34 patients with bacterial meningitis (H. influenzae, Salmonella, N. meningitides, S. pneumoniae). Cefuroxime 1.5 g administered for uncomplicated gonorrhoea produced cure rates > 98 % for non-penicillinase isolates and 100 % for Lactamase-positive strains. However, 26.9 % of the males developed post gonococcal urethritis. For urethral, oral, or pharyngeal gonorrhoea in children, a single dose of cefuroxime 25 mg/kg was safe and effective. In 96 patients who underwent total joint replacement with pre-and postoperative cefuroxime (three doses), Hugh's observed only two bone or joint infections in an open study. 128 Patients who received either cefuroxime or placebo as prophylaxis for coronary artery bypass graft surgery had equal rates (35 % each) of sternal or leg wound infections; however, cefuroxime produced significantly fewer cases of pneumonia than placebo (4 % and 33 %, respectively). A single dose of cefuroxime 1.5 g in patients undergoing high-risk gastric or biliary tract surgery is superior to placebo. Cefuroxime has received approval for the treatment of susceptible microorganisms in lower respiratory tract infections, skin and soft tissue infections, urinary tract infections, septicaemia, uncomplicated, and meningitis, and disseminated gonorrhoea and has been approved for surgical prophylaxis. The potential use of cefuroxime over other second-generation agents is an alternative treatment to standard meningitis therapy in children (i.e., ampicillin and chloramphenicol) in light of increasing lactamase-producing H. influenzae strains. Cefuroxime has good activity against staphylococci (including t1-lactamase-positive strains) and non-enterococcal streptococcus isolates. Cefuroxime has high in vitro activity against organisms in the Enterobacteriaceae family but is superior to cephalothin, including cephalothin-resistant organisms. Neu and Fu have shown that cefuroxime is very stable to most t1-lactamases. Gonococci, including penicillin-resistant isolates, are very sensitive to cefuroxime. "H. influenzae, including ampicillin-resistant isolates, are equally sensitive to

cefuroxime. Cefuroxime may have greater stability to TEM-enzymes produced by these organisms." Although cefuroxime demonstrated no inoculum effect with S. aureus, a small inoculum effect has been documented with several Enterobacteriaceae. The pharmacokinetics of cefuroxime can be described by a two-compartment model. Variations in the literature in observed peak concentrations of cefuroxime are probably caused by variable infusion lengths and the timing of subsequent peak serum samples. Cefuroxime has the shortest half-life of these newer second-generation agents, -1.2 hours. Cefuroxime's half-life during haemodialysis and intraperitoneal dialysis (IPD) has been reported at 3.5 and 13.5 hours, respectively. Cefuroxime has been measured in peritoneal fluid in patients without peritonitis. Cefuroxime has been measured in the bronchial secretion, gall bladder wall, sputum, bile, aqueous humour, bone tissue, pericardial fluid, uterine tissue, cervix, fallopian tubes, atrial appendage, ovaries, and prostatic tissue. Studies in pregnant women have shown that cefuroxime reaches the myometrium, amniotic fluid, placenta, and umbilical cord. Several studies have examined cefuroxime's penetration into the cerebrospinal fluid (CSF) in patients with inflamed and non inflamed meninges. The mean half-life of cefuroxime may be prolonged to 15 hours when creatinine clearance is < 10ml/rnin. Only cefuroxime has been documented to penetrate significantly across inflamed meningitis,

Review of the Pharmacology, Pharmacokinetics, and Clinical Use of Cephalosporins - 1990

Cefuroxime is an orally available second-generation cephalosporin and considered cephamycin because of its methoxy side chain at C7. Cefuroxime is active against the same organisms as the 1st-generation cephalosporins, but have more activity against certain aerobic gram-negative bacteria and Haemophilus influenzae. Cefuroxime interferes with the cell-wall synthesis of bacteria, leading to lysis of the infectious organism. Cefuroxime Axetil is effective in a single dose for uncomplicated urethral, endocervical, and rectal gonorrhoea. Cefuroxime is mainly prescribed for pneumonia, and bone and joint infections. It is active against H. influenzae type B (including lactamase producing strains), pneumococci, Streptococcus pyogenes, and Staphylococcus aureus. Because it covered H. influenzae and its degree of penetration into the cerebrospinal fluid, it has also been used to treat meningitis in the paediatric population. Third-generation cephalosporins are considered superior to earlier generations for meningeal infections because of their greater potency, superior penetration, and resultant higher bactericidal titers in the cerebrospinal fluid. Compared to the older cephalosporins, cefuroxime Axetil has increased activity *in vitro* against E. coli and other Enterobacteriaceae. It is as efficacious as cefaclor, amoxicillin/clavulanic acid, and cephalexin in the treatment of urinary tract infections. Cefuroxime Axetil may be useful for uncomplicated urinary tract infections that are resistant to less expensive drugs, but serious urinary tract infections require other forms of therapy. Although cefuroxime Axetil has exhibited activity against the major pathogens involved in otitis media concerns are raised about the use of cefuroxime in meningeal infections as reports are suggesting delayed sterilization of the cerebrospinal fluid, treatment failure, and relapse in patients with H. influenzae type-B infection.

Effectiveness of short-course therapy (5 days) with Cefuroxime Axetil in treatment of secondary bacterial infections of acute bronchitis- 1995

Cefuroxime Axetil is an oral ester prodrug of cephalosporin antibiotic and is characterized by stability to b-lactamases and demonstrates favourable in vitro activity against a wide range of gram-positive and gram-negative organisms, including the bacterial pathogens commonly associated with acute bronchitis. In recent years, patients with common bacterial infections are given reducing the duration of antibiotic treatment regimens. While in treatment of

lower respiratory tract infections cefuroxime Axetil has been compared with amoxicillin-clavulanate for in many clinical trials, none have examined the effectiveness of a treatment regimen as short as 5 days The purpose of the present study was to compare the efficacy and safety of a 5- or 10-day twice-daily course of cefuroxime Axetil with those of a 10-day three-times-daily course of amoxicillin-clavulanate in the treatment of patients acute bronchitis. Patients with the following characteristics: recent onset of productive cough, increase in the daily volume of sputum production, qualitative change in sputum and chest X rays indicating the absence of a new localized infiltrate, pleural effusion or consolidation are selected at the time of enrolment within 7 days from date of symptom onset. Sputum specimens cultures containing 10 epithelial cells per low power field (3100) and 25 polymorphonucleated leukocytes per low power field (3100) were accepted. Of the 423 patients, the response was obtained in 82, 86, and 83% of clinically evaluable patients treated with cefuroxime Axetil for 5 or 10 days. Patients demonstrated marked improvement by 3 to 5 days after initiation of therapy, as judged by the reduction in the proportion of A satisfactory bacteriologic response was obtained in 87, 91, and 86% of bacteriologically evaluable patients treated with cefuroxime Axetil for 5 or 10 days. Treatment failures in the cefuroxime Axetil (5 days) group occurred in one patient each yielding H. influenzae, S. pneumoniae, or group A b-haemolytic streptococcus, while the four patients in this group who were assessed as presumed bacteriologic failures yielded H. parainfluenzae (two patients), H. influenzae, or Staphylococcus aureus. In the one cefuroxime Axetil (5 days) patient who was assessed as a bacteriologic cure with superinfection, the pre-treatment pathogen (H. influenzae) was eradicated and two new pathogens (group A b-haemolytic streptococcus and S. aureus) were subsequently isolated posttreatment. The one treatment failure in the cefuroxime Axetil (10 days) group occurred in a patient yielding H. parainfluenzae, while Klebsiella ozaenae was the pathogen in the one patient in this group with a bacteriologic recurrence. The three cefuroxime Axetil (10 days) patients who were assessed as presumed bacteriologic failures yielded either H. parainfluenzae (two patients) or both S. pneumoniae and S. aureus. Lastly, the two treatment failures in the amoxicillin-clavulanate group occurred with patients yielding H. parainfluenza or Escherichia coli, while in the two patients in this group who were assessed as bacteriologic cures with superinfection, the pre-treatment pathogen (H. parainfluenza or Haemophilus species) was eradicated and a new pathogen (H. influenzae in both patients) was subsequently isolated post-treatment. The clinical cure or improvement rate reported is (82%) with the 5-day regimen of cefuroxime Axetil at 250 mg twice daily is similar to that of previous clinical comparisons of 10-day treatments for acute bronchitis or acute exacerbations of chronic bronchitis with cefuroxime Axetil. The bacteriological cure rate achieved with the 5-day regimen of cefuroxime Axetil is (87%). The efficacy of cefuroxime Axetil in acute bronchitis may be partly related to the concentrations of cefuroxime achieved in lower respiratory tract tissue and fluids. Oral antibiotic treatment for acute bronchitis requires consideration of clinical and bacteriological efficacy and adverse event profile along with the convenience of dosing and medical costs. In this regard, a 5-day, twice-daily regimen of cefuroxime Axetil with less expense to the patient might be considered advantageous compared with a three times-daily 10-day dosing regimen of amoxicillin-clavulanate.

Formulation and characterization of Cefuroxime Axetil nanoemulsion for improved bioavailability - 2012

Poor bioavailability of cefuroxime is addressed through the formulation of cefuroxime nano-emulsion with Deoxycholic acid, Capmul MCM, Pluronic F127, Soya lecithin and distilled water. It is

recorded as drug content is at 97.12± 0.27%w/v and mean globular size at 121.3 nm. Drug diffusion of nano-emulsion is 80.7261% > 51.0048% of plain cefuroxime suspension. The marketed preparation has a very poor oral bioavailability of 25%- 30% is varied upon the presence or absence of food. Oil phase (Capmul MCM, Soya lecithin, Deoxycholic acid and Cefuroxime Axetil was heated to 70°C) was gradually added to the aqueous phase (Pluronic F127 and distilled water was also heated to 70°C separately) under high-speed magnetic stirring to form a pre-emulsion and was sonicated at 100 W for 9 minutes to get a nano-sized emulsion. This prepared nano-emulsion was stored in a glass vial until further characterization. The mean Globule size and polydispersity index were measured at 25° C by photon correlation spectroscopy (PCS). Nano-emulsion had a pH between 7.4-7.6 to ensures the stability of formulation over its shelf life. The zeta potential was measured by determining the electrophoretic mobility of the oil droplets. Using transmission electron microscopy (TEM) operating at 200 kV with a resolution of 0.27 nm and magnifications of the order of 750,000X, morphology and structure of the nano-emulsion were studied. Lipid nano-emulsion of Cefuroxime Axetil was prepared by ultrasonication method.The negative zeta potential is due to charged induced surfactants utilized in the formulation. Nano-emulsion had a pH between 7.4-7.6. Comparative *in vitro* drug release study, *in vitro* intestinal permeability study and *in vivo* study demonstrated that lipid nano-emulsion can significantly improve drug solubilisation and bioavailability of a poorly absorbed drug.

Computer-Aided Design of Cefuroxime Axetil/Cyclodextrin System with Enhanced Solubility and Antimicrobial Activity - 2019

A study was done to investigate changes in cefuroxime axetil (CA) solubility and antimicrobial efficacy when incorporated into cyclodextrin (CD). Cefuroxime an oral cephalosporin prodrug is an *invivo* transformed active form of Cefuroxime axetil (CA), exhibits a broad spectrum of activity against Gram-negative and Gram-positive bacteria. Dissolution profiles of CA–HPβCD show significant improvement with an increase of the antimicrobial efficacy of CA up to 4-fold compared to pure CA. With validated in silico model of CD and most thermodynamically favoured Solid-state CA–HPβCD system, a theoretical model based on docking and molecular mechanics/generalized born surface area was built using a curated dataset of API CD stability constants, differential scanning calorimetry (DSC), Fourier-transform infrared (FT-IR), and X-ray diffraction (XRPD) methods. minimal inhibitory concentration (MIC) value changes related to ones of the pure CA are used for the study of the microbiological activity of the CA–HPβCD inclusion system. With an average correlation R = 0.7, the theoretical model was successfully validated. The designed theoretical model CA–CD system is validated with experimental data at an acceptable level of mean correlation of R > 0.7 and can be successfully streamlined using in silico methods. A stable system with significant changes in the dissolution profile and antimicrobial activity increase for several Gram-negative bacteria species is obtained by CA solution with HPβCD.

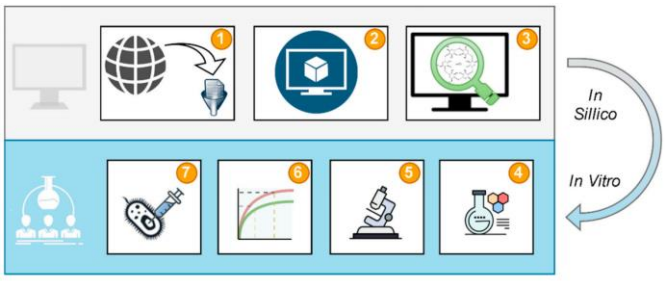

Figure 2. Study design: Data curation (1), model development (2), virtual screening (3), system preparation (4), characterization (5), dissolution tests (6), and antimicrobial efficacy tests (7).

Clinical evidences: Nil

IV. CONCLUSION

This research review's purpose is to help the reader understand different aspects posed by the research on the comparative analysis of Amoxicillin and

Cefuroxime. This is significant because it gives insights about the antibacterial action of these antibiotics while highlighting their advantages and disadvantages and gives researchers an idea about their scope for future use. There has been much research and discussion conducted on these opinions of these antibiotics as well as the comparative analysis of Amoxicillin and Cefuroxime. Most of the research found was on the efficacy, efficiency, administration, dosage, immediate and long term effects, side effects and tolerability of the Cefuroxime and Amoxicillin. The review highlights the antibacterial effects of Amoxicillin and Cefuroxime antibiotics the bacterial infections they combat and their advantages on renal functions of the body. More research and testing is required to gain a better understanding of the comparative analysis of Amoxicillin and Cefuroxime.

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ETHICS APPROVAL AND CONSENT TO PARTICIPATE.

Not applicable.

HUMAN AND ANIMAL RIGHTS

No Animals/Humans were used for studies that are base of this research.

CONSENT FOR PUBLICATION

Not applicable.

AVAILABILITY OF DATA AND MATERIALS

The author confirms that the data supporting the findings of this research are available within the article.

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The authors whose names are listed immediately above certify that they have NO affiliations with or involvement in any organization or entity with any financial interest (such as honoraria; educational grants; participation in speakers' bureaus; membership, employment, consultancies, stock ownership, or other equity interest; and expert testimony or patent-licensing arrangements), or non-financial interest (such as personal or professional relationships, affiliations, knowledge or beliefs) in the subject matter or materials discussed in this manuscript.

VI. REFERENCES

[1]. Kalman, D. & Barriere, S. L. Update on Antimicrobial Agents.

[2]. Bodey, G. P. & Nance, J. Amoxicillin: In Vitro and Pharmacological Studies. ANTIMICROBIL AGENTS AND CHEMOTHERAPY 358–362 (1972).

[3]. Bright, D. A., Gaupp, F. B., Becker, L. J., Schiffert, M. G. & Ryken, T. C. Amoxicillin overdose with gross hematuria. Western Journal of Medicine vol. 150 (1989).

[4]. Kalman, D. & Barriere, S. L. Review of the pharmacology, pharmacokinetics, and clinical use of cephalosporins. Texas Heart Institute Journal vol. 17 (1990).

[5]. Criteria of drug-induced liver disorders. Report of an International Consensus Meeting. in Journal of Hepatology vol. 11 (1990).

[6]. Konishi, K., Suzuki, H., Hayashi, M. & Saruta, T. Pharmacokinetics of cefuroxime axetil in patients with normal and impaired renal function. J. Antimicrob. Chemother. 31, (1993).

[7]. Jones, D. P., Gaber, L., Nilsson, G. R., Brewer, E. D. & Stapleton, F. B. Acute Renal Failure Following Amoxicillin Overdose. Clin. Pediatr. (Phila). 32, (1993).

[8]. Lode, H., Fassbender, M., Schaberg, T., Borner, K. & Koeppe, P. Comparative Pharmacokinetics of the New Oral Cephalosporins. Drugs 47, (1994).

[9]. McLinn, S. E. et al. Comparison of cefuroxime axetil and amoxicillin-clavulanate suspensions in treatment of acute otitis media with effusion in children. Antimicrob. Agents Chemother. 38, (1994).

[10]. Henry, D. et al. Effectiveness of short-course therapy (5 days) with cefuroxime axetil in treatment of secondary bacterial infections of acute bronchitis. Antimicrob. Agents Chemother. 39, (1995).

[11]. Belko, J., Urueta, G. & Emre, U. Amoxicillin overdose manifested by hematuria and acute renal failure. Pediatr. Infect. Dis. J. 14, (1995).

[12]. Henry, D. et al. Effectiveness of Short-Course Therapy (5 Days) with Cefuroxime Axetil in Treatment of Secondary Bacterial Infections of Acute Bronchitis. ANTIMICROBIAL AGENTS AND CHEMOTHERAPY vol. 39 2528–2534 (1995).

[13]. Handsfield, H. H., Clark, H., Wallace, J. F., Holmes, K. K. & Turck, M. Amoxicillin, a new penicillin antibiotic. Antimicrob. Agents Chemother. 3, (1973).

[14]. Perry, C. M. & Brogden, R. N. Cefuroxime Axetil: A Review of its Antibacterial Activity, Pharmacokinetic Properties and Therapeutic Efficacy. Drugs vol. 52 (1996).

[15]. Maria, V. A. J. & Victorino, R. M. M. Development and validation of a clinical scale for the diagnosis of drug-induced hepatitis. Hepatology 26, (1997).

[16]. Hautekeete, M. L. et al. HLA association of amoxicillin-clavulanate-induced hepatitis. Gastroenterology 117, (1999).

[17]. Aithal, G. P., Rawlins, M. D. & Day, C. P. Clinical diagnostic scale: A useful tool in the evaluation of suspected hepatotoxic adverse drug reactions. J. Hepatol. 33, (2000).

[18]. O'Donohue, J. et al. Co-amoxiclav jaundice: Clinical and histological features and HLA class II association. Gut 47, (2000).

[19]. Schrag, S. J. et al. Effect of short-course, high-dose amoxicillin therapy on resistant pneumococcal carriage: A randomized trial. J. Am. Med. Assoc. 286, (2001).

[20]. Lucena, M. I., Camargo, R., Andrade, R. J., Perez-Sanchez, C. J. & Cuesta, F. S. D. La. Comparison of two clinical scales for causality assessment in hepatotoxicity. Hepatology 33, (2001).

[21]. de Abreu, L. P., Ortiz, R. A. M., de Castro, S. C. & Pedrazzoli, J. HPLC determination of amoxicillin comparative bioavailability in healthy volunteers after a single dose administration. J. Pharm. Pharm. Sci. 6, (2003).

[22]. Curtin-Wirt, C. et al. Efficacy of penicillin vs. amoxicillin in children with group A beta hemolytic streptococcal tonsillopharyngitis. Clin. Pediatr. (Phila). 42, (2003).

[23]. Fogazzi, G. B., Cantù, M., Saglimbeni, L. & Daudon, M. Amoxycillin, a rare but possible cause of crystalluria. Nephrol. Dial. Transplant. 18, (2003).

[24]. Karney, W. W., Turck, M. & Holmes, K. K. Comparative therapeutic and pharmacological evaluation of amoxicillin and ampicillin plus probenecid for the treatment of gonorrhea. Antimicrob. Agents Chemother. 5, (1974).

[25]. Hong, L. et al. Association of amoxicillin use during early childhood with developmental tooth enamel defects. Arch. Pediatr. Adolesc. Med. 159, (2005).

[26]. Fontana, R. J., Shakil, A. O., Greenson, J. K., Boyd, I. & Lee, W. M. Acute liver failure due to amoxicillin and amoxicillin/clavulanate. Dig. Dis. Sci. 50, (2005).

[27]. Geddes, A. M., Klugman, K. P. & Rolinson, G. N. Introduction: historical perspective and development of amoxicillin/clavulanate. Int. J. Antimicrob. Agents 30, (2007).

[28]. Muller, A. E. et al. Pharmacokinetics of amoxicillin in maternal, umbilical cord, and neonatal sera. Antimicrob. Agents Chemother. 53, (2009).

[29]. Salvo, F., Sarro, A. De, Caputi, A. P. & Polimeni, G. Amoxicillin and amoxicillin plus clavulanate: A safety review. Expert Opinion on Drug Safety vol. 8 (2009).

[30]. Kaur, S. P., Rao, R. & Nanda, S. Amoxicillin: A broad spectrum antibiotic. International Journal of Pharmacy and Pharmaceutical Sciences vol. 3 (2011).

[31]. Patel, Y., Poddar, A. & Sawant, K. Formulation and characterization of Cefuroxime Axetil nanoemulsion for improved bioavailability. in Journal of Pharmacy and Bioallied Sciences vol. 4 (2012).

[32]. P., Y., F., G.-B., H., F., R., T. & S., I. Bioavailability of amoxicilin dissolved in human milk. Journal of Population Therapeutics and Clinical Pharmacology vol. 19 (2012).

[33]. Gillies, M. et al. Common harms from amoxicillin: A systematic review and meta-analysis of randomized placebo-controlled trials for any indication. CMAJ 187, (2015).

[34]. Hentzien, M. et al. Macroscopic amoxicillin crystalluria. The Lancet vol. 385 (2015).

[35]. Foord, R. D. Cefuroxime: human pharmacokinetics. Antimicrob. Agents Chemother. 9, (1976).

[36]. Isanaka, S. et al. Routine Amoxicillin for Uncomplicated Severe Acute Malnutrition in Children. N. Engl. J. Med. 374, (2016).

[37]. Ianiro, G., Tilg, H. & Gasbarrini, A. Antibiotics as deep modulators of gut microbiota: Between good and evil. Gut 65, (2016).

[38]. Tayyeb, J. Z. et al. Amoxicillin modulates apoa-i transcription and secretion, predominantly via PPARα transactivation inhibition. Int. J. Mol. Sci. 20, (2019).

[39]. Kleppe, D. M. et al. Amoxicillin-Induced Crystalline Nephropathy Presenting as Ureteral Obstruction. Clin. Pediatr. (Phila). 59, (2020).

[40]. Mizera, M. et al. Computer-aided design of cefuroxime axetil/cyclodextrin system with enhanced solubility and antimicrobial activity. Biomolecules 10, (2020).

[41]. Spyker, D. A., Rugloski, R. J., Vann, R. L. & O'Brien, W. M. Pharmacokinetics of amoxicillin: dose dependence after intravenous, oral, and intramuscular administration. Antimicrob. Agents Chemother. 11, (1977).

[42]. Humbert, G., Spyker, D. A., Fillastre, J. P. & Leroy, A. Pharmacokinetics of amoxicillin: Dosage nomogram for patients with impaired renal function. Antimicrob. Agents Chemother. 15, (1979).

[43]. Tartaglione, T. A. & Polk, R. E. Review of the New Second-Generation Cephalosporins: Cefonicid, Ceforanide, and Cefuroxime. Ann. Pharmacother. 19, (1985).

[44]. Sjovall, J., Westerlund, D. & Alvan, G. Renal excretion of intravenously infused amoxycillin and ampicillin. Br. J. Clin. Pharmacol. 19, (1985).

[45]. Kwatra, B. COLLAGEN SUPPLEMENTATION : THERAPY FOR SKIN DISORDERS : A REVIEW. World J. Pharm. Res. 9, 2504–2518 (2020).

[46]. Kwatra, B. LOCATOR THEORY FOR ELE-MENTS IN PERIODIC TABLE 'LEPT'. Glob. J. Pure Appl. Chem. Res. 5, 9–10 (2017).

[47]. Kwatra, B. A REVIEW ON POTENTIAL PROPERTIES AND THERAPEUTIC APPLICATIONS OF LYCOPENE. Int. J. Med. Biomed. Stud. 4, 33–44 (2020).

[48]. Kwatra, B. A REVIEW ON POTENTIAL PROPERTIES AND THERAPEUTIC APPLICATIONS OF BRANCHED CHAIN AMINO. WORLD J. Pharm. Pharm. Sci. 9, 561–588 (2020).

[49]. Kwatra, B. EXPRESSION AND CHARACTERIZATION IN PICHIA PASTORIS BY CLONING OF DELTA 4 DESATURASE FROM ISOCHRYSIS GALBANA. Indian J. Appl. Res. 9, 1–2 (2019).

[50]. Kwatra, B. CALCIUM AND IRON ABSORPTION: INVITRO STUDIES. Int. J. Med. Biomed. Stud. 3, 59–61 (2019).

[51]. Kwatra, B. HACKING THE BLOOD-BRAIN BARRIER. Eur. J. Biol. Med. Sci. Res. 5, 10–13 (2017).

[52]. Kwatra, B. A Review on Potential Properties and Therapeutic Applications of Vitamin D. Int. J. Sci. Res. 9, 682–691 (2020).

[53]. Kwatra, B. HYDROQUINONE: A novel growth inhibitor and apoptosis inducer in U-251 MG CELLS. Int. J. Med. Biomed. Stud. 3, 15–16 (2019).

[54]. Kwatra, B. Allicin-An After Digestion Antimicrobial Agent. ACTA Sci. Microbiol. 2, 48–51 (2019).

[55]. Kwatra, B. A REVIEW ON POTENTIAL PROPERTIES AND THERAPEUTIC APPLICATIONS OF GRAPE SEED EXTRACT. World J. Pharm. Res. 9, 2519–2540 (2020).

[56]. Kwatra, B. Studies on People Employed in High Risk Workplace : Between Genetic Polymorphism for Tumor Necrosis Factor (TNF- A) and Blood Pressure. Int. J. Innov. Res. Technol. 6, 268–270 (2020).

[57]. Kwatra, B. Candidate genes of OCD interacts with human retrovirus to form new link in inflammatory hypothesis. Int. J. Sci. Appl. Res. 7, 1–2 (2020).

[58]. Kwatra, B. COLLAGEN SUPPLEMENTATION : THERAPY FOR THE PREVENTION AND TREATMENT OF OSTEOPOROSIS AND OSTEOARTHRITIS : A REVIEW. WORLD J. Pharm. Pharm. Sci. 9, 589–604 (2020).

[59]. Kwatra, B. A Review on Potential Properties and Therapeutic Applications of DHA and EPA. ijppr.humanjournals 16, 140–176 (2019).

[60]. Kwatra, B. Tinospora Crispa As A Future Cure For Obesity/Cholesterol. Int. J. Sci. Technol. Res. 6, 340–341 (2017).

[61]. Bharat Kwatra. Procuring Natural Dye for Solar Cell Using Leaf Waste. Int. J. Sci. Eng. Res. 7, 46–47 (2019).

[62]. Kwatra, B. THE SIMVASTATIN AND DMXAA ON THE CO-CULTURE OF B16.F10 MELANOMA CELLS AND MACROPHAGES SHOWS ANTITUMOR ACTIVITY. World J. Pharm. Res. 8, 1318–1319 (2019).

[63]. Kwatra, B. Bioactive-Compounds: alternative to control Candida spp. Int. J. Sci. Res. Rev. 8, 221–223 (2019).

[64]. Kwatra, B. Effects of Mineral Separation by Time and Enteric Coating Mechanism for Calcium and Iron Absorption in Mammalia. Int. J. Sci. Res. 8, 1265–1270 (2019).

[65]. Kwatra, B. Maprovit 3, 6, 9: Perfect Companion of your Immune System to Fight Corona Virus Hit. Int. J. Sci. Res. 9, 241–241 (2020).

[66]. Kwatra, B. MECHANISMS OF PATTERN FORMATION OF FBP17 IN MAST CELLS. Int. J. Adv. Res. 7, 413–414 (2019).

[67]. Kwatra, B. A REVIEW ON POTENTIAL PROPERTIES AND THERAPEUTIC APPLICATIONS OF BROMELAIN. www.wjpps.com 8, 488–500 (2019).

[68]. Kwatra, B. Holothuroidea (Sea Cucumber): Key to Anti-Aging. Int. J. Sci. Res. 8, 884–884 (2019).

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