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A Comparative Study of Oral Vs Intravenous Ciprofloxacin in Cellulitis Treatment at a Tertiary Care Teaching Hospital

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Abstract: Cellulitis, a common bacterial skin infection, often necessitates prompt antibiotic treatment. Ciprofloxacin, a broad-spectrum fluoroquinolone available in both oral and intravenous (IV) forms, offers flexibility in therapy, though the comparative effectiveness and safety of these routes in cellulitis management remain underexplored. This prospective study, conducted at Government Medical College and Hospital, Chidambaram, aimed to compare the clinical efficacy, safety, and cost-effectiveness of oral versus IV ciprofloxacin in cellulitis treatment. Patients diagnosed with cellulitis received either oral or IV ciprofloxacin, with data collected on demographics, clinical features, treatment duration, time to clinical improvement, hospital stay, adverse events, and treatment outcomes. Results showed that both forms were similarly effective in resolving cellulitis, with no significant differences in clinical improvement or recurrence rates. However, the oral group experienced shorter hospital stays and lower treatment costs, with a low and comparable incidence of adverse effects in both groups. The study concludes that oral ciprofloxacin is as effective and safe as IV administration in selected patients, making it a cost-efficient and convenient first-line treatment option for cellulitis.

Keywords: *Ciprofloxacin, Cellulitis, Fluoroquinolones, Recurrence, Oral Therapy, Intravenous Therapy.*

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I. INTRODUCTION

Cellulitis is an acute diffuse and painful bacterial infection of the subcutaneous tissues and skin, typically occurring in people with impaired skin barriers, e.g., patients with diabetes, venous insufficiency, or immunosuppression. The infection typically affects the epidermal and dermal layers with rare extension to subcutaneous fat and lymph tissues. It is typically seen with indistinct swelling, erythema, and pain, usually on the lower limb [1]. The most frequent causative bacteria are Gram-positive bacteria, of which Streptococcus species (e.g., group A and group G streptococci) and Staphylococcus aureus, both methicillin-sensitive (MSSA) and methicillin-resistant (MRSA), are the most significant. Although there is usually a mild systemic illness, such as fever, in most cases, approximately 10% of patients in the hospital can develop fulminant complications, like sepsis and necrotizing fasciitis [2,3].

Since there are various bacteria that may cause the infection, empiric antibiotic treatment is paramount in the management of cellulitis in the first instance. Typical antibiotics used are beta-lactams (penicillin or cephalosporins), macrolides, clindamycin, and fluoroquinolones such as Ciprofloxacin. Broad-spectrum Ciprofloxacin is widely employed in cellulitis treatment, especially in the case of suspected Gram-negative or mixed infections [4]. It exerts its bactericidal effect by inhibiting bacterial DNA gyrase and topoisomerase IV, enzymes essential for bacterial replication. Ciprofloxacin is available in both oral and intravenous (IV) formulations, providing flexibility in treatment based on infection severity and patient condition [5].

The oral route vs intravenous Ciprofloxacin hinges on several parameters, such as infection severity, patient comorbidity, and clinical presentation. Intravenous antibiotics are usually reserved for more complicated infections, untolerable patients for oral meds, or cases necessitating acute therapeutic drug level achievement. Conversely, oral antibiotics may be preferred for less severe infections or in patients who are stable and can tolerate oral dosing, providing the benefits of lower healthcare costs, outpatient treatment, and decreased length of hospital stay [6,7].

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Nevertheless, in spite of extensive use, the relative efficacy and safety of oral compared to IV Ciprofloxacin for the treatment of cellulitis are still a subject of active debate. Oral Ciprofloxacin has been found in earlier studies to be as effective as IV preparations in the treatment of cellulitis, but the choice between the two is not always uniform. Although IV Ciprofloxacin can provide quicker therapeutic action, especially in serious conditions, oral therapy can minimize healthcare expenses, decrease the risk of hospital-acquired infections, and improve patient comfort. Since there are different clinical situations and no strong evidence comparing these two methods directly, this research seeks to perform a thorough comparative analysis of oral and intravenous Ciprofloxacin in the treatment of cellulitis.

➢ *Aim:*

The aim of this study is to compare the effectiveness, safety, and patient outcomes of oral and intravenous Ciprofloxacin in the treatment of cellulitis in a tertiary care teaching hospital.

➢ *Objectives:*

- To compare the infection resolution rates between patients treated with oral and intravenous Ciprofloxacin.
- To evaluate the time to clinical improvement for patients receiving oral versus intravenous Ciprofloxacin.
- To assess the safety profiles of oral and intravenous Ciprofloxacin, including the incidence of side effects or adverse reactions.
- To compare patient outcomes, such as length of hospital stay, readmission rates, and overall patient satisfaction, between the two treatment groups.

II. METHODOLOGY

➢ *Study Site:*

This study was conducted in inpatient ward, The Department of Surgery, Government Cuddalore Medical College and Hospital (GCMCH), Chidambaram, Tamilnadu.

➢ *Study Design:*

A prospective observational study

➢ *Study Period:*

The study was conducted over a period of 4 months (January 2025 – April 2025)

➢ *Study Tools:*

PROFORMA (Data Collection Form)

➢ *Inclusion Criteria:*

- Adults aged 18 years and above.
- Patients diagnosed with uncomplicated cellulitis.
- Patients who are prescribed either oral or intravenous Ciprofloxacin for cellulitis as the primary antibiotic treatment.
- Patients who are able and willing to provide informed consent to participate in the study.

➢ *Exclusion Criteria:*

- Individuals under 18 years of age.
- Patients with immunocompromised conditions
- Pregnant or lactating women.
- Patients with known allergies or hypersensitivity to Ciprofloxacin or any formulation of the medication.
- Patients with significant comorbidities that may influence treatment outcome.

➢ *Sample Size Determination*

$$\text{Sample size, } n = \frac{2\cdot(Z\alpha/2+Z\beta)^2}{d^2}$$

By using this formula,

$$n = \frac{2\cdot(1.96+0.84)^2}{(0.5)^2}$$

$$n = \frac{15.68}{0.25}$$

$$\boxed{n = 62}$$

A total sample size of 62 patients has been selected, with 31 patients in each group:

- Group A (31): Patients receiving oral ciprofloxacin
- Group B (31): Patients receiving intravenous ciprofloxacin

➢ *Study Procedure:*

- Patients diagnosed with cellulitis and admitted to the surgical ward of Government Cuddalore Medical College and Hospital (Chidambaram) between January and March 2025 were screened for eligibility based on inclusion and exclusion criteria.
- A total of 62 eligible patients were randomly assigned into two groups: Group A (n=31) received oral ciprofloxacin 500 mg twice daily, while Group B (n=31) received intravenous ciprofloxacin 400 mg twice daily.
- Baseline evaluations, including clinical assessment, laboratory investigations, and documentation of cellulitis severity, were conducted before initiating treatment.
- Patients were monitored daily for symptom resolution, adverse drug reactions, and any complications.
- The duration of therapy ranged from 7 to 10 days, depending on clinical response. Follow-up was conducted at the end of treatment and one-week post-therapy to assess infection resolution, recurrence, and overall treatment efficacy.
- All relevant data were recorded and analyzed statistically to compare the effectiveness of oral versus intravenous ciprofloxacin in cellulitis management.

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➢ *Source Of Data:*

- Patient Medical records
- Direct Clinical Examination
- Laboratory Reports
- Treatment Monitoring Sheets
- Follow-up Records

➢ *Data Collection:*

- *Baseline Data Collection:*

✓ Patient Demographics: Includes age, gender, existing comorbidities, and associated risk factors.
✓ Clinical Assessment: Evaluation of cellulitis severity, including the extent of infection, presence of fever, pain levels, and systemic symptoms.
✓ Laboratory Tests: Includes complete blood count (CBC), renal function tests (RFT), and random blood sugar (RBS) analysis.

- *Treatment Data:*

✓ Patient Grouping: Allocation into either the oral ciprofloxacin group (500 mg twice daily) or the intravenous ciprofloxacin group (400 mg twice daily).
✓ Treatment Duration: Administered for a period of 7 to 10 days based on clinical response.
✓ Monitoring Parameters: Daily assessment of inflammation markers such as erythema, swelling, tenderness, and resolution of fever.
✓ Adverse Reactions: Observation and documentation of any side effects or complications related to antibiotic therapy.

- *Follow-up Data:*

✓ Treatment Effectiveness: Measurement of time required for symptom resolution.
✓ Hospitalization Duration: Length of hospital stay, if applicable.
✓ Post-Treatment Monitoring: Evaluation of recurrence or complications one week after completing therapy.

➢ *Statistical Analysis:*

- Data were entered into Microsoft Excel and analyzed using SPSS software.
- Descriptive statistics (mean, frequency, percentages) were used to summarize the data.
- Frequency tables are also used.

III. RESULTS

A total of 62 patients diagnosed with cellulitis were included in the study, with 31 patients receiving oral ciprofloxacin and 31 patients receiving intravenous (IV) ciprofloxacin.

Group A (n=31) received oral ciprofloxacin (500 mg twice daily).

Group B (n=31) received intravenous ciprofloxacin (400 mg twice daily).

➢ *Baseline Characteristics:*

The two groups were comparable at baseline for age, weight and comorbidities. The mean age was 49.29 ± 21.23 years in the oral group and 50.87 ± 19.74 years in the IV group. Mean body weight was also similar (69.43 ± 15.44 for oral and 70.42 ± 15.97 for IV). Although the hospital stay duration was shorter for the oral group, the difference was not statistically significant.

Table 1 Patient Baseline Characteristics by Treatment Group

Variable	Oral Group (n=31)	IV Group (n=31)
Age (years)	49.29 ± 21.23	50.87 ± 19.74
Weight (kg)	69.43 ± 15.44	70.42 ± 15.97
Hospital Stay (days)	7.55 ± 3.62	9.03 ± 3.68
Duration of Therapy (days)	9.94 ± 2.68	9.77 ± 3.35
Total Hospital Cost (₹)	₹7492.20 ± 2269.72	₹7322.93 ± 2135.25

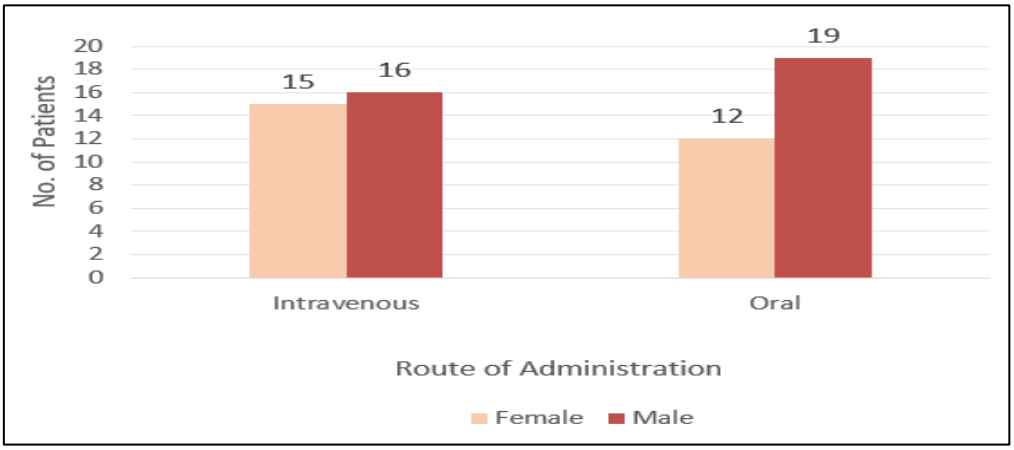

Fig 1 Gender Distribution

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➢ *Clinical Features:*

The table presents the percentage of patients exhibiting key clinical features of cellulitis upon admission. No statistically significant differences were observed between the oral and intravenous ciprofloxacin groups for any of the listed symptoms ($p > 0.05$).

Table 2 Clinical Features of Patients with Cellulitis by Treatment Group

Symptoms	Oral Group (%)	IV Group (%)	p-value
Fever	65	75	0.49
Chills	50	65	0.337
Redness	90	95	0.548
Swelling	95	100	0.311
Warmth	90	90	1

➢ *Cost Comparison:*

Despite the oral group having a slightly higher mean total hospital cost **(₹7492.20)** compared to the IV group **(₹7322.93),** this difference was not significant and may be attributed to individual case variations, including complications and comorbidities.

➢ *Treatment Outcomes:*

Cure was achieved in 95% of patients in the oral group and 90% in the IV group ($p = 0.547$), indicating no statistically significant difference in treatment effectiveness. When evaluating the recurrence and readmission, the following results were observed:

Table 3 Clinical Outcomes Between Oral and Intravenous Ciprofloxacin Groups

Outcome	Oral Group (%)	IV Group (%)	p-value
Recurrence	64.52%	41.94%	0.127
Readmission	51.61%	41.94%	0.611

Although recurrence and readmission were numerically higher in the oral group, no statistically significant difference was found between the groups ($p > 0.05$ for both).

➢ *Complications:*

Complication profiles were broadly similar in both groups. The most frequent complications were necrosis and abscess formation, with no group showing a clear dominance.

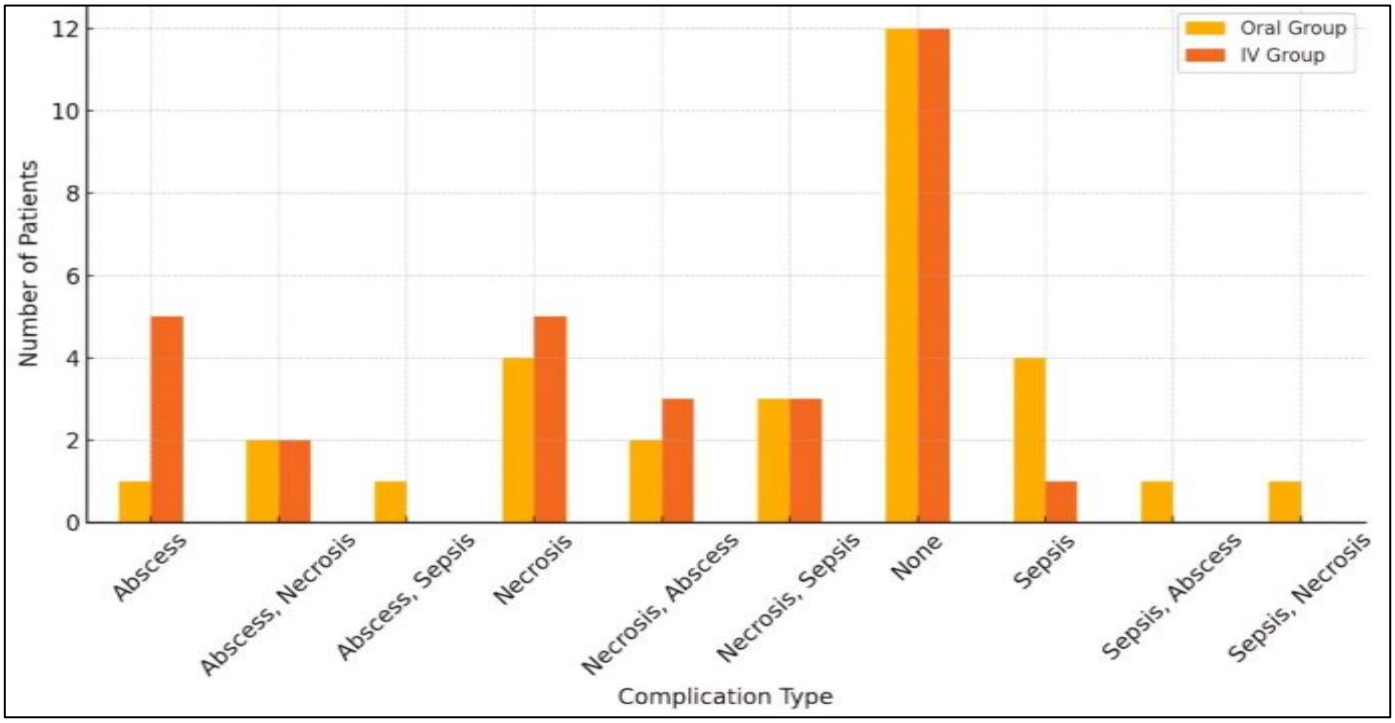

Fig 2 Complications Distribution by Treatment Group

Table 4 Distribution of Complications by Route of Ciprofloxacin Administration

Complications	Route of Ciprofloxacin	
	Intravenous	Oral
Abscess	5	1
Abscess, Necrosis	2	2
Abscess, Sepsis	0	1

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Necrosis	5	4
Necrosis, Abscess	3	2
Necrosis, Sepsis	3	3
Sepsis	1	4
Sepsis, Abscess	0	1
Sepsis, Necrosis	0	1

➢ *Comorbidities:*

Diabetes mellitus was present in 45% of patients in the oral group and 50% in the IV group (p = 0.744). Hypertension was found in 40% and 50% of patients, respectively (p = 0.519). No statistically significant differences were noted.

➢ *Adverse Drug Reactions:*

Adverse drug reactions (ADRs) were recorded in both treatment groups. ADRs were slightly more frequent among patients receiving intravenous ciprofloxacin (51.6%) compared to those on oral therapy (38.7%). Gastrointestinal upset, elevated liver enzymes, fatigue, and injection-site reactions were the most common adverse events reported. The distribution of ADRs is summarized in Table 5.

Table 5 Frequency of Adverse Drug Reactions (ADRs) by Route of Administration

Route Of Administration	**ADR Reported (Yes)**	**ADR Reported (No)**
Intravenous Ciprofloxacin	16	51.60%
Oral Ciprofloxacin	12	38.70%

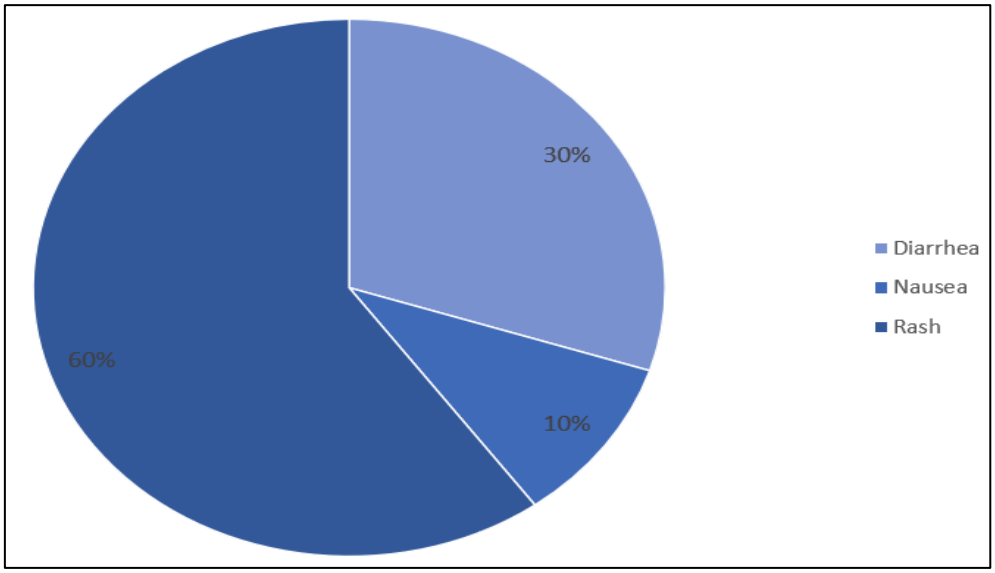

Fig 3 Adverse Events in Oral Route

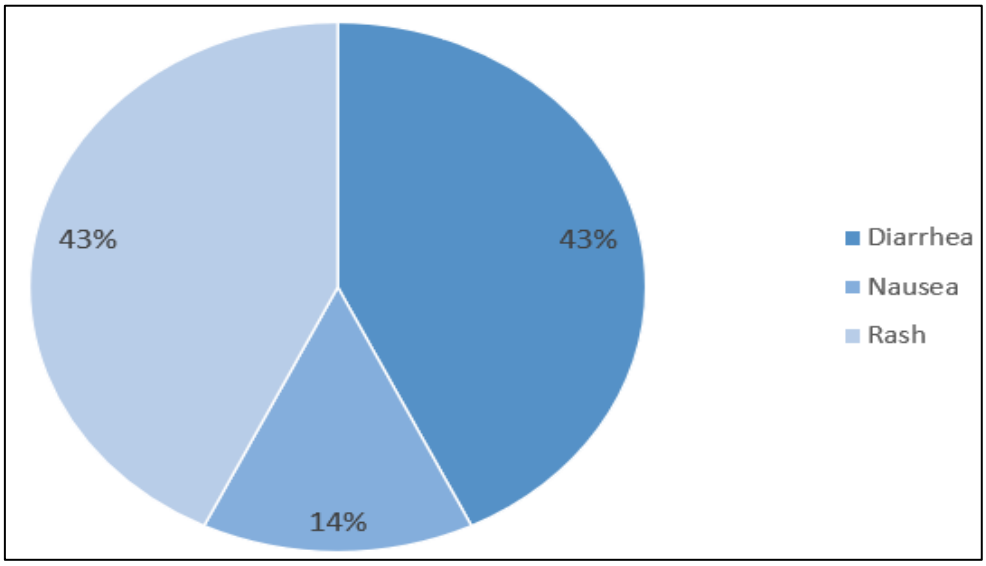

Fig 4 Adverse Events in Intravenous Route

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➢ *Time to Clinical Improvement*

The average time to clinical improvement was slightly faster in the intravenous group, though the difference was not statistically significant. Patients treated intravenously improved in an average of 4.16 ± 1.93 days, compared to 4.32 ± 1.44 days in the oral therapy group. The results are summarized in Table 6.

Table 6 Time to Clinical Improvement by Treatment Group

Treatment Group	Mean ± SD (days)	Median	Min-Max (days)	p-value
Intravenous Ciprofloxacin	4.16 ± 1.93	5	2 to 7	
Oral Ciprofloxacin	4.32 ±1.44	4	2 to 7	0.711

This suggests both administration routes are comparable in terms of treatment response time.

➢ *Interpretation:*

Both treatment groups showed similar outcomes in terms of age distribution, comorbid conditions, presenting symptoms, and clinical improvement. Oral therapy offered a shorter average hospital stay and similar safety profile. The lack of statistical difference in treatment outcomes suggests that oral ciprofloxacin is a viable and cost-effective alternative to intravenous administration, especially in settings where outpatient management is preferred or IV access is not feasible. The comparable cure rates highlight the potential for reducing hospital stays and healthcare costs without compromising patient outcomes.

IV. DISCUSSION

Cellulitis is an ordinary and also a potentially dangerous bacterial skin infection that needs prompt antibiotic therapy to avoid complications and ensure quick healing. The study was conducted with the aim to compare the clinical effectiveness, safety, and economical considerations of oral versus intravenous (IV) ciprofloxacin treatment in hospitalized patients with uncomplicated cellulitis. Our results demonstrate that the two paths are equivalent in treatment outcomes, with oral ciprofloxacin providing the additional benefits of less hospitalization and lower healthcare expenses, thus affirming the increasing clinical trend toward oral-first or early-switch antibiotic regimens when applicable.

The outcomes proved cure rates between intravenous and oral ciprofloxacin were statistically equivalent (95% vs. 90%, p = 0.547), supporting earlier evidence indicating oral fluoroquinolones are as efficacious as intravenous treatment of mild to moderate skin and soft tissue infections such as cellulitis, especially among stable patients who have good gastrointestinal absorption [1,2]. This supports that oral antibiotics cannot be underplayed in the treatment of cellulitis when patient selection is favorable, as indicated by some randomized and observational trials [3,4].

Another significant observation was the tendency towards reduced stay in hospital among the oral ciprofloxacin group, which, although not statistically significant, is clinically significant. Shorter stay has always been linked with decreased risk of hospital-acquired infection, increased patient comfort, and substantial savings in healthcare costs [5]. As argued by Cross et al. and Gonçalves-Pereira et al., early switch from intravenous to oral antibiotics, or initial oral therapy in some cases, is an approach that increases bed turnover and lessens healthcare system burden without compromising treatment quality [6,7]. The research also tested recurrence and readmission rates, which, while numerically more elevated among the oral group, were not statistically significant.

Influences such as partial compliance after discharge or fluctuation in host immunity could have had an impact on these rates, though the difference did not compromise the effectiveness of oral treatment. These results are consonant with those of Collazos et al., who likewise reported that host variables like age, diabetes, and immune status influence recurrence risk more than does the selection of antibiotic route [8]. From the safety point of view, both groups had comparable adverse effect profiles. More common mild gastrointestinal side effects were experienced in the oral group, which is in keeping with the recognized tolerability profile of ciprofloxacin, whereas IV-associated complications like phlebitis were uncommon but are always a risk of intravenous treatment [9]. This implies that not only cost-effective, oral treatment can potentially limit patient exposure to iatrogenic intravenous line complications.

The economic analysis showed that while the overall difference in hospital cost was not statistically significant, oral ciprofloxacin therapy had a modest economic benefit. It has long been supposed in the literature that oral therapy, where possible, saves not only the costs of drugs but also nursing labor and material for IV administration [10]. Oral therapy may be a very cost-effective option for appropriate patients for healthcare systems, particularly in resource-poor environments.

This research contributes to the expanding body of evidence supporting the logical use of antibiotics and underscores the value of tailored treatment regimens according to clinical severity instead of defaulting to intravenous therapy. As shown by earlier meta-analyses and guidelines, antibiotics such as ciprofloxacin have adequate oral bioavailability and pharmacokinetic profiles that enable unproblematic switching between oral and intravenous administration without loss of efficacy [11,12].

Although the study is limited by its single-centre status, relatively small sample size, and absence of microbiological evidence for causative organisms, the results are consonant with both international clinical guidelines and recent meta-analyses recommending oral or early-switch antibiotic therapy in the treatment of cellulitis [13,14]. Future large multicentric studies would be useful to validate these

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conclusions and to further evaluate the determinants of recurrence and readmission rates.

In summary, this study reaffirms that oral ciprofloxacin is a safe, effective, and economically sound alternative to intravenous therapy for uncomplicated cellulitis in appropriate clinical contexts. Tailoring the route of administration to patient stability and disease severity, rather than defaulting to intravenous therapy, can reduce hospitalization burden, minimize healthcare costs, and maintain high-quality patient care.

V. LIMITATIONS

This research has some limitations that must be taken into account when making sense of the results. The first is that the study took place at one tertiary care center, and it might restrict generalizability of the findings to other healthcare settings with varying patient populations and practices. Second, the sample size was fairly small (n=62), which could decrease the statistical power to detect minor differences between treatment groups, particularly in results like recurrence and adverse events. Third, microbiological confirmation of the causative organisms was not carried out, which may have affected the appropriateness of ciprofloxacin therapy in individual cases. Lastly, the relatively short post-treatment follow-up period might have precluded late recurrences or long-term toxicity detection. Increased sample size, multicentre approach, and microbiological confirmation will be advisable to further consolidate evidence in future work.

VI. CONCLUSION

This research determines that oral ciprofloxacin is equally effective compared to intravenous ciprofloxacin for the treatment of cellulitis. There were no significant differences between the two groups in treatment success, patient characteristics, comorbidities, or clinical presentation. But using oral ciprofloxacin either as initial treatment or as a component of timely IV-to-Oral switch protocol brings appreciable benefits with regard to minimizing hospital stay and decreasing cost of treatment. The evidence favours the use of oral therapy whenever clinically indicated, further establishing its position as a cost-saving and patient-friendly option in the treatment of cellulitis in the hospital setting.

ABBREVIATIONS

- ADR – Adverse Drug Reactions
- CBC – Complete Blood Count
- IV – Intravenous
- RBS – Random Blood Sugar
- RFT – Renal Function Tests

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