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ORIGINAL ARTICLE

Watch-Antibiotic: Teicoplanin: Usage Practices in Various Departments of a Tertiary Care Hospital, Coimbatore, Western Tamil Nadu

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Abstract

Background: Watch - antibiotics have high potential to develop resistance. Teicoplanin is one of the antibiotics given under Watch classification in Access, Watch and Reserve (AWaRe), 2023 classification. Aim of this study is to evaluate the usage pattern of Teicoplanin in various departments and the cost of Teicoplanin therapy. **Methods:** Retrospective study was conducted and medical records prescribed with Teicoplanin from Jan 2021 to Dec 2023 were evaluated for their usage pattern. **Results:** Totally 84 case records were prescribed with Teicoplanin during the study period. It was prescribed mostly in Nephrology department (28.57%) followed by General medicine (22.62%) and for genitourinary system (17.9%) infections. Teicoplanin was frequently used for *Staphylococcus aureus* (44 cases & 52.38%) infection. Out of 44 cases of *Staphylococcus aureus*, 36 cases were MRSA. Teicoplanin was used in 100mg, 200mg, 400mg and 600mg doses. Average days of Teicoplanin therapy was 5.95 days. Two different brands of Teicoplanin were used. Among them, cost of brand-1 is 11955.38 INR per patient and brand-2 is 10190.77 INR per patient. Nil adverse drug reactions were reported during the study period. **Conclusion:** Using Teicoplanin as Empirical therapy is not advised. Judicious monitoring is advised to prevent the overuse and misuse of Teicoplanin.

Keywords: Teicoplanin, Drug utilization, Cost analysis

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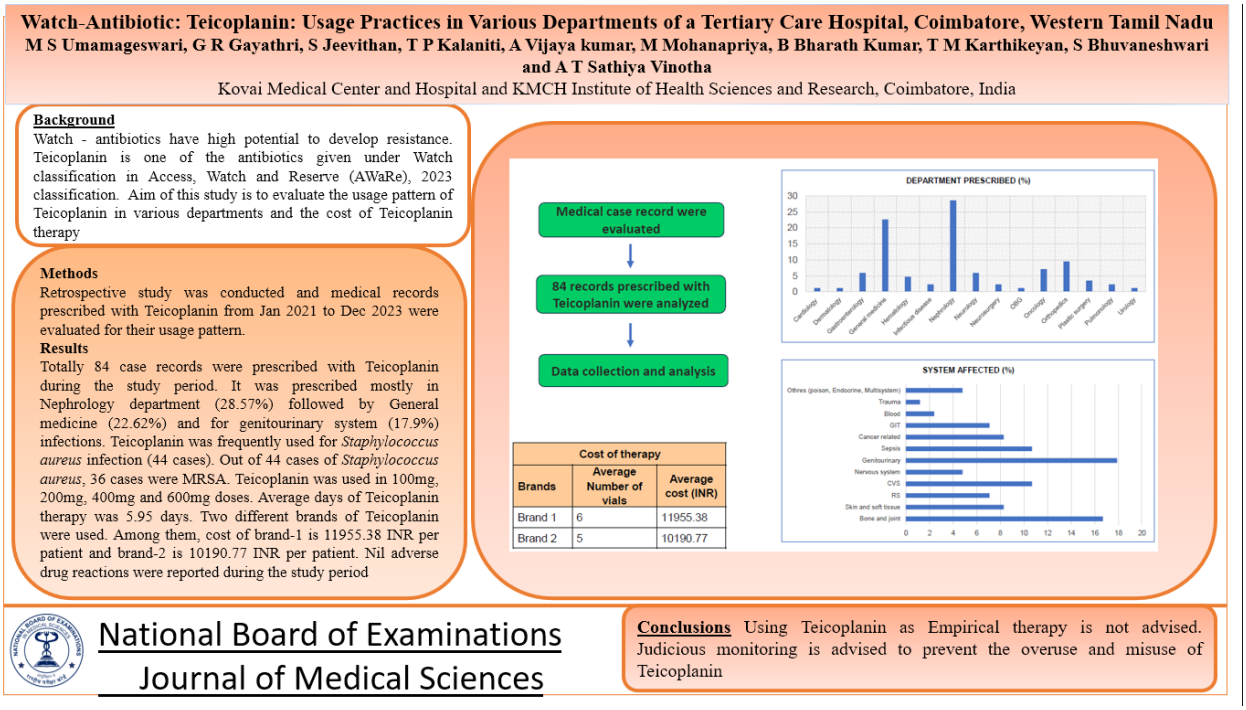
Graphical Abstract



Introduction

As mentioned by National Ambulatory Medical Care, antibiotics are the second leading drugs prescribed by the health care professionals. Antimicrobials are used for the purpose of prevention and treatment. Criteria for selecting an optimal antibiotic for the specific patient include clinical condition, safety, efficacy, contraindications, and cost of therapy. Overuse or inappropriate use of antibiotics may lead to drug interactions, financial burden, drug resistance, and poor treatment outcomes which include loss of life [1].

The World Health Organization classified antibiotics into Access, Watch, and Reserve (AWaRe) in the year 2017 with the intention of increasing the consumption of 'access' antibiotics and reducing the utilization of 'watch' and 'reserve' antibiotics. Watch antibiotics have a broad spectrum of action and have a higher antibiotic resistance potential. As per the 'AWaRe' classification of antibiotics for evaluation and monitoring of use guidelines, Teicoplanin is one of the antibiotics listed under the watch list by WHO in the year 2023 [2,3].

Teicoplanin is isolated from the fermentation broth of a strain of *Actinoplanes teichomyceticus*. It is one of the glycopeptide antibiotics. Teicoplanin is the mixture of five glycopeptide analogues that are closely related. It has a heptapeptide structure consisting of seven aromatic amino acids, distinct carbohydrates d-mannose and d-glucosamine, and an acyl residue that carries various fatty acids [4,5].

It exhibits the advantages of more activity against *Enterococcus,* bears less renal toxicity, and less histamine release than Vancomycin, which is another antibiotic

from the same class. Vancomycin-resistant enterococci (VRE) are also susceptible to Teicoplanin. Teicoplanin is active against gram-positive organisms including Methicillin-resistant *Staphylococcus aureus* (MRSA) and penicillin resistant *Streptococcal* infections. It is used for osteomyelitis, alternative to Vancomycin for surgical prophylaxis, and for multidrug resistant infections [6,7]. It is also active against *Clostridium* species like *Clostridium difficile, Clostridium perfringens, Corynebacterium jeikeium, and* resistant species of *Corynebacterium* group *D2, Peptostreptococcus species, Propionibacterium acnes, and Listeria monocytogenes [8-10]*. Teicoplanin acts by inhibiting cell wall synthesis by binding to the D-ala-D-ala sequence and interfering with the trans-glycosylation reaction [11].

Irrational prescription of Teicoplanin leads to an increase in the incidence of Glycopeptide antibiotic-resistant MRSA, prolonged hospitalization, treatment failure, and higher cost of therapy [12]. This necessitates conducting this study with the aim of evaluating the usage pattern of Teicoplanin among various departments and the cost of therapy of Teicoplanin in a tertiary care hospital, Coimbatore.

Materials and Methods

Materials

A Retrospective cross-sectional study was carried out at Kovai Medical Center and Hospitals, Coimbatore. The study was conducted for 6 months after getting approval from the Scientific Research Committee (SRC/374/2024) and the Institutional Human Ethics Committee (EC/AP/1138/03/2024). Medical records of patients admitted under various departments who were treated with Teicoplanin from Jan 2021 to Dec 2023 were included in the study. Complete enumeration method was used for the selection of medical records.

Inclusion and Exclusion Criteria

The inclusion criteria were medical records of all age groups, either gender, with or without concomitant diseases and who were treated with Teicoplanin. The exclusion criteria were medical records which were not legible and incomplete.

Methods

Anonymized data from the medical records were entered in the Microsoft Excel Worksheet 2019. The data collection proforma contained the sections for demographic profile, history, diagnosis, departments under which the patient was admitted, primary system affected, empirical antibiotics used, culture sensitivity report, resistance pattern, brands of Teicoplanin used, dose, frequency, duration of Teicoplanin treatment, number of vials used, its cost, adverse drug reactions encountered (if any) and treatment outcome. The data collection tool was validated by pilot testing and refinement with few case records and modified according to the feedback obtained from the coinvestigators for its completeness.

Statistical analysis

The data was analyzed using SPSS version 27.0. The numerical variables were represented by mean ± standard error of mean (Mean ± SEM). The categorical variables

were expressed by frequency and percentage [13].

Results

A total of 84 medical records were found to be prescribed with Teicoplanin during the study period. All the medical records fulfilled the inclusion criteria. None of the case sheets were excluded. Demographic characters, medical history, past history, empirical antibiotic usage, sensitivity pattern of microorganisms, usage pattern of Teicoplanin therapy, and outcome were evaluated.

Out of 84 patient medical records, 62 were males (73.8%) and 22 were females (26.2%). 79 patients were from Tamil Nadu (94%), and 5 patients were outside Tamil Nadu (6%). Table 1 explains the age distribution, comorbid conditions, various departments that prescribed Teicoplanin, and specimens collected for microbiological analysis. Figure 1 explains the system affected.

Table 1. Demographic information

Variables (N=84)	Frequency	Percent (%)
Age		
Below 18	2	2.38
18 to 60	46	54.76
Above 60	36	42.86
Comorbidity (Multiple response)		
Diabetes mellitus	39	46.43
Hypertension	29	34.52
Chronic Kidney Disease	10	11.90
Coronary Artery Disease	9	10.71
Nil	17	12.24
Departments		
Nephrology & Urology	25	29.76
General medicine	19	22.62

Orthopedics	8	9.52
Oncology	6	7.14
Gastroenterology	5	5.95
Neurology	5	5.95
Hematology	4	4.76
Plastic surgery	3	3.57
Other departments	9	10.71
Specimen (multiple response)		
Blood	38	45.2
Urine	25	29.8
Pus	24	28.6
ET	1	1.2
Multiple specimen	4	4.8

Other departments:
Neurology, Infectious disease, and Pulmonology – 2 patients each (2.38% each)
Cardiology, Dermatology, and Obstetrics & Gynecology – 1 patient each (1.19% each)

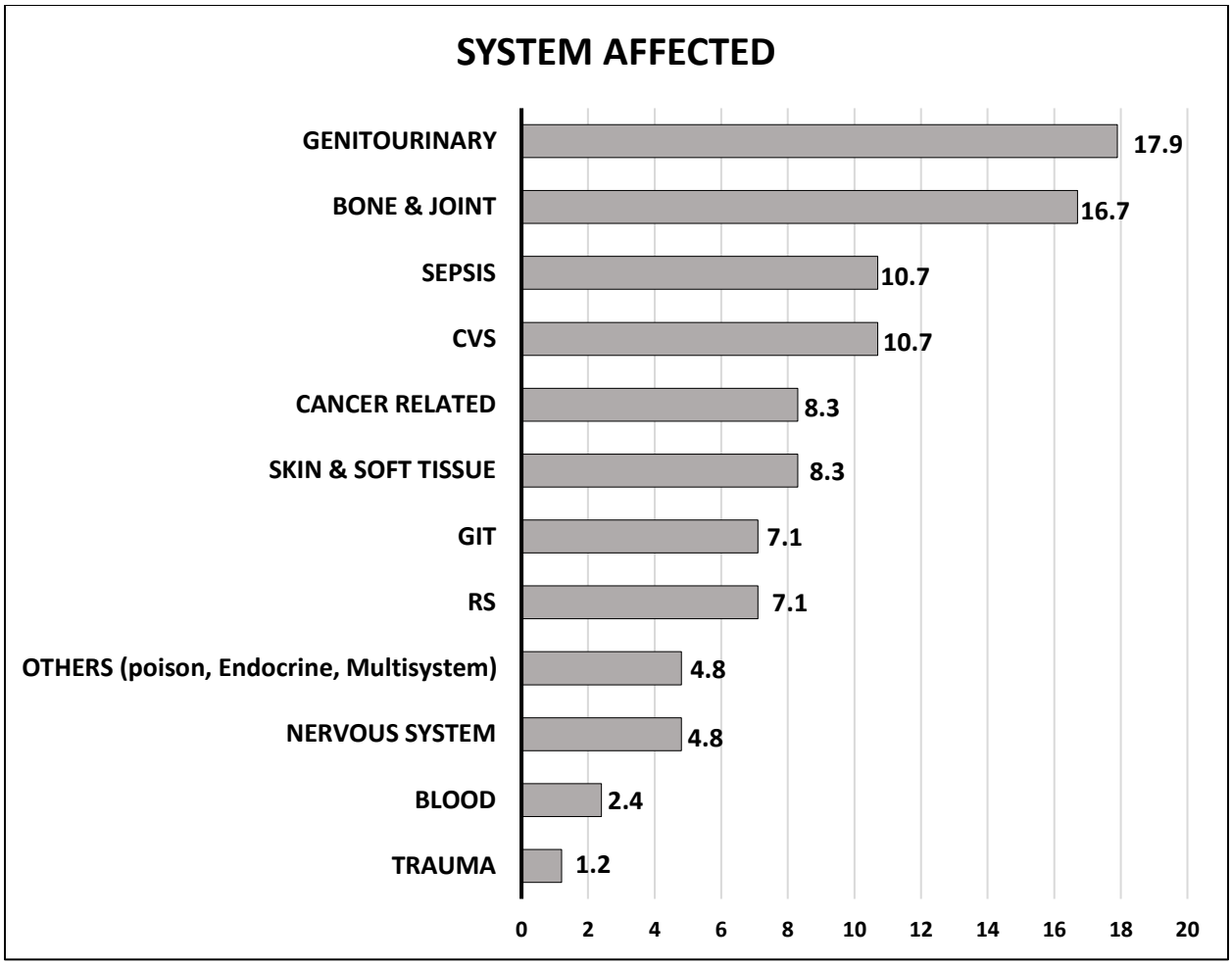


Figure 1. System affected (in percentage)

First Empirical antibiotic was used at the time of admission for those who were suspected of having high-risk bacterial infections and Second Empirical antibiotic was used when patients did not show any response to the first empirical antibiotic before the culture report. After the availability of the culture report and the resistance pattern, Teicoplanin was administered. For 61 patient first empirical antibiotic was administered, and for 12 patients second empirical antibiotic was administered. The percentages of usage of empirical antibiotics are given in Figures 2 and 3. Empirical antibiotics were not prescribed for 23 patients (27.4%). This early antibiotic treatment was chosen based on diagnosis, site of infection, severity of infection, and immune status of the patient. It contributed to the improvement of the disease condition before the identification of specific bacteria and culture-sensitivity testing results.

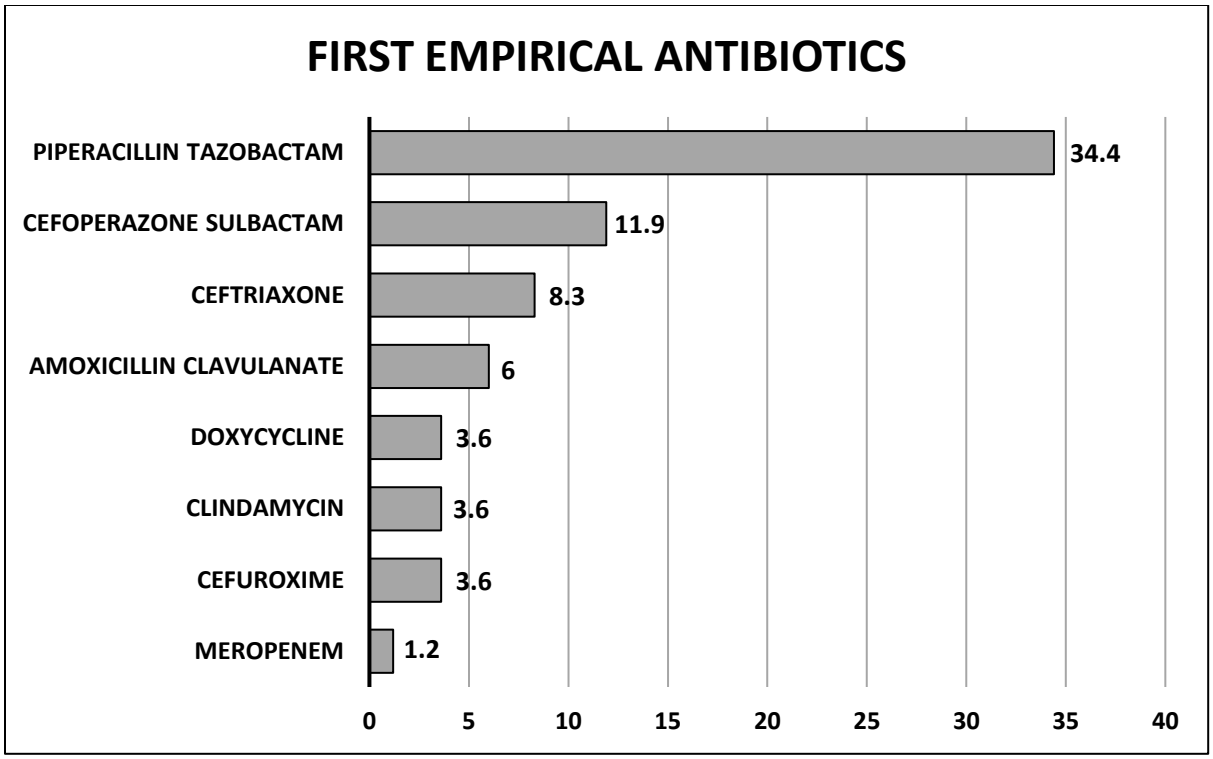


Figure 2. Usage of First Empirical antibiotics (%)

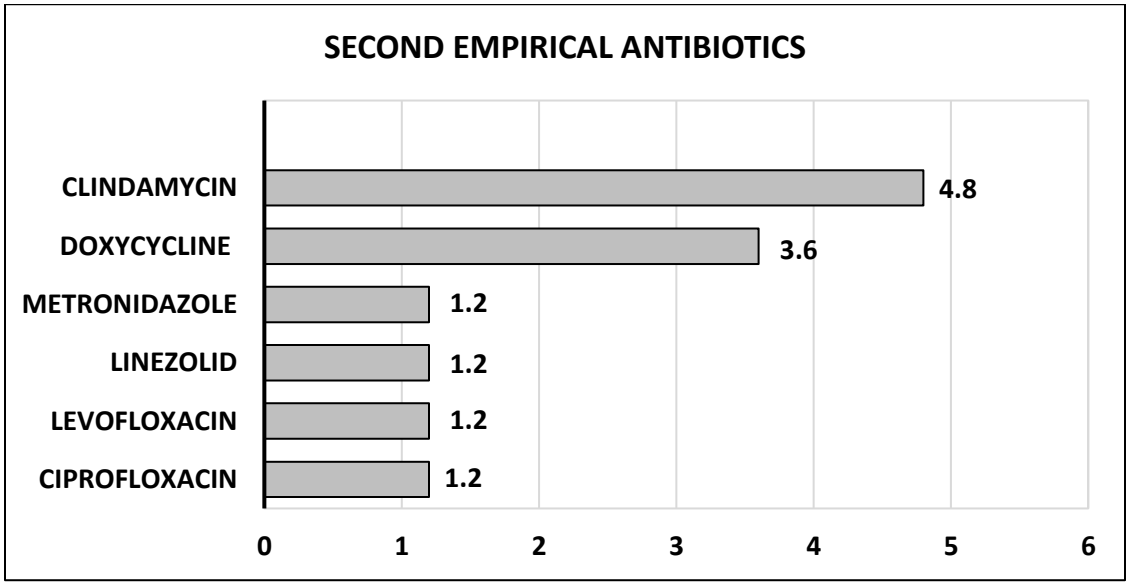


Figure 3. Usage of Second Empirical antibiotics (%)

The first culture specimen was collected from all 84 patients. Second culture specimen was taken for 6 patients and multiples specimens were collected (blood 3.6% and urine 4.8%). Table 2 explains various organisms isolated from culture and their resistant pattern.

Table 3 explains the dose of Teicoplanin therapy and dosing frequency. Two different brands of Teicoplanin were used. The average number of vials of Brand-1 was 6.45±0.36, and Brand-2 was 5±0.82. The average cost of each vial of Brand -1 was INR 1886.74±64.79 and the average total cost of Brand-1 was INR 11955.4±854.35 per patient. The average cost of each vial of Brand-2 was INR 1800.19±391.40, and the average of total cost of Brand-2 was INR 10190.77 ±3734.35 per patient. The average days of therapy with Teicoplanin was 5.95±0.412 days (results are expressed in Mean ± SEM). Daily Defined Dose (DDD) was calculated based on World Health Organization Anatomical Therapeutic Chemical/DDD [14]. Department wise, the DDD of Teicoplanin was 6.47.

Table 2. Organism isolated and Resistant pattern

First culture specimen			
Organisms-1	**Number of cases**	**Resistant pattern**	**Number of resistant cases**
Staphylococcus aureus	44	MRSA	36
		MSSA	8
Enterococcus faecalis	12	MDS	3
Enterococcus faecium	12	MDR	1
		VRE	1
		MRE	1
E coli	1	MDS	1
Elizabethkingia meningoseptica	1	MDR	1
Enterococcus gallinarium	1	VRE	1
Klebsiella pneumoniae	1	PCP	1
Nocardiosis	1	Nil	0

Providencia sps	1	Nil	0
Pseudomonas aeruginosa	2	MDS	2
Culture negative	8	Not applicable	Not applicable
Second culture specimen			
Organisms 2	**Number of cases**	**Resistant pattern**	**Number of resistant cases**
Klebsiella pneumoniae	3	PCP	2
Culture negative	3	Not applicable	Not applicable

MDS – Multi Drug Sensitive, MDR- Multi Drug Resistant, VRE - Vancomycin-Resistant *Enterococci*, MRE- Multidrug-Resistant *Enterococci*, PCP - Potential Carbapenemase Producer, MRSA - Methicillin-Resistant *Staphylococcus aureus*, MSSA - Methicillin- Susceptible *Staphylococcus aureus*

Table 3. Teicoplanin dose and frequency:

Dose of therapy			**Dosing frequency**		
Dose of Teicoplanin	**Frequency**	**Percentage**	**Dosing Frequency**	**Frequency**	**Percentage**
100mg	1	1.2	OD	1	1.190476
200mg	1	1.2	OD	1	1.190476
400mg	77	91.7	OD/Q48H/Q72H	66/10/1	78.5/11.9/1.19
600mg	5	6.0	OD/Q48H	4/1	4.8/1.2

OD – Once daily administration, Q48H - Every 48 hours administration, Q72H - Every 72 hours administration

67 patients received Teicoplanin as monotherapy. In 17 patients, Teicoplanin was used as combination therapy with another antibiotic, which is given in Table 4. Teicoplanin as monotherapy or combination therapy: among 84 patients, 72 patients were discharged alive (85.71%), and 2 patients were discharged against medical advice (2.38%) and 10 patients were declared dead (11.90%). Teicoplanin mono/combination therapy showed an 85.71% cure rate. Nil adverse drug reactions were reported among all 84 medical records.

Table 4. Antibiotics combined with Teicoplanin

Antibiotics combined with Teicoplanin	Dose	Frequency	Percent
Polymyxin-B	7.2 Lakhs unit BD	1	1.2
Amoxicillin+Clavulanate	1.2g TID	1	1.2
Ceftazidime avibactam + aztreonam	2.5g/2g TID	1	1.2
Ceftriaxone	1g BD	1	1.2
Fosfomycin	4g TID	1	1.2
Meropenem	1g TID/500mg TID	6/1 (Total 7)	8.3
Piperacillin and Tazobactam	400mg OD	6	7.2

OD - Once daily administration, BD – Twice daily administration, TID – Three times a day administration

Discussion

Teicoplanin is one of the Watch-group of antibiotics as per the 2023 WHO AWaRe classification. Rational use of antibiotics is an important measure to prevent antibiotic resistance. Usage patterns of antibiotics help the clinicians to foster the rational use of antibiotics at the correct dosage and duration and at less cost [15].

This study showed Teicoplanin was mostly prescribed in the Nephrology department (28.57%), followed by General Medicine department (22.62%). The common system affected was genitourinary (17.9%), followed by bone and joint (16.7%), then CVS (10.7%), and sepsis (10.7%). Piperacillin+Tazobactam (34.5%) was the commonly used empirical antibiotic, followed by Cefoperazone+Sulbactam (11.9%). Masoud Hajialigol et al. studied the irrational prescription of Teicoplanin in a lage academic hospital in Isfahan, Iran. 64% of

Teicoplanin usage was found to be in medical wards, followed by ICU and surgical wards. In 240 cases, Teicoplanin was administered as empirical therapy out of 256 cases [16]. In our study Teicoplanin was administered only after the culture sensitivity report.

Out of 84 cases, common organisms isolated were *Staphylococcus aureus* (44 cases 52.38%), *Enterococcus faecium, and Enterococcus faecalis* (12 cases each, 14.28% each). Out of 44 cases of *Stap. aureus,* 36 cases were MRSA. Teicoplanin was also used for Nocardiosis and *Providencia* infection. Eun A Kim et al. did a study in a university hospital in Seoul, Korea in the years 1999 to 2000. It showed that Teicoplanin was used mostly for surgical wound infection, followed by lower respiratory tract infection. In 69% of cases, MRSA was the organism detected [17]. In our study, 42.9% cases of MRSA was detected.

Sophiya TV et al. evaluated the utilization pattern of Colistin, Teicoplanin, and Tigecycline in a tertiary care hospital in Tamil Nadu. According to their study, Teicoplanin was prescribed for *Staphylococcus* infection, followed by *Enterococcus* and *Streptococcus* infections. It was also prescribed for *Shewanella* infection, *E. coli, Klebsiella*, Methicillin-resistant coagulase-negative *Staphylococci* (MR Cons), *Citrobacter*. In that study, Teicoplanin was mostly used for sepsis, followed by renal diseases, and respiratory tract infections [18]. The results of this study support the part of our work.

Our study found out Teicoplanin was used in 100mg, 200mg, 400mg, and 600mg. 100mg and 200mg were used in the age group of 18 and below and used as once-daily frequency. The frequently used dose was 400mg (91.7%) in above 18 years of age with the dosing frequency of once daily at 78.5%, Q48H at 11.9% and Q72H at 1.2%. The dose frequency was followed according to the status of the renal condition. The average number of days of Teicoplanin therapy administered in our study was 5.95 days. Bahram FF et al. studied utilization evaluation of Carbapenems, Linezolid, and Teicoplanin in a teaching hospital in Tehran, Iran. In their study Among all the drugs compared, 21.6 % of cases received Teicoplanin. The consumed vial/patient was 7.7, the average dose was 394.4, the ratio of prescribed daily dose to DDD was 0.98, and the average duration of treatment was 7.84 days. Teicoplanin was mostly used for respiratory infection (20.68%), followed by skin infection (13.79) and then sepsis (10.34). It was also used for abdominal infection, chest infection, and neutropenic patient (3.44 each) [19].

In 17 patients, Teicoplanin was combined with other antibiotics. In that 8.3% cases used meropenem, 7.2% cases used Piperacillin+Tazobactam. Other drugs combined were Polymyxin-B, Amoxicillin+clavulanate, Ceftazidime avibactam + Aztreonam combination, Ceftriaxone, and Fosfomycin (each 1.2%). According to Eun A Kim et al. study, the mean duration of Teicoplanin usage was 16.5 days, and Teicoplanin was combined mostly with aminoglycosides [17].

Subin et al. studied the incidence of Teicoplanin in non-susceptible *Staphylococcus epidermidis* strains in South Korea between 2016 and 2021. Authors found out that the minimum inhibitory

concentration (MIC) of Teicoplainin was increased from 4mg/L to 8mg/L in 2021. The incidence of Teicoplanin non-susceptible (MIC>16mg/L) is increased in the same year. They concluded that the increased incidence of *S. epidermidis* with Teicoplanin nonsusceptibility (elevated MIC) over the six-year period of study duration [20]. In our study, no *Staph. epidermidis* is isolated in culture.

Christine et al. studied pharmacokinetics of Teicoplanin in renal failure patients. They have compared the pharmacokinetics in healthy volunteers with moderate and severe renal failure patients. They found out that renal failure did not affect the distribution but decreased the renal clearance. They advised that Teicoplanin can be administered every two and three days in patients suffering from moderate and severe renal failure [21]. Our study showed the usage pattern as once in Q48H (11 patients) and Q72H (1 patient) administration in patients with renal diseases.

Two different brands of Teicoplanin were used at our hospital. The average vial count of Brand-1 is 6, and Brand-2 is 5. The average cost of Brand-1 is 11955.38 INR per patient and for Brand-2 is 10190.77 INR per patient. Vázquez et al. compared the cost-effectiveness of Teicoplanin vs Vancomycin as 2nd line empirical therapy in neutropenia patients in 1999. The average cost per patient was $450±180 for the Teicoplanin group and $473±347 for the Vancomycin group. They concluded that there is no statistical difference between Vancomycin and Teicoplanin therapy in the cost-effectiveness of therapy [22].

Simoens et al. studied the cost of therapy for catheter related infection in patients treated with Teicoplanin and Vancomycin in the year 2006 at University Hospitals Leuven. Mean treatment cost was 1,272€ for Teicoplanin and 1,041€ for Vancomycin. They found out that Teicoplanin acquisition cost is higher than Vancomycin. But laboratory monitoring of the therapeutic plasma level of Vancomycin is costlier than Teicoplanin [23]. In their study, the cost of therapy with Teicoplanin is approximately 120907.42 INR, according to the conversion of Euro to INR in Mar 2025. In our study, Combined Brand-1 & Brand-2, the average cost of therapy was 11073 INR.

Batoul et al. did a randomized controlled trial comparing the therapeutic effects of Teicoplanin & Vancomycin among patients who underwent cardiac surgery due to MRSA infective endocarditis. Among 28 patients in the Teicoplanin arm, eight patients developed acute kidney injury and one patient developed thrombocytopenia [24]. In our study, no adverse drug reaction was reported during the study period. The dose was selected depending upon the renal status of the patient may be the reason behind this. Out of 84 patients who received Teicoplanin therapy, 72 patients (85.71%) were discharged alive, 10 patients (11.90%) showed negative outcomes, and 2 patients (2.38%) were discharged against medical advice.

In this retrospective study time taken for the microbial eradication and normalization of infectious markers were not analyzed, and it was a single-centric study. A prospective multicentric study in a larger

population is warranted to evaluate the effective usage pattern.

Conclusion

This study concludes that Teicoplanin was frequently used in the Nephrology department. It is used for MRSA, *Enterococcus faecalis, and Enterococcus faecium* (VRE) infections. The frequently used dose was 400mg OD and the dose was decided depending on the renal status of the patients. The average cost of Teicoplanin therapy was INR 11073, and the average duration of therapy was 5.97 days, with 85.71% successful outcome. Usage patterns of broad-spectrum antibiotics like Teicoplanin must be watched carefully to prevent the development of resistance. Using Teicoplanin as Empirical therapy is not advised. It is mandatory to study antibiotic sensitivity and resistance pattern to prescribe antibiotics like Teicoplanin. Judicious use of antibiotics is mandatory for the reduction of overuse and misuse.

Authors contributions

All authors involved and contributed in study design, data collection, analysis and interpretation of data. They took part in manuscript writing, revising, and gave final approval for publication.

Funding

No funding was received for conducting this study.

Conflicts of Interest

The authors declare that they do not have conflict of interest.

Ethical Approval

This study is approved by the Institutional Human Ethics Committee of Kovai Medical Center and Hospital Ltd. (EC/AP/1138/03/2024).

Data availability

Raw data is available with the corresponding author and provided upon request

Informed Consent Statement

This study did not involve human participants, and therefore, informed consent was not required.

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