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Optimizing Antibiotic Stewardship: Impact of Intravenous to Oral Conversion in General Medicine at a Tertiary Care Hospital

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Abstract

Antibiotics are used for the effective management of infectious diseases, a practice that is frequently misapplied nowadays. In order to monitor the conversion of IV to oral antibiotics, assess their rationality, and evaluate their effect on the length of hospital stays a prospective observational study was conducted. The study was divided into two phases; a baseline period of two months in which the antibiotics prescribed in the general medicine department were analysed. The intervention phase of four months consisted of the introduction of guidelines for IV to oral switch and conversion and analysis of IV to oral antibiotic conversion. The results revealed the majority of the participants were females and were from the age group 60 and above. A greater part of the study population had comorbidities, and the most common comorbidity was hypertension with type 2 diabetes mellitus. The conversion of IV to oral antibiotics was analysed for 159 patients and 79% of the antibiotics were converted and 21% were not. The most frequent type of conversion practice observed was switch therapy followed by step-down therapy and sequential therapy. The majority of the antibiotics were prescribed without a culture and sensitivity test. It was shown that the average length of hospital stay was 4.13 ± 1.5 days.

Keywords: Antibiotics, IV to oral conversion, antimicrobial stewardship, antibiotic resistance.

1. INTRODUCTION

Antibiotics are the substances produced by microorganisms, that selectively suppress the growth of or kill other microorganisms [1]. People are impacted by infectious diseases all over the world and thus, antibiotic treatment is essential for the efficient treatment of infectious diseases [2]. Antibiotics have made the once fatal infections now readily treatable, revolutionizing the practice of medicine. Timely initiation of antimicrobial therapy to treat infections reduces morbidity and mortality, for example, in cases of sepsis [3]. For the management of serious infections in hospitals, most clinicians prefer intravenous (IV) antibiotics [4]. In recent times, some authors have advocated for a treatment approach that begins with a brief course of intravenous (IV) therapy, followed by a switch to oral treatment for the remainder of the course. This strategy, often referred to as IV-to-oral conversion or step-down therapy, aims to optimize patient outcomes, reduce hospital stays, and minimize the risks associated with prolonged IV therapy [5].

Approximately 30% of the antibiotics prescribed nowadays are either unnecessary or sub-optimal. Like all medications, antibiotics also have adverse effects. So, the patients who are unnecessarily given antibiotics are placed at risk for these adverse effects [3]. Antibiotic resistance is an outcome of improper usage of antibiotics [4]. Across the globe, antibiotic resistance is rising to dangerously high levels. Our ability to cure even common infections are being threatened by the advent of novel resistance mechanisms. The emergence and spread of antibiotic resistance are exacerbated in locations where the antibiotics are available without a prescription. Indeed, in regions lacking established treatment guidelines, overprescription of antibiotics by doctors and misuse by the general public can be significant issues. This misuse

often contributes to antibiotic resistance, making infections harder to treat. Implementing robust stewardship programs and clear guidelines can help mitigate these problems, ensuring antibiotics are used more effectively and safely [6]. The misuse of antibiotics, increasing antibiotic resistance, and adverse effects paved the way for the concept of Antimicrobial Stewardship (AMS).

An Antimicrobial Stewardship Program (ASP) can be defined as the set of actions performed in hospitals for the rational use of antibiotics, reduction of adverse events, dosage errors, the appearance of multi-resistant bacteria, and shortening of the length of hospital stay [7]. The goal of this approach is to reduce the overuse of antibiotics by evaluating the diagnosis and therapy within 48-72 hours and modifying the antibiotic based on culture and sensitivity data, and the use of antibiotics for the shortest duration needed [8].

The antimicrobial stewardship (AMS) program seeks to reduce antimicrobial resistance (AMR) by ensuring the optimal use of antimicrobial agents, thereby enhancing patient safety and treatment efficacy [9]. The main aim of the program is to focus on optimizing various aspects of antimicrobial use, including the selection of agents, dosing, route of administration, and duration of therapy. The goal is to achieve the best clinical outcomes for curing or preventing infections while minimizing unintended consequences such as the development of resistance, adverse drug events, and unnecessary costs" [10, 11].

Intravenous (IV) antibiotic therapy must be initiated to quickly manage the severity of infection and to prevent potentially fatal consequences in patients [12]. However, even in cases where oral (PO) administration of antibiotics is feasible, the majority of inpatients are given prolonged intravenous antibiotic therapy [8]. Prolongation of IV therapy even when the patient has achieved clinical stability is unnecessary and this may cause discomfort for the patients and may lead to non-compliance as well as injection related problems like secondary infections [12].

Providing the patient short intravenous course of therapy for 2-3 days followed by conversion of the antibiotic to oral (PO) to complete the course of antibiotics is beneficial to the patient. But, the intravenous (IV) needs to be continued in case of serious/life-threatening infections, in critically ill patients or any contraindications to oral administration [8].

Once the patient is clinically stable, the antibiotics can be switched from IV to oral to optimize its use. This have been proved to decrease the length of hospital stay (LOHS), reduce the staff workload and lower the economic burden for the patient [13].

Early switch over from IV to oral therapy has the following major advantages;

- **Lower the risk of cannula-related infections**: Administration of IV medications requires insertion of cannula, which remains in place for some days. It may lead to secondary bacterial and fungal infections. This leads to additional antibiotic therapy and causes financial burden to the patient.
- **Risk of thrombophlebitis**: Oral administration has no risk of thrombophlebitis.
- **Cheaper than IV therapy**: Oral medications are more affordable than parenteral medications.
- **Reduction in the hidden costs**: Parenteral administration of medications includes additional expenses like cost of diluents, equipment for administration, needles, syringes and nursing time. Administration of injections requires an experienced professional, this might cause a financial burden for the patient.
- **Earlier discharge**: Early switch of IV to oral medications decreases the length of hospital stay (LOHS), thereby results in an earlier discharge [14].
- **Patient comfort**: IV therapy may hinder with the mobility of the patient, while oral therapy does not have this problem [5].

The absence of established IV to oral antibiotic conversion guidelines and failure in identification of patients eligible for IV to oral conversion are some of the obstacles that impede the timely conversion of IV to oral antibiotics [15].

1.1 TYPES OF IV TO ORAL CONVERSION

The types of intravenous to oral conversion can be classified into three types:

A. Sequential therapy

It refers to the act of replacing a parenteral version of a medication with its oral counterpart of the same compound [14].

For example:

i. Conversion of intravenous ciprofloxacin (600 mg every 12 h) to oral ciprofloxacin (600 mg every 12 h).
ii. Conversion of intravenous doxycycline (100–200 mg every 12 h) to oral doxycycline (100–200 mg every 12 h).
iii. Conversion of intravenous linezolid (600 mg every 12 h) to oral linezolid (600 mg every 12 h) [15].

Sequential antimicrobial therapy programme is both convenient for patients and cost-effective health care interventions for hospitals [16].

B. Switch therapy

It describes the conversion of an intravenous (IV) medication to an oral (PO) equivalent; within the

same class and has the same level of potency, but of a different compound [14].

For example:

i. Conversion of intravenous ceftriaxone (1 g every 12 h) to oral cefixime (200 mg every 12 h).
ii. Conversion of intravenous pantoprazole (40 mg every 12 h) to oral rabeprazole (20 mg every 12 h) [15].

Switch therapy programme will potentially have most impact on antibiotic prescribing for common community acquired infections that result in hospitalization (e.g., Community Acquired Pneumonia-CAP), difficult-to-cure infections that require prolonged therapy (e.g., osteomyelitis), and less common infections that need expensive broad-spectrum agents (e.g., neutropenic sepsis) [16].

C. Stepdown therapy

It refers to the conversion from an injectable medication to an oral agent in another class or to a different medication within the same class where the frequency, dose, and the spectrum of activity (in the case of antibiotics) may not be exactly the same [14].

For example:

i. Conversion of intravenous ceftazidime (1–2 g every 8 h) to oral ciprofloxacin (500–750 mg every 12 h).
ii. Conversion of intravenous cefotaxime (500–750 mg every 12 h) to oral ciprofloxacin (500–750 mg every 12 h) [15].

When to switch

The optimal time to consider switching a patient to oral therapy is after 2 to 4 days of intravenous therapy. This period of time allows the clinician to evaluate the patient's microbiology findings and assess their response to treatment. A large number of clinical trials support the early switching to oral antibiotics after this period of time with equal treatment efficacy and no adverse effects on patient outcome [13].

2. MATERIALS AND METHODS

A prospective observational study was carried out for 6 months (2 months baseline period and 4 months intervention phase) in the General medicine department of a tertiary care hospital. The study was done after the ethical approval by Institutional review board. All patients above 18 years of age, hospitalized for more than 24 hours receiving IV antibiotics and non-immunocompromised were included in the study. Patients admitted to ICU, oral route compromised (vomiting, NPO, malabsorption syndrome), pregnant and breastfeeding women and paediatrics were excluded from the study. Data was collected using case report form. The collected data was analyzed using SPSS version 20.0 and Epi Info version 7.2.5.0.

3. RESULTS

This study consisted of 159 patients whose medication charts were reviewed and the conversion of IV to oral antibiotics were assessed.

Table 1: Demographic details of patients

Si. No	Demographics	Frequency	Percentage
Based on gender			
1.	Male	95	60%
2.	Female	64	40%
Based on age			
3.	18-59 years	57	35.8%
4.	60 and above	102	64.2%

Out of 159 patients 95 (60%) were females and 64 (40%) were males. Based on that the patients were divided into two age groups: 18-59 years and 60 years and above. Of the patients we had 57 (35.8%) were between the ages 18-59 years and 102 (64.2%) of the age group 60 and above (Table 1).

Among the patients who took part in the study, 121 (76.1%) patients had comorbidities and 38 (23.8%) patients were devoid of any comorbidities. (Figure 1) and the most common comorbidity observed was hypertension with type 2 diabetes mellitus followed by type 2 diabetes mellitus and hypertension.

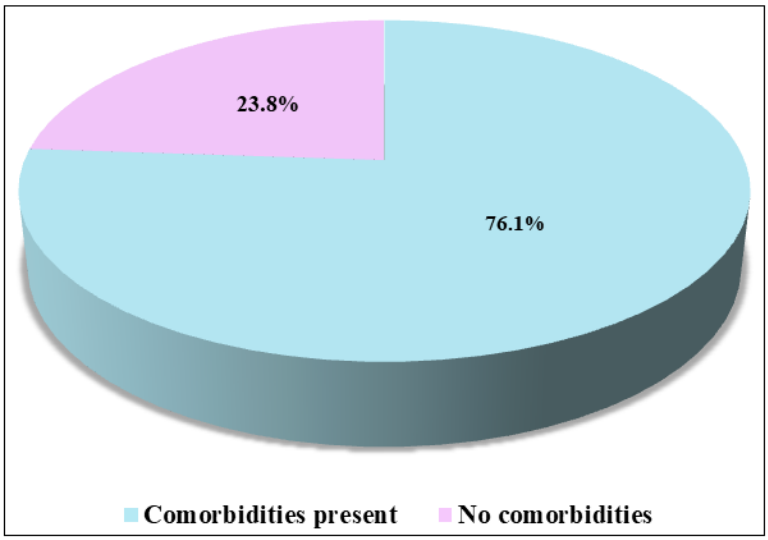

Figure 1: Details about presence of comorbidities

The most common type of diagnosis observed was LRTI followed by UTI and Acute gastroenteritis.

3.1 MICROBIAL CULTURE AND SENSITIVITY TESTS

Only 18 (11%) out of 159 patients was advised culture and sensitivity tests. 13 (72%) cultures out of 18 were positive and the remaining 5 (28%) were negative. Majority of the cultures were sent after prescribing the antibiotic (Table 2).

Table 2: Details about microbial culture

MICROBIAL CULTURE		FREQUENCY	PERCENTAGE
Sent		18	11%
Not sent		141	89%
Sample	Urine	12	67%
	Sputum	5	28%
	Blood	1	6%
Results	Positive	13	72%
	Negative	5	28%
Culture sent	Before prescribing antibiotic	1	6%
	After prescribing antibiotic	17	94%

TYPES OF ANTIBIOTICS PRESCRIBED

Table 3: Most frequently prescribed antibiotic classes

Si. No	Antibiotic class	Frequency	Percentage
1.	Cephalosporins	112	60.86%
2.	Penicillins	46	25%
3.	Carbapenem	7	3.80%
4.	Others	19	10.32%

Out of 184 antibiotic courses prescribed for 159 patients the most frequently used antibiotic class was Cephalosporins (60.86%), followed by Penicillins (25%), Carbapenem (3.80%) and others (10.32%) (Table 3).

The most frequently used antibiotics during the hospital stay was Ceftriaxone (30.98%) followed by Cefoperazone and Sulbactam (28.80%), Piperacillin and Tazobactam (20.11%), and others (20.11%). During the discharge IV antibiotics were switched to oral, among that Cefexime (32.72%) was most commonly prescribed followed by Cefpodoxime (24.07%), Amoxicillin and Clavulanic acid (9.26%), and others (33.95%).

TYPES OF ANTIBIOTIC CONVERSION PRACTICE

Out of the 184 antibiotic courses given for 159 patients, 145 (79%) antibiotics were converted from IV to PO and 39 (21%) were not converted (Figure 2).

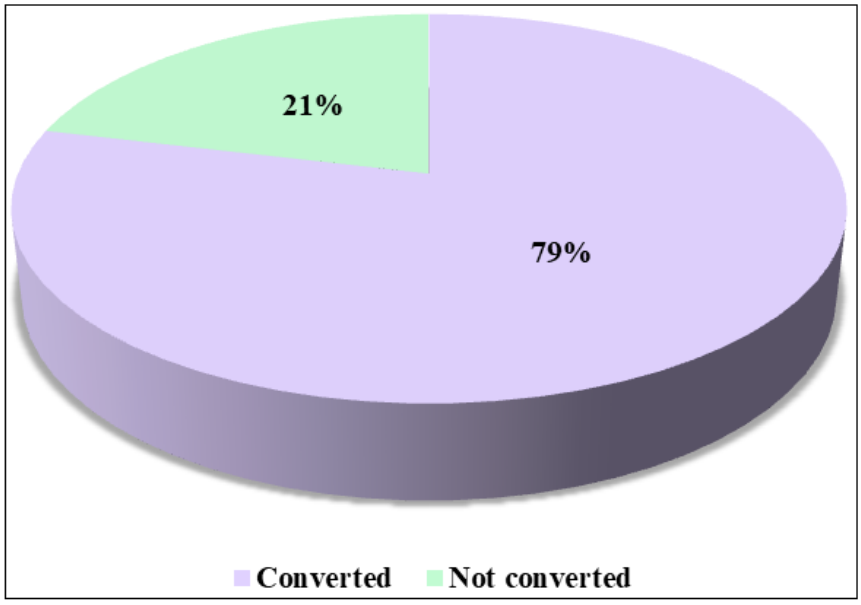

Figure 2: Frequency of IV to oral conversion

From the 145 converted antibiotics, the most frequent type of conversion observed was switch therapy (55.1%) followed by step-down (35.8%) and sequential therapy (8.9%) (Figure 3).

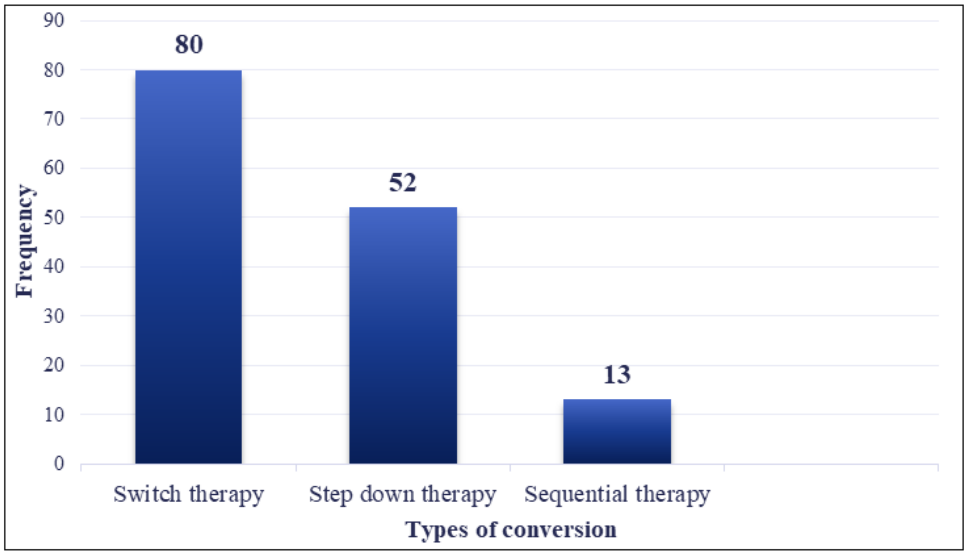

Figure 3: Types of IV to oral conversion

Out of the 145 antibiotics converted only 1 was done during the hospital stay itself. During the hospital stay it was feasible to switch the antibiotics from intravenous to oral. However, this was not done, and the antibiotics were only modified at the time of discharge. It is necessary to observe the patient for 24 hours following the switch from intravenous to oral antibiotics, which was not done in most of the cases.

Of the 39 medications that were not converted, 10 were discharged as intravenous antibiotics alone, and 29 were stopped without being switched to an oral medication at the time of discharge.

LENGTH OF HOSPITAL STAY

It was discovered that the average hospital stay (LOHS) was 4.13 ± 1.5 days. Of the 159 patients, about 66 were discharged before the antibiotic's course was completed, and 93 patients had the course of antibiotics completed (Figure 4).

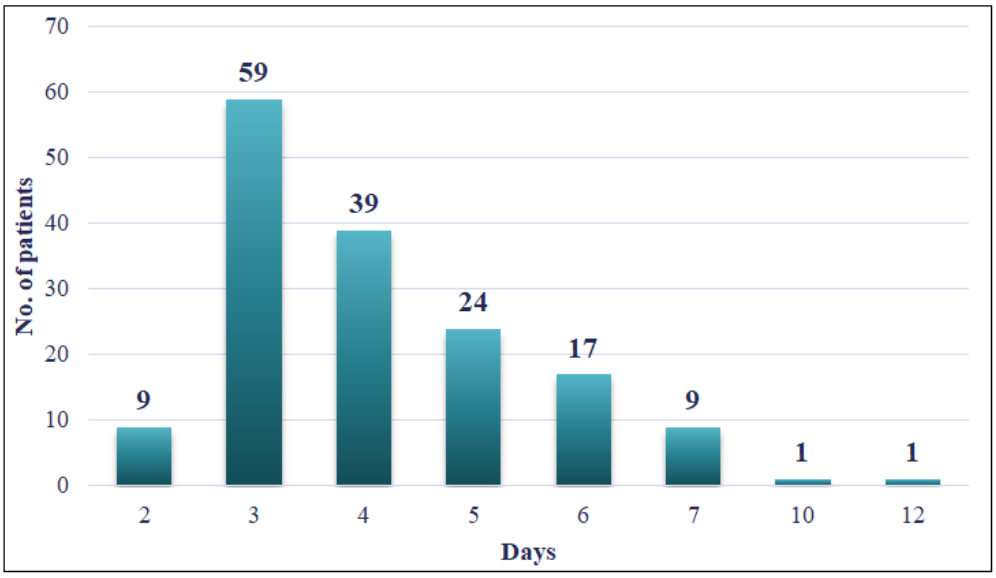

Figure 4: Length of hospital stay

4. DISCUSSION

This study aimed to determine the efficacy of the conversion of intravenous (IV) to oral antibiotics, as well as length of hospital stays (LOHS) and rationality of treatment.

The patient case sheets were examined and data was gathered during the baseline phase of our study in which no interventions were made. A guideline for IV to oral conversion was made and was introduced to the general medicine department. However, the conversion from IV to PO was not carried out in compliance with the guidelines.

The factors that determine the conversion of intravenous (IV) to oral (PO) antibiotic practice are the availability of appropriate oral formulations for the IV to oral switch, prescriber expertise and practice, and healthcare policies [17]. Misconceptions, ignorance of the existence of explicit guidelines on IV to oral conversion, and unfamiliarity with guideline recommendations are some of the obstacles to the prompt conversion of IV to PO. As soon as the patient is stable, switching from intravenous to oral antibiotics helps to shorten hospital stays and reduce related expenses, which lowers the financial strain on the patient [2].

The majority of the patients in our study were females. Comparable results were found in the previous study by Bellapu Anusha *et al*., [15], where women made up the majority of participants compared to men.

Ages above 60 demonstrated a higher likelihood of needing antibiotic medication, followed by those between the ages of 18 and 59. Tamilselvan *et al*.,'s study [4] revealed similar results, with the greater part of the patients receiving antibiotics being older than 61.

Of the 159 patients who took part in the study, 121 had comorbidities, whereas 38 did not. The most frequent comorbidity was Hypertension with Type 2 Diabetes Mellitus.

Age, sex, and the existence of comorbidities were assessed in the study, and it was discovered that these characteristics had no influence on the switch from IV to oral antibiotics.

Switch therapy was the most common IV to PO conversion method in this study, followed by step-down therapy and sequential therapy.

Of the 159 antibiotics, only 145 underwent the conversion from IV to PO, while 39 did not undergo the conversion. According to our inclusion and exclusion criteria, all of these individuals were qualified for IV to oral conversion; nevertheless, 39 antibiotics were not converted, despite meeting the eligibility requirements.

During the hospital stay, several antibiotics were abruptly stopped before their course was completed. The majority of the medicines were converted at the time of discharge, despite the fact that converting from an IV to an oral antibiotic requires a 24-hour observation period. Only one patient in our study had an early switch from IV to oral medication throughout their hospital stay.

Complications like reinfection were one of the reasons antibiotics were not converted from intravenous to oral therapy sooner. The acceptance of the patients is another significant obstacle to IV to oral conversion.

Cephalosporins were the antibiotics that were converted frequently, followed by Penicillins. Cephalosporins were the most commonly prescribed antibiotic at the hospital where the study was conducted.

For this reason, Cephalosporins were the most often converted antibiotic from intravenous (IV) to oral (PO).

The most frequently used antibiotic in our study was Ceftriaxone. As it does not have a definitive oral equivalent, switch therapy and step-down therapy was used for its conversion to an oral agent. Similar findings were also observed in the study conducted by Shrayteh *et al*., [8].

In order to treat an illness effectively, identify the causative organism, and choose the right antibiotic, culture and sensitivity testing are essential. A culture and sensitivity test was not conducted for the majority of the patients in this study. Most of the patients received empirical treatment. A culture and sensitivity test were performed for 18 patients, the majority of which was done after the antibiotic was prescribed. The test was done for just one patient prior to the antibiotic prescription.

When the antibiotics' rationale was evaluated, it was discovered that the bulk of the antibiotics were given without a culture and sensitivity test, and that about 66 patients were discharged before the antibiotic's course had been completed.

The average length of hospital stays was 4.13 ± 1.5 days. However, the antibiotics were only converted at the time of discharge. Therefore, the duration of the hospital stay would have been considerably shorter if the antibiotics had been converted while the patient was admitted to the hospital.

It is anticipated that physicians would alter the way they prescribe antibiotics. In order to reassure doctors that prescribing antibiotics in accordance with guidelines is safe and effective, this needs to be supported with appropriate guidelines and professional guidance [18].

The available studies prove that there is sufficient evidence to switch from IV to oral if the patient has improved after a few days. But the compelling reasons change the current prescribing practices, an important question to alter practices.

5. CONCLUSION

Antibiotic conversion from intravenous to oral therapy can shorten the length of hospital stays and save associated costs. Additionally, early discharge also improves patient mobility and comfort. Our study demonstrated the necessity of a structured approach and standard guidelines for the rational use of antibiotics and assessment of patients' clinical status for conversion of IV to PO antibiotics.

The most frequent conversion employed in this study was switch therapy followed by step-down therapy and sequential therapy. From our study, it was found that in the majority of the cases antibiotics were prescribed empirically. There is a need for performing culture and sensitivity tests to provide proper treatment of the infection, which was not done in the majority of the cases. Some of the antibiotics were also discontinued without completion of the course. There is a need for awareness of IV to PO conversion practice and short-term training of health-care teams is vital for better antibiotic conversion practice.

Conversion of IV to PO was significantly delayed in a significant proportion of patients due to various barriers. These barriers include unfamiliarity with the guideline recommendations, lack of outcome expectancy, misconceptions, patients' acceptance and not being aware of the existence of the guidelines for IV to oral conversion. Even though guideline recommendations were put forward, they were not followed. Addressing these issues can help to reduce inappropriate use of antibiotics, can prevent antimicrobial resistance (AMR) and other complications related to inappropriate use of antibiotics.

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Conflict of Interest: The authors declare that they have no conflicts of interest.

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