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Original Research Article

Antimicrobial Consumption Trends over A Five-Year Period in a Tertiary Care Hospital in Hyderabad, Telangana

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Abstract

Introduction: A significant concern to world health is antibiotic resistance, which is fuelled by antibiotic overuse. The effectiveness of current antibiotics is decreasing due to increased bacterial resistance. Antibiotic inefficiency leads to death, morbidity, and excess medical expenses.

Methods: Data from inpatients at Osmania General Hospital and its ten affiliated facilities were collected between January 2017 and December 2021 for this retrospective study. Daily defined dose (DDD)/100 patient days was used to express antibiotic consumption data. The analysis of the linear graph and bar graphs used to represent monthly consumption to show the changing trends in the usage of antibiotics.

Results: During the course of five years, the total amount of antibiotics consumed shows a significant fluctuation. When compared to the ACCESS group in this study, the proportion of the WATCH group of antibiotics consumption was higher.

Conclusion: Antibiotic stewardship programme with education and sensitization of proper antimicrobial prescription is the need of the hour.

Keyword: Antibiotics, Antibiotic Consumption, Antimicrobial Resistance, Aware Group of Antibiotics, Daily Defined Dose.

Introduction

The discovery of antibiotics, which is regarded as one of the turning points in medical history, gave humans a fundamentally new approach to infection control. [1] Many infectious diseases saw a dramatic decrease in mortality and morbidity. Yet, bacteria have retaliated by using a number of antibiotic evasion strategies. [2,3] A major concern to world health is antibiotic resistance, which is fuelled by antibiotic use. Antibiotic resistance in India has been linked in large part to widespread inappropriate human antibiotic use. [3] Increasing microbial resistance now reduces the effectiveness of available antibiotics.[4]

.This lack of efficacy of antibiotics raises mortality, morbidity, and medical expenses [5].

Because more antibiotics are being used, there is a direct correlation between this and the development of resistance in bacteria. [6]

Despite being the country with the highest volume of antibiotic usage, India lacks the institutional system of antibiotic use surveillance needed to oversee an antimicrobial stewardship programme similar to those in the US and Europe.

The World Health Organization (WHO) amended the Essential Medication List (EML) in 2017 and divided the antibiotics into three categories: Access, Watch, and Reserve (AWaRe) [7-9] in order to monitor the use of antimicrobials. The first and second choices for empirical treatment of 21 prevalent clinical disorders are antibiotics from the Access category. First choices are agents with a narrow spectrum, while second options are agents with a broad spectrum but greater resistance potential.

Because more antibiotics are being used, there is a direct correlation between this and the development of resistance in bacteria. [6]

First-choice medications include antibiotics such as Amoxicillin/Ampicillin, Benzathine penicillin, Trimethoprim-Sulfamethoxazole, Amoxicillin-clavulanic acid, and Cloxacillin. When compared to the ACCESS group, the antibiotics in the WATCH group have a higher risk for resistance. Examples of these antibiotics include third-generation Cephalosporins, Fluoroquinolones, and Carbapenems. Antibiotics of last resort such as Polymyxins and fourth- and fifth-generation Cephalosporins are included in the RESERVE category. The WHO recommends limiting the use of the other two groups of antibiotics and making the ACCESS group of antibiotics broadly accessible and reasonably priced.

The first phase and one of the "fundamental pillars" of a good antimicrobial stewardship programme is monitoring antibiotic use and resistance patterns. [10]

DDD metrics and AWaRe classification measurements of antibiotic consumption would give a thorough picture of the level of appropriateness of antibiotic use.

By computing DDD/100 BD over a five-year period, this study seeks to assess the changing pattern of antibiotic consumption and its ramifications.

Methods

Data from hospital-wide inpatients gathered between January 2017 and December 2021 from Osmania General Hospital and its eleven affiliated hospitals were included in this retrospective study. The intake of antibiotics was expressed as defined daily doses (DDDs) per 100 patient days. The suggested method for quantifying antibiotic intake in a hospital context is DDD/100-BD. DDD/100-BD is calculated by multiplying the amount of DDDs by the number of patient days.

A table with the name, strength, amount, and date of each antibiotic dispensation was created by extracting the information from the pharmacy records. The data covered the period from January 2017 to December 2021. To obtain the value in DDD/100 BD, this data was input into the AMC Tool.

We used the WHO AWaRe classification system and classified the antibiotics into three groups: ACCESS, WATCH, RESERVE groups. The linear graph, which shows monthly consumption, was used to illustrate the shifting trends in antimicrobial use.

The most frequently used antibiotics throughout the course of five years were compared and examined using bar graph presentations.

The % contribution of each antibiotic to the overall antibiotic consumption for that year was calculated, and it was scaled to 100 to allow us to visualise the consumption percentage.

Results

The DDD is a globally accepted unit of measuring drug consumption in different strengths, pack sizes or combinations.

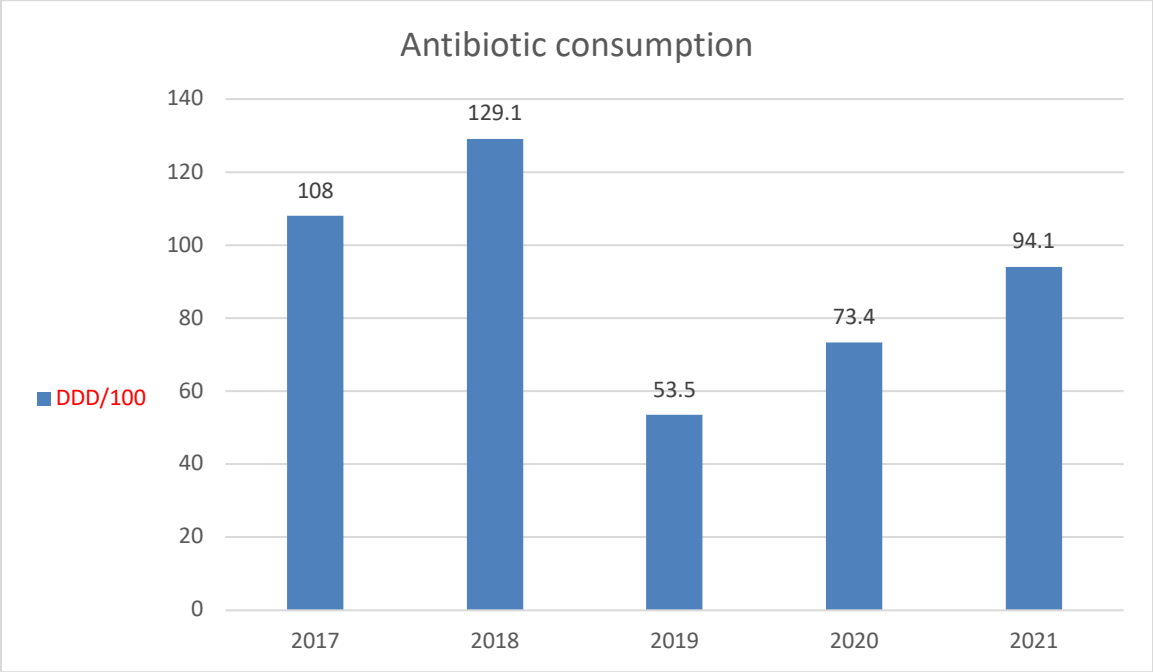


Figure 1: Antibiotic consumption in OGH Hyderabad from 2017-2021

The total amount of antibiotics consumed varies significantly during the course of the five years. The average antibiotic consumption rate (measured in DDD/100 bed days) reveals that antibiotic use gradually increased from 2017 to 2018, then sharply decreased from 2019 to 2020.

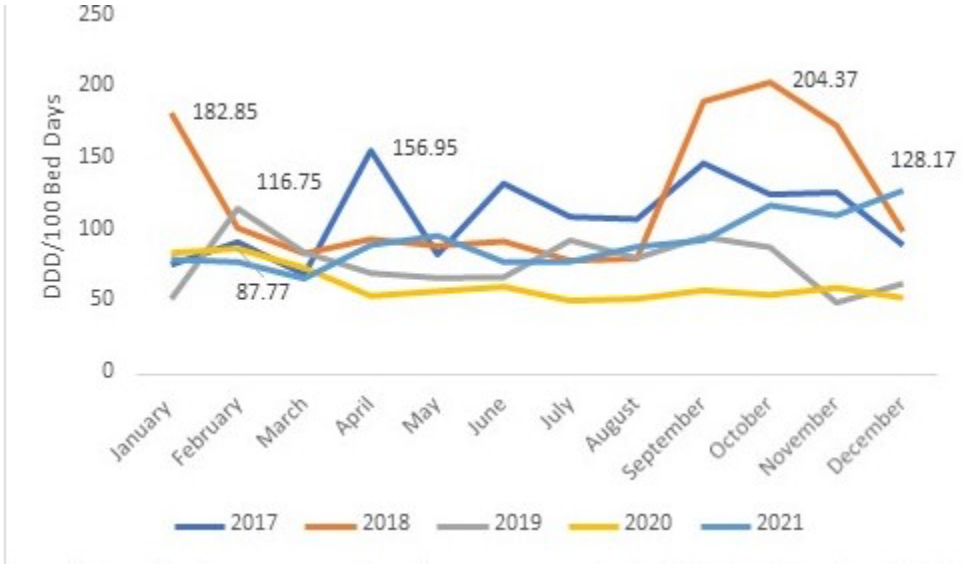


Figure 2: Trend of antibiotic consumption from 2017 to 2021

The monthly usage of antibiotics exhibits substantial oscillations on the line graph. Except for 2020, when there is little seasonal change, there appears to be a noticeable increase in consumption from September to December every year.

Similar results were observed in a study conducted by Kotwani *et al*. among outpatients in New Delhi, where it did appear that there was an overall increase in the use of penicillins, tetracyclines, and macrolides (drugs commonly used to treat acute respiratory tract infections) from December to March.

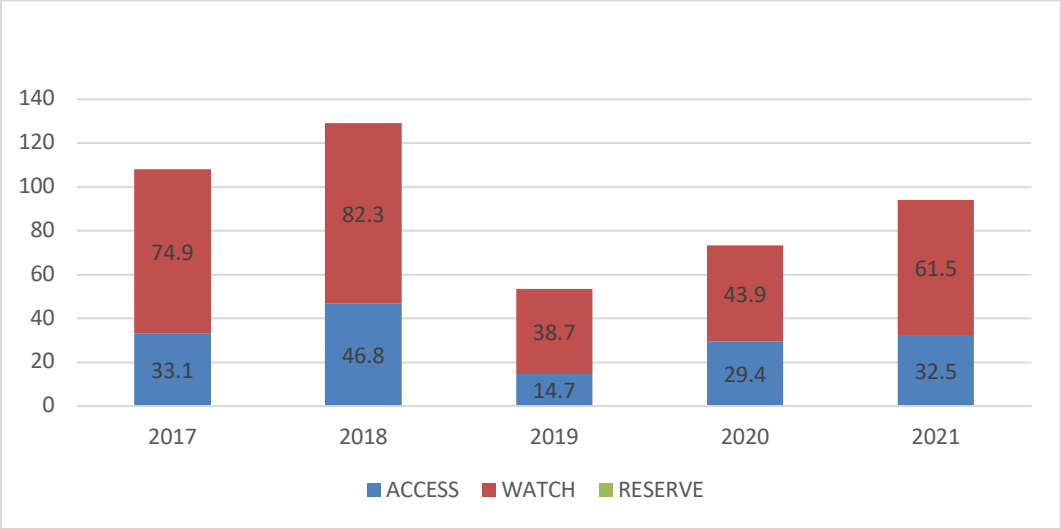


Figure 3: WHO AWaRe category wise consumption of antibiotics from 2017 to 2021

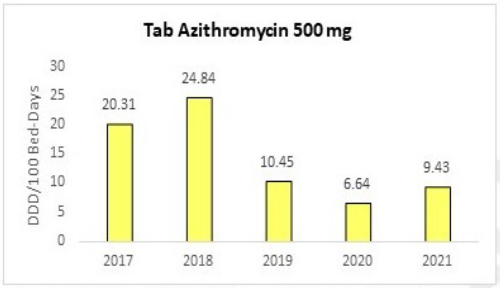
In this study, all through the five years i.e from 2017 t0 2021 the proportion of WATCH antibiotic consumption is more when compared to the Access group of antibiotics .

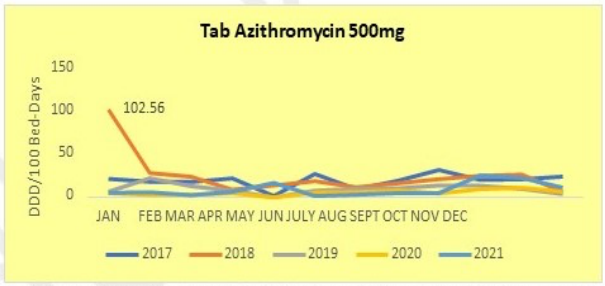
Table 1: Year wise top five antibiotics consumed in Osmania General Hospital from 2017-2021

S. No.	2017	2018	2019	2020	2021
1	Azithromycin 500mg DDD-20.9 Aware (w)	Azithromycin 500mg DDD- 26.8 Aware (w)	Cefixime 200mg DDD-8.875 Aware- (W)	Cefixime 200mg DDD-16.07 Aware- (W)	Cefixime 200mg DDD-26.68 Aware- (W)
2	Amoxi clavu 625mg DDD-20.3 Aware (A)	Ciprofloxacin 500mg DDD- 21.03 Aware (w)	Inj.Cefotaxime 1gm DDD- 8.586 Aware (w)	Amoxi clavu 625mg DDD-9.24 Aware (A)	Inj. Ceftriaxone 1g DDD-14.43 Aware- (w)
3	Ofloxacin 200mg DDD-18.33 Aware- (w)	Amoxi clavu 625mg DDD-17.66 Aware (A)	Inj. Ceftriaxone 1g DDD-8.46 Aware- (w)	Metrogyl 400mg DDD-8.85 Aware (A)	Metrogyl 400mg DDD-13.45 Aware (A)
4	Cefixime 200mg DDD-11.22	Inj. Amoxi clavu 1.2g, DDD-14.88	Azithromycin 500mg DDD-6.867	Azithromycin 500mg DDD-7.69	Azithromycin 500mg DDD-9.43

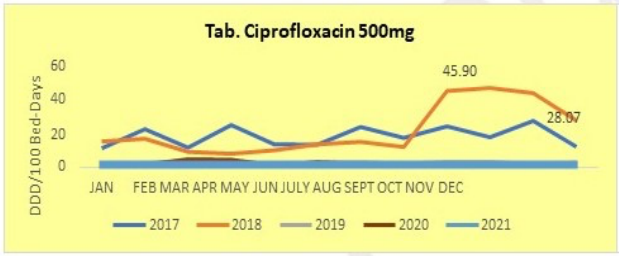
	Aware- (W)	Aware (A)	Aware (w)	Aware (w)	Aware (w)
5	Norfloxacin 400mg DDD-9.728 Aware- (W)	Cefixime 200mg DDD-14.54 Aware- (W)	Amoxi clavu 625mg DDD-4.689 Aware (A)	Inj.Cefotaxime 1gm DDD- 7.49 Aware (w)	Doxycycline DDD-5.89 Aware-(A)

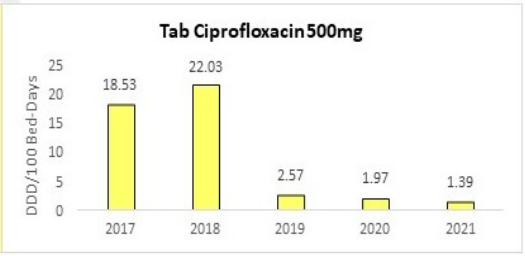
The three antibiotic classes with the highest consumption throughout the course of the five years were Macrolides, Fluoroquinolones, and 3rd generation Cephalosporins. Ceftriaxone and Cefixime were the most often used cephalosporins. The Macrolide group antibiotic with the largest consumption was azithromycin.

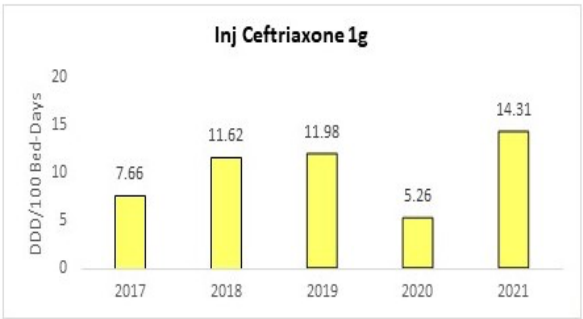


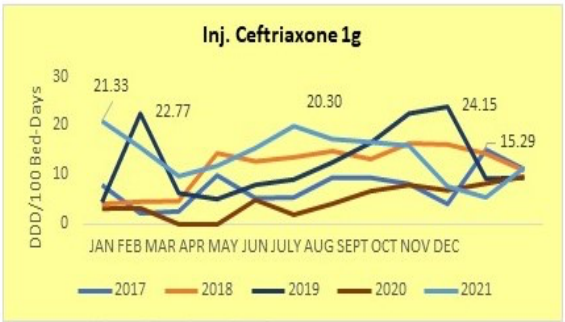


Annual consumption of Tab Azithromycin ranges from 6.64 DDD per 100 bed-days (2020) to 24.84 DDD per 100 bed-days (2018) across the five years. Highest consumption of the antibiotic is noticed during January 2018.









Consumption of Inj. Ceftriaxone 1g ranges from 5.26 DDD/100 Bed-Days (2020) to 14.31 DDD/100 Bed-Days (2021). Consumption of this antibiotic remained similar across the years except 2020.

Figure 5: Consumption data of top 5 antibiotics

Overall, it did appear that antibiotics (Cephalosporins, Macrolides) used for acute respiratory tract infections (ARI) and antibiotics (Fluoroquinolones) used for diarrhoea were used more frequently during the winter and humid summer, respectively.

Discussion

Results from the current study demonstrate the significance of monitoring antibiotic use over a five-year period, as consumption of different antibiotic classes was obviously different.

Over the course of the five-year period, from 2017 to 2021, there were several variations in antibiotic consumption, and one of the numerous causes of these variations may have been the drugs accessibility in that year.

The availability of medications at hospital pharmacies has a significant impact on antibiotic consumption, which in turn contributes to an overuse of widely accessible broad-spectrum antibiotics.

There is gradual increase in the antibiotic consumption from 2017 to 2021 except in 2020 where in the consumption decreased.

Highest consumption was seen in the year 2018 (129.1 DDD/100 BD) and the least was observed in 2019(DDD/100 BD). There was an increase in consumption in the year 2021 (94.1 DDD/100 BD) but it did not reach the peak as seen in the year 2018.

Similar study done by Shaffi *et al* in 2019 showed a total antibiotic consumption of 77.1%. Daniel *et al* in his study showed 97.2 DDD/100 BD in 2014 and later dropped to 46.9 DDD/100BD.

Ellie *et al* in their study mentioned that there is an increase of 65% in the overall global consumption of antibiotics since 2000. Human antibiotic consumption in India is among the highest in the world. If no policy changes are brought about and constant antibiotic consumption rates set at current levels of use, global antibiotic use is projected to increase 15% between 2015 and 2030.

Throughout a 12-month period, a slight change in the intake of several antibiotics was seen.

This variance may have resulted from variations in the availability of antibiotics from the primary central storage to public health facilities. There may be a difference in consumption between monthly trends because there are more infections in the winter and rainy seasons. During winter there is an increased risk of acute respiratory infections, and it is likely that this contributed to the somewhat greater consumption of various antibiotics during this period in our study. This could have included incorrect prescriptions for coughs and colds.

According to the European Surveillance of Antimicrobial Consumption (ESAC) survey, all nations use more outpatient antibiotics during the winter months. According to the authors, this seasonal shift may be a result of a rise in the number of prescriptions written during the winter in many countries due to an increased prevalence of respiratory tract infections.

ACCESS antibiotic consumption accounted for about one-third of the total antibiotic consumption in the hospital, while the proportion of WATCH antibiotic consumption maintained at 50-70%.

WATCH category consumption has steadily increased from 2017-2021 although maximum consumption was in 2018 and 2019 at 68%.

Similar proportion of ACCESS and WATCH group antibiotic consumption was seen in studies by Kotwani *et al* in 2011 and in a Short report on antibiotic consumption by Gandra and Anita Kotwani in 2019. The use of WATCH group antibiotics namely second and third generation cephalosporins is associated with widespread availability of these antibiotics.

The top five antibiotics consumed in our hospital were the 2nd and 3rd generation Cephalosporins, Quinolones and Macrolides followed by combination drug Amoxycillin and clavulanic acid. Gandra and Kotwani *et al* in their study mentioned that three most prescribed Cephalosporins were Cefuroxime, Cefixime and combination of Cefixime clavulanic acid.

Similar observations were seen in the study by Shaffi *et al*.

Another study done by Daniel *et al* in Ethiopia reported that Benzyl penicillin G, Gentamicin, Amoxicillin, Ciprofloxacin, and Ceftriaxone were the top five consumed antibiotics.

Global consumption of antibiotics study between 2000 to 2015 also mentions that antibiotic consumption rate increased 399, 125, and 119% for Cephalosporins, Quinolones, and Macrolides, respectively. A large proportion of increased use of Cephalosporins could be due to changing prescribing practices for respiratory tract infections, skin and soft tissue infections where Cephalosporins have replaced Penicillins.

In 2017 and 2018 consumption of Macrolides was highest whereas from 2019 to 2021 Cefixime was the highest consumed antibiotic.

The consumption of broad-spectrum antibiotics categorized under the WATCH list is proportionately very high (60-70%). While the global goal is to have at least a 60% share for ACCESS antibiotics, we found reversed ACCESS-to-WATCH ratio.

In our analysis, the broad-spectrum third generation Cephalosporins alone constituted 25-30% of all antibiotics. This may reflect inappropriate prescription and indicates the need for stricter regulations and stewardship programs. Ceftriaxone and Cefixime were the most common prescribed beta lactam drugs (50%). Similar observations have been made by other researchers across India and other developing countries. Cephalosporins continue to be used as the most used antimicrobial in ICU. High margin of safety and broad-spectrum activity could be a reason for this.

Beta lactams, Carbapenems and Metronidazole have predominantly been used in other studies as well [11-14].

Second and third generation cephalosporins are an excellent option for prescribers in both adults and children due to their broad-spectrum activity, availability in oral and parenteral forms, simple administration, and few side effects. While extended spectrum beta-lactamase (ESBL) generating Enterobacteriaceae (such E. coli), which are a typical components of human intestinal flora, are capable of colonising the body when second and third generation cephalosporins are used, despite the fact that they have many benefits. Clinical isolates taken from both adults and children in India were found to have a significant incidence of third generation Cephalosporin resistant Enterobacteriaceae, which is consistent with the selection pressure-driven increase in third generation Cephalosporin intake [11].

Penicillins are recommended as the first line antibiotics for treatment of respiratory tract infections [12]. However, recent trends indicate that Penicillins are increasingly substituted by second and third generation Cephalosporins for treatment of respiratory tract infections in both outpatient [12] and inpatient settings.

Third generation Cephalosporins belonging to WATCH group should be reserved for very sick patients or patients admitted to intensive care units or when there is a clinical deterioration on first line agents belonging to ACCESS group.

Quinolones belonging to WATCH group have been the main stay of treatment for enteric fever and bacterial dysentery which account for a huge burden of infections in India. Several recent studies reported increasing Quinolone resistance among bacteria causing this infection. However, recent data indicate that S. Typhi has become susceptible to older antibiotics like Amoxicillin, Trimethoprim/Sulfamethoxazole and Chloramphenicol which belong to ACCESS group. These results indicate the opportunity to examine and report outcomes using older first-line antibiotics (Amoxicillin, Trimethoprim/Sulfamethoxazole, and Chloramphenicol) belonging to ACCESS

group among mild and moderately severe enteric fever cases especially in centres where microbiological and antimicrobial susceptibility services are available.

Conclusion

In the present study WATCH group antibiotics consumption is on the higher side. A recent report analysed antibiotic sales data in India between 2007 and 2012 which showed that consumption of WATCH group and RESERVE group antibiotics are increasing rapidly when compared to ACCESS group of antibiotics.

Antimicrobial resistance is mostly caused by antibiotic overuse. Antibiotics are misused for viral illnesses that go away on their own, abused for mild infections, and underutilised because of cost considerations.

To combat the threat of antibiotic resistance, an antimicrobial stewardship programme including educational interventions and sensitization of medical students to rational antimicrobial prescription is urgently needed.

It is critical to implement new rules and reinforce existing ones to monitor and regulate the use of antibiotics in light of the growing public health concern of antibiotic resistance.

The quality of prescriptions will be further improved via prescription audits at every level of healthcare and feedback to prescribers and facility managers.

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