Postgraduate Journal of Pediatrics and Adolescent Medicine
Volume 3, Issue 1 - 2026 , Pg. No. 1-6
Peer Reviewed & Open Access Journal

Research Article

Quality Improvement Initiative to Evaluate and Enhance Antibiotic Prescribing Practices in a Tertiary Care Children's Hospital in India

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How to cite this article:
Kaur S, Singhal K K, Singh S, Quality Improvement Initiative to Evaluate and Enhance Antibiotic Prescribing Practices in a Tertiary Care Children's Hospital in India. Postgrad J Pediatr Adol Med. 2026;3(1): 1-6.

Date of Submission: 2025-03-09
Date of Acceptance: 2025-05-08

A B S T R A C T

Background: Infectious diseases remain a significant cause of morbidity and mortality worldwide, and antibiotics play a crucial role in their treatment. However, the inappropriate or irrational use of antibiotics leads to increased healthcare costs, adverse drug effects, and, most critically, the emergence of multidrug-resistant microorganisms, which has become a pressing global concern. To address this issue, we conducted a study at our hospital to evaluate the quality of antibiotic prescribing practices and to enhance the rational use of antibiotics in our pediatric medical unit.

Methods: This study was designed as a time-interrupted, non-randomized controlled trial conducted in a tertiary care children's hospital in India. Data was collected from patients randomly selected from the Pediatric Outpatient Department (OPD) who were prescribed antibiotics for suspected bacterial infections. Plan-Do-Study-Act (PDSA) cycles were planned and conducted to increase the appropriate use of antibiotics. Three cycles were conducted over the period of the next three months, which included conducting seminars, poster displays, and the distribution of mobile-friendly guideline documents.

Results: We assessed 50 prescriptions over one month to evaluate the appropriateness of antibiotics prescribed. In the pre-intervention (baseline) phase, only 66.67% of cases adhered to the hospital's antibiotic policy. After collecting baseline data, the first Plan-Do-Study-Act (PDSA) cycle was conducted. Post-PDSA 1, the appropriateness of antibiotic prescriptions improved to 70.13%. To assess sustained response, PDSA cycle-3 was conducted, which showed a remarkable increase of appropriateness to 100% at the end of the four weeks.

Conclusions: Quality improvement methods, such as educational interventions, frequent reminders, and regular monitoring, significantly enhanced residents' awareness and improved their antibiotic prescribing practices. Sustained reinforcement and consistent monitoring are essential for the success of quality improvement initiatives and achieving the desired outcomes.

Keywords: Antibiotic prescribing, Rational use of antibiotics, Pediatric outpatient department, Quality improvement, Plan-Do-Study-Act (PDSA) cycle

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Introduction

Problem Description

Infectious diseases remain a leading cause of morbidity and mortality worldwide, especially in developing countries like India.[1] Antibiotics remain the cornerstone of treatment for bacterial infections. Inappropriate or irrational use of antibiotics not only increases individual drug costs and the overall financial burden but also leads to adverse drug effects and, most importantly, the emergence of multidrug-resistant microorganisms—a pressing global concern today.[2]

Worldwide, many countries and organizations, including the World Health Organization (WHO), have made antibiotic stewardship a top priority to address this emerging and serious problem.[3] Antibiotic stewardship is a strategy aimed at improving and ensuring the appropriate use of antibiotics while maintaining optimal individual care. The core elements of an antibiotic stewardship program include establishing standards for antibiotic prescriptions, identifying high-priority conditions where prescriptions are frequently inaccurate, providing individualized feedback, and regularly auditing antibiotic prescription rates and outcomes.[2,4]

Available knowledge

The burden of antimicrobial resistance (AMR) has become a global challenge. A recent study showed in 2019, 4.75 million deaths were attributable to diseases due to resistant pathogens, and 1.27 million of those deaths were due to resistant pathogens. 1 in 5 of those deaths occurred among children under 5 years old.[5]

In India in 2019, there were 297,000 deaths attributable to AMR and 1,042,500 deaths associated with AMR. India has the 60th highest age-standardized mortality rate per 100,000 population associated with AMR.[6]

This situation has emerged due to inappropriate usage of antibiotics. Studies have shown that antibiotics are prescribed in 10–15% of total outpatient consultations, with 10–30% of these being used inappropriately. This may be attributed to higher rates of antibiotic prescriptions or the greater burden of infectious diseases in low-income countries (60%) compared to high-income countries (5%).[7,8] India has the second highest overall antibiotic consumption worldwide, with a 47% increase between 2010 and 2020 from 5,411 to 7,976 million defined daily doses.[9]

Rationale

Given the high rates of antibiotic prescriptions, there is a pressing need to assess the appropriateness of antibiotic use in our country. This is essential for improving the quality of prescriptions and ensuring the proper use of antibiotics. Various educational methods and interventions have been implemented in hospitals worldwide to enhance antibiotic prescribing practices. These include the development and implementation of official hospital antibiotic policies, checklists for appropriate antibiotic use, educational seminars, and other strategies.[10,11,12] Each hospital or clinical unit requires a tailored approach to implement its antibiotic policy and ensure compliance based on local microbial trends. Therefore, we conducted a quality improvement project at our hospital to assess the quality of antibiotic prescriptions and improve antibiotic use in our pediatric medical unit.

Aims

To improve the compliance of appropriate antibiotic prescriptions in pediatric patients, in accordance with the standard protocols from the current 66.67% to 90% or more over a period of 3 months.

Methods

Context

This quality improvement study was conducted in the Department of Pediatrics at Kalawati Saran Children's Hospital, Lady Hardinge Medical College, New Delhi, India. The hospital is a tertiary care center with 403 beds and more than 250,000 outpatient visits annually. Data were collected from 1st May to 31st August 2024, focusing on children presenting to the outpatient department (OPD) for the first time with no prior history of antibiotic use from external sources and who were prescribed antibiotics. All collected data were anonymized. The inclusion criteria comprised children presenting to the OPD and prescribed antibiotics for treatment, while the exclusion criteria included children who were already on antibiotics from external sources at the time of presentation. The primary outcome measure of the study was the proportion of antibiotic prescriptions that adhered to the hospital's antibiotic policy. The secondary outcome variable was the assessment of the quality of prescriptions. Prescriptions were collected and assessed for quality, including the mention of a provisional diagnosis, indication for antibiotic use, and adherence to the proper dosage and formulation according to the hospital's antibiotic policy.

Interventions

A multidisciplinary team, consisting of faculty, senior residents, and junior residents, was formed to assess the appropriateness of antibiotic prescriptions and compliance with the existing hospital policy. The team established a Specific, Measurable, Achievable, Relevant, Time-bound (SMART) aim: to improve compliance with appropriate antibiotic prescriptions from the current 66.67% to 90% or more over the next 3 months.

Prescriptions of patients presenting to the OPD for the first time and prescribed antibiotics were randomly collected and assessed for appropriateness and prescription quality using the following criteria on a biweekly basis (Tuesday and Friday OPDs) for a month. The pre-intervention results were evaluated at the end of the first month.

Root-cause analysis was conducted to find the reasons for non-adherence to the policy, and a fishbone diagram (Figure 1) was created to illustrate the various factors contributing to poor compliance.

Measures

To enhance appropriateness, interventions were implemented, and data were again collected on a biweekly basis for a month, with results reassessed at the end of the second month.

The first Plan-Do-Study-Act (PDSA-1) cycle involved conducting an educational seminar for the unit's residents, where the common issues leading to non-adherence were discussed. The primary objective of the seminar was to introduce and sensitize the residents to the hospital's antibiotic policy. The seminar addressed the emerging problem of non-adherence, the associated risks of antibiotic resistance, and the rationale behind the guideline recommendations. It also included the results of the baseline study previously conducted and recent studies from across the country regarding the rise of antimicrobial resistance. The seminar was followed by the circulation of the policy, including displaying posters in areas where patients are first seen (OPD rooms and treatment rooms) and distributing a portable document soft copy via digital media groups for easy access. New residents assigned to the unit were also introduced to the policy. After the PDSA cycle -1, about 50 prescriptions were randomly selected over a period of 4 weeks and assessed for adherence to the antibiotic policy at the end of the month. The results showed an improvement in adherence; however, the improvement was less than expected. Hence, a review meeting was held to discuss the challenges faced and potential reasons for the limited response. Following this, a second PDSA cycle was implemented.

The PDSA cycle-2 involved reinforcement by sending reminders, along with a soft copy of the hospital policy document, via digital media channels to resident doctors' groups biweekly, before each OPD. Prescriptions were again collected on a biweekly basis for a month, and results were analyzed at the end of the month. Post-PDSA-2, the results showed a significant improvement, achieving the target.

Further, to monitor the long-term sustained effect of the interventions, PDSA cycle-3 was conducted over the next month. It involved sending reminders to the residents on the common group on digital media along with sending a soft copy of the hospital policy document just before every OPD day (biweekly basis). Monitoring of the prescription for quality assessment continued on a biweekly basis (Table-1).

- **Statistical Analysis:** Data were collected in case record forms and were then entered onto Microsoft Excel on a bi-weekly basis. Most descriptive data were expressed as numbers or percentages.
- **Ethical statement:** Data was anonymized before analysis, and patient confidentiality was strictly maintained. All electronic data was securely stored in password-protected systems. The authors have no conflict of interest in the conduct of this study. As this is a quality improvement study, ethical clearance was not sought.

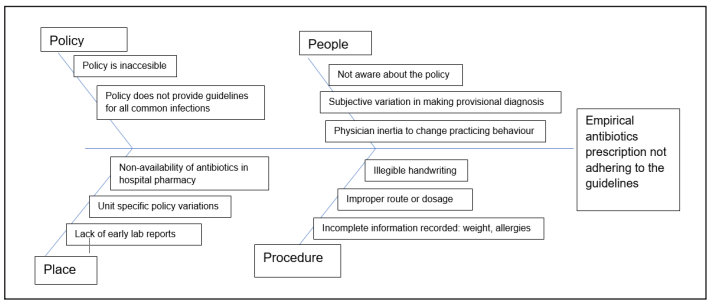


Figure 1.Fish-Bone Analysis to Illustrate the Various Possible Factors Responsible for to Poor Compliance

Table 1.Describing the interventions done during each PDSA cycle

PDSA cycle	Interventions done
PDSA cycle 1	• An educational seminar held: to introduce the problem and sensitize the concerned residents of the unit with the existing hospital antibiotic policy • Posters of the policy displayed in OPD and treatment rooms. • Circulating soft copy via digital media.

PDSA cycle 2	• Re-distribution of soft copy of the hospital policy document, via digital media channels to resident doctors' groups, along with sending reminders before every OPD (biweekly). • Collection of prescriptions and assessing for the quality on biweekly basis.
PDSA cycle 3	• Sending reminders along with soft copy of the hospital policy document, via digital media channels to resident • Monitoring of the prescription for quality assessment continued on biweekly basis

Results

The baseline (pre-intervention) percentage of antibiotic prescriptions that adhered to the hospital policy was 66.67%, which was lower than expected. To address this issue, a root cause analysis was conducted.

The first Plan-Do-Study-Act (PDSA) cycle, conducting a seminar to raise awareness among the residents about the inappropriate use of antibiotics, the challenges involved, and the hospital's antibiotic policy, was done. Along with this, posters displaying the hospital antibiotic policy were displayed in the OPDs and examination rooms. At the end of the month, after the first PDSA cycle, the appropriateness of prescriptions increased to 70.13%. Although there was improvement, the difference was below our expectations and target.

Subsequently, the need for a second PDSA cycle was identified. In the second cycle, the hospital antibiotic policy was reinforced via digital media by sending soft copies of the document to the main groups of resident doctors as reminders biweekly before OPD days. Following the PDSA-2 cycle, prescriptions were again collected biweekly and assessed at the end of the month. The results showed a significant improvement, with 94.7% of prescriptions adhering to the policy, achieving our target.

To monitor the long-term effects and sustained behavior change, the third PDSA cycle was conducted over the next one month. Before each OPD, the hospital antibiotic policy continued to be reinforced through digital media. Prescriptions were collected biweekly and assessed at the end of the month. By the end of the month, the appropriateness of antibiotic prescriptions had further increased to 100%, demonstrating a sustained response (as shown in Figure 2).

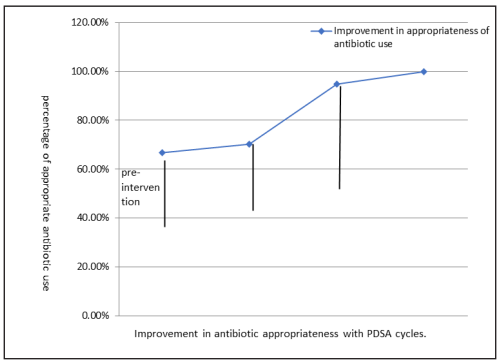


Figure 2.showing subsequent improvement in the antibiotic appropriateness following quality interventions (PDSA cycles)

Discussion

Summary

The pre-intervention results were analyzed at the end of the first month, and the proportion of appropriate prescriptions for antibiotics was found to be 66.67%. It was less than expected. Root cause analysis revealed poor knowledge and lack of accessibility to the hospital antibiotic policy as the likely cause. Since the first contact of the OPD patients in the majority of the cases are the residents of the department, creating awareness and change of behavior of the residents was considered an important step to achieve the aim. Quality improvement strategies included reinforcing the hospital antibiotic policy amongst the residents by seminars, displaying posters in OPDs and examination rooms, and sharing in the groups using social media frequently. This led to improvement in the antibiotic appropriateness from 66.67% pre-intervention to 70.13% by the end of the second month (post-PDSA-1), which further increased to 94.7% at the end of the third month after PDSA-2 and even 100% at the end of the fourth month (post-PDSA-3) on frequent monitoring.

Interpretation

Similar to our study, a quality improvement project was conducted by *Hamilton et al*. (2018) in the outpatient department of a rural district general hospital in Masanga, Sierra Leone, West Africa. They made the hospital

antibiotic policy according to the local setting. They took 243 prescriptions, and at baseline, 66% of the antibiotic prescriptions were appropriate according to the policy, which was quite similar to our prevalence. In PDSA-1 the policy was introduced to all medical, paramedical, and pharmacy staff. After PDSA-1, the appropriateness increased to 85%. PDSA-2 focused on easy accessibility and durability, making the document hard copy available in OPD rooms, the pharmacy, the emergency ward, and physicians' offices. A soft copy was also added to the computer of the seminar room. However, unfortunately, the appropriateness decreased to 65%. This might be due to the large number of paramedics and medics involved. They concluded that implementing empirical antibiotic guidelines can be effective in improving the practices; however, its long-term sustainability is difficult. Compared to this study, we were able to sustain the improved response for several reasons. Our focus on a smaller, more manageable group of healthcare providers in a single pediatric unit allowed for more targeted interventions and closer monitoring. In contrast, the study by Hamilton involved multiple departments, which made consistent adherence to the antibiotic policy more challenging. The smaller scale of our study allowed for more effective reinforcement of the hospital's antibiotic policy, contributing to sustained improvements in prescription appropriateness.

Kushala et al. (2017) conducted a similar quality improvement initiative to improve the empiric antibiotic prescribing practices in patients admitted to the ward in a tertiary care children's hospital in India. The adherence to the antibiotic prescription was 59% pre-intervention, almost similar to our results. Similar to our study, the PDSA-1 cycle was conducted in the department through seminars, pasting posters in the treatment room and emergency room of the unit, followed by circulating cellphone-friendly documents. Following this, 50 random cases were selected and assessed for adherence to the policy at the end of the first, second, third, and sixth months. After PDSA-1, adherence increased to 72%, which was statistically insignificant (p=0.09). A PDSA-2 cycle was done with weekly reminders sent on social media groups. The adherence significantly improved to 90% (p=0.04). It was seen that this improvement persisted at the end of the third month (86%) and sixth month (78%). The results were quite similar to our study. So, they concluded that quality improvement initiatives like educational interventions can improve the antibiotic prescribing practices of treating doctors in hospitalized children.

Another quality improvement project was conducted at a tertiary care hospital in South India in the years 2018-2020 to study the adherence to antibiotic policy in acute admissions by *Pillay et al*. Compliance with the antibiotic policy and length of hospital stay (LOS) were the outcome measures of the study. The first PDSA cycle consisted of auditing and educating the residents about the hospital antibiotic policy. A mobile application, 'DigitalAMS,' was made and introduced at this point. It was found that out of all patients acutely admitted from 10 November to 9 December 2018, 60% of patients received antibiotics empirically, out of which only 15% of patients were compliant with the policy, which was much less than in our study. The average LOS was 5.9 days. Repeated educational sessions were conducted over the next 1 year. A re-audit was then done from 5 January 2020 to 4 February 2020, in which, similar to previous ones, 60% of the acutely admitted patients were prescribed antibiotics. However, this time the appropriateness and compliance increased to 52.5%, with the average LOS being 4.9 days. Therefore, they concluded that interventions like repeated feedback, educational sessions, and using low-cost interventions like a mobile application can improve the quality of antibiotic prescriptions, reduce the average LOS, and even improve the clinical outcomes. Antibiotic usage in some of the reported studies was lower compared to our study. A likely reason for this difference could be that those studies included very sick patients with acute presentations, leading to a higher number of initial empirical antibiotic prescriptions, which may have contributed to overuse.

Limitations

Due to the frequent rotation of residents (every 1.5 months between units), sustaining the improved practices presents a challenge. Additionally, the intervention and monitoring period, limited to three months, may not have been long enough to instill lasting changes in the prescribing behavior of the residents.

Conclusion

Antibiotic appropriateness remains suboptimal, even in tertiary care teaching hospitals. Quality improvement initiatives, such as behavior-targeted interventions—like circulating the hospital antibiotic policy through educational seminars, displaying posters in OPDs and examination rooms, and reinforcing the policy through mobile applications or soft copies—can significantly improve the antibiotic prescribing practices and reduce inappropriate antibiotic use. However, sustained improvements require long-term monitoring and continuous reinforcement over extended periods. Therefore, quality improvement initiatives are effective tools for antibiotic stewardship and can be readily implemented in secondary and tertiary care centers.

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