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# KNOWLEDGE, AWARENESS AND PRACTICE ON RATIONAL USE OF ANTIBIOTICS AMONG SCHOOL CHILDREN

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**ABSTRACT**

Antimicrobial resistance (AMR) is a worldwide issue. Raising awareness about the prudent utilization of antibiotics to combat antimicrobial resistance (AMR) is crucial. The study aims to enhance knowledge regarding the prudent utilization of antibiotics by utilizing unique games designed for children. Novel gamified treatments are designed to educate individuals on the rational utilization of antibiotics. The utilization of antibiotics was first presented through blackboard teachings, specifically for the treatment of bacterial infections affecting the respiratory tract, gastrointestinal tract, urinary tract, and skin. A video animation illustrated the negative consequences of using antibiotics irrationally. The avoidance of drugs in respiratory infections and gastroenteritis was taught using the educational games "Bucketing the Ball" and "Monkeying with Donkey." Both pre-test and post-test questionnaires were administered and assessed. Following the intervention, there was a significant increase in understanding of the appropriate use of antibiotics solely for bacterial infections, with the percentage rising from 11.5% to 82.5%. Additionally, awareness of the negative consequences of antibiotics increased, increasing from 2.5% to 82.5%. The awareness regarding the appropriate use of antibiotics for respiratory infections and gastroenteritis increased significantly from 5.1% to 96.77%. Similarly, awareness regarding the proper use of antibiotics for urinary and skin infections improved from 19.6% to 90.38%. Additionally, the percentage of people who refrained from purchasing antibiotics directly from a pharmacy without a prescription and who completed the full course of antibiotics increased from 20.3% to 91.92%. All components have a p-value less than 0.05. The general public needs to gain a higher level of awareness regarding the rational use of antibiotics. The current imperative is to foster awareness among healthcare providers and the general public—novel gamified approaches foster enhanced and enduring awareness in this regard.



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## 1. INTRODUCTION

Antimicrobial resistance (AMR) is one of the most alarming problems, and the toughest challenge posed to human health this century (1–3). As the AMR crisis has peaked, experts have declared that the Era of ineffective antibiotics is fast approaching (4). It has been estimated by the World Health Organization (WHO) that about half of antimicrobial medicines are inappropriately prescribed, and about half of the patients fail to take their medicines completely(5). The clinical efficacy of antibiotics depends greatly on their correct use, which in turn depends on the patients, physicians, and pharmacists (5). The lack of knowledge and widespread problems in attitudes, beliefs, and behaviors have been reported among consumers, which directly influences rational antibiotic usage (5). Alongside this, the physicians' decision is influenced by factors such as the fear of losing the patient's trust, a lack of correct information on indications for antibiotic use, and

pressure from patients and families. In such cases, the patient's expectations influence antibiotic prescription, and antibiotics are more likely to be prescribed in a pressured context (5). A survey conducted by Minen et al. in the northeast of the United States indicated a need for education and feedback on antimicrobial prescribing(6). A study by Cebotarenco and Bush observed that mothers often influence medical decisions on antibiotic prescriptions for their children (7).In a study conducted by Tang et al. in China, it was found that among all the positive cases of Upper Respiratory tract infections (URTIs), 81.7 % were viral infections, only 11.6% of cases were bacterial, and 6.7% cases were bacterial and viral co-infections (8). However, a lack of reasonable differentiation of viral and bacterial causes of infections based on clinical features and a lack of rapid and accurate tests for the differentiation of the two have contributed to the abuse of antibiotics worldwide (8). Despite evidence of no benefit, misuse of antibiotics in the treatment of Acute Respiratory Tract Infections (ARTIs) has been the leading cause of antibiotic prescription at outpatient visits, with over 80% receiving antibiotics unnecessarily in Lower Middle-Income Countries (LMICs) (9). In a study conducted by Collins et al. in the United States for ten years involving patients diagnosed with viral and bacterial gastrointestinal infections from the National Ambulatory Medical Care Survey and National Hospital Ambulatory Medical Care Survey (NAMCS/NHAMCS), 12.3% of viral gastroenteritis antibiotics were unnecessarily used (10).

Some other common infections encountered on an outpatient basis are Urinary tract infections and suppurative/necrotic skin and soft tissue infections. Bacteria most often cause these and require antibiotics for treatment (11–13). So, in the community seeking outpatient health care, respiratory tract infections and gastroenteritis are more often irrationally treated with antibiotics. Several countries have developed campaigns to modify public misconceptions regarding the effectiveness of antibiotics, to promote appropriate use of antibiotics, and to prevent the development of antibiotic resistance (11, 14, and 15). In India, the National Action Plan (NAP) for controlling AMR was released in April 2017 by the Indian Ministry of Health and Family Welfare (16). Different priorities for antimicrobial resistance in India are outlined in the NAP. The current NAP is comprehensive and aligns well with the World Health Organization (WHO) Global Action Plan (GAP) for AMR. The first strategy is to improve awareness and understanding of AMR through effective communication, education, and training (17). So, an organizational or healthcare-system-wide approach for supporting and monitoring the prudent use of antibiotics to preserve their effectiveness is necessary among the general public, physicians, and pharmacists/drug dispensers (17).

The public needs to be educated on the ill effects of unnecessary antibiotic use, like entering into the post-antibiotic Era, increased mortality and morbidity due to drug-resistant infections, obesity with consequences, allergic disorders, and inflammatory bowel diseases (13,18). They need to be educated that viruses and a few bacteria most often cause common respiratory infections and gastroenteritis. They need to understand that most such infections rarely require antibiotic therapy. Other common infections like urinary tract infections and skin and soft tissue infections are most often caused by bacteria and thus require antibiotic therapy.

## 2. MATERIALS & METHODS

High school students from 12 different ASS High Schools in English, located in the most thickly populated areas of the city of Arkansas, USA, mostly belonging to middle and lower socioeconomic strata, constituted the study material. Informed consent was obtained from each school before the scientific awareness and intervention program. Figure 1 depicts the areas from which different schools were chosen to create awareness, and Table 1 depicts the identification numbers allotted to each school.

A total of 2195 students were included in the study. These students belonged to twelve ASS High Schools spread over the different areas of the city of Arkansas. All the students were made to assemble in the auditorium. The students were divided into fifteen groups in each school. The total number of groups was 180 across 12 schools. The pre-test questionnaire was first administered to each group over 15 minutes. The intervention was then conducted through the following:

Introduction to four types of microbes (bacteria, virus, fungi, and parasite) and use of antibiotics only for bacterial infections of the respiratory tract, gut, urinary tract, and skin through blackboard teaching. As bacteria cause most urinary tract infections and skin and soft tissue infections, awareness was created not to neglect them, seek medical care, and use antibiotics wherever necessary. Animated video on the ill effects of unnecessary use of antibiotics. Games on when and when not to use antibiotics to prevent irrational use. A post-test Questionnaire was administered to assess the effectiveness of intervention/education in all the schools (Total number of groups in 12 schools=180).

## 2.1. Questionnaire

A questionnaire was designed in the local language for 30 marks that were divided into three parts. The first part consisted of two questions focusing on the appropriate use of antibiotics and the ill effects of antibiotics, where the students had to write True/False and mention any four ill effects of antibiotics, respectively. The second part involved a host of upper and lower respiratory tract infections and gastroenteritis caused by viruses and bacteria (5, 11, 19, and 20). The students had to tick only the bacterial symptoms, which required antibiotic therapy, and not the viral symptoms. The third part comprised 10 statements, which mainly focused on the common infections that most often required antibiotics and the ill effects of antibiotics, like obesity. The students had to write true/false about these statements.

## 2.2. Game Design

Learning Objective- Helps in understanding that not all respiratory infections require to be treated with antibiotics so that unnecessary use of antibiotics can be prevented. Wherever necessary, antibiotics should be administered, Bucketing the ball (For Respiratory infections). Each viral and bacterial respiratory tract infection feature was written on individual plastic balls. These balls were distributed to a set of students. As they played the game, the instructors assigned each feature written on the ball to either viral or bacterial cause. Accordingly, students were instructed to throw the ball into the two buckets labeled 1. No antibiotics are required (for viral infections), and 2. Antibiotics are required (for bacterial infections). Looking at them, the other students learned to differentiate the features of viral and bacterial infections. The next set of students made to play had to differentiate the different features by themselves and throw the ball from a distance into the appropriate buckets. Those students who identified the features correctly and appropriately bucketed the ball were rewarded with a pencil. Figure 2 depicts the illustration for the Bucketing the Ball game. Even if the students cannot differentiate the features correctly, they can at least understand that not all respiratory infections require antibiotics and that consulting the doctor is important before self-medicating with antibiotics irrationally.

Pre-Test result analysis: The knowledge of the ill effects of antibiotics was the least during the pre-test (2.5%). The knowledge of using antibiotics only for bacterial infections was also very low (11.5%). The awareness of when not to use and when to use antibiotics for common infections like respiratory tract infections and gastroenteritis was also very low (5.1%). The awareness of the use of antibiotics for urinary tract infection and skin and soft tissue infection was better compared to the first three components (19.6%) in the pre-test. The practice of not buying antibiotics from the pharmacy and completing the antibiotic course was also better compared to the first three components (20.3%) in the pre-test.

After the intervention, the knowledge of the ill effects of antibiotics improved from 2.5% to 82.5% (p-value $< 0.05$). The knowledge of the use of antibiotics only for bacterial infections improved from 11.5% to 82.5% (p-value $< 0.05$). The awareness of when not to use and when to use antibiotics for common infections like respiratory tract infections and gastroenteritis improved from 5.1% to 96.77% (p-value $< 0.05$). The awareness of increased use of antibiotics for urinary infections, skin, and soft tissue infections, and not neglecting them improved from 19.6% to 90.38% (p-value $< 0.05$). The practice of not buying antibiotics directly from the pharmacy without a prescription and completing the antibiotic course improved from 20.3% to 91.92 % (p-value $< 0.05$). Our intervention was effective and statistically significant, as all the p-values were below 0.05.

As per the grading described in the methodology, in the pre-test, the majority of the schools had poor knowledge and awareness (10/12 schools), and two schools had very poor performance. In the post-test, the majority of the schools had good performance (9/12 schools), two schools had fair performance (2/12), and only one school had an excellent performance. Table 3 and Figure 4 depict the performance of different schools before and after the intervention.

Table 3 Depicts the performance of different schools before and after the intervention.

| School Name | Pre-test -Mean ± SD and (Grading ) | Post-test -Mean ± SD and (Grading) | p value |
|---|---|---|---|
| **School-01** | 6.93 ±2.15 (Poor) | 21.73 ±3.34 (Good) | 0.001 |
| **School-02** | 5.46 ±3.11 (Poor) | 20.66 ±4.43 (Good) | 0.001 |
| **School-03** | 7.26 ±2.49 (Poor) | 22.4 ±4.45 (Good) | 0.001 |
| **School-04** | 7 ±2.2 (Poor) | 20 ±4.17 (Fair) | 0.001 |
| **School-05** | 4.33 ±2.87 (Very Poor) | 21.86 ±3.94 (Good) | 0.001 |
| **School-06** | 6.66 ±2.35 (Poor) | 26.46 ±3.39( Excellent) | 0.001 |
| **School-07** | 4.4 ±3.04 (Very Poor) | 23.8 ±3.52 (Good) | 0.001 |

| | | | |
|---|---|---|---|
| **School-08** | 5.53±3.52 (Poor) | 19.73 ±3.78 (Fair) | 0.001 |
| **School-09** | 6.86 ±2.61 (Poor) | 23.46 ±3.15 (Good) | 0.001 |
| **School-10** | 6.66 ±2.41 (Poor ) | 24.2 ±4.07 (Good) | 0.001 |
| **School-11** | 6.26 ±2.71 (Poor) | 22.6 ±4.03 (Good) | 0.001 |
| **School-12** | 6.13 ±2.35 (Poor) | 25 ±2.75 (Good) | 0.001 |

## 3. DISCUSSION

In this study, the knowledge of the use of antibiotics only for bacterial infections improved from 11.5% to 82.5%. In the study by Azevedo et al., they found that the knowledge of the correct use of antibiotics for bacterial diseases rather than viral diseases rose from 43% to 76% after the teaching activity (5). In this study, the awareness of when not to use and when to use antibiotics for common infections like respiratory tract infections and gastroenteritis improved from 5.1% to 96.77%. The awareness of the use of antibiotics for urinary infections and skin and soft tissue infections improved from 19.6% to 90.38%. The practice of not buying antibiotics from the pharmacy and completing the antibiotic course improved from 20.3% to 91.92%. More studies need to be conducted similar to ours, and hence, there is not much literature available to compare and correlate.

In our study, out of twelve schools, one school had an excellent performance, while nine schools had a good performance, and two schools had a fair performance post-intervention. After the intervention, the knowledge of the effects of antibiotics improved from 2.5% to 82.5%. In a study conducted by Azevedo et al., the knowledge of the risk of resistance to antibiotics by their irrational use rose from 48% to 74% after the teaching activity(5).

During the study, we observed that wherever the teachers had a good commitment to getting the students educated, the post-test results of those students were much better. This indicates that training the school teachers on the rational use of antibiotics would help their students learn better about this issue and help improve awareness among the school children. These interventions can be replicated in other schools. Repeated awareness programs should be conducted to promote long-lasting effects on knowledge, awareness, and practice of rational use of antibiotics.

Studies from countries like Kuwait, Arabic countries, Tanzania, Malaysia, and Ethiopia have concluded that the study population needs to gain higher knowledge and awareness of antibiotic use and antimicrobial resistance (AMR). Many misconceptions prevail on antibiotics for viral infections like flu and fever. People demand antibiotics from doctors for these infections, and doctors prescribe antibiotics to meet the patient's expectations. The patients are found to discontinue the antibiotics once they feel symptomatically better. These studies have concluded that disseminating awareness of the rational use of antibiotics is essential to fight against the rise of antimicrobial resistance (21–25).

In contradiction to all the above studies, a study from Romania has concluded that the study participants had adequate knowledge of antibiotics and their rational use (19).

There is an urgent need to raise awareness of antimicrobial resistance and the rational use of antibiotics in the wider population. It was observed that even well-educated adults needed a clear idea that antibiotics could be used only for bacterial infections. Education through television, radio, YouTube lectures, and documentary movies can be used to reach out to the larger population. Educating people using social media like WhatsApp, Facebook, Instagram, LinkedIn, and Twitter can also be exploited. Many other health awareness days, like World Diabetes Day, World Tuberculosis Day, World Heart Day, etc., have wider publicity in the media. Still, the World Antibiotic Awareness Week lacks any attention. Hence, the World Antibiotic Awareness Week should be celebrated more widely.

With the rising incidence of diabetes and immunocompromised states (Cancer chemotherapy, HIV-AIDs, Immunosuppressive therapy in transplant patients, and auto-immune diseases) across the globe, antibiotics need to be preserved to treat infections in these patients. Antibiotics are not only used to treat infections but also prophylactically in the above-mentioned immunocompromised conditions to save lives.

## CONCLUSION

The knowledge, awareness, and practice of rational use of antibiotics could be better among the general public. With raising AMR and avoiding entering the post-antibiotic Era, the need of the hour is to create awareness of the rational use of antibiotics among healthcare providers, pharmacists, and the general public. Greater publicity is required on the rational use of antibiotics and antimicrobial resistance through all media types. The World Antibiotic Awareness Week should become a national agenda to raise awareness. Innovative gamified interventions create better and long-lasting awareness of this burning global issue.

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## ETHICAL APPROVAL

Nil

## COMPETING INTEREST

The authors declare no conflict of interest.

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