International Journal of Community Medicine and Public Health
Myo PCN et al. Int J Community Med Public Health. 2026 Apr;13(4):1668-1673
http://www.ijcmph.com
pISSN 2394-6032 | eISSN 2394-6040

DOI: https://dx.doi.org/10.18203/2394-6040.ijcmph20261011

Original Research Article

Effect of an educational intervention on knowledge and attitude of antimicrobial resistance among school children in Nay Pyi Taw union territory: a quasi-experimental study

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Received: 27 January 2026
Accepted: 02 March 2026

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ABSTRACT

Background: Antimicrobial resistance (AMR) is a global threat to health and human development by interrupting the efforts and investments of countries to effectively combat the infectious diseases. The overuse and misuse of antimicrobial agents has been recognized as the main cause of AMR. Children of today are antibiotic consumers and prescribers of tomorrow. Building foundational knowledge early shapes their future decisions regarding antibiotic use. Therefore, educational intervention programs targeting them can be effective and have a long-term impact.
Methods: A quasi-experimental study was conducted among grade-10 students attending public schools during the academic year 2025-26 in Nay Pyi Taw Union Territory, Myanmar. This study consisted of a baseline assessment, the educational intervention using Power point slides, discussion, game and group activities and post-intervention assessment among students in the intervention group compared to a control group using the validated knowledge and attitude questionnaires adapted from the questionnaires of lesson plans, worksheets and activities of e-Bug.
Results: A total of 300 students participated in the study. There was statistically significant change in students' knowledge and attitude. The mean knowledge and attitude scores were increased in the intervention group compared to the control group. The mean difference in knowledge scores was 2.7 (95% CI=2.3 to 3.2) and the mean difference in attitude scores was 1.2 (95% CI=0.7 to 1.7).
Conclusions: Educational intervention on knowledge and attitude of antimicrobial resistance among school children is an effective strategy to enhance our younger generation's responsible antibiotic use.

Keywords: Antimicrobial resistance, Antibiotics, Attitude, e-Bug, Knowledge

INTRODUCTION

AMR is a global threat to health and human development by interrupting the efforts and investments of countries to effectively combat infectious diseases. The main cause is the overuse and misuse of antimicrobial agents. Moreover, improper dosing and substandard antimicrobials also contribute to the development and spread of AMR.[1] Therefore, it is important to take immediate actions to raise awareness of antimicrobial resistance through public communication programs targeting different audiences in human health, animal health, agricultural practice and consumer sectors. A learning resource developed by the UK Health Security Agency, formerly known as Public Health England is called e-Bug.

It has been designed to bring the world of microbes, antibiotics and infection prevention practices and antibiotic use to life for school children. Over 27 international countries are participated in the e-Bug project and it can be verified as a valuable resource in improving students' knowledge about the importance of microbes, their spread, treatment and prevention and also

responsible antibiotic use.[2] Furthermore, the National institute for health and care excellence (NICE) guidance on 'Antimicrobial Stewardship' recommends that the e-Bug learning resource should be used in all schools to teach children about hygiene, the spread of infection and antibiotics.[3]

AMR is one of the top ten global public health threats facing humanity and also represents a global challenge. In 2019, 4.95 million people died from drug-resistant infections and 1.27 million of those deaths were directly caused by AMR and 1 in 5 of those deaths happened among children under 5 years old.[4] Prolonged illness due to AMR not only results to death and disability, but also longer hospital stays, the need for more expensive medicines and financial burdens for those impacted.[5]

Nowadays, medicines are most broadly used for prophylactic and therapeutic purposes. At the same time, the rate of antibiotic use among children is also extremely high. In Myanmar, there were 11,200 deaths attributable to AMR and 40,200 deaths associated with AMR in 2019. In the Southeast Asia region, Myanmar has the second-highest age-standardized mortality rate associated with AMR. The number of deaths caused by AMR in Myanmar exceeds those from other diseases such as respiratory infections, tuberculosis, diabetes, kidney diseases, digestive diseases, maternal and neonatal disorders and unintentional injuries.[6] Furthermore, there is a vital need to prioritize health education for our future generations, as the current school curriculum offers only basic knowledge in health and hygiene and it does not adequately cover the important topics about antibiotic use, the adverse reactions to medications.

Educating future generations about the appropriate use of antibiotics remains a critical area that requires further research. This study was designed to assess the effectiveness of an educational intervention on knowledge and attitudes related to antimicrobial resistance and appropriate antibiotic use among students in the intervention group compared to a control group.

The data from this study will be valuable for developing future educational programs to enhance the younger generation's responsible antibiotic use. This could empower them to take a proactive approach to managing their health. Additionally, by educating children and providing take-home materials, we can also reach parents and other family members, thus expanding the intervention's impact beyond just the participating students.

METHODS

Study setting and participants

The quasi-experimental study was conducted in the selected schools in Nay Pyi Taw Union Territory during January to September 2025. The ethical approval was obtained from Institutional Review Board of University of Public Health, Yangon.

The sample size was calculated by G Power Software (version 3.1.9.7) for 80% power to detect and at the 0.05 level of significance and total sample was required was 300 students after adding non-response rate and allocated150 students for each group (intervention and control group). Multistage sampling method was used in this study and Nay Pyi Taw Union Territory was purposively selected because it had the highest school enrollment and attendance rates during the academic year 2025-26. Among four districts in that region, Pyinmana district and Ottarathiri district were purposively selected.

From each district, two schools were randomly selected one for control and another for intervention, wherein all students enrolled in the chosen school from grade 10 were invited to participate in the study and 75 students from each school were collected using systematic random sampling method. As a result, 300 students who met the eligibility criteria were recruited from four schools. Both written informed consent and assent forms were obtained from students and their parents.

Educational intervention

The educational intervention was designed from lesson plans, worksheets and activities of e-Bug: an international educational resource covering the world of microbes and disease operated by UK Health Security Agency. Educational module, which lasted about 50 minutes, was designed and in which 25 minutes for PowerPoint lecture, another 25 minutes for discussion, game and group activities on antimicrobial resistance to achieve the learning outcomes. Baseline and post-intervention assessments after two weeks were done using a validated knowledge and attitude questionnaires adapted from the lesson plans, worksheets and activities of e-Bug (key stage 3 for 11-14 years of age) and also edited and adapted to the local situation and research objectives. This was also pre-tested in schools around the Bago region before being used in the study (Cronbach's Alpha 0.83).

Statistical analysis

Data were analyzed using IBM Statistical Package for Social Sciences (Version 18.0). The socio-demographic and background characteristics of students were presented as frequencies and percentages for categorical variables and mean and standard deviation for continuous variables.

To test the statistical significance of the change in the mean score of knowledge and attitude of AMR determinants among high school students before and after the educational intervention, a paired t-test was applied. A p value of less than 0.05 was considered as statistically significant.

RESULTS

Among the eligible students in the selected schools, 300 students participated in the study. A total of 293 students participated in the post-test (145 in intervention and 148 in control), resulting in a follow-up rate of 97.7%. The demographic characteristics of students in the control and intervention groups did not differ by age, sex, residence, type of caregiver and presence of health care provider in their family members. Among the 293 students, 45.1% were males and 54.9% were females who belonged to the age group of 13 to 15 years.

In the control group, 50.7% of students were from rural areas and 49.3% were from urban and in the intervention group 49% were from rural and 51% were from urban. The caregivers of most of the students were their parents 88.5% in the control and 87.6% in the intervention group respectively. Then, 16.9% of students in the control group had health care provider in their family member and 22.1% in the intervention group (Table 1). The knowledge and attitude sections consisted of 12 and 4 items, respectively. Each correct answer was received score of 1, while incorrect answers received 0, resulting in maximum possible scores of 12 for knowledge and 16 for attitude. It was observed that the mean knowledge score before the intervention was 8.3±1.6 in the intervention group and 8.2±1.5 in the control group; after the intervention, the score improved to 11.1±1.5 in the intervention group, while it decreased to 8.2±1.8 in the control group (Table 3). The mean attitude at baseline assessment in the intervention group was 13.9±1.9 and improved to 15.4±1.4 after the intervention, while it increased from 13.2±2.2 to 13.6±2.1 in the control group (Table 6).

There was statistically significant difference in the knowledge and attitude of study participants following the educational intervention in tables 7 and 8. The mean knowledge scores were increased 2.7±0.2 in the intervention group, while they decreased 0.04±0.2 in the control group and mean attitude scores were 1.6±0.2 in the intervention group, while they increased 0.4±0.2 in the control group. The mean difference in knowledge scores was 2.7 (95% CI=2.3 to 3.2) and the mean difference in attitude scores was 1.2 (95% CI=0.7 to 1.7).

Table 1: Background characteristics of the respondents.

Characteristics	Intervention (n=145) N (%)	Control (n=148) N (%)	P value
Age (in years)			0.987
≤14	90 (62.1)	92 (62.2)	
>14	55 (37.9)	56 (37.8)	
Sex			0.874
Male	79 (54.5)	82 (55.4)	
Female	66 (45.5)	66 (44.6)	
Residence			0.77
Rural	71 (49.0)	75 (50.7)	
Urban	74 (51.0)	73 (49.3)	
Type of care giver			
Parents	127 (87.6)	131 (88.5)	0.891
Relatives	15 (10.3)	15 (10.1)	
Others	3 (2.1)	2 (1.4)	
Healthcare provider in family members			0.263
Presence	32 (22.1)	25 (16.9)	
Absence	113 (77.9)	123 (83.1)	

Table 2: Baseline knowledge of the respondents on AMR (n=293).

Knowledge on antimicrobial resistance	Intervention		Control	
	N	%	N	%
Antibiotics can treat to kill bacteria	133	91.7	123	83.1
Antibiotics can stop bacteria growing	115	79.3	128	86.5
Antibiotics not only kill the harmful bacteria that make you unwell, antibiotics also kill the natural bacteria (commensal) that help keep you healthy	73	50.3	80	54.1
Antibiotics can help patients who have bacterial infections after operations get better	117	80.7	116	78.4
Misuse of antibiotics can encourage the bacteria to become resistant to antibiotics	117	80.7	109	73.7
Antibiotics cannot help colds get better more quickly	69	47.6	63	42.6

Continued.

Knowledge on antimicrobial resistance	Intervention		Control	
	N	%	N	%
Antibiotics can't kill virus	55	37.9	62	41.9
Most coughs are caused by viruses and are therefore not helped by antibiotics	46	31.7	49	33.1
Antibiotics cannot help sore throats get better more quickly	72	49.7	73	49.3
It is very important to finish a course of prescribed antibiotics and not just stop halfway through?	135	93.1	138	93.2
Using left over antibiotics is not good	135	93.1	131	88.5
Antibiotics should be taken with prescription	144	99.3	145	97.9

Table 3: Distribution of total knowledge scores regarding AMR.

Study group	Study time	Mean	SD	Median	Min	Max
Intervention	Baseline	8.35	1.6	8	5	12
	2 weeks post-intervention	11.05	1.5	12	4	12
Control	Baseline	8.22	1.5	8	5	12
	2 weeks post-intervention	8.18	1.8	8	3	12

Table 4: Baseline attitude of the intervention group (n=293).

Attitude on antimicrobial resistance	Intervention			
	SA N (%)	SA N (%)	SA N (%)	SA N (%)
It is very important to finish a course of prescribed antibiotics and not just stop halfway through?	110 (75.9)	33 (22.8)	0 (0)	2 (1.4)
Our overuse and misuse of antibiotics can encourage the bacteria to become resistant to antibiotics	60 (41.4)	61 (42.1)	18 (12.4)	6 (4.1)
Antibiotics should be taken with prescription	89 (61.4)	36 (24.8)	13 (8.9)	7 (4.8)
Using left over antibiotics is good	97 (66.9)	32 (22.1)	5 (3.5)	11 (7.6)

SA=Strongly Agreed, A=Agreed, D= Disagreed, SD=Strongly Disagreed.

Table 5: Baseline attitude of the control group (n=293).

Attitude on antimicrobial resistance	Control			
	SA N (%)	A N (%)	D N (%)	SD N (%)
It is very important to finish a course of prescribed antibiotics and not just stop halfway through?	98 (66.2)	43 (29.1)	6 (4.1)	1 (0.7)
Our overuse and misuse of antibiotics can encourage the bacteria to become resistant to antibiotics	55 (37.2)	67 (45.3)	19 (12.8)	7 (4.7)
Antibiotics should be taken with prescription	65 (43.9)	56 (37.8)	17 (11.5)	10 (6.8)
Using left over antibiotics is good	81 (54.7)	45 (30.4)	6 (4.1)	16 (10.8)

SA=Strongly Agreed, A=Agreed, D= Disagreed, SD=Strongly Disagreed.

Table 6: Distribution of total attitude scores regarding AMR.

Study group	Study time	Mean	SD	Median	Min	Max
Intervention	Baseline	13.9	1.9	14	7	16
	2 weeks post intervention	15.4	1.4	16	8	16
Control	Baseline	13.2	2.2	14	7	16
	2 weeks post intervention	13.6	2.1	14	8	16

Table 7: Comparison of change in knowledge score regarding AMR between intervention and control group.

Study group	Mean change (se)	Mean difference score (intervention-control) (95% CI)	P value
Intervention	2.70 (0.2)	2.7 (2.3 - 3.2)	<0.001
Control	-0.04 (0.2)		

Table 8: Comparison of change in attitude score regarding AMR between intervention and control group.

Study group	Mean change (SE)	Mean Difference Score (Intervention-Control) (95% CI)	P value
Intervention	1.6 (0.2)	1.2 (0.7 - 1.7)	<0.001
Control	0.4 (0.2)		

DISCUSSION

Nowadays, medicines are most broadly used for prophylactic and therapeutic purposes. At the same time, the rate of antibiotic use among children is also extremely high. Inappropriate antibiotic usage, including overdosing for symptom relief, easily purchasing over-the-counter medications, not completing the full drug course and poor adherence to infection prevention and control measures, can lead to drug resistance in children. Finally, this results in life-threatening conditions and creates significant burdens on healthcare systems.[7] In 2019, the United Nations Children's Fund (UNICEF)'s technical note on antimicrobial resistance focused that "AMR is perhaps the greatest threat to child survival and health of this generation". This reflects the need to take immediate global actions emphasized on children to control the results of AMR, ranging from morbidity and mortality at the individual level to the financial burden at the community level.[8]

Addressing infection prevention and control and antimicrobial resistance is a complex issue, especially in children who are significant carriers of common cold viruses and are often prescribed antibiotics. Therefore, the rate of antibiotic prescriptions is high in this age group. Children of today are antibiotic consumers and prescribers of tomorrow. Therefore, educational intervention programs targeting them can be effective and have a long-term impact.

A school-based educational intervention study showed that the e-Bug teaching pack demonstrated a significant improvement in students' knowledge and there was no significant decrease in students' knowledge observed after a 6 weeks period.[9] A mixed methods pilot study of Beat the Bugs showed that a community education course on hygiene, self-care and antibiotics is a useful intervention in increasing awareness and educating the community on important public health topics, including microbes, hand, respiratory, food and oral hygiene, self-care and antibiotics.[10] A study in Kerala, India, stated that there was a statistically significant difference in the knowledge, attitude and behavior of study participants due to the educational intervention based on improving the knowledge, attitude and behavior of school children and also it is effective to address the growing threat of antimicrobial resistance.[11]

Several of the individual activities within the Beat the Bugs community course including making a microbe, the hand-washing activity, the snot-gun and how clean is your kitchen have previously been evaluated in a school environment as part of the e-Bug peer education project delivered to 9 to 11-years old and found that there was a significant improvement in participant knowledge for all topics covered in the intervention.[12] The findings reiterate these earlier studies' findings that educating children during school-going age on the need for awareness on AMR and inculcate scientific interest towards shaping appropriate antimicrobial use.

Strengths and limitations

The study is the first quasi-experimental study conducted among schoolchildren in the Nay Pyi Taw Union Territory, which focused on improving health literacy regarding antibiotic use and antimicrobial resistance that there was a high follow-up and response rate in this study.

The study intervention involved hands-on practice, interactive teaching methods like group activities and demonstrations, joyful gaming sessions and the emphasis on antimicrobial resistance. Authors used almost all questions from the e-bug program as a module to cover topics on various AMR determinants. However, the study was conducted only in Nay Pyi Taw Union Territory; findings from this study can be generalized to the areas with the same settings.

CONCLUSION

This quasi-experimental study showed increased knowledge and attitude following an educational intervention on antimicrobial resistance among school children. Since the study showed improvement and encouraging outcomes, replication and scaling up of such educational intervention for improving awareness of antimicrobial use emphasized on AMR, is required to ensure sustainability.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Myo PCN, Mon AS, Lwin SMM, Ab. Effect of an educational intervention on knowledge and attitude of antimicrobial resistance among school children in Nay Pyi Taw union territory: a quasi-experimental study. Int J Community Med Public Health 2026;13:1668-73.