ORIGINAL RESEARCH

The Predictors Influencing the Rational Use of Antibiotics Among Public Sector: A Community-Based Survey in Thailand

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Background: The spread and emergence of antimicrobial resistance is the significant public health concerns over past decades. The major leading cause comes from irrational use of antibiotics.

Aim: To explore the characteristics of rational use of antibiotics and identify its predictive factors among public sector living in Nakhon Nayok Province, Thailand.

Methods: This project was conducted by using the data-source from Rational Use of Antibiotics (RUA) Survey Project at Nakhon Nayok Province. A cross-sectional community-based study method and face to face interviews were conducted. Two hundred fifty-four participants were selected by using Quota sampling method. Descriptive statistics were used to describe the sociodemographic and antibiotics use characteristics. Chi-square test were utilized to determine the association between explanatory variables and major outcome while multiple logistic regression was analysed to identify the predictors of antibiotics use behavior.

Results: The mean age of the participants was 42 years, those with aged between 35 and 56 had more rational use of antibiotics behavior than those with 13–34 years while older adults (57–78 years) were significantly associated with irrational use of antibiotics [AOR = 0.38; 95% CI (0.17–0.85)] than those with less than 34 years of age. Less than half (45.7%) and about one third of them (31.1%) showed adequate knowledge and appropriate attitude towards antibiotics use. An adequate knowledge [AOR = 3.37; 95% CI (1.92–5.90)], appropriate attitude [AOR = 2.90; 95% CI (1.54–5.43)], not using antibiotics within last 3 months [AOR = 1.89; 95% CI (1.04–3.43)], and not visiting drugstore when having three main diseases [AOR = 2.04; 95% CI (1.06–3.92)] were the significant predictors of rational antibiotics use (p-value <0.05).

Conclusion: Strategies development in terms of knowledge and attitude enhancement about antibiotics use particularly at the different ages together with RDU pharmacy encouragement and policy restriction of community drugstores antibiotics sales are the most effective method to promote rational antibiotics use behavior in the public sector.

Keywords: rational use of antibiotics, public sector, community-based survey, predictive factors, Thailand

Background

WHO defined "Rational Use of Medicine" as using correct medications that are relevant to clinical requirements of the patients, in exact doses according to the individual needs, for sufficient duration of time and at the lowest cost to them. A number of studies in different countries have hypothesized that behavior of rational antibiotic use was related to several factors such as age,[1,2] gender,[3] educational status,[3,4] level of household income,[1] health insurance[1,5] and knowledge about antibiotic use[3,4,6,7] of the participants.

Antibiotics are the most frequently used medications in majority of the developed and developing countries [especially when having 3 main diseases (Upper respiratory infection; URI, Acute Diarrhea; AD/ acute

Gastroenteritis/ food poisoning and antibiotic prophylaxis in simple/ fresh wound; FW)]. Irrational use of medicines, especially antibiotics is one of the leading causes of AMR[8] and was commonly seen in many developing countries with low level of Healthcare systems.[9] WHO stated that the amount of antibiotics used in community areas was 80% of total antibiotics dispensed, of which 20–50% were used irrationally.[10] Such irrational use of antibiotics can give rise to the development of resistance in certain microorganisms to effective antimicrobials, resulting in emergence and spread of antibiotic resistance at the community levels.[11]

The spread and emergence of antimicrobial resistance (AMR) is a global major public health challenge and concern that occurs across the world during recent years[12] and it increases significantly in several countries which has Health and economic impacts on the life of people.[13] Currently, more than 700,000 deaths happen around the world each year due to the higher prevalence of AMR infections and it was forecasted to project up to 10 million deaths by 2050 unless immediate and multidisciplinary actions were carried out in response to this critical situation.[14,15] Asia region alone is considered as the most vulnerable area which over 4.7 million deaths due to AMR are predicted in 2050.[16] Moreover, the World Health Organisation (WHO) also mentioned that South East Asia region is at the highest risk of AMR consequences where its problems on the issue of huge burden on health system and well-being of people are often neglected.[17,18]

In Thailand, the prevalence of bacterial infections, caused by AMR pathogens rose from less than 10% to over 40% between 2000 and 2011 and these kinds of infections, required 3.24 million days of hospitalization and about 38,000 deaths in 2010.[19,20] Apart from the significant threats to many lives, AMR infections could lead to a remarkable economic burden of each country by resulting in a total cost of US$ 202 millions to the infections according to a recent study on AMR.[19,21] According to the 2017 national household survey in Thailand, around 30% of adults misused the antibiotics and half of them had no idea about the after effect of antibiotics overuse. On top of these, only 17% of the whole population had received the correct information about rational use of antibiotics.[22]

These findings concluded that AMR became a crucial public health problem that requires urgent and comprehensive actions from many stakeholders to avert the consequences at both community and national levels.[19] The Ministry of Public Health aware of the protection of people to receive the medicine treatment which is efficient, safe and cost effective, for this reason, in 2013, the Ministry of Public Health specified health system service development policy for rational drug use as the "Service plan of Rational drug use in hospital" (RDU service plan) under the Office of the Permanent Secretary for Public Health. However, only the Promotion of Rational antibiotics use behavior among healthcare personnel in health care setting is not the root cause problem solving because it should also be implemented in the public sector.

This paper highlights the reports on the research that explores the significant predictors of rational use of antibiotics behavior among community people. To our knowledge, very few studies have been conducted in Thailand. Since using antibiotics without necessity was detected in most of the hospitals, healthcare facilities, community, and drugstores, as well as in some cases, self-medication by the individuals.[23] Identification of factors associated with rational antibiotic use behavior is crucial to generate effective interventional and policies including strategies for controlling unnecessary use of antibiotics in the communities which designed for changing behavior of the public sector towards better and more reasonable way of using antibiotics.

Materials and Methods
Study Area and Sampling

This research was conducted by using the data-source from "Rational Use of Antibiotics (RUA) Survey Project"[24] which was performed with the cross-sectional method to survey community members at Nakhon Nayok Province, which is one of the central provinces that locates in northeast of Bangkok and the executive board of medical facilities and related organization give importance to Rational Drug Use (RDU) service plan national policy and need to publicize the implementation to the public sector.

Nakhon Nayok Province is divided into four main districts; Mueang Nakhon Nayok, Pak Phli, Ban Na and Ongkharak. Required sample size was calculated by using the formula as 20 numbers of subjects per one independent

variable according to the rule of thumb.[25] As from the literature, expert opinions and theoretical framework of 11 explanatory factors were contained in this study included gender, age, education, occupation, prevalence of antibiotics use, knowledge, attitude towards antibiotics use, pattern of antibiotics use and intention, antibiotics accessible sources, antibiotics usage information attainment channels and usage of herbal medicines, 220 participants were required. However, in order to reduce incomplete information by insufficient data and subjects' withdrawal during the data collection process, sample size was further increased by 15%. Therefore, 254 samples were recruited which were the people living in Nakhon Nayok Province who were not mentally ill, agreed to participate in the study and used to take antibiotics with the aged between 13 and 78 years that were chosen by applying Quota sampling method from the proportion of general population in each setting which covered all four districts of Nakhon Nayok Province. This proportion was taken from proportional comparison with 10% of total patients who went to OPD per week in each of the three government hospitals (Banna Hospital, Ongkharak Hospital and Pak Phli Hospital) and it also included patients from Health Promoting Hospitals, Primary and Secondary school teachers, community members and those who worked in government or private establishments.

Research Instruments

Structured questionnaires were developed from RUA survey project by adapting standard structured questionnaires of the previous studies and literature reviews, moreover, to ensure the face validity of research instruments, before the pilot study were conducted, all questions were reviewed by the eminent persons which were the RDU/ RUA specialist physicians.

The knowledge part reliability coefficient of the questionnaires was calculated using Kuder-Richardson 21 formula (KR21) and the value was 0.73. As for the reliability of attitude towards antibiotics use section and self-care when having 3 main diseases, the internal consistency of related items was recorded using Cronbach's Alpha coefficient of 0.81.

The questionnaires comprised 7 main sections: Sociodemographic characteristics of the respondents (Q1-Q7), Prevalence of antibiotic use (Q8-Q10), Knowledge (Q11-Q22), Attitude (Q23-Q39), Antibiotic accessibility sources/ Antibiotic usage information attainment channels/ Usage of herbal medicines (Q40-Q46), Pattern of antibiotic use intention (Q47-Q76) and Antibiotic use behavior (Q77-Q79). Questions related to the Knowledge were further divided into two categories that were "Knowledge about the causes of diseases (Q11-Q13) and "Knowledge about antibiotic use (Q14-Q22)". Before the interview took place, the researcher showed respondents the pictures of some commonly used antibiotics and asked them "What type of the drugs in these pictures?" to ensure their understandings about the type of drug. After they answered the question, we replied them the correct answer and informed them to call those drugs as "Antibiotics or Disinfectants", then the interview was started.

Data Management and Analysis

Statistical Package for Social Science (SPSS) version 26 was used for data coding, management and analysis. Descriptive statistics was performed to compute mean, median, standard deviation, inter quartile range, frequency and percentage which were used to describe sociodemographic characteristics, responses to knowledge, attitude questions and distribution of rational antibiotic use. Responses to knowledge items were divided into two groups: "Yes" and "No" and final result was determined by using the mean of total correct score as a cut point for organizing into two groups: "Inadequate knowledge (score of 0–5)" and "Adequate knowledge (score of 6–12)". For the attitude section, five-point Likert scale was used to classify the responses into 5 groups: "Totally disagree", "Disagree", "Not sure", "Agree" and "Totally agree". "Criterion reference at 70" was used to measure the attitude of respondents as follows: those scoring higher than 70% of total score were had "Appropriate attitude (score of 60–85)" and those scoring lower than 70% were had "Inappropriate attitude (score of 0–59)". Behavior of antibiotic use was assessed by 3 questions and for this research, respondents who had 2–3 correct answers were identified as "Rational behavior" and those who had no or one correct answers were identified as "Irrational behavior".

Chi-square test was performed to examine the association between explanatory factors and rational behavior of antibiotic use of the respondents. Finally, Multiple Logistic Regression (MLR) was applied to identify the predictors of rational behavior of antibiotic use by adjusting the confounding factors.

Rational Use of Antibiotics (RUA) survey was approved by the Ethical Review Committee for Research in Human Subject, Nakhon Nayok Provincial Public Health Office with certificate number NPHO 2019–0010. In case of the participants were under the legal age of majority in Thailand, they were approved by the ethics committees to give information by providing informed consent on behalf of their own or obtained from their parents. And this research was also conducted under the approval of Ethical Committee of Mahidol University with certificate number 2020/027.1910.

Results

Characteristics of Respondents

Study population consisted of 254 respondents, of which nearly three quarters (72.4%) were female and about half of them were married. The mean age was 41.94 years (SD =15.78). Young (13–34years) and middle aged individuals (35–56years) were the majority of the respondents (80.3%). Most of them had educational level under or completed the secondary school (40.2%), followed by those achieving higher education such as completed Bachelor or Master's degree (33.4%). Nearly one-third of them (31.5%) were recorded as private employees. The respondents who had household income less than 20,000 Baht were 72.8%. Regarding types of health insurance schemes, nearly half of them had enrolled into Universal Coverage Scheme (UCS) as shown in Table 1.

Prevalence of Antibiotic Use Among the Respondents

The individuals who used any types of antibiotics during the last 3 months and the last 3–6 months were 30.7% and 31.5% respectively. Most of them (59.8%) reported that they were already took antibiotics within the last one year (Table 2).

Table 1 Socio-Economic Characteristics of Respondents

Sociodemographic Characteristics	Frequency (n)	Percent (%)
Gender		
Female	184	72.4
Male	70	27.6
Age		
13–34 years	108	42.5
35–56 years	96	37.8
57–78 years	50	19.7
Mean (SD) = 41.94 (15.78), Min = 13, Max = 78		
Marital Status		
Single	92	36.2
Married	128	50.4
Widow/ Divorced/ Separated	34	13.4
Educational Status		
Under and completed Secondary School	102	40.2
Moderate Level (Vocational Certificate, Diploma)	67	26.4
Completed Bachelor or Master Degree or higher	85	33.4
Occupation		
Private Employee	80	31.5
Civil Servant/ Government Employee	72	28.3
Other (Farmer, Merchant/ Self Employed and others)	102	40.2
Monthly Household Income		
300–8000 Baht	80	31.5
8001–20,000 Baht	105	41.3
20,001–100,000 Baht	69	27.2
Median (IQR) = 15,000 (9516, 20,000), Min = 300, Max = 100,000		

Table 2 Prevalence of Antibiotic Use

Prevalence of ATB Use	Number	Percent (%)
ATB use within last 3 months		
Not use	176	69.3
Used	78	30.7
ATB use within last 3–6 months		
Not use	174	68.5
Used	80	31.5
ATB use within last 1 year		
Not use	102	40.2
Used	152	59.8

Knowledge, Attitude, Behavior in Respect to Antibiotic Use

Over half of the respondents (54.3%) had inadequate knowledge about antibiotic use and causes of the main diseases. Likewise, most of them (68.9%) had inappropriate attitude related to antibiotic use and self-care when they had three main diseases. However, about half of them (51.2%) showed rational behavior towards antibiotic use in this research.

Antibiotic Access Sources/Antibiotic Usage Information Attainment Channels

Most respondents reported that their main sources of antibiotic (52.4%) attainment were hospitals and health promoting hospitals (HPH), followed by drugstore and grocery (35.4%). The majority (55.5%) firstly went to the hospitals and HPH when they felt sick and wanted to take antibiotics. Almost all of them (98.0%) replied that they would search for antibiotics when they were not prescribed antibiotics at the first place they visited and 56.2% chose 'clinics' as the second place to get antibiotics as depicted in Figure 1. Over 80% of the respondents searched for related information about antibiotic use from different channels, the majority (63.4%) searched for information from the physician or healthcare professionals at the hospitals.

Pattern of Antibiotics Use Intention

Table 3 presents the pattern of antibiotics use intention. About three-quarters of the respondents admitted that they went to the hospital or HPH and drugstore when they had three main diseases. While less than half of them (41.4%) intended to take antibiotics when they visited drugstore, only few proportion were willing to use antibiotics when they visited the
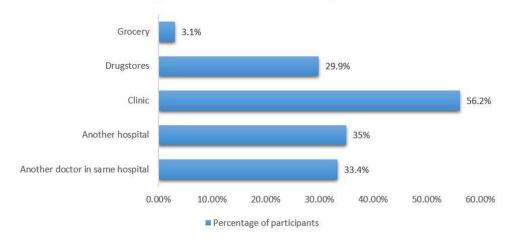

Figure 1 Percentage of the participants who went to the second place if ATBs were not prescribed at the first place.

Table 3 Pattern of Antibiotic Use Intention

Pattern of Antibiotic Use Intention	Frequency (n)	Percent (%)
Participants who visited Hospital/ HPH		
Not intended to use ATBs	158	83.6
Intended to use ATBs	31	16.4
Participants who visited Clinic		
Not intended to use ATBs	127	87.0
Intended to use ATBs	19	13.0
Participants who visited Drugstore		
Not intended to use ATBs	110	58.6
Intended to use ATBs	78	41.4
ATB prescription by Hospital/ HPH		
Not prescribed	88	46.6
Prescribed	101	53.4
ATB prescription by Clinic		
Not prescribed	34	23.3
Prescribed	112	76.7
ATB dispensing by Drugstore		
Not dispensed	55	29.3
Dispensed	133	70.7

hospital or HPH (16.4%) and clinic (13.0%). In terms of antibiotic prescription, most respondents reported they was prescribed or dispensed antibiotics when they visited clinics (76.7%) and drugstores (70.7%).

Factors Related to Rational Behavior of Antibiotic Use

When performing MLR analysis, Enter method was firstly used for independent factors like Knowledge and Attitude because they are important variables that used to determine antibiotic use behavior. Forward Likelihood (LR) method was then performed as the best fit model for other variables to identify the predictors of rational behavior of antibiotic use. In MLR analysis by adjusting confounding factors, "Knowledge" and "Attitude" were significantly associated with antibiotic use behaviour, with the suggestion that respondents with sufficient knowledge and appropriate attitude were more likely to practice rational behavior. Both "Prevalence of antibiotic use within last 3 months" and "Visiting drugstore" were also found to be significant factors, with the respondents who did not use any kinds of antibiotics during last 3 months and visit drugstore if they had 3 main diseases, tended to show better practices than their counterparts. On the issue of age groups, the respondents between the ages of 35–56 had more rational use of antibiotics behavior than those with aged between 13 and 34 while older adults (57–78 years) were significantly associated with irrational behavior of antibiotics use comparing with the participants who were less than 34 years of age. For these results, age groups was related to rational drug use as concluded in Table 4.

Discussion

This was one of the few studies in Thailand that were conducted to explore the characteristics of rational use of antibiotics and to identify factors associated with rational behavior among community members.

In our research, the prevalence of respondents having rational behavior of antibiotics use was 51.2%, a significantly lower percentage than these of studies in United Kingdom (90%),[26] Namibia (80%),[27] Hong Kong (78.5%) and Sydney (76.2%).[4] Relatively similar percentage was detected in one of previous studies with 55% of respondents in Spain showing appropriate behavior of such use.[26] However, our finding was slightly higher than that of previous study in Taiwan where 47.2% of respondents expressed responsible behavior towards using antibiotics.[28] Various results could be explained by the differences in levels of health literacy of general population in regard to antibiotics use and self-

Table 4 Predictive Factors Associated with Rational Use of Antibiotics Using Multiple Logistic Regression (n=254)

Variables	AOR[a]	95% CI	p-value[b]
Age Groups			
13–34 years	1		
35–56 years	1.62	(0.88–2.98)	0.124
57–78 years	0.38	(0.17–0.85)	0.018*
ATB use (last 3 months)			
Used	1		
Not used	1.89	(1.04–3.43)	0.037*
Knowledge of participants			
Inadequate	1		
Adequate	3.37	(1.92–5.90)	0.0001***
Attitude of participants			
Inappropriate	1		
Appropriate	2.90	(1.54–5.43)	0.001**
Visiting Drugstore			
Visited	1		
Not Visit	2.04	(1.06–3.92)	0.033*
Intention to use ATBs when visiting Hospital/ HPH			
Intended	1		
Not Intended	2.412	(0.978–5.947)	0.056

Notes: [a]Adjusted for all variables in the table, [b]*p-value<0.05, **p-value<0.01, ***p-value<0.001.
Abbreviations: AOR, adjusted odds ratio; CI, confidence interval.

care, cultural norms in terms of views and trust to healthcare providers, and standard criteria to define rational antibiotics use.

Among socio-economic characteristics, only age and education level of respondents were found to be significantly associated with behavior of antibiotics use. Respondents with higher educational status were more likely to have better practices towards antibiotics use, a finding that supported previous studies in Nepal, Sydney and Hong Kong[3,4] but contrasting with French study that postulated appropriate behavior of using antibiotics were more frequently observed in subjects with low educational level.[2] We recorded younger age groups to practice more rational antibiotics use than old individuals, a similar observation to that of Egyptian study,[1] Serbia study and contrary result to those found in studies of France, Sydney, Norway and Hong Kong where older respondents showed better practices.[2,4] Moreover, one study from Turkey stated that young respondents with higher education are more likely to be irrational about using the antibiotics.[29] In respect of extent of antibiotics use, we found about 60% of respondents reported to have used antibiotics within one year prior to surveying. This figure was lower than those of other comparative studies[27,30–32] but quite higher than the results of studies in Bahir Dar, Lithuania[9,33] and in Taiwan which showed 55% of patients who visited emergency department were on regular use of antibiotics.[34] Socio-demographic factors like age, educational status, income level together with individuals' knowledge and attitude about the aspect of antibiotics use, antibiotics prescribing patterns of responsible doctors, and degree to which one's national policies can optimize antibiotics usage, can contribute to such wide variation in magnitude of antibiotics usage.

We observed that over half of respondents (54.3%) had insufficient level of knowledge about antibiotics use, a significant higher percentage than that of comparable Serbian study[6] and Malaysian studies, in which half of the respondents lacked for the knowledge of antibiotics appropriate usage.[35] Base on our study, knowledge was the most significant predictor for antibiotics use behavior, with the suggestion that respondents with adequate knowledge were more likely to show rational behavior, similar findings were found out in many previous studies.[3,4,6,7,36] Apart from knowledge, attitude was recorded to be another reliable independent factor of antibiotics use behavior. Respondents with appropriate attitude tended to express more rational behavior than those having inappropriate attitude, the studies against this observation were found in Malaysia, Sydney and Hong Kong.[4,35]

One interesting finding stated that respondents who had sufficient knowledge were able to have more likelihood of showing positive attitude towards antibiotics use which was harmonious with other previous researches.[7,36,37] Generally, having proper knowledge about health related topics can lead to positive attitude towards health seeking behavior which will produce better practice of health behavior.

Concerning sources of antibiotics accessibility among the respondents, most of them frequently visited healthcare facilities when they wanted to take antibiotics in case they got certain symptoms. The result was revealed that hospital and HPH were reported as the major sources if they have common medical illness, therefore, respondents in this study area were seemed to rely mostly on hospitals or HPH as their trusted health centres. Our finding revealed that almost all of the respondents were asked for antibiotics if they were not prescribed antibiotics at the first visit and most of them selected clinics as the second place for requesting antibiotics.

With respect to information channels for antibiotics usage, physicians or other healthcare providers were recorded as the most commonly information source for about 63% of respondents. Our observation was significantly higher than that of United Kingdom study which stated only 13% of subjects using this channels.[26] However, the percentage of respondents in UK study acquiring information from the internet was found to be similar to our study. Such variation in different findings could be explained by cultural perspective of individuals towards certain health related behavior, which supported most Asian people are more likely to approach doctors or other healthcare professionals for finding out information about one's health.

In this research, those respondents who visited local drugstores when they had symptoms of main diseases were less likely to show rational practices of antibiotics use than their counterparts. The suggestion of the possible reason is that those who were not visited drugstores might have better knowledge about self-limiting nature of these common diseases and better practice for taking care of their own health rather than using antibiotics. Although, most of them went to healthcare places such as hospitals, HPH and clinics when having main diseases, only small percentage had intention to request antibiotics, except for those who visited drugstores, indicating over one-third having such intention of antibiotics use. In accordance with this finding, local people showed certain degree of dependency on healthcare centres in spite of having self-limiting diseases for taking care of their own health rather than intention to use antibiotics.

In terms of antibiotics use in healthcare facilities, we observed that prescribing and dispensing antibiotics in clinics and drugstores were significantly higher than those of hospital or HPH. Several factors like non-compliance to antibiotics sales policy by suppliers, increased demand by the consumers in case of self-medication to treat some medical conditions and the lack of law enforcement regarding antibiotics use and sales might contribute to widespread antibiotics consumption at both clinics and community drugstores.

Conclusion

To our knowledge, it was one of very few studies in Thailand that were conducted to assess the extent of antibiotics use and to identify related factors of rational behavior of using antibiotics among general population. Since data source used in this research was collected in only one province as the provincial model, generalizability should be of concern when applying related findings to other areas. Further researches should be conducted by using a larger scale study to get more definitive findings. Based on the results of this study, it is important to encourage people to have the correct knowledge and appropriate attitudes about rational use of antibiotics. In addition, a nationwide study of the association between rational antibiotic use at different ages is recommended as a data base for policy interventions that promote antibiotic use at the different ages. Encouraging RDU in drugstore or RDU pharmacy, and public policy restriction with respect to antibiotics sales in drugstores is a challenge of optimise antibiotics consumption by the community people whenever they had common medical illnesses which helps to reduce irrational drug use in the community.

Abbreviations

AD, Acute Diarrhea; AMR, Antimicrobial Resistance; AOR, Adjusted Odd Ratio; ATB, Antibiotics; FW, Fresh wound; HPH, Health Promoting Hospital; MLR, Multiple Logistic Regression; RDU, Rational Drug Use; RUA, Rational Use of Antibiotics; URI, Upper Respiratory Infection; WHO, World Health Organization.

Data Sharing Statement

The corresponding author can make the required data and material available whenever needed, upon reasonable request.

Ethics Approval and Inform Consent

Rational Use of Antibiotics (RUA) survey was approved by the Ethical Review Committee for Research in Human Subject, Nakhon Nayok Provincial Public Health Office with certificate of NPHO 2019-0010 and this research was also conducted under the approval of Ethical Committee of Mahidol University with certificate of 2020/027.1910. The Committee are in full compliance with International Guidelines of Human Research Protection such as Declaration of Helsinki, The Belmont Report, and CIOMS Guidelines and are independent of all the institutions involved and had no role in the design, conduct or reporting of the research. All the participants gave informed consent and verbal consent to the researchers before the interviews took place.

Disclosure

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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