

Proportion, Patterns and Associated Factors of Inappropriate Antibiotic Prescriptions in Acute Upper Respiratory Tract Infection

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Abstract

Objectives: To study the proportion, patterns, and factors associated with inappropriate antibiotic prescription (IAP) in acute upper respiratory tract infection (ARTI) at the Student Health Center (SHC), Prince of Songkla University (PSU). **Methodology:** A descriptive retrospective study was conducted by reviewing medical records from the hospital information system (HIS) of Songklanagarind Hospital. Seven hundred and thirty ARTI patients, who met inclusion criteria at the SHC, PSU from 1 January to 30 September 2018 and diagnosed with common cold, acute pharyngitis, and acute tonsillitis under the ICD10 code. Four hundred and thirty-four patients were excluded after medical record review. Descriptive and inferential statistics were employed in the data analysis using the R® 4.0.0. software program. Associations were evaluated via odds ratios with 95% confidence intervals. The level of statistical significance was set at $p < 0.05$ using multivariate analysis. **Results:** Two hundred and ninety-six participants were enrolled in the study. The proportion of antibiotic use in ARTI was 17.2% (51 of 296). Among antibiotic prescriptions, the proportion of IAP was 80.4% (41 of 51). The patterns of IAP were as follows: no antibiotics indication 90.2% (37 of 41), wrong duration 26.2% (11 of 41,—a 5 day amoxicillin therapy was the most common 27.2%), and wrong dose 12.2% (5 of 41,—all received amoxicillin in the dose of 2,000 mg/day). The multivariate analysis demonstrated that factors significantly associated with IAP were being a patient with an underlying disease (adjusted OR=4.22, $p < 0.001$) and a nurse practitioner as prescriber (adjusted OR=10.93, $p < 0.001$). **Conclusion:** Antibiotic prescriptions in ARTI at the SHC, PSU did not exceed the 20% rate set in the rational drug use hospital policy for antibiotic prescription criteria. Nevertheless, the proportion of IAP among ARTI patients was high, and the most common pattern was prescribing antibiotics without an indication. Therefore, future research should focus on how to enhance the adherence to antibiotic prescription guidelines to promote appropriate antibiotic prescription, especially among nurse practitioners.

Keywords: inappropriate antibiotic prescriptions, acute upper respiratory tract infection, rational drug use hospital policy, student health center

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สัดส่วน ลักษณะและปัจจัยที่เกี่ยวข้องของการใช้ยาปฏิชีวนะอย่างไม่สมเหตุผลในโรคติดเชื้อระบบทางหายใจส่วนบนเฉียบพลัน

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บทคัดย่อ

วัตถุประสงค์: เพื่อศึกษาสัดส่วน ลักษณะและปัจจัยที่เกี่ยวข้องของการใช้ยาปฏิชีวนะอย่างไม่สมเหตุผล ในโรคติดเชื้อระบบทางหายใจส่วนบนเฉียบพลัน ที่ศูนย์สุขภาพนักศึกษา มหาวิทยาลัยสงขลานครินทร์ **ระเบียบวิธีศึกษา:** เป็นการศึกษาย้อนหลังเชิงพรรณนา โดยทบทวนเวชระเบียนจากระบบสารสนเทศโรงพยาบาล ผู้ป่วยโรคติดเชื้อทางหายใจส่วนบนเฉียบพลันที่เข้าเกณฑ์ในการศึกษา 730 คน ที่มาศูนย์สุขภาพนักศึกษา มหาวิทยาลัยสงขลานครินทร์ ระหว่าง 1 มกราคม - 30 กันยายน 2561 ได้รับการวินิจฉัยโรคหัด โรคคอตีบ อหิวาต์ โรคคอตีบ อหิวาต์ โรคคอตีบ อหิวาต์ ตามรหัส ICD-10 เมื่อทบทวนข้อมูลในเวชระเบียนผู้ป่วย 434 คนถูกคัดออกจากการศึกษา วิเคราะห์ข้อมูลโดยใช้สถิติเชิงพรรณนาและสถิติเชิงอนุมานโดยใช้โปรแกรม R® วิเคราะห์ความสัมพันธ์ด้วย odds ratios และ 95% confidence interval กำหนดระดับนัยสำคัญทางสถิติไว้ที่ 0.05 ด้วยการวิเคราะห์พหุตัวแปร (multivariate analysis) **ผลการศึกษา:** ผู้เข้าร่วม 296 คนเข้าสู่การศึกษา สัดส่วนการใช้ยาปฏิชีวนะในโรคติดเชื้อทางหายใจส่วนบนเฉียบพลันร้อยละ 17.2 (51 จาก 296 คน) ในกลุ่มผู้ได้รับยาปฏิชีวนะ พบสัดส่วนการใช้ยาปฏิชีวนะที่ไม่สมเหตุผลร้อยละ 80.4 (41 จาก 51 คน) ลักษณะของการใช้ยาปฏิชีวนะที่ไม่สมเหตุผลมีดังนี้ การได้รับยาปฏิชีวนะโดยไม่มีข้อบ่งชี้ร้อยละ 90.2 (37 จาก 41 คน) การได้รับยาปฏิชีวนะผิดระยะเวลาร้อยละ 26.2 (11 จาก 41 คน) ยาปฏิชีวนะที่ได้รับผิดระยะเวลามากที่สุดคือ amoxicillin 5 วัน (ร้อยละ 27.2) และการได้รับยาปฏิชีวนะผิดขนาดร้อยละ 12.2 (5 จาก 41 คน) ผู้ได้รับยาผิดขนาดทุกคนได้ amoxicillin 2,000 มิลลิกรัมต่อวัน การวิเคราะห์พหุตัวแปรพบปัจจัยที่เกี่ยวข้องกับการใช้ยาปฏิชีวนะที่ไม่สมเหตุผลอย่างมีนัยสำคัญทางสถิติ คือ ผู้ป่วยมีโรคประจำตัวมีการใช้ยาปฏิชีวนะที่ไม่สมเหตุผลมากกว่าผู้ป่วยไม่มีโรคประจำตัว (adjusted OR = 4.22, $p < 0.001$) และผู้ตรวจที่เป็นพยาบาลเวชปฏิบัติมีการใช้ยาปฏิชีวนะที่ไม่สมเหตุผลมากกว่าอาจารย์แพทย์ (adjusted OR = 10.93, $p < 0.001$) **สรุปผลการศึกษา:** ศูนย์สุขภาพนักศึกษามีการใช้ยาปฏิชีวนะในโรคติดเชื้อระบบทางหายใจส่วนบนเฉียบพลัน ไม่เกินเกณฑ์ร้อยละ 20 ตามนโยบายโรงพยาบาลส่งเสริมการใช้ยาอย่างสมเหตุผล แต่ยังมีการใช้ยาปฏิชีวนะอย่างไม่สมเหตุผลในระดับที่จัดว่าสูง ส่วนใหญ่ได้รับยาปฏิชีวนะโดยไม่มีข้อบ่งชี้ จึงจำเป็นต้องวิจัยต่อเพื่อให้การใช้ยาปฏิชีวนะเป็นไปตามแนวทางการใช้ยาปฏิชีวนะอย่างสมเหตุผล โดยเฉพาะในกลุ่มพยาบาลเวชปฏิบัติ

คำสำคัญ: การใช้ยาปฏิชีวนะอย่างไม่สมเหตุผล, โรคติดเชื้อทางหายใจส่วนบนเฉียบพลัน, นโยบายโรงพยาบาลส่งเสริมการใช้ยาอย่างสมเหตุผล, ศูนย์สุขภาพนักศึกษา

Background and Rationale

Acute upper respiratory tract infections (ARTI) especially the common cold, acute pharyngitis, and acute tonsillitis, are common diseases encountered in general practice around the world. About 12 million people per year who visit outpatient departments in the USA with ARTI.⁽¹⁾ Moreover, 156 million new ARTI episodes per year

are reported globally, of which 96.7% occur in developing countries.⁽²⁾

Group A beta-hemolytic streptococcus (GABHS) is the most important bacterial cause in acute pharyngitis and acute tonsillitis which should be treated with antibiotics to shorten the duration of the disease and prevent potential complications from GABHS pharyngitis/tonsillitis,



especially rheumatic fever and rheumatic heart disease. However, viruses are the most common cause of ARTI with only 5-15% of adult cases have bacterial causes.⁽³⁾ A 2004 study from Siriraj Hospital, Thailand found a GABHS infection rate of 7.9% in ARTI 16% in acute pharyngitis/acute tonsillitis and 3.7% in the common cold.⁽⁴⁾

Centor scores are commonly used clinical prediction rules for GABHS pharyngitis/tonsillitis. The Centor score uses signs and symptoms like the absence of cough, swollen/tender anterior cervical nodes, tonsillar exudate, and temperature $>38^{\circ}\text{C}$ each sign/symptom is assigned a score of 1 and the total score is 4.⁽⁵⁾ In places where a throat swab culture and/or a rapid antigen detection test (RADT) is unavailable, too costly, or taking a long time to obtain the result, as the case of most settings in Thailand, an empirical antibiotics should be considered in patients with a Centor score of ≥ 3 (specificity = 0.82, 95% CI 0.72 to 0.88)^(6,7) as a high risk of GABHS pharyngitis/tonsillitis.

Inappropriate antibiotic prescription (IAP) causes antimicrobial resistance; it is one of the most important healthcare problems around the world, including Thailand. The burden of anti-

microbial resistance in Thailand was estimated in 2010 to result in 3.24 million days of longer hospitalization and 38,481 deaths per year as well as a cost of 2,539-6,084 million baht in antibiotics required for antimicrobial resistance treatment.⁽⁸⁾ However, IAP in ARTI occurs in various ways; a few of them are prescribing antibiotics without indication, without relevant regimen such as using the wrong drug, wrong dose, or wrong duration. A study in the USA showed that 60% of patients that came to see doctors with a sore throat received antibiotics and tended to receive broad-spectrum antibiotics rather than narrow-spectrum.⁽⁹⁾ A study in Indonesia found that 88.2% of acute pharyngitis patients received antibiotics; 87.4% had an inappropriate indication, 0.09% received an inappropriate drug, and almost all patients received for an inappropriate duration.⁽²⁾ In Thailand, studies had shown that 80% of ARTI patients received antibiotics⁽¹⁰⁾, 72% of acute pharyngitis/tonsillitis patients at Kornburi Hospital were prescribed antibiotics, and 85% received antibiotics without appropriate indications.⁽¹¹⁾ Moreover, a study conducted at a subdistrict health-promoting hospital in Buayai contracted unit of primary care reported

Table 1. Centor score⁽⁵⁾

Symptoms	Points	Score	Post-test probability (%)
Tonsillar exudates	1	0	2.5
Tender anterior cervical adenopathy	1	1	6.5
Absence of cough	1	2	15.4
History of fever ($> 38.0^{\circ}\text{C}$)	1	3	31.6
		4	55.7

a 29.8% of antibiotics prescribed in medical record data that did not correspond to the treatment guidelines. This included medications used without indications (81.3%), inappropriate medication regimen (14.1%), and failure to prescribe antibiotic in patients with indication (4.6%).⁽¹²⁾

There are many factors affecting the IAP decision among both the patients and healthcare providers; they include patient age⁽¹¹⁾, gender⁽¹³⁾, underlying disease⁽¹⁴⁾, type of health insurance⁽¹³⁾, education program⁽¹⁵⁾, category of healthcare providers⁽¹⁶⁻²⁰⁾, and doctor-patient encounter time.⁽¹³⁾

The Thai National Strategic Plan on Antimicrobial Resistance (2017–2021) was set up to reduce the morbidity, mortality, and economic impact of antimicrobial resistance by aiming to reduce inappropriate antibiotic use and increase public awareness of antimicrobial resistance, including raising the knowledge of medical personnel regarding the appropriate prescription of antibiotics.⁽²¹⁾ Furthermore, the Rational Drug Use Hospital Guideline has limited antibiotic use in ARTI and acute bronchitis at outpatient settings not exceeding 20%.⁽²²⁾ Songklanagarind Hospital has participated in the Rational Drug Use Hospital Project by establishing hospital guidelines for the rational drug use since November 10, 2017 with the goal of promoting the appropriate drug use in the hospital as well as the Student Health Center, Prince of Songkla University (PSU). The Student Health Center is operated by staff, resident physicians, and nurse practitioners from the Faculty of Medicine, PSU and provides healthcare services to PSU students. Its medical record data show that ARTIs, including

the common cold, acute pharyngitis, and acute tonsillitis, are the top 5 most common diseases diagnosed at the center. Presently, there is a limited number of studies that have explored antibiotic prescription. This study aimed to determine the proportion, patterns, and factors associated with an inappropriate antibiotic use in ARTI prescribed at the Student Health Center, PSU.

Methodology

Study design: A descriptive retrospective study.

Participants: ARTI patients who visited the Student Health Center, PSU, between January 1, 2018 and September 30, 2018.

Inclusion criteria: ARTI patients diagnosed as ICD-10 codes—acute nasopharyngitis [common cold] ICD-10 J00, acute pharyngitis J02 (J02.0 streptococcal pharyngitis, J02.8 acute pharyngitis due to other specified organisms, J02.9 acute pharyngitis, (unspecified), and acute tonsillitis J03 were included.

Exclusion criteria: Based on medical record data, (1) patients with a history of using antibiotics during the previous 7 days, and (2) patients with insufficient information to compute a Centor score were excluded.

Setting: Student Health Center, Prince of Songkla University.

Data collection:

1. Hospital numbers of the ARTI patients who were diagnosed with a common cold, acute pharyngitis, and acute tonsillitis (in accordance

with the listed ICD-10 codes) between January 1, 2018 and September 30, 2018 were retrieved from the hospital information system (HIS) with the specified inclusion and exclusion criteria.

2. Data on the ARTI patients were collected from the medical records and recorded in the record form. The abstracted data consisted of: (1) demographic data such as gender, age, health insurance, and study program, and (2) clinical data like underlying disease, history of drug allergy, diagnosis, category of healthcare providers, history and physical examination data related to the Centor criteria, and antibiotic prescription data such as the type of drug, dosage, frequency, and duration of therapy. The antibiotic prescriptions that did not follow the protocol presented in Figure 1 were considered inappropriate.

3. The data collected were input into the EpiData version 3.1 software. ID numbers were

assigned to each participant, and only those ID numbers were used on the data sets for analysis. No personally identifiable data were stored, and individual confidentiality was ensured. Data access was strictly granted only to the researchers. The data files will be destroyed within five years of their creation.

Data editing: Data cleansing was conducted to detect inaccuracies in the records of the computer database management system using the EpiData version 3.1 software.

Data analysis: Data were analyzed using the R[®] 4.0.0. program. The descriptive data were presented as frequency and percentage. Baseline characteristics were compared between the groups using the chi-square test. The multivariate logistic regression model was used to determine the variables associated with the outcome measures of inappropriate antibiotic prescriptions.

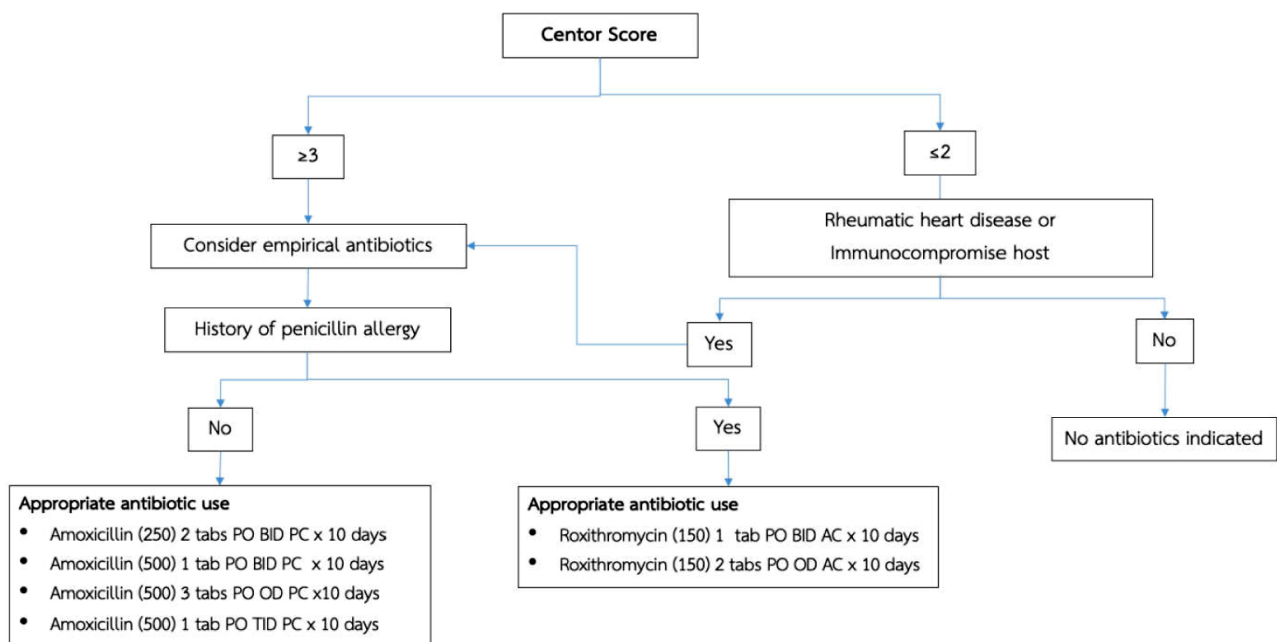


Figure 1. Flow chart of antibiotic prescription criteria according to the Rational Drug Use Hospital Guideline⁽²²⁾

Adjusted odds ratios (OR) and 95% confidence intervals (CI) were also derived. The level of statistical significance was set at $p < 0.05$.

Ethical approval: This study was conducted in compliance with the Helsinki Declaration protocol and approved by Human Research Ethics Committee, Faculty of Medicine, Prince of Songkla University (Ref. 61-035-9-4).

Results

Baseline characteristics

The hospital numbers of 730 ARTI patients who visited the Student Health Center, PSU were reviewed (Table 2). Most of them were female (76.2%) with a mean age of 20.7 ± 1.6 years. The majority were studying in non-health science program (77.4%). Universal coverage scheme was the main type of health insurance (75.9%), and 18.9% of the ARTI patients had underlying diseases such as allergic rhinitis (55.8%), asthma (10.9%), and dyspepsia/gastroesophageal reflux disease or GERD (7.2%). A history of drug allergy characterized 5.9% of the students, with allergy to penicillin being the most prevalent (34.1%). The most common diagnosis was the common cold (79.9%), and more than half of the ARTI patients were diagnosed by staff physicians (51.9%).

Of the 730 ARTI patients who met the criteria for inclusion, 434 were excluded after the review of medical records—49 had a history of using antibiotics during the 7 days prior to presentation, and 385 had insufficient data to compute the Centor score. Hence, 296 participants were enrolled and

evaluated for the study outcomes.

As shown in Table 3, a Centor score of ≥ 3 was determined for 4.1% (12 of 296) of the participants indicating that they should have received empirical antibiotics.

Proportion of inappropriate antibiotic prescription in ARTI patients

Fifty one of the 296 participants (17.2%) received antibiotics to treat their ARTI. The most frequently used antibiotic was amoxicillin 500 mg (94.1%, 48 of 51) with a dose of 1,000 mg/day (54.2%, 26 of 48) [Table 4]. The most common duration of therapy was 10 days (83.3%, 40 of 48). The other antibiotic used was roxithromycin 150 mg (5.9%, 3 of 51).

Of the participants who received antibiotics, 10 met the criteria for an antibiotic prescription (Centor score ≥ 3), and the remaining 41 participants did not. Therefore, the proportion of IAP was 80.4%. Additionally, none of the patients suspected of having a bacterial infection (Centor score ≥ 3) were not prescribed antibiotics in this study.

Patterns of inappropriate antibiotic prescription in ARTI patients

Three patterns of IAP were identified: receiving antibiotics without appropriate indication (Centor score ≤ 2) [90.2%, 37 of 41], wrong duration of therapy (26.2%, 11 of 41), and wrong dosage (12.2%, 5 of 41) [Table 4]. No participant received the wrong drug in this study, and one participant could be IAP with more than one pattern.

Table 2. Demographic and clinical characteristics of the ARTI patients (N=730)

Characteristics	ARTI patients (%)
Gender	
- Male	174 (23.8)
- Female	556 (76.2)
Age (Mean ± S.D.): 20.7 ± 1.6 years min-max: 18-30 years old	
Health insurance	
- Universal Coverage Scheme	554 (75.9)
- Cash	153 (21.0)
- Government Officer Scheme	23 (3.2)
Study program	
- Non-health science	565 (77.4)
- Health science	165 (22.6)
Patients with underlying disease (n=138)	
- Allergic rhinitis	77 (55.8)
- Asthma	15 (10.9)
- Dyspepsia/GERD	10 (7.2)
- Hyperthyroidism	8 (5.8)
- Migraine	6 (4.3)
- Major depressive disorder	5 (3.6)
- Anemia	5 (3.6)
- SLE	4 (2.9)
- G-6-PD	3 (2.2)
- Other	5 (3.6)
Patients with a history of drug allergy (n=43)	
- Penicillin	14 (34.1)
- NSAIDs	8 (19.5)
- Bactrim	6 (14.6)
- Cephalosporin	3 (7.3)
- Azoles	2 (4.9)
- Other	6 (14.6)
- Unknown	2 (4.9)
Diagnosis	
- Common cold	583 (79.9)
- Acute pharyngitis	85 (11.6)
- Acute tonsillitis	62 (8.5)
Attending healthcare provider	
- Staff physician	379 (51.9)
- Resident physician	185 (25.4)
- Nurse practitioner	166 (22.7)

Eleven participants received the wrong duration of therapy—most of them received amoxicillin 500 mg for 5 days (27.2%, 3 of 11), 6 days (18.2%, 2 of 11), and 7 days (18.2%, 2 of 11) and roxithromycin 150 mg for 7 days (18.2%, 2 of 11) [Table 4].

Table 3. Centor score data of the participants (N=296)

Centor score	Participants (%)
Centor score ≥ 3	12 (4.1)
Centor score ≤ 2	284 (95.9)
Absence of cough	78 (26.4)
Fever (T > 38 °C)	37 (12.5)
Tonsillar exudate	35 (11.8)
Tender anterior cervical adenopathy	15 (5.1)

Wrong dosage was identified in 5 participants; all of them received amoxicillin 2,000 mg/day.

Factors associated with inappropriate antibiotic prescriptions

A bivariate analysis was performed to identify factors that may lead to IAP. The significant factors associated with IAP in this study were the attending healthcare provider being a nurse practitioner (OR=8.34 [95% CI 2.88-24.08], $p = < 0.001$) and a patient with an underlying disease (OR = 2.96 [95% CI 1.30-6.46], $p = 0.003$).

After adjusting for potential confounders, the multivariate analysis also determined having an underlying disease and the attending healthcare provider being a nurse practitioner to associate

Table 4. The proportion and patterns of inappropriate antibiotic prescriptions (N = 296)

Antibiotic prescription (N=296)	Participant (%)
Antibiotic use	51 (17.2)
Inappropriate antibiotic prescription (IAP)	41 (80.4)
One IAP pattern	31
Two IAP patterns	8
Three IAP patterns	2
Receiving antibiotics without indications (n=41) (Centor score ≤ 2)	37 (90.2)
Receiving the wrong dose (n=41)	5 (12.2)
Amoxicillin 2,000 mg/day	5
Receiving the wrong duration (n=41)	11 (26.2)
Amoxicillin 5 days	3
Amoxicillin 6 days	2
Amoxicillin 7 days	2
Amoxicillin 15 days	1
Roxithromycin 7 days	2
Roxithromycin 14 days	1

Table 5. Factors associated with inappropriate antibiotic prescriptions

Characteristics	All (N = 296)	Inappropriate use (N = 41)	OR (95% CI)	p-value (bivariate analysis)	Adjusted OR (95% CI)	p-value (multi-variate analysis)
Gender						
- Male	65	7 (10.8)	Referent	0.415		
- Female	231	34 (14.7)	1.43 (0.58-4.02)			
Age						
- 18-22 years	261	33 (12.6)	Referent	0.100		
> 22 years	35	8 (22.9)	2.05 (0.74-5.13)			
Health insurance						
- Universal Coverage and Government Officer Schemes	244	32 (13.1)	Referent	0.427		
- Cash payment	52	9 (17.3)	1.39 (0.54-3.24)			
Study program						
- Health science	70	13 (18.6)	Referent	0.191		
- Non-health science	226	28 (12.4)	1.61 (0.72-3.46)			
Underlying disease						
- No	244	27 (11.1)	Referent	0.003*	Referent	< 0.001*
- Yes	52	14 (26.9)	2.96 (1.30-6.46)		4.22 (1.89-9.42)	
Healthcare providers						
- Staff physician	175	22 (12.6)	Referent		Referent	
- Resident physician	99	7 (7.1)	0.53 (0.18-1.35)	0.155	0.50 (0.20-1.24)	0.134
- Nurse practitioner	22	12 (54.5)	8.34 (2.88-24.08)	< 0.001*	10.93 (4.03-29.62)	< 0.001*

significantly with IAP (Table 5). Patients with an underlying disease had a higher chance of receiving IAP compared to those without any underlying disease (adjusted OR = 4.22 [95% CI 1.89-9.42], $p = < 0.001$). Nurse practitioners had a higher occurrence rate of IAP compared to staff physicians (adjusted OR=10.93 [95% CI 4.03-29.62], $p = < 0.001$).

Discussion

The proportion of antibiotic prescriptions in

ARTI patients, which included those diagnosed with a common cold (ICD -10 J00), acute pharyngitis (ICD-10 J02) and acute tonsillitis (ICD-10 J03), was 17.2% (51 of 296). The antibiotic prescriptions for ARTI at this outpatient setting did not exceed the 20% maximum target rate for antibiotic prescription specified by the Rational Drug Use Hospital Policy.⁽²²⁾ However, the ARTI patients who met the inclusion criteria for this study did not include those diagnosed via ICD-10 J06 (acute upper respi-

ratory infections of multiple and unspecified sites). Thus, these results do not warrant the conclusion that the Student Health Center, PSU complied successfully with the Rational Drug Use Hospital Policy criteria that led to the limiting of antibiotic use for this condition ($\leq 20\%$).

Only 3.4% (10 of 296) of ARTI patients met the criteria for antibiotic prescription (Centor score ≥ 3); this was lower than the rate found by the study of Treebupachatsakul et al. at Siriraj Hospital, which reported the 7.94% prevalence of GABHS in ARTI patients using throat swab cultures.⁽⁴⁾ This may be due to differences in population between the studies. The Treebupachatsakul study was conducted in a general population including children and adults, whereas all participants of this study were university students (mean age 20.7 years).

The proportion of IAP in ARTI patients that received antibiotic was 80.4% (40 of 51). This finding was similar to that of the study by Ratanapongleka⁽¹¹⁾ conducted in a community hospital in Nakhonratchasima Province, which found an 85.0% rate of antibiotic use without indications. Similarly, a study from Indonesia by Yuniar et al.⁽²⁾ found an 80.0% prevalence rate of overprescribing antibiotics in the treatment of acute pharyngitis. However, our finding was higher than the proportion reported by Puyati and Kanjanarach⁽¹²⁾ conducted in a subdistrict health-promoting hospital of Bua Yai, Nakhonratchasima; they found only 29.8% of antibiotic prescriptions in the medical record data did not correspond to the treatment guidelines.

The most common pattern of IAP in this study

was receiving antibiotics without appropriate indication (90.2%, 37 of 41). This was similar to that of the Puyati and Kanjanarach study⁽¹²⁾ (81.3%), and the Yuniar et al.⁽²⁾ study from Indonesia (87.4%); while 4.6% of patients in the Bua Yai subdistrict health promoting hospital study did not receive antibiotics despite having correct indication for use (untreated indication), but the untreated indication was not found in our study. The types of antibiotic used in this study were amoxicillin 500 mg and roxithromycin 150 mg compliant to the Rational Drug Use Guideline. However, receiving the wrong therapy duration (26.2%) and the wrong drug dose (12.2%) were frequently found in our study similar to the Bua Yai⁽¹²⁾ study of a 14.1% inappropriate antibiotic regimens.

After multivariate analysis, significant factors associated with IAP were patients with an underlying disease and the attending healthcare provider being a nurse practitioner. Being a patient with an underlying disease was a factor associated with more IAP compared with being a patient without any underlying disease; this was similar to the study of Malo et al.⁽¹⁴⁾ conducted among patients diagnosed with acute bronchitis in the primary care setting of Aragón, Spain during 2011. They found that the likelihood of appropriate treatment was lower for patients who presented with chronic co-morbidities. Our finding may be attributed to our study participants predominantly suffered from respiratory tract underlying diseases such as allergic rhinitis (55.8%) and asthma (10.9%). It was possible that the attending doctors might be more concerned about severe illness in patients



with such underlying diseases or that patients with respiratory tract underlying conditions tended to ask for antibiotics more than other patients.

The nurse practitioner was a factor associated with more IAP compared with staff physicians; this result was different from the findings of the Ladd study⁽¹⁹⁾ in the US through the retrospective, national, probability sample data of nurse practitioner (NP) and medical doctor (MD) visits for patients with viral ARTI between 1997 and 2001. It found no significant differences in antibiotic prescription for viral ARTI between NPs (50.4%) and MDs (53%). The study of Ness et al,⁽²⁰⁾ reported that guidelines/protocols; safety, tolerability, and efficacy of the antimicrobial itself; patient/parent pressure; and personnel training/experience were influencing factors of antimicrobial agent prescribing behavior in independent nurse prescribers.

The comparison between resident physicians and staff physicians found no significant difference in IAP; this result was different from that of a previous study by Tell et al.⁽¹⁷⁾ that was conducted in the health center setting of Sweden. It found that interns, resident physicians, and younger general practitioners prescribed antibiotic following the guideline more than older general practitioners. However, the present study's finding was similar to that of the Gómez et al.⁽¹⁸⁾ study that was conducted in a university hospital in Spain and found no major significant difference in antibiotic prescription between staff and training physicians. The finding of the present study may be explained by the fact that both resident and staff physicians were a part of the same educational system at a

nationally accredited medical school, thus, both tended to follow clinical practice guidelines; but nurse practitioners were recruited to work as supporting personnel to the medical school hospital system.

There were some limitations in this study. First, there was the occurrence of incomplete data. This was a retrospective study—data were collected via the review of medical records from the HIS—which is a study design that is prone to data being missing or incomplete. Second, this study utilized only data from the medical records at the Student Health Center, PSU that might have introduced some bias concerning factors associated with antibiotic prescriptions. All our participants were university students; thus, they had different characteristics from members of the general population. Third, our study had high missing rate of the Centor score data. Due to incomplete medical records, only cases with positive findings were recruited, this selection bias might lead to overestimated IAP. Lastly, due to the nature of the cross-sectional design, this study was not able to determine the cause-effect association of its findings.

Currently, the Centor score remains the most important clinical prediction rule for GABHS pharyngitis/tonsillitis because rapid antigen detection and culture tests for GABHS are not readily available in Thailand; they are costly for the Thai context, and it may take a relatively long time for the results to be available. If the score is crucial in the proper conduct of assessments of the appropriateness of antibiotic prescriptions in GABHS,

future research question should focus on how to ensure completeness of HIS data for national assessment of RDU.

Conclusion

Even though the antibiotic prescriptions in ARTI patients at the SHC, PSU did not exceed 20% of total IAP in accordance with the Rational Drug Use Hospital Policy for antibiotic prescription criteria, the proportion of IAP among ARTI patients in this setting was high, with the predominant pattern being receiving antibiotics without indications. Therefore, future research should focus on the enhancement of the healthcare personnel's antibiotic prescriptions with the aim of promoting appropriate antibiotic prescription in this setting, especially among nurse practitioners.

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