Research Square

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Physicians' Attitudes as a Key Predictor of Responsible Antimicrobial Use: A Cross-Sectional Dual Physician-Patient KAP Study

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Abstract

Background and Objectives:

Antimicrobial resistance (AMR) is a growing global public health threat associated with substantial morbidity, mortality, and economic burden. Both physicians' prescribing behaviors and patients' antimicrobial use influence antimicrobial stewardship; however, few studies have assessed AMR-related knowledge, attitudes, and practices (KAP) among both groups within the same setting. This study examined AMR-related KAP among physicians and patients in Khon Kaen Province, Thailand.

Methods

A cross-sectional KAP survey was conducted across 29 hospitals in Khon Kaen Province between July and September 2021. A total of 80 physicians and 412 patients participated. Data were collected using pilot-tested, expert-reviewed questionnaires. Descriptive statistics and multivariable linear regression analyses were performed to compare KAP patterns and identify factors associated with practice scores.

Results

Among physicians, more positive attitudes toward AMR were significantly associated with better practice scores ($\beta = 0.26$, 95% CI: 0.15–0.37; $p < 0.001$). Physicians demonstrated high mean knowledge scores (89.5%) but lower practice scores (71.4%), indicating a knowledge–practice gap. In contrast, patients had limited knowledge (31.2%) but relatively high practice scores (80.5%), suggesting compliance with antimicrobial-related instructions despite limited understanding. A shared concern in both groups was the management of upper respiratory tract infections (URTI): around half of patients believed antimicrobials were effective for fever, cough, and colds, while a similar proportion of physicians reported sometimes, often, or always prescribing antimicrobials for URTI.

Conclusions

The patient KAP pattern likely reflects strong reliance on and trust in physicians' recommendations in Thailand, underscoring physicians' pivotal role in antimicrobial stewardship. Alongside patient education, strengthening physicians' AMR attitudes and prescribing practices is critical for stewardship and health system resilience against AMR. In particular, the management of URTI represents a practical, high-yield intervention point, given its high prevalence and shared misconceptions and practices among both physician and patient groups.

1. Introduction

Antimicrobial resistance (AMR) is a rising global threat, associated with an estimated 4.7 million deaths in 2021 and is projected to nearly double by 2050 [1]. AMR also imposes a substantial economic burden. Studies estimate that AMR-related costs could reach as high as US$2 billion annually in Japan, US$4.6 billion in the United States, and US$77 billion in China, driven by prolonged hospital stays, higher readmission rates, and increased mortality [2]. Among the various contributing factors, the inappropriate and excessive use of antibiotics is a major driver of AMR. In 2023, global antibiotic consumption reached an estimated 34.3 billion defined daily doses (DDD), a 16.3% increase from 2016, with the most pronounced growth occurring in lower- and middle-income countries [3].

Healthcare providers are key stakeholders in antimicrobial stewardship initiatives aimed at optimizing antimicrobial use and combating AMR. The Global Action Plan on Antimicrobial Resistance emphasizes improving AMR awareness among both the general public and healthcare professionals [4]. Insufficient physician awareness and inadequate prescribing knowledge remain significant concerns, with many continuing to prescribe antimicrobials despite recognizing their limited effectiveness for certain conditions [5, 6].

On the demand side, public awareness and practices related to AMR also remain suboptimal. Studies conducted by the World Health Organization (WHO) across multiple countries have shown that up to 77% of individuals had used antibiotics within the preceding 12 months, with 21–24% using them inappropriately for viral illnesses such as influenza and sore throat [7, 8]. Furthermore, a 2022 study involving participants from 14 European countries reported that more than half of respondents incorrectly believed that antibiotics are effective for treating influenza [8]. Notably, poor knowledge and inappropriate practices regarding antibiotic use are particularly prevalent in low- and middle-income countries than in high-income countries [7, 8].

Thailand, an upper-middle-income country in Southeast Asia, has observed 55,700 AMR-associated deaths in 2021[9]. Despite the country's commitment to reducing AMR-associated deaths, in alignment with the 2024 UN General Assembly meeting on AMR, current estimates suggest a continuing upward trend [9]. Global pharmaceutical data indicate that antibiotic consumption in Thailand more than doubled, rising from 12.7 to 28.3 DDD per 1,000 inhabitants per day between 2016 and 2023, representing the highest increase among reported countries [3]. To address these challenges, Thailand implemented the first National Action Plan on Antimicrobial Resistance (2017–2022) and is currently implementing the second phase (2023–2027). While progress has been achieved across several areas, policymakers recognize that public awareness remains a critical domain requiring further investment [10].

Concerns about inadequate awareness in Thailand are well supported by literature. The 2023 health and welfare survey found that approximately half of the Thai population had inaccurate knowledge about antibiotics. Specifically, 55% of respondents believed antibiotics could kill viruses, and 49% believed antibiotics were effective for treatment of colds and influenza [11].

On the service provider side, studies highlight variation in perceptions and practices regarding antibiotic use. A recent nationwide study among nursing students in 2024 reported poor antibiotic-related knowledge, with 70% believing antibiotics can treat colds and flu [12]. A 2023 study across 17 Subdistrict Health Promoting Hospitals found that 90% of the nurses correctly answered that antibiotics should not be used for flu-like symptoms [13]. In contrast, a qualitative study among community pharmacists revealed that there are instances when they did not comply standard guidelines due to various pressure such as patient demand, fear of losing clients and promotion from pharmaceutical companies [14].

Although research has explored the perspectives of various healthcare professional groups in Thailand, studies focusing on physicians—who constitute a major group of antibiotic prescribers—remain limited. Moreover, at the global level, studies examining both physicians and patients within the same healthcare setting are relatively scarce.

Therefore, we designed a study including both physicians and patients from the same hospital setting in Khon Kaen Province, Thailand. The study assessed their knowledge, attitudes, and practices regarding antimicrobial use and AMR from complementary perspectives, providing a more comprehensive understanding of the issue. The study also aims to identify factors associated with good practices. The findings are expected to inform the development of targeted communication strategies and policies for both healthcare professionals and the general public in Thailand and potentially in other similar settings.

2. Methods

A cross-sectional Knowledge, Attitude, and Practice (KAP) survey was conducted in Khon Kaen Province between July and September 2021. Physicians were recruited from 29 public hospitals, comprising district hospitals, provincial and general hospitals (including Khon Kaen Hospital, Chum Phae Hospital, and Sirinthorn Hospital), and the university-affiliated Srinagarind Hospital. Patients and their attendants were recruited from two hospitals: Srinagarind Hospital and Nam Pong district Hospital.

Convenience sampling was used to recruit the participants. Physicians were invited to participate voluntarily through official invitation letters containing QR codes, with one follow-up reminder. The QR codes provided direct access to the KAP questionnaire on Google Forms. For patients and their attendants, data were collected by hospital staff trained by the research team. Eligible participants were adults aged 18 years or above; critically ill patients were excluded from the study.

Separate questionnaires for physicians and patients were developed for this study, informed by previous studies and guidelines [7, 15, 16] (Supplementary files S1-S2). Content and face validity were established through review by experts, including infectious disease specialists, community health specialists and family medicine specialists. The questionnaires were subsequently pilot-tested prior to data collection to further assess comprehensibility and response burden.

The physicians' questionnaire comprised 5 knowledge items, 13 attitude items, and 11 practice items, while the patients' questionnaire included 16 knowledge items, 16 attitude items, and 7 practice items.

Physicians' knowledge was assessed using multiple-choice clinical scenario questions, whereas patient knowledge was assessed using 'true/false/don't know' options. Attitudes and practices were measured using a 5-point Likert scale.

Data were entered and cleaned using Microsoft Excel, and statistical analyses were conducted using R version 4.5.3 [17].

Individual questionnaire items were examined to assess response patterns and the extent of adherence to standard guidelines among participants. For analytical purposes, patient attendants were grouped with the patient cohort and categorized as having no current disease, as they represented community members accompanying patients and completed the same questionnaire.

Correct knowledge responses were assigned one point and incorrect or "Don't know" responses were assigned zero points. Attitude and practice items were scored on a five-point Likert scale ranging from 1 (least favorable) to 5 (most favorable). Item scores were summed into a formative index and converted to percentage scores, with higher scores indicating more favorable attitudes and practices.

Missing values for income accounted for approximately 16% of the patient sample and were retained as a separate category to minimize data loss. Missing data for all other variables were less than 4% and were handled using complete-case analysis. Domain percentage scores were calculated using non-missing responses only, provided that no participant had more than 20% missing items within a domain.

Attitude items were further grouped into two thematic domains—antimicrobial use and antimicrobial resistance (AMR)—for both physicians and patients. Items under the antimicrobial use domain assessed respondents' attitudes toward antimicrobial usage, while items under the AMR domain evaluated perceptions of AMR as a global and local public health threat.

Unadjusted and multivariable linear regression analyses were conducted to identify factors associated with the primary outcome (practice scores). Variables included in the multivariable models were selected based on prior literature [11, 18, 19] and theoretical plausibility. Regression model assumptions, including linearity, homoscedasticity, residual normality, and multicollinearity, were assessed using standard diagnostic plots and statistical tests. For group comparisons, the Wilcoxon rank-sum test and Kruskal-Wallis test were used as KAP scores were not normally distributed.

3. Results

3.1 Demographic Characteristics

A total of **80 physicians** from different specialties participated in the survey. The cohort was relatively young, with a median age of 29 years, and general practitioners constituted the largest group (38%). In the patients' cohort, a total of 412 participants were included, with a median age of 47 years, of whom

25% were patients' attendants. The majority were farmers (36%) and covered by the universal coverage scheme[1] (58%) (Table 1).

3.2 AMR knowledge, attitude, practice scores pattern

Distinct patterns in knowledge, attitude, and practice scores between physicians and patients were observed. Physicians had the highest scores for knowledge, followed by attitude and practice, whereas the patients showed the reverse pattern (figure 1).

3.3 Knowledge

Among physicians, all five clinical quiz questions were answered correctly by more than **80%** of respondents. The most frequent inaccurate responses were related to prescribing antibiotics for patients presenting with upper respiratory tract infection (URTI) symptoms, including fever, runny nose, cough, and green sputum (16.2%). Another common misconception (16.2%) was antibiotic selection for suspected Group A Streptococcus pharyngitis/tonsillitis. Some respondents chose broader-spectrum or non-recommended antibiotics, such as amoxicillin-clavulanate or clarithromycin.

Among patients, notable knowledge gaps were observed regarding basic concepts of antimicrobials and AMR. A substantial portion of respondents (35-56%) selected "don't know" across all the knowledge questions (Table 2). Comparable to physicians, misconceptions regarding URTI management were common, with 54% of respondents believing that antimicrobials can treat the common cold. The same knowledge gap was reported for pain and inflammation (54%) and fever (46%) (Table 2).

3.4 Attitude

In the physician cohort, agreement with prescribing antibiotics to prevent possible complications was reported by 65% of respondents, and 26% agreed with prescribing antibiotics when the diagnosis was unclear. While 92% of respondents recognized AMR as a major problem at the national level, only 64% perceived it as a significant issue within their own practice settings. Furthermore, 66% agreed that AMR is driven by variations in antibiotic prescribing practices across different hospitals. Negligible 1.2% agreed that **patient requests could influence antimicrobial prescribing** (Figure 2).

In contrast, 61% of patients expected physicians to prescribe antimicrobials when they were ill. Other attitudes toward antimicrobial stewardship were generally favorable. The majority reported that they would not purchase antimicrobials online (72%), would not share antimicrobials with others (67%), and would not self-medicate for cough (59%). Participants' reliance on physicians was also evident, with 82% indicating that only physicians should prescribe antimicrobials and 85% agreeing that physicians play a primary role in addressing AMR (Figure 3).

3.5 Practice

Among the physicians, the most common inappropriate practice was prescribing antibiotics for general prophylaxis (**68%**). Furthermore, **65%** of respondents reported sometime, often or always prescribing antibiotics for URTI, and **51%** reported doing so for fever, both of which are not recommended practices (Figure 2).

Among patients, most responses to the practice items were consistent with recommended guidelines and instructions. The weakest practice identified was the tendency to discontinue antimicrobials prematurely, with 36% of respondents reporting that they often to always stopped treatment once they felt better (Figure 3).

3.6 Physicians: Factors associated with practice scores

In the physician cohort, unadjusted analysis indicated that practice scores were significantly associated with specialty groups, with higher scores observed among internal medicine physicians and lower scores among antibiotic-sparing specialties such as radiology, rehabilitation, occupational health, psychiatry and anesthesiology. Attitude toward AMR was also significantly associated with practice scores (β = 0.29; 95% CI: 0.19 to 0.40) (Table 3).

In multivariable linear regression analysis, after adjusting for potential confounders, practice scores remained significantly associated with AMR attitude scores (β = 0.26; 95% CI: 0.15 to 0.38). Each 10-point increase in AMR attitude scores was associated with an average 2.6-point increase in practice scores. Specialty group also remained significantly associated with practice scores, with antibiotic-sparing specialties scoring lower than the reference group, internal medicine (β = −7.7; 95% CI: −14.0 to −1.3). Higher knowledge scores were associated with slightly lower practice scores after adjustment (β = −0.10, 95% CI: −0.20 to −0.004; p = 0.041) but the magnitude of the association was modest (Table 3).

3.7 Patients: Factors associated with practice scores

In the patient cohort, unadjusted linear regression analysis showed that attitude toward antimicrobial usage was significantly associated with practice scores (β = 0.64; 95% CI: 0.55 to 0.74). Furthermore, occupation, health insurance scheme, marital status, disease category or attending ward, and income quintile were significantly associated with practice score in the unadjusted linear regression analysis. Higher practice scores were observed among government employees, respondents covered by the Civil Servant Medical Benefit Scheme, single individuals and patients with diseases under the other category such as thyroid diseases, allergies, blood disorders and heart failures, whereas lower scores were observed among the middle-income quintile (Table 4).

After adjusting for potential confounders in multivariable linear regression analysis, attitude toward antimicrobial usage remained significantly associated with practice scores (β = 0.61; 95% CI: 0.51 to 0.72). In practical terms, a 10-point higher attitude score was associated with a 6.1-point higher practice score (Table 4).

Other variables that were significantly associated in unadjusted analyses were no longer significant after adjustment. However, an interaction between sex and marital status was identified (p = 0.021). Specifically, widowed or separated males had significantly lower practice scores compared to their female counterparts (β = −11.0; 95% CI: −20.0 to −1.7) (Table 4).

4. Discussions

Our study found that knowledge relating to antimicrobials and antimicrobial resistance (AMR) was limited among patients, despite relatively high practice scores. In contrast, physicians exhibited high knowledge scores but comparatively lower practice scores. Furthermore, the links between attitudes and practices differed between the two groups. While attitudes toward antibiotic use were associated with better practices among patients, physicians' practices were more strongly influenced by their attitudes toward AMR.

One common gap observed among both physicians and patients relates to their perceptions and antibiotic use for upper respiratory tract infections (URTIs). Notably, although only 16% of physicians answered the URTI-related knowledge questions incorrectly, 65% reported prescribing antibiotics for these predominantly viral conditions in routine practice. Given that URTIs represent one of the most common reasons for healthcare consultations [21], this high propensity to prescribe antibiotics is concerning, particularly as prescribing rates in our cohort may exceed the 2021 national rate of 22.1%, reported in Thai hospitals [10]. Studies from India [22] and China [23] have demonstrated substantial regional variation in AMR-related knowledge, attitudes, and practices. Similar regional variation may exist within Thailand; therefore, further studies are needed to determine whether antibiotic prescribing practices differ across regions.

Antimicrobial prescribing behavior can be influenced by a range of environmental and social factors, including high patient volume, precautionary prescribing in the context of diagnostic uncertainty, limited access to decision-support tools, and pressure to maintain patient satisfaction [5, 24–26]. Consistent with these influences, physicians' attitudes toward AMR emerged as an important factor associated with prescribing practices in our study. Physicians who demonstrated greater awareness of AMR and recognized it as a problem within their own workplace reported better antimicrobial stewardship practices. This observation aligns with the Theory of Planned Behavior, which suggests that attitudes contribute to behavioral intentions and subsequent actions [27]. Therefore, efforts to improve prescribing practices should extend beyond knowledge enhancement alone and also address the attitudinal, motivational, and contextual factors that influence clinical decision-making.

Given the influence of attitudinal and contextual factors on prescribing behavior, antimicrobial stewardship interventions should incorporate professional education as a core component. Thailand ranked 11th among 114 countries in a global assessment of AMR governance, reflecting substantial progress in addressing AMR [28]. However, the same report rated a comparatively lower score in the professional education domain [28], highlighting the need to strengthen AMR-related content in both

undergraduate curricula and continuing professional development programs. Such efforts are particularly important given that, according to the 2023 Thailand National Health and Welfare Survey, healthcare facilities and pharmacies accounted for nearly all reported sources of antibiotics (98.3%) [29]. Collectively, these findings underscore the importance of investing in behavior change-oriented AMR education for healthcare professionals. In addition to physicians, pharmacists should be a key target of these interventions, given the growing contribution of pharmacies as a source of antibiotics, which increased from 26.7% in 2017 to 39.6% in 2023 [29].

While broad educational interventions are important, our findings also suggest that stewardship efforts may need to be tailored to specific groups of healthcare professionals. In our study, we identified significant specialty-specific variations in antimicrobial stewardship, with lower practice scores observed among specialties that do not routinely prescribe antibiotics. Although these clinicians rarely manage primary infections, they retain prescribing authority. Their lower scores likely reflect limited engagement with antimicrobial updates, highlighting a critical gap in universal hospital stewardship programs. Existing evidence across the world also demonstrates differences in AMR-related awareness across specialties [30] and in prescribing practices among different healthcare providers [31–33]. Therefore, it is essential to regularly assess gaps in current interventions and implement inclusive, targeted strategies to ensure a consistent standard of antimicrobial stewardship competencies across all healthcare professionals.

Regarding the inverse pattern observed among patients, who demonstrated appropriate practices despite limited knowledge of antimicrobials, social and contextual factors may provide a partial explanation. Trust in physicians is generally high in Thailand, and patients tend to comply with medical advice with little hesitation [34, 35]. This pattern is also reflected in findings from the National Health and Welfare Surveys, in which fewer than half of respondents correctly answered basic antibiotic knowledge questions (e.g., whether antibiotics can treat influenza), whereas a substantially higher proportion (> 80%) reported appropriate practices, such as completing the full course of prescribed antibiotics [11, 29]. Moreover, respondents in this study were patients or their attendants in hospital settings and may have recently received specific instructions on appropriate medication use, including what to do or avoid when taking antimicrobials. Thus, their appropriate practices may reflect adherence to healthcare providers' advice rather than a comprehensive understanding of antimicrobial use and AMR. These findings underscore the importance of strengthening patient education and counselling on such topics.

Finally, our findings also highlight an equity consideration among patient populations. We identified male widowers as a subgroup requiring targeted attention, as they demonstrated significantly lower practice scores than their female counterparts. This disparity may reflect smaller social networks and reduced access to support [36], underscoring the need for inclusive educational and social support strategies. Addressing these gaps could promote health equity while improving adherence to appropriate antimicrobial-use practices at the population level.

4.1 Strengths and limitations

This study is among the first to examine both physicians and patients within the same geographic setting in Thailand. Although the survey questions were not directly comparable, the findings provide complementary perspectives that contribute to a more comprehensive understanding of antimicrobial use across both the supply and demand sides.

Convenience sampling may have introduced selection bias and limited the generalizability of findings. The physician sample size was also relatively modest; therefore, findings from the analyses should be interpreted with caution and confirmed in larger studies. Additionally, the physicians' responses may not be representative of older age groups, as the study participants' median age was 29 years.

The findings are also subject to reporting biases, which may result in the overreporting of desirable behaviors and underreporting of less favorable practices. Furthermore, comprehension bias should be considered, as the study topic may not have been equally familiar to all participants, particularly among patients, potentially affecting the accuracy of responses. To mitigate this bias, patient and attendant interviews were conducted with trained staff.

The data were collected in 2021; therefore, the findings may not fully reflect current knowledge, attitudes, and practices related to antimicrobial use and AMR. Nevertheless, the findings remain informative, given the limited number of recent studies that have concurrently examined both physicians and patients in Thai hospital settings.

5. Conclusion

This study revealed contrasting patterns of knowledge, attitudes, and practices related to antimicrobial use and AMR among physicians and patients. Despite limited knowledge, patients demonstrated relatively high practice scores, possibly reflecting strong trust in healthcare professionals and Thailand's supportive antimicrobial stewardship environment. In contrast, although physicians demonstrated high levels of knowledge, prescribing practices that were inconsistent with guideline recommendations remained common. Notably, physicians who perceived AMR as a significant problem demonstrated better antimicrobial stewardship practices. Given the central role of physicians in antimicrobial use, targeted interventions that strengthen AMR awareness, foster positive attitudes toward stewardship, and promote appropriate prescribing practices should be prioritized. As URTI is highly prevalent and the misconceptions and prescribing practices observed among both physicians and patients, URTI management may represent a particularly important target for antimicrobial stewardship interventions. Further research is needed to explore regional variations and subgroup-specific gaps among healthcare providers and patients to inform more tailored and effective antimicrobial stewardship strategies.

Abbreviations

AM
Antimicrobial(s)
AMR

Antimicrobial Resistance
AMU
Antimicrobial Usage
CI
Confidence Interval
CSMBS
Civil Servant Medical Benefit Scheme
DDD
Defined Daily Dose
KAP
Knowledge, Attitudes, and Practices
NCD
Non-Communicable Diseases
ObGyn
Obstetrics and Gynecology
R^2
Coefficient of Determination
SHI
Social Health Insurance
SSS
Social Security Scheme
UCS
Universal Coverage Scheme
URTI
Upper Respiratory Tract Infection
WHO
World Health Organization

Declarations

Ethics Approval and consent to participate

Ethical approval for the study was obtained from the Centre for Ethics in Human Research, Khon Kaen University (Project ID: HE641122). The study was conducted in accordance with the ethical principles of the Declaration of Helsinki (1964) and its subsequent amendments. Informed consent was obtained from all participants.

Consent for publication

Not applicable.

Competing Interests

The authors declare that they have no competing interests.

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Author Contribution

HMT, SA, JJ, and RC contributed to the conception, fund mobilization, study design, supervision, and review of the work. PK, BJ, and PN contributed to the methodology, questionnaire development, data collection, data management, and manuscript editing. MAS led the analysis, data interpretation, and manuscript drafting. All authors read and approved the final manuscript.

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Data Availability

The datasets generated and/or analyzed during the current study are not publicly available due to ethical and confidentiality restrictions but are available from the corresponding author on reasonable request.

References

1. Naghavi M, Vollset SE, Ikuta KS, et al. Global burden of bacterial antimicrobial resistance 1990–2021: a systematic analysis with forecasts to 2050. Lancet. 2024;404:1199–226. https://doi.org/10.1016/S0140-6736(24)01867-1.
2. Poudel AN, Zhu S, Cooper N, et al. The economic burden of antibiotic resistance: A systematic review and meta-analysis. PLoS ONE. 2023;18:e0285170. https://doi.org/10.1371/journal.pone.0285170.

3. Klein EY, Impalli I, Poleon S, et al. Global trends in antibiotic consumption during 2016–2023 and future projections through 2030. Proc Natl Acad Sci. 2024;121:e2411919121. https://doi.org/10.1073/pnas.2411919121.
4. World Health Organization. Global Action Plan on Antimicrobial Resistance. Geneva, Switzerland: WHO Document Production Services; 2015.
5. Md Rezal RS, Hassali MA, Alrasheedy AA, et al. Physicians' knowledge, perceptions and behaviour towards antibiotic prescribing: a systematic review of the literature. Expert Rev Anti Infect Ther. 2015;13:665–80. https://doi.org/10.1586/14787210.2015.1025057.
6. Lansink C, Sinha B, Meessen N, et al. Why Do Physicians Prescribe Antibiotics? A Systematic Review of the Psycho-Socio-Organisational Factors Related to Potentially Inappropriate Prescribing of Antimicrobials in Europe. Infect Dis Rep. 2024;16:664–83. https://doi.org/10.3390/idr16040051.
7. World Health Organization. Antibiotic Resistance: Multi-country public awareness survey. Geneva, Switzerland: 2015.
8. WHO Regional Office for Europe. People's knowledge, attitudes and behaviours pertaining to antimicrobial resistance cross-sectional survey of 14 Member States in the WHO European Region. Copenhagen: 2024.
9. Institute for Health Metrics and Evaluation. The burden of antimicrobial resistance (AMR) in Thailand n.d. https://www.healthdata.org/sites/default/files/2023-09/Thailand.pdf (accessed January 27, 2026).
10. Ministry of Public Health. Thailand. Thailand's Second National Action Plan on Antimicrobial Resistance 2023–2027 n.d.
11. Tangcharoensathien V, Chanvatik S, Kosiyaporn H, et al. Population knowledge and awareness of antibiotic use and antimicrobial resistance: results from national household survey 2019 and changes from 2017. BMC Public Health. 2021;21:2188. https://doi.org/10.1186/s12889-021-12237-y.
12. Jianvitayakij S, Niyomyart A, Junsawang C, et al. Knowledge of antibiotics and antibiotic resistance, antibiotic use and eHealth literacy among nursing students in Thailand: a cross-sectional study. BMJ Open. 2024;14:e090956. https://doi.org/10.1136/bmjopen-2024-090956.
13. Boontein P, Utriyaprasit K, Poungkaew A, et al. Antibiotic Usage Patterns of Community-Dwelling Adults in Thailand: A Cross-Sectional Study. J Adv Nurs. 2026;82:414–27. https://doi.org/10.1111/jan.16870.
14. Netthong R, Donsamak S, John DN, et al. Empowering Thai community pharmacists in combating antimicrobial resistance: Qualitative insight and sentiment analysis. Explor Res Clin Soc Pharm. 2024;16:100535. https://doi.org/10.1016/j.rcsop.2024.100535.
15. National Statistical Office, Ministry of Digital Economy and Society, Thailand. The 2019 health and welfare survey 2020. https://www.nso.go.th/nsoweb/nso/survey_detail/96?set_lang=en#gsc.tab=0 (accessed May 13, 2026).

16. Subcommittee for Rational Drug Use Promotion. Rational Drug Use Hospital Manual. 1st ed. The Agricultural Cooperative Federation of Thailand Printing House; 2015.
17. R Core Team. R: A language and environment for statistical computing n.d.
18. Phueanpinit P, Siriwattanasakul N, Tichakorn P, et al. Knowledge and perceptions of outpatients regarding upper respiratory tract infections and awareness of an Antibiotics Smart Use campaign in Thailand. J Pharm Pract Res. 2022;52:294–302. https://doi.org/10.1002/jppr.1801.
19. Precha N, Sukmai S, Hengbaru M, et al. Knowledge, attitudes, and practices regarding antibiotic use and resistance among health science and non-health science university students in Thailand. PLoS ONE. 2024;19:e0296822. https://doi.org/10.1371/journal.pone.0296822.
20. Pongpisut Jongudomsuk. Thailand health system review. 2nd edition. Manila: World Health Organization on behalf of the Asia Pacific Observatory on Health Systems and Policies; 2024.
21. Sirota SB, Doxey MC, Dominguez R-MV, et al. Global, regional, and national burden of upper respiratory infections and otitis media, 1990–2021: a systematic analysis from the Global Burden of Disease Study 2021. Lancet Infect Dis. 2025;25:36–51. https://doi.org/10.1016/S1473-3099(24)00430-4.
22. Rana S, Kaur KN, Narad P, et al. Knowledge, attitudes and practices of antimicrobial resistance awareness among healthcare workers in India: a systematic review. Front Public Health. 2024;12:1433430. https://doi.org/10.3389/fpubh.2024.1433430.
23. Fan Z, Zhang Y, Wu Y, et al. Public understanding and misuse of antibiotics in China: insights from a comprehensive national survey. Lancet Reg Health - West Pac. 2025;62:101682. https://doi.org/10.1016/j.lanwpc.2025.101682.
24. Mabaya G, Evans JM, Longo CJ, et al. A Behavioral Analysis of Factors That Influence Antibiotic Prescribing in Hospitals: A Metasynthesis of Reviews. Open Forum Infect Dis. 2024;12:ofae728. https://doi.org/10.1093/ofid/ofae728.
25. Lim DW, Htun HL, Ong LS, et al. Systematic review of determinants influencing antibiotic prescribing for uncomplicated acute respiratory tract infections in adult patients at the emergency department. Infect Control Hosp Epidemiol. 2022;43:366–75. https://doi.org/10.1017/ice.2020.1245.
26. Chan OSK, Lam W, Zhao S, et al. Why prescribe antibiotics? A systematic review of knowledge, tension, and motivation among clinicians in low-, middle- and high-income countries. Soc Sci Med. 2024;345:116600. https://doi.org/10.1016/j.socscimed.2024.116600.
27. Godin G, Bélanger-Gravel A, Eccles M, et al. Healthcare professionals' intentions and behaviours: A systematic review of studies based on social cognitive theories. Implement Sci. 2008;3:36. https://doi.org/10.1186/1748-5908-3-36.
28. Patel J, Harant A, Fernandes G, et al. Measuring the global response to antimicrobial resistance, 2020–21: a systematic governance analysis of 114 countries. Lancet Infect Dis. 2023;23:706–18. https://doi.org/10.1016/S1473-3099(22)00796-4.
29. National Statistical Office, Ministry of Digital Economy and Society, Thailand. The 2023 health and welfare survey 2024.

https://www.nso.go.th/nsoweb/storage/survey_detail/2023/20230929131046_99194.pdf (accessed May 13, 2026).

30. Babatola AO, Fadare JO, Olatunya OS, et al. Addressing antimicrobial resistance in Nigerian hospitals: exploring physicians prescribing behavior, knowledge, and perception of antimicrobial resistance and stewardship programs. Expert Rev Anti Infect Ther. 2021;19:537–46. https://doi.org/10.1080/14787210.2021.1829474.
31. García C, Llamocca LP, García K, et al. Knowledge, attitudes and practice survey about antimicrobial resistance and prescribing among physicians in a hospital setting in Lima, Peru. BMC Clin Pharmacol. 2011;11:18. https://doi.org/10.1186/1472-6904-11-18.
32. Rana S, Kaur KN, Narad P, et al. Knowledge, attitudes and practices of antimicrobial resistance awareness among healthcare workers in India: a systematic review. Front Public Health. 2024;12:1433430. https://doi.org/10.3389/fpubh.2024.1433430.
33. Gonzales R, Camargo CA, MacKenzie T, et al. Antibiotic Treatment of Acute Respiratory Infections in Acute Care Settings. Acad Emerg Med. 2006;13:288–94. https://doi.org/10.1197/j.aem.2005.10.016.
34. Jiraporncharoen W, Pinyopornpanish K, Junjom K, et al. Exploring perceptions, attitudes and beliefs of Thai patients with type 2 diabetes mellitus as they relate to medication adherence at an out-patient primary care clinic in Chiang Mai, Thailand. BMC Fam Pract. 2020;21:173. https://doi.org/10.1186/s12875-020-01233-7.
35. Wattanapisit A, Saengow U. Patients' perspectives regarding hospital visits in the universal health coverage system of Thailand: a qualitative study. Asia Pac Fam Med. 2018;17:9. https://doi.org/10.1186/s12930-018-0046-x.
36. Isherwood L. The gendered experience of social resources in the transition to late-life widowhood. Ageing Soc. 2023;43:689–705. https://doi.org/10.1017/S0144686X21000829.

Footnotes

1. Thailand's three main public health insurance schemes comprise the Civil Servant Medical Benefit Scheme (CSMBS), Social Health Insurance (SHI), and Universal Coverage Scheme (UCS). CSMBS covers government employees and dependents, SHI covers private-sector employees, and UCS covers the remaining population.[20]

Tables

Table 1 to 4 are available in the Supplementary Files section.

Figures

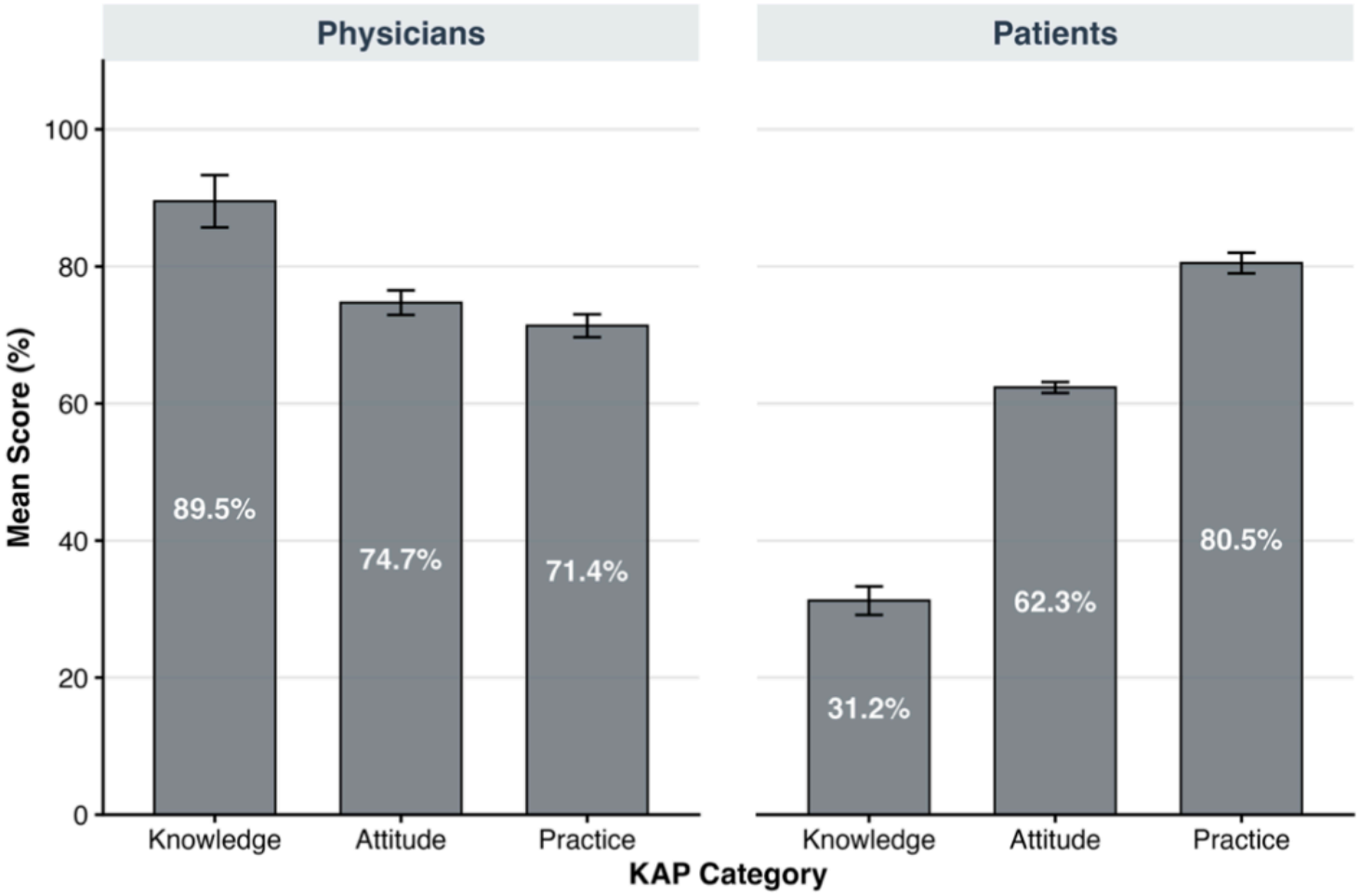


Figure 1

Mean percentage scores of KAP items among physicians and patients, with 95% confidence intervals.

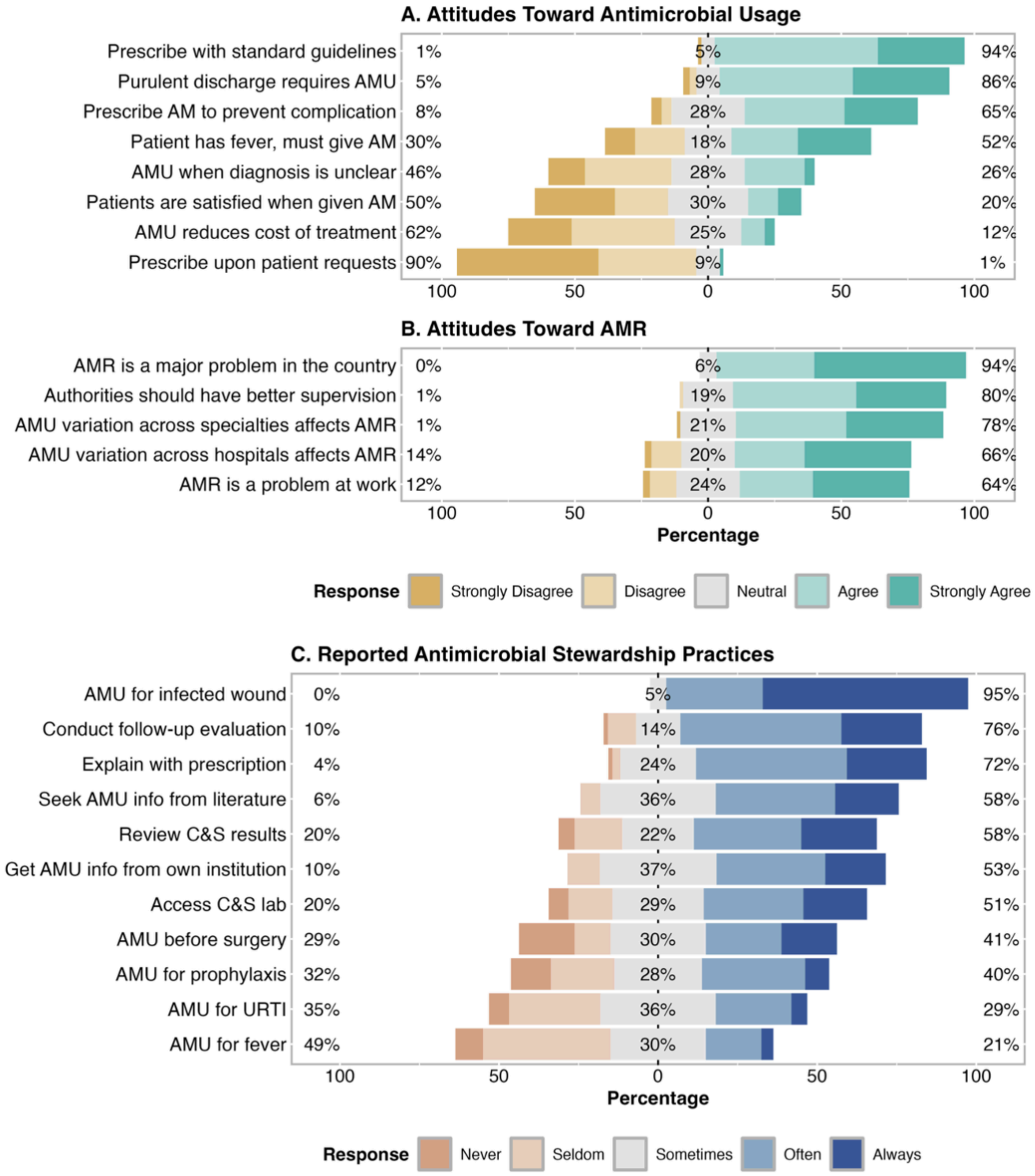


Figure 2

Percentage distribution of physicians' responses to attitude and practice items on antimicrobial use and AMR

Note. Panels A and B show 5-point scales (Strongly Disagree to Strongly Agree); Panel C shows frequencies (Never to Always). Outer percentages represent the combined proportions of the two outer

categories on each side. (e.g., in Panel A, for the top item, 1% strongly disagreed/disagreed while 94% agreed/strongly agreed). Abbreviations: AMU = antimicrobial usage, C&S = culture and sensitivity

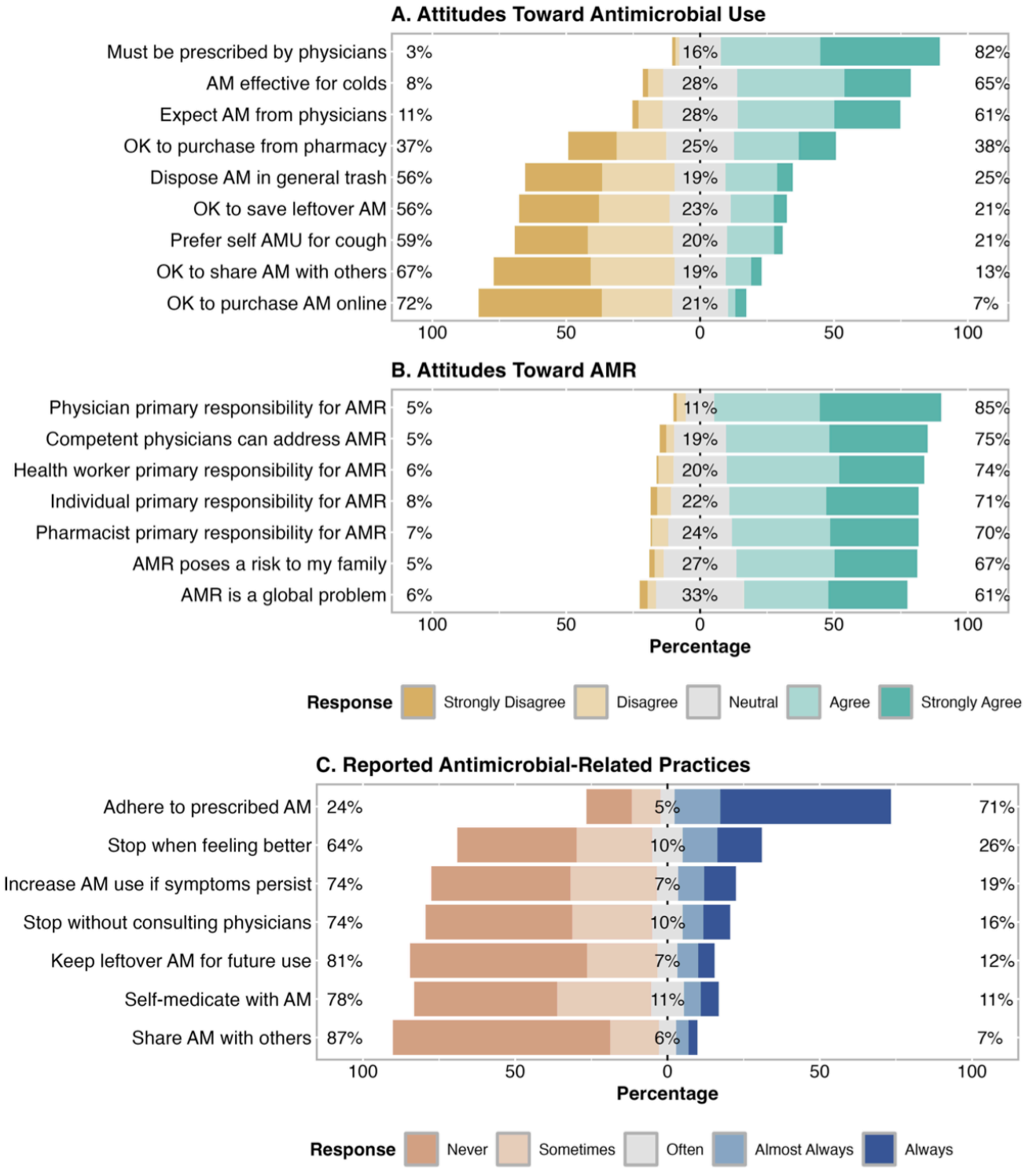


Figure 3

Percentage of patients' responses to attitude and practice items on antimicrobial use and AMR

Note. Panels A and B show 5-point scales (Strongly Disagree to Strongly Agree); Panel C shows frequencies (Never to Regularly). Outer percentages represent the combined proportions of the two outer categories on each side (e.g., in Panel A, for the top item, 3% strongly disagreed/disagreed while 82% agreed/strongly agreed). Abbreviation: AM = Antimicrobial(s)

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- SupplementaryFileS1PhysicianQuestionnaire.docx
- SupplementaryFileS2PatientQuestionnaire.docx
- Table1234.docx