ORIGINAL ARTICLE

Antibiotic Prescribing Rates and Patterns at the Pediatric Outpatient Clinic of King Chulalongkorn Memorial Hospital

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Background: The World Health Organization (WHO) developed the AWaRe, which is the Access, Watch, and Reserve framework to optimize antibiotic use and promote stewardship, with a target of having at least 60% of the prescribed antibiotics come from the Access category. However, data on pediatric outpatient antibiotic prescribing in Thailand remain limited.

Objective: To evaluate the frequency, patterns, and appropriateness of antibiotic prescriptions among pediatric outpatients with suspected infections, focusing on respiratory symptoms.

Materials and Methods: A point-prevalence study was conducted over two years, in 2022 and 2023, in the pediatric outpatient department of King Chulalongkorn Memorial Hospital (KCMH), that included all children under 18 years of age who presented with acute infection symptoms on the survey day. Data on demographics, symptoms, and antibiotic prescriptions were collected and classified by a single investigator using the WHO AWaRe classification. The rationality of prescriptions was evaluated based on WHO guidelines.

Results: Among 354 pediatric patients, 39 (11.0%) received antibiotics. Most prescriptions (77.5%) were from the Access group, primarily amoxicillin at 47.5% and amoxicillin-clavulanic acid at 20.0%, both of which were recommended first-line treatments for respiratory infections. Antibiotics from the Watch group accounted for 22.5%, while no Reserve group antibiotics were prescribed. All cases of sinusitis received antibiotic treatment, and the overall antibiotic prescribing rate for respiratory illnesses was 10.8%. Additionally, 87.5% of all prescriptions complied with WHO guidelines.

Conclusion: The present study highlights a low rate of antibiotic prescriptions among pediatric outpatients, accompanied by high adherence to WHO guidelines and a predominant use of Access group antibiotics. These findings underscore the importance of maintaining rational prescribing practices.

Keywords: Antibiotics; Prevalence; AWaRe; Outpatient; Primary care; Point prevalence survey; PPS

Received 17 April 2025 | Revised 5 October 2025 | Accepted 6 October 2025

J Med Assoc Thai 2025;108(11):898-905

Website: http://www.jmatonline.com

Antimicrobial resistance (AMR) is a global threat to health and development[1]. The inappropriate and excessive use of antimicrobials is a major driver of drug-resistant pathogens, contributing to increased mortality, morbidity, hospital length of stay, and healthcare costs[2-4]. Outpatient clinics are key sites for prescribing antibiotics, offering a critical opportunity to address inappropriate use and combat antibiotic resistance. They also generate essential data to inform antimicrobial stewardship strategies, particularly in low- and middle-income countries (LMICs). The overall antibiotic prescribing rate in outpatient settings ranges from 12.6% to 35.7%[5-8]. These rates vary across regions. In the United States, the overall rate is 12.6%, with 22.1% for respiratory infections[5]. In Sri Lanka, the rates are higher at 35.7% overall and 47.3% for respiratory infections[7]. In Jordan, the overall prescribing rate is 19.5%, with 50.8% for respiratory infections[6], while Northern Spain reports an overall rate of 14%[8].

In 2022, the World Health Organization (WHO) released the WHO Essential Medicines List (EML) AWaRe (Access, Watch, Reserve) Antibiotic Book[9,10], which provides detailed guidance on the selection, dosage, and duration of antibiotic treatment for 35 common infections in both adults and children, across primary care and hospital settings. The AWaRe

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How to cite this article:

Tojumroen B, Subchartanan J, Cook A, Goelen J, Anugulruengkitt S. Antibiotic Prescribing Rates and Patterns at the Pediatric Outpatient Clinic of King Chulalongkorn Memorial Hospital. J Med Assoc Thai 2025; 108:898-905.

DOI: 10.35755/jmedassocthai.2025.11.898-905-02979

Book is based on the AWaRe classification system[11], which categorizes antibiotics according to their potential to promote AMR. Access group antibiotics are characterized by a narrow spectrum of activity and a favorable safety profile with regard to side effects. Common examples include amoxicillin, amoxicillin-clavulanate, cloxacillin, and metronidazole. Watch group antibiotics are broader-spectrum agents and considered first-choice options for patients with more severe clinical presentations or when resistance to Access antibiotics is likely. Examples include azithromycin, cefdinir, cefixime, and ceftriaxone. Reserve group antibiotics are last-resort agents, reserved for the treatment of confirmed or suspected multidrug-resistant infections. Examples include colistin, fosfomycin, tigecycline, and linezolid. The WHO recommends that at least 60% of all antibiotic use should come from the Access group. It also advises that nine out of the ten most common infections in primary care should be treated with Access antibiotics.

In Thailand, the Rational Drug Use Committee released the Rational Drug Use Hospital Manual[12] to help reduce unnecessary antibiotic use, particularly for respiratory infections in outpatient settings, which are often viral rather than bacterial. The manual sets a national target to reduce antibiotic prescribing for upper respiratory tract infections and acute bronchitis in outpatients to below 20%.

Despite the absence of a standardized method for measuring the quantity and appropriateness of antibiotic use in outpatient settings, point prevalence surveys (PPS) are considered a reliable approach. PPS is a method that collects anonymized data on patients receiving antibiotics on a single day, including demographics, specific antibiotics prescribed, and clinical indications. These surveys have been widely and successfully used to assess antibiotic use and prescribing patterns in hospitals worldwide[13-24], with the WHO providing specific guidelines[16] for their implementation in hospital settings. However, although the majority of antibiotic prescribing occurs in primary healthcare and ambulatory care settings, PPS has not been widely adapted for use in these environments.

To inform and monitor antibiotic use targets and prescribing practices in outpatient settings, the use basic tools such as PPS is essential. Currently, no data exist on antibiotic prescribing rates and patterns at the pediatric outpatient clinic of King Chulalongkorn Memorial Hospital (KCMH). This study aimed to describe the rates and patterns of antibiotic prescribing at the pediatric outpatient clinic using the PPS method.

Materials and Methods

Study design and participants

The present retrospective study was conducted at the pediatric outpatient clinic of KCMH, a tertiary care medical school center located in Bangkok, Thailand. The target population included children under 18 years of age presenting to the pediatric outpatient department on the survey day in 2022 and 2023. All the patient data were extracted from electronic medical records (EMRs) without involving the attending physician's decision-making processes or any patient-identifiable information. The attending physicians were unaware of the specific days on which data collection took place. Inclusion criteria comprised all children presenting with acute infection symptoms on the survey day, with "acute" defined as symptoms lasting fewer than 14 days. Exclusion criteria included patients seeking care for underlying chronic conditions and those visiting pediatric subspecialty clinics. No sample size calculation was performed. All eligible participants on the survey day were included. This study was part of the Antimicrobial Resistance, Prescribing, and Consumption Data to Inform Country Antibiotic Guidance and Local Action (ADILA) Antibiotic Prescribing in Primary Healthcare Point Prevalence Survey (APC PPS), a multi-center, multi-country series of PPS that received ethics approval from St. George's Research Ethics Committee in the United Kingdom. The present study also received local approval from the Chulalongkorn University Institutional Review Board (IRB No. 0002/66). Informed consent was exempted due to retrospective nature of the study.

Study procedures

The primary objective of the present study was to quantify the frequency and pattern of antibiotic prescribing among children presenting to the outpatient clinic using the PPS method. Secondary objectives included 1) quantify the proportion of each AWaRe antibiotic prescribed among patients who received an antibiotic prescription, and 2) assessing frequency and pattern of antibiotic prescribing specifically among children with respiratory illnesses presenting to the outpatient clinic.

Surveys were conducted over 12 months in 2022 and five months in 2023 to account for potential seasonal variation in infection patterns presenting at

Table 1. Patient demographic data

Patient demographic data	Overall (n=354)		2022 (n=166)		2023 (n=188)		p-value[a]
	Frequency	%	Frequency	%	Frequency	%	
Sex							
Male	187	52.8	86	51.8	101	53.7	0.8
Age							
Infant (1 to 12 months)	51	14.4	23	13.9	28	14.9	0.331
Toddler (13 to 24 months)	33	9.3	15	9.0	18	9.6	
Preschooler (>2 to 4 years)	145	41.0	63	38.0	82	43.6	
School-aged (5 to 12 years)	101	28.5	56	33.7	45	23.9	
Adolescents (13 to 18 years)	24	6.8	9	5.4	15	8.0	
Comorbidity							
None	290	82.0	147	88.6	143	76.0	0.004
Hematology-oncology	20	5.6	5	3.0	15	8.0	0.035
Allergic rhinitis	11	3.1	5	3.0	6	3.2	0.585
Congenital heart disease	7	2.0	2	1.2	5	2.7	0.455
Developmental disorder	5	1.4	2	1.2	3	1.6	0.558
Genetic disease	4	1.1	0	0	4	2.1	0.078
Asthma	4	1.1	1	0.6	3	1.6	0.626
Others	13	3.7	4	2.4	9	4.8	0.184

(a) Continuity correction of chi-square tests or Fisher's exact test

ambulatory cares facilities. Data were retrospectively collected from EMRs. In 2022, data were collected on the first day of each month using PPS, totaling 12 survey days. In 2023, data collection was conducted between June and October, with two single-day PPS conducted within a two-week period (a "set"), repeated every four weeks for five months. Each survey session was conducted over approximately four hours, representing a standard half-day clinic session on a typical working day.

Data management and analysis

Retrospective data collection was anonymized at the time of capture and did not contain any personal or identifiable information. Data were collected using Open Data Kit (ODK) and analyzed using descriptive statistics (frequencies and percentages) and analytical statistics (chi-square test) in IBM SPSS Statistics, version 29.0 (IBM Corp., Armonk, NY, USA). Continuity-corrected chi-square tests were used to analyze differences in patients' baseline demographic data, presenting infection symptoms/diagnoses, antibiotic prescribing rates and patterns, the proportion of antibiotic prescriptions by AWaRe group, antibiotic prescribing for respiratory illnesses, and the comparison of AWaRe antibiotic prescribing by age group. A p-value of less than 0.05 was considered statistically significant. The appropriateness of antibiotic use was evaluated based on the WHO EML AWaRe Antibiotic Book[9,10].

Results

Demographics

During the study period, 354 children with suspected infections were included, distributed across two data collection periods in 2022 with 166 and 2023 with 188, as shown in Table 1. Of these, 187 (52.8%) were male. Preschool-aged children, older than 2 to 4 years, represented the largest age group, comprising 41.0% with 145 patients, with a slight increase from 38.0% in 2022 to 43.6% in 2023. School-aged children, aged between 5 and 12 years, accounted for 28.5% with 101 patients, with a higher proportion in 2022 at 33.7% compared to 2023 at 23.9%. Adolescents, aged from 13 to 18 years, made up the smallest group, constituting 6.8% (24 patients), with 5.4% in 2022 and 8.0% in 2023. Most children had no comorbidities, thus, 290 (82%). However, the proportion of patients without comorbidities significantly decreased in 2023 at 76.0% compared to 2022 at 88.6% (p=0.004).

Presenting infection symptoms/diagnosis

The three most common symptoms prompting outpatient visits were fever at 82.5%, acute cough at 64.4%, and runny nose/nasal congestion/coryza at 60.2%. All of these symptoms were more frequently reported in 2023 compared to 2022, reflecting

Table 2. Presenting infection symptoms/diagnosis among 354 patients

Presenting infection symptoms/diagnosis	Overall (n=354)		2022 (n=166)		2023 (n=188)		p-value[a]
	Frequency	%	Frequency	%	Frequency	%	
Fever							
Yes	292	82.5	130	78.3	162	86.2	0.072
Acute cough	228	64.4	91	54.8	137	72.9	<0.001
>5 days	1	0.3	0	0	1	0.5	
Shortness of breath/difficulty breathing	20	5.6	2	1.2	18	9.6	
Sore throat/pharyngitis/tonsillitis	54	15.3	27	16.3	27	14.4	0.727
Facial pain or pressure/sinusitis	3	0.8	1	0.6	2	1.1	1.0
Runny nose/nasal congestion/coryza	213	60.2	91	54.8	122	64.9	0.068
Middle ear pain/acute otitis media	11	3.1	4	2.4	7	3.7	0.686
Uni-lateral ear pain	10	2.8	4	2.4	6	3.2	
Bi-lateral ear pain	1	9.1	0	0	1	0.5	
Otorrhea/ear discharge	2	0.6	2	1.2	0	0	
Acute diarrhea/gastroenteritis	53	15.0	27	16.3	26	13.8	0.623
Bloody diarrhea	2	0.6	0	0	2	1.1	
Increased urgency or frequency of urination/UTI	4	1.1	2	1.2	2	1.1	1.0
Wound/burn/bite infection	2	0.6	2	1.2	0	0	0.219
Skin rash/spots - without swelling	17	4.8	12	7.2	5	2.7	0.079
Skin swelling/redness/warmth/pain	5	1.4	2	1.2	3	1.6	1.0
Swollen lymph nodes	5	1.4	2	1.2	3	1.6	
Other primary infection presentation/diagnosis							
Nausea/vomiting	22	6.2	9	5.4	13	6.9	
Chalazion	1	0.3	0	0	1	0.5	
Eye discharge/conjunctivitis	1	0.3	0	0	1	0.5	
Myalgia/Myositis	3	0.9	0	0	3	1.6	

UTI=urinary tract infection

(a) Continuity correction of chi-square tests or Fisher's exact test

seasonal variation or changes in infection prevalence. Notably, the proportion of patients presenting with acute cough increased significantly from 54.8% in 2022 to 72.9% in 2023 (p<0.001). Additional details on presenting symptoms and diagnoses are provided in Table 2.

Antibiotic prescribing rates and patterns

Only 39 of the 354 children (11.0%) received an antibiotic prescription, as shown in Figure 1, which presented the types and frequencies of antibiotics prescribed. The majority of patients, thus, 315 patients (89.0%) did not receive antibiotics, with slightly higher, though not statistically significant, non-prescription rates observed in 2022 at 91.6% compared to 2023 at 86.7% (p=0.098).

Among the 39 children who received antibiotic prescriptions, one patient diagnosed with community-acquired pneumonia was prescribed two antibiotics, ceftriaxone and azithromycin, resulting in 40 antibiotic prescriptions analyzed. Amoxicillin was the most commonly prescribed antibiotic, accounting for 47.5% (19 patients). Its use increased from 15.0% in 2022 to 32.5% in 2023, although the difference was not statistically significant (p=0.119). Amoxicillin-clavulanic acid was prescribed in 20.0% (8 patients), with an increase in 2023 at 15.0% compared to 2022 at 5.0%. Less frequently prescribed antibiotics included cefixime, for 5.0% (2 patients) and ceftriaxone for 15.0% (6 patients).

Proportion of antibiotic prescribing by AWaRe group

Figure 2A illustrates the distribution of antibiotic prescriptions according to the WHO AWaRe classification. Overall, Access group antibiotics accounted for 77.5% of prescriptions, including amoxicillin and amoxicillin-clavulanic acid. Watch group antibiotics comprised 22.5% of prescriptions, consisting of azithromycin, cefixime, and ceftriaxone. Notably, no antibiotics from the Reserve group were prescribed. There was no

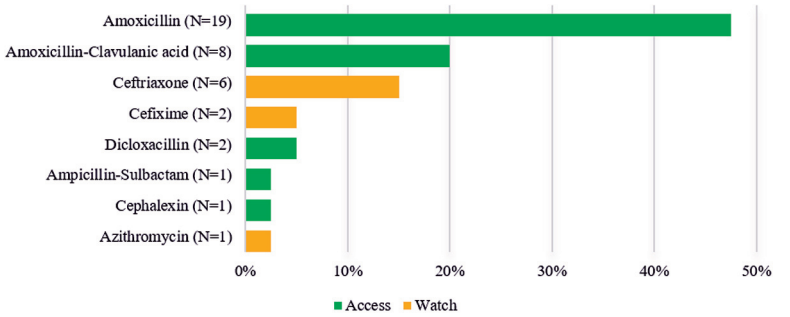

Figure 1. Antibiotic prescribing rates and patterns (n=40).

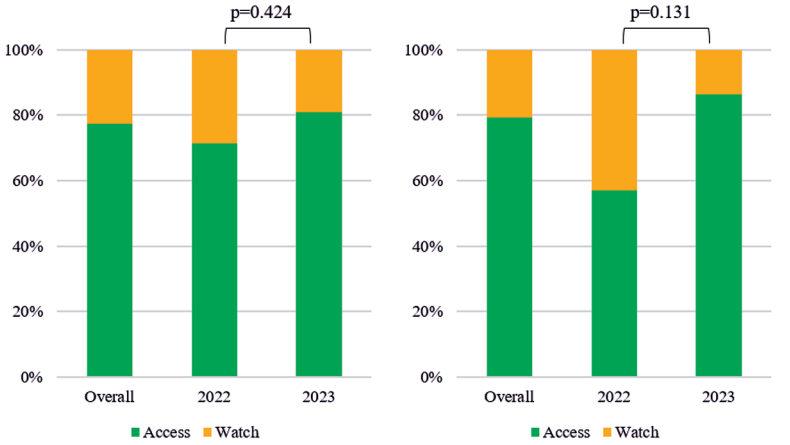

Figure 2. (A: left) AWaRe antibiotics prescribing rate (n=40), (B: right) AWaRe antibiotics prescribing rate among respiratory illnesses (n=29).

statistically significant difference in the proportion of AWaRe antibiotic prescriptions between 2022 and 2023 (p=0.424).

Antibiotic prescribing among respiratory illnesses

Among 268 patients presenting with respiratory illnesses, the overall antibiotic prescribing rate was 10.8% (29 patients), which increased significantly from 6.0% (7 patients) in 2022 to 14.5% (22 patients) in 2023 (p=0.028). The rate of antibiotic prescribing varied by clinical condition with 9.2% (21 patients) for acute cough, 13.0% (7 patients) for sore throat, 100% (3 patients) for sinusitis, and 9.9% (21 patients) for runny nose, as illustrated in Figure 3. The distribution of AWaRe antibiotic prescriptions within this group showed that Access group antibiotics accounted for 57.1% of prescriptions in 2022, increasing to 86.4% in 2023. In contrast, Watch group antibiotics decreased from 42.9% in 2022 to 13.6% in 2023 (Figure 2B). However, this change was not statistically significant (p=0.131).

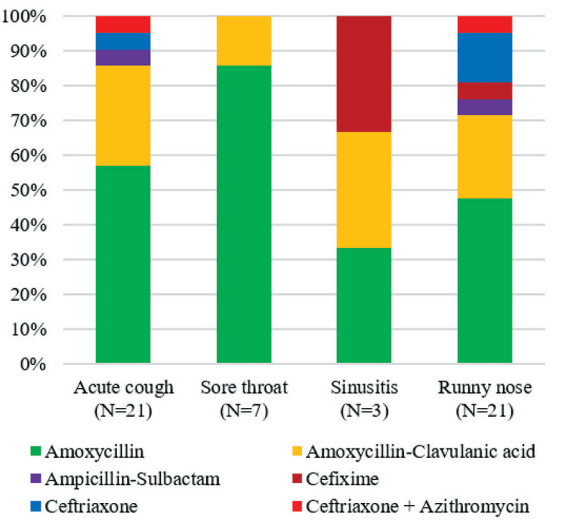

Figure 3. Antibiotics prescribing rate among respiratory illnesses (n=29).

Appropriateness of antibiotic prescribing

The appropriateness of antibiotic prescriptions

was assessed according to the WHO AWaRe guidelines. Overall, 87.5% (35 patients) of prescribed antibiotics were considered rational, while 12.5% (5 patients) were categorized as non-rational. The five non-rational prescriptions included four cases of common cold, in which two patients received amoxicillin and two received amoxicillin-clavulanic acid, and one case of viral acute gastroenteritis (AGE), in which amoxicillin was prescribed.

Comparison of AWaRe antibiotic prescribing by age group

There was a statistically significant difference in the pattern of antibiotic prescribing between age groups. Among the seven children under two years of age who received antibiotics, Access group antibiotics accounted for 42.9% (3 patients), while Watch group antibiotics comprised 57.1% (4 patients). In contrast, among the 32 children older than two years, 87.5% (28 patients) of prescriptions were from the Access group, and only 12.5% (4 patients) were from the Watch group. The use of Watch group antibiotics was significantly more common in the younger age group, p=0.038.

Discussion

In the present study, only 11% of pediatric outpatients received antibiotic prescriptions, with the majority falling under the "Access" category of the WHO's AWaRe framework, thereby meeting the WHO target. This distribution reflects strong adherence to WHO guidelines, which emphasize prioritizing Access antibiotics while limiting the use of broader-spectrum agents in outpatient settings. These findings are consistent with the goals of antimicrobial stewardship, which aim to promote appropriate antibiotic use and reduce the risk of AMR.

The overall antibiotic prescribing rate observed in the present study is low compared to findings from other settings. For instance, a 2021 study in Sri Lanka reported that 35.7% of outpatients received antibiotics, predominantly for respiratory symptoms[6]. Similarly, a systematic review of LMICs found a pooled antibiotic prescription rate of approximately 52% in primary care[25]. The significantly lower rate observed in the present study may be attributed to the timing of data collection, which occurred during the COVID-19 pandemic. During this period, respiratory tract infections were the most commonly reported symptoms, yet these were less likely to result in antibiotic prescriptions due to their viral etiology.

The study highlights that respiratory symptoms, particularly acute cough and sore throat, were the primary reasons for antibiotic prescriptions. Similar trends have been reported in other studies. For example, a 2020 study noted that respiratory infections were frequently over-treated with antibiotics in LMICs due to diagnostic challenges and the lack of rapid diagnostic testing[25]. However, the present findings demonstrate a more restrained approach to prescribe for these symptoms, which contributed to the overall lower rate of antibiotic use observed. The antibiotic prescribing rate among patients with respiratory illnesses in the present study was 10.8%, which met the national target set by Thailand's Rational Drug Use (RDU) policy.

The high rate of rational prescribing observed in the present study, at 87.5%, is notable and may reflect strong adherence to clinical guidelines and an institutional emphasis on rational antibiotic use. This contrasts with findings from other settings, such as a 2016 study in the United States, which estimated that only 70% of outpatient antibiotic prescriptions were appropriate[5]. Such differences may be attributed to variations in healthcare system structures, local stewardship policies, or the timing of data collection, all of which can influence prescribing behaviors and patient presentation patterns. In the present study, amoxicillin was the most frequently prescribed antibiotic, consistent with its recommendation as a first-line treatment for pediatric respiratory infections. This prescribing pattern was also reflected in the 2022 study from Jordan, where amoxicillin accounted for a significant proportion of antibiotic prescriptions in pediatric settings[7]. Notably, the use of Watch group antibiotics was significantly higher among children under two years of age. This suggests potential age-related variability in prescribing practices, which may warrant further investigation to ensure alignment with antimicrobial stewardship principles and WHO AWaRe recommendations.

A key strength of the present study is the use of a PPS design, which enabled the capture of seasonal variations in clinical presentations, offering a more comprehensive understanding of prescribing patterns and symptom prevalence over time. While the findings are encouraging, limitations should be noted. The study was conducted at a single outpatient clinic, which may limit the generalizability of the results to other settings. However, as this study is part of the ADILA APC PPS, a multi-center, multi-country series of PPS, the final aggregated data will provide a broader and more representative foundation for

generalization.

Conclusion

The present study highlights the low prevalence of antibiotic prescribing in a pediatric outpatient setting, with a predominant reliance on Access group antibiotics, in alignment with WHO recommendations. These findings support ongoing efforts to reduce unnecessary antibiotic use and promote rational prescribing practices, thereby, contributing to strengthened antimicrobial stewardship.

What is already known about this topic?

Antibiotic prescribing rates in outpatient settings vary across regions, from 12.6% to 35.7%, but there is no data available for Thailand.

What does this study add?

The overall antibiotic prescribing rate was 11.0%, and 10.8% specifically for respiratory infections. The high rate of rational prescribing observed in this study is noteworthy and may reflect strong adherence to clinical guidelines, as well as an institutional commitment to promoting rational antibiotic use. While this study offers valuable insight into antibiotic prescribing practices at a single pediatric outpatient center, further research is needed to assess the prevalence and patterns of antibiotic prescribing across pediatric outpatient departments throughout Thailand.

Acknowledgement

The authors acknowledge the Department of Pediatrics, Faculty of Medicine, Chulalongkorn University, and ADILA APC PPS as part of the ADILA project, St. George's, University of London, the United Kingdom.

Funding disclosure

This research was funded by the Ratchadapiseksompotch Fund, Faculty of Medicine, Chulalongkorn University) Grant No. GA66/064. ADILA was funded by the Wellcome Trust, 222051/Z/20/Z.

Conflicts of interest

The authors declare no relevant financial relationships to disclose in connection.

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