International Journal of Infectious Diseases 52 (2016) 16–22

Contents lists available at ScienceDirect

International Journal of Infectious Diseases

journal homepage: www.elsevier.com/locate/ijid

Antimicrobial drug use in primary healthcare clinics: a retrospective evaluation

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ARTICLE INFO

Article history:
Received 2 July 2016
Received in revised form 7 September 2016
Accepted 8 September 2016

Corresponding Editor: Eskild Petersen, Aarhus, Denmark

Keywords:
Drug utilization study
Prescribing pattern
Upper respiratory tract infection
Antibiotic guideline
Defined daily dose

SUMMARY

Objectives: To examine the appropriateness of antibiotics prescribed for acute infection based on the Malaysian national antibiotic guidelines and the defined daily dose (DDD) system of the World Health Organization (WHO). This study also aimed to describe the factors influencing the drug use pattern and to investigate the procurement patterns of antibiotics in the primary healthcare setting.

Methods: A retrospective cohort follow-up study of randomly selected patients from all patients who received any antibiotic between January and December 2013 was conducted at three primary healthcare clinics in Selangor State of Malaysia. For each patient, the following information was recorded: name of the antibiotic, frequency and dose, and Anatomical Therapeutic Chemical (ATC) group. The defined daily dose per 1000 inhabitants per day was calculated for each antibiotic. The national antibiotic guidelines were used to assess the appropriateness of each antibiotic prescription.

Results: A total of 735 patients were included in the study. The five most used antibiotics were amoxicillin (1.36 g, 35.2%), cloxacillin (0.68 g, 26.3%), erythromycin (0.32 g, 22.3%), bacampicillin (0.13 g, 7.2%), and cephalexin (0.11 g, 6.9%). Respiratory tract infections were the most commonly treated infections, and the doctors' preferred antibiotic for the treatment of these infections was amoxicillin. More than 18% of all amoxicillin prescriptions were deemed inappropriate according to the national antibiotic guidelines. In terms of procurement costs, USD 88 885 was spent in 2011, USD 219 402 in 2012, and USD 233 034 in 2013 at the three primary healthcare clinics, an average of USD 180 440 per year for the three clinics.

Conclusions: This study reports the antibiotic usage at three primary healthcare clinics in Klang Province. The most prescribed antibiotic was amoxicillin in capsules (250 mg), which was mainly prescribed for respiratory infections. Although the national antibiotic guidelines state that amoxicillin is a preferred drug for acute bacterial rhinosinusitis, this drug is also being prescribed for other disease conditions, such as acute pharyngitis and acute tonsillitis. This result shows that current practice is not following the current antibiotic guidelines, which state that phenoxypenicillin should be the preferred drug.

1. Introduction

In 2011, about 10.1% of annual drug expenditure for primary care clinics was used for antibiotics. Approximately 164.97 million Malaysian ringgit (MYR) (equivalent to USD 43.5 million) was spent for the purchase of antibiotics for all Ministry of Health hospitals and primary care clinics.[1] In the primary care setting, oral antimicrobial drugs feature consistently in the top therapeutic classes of drugs in terms of frequency of use and cost. Thus, the antibiotic usage pattern should be monitored to determine the appropriateness of use and the cost burden of antibiotics in primary care.

Inappropriate prescribing will eventually cause treatment failure and poses a threat to patient safety, which may lead to other issues, such as non-adherence and wastage of resources.[2]

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http://dx.doi.org/10.1016/j.ijid.2016.09.013

Many factors are associated with inappropriate prescribing of antibiotics. These factors may include the limited knowledge and experience of the medical practitioner, personal preference, and parental or patient pressure.[3,4] Physicians and patients both play an important role in monitoring drug use patterns. Prescription decisions and patterns are influenced by the patient's expectations and the doctor's perception of the patient's expectations.[5]

Although the guidelines provided by the Malaysian Ministry of Health can be considered the basis for the rational use of antibiotics in the healthcare setting, it is difficult to ensure that these guidelines are diligently followed. One method to ensure correct prescribing and use is through the undertaking of a drug utilization study (DUS). The DUS evaluates the marketing, distribution, prescription, and use of drugs in society, with specific emphasis on the resulting medical, social, and economic consequences. Healthcare providers should focus on certain components of drug use with regard to DUS criteria; these components include the use, selection, dosage, interactions, and preparation. The DUS plays a key role in understanding, interpreting, evaluating, and improving the prescription, administration, and use of medications. Policymakers and procurement management personnel find DUS valuable because the results may be used to promote the efficient use of scarce healthcare resources.[6] In addition, DUS can be a tool to detect abuse and inappropriate drug usage, which are possible in certain healthcare settings. The DUS can be performed as a prospective, current, or retrospective study. The retrospective DUS involves a review of drug therapy after the patient has completed the course of therapy. This review poses less risk of bias because the prescriber is not aware of the data collection.[7]

The prescription of antibiotics is mainly indicated for the empirical therapy of upper respiratory tract infections (URTIs), urinary tract infection (UTIs), and mild community-acquired pneumonia.[1,8] A surveillance study conducted among Malaysian Ministry of Health hospitals found that antibiotics are often used for therapeutic uses and are commonly given to patients with lower respiratory tract infections.[4] Another study showed that antibiotics are more often prescribed for patients with URTIs than for those without an URTI.[9] Nevertheless, the national antimicrobial resistance surveillance data in 2007 showed high resistance of Gram-negative bacteria, such as *Klebsiella spp* (99%), *Enterobacter spp* (93%), *Escherichia coli* (69%), *Proteus spp* (48%), and *Haemophilus influenzae* (20%), to ampicillin. Hence, the use of these antibiotics as empirical therapy in the primary healthcare setting should be reviewed and changed.[10]

Information on the utilization and appropriateness of antibiotic use among adults in the primary healthcare setting is important, especially when the antibiotics are prescribed for acute diseases. The effectiveness of the antibiotics and occurrence of adverse drug reactions might be related to usage patterns. Thus, a DUS on antibiotic usage should be performed to ensure the implementation of the current drug policies and drug formulary at the health clinic level. Additionally, there is a paucity of pertinent data from cross-sectional and retrospective studies on the comparative prescribing of medical specialist versus medical doctor.

The aim of the present study was to examine the appropriateness of antibiotics prescribed for acute infections based on the Malaysian national antibiotic guidelines of 2014 and the defined daily dose (DDD) system of the World Health Organization (WHO). Furthermore, this study also aimed to describe the factors influencing the drug use pattern and to investigate the procurement patterns of antibiotics in the primary care setting.

2. Materials and methods

This was a retrospective study examining the utilization of selected antibiotics in three government health clinics. The health clinics selected are situated in Klang (Anika), Pandamaran, and Bukit Kuda, which are all within Klang Province. Klang Province has a total of 11 health clinics that offer primary health maintenance services. The clinics at Pandamaran, Anika, and Bukit Kuda are under the management of Klang Province Health Department. Klang Province had a population of 744 062 in 2010. These three large-scale health clinics are located in the centre of the Province of Klang and have the highest population densities. They provide general outpatient care, maternal and child care, dental care, and rehabilitation care. In addition, they also provide laboratory and radiological services. Patients attending these clinics are seen by non-specialist medical doctors or primary care specialists, who are known locally as family medicine specialists.

2.1. Data collection

Information was collected from the electronic clinic management system dispensing records and profile databases. For inclusion in the study, the patient had to be aged between 18 and 60 years and to have been prescribed oral antibiotics. Patients given topical antibiotics, dental treatment, or prophylaxis were excluded from this study. All records of patients attending the three clinics during the period January to December 2013, who fulfilled the necessary criteria, were screened. Out of these records, 245 records from each clinic were chosen at random based on numbering in an alphabetical list. Data gathered from all dispensing records of encoded antibiotics were collected. The prescribed medicine, frequency, and dose were recorded for each patient to obtain the DDD per 1000 inhabitants per day. The national antibiotic guidelines 2014 were used to evaluate the quality of prescription. Comparisons of the DDD between drugs and clinics were assessed against the prescriber and patient characteristics.

2.2. Outcome parameter

The Anatomical Therapeutic Chemical (ATC) classification system is issued by the WHO as a tool for presenting drug utilization statistics in international comparisons. In this classification, each active ingredient of a drug is given a distinct code. Furthermore, the DDD is defined as "the average maintenance dose of the drug when used on its major indication in adults".[11] The DDD can be related to drugs with the ATC classification (Table 1). The DDD does not reflect the prescribed daily dose or recommended dose for the treatment of each patient. However, the DDD is the average maintenance dose taken by adult patients for certain indications. The DDD is also a unit of measurement that can be used as a tool for presenting drug utilization statistics for consideration by pharmacy and therapeutic committee members in drug utilization reviews and drug regimen review activities.[12] The DDD can be presented in many ways; for example, the DDD can be expressed as the DDD per 1000 inhabitants per day when describing chronic disease drug use, or as the DDD per 100 bed-days if inpatient drug use is described.[13] In the present study, the DDD per 1000 patients per day (DID) was used. The DDD result was compared with the current WHO classification of ATC/DDD for the DDD analysis.[12] The antibiotics used in this study are listed in Table 1.

In this study, the data were recorded as the DDD per 1000 inhabitants per day. The quantity of drug use was calculated as follows: DDD/1000 inhabitants/day = $T \times 1000/(\mathrm{DDD} \times P \times 365)$, where T is an estimate of the total quantity of the drug (mg) utilized in the year under consideration, DDD is the DDD assigned for the drug according to the ATC/DDD system, P is the population of health clinics studied, and 365 refers to the 365 days in a year.

The DDD was compared to the treatment agreed in the national antibiotic guidelines to assess the prescribing quality and appropriateness.

Table 1
List of defined daily doses and ATC codes for selected antibiotics

ATC code	Drug class and agent	DDD from WHO (g)
J01C A04	Amoxicillin	1
J01C R02	Amoxicillin and enzyme inhibitor	1
J01C F02	Cloxacillin	2
J01D B01	Cephalexin	2
J01D D04	Ceftriaxone	2
J01C E02	Phenoxymethylpenicillin	2
J01C E08	Benzathine benzylpenicillin	3.6
J01C A06	Bacampicillin	1.2
J01F A01	Erythromycin ethylsuccinate	2
J01D C02	Cefuroxime	0.5
J01E E01	Sulfamethoxazole and trimethoprim	1.92
J01A A07	Tetracycline	1
J01A A02	Doxycycline	0.1

ATC, Anatomical Therapeutic Chemical; DDD, defined daily dose; WHO, World Health Organization.

2.3. Statistical analysis and interpretation

Data were analyzed using IBM SPSS Statistics version 22.0 (IBM Corp., Armonk, NY, USA) and Microsoft Excel version 2010. Data from the patient's prescription record and demographic profile were assessed using descriptive statistics, such as the mean and standard deviation (SD).

2.4. Ethical considerations

This study was approved by the Ethics Committee of Universiti Teknologi MARA and the Clinical Research Centre, Ministry of Health Malaysia. All authors ensured that all data, such as the patient profiles and medical records retrieved from the health information system (Teleprimary Care), were strictly used for research purposes; confidentiality was maintained.

3. Results

A total of 3902 patients attended the three health clinics between January and December 2013. Among the medications dispensed, 17 different antibiotics were used a total of 4460 times. A total of 3879 patients were eligible for further investigation. From the database, 404 (10.4%) patients were prescribed more than one antibiotic within the year 2013, and a total of 167 patients (4.3%) were dispensed different classes of antibiotics throughout the year. All patient IDs were gathered in ascending order and selected at random. The procedure resulted in the selection of data from a total of 735 patients, which was about 18.9% of the total population.

3.1. Socio-demographic characteristics

The records of a total of 735 patients were analyzed. There were significantly more females than males (60.4% vs. 39.6%). The mean age (SD) of the patients was 36.11 (12.66) years. In terms of ethnicity, approximately 40.3% were Malay, 38.4% Indian, 15.3% Chinese, and 6% other ethnicities (Table 2).

3.2. DDD of antibiotics

The doses consumed per day were estimated to obtain the DDD of each antibiotic in 2013 (Figure 1). The total antibiotics used for the three clinics was 2.675 DID. The five most utilized antibiotics were amoxicillin (1.36 DID), cloxacillin (0.68 DID), erythromycin (0.32 DID), cephalexin (0.11 DID), and bacampicillin (0.13 DID). Amoxicillin was found to be the most utilized antibiotic in the population, and was used about two-fold more than cloxacillin.

Table 2
Socio-demographic characteristics of the patients

Characteristics	Number (%)
Age, years	
18–30	304 (41.4)
31–45	224 (30.5)
46–60	207 (28.1)
Sex	
Male	291 (39.6)
Female	444 (60.4)
Ethnicity	
Malay	296 (40.3)
Indian	282 (38.4)
Chinese	112 (15.3)
Other	45 (6.1)

The least utilized antibiotics were cefuroxime, trimethoprim–sulfamethoxazole, doxycycline, and amoxicillin–clavulanic acid. The patients aged 18–30 years had the highest DDD for antibiotics (Figure 2).

In terms of the site of infection, most were respiratory infections. Amoxicillin had the highest DDD in the three health clinics for respiratory infection, followed by erythromycin. For respiratory infections, the DDD was also higher for amoxicillin; therefore, amoxicillin was the most used drug to treat these conditions. About 54.2% of the patients were prescribed amoxicillin capsules (250 mg); this accounted for 65.4% of patients diagnosed with an URTI. According to the national antibiotic guidelines, amoxicillin is not a suitable drug for the treatment of URTIs, except for acute bacterial rhinosinusitis. In the clinics, amoxicillin was prescribed for acute tonsillitis (6.5%, $n = 14$) and acute pharyngitis (11.9%, $n = 26$). However, the appropriate drug for acute tonsillitis and acute pharyngitis is phenoxymethylpenicillin.[14]

The results showed that all age groups received cephalexin for UTIs in accordance with the national antibiotic guidelines. Amoxicillin usage in patients with skin and soft tissue infections in the age groups 31–45 years and 46–60 years was in accordance with the national antibiotic guidelines. About 60% of prescriptions for patients aged 18–30 years followed the indications in the national antibiotic guidelines. However, no significant difference was observed between age groups for the rate of concordance with the WHO DDD and national antibiotic guidelines.

3.3. Factors influencing the antibiotic pattern

3.3.1. Patient characteristics

Patients were classified into three groups according to their age; 18–30, 31–45, and 46–60 years. No significant differences were found in the prescribing pattern for most of the antibiotics. Nevertheless, some differences were observed in specific age groups. For instance, bacampicillin tablets (400 mg) were frequently prescribed in the 18–30 years group. In addition, male patients aged 31–45 years received 1.5 dose of cloxacillin.

3.3.2. Physician characteristics

Physician characteristics are an important determinant in antibiotic utilization. Some physicians fear that disease outcomes may be poor without antibiotic treatment. Therefore, they tend to prescribe inappropriately to obtain the preferred results. The peer norms and local medical culture are important influences on prescribing behaviour.[15]

In this study, primary care specialists prescribed only 1.4% of antibiotics. The use of the specialist-prescribed item cefuroxime by primary care specialists was only 10% (specialist-prescribed items are known locally as medication list A); the other antibiotics

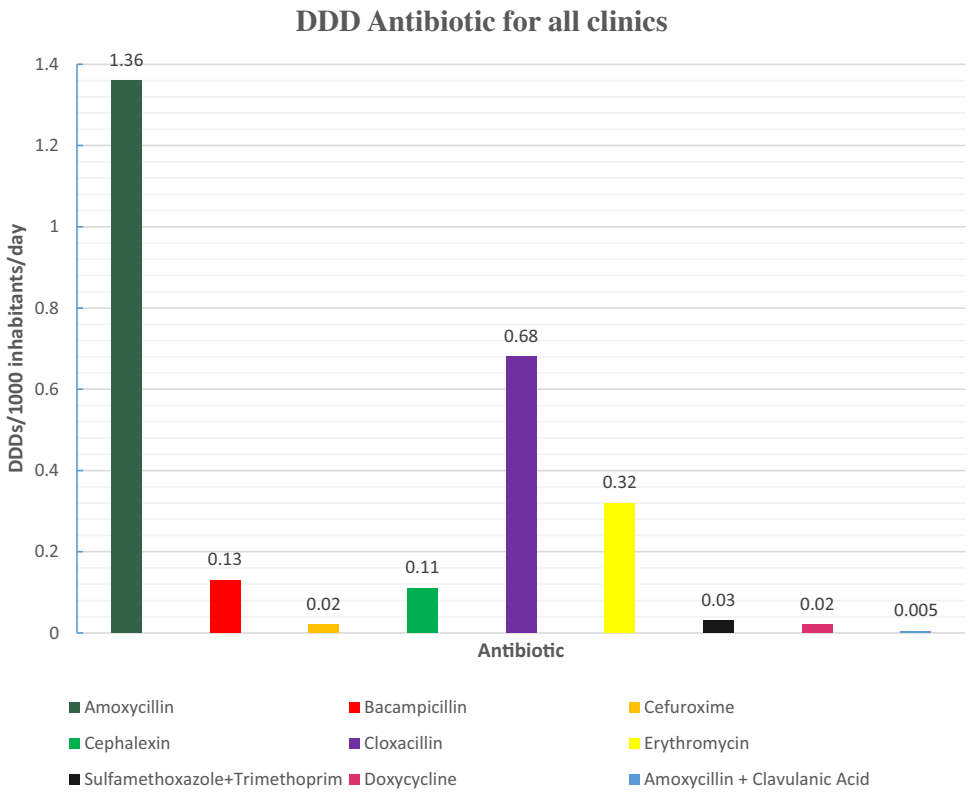

Figure 1. Defined daily dose (DDD) of antibiotics for all three selected clinics.

belong to the non-specialist prescription items (known locally as medication list B) (Table 3).

3.4. Procurement data

From 2011 to 2013, an upward trend in overall procurement of antibiotics was seen. However, some antibiotics, such as cephalexin monohydrate capsules (250 mg), showed a decreasing trend from 2012 to 2013 (Table 4). There was a 2.6-fold increase in total cost of antibiotics procured from the year 2011 to 2013 (Table 4). The highest expenditure for all 3 years was for amoxicillin capsules (250 mg). The top five antibiotics purchased were amoxicillin capsules (250 mg, 36%), erythromycin ethylsuccinate tablets (400 mg, 12.9%), cloxacillin sodium capsules (250 mg, 8.9%), cephalexin monohydrate capsules (250 mg, 6.8%), and erythromycin ethylsuccinate 200 mg/5 ml suspension (6.7%). Amoxicillin

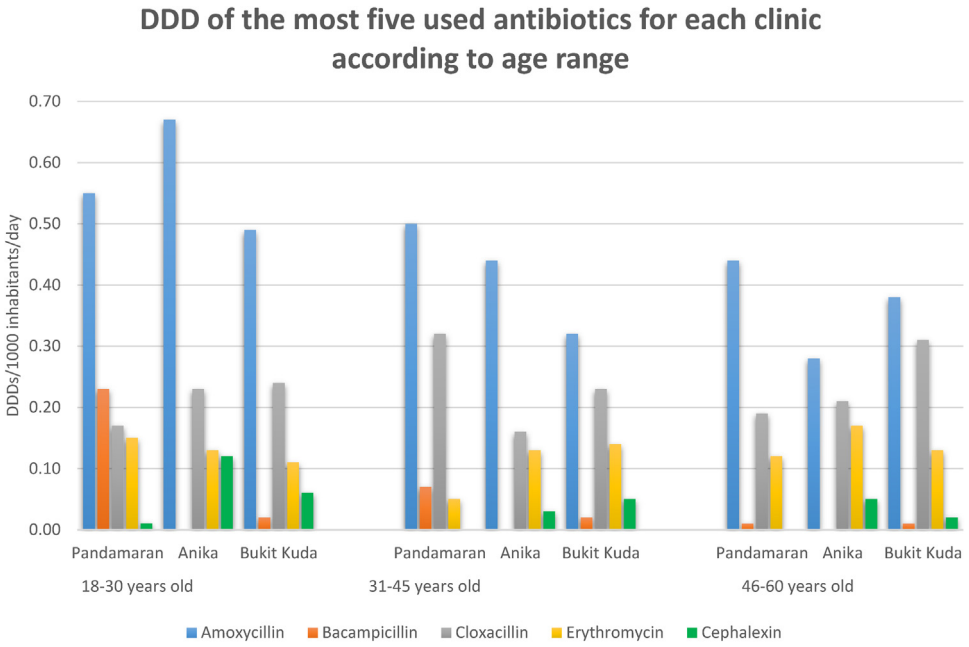

Figure 2. Defined daily dose (DDD) of the most five used antibiotics for each clinic according to age range.

Table 3
Prescription frequencies by type of prescriber according to the antibiotics

Antibiotic type	Specialist (n = 10)		Non-specialist (n = 725)	
	n	%	n	%
Amoxicillin 250 mg capsule	1	10.00	255	35.2
Bacampicillin 400 mg tablet	0	0	52	7.2
Cefuroxime axetil 250 mg tablet	1	10.0	1	0.1
Cephalexin monohydrate 250 mg capsule	1	10.0	50	6.9
Cloxacillin sodium 250 mg capsule	2	20.0	191	26.3
Erythromycin ethylsuccinate 400 mg tablet	1	10.0	162	22.3
Sulfamethoxazole 400 mg + trimethoprim 80 mg tablet	3	30.0	7	1.0
Doxycycline 100 mg capsule	0	0	5	0.7
Amoxicillin + clavulanic acid 625 mg tablet	1	10.0	0	0.0
Cloxacillin sodium 125 mg/5 ml suspension	0	0	1	0.1
Cefuroxime axetil 125 mg tablet	0	0	1	0.1

Table 4
Cost of antibiotics purchased (in Malaysian ringgit (MYR); 1 MYR = USD 0.24)

Antibiotics	2011	2012	2013
Amoxicillin 250 mg capsule	103 898	370 443	304 854
Cloxacillin sodium 250 mg capsule	23 932	155 022	168 292
Cefuroxime 125 mg tablet	NA	NA	132 560
Erythromycin ethylsuccinate 400 mg tablet	117 898	86 196	74 360
Erythromycin ethylsuccinate 200 mg/5 ml suspension	15 392	71 113	58 199
Bacampicillin hydrochloride 400 mg tablet	16 590	23 431	47 268
Cloxacillin 125 mg/5 ml suspension	5728	14 637	35 567
Amoxicillin and clavulanic acid 625 mg tablet	7437	27 326	33 895
Cephalexin monohydrate 250 mg capsule	30 723	82 066	33 735
Amoxicillin trihydrate 125 mg/5 ml syrup	16 023	9435	11 236
Cefuroxime axetil 250 mg tablet	2396	7605	10 904
Phenoxymethylpenicillin 125 mg tablet	1220	13 567	8778
Cephalexin 125 mg/5 ml syrup	6950	5089	3680
Doxycycline hyclate 100 mg capsule	1811	4243	3553
Sulfamethoxazole 400 mg and trimethoprim 80 mg tablet	1519	4976	2744
Benzathine penicillin 2.4 MIU injection	1159	1895	1707
Ceftriaxone 0.25 g injection	555	561	804
Sulfamethoxazole 200 mg + trimethoprim 40 mg/5 ml syrup	1656	-	-
Tetracycline HCl 250 mg capsule	656	-	-
Total	355 542	877 608	932 136

NA, Not Available.

capsules (250 mg) topped the list because of demand, and the price per pill was slightly more expensive (MYR 0.46). Most of the antibiotic prices had increased in 2012 (Table 4). This increase contributed indirectly to the increase in total procurement costs from 2011 to 2012.

4. Discussion

Procurement data are important in DUS. These data are used to portray whether the antibiotic usage is concurrent with the antibiotics purchased. From 2011 to 2012, the procurement trend for antibiotics showed an ascending pattern. A factor that contributed to the ascending pattern in antibiotics was the incremental increase in price per pill in 2012. From 2011 to 2012, price differences were observed for amoxicillin capsules (250 mg, MYR 0.32/tablet), cloxacillin sodium capsules (250 mg, MYR 0.23/tablet), and phenoxymethylpenicillin tablets (125 mg, 0.33/tablet). A decreasing purchasing trend was observed in 2013, specifically for amoxicillin capsules (250 mg, 17.7%) and cephalexin monohydrate capsules (250 mg, 58.9%). This change might have been caused by an increasing stock holding in 2013 for both antibiotics (amoxicillin capsules (250 mg) = 31.8% and cephalexin monohydrate capsules (250 mg) = 3.6%). Furthermore, antibiotics with a constantly increasing purchasing trend each year, such as cloxacillin sodium capsules (250 mg), amoxicillin and clavulanic acid tablets (625 mg), and bacampicillin hydrochloride 400 mg tablets, are still available. Analysis of the results of the utilization data showed that in 2013 amoxicillin capsules (250 mg) were the most prescribed antibiotic, followed by cloxacillin capsules (250 mg) and erythromycin tablets (400 mg). Therefore, the purchasing criteria were followed, which were concurrent with drug usage.

In 2013, cefuroxime 125 mg tablets were procured for the first time. These tablets cost 132 560 MYR (equivalent to USD 35 000), which had a great impact on the total antibiotic procurement. However, the usage of cefuroxime 125 mg tablets was low (MYR 569). Consequently, the antibiotic was overstocked in 2013 (31.8%). The antibiotics were overestimated because they were a first-time purchase, and no prediction on utilization could be estimated based on previous data. Also, the antibiotic was listed as a specialist-prescribed item, and only primary care specialists are authorized to prescribe these, hence the antibiotic was a slow-moving item. The 2.6-fold increase in the total cost of antibiotics over the years 2011–2013 was largely due to the high procurement of amoxicillin capsules (250 mg).

Of note, the most utilized antibiotics were amoxicillin (1.36 DID), cloxacillin (0.68 DID), and erythromycin (0.32 DID). The results of the present study are comparable to those of a study conducted in India that reported an overall medicine consumption of 1.53 DID, with about 98.3% contributed by antibiotics and about 50% serving as empirical antimicrobial therapy. However, the most widely used antibiotics were artesunate (13%), ceftriaxone (11%), and metronidazole (10.5%) because of community infections of malaria and typhoid.[16]

In Malaysia, a DDD study was conducted by The National Medicine Use Survey, and the report was published as the Malaysian Statistics on Medicines (MSOM).[17] The MSOM collected data on drugs utilized in the private and government sectors, including hospitals, primary healthcare, and health institutions. Unfortunately, the data were combined, and individual data were not stated. Thus, no direct comparisons can be made with previous data for primary healthcare clinics.[17] The MSOM reported that amoxicillin (DDD 0.73 g), cephalexin (DDD 0.058 g), and erythromycin (DDD 0.53 g) were the three most utilized antibiotics. These results are in agreement with the current study regarding the top three antibiotics used, but the doses differ: amoxicillin (DDD 1.36 g), cephalexin (DDD 0.11 g), and erythromycin (DDD 0.32 g). These results appear to be in agreement with those from other Asian countries, such as China, where cephalosporins, penicillin, and macrolides are the most utilized antibiotics.[18]

The difference between the DDD in primary healthcare clinics and government hospitals was high in the MSOM, probably because the choice of antibiotic classes is broad in government hospitals. For example, amoxicillin is classified as penicillin with extended spectrum (J01C A). By contrast, the choices are limited in primary healthcare clinics, and only amoxicillin and bacampicillin can be prescribed by non-specialist medical doctors. The limited choice will indirectly increase amoxicillin usage when compared with other referral government hospitals with specialist medical doctors in the MSOM. The MSOM cover government hospitals and primary healthcare clinics. Thus, the drug choices are broad, and they cover all classes of drugs registered in Malaysia.

According to the MSOM, amoxicillin is among the most widely used drugs in both government and private sectors. It is probably used for URTIs, UTIs, and mild community-acquired pneumonia. The results of the present study showed that amoxicillin was inappropriately prescribed for some URTI cases (about 18.4% of the URTI cases), such as tonsillitis and pharyngitis. This finding is comparable to that of a study conducted by Teng et al., which demonstrated an excessive antibiotic prescription for URTI, and the antibiotic choices for both URTI and UTI were not consistent with the guidelines.[4] Similar results were reported from Zimbabwe, where about 12.3% of the prescribed antibiotics were evaluated as inappropriate. A study from China documented that only 60.6% of the prescribed antibiotics for outpatients were considered inappropriate for outpatient clinics.[18]

In the present study, only cephalexin was prescribed in accordance with the national antibiotic guidelines (100%) for UTI. Most of the antibiotics did not comply with the DDD, perhaps because of the prescribing trends, and the dose was based on the diagnosis. This study revealed no significant influence of patient characteristics on the antibiotic prescribed. These results are in accordance with those of a previous study conducted in Seremban Province, which found that antibiotic prescription is not influenced by age, sex, race, comorbidity, or duration of symptoms data.[19]

Prescriber behaviour is one of the determinants of antibiotic utilization. Prescribers are often concerned about the outcomes of their prescriptions being poor or delayed. This concern may lead to the over-prescription of antibiotics and a lack of compliance with the guidelines. Studies from other countries, including those in Europe, have reported the same problem; for example, general practitioners in Ireland have been shown not to adhere to the antibiotic prescription guidelines.[20]

Prescription authority is also one of the factors influencing the prescribing pattern. For example, only primary care specialists have the authority to prescribe restricted antibiotics (medication list A). Newer antibiotics will also be restricted. This restriction indirectly helps prevent the development of resistance because the medical officer has to obtain the approval of primary care specialists before prescribing these antibiotics. From the observed data, approximately 99% of antibiotics are prescribed by a junior medical doctor. The present study showed that about 0.2% of junior medical doctors prescribed restricted antibiotics. In such a situation, the non-specialist medical doctor should obtain approval by countersigning the prescription, or the primary care specialist should be called before the prescription is fulfilled.

Patient behaviour also contributes to the utilization of antibiotics; the patient may demand antibiotics without valid reasons. In some instances, the prescriber feels the need to fulfil the patient's request for an antibiotic even if their illness has a viral aetiology, because of the patient's persistent requests.[21] A lack of knowledge and compliance with antibiotics are important determinant factors in contributing to utilization. Patients have little knowledge of the importance of compliance in consuming antibiotics.[22–24] Thus, they may cease therapy before the full course has been taken in the case where symptoms have resolved. Skipping therapy may indirectly lead to more frequent visits because of the antibiotic resistance caused by unnecessary increased antibiotic utilization.

Necessary measures should be taken to regulate antibiotic prescription. Factors leading to a deviation from the prescriber's choice of antibiotics should be investigated. These issues should be proposed at the drug committee meeting of each clinic. Collaboration between the pharmacist and prescriber is important to monitor the prescribing pattern of antibiotics. Pharmacists should be proactive and establish a good rapport with prescribers so that compliance with the guidelines can be instilled. Continuous education will ensure that prescribers are up to date with all of the guidelines and procedures for the selection and use of drugs.

An antibiotic audit should be routine practice to ensure quality prescribing of antibiotics in primary care services. This measure will help to optimize the appropriate utilization and gather information on antibiotic susceptibility patterns, which is still lacking for the primary care level. Hence, pharmacists must attain knowledge on how to implement the DDD and initiate utilization studies to present the findings at drug committee meetings. When antibiotics are inappropriately used, the managerial level of the Province Health Office should be alerted to the situation so that improvement measures can be initiated.

In conclusion, this study investigated the antibiotic usage at three health clinics in Klang Province. The most frequently prescribed antibiotic was amoxicillin in the form of 250 mg capsules; this was mainly prescribed for respiratory infections. Although the national antibiotic guidelines state that amoxicillin is a preferred drug for acute bacterial rhinosinusitis, this drug is also being prescribed for other disease conditions, such as acute pharyngitis and acute tonsillitis. This result shows that current practice is not following the antibiotic guidelines, which state that phenoxypenicillin should be the preferred drug.

Author contributions

SS, LCM, and MMM conceived and designed the experiments. SS, MEA, STRZ, LCM, and MMM analyzed the data. SS, MEA, STRZ, LCM, and MMM wrote the paper. SS, MEA, STRZ, LCM, and MMM critically reviewed the manuscript for important intellectual content.

Acknowledgements

We thank Norharlina binti Sulaiman (Head of Pharmacy Department), Dr Nazrila Hairizan Nasir, Dr Izan Hairani Ishak (primary care specialist), and the pharmacists of Klang Province Health Department for their assistance in the data collection.

Funding: This work was supported by Research Entity Initiative (Vector-Borne Diseases Research Group-VERDI): 600-IRMI/DANA 5/3/REI (0004/2016). The authors would like to express their gratitude to Ministry of Higher Education and Universiti Teknologi MARA (UiTM), Malaysia for financial support for this research. The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

Conflict of interest: The authors declare that they have no competing interests.

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