Antibiotic Prescribing Behaviour In The Community: A Service Evaluation

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ABSTRACT

Background: A service evaluation was conducted to identify any areas for improvement in antibiotic prescribing in the community, and to generate baseline data on antibiotic prescribing.

Objectives of study: To test whether the specified characteristics of community doctors and patients were significantly associated with increased prescribing frequency; to identify the most frequently prescribed antibiotics; and to identify the most frequently recorded positive signs in patients who had been prescribed antibiotics.

Methods: The study included all patients who were prescribed antibiotics at Bandar Seri Begawan Health Centre during public holidays. Study period was 12 months on characteristics of doctors and patients, and 1 month on types of antibiotics and recorded signs. Data was analyzed using Real Statistics software platforming on Microsoft Excel.

Results:
Antibiotic prescribing was more frequent in expatriate doctors (p<0.001), general clinic (p<0.001), and older patients (p<0.001). The most frequently prescribed oral and topical antibiotics were amoxycillin (54%), and chloramphenicol (32%). The most frequently recorded positive signs in patients with oral and topical antibiotics were tonsillopharyngeal inflammation, and eye or conjunctival inflammation, respectively.

Conclusion:
The study recommends auditing of antibiotic prescribing in tonsillitis and eye or conjunctival inflammation, and improvement in other identified areas.

Keywords:
Anti-bacterial agents; Community medicine; Health service evaluations; Inappropriate prescriptions; Physician's practice patterns

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INTRODUCTION

Widespread and inappropriate use of antibiotics can lead to antibiotic resistance, a problem that was initially confined to hospitals, but is becoming increasingly prevalent in the community, world-wide.[1,2] Infections caused by resistant bacteria often are difficult to treat, and can result in prolonged illness, higher health-care expenditures, and a greater risk of death.[2]

The rate of antibiotic prescribing is known to vary amongst physicians, possibly due to differences in background training[3] and practice experience.[3] Characteristics of doctors that have been significantly associated with higher frequency of antibiotic prescribing are: male,[4,5], older age,[4,6] overseas qualification,[4] and more years in practice.[7] However, there are other studies that have reported no significant association with sex,[6,8] age,[8] nor years in practice.[8]

Male patients have been significantly associated with higher frequency of being prescribed antibiotics.[6] Older ages have also been similarly associated,[9] but the converse was found in other studies.[6,10] Yet another study found concurrent highest rates in children and the elderly.[11] Regional variation in prescribing frequency of antibiotics has been reported.[4,12] A study associated the highest frequency with the patient age-group of above 80 years in a Northern European county, but the same study associated it with the patient age-group of 0-9 years in a Southern European province.[12] The association between antibiotic prescribing frequency, and patient's sex,[13,14] age[13,14] and race[14] were reported as insignificant in other studies.

In countries where antibiotics are only available on prescription, the role of doctors are pivotal in minimising inappropriate antibiotic use. Healthcare institutions should monitor and reinforce the need for discriminate antibiotic prescribing especially amongst doctors and patients bearing characteristics that have been associated with its increased prescribing frequency. Also important would be conducting audits on appropriateness of antibiotic prescribing in the most common illnesses for which antibiotics are prescribed. Unfavourable findings would indicate the need for re-education on proper management of the illnesses.

In Brunei Darussalam, community prescription of antibiotics come from either government-run health centres or private clinics. In Brunei-Muara District, the most densely populated district, all the government-run health centres are closed on public holidays except the Bandar Seri Begawan Health Centre, which is located in the capital. The public-holiday service operates on a walk-in basis for acute health-related problems. Doctors delivering the service are on a rotation roster, and come from mutually exclusive non-hospital-based specialties: outpatient services (OPS), maternal health services (MHS), child health services (CHS), and other health services. The latter refers to permanent job descriptions that do not comprise consulting patients in an outpatient setting for the majority of their working hours, but are occasionally involved in such a task. At the health centre, patients are allocated to either the "flu

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clinic" or "general clinic". Patients whose chief complaints were symptoms suggestive of respiratory tract infection were registered under the flu clinic, and those with any other symptoms, under the general clinic. Allocation of clinics was determined at the screening desk at the point of entry to the building, staffed by trained nurses. Doctors were assigned to either of the clinics randomly, although doctors from MHS and CHS tended to serve only at the flu clinic.

A service evaluation was conducted to evaluate the prescribing behaviour of community doctors during public holidays at Bandar Seri Begawan Health Centre, to generate baseline data which has been lacking, with which future studies could compare, and to uncover any areas for potential improvement in the service.

Specific objectives were:
i) to establish whether the specified characteristics of community doctors and patients in this study were associated with increased prescribing frequency of antibiotics;
ii) to identify the most frequently prescribed antibiotics in the community during public holidays; and
iii) to identify the most frequently recorded positive signs in patients who had been prescribed antibiotics in the community during public holidays.

METHODS

The study was retrospective and observational, conducted by only one researcher, to eliminate inter-observer errors. The study population was all patients who had registered for doctor consultation or other services at Bandar Seri Begawan Health Centre during public holidays. Public holidays were Fridays, Sundays, and other national holidays occurring on other days of the week. The study did not include non-public holidays due to practical reasons. The study period for data on characteristics of doctors and patients was 12 months, from July 2014 to June 2015. For expediency, the study period for data on the most frequently prescribed antibiotics and on recorded positive signs was one month, randomly selected at May 2015. The study included only consultations in which antibiotics of any route had been prescribed. Consultations within the first three months of a doctor's service in any specialty, if occurring during the study period, were excluded to minimise possible influence on behaviour from the previous post. Patients who registered for nursing services only (such as for wound care), or who left without any doctor consultation taking place were excluded. Where a patient had been registered to both the flu clinic and general clinic at the same visit but only went for consultation in one of the clinics, the non-consultation registration was excluded.

Using the search function of the computerised health record system, "Bru-HIMS", a list of all patients who had been registered for a visit on each of the holidays ("List Of OPD Visits") was generated. Then, the "Drug Usage By Source" report was generated to identify the types of antibiotics prescribed and to whom each had been prescribed. The same system was then used to access the record of each of the prescriptions. The reports were generated in Excel format, from which various data of interest were extracted: the total number of consultations and number of consultations with antibiotic prescription on each of the holidays; type of clinic; identity of the doctor for each of the consultations; and demographic details of the patients.

Data on doctor and patient characteristics were analyzed to determine any significant association with antibiotic prescribing frequency. Analysis was by binary logistic regression, using Microsoft Excel functions augmented by the Real Statistics Resource Pack software [Release 4.3; Copyright (2013 – 2015) Charles Zaiontz; www.real-statistics.com]. The software employed Newton's method for analysis, with an alpha level of 0.05, and classification cutoff level of 0.5. There were 11 regressors (doctor's sex, age, seniority, nationality, specialty, prior duration of service in current post, prior duration of service since graduation, total number of consultations by doctor in study period; type of clinic; and patient's sex and age), with six interaction terms. Categorical variables were coded using numeric forms.

Interactions were suspected between "prior duration of service in current post", "prior duration of service since graduation", and "doctor's age". It was thought that both durations, at least the latter, would likely be proportional to age. Interaction terms included combinations of any two of the variables, and all three together. Another suspected interaction was between "total number of consultations by doctor in study period" and "type of clinic", as it was thought that doctors who served at the flu clinic were likely to have seen more patients than those who served at the general clinic, due to the relatively less complex nature in the management of flu and, hence, higher turnover rates. As doctors from MHS and CHS were often placed in the flu clinic, another interaction term was generated for "doctor's specialty" and "type of clinic".

In the analysis of positive signs, these were first transcribed using the exact phrases. Different phrases bearing the same underlying meaning were then grouped together, to generate several standardised terms. It was possible for a patient to have more than one positive sign, and recorded so. However, a positive sign such as eczematous lesion that was present at different sites was counted once. In patients with both positive and normal signs recorded, only the positive signs were transcribed.

Names of doctors and patients were analyzed with alpha-numeric codes. There was no conflict of interest, and no financial grant was involved in the study. The local research ethics committee was consulted, and no review by the committee was made. Exemption was justifiable by virtue of the study being a service evaluation,[15] and taking into consideration the ethical principles outlined in the World Medical Association Declaration of Helsinki.[16]

RESULTS

There were 120 holidays in the 12-month study period,

served by 85 doctors. From the total of 30,083 registration, only 26,845 (89%) were eligible for analysis. Most of the excluded patients were consulted by trainee doctors, all of whom had not spent more than three months at any one time during the study period, or had received nursing services only. The number of patients included exceeded the recommended minimum sample size in this study; the minimum was 100 patients, using the work of Peduzzi et al[17] as the guideline. Antibiotics were prescribed in 6,967 (26%) of the included consultations. Demographics of doctors and patients are shown in Table 1.

Table 1: Demographic data of doctors and patients

Variable	Frequency, n(%)	Number of consultations not prescribed antibiotics, n(%)	Number of consultations prescribed antibiotics, n(%)
Doctor's sex			
Male	30 (35)	9498 (48)	3363 (48)
Female	55 (65)	10380 (52)	3604 (52)
Doctor's seniority			
Medical officer	66 (78)	16827 (85)	5922 (85)
Senior medical officer	17 (20)	2741 (14)	937 (13)
Specialist	2 (2)	310 (2)	108 (2)
Doctor's nationality			
Nationals	36 (42)	6567 (33)	2246 (32)
Expatriates	49 (58)	13311 (67)	4721 (68)
Doctor's specialty			
Outpatient services (OPS)	66 (78)	16151 (81)	5683 (82)
Maternal health services (MHS)	11 (13)	2323 (12)	826 (12)
Child health service (CHS)	4 (5)	963 (5)	284 (4)
Other health services	4 (5)	441 (2)	174 (2)
Doctor's prior duration of service in current post			
Less than five years (post started in 2010 or later)	39 (46)	8338 (42)	2929 (42)
5-10 years (post started within 2005-2009)	16 (19)	3351 (17)	1155 (17)
More than 10 years (post stated before 2005)	30 (35)	8189 (41)	2883 (41)
Doctor's total work experience since graduation			
Less than five years (graduated in 2010 or later)	1 (1)	229 (1)	72 (1)
5-10 years (graduated within 2005-2009)	18 (21)	3677 (18)	1244 (18)
More than 10 years (graduated before 2005)	66 (78)	15972 (80)	5651 (81)
Total number of consultations by doctor			
0-25th percentile	23 (27)	2608 (13)	911 (13)
26-50th percentile	20 (24)	3929 (20)	1368 (20)
51-75th percentile	21 (25)	4945 (25)	1675 (24)
76-100th percentile	21 (25)	8396 (42)	3013 (43)
Type of clinic			
Flu clinic	not relevant	12466 (63)	4227 (61)
General clinic	not relevant	7412 (37)	2740 (39)
Patient's sex			
Male	12906 (48)	9685 (49)	3221 (46)
Female	13939 (52)	10193 (51)	3746 (54)
Doctor's age mean 43.8 +/- 9.9 yr, median 42.6yr			
Patient's age mean 24.1 +/- 17.7 yr, median 22.8yr			

Table 2: Results of Binary Logistic Regression. Values rounded to 3 significant figures where applicable.

	Coefficient b	*Standard error*	*Wald*	*p-value*	*exp(b)*	*lower*	*upper*
Intercept	-0.352	1.15	0.0938	0.759	0.704		
Independent variables							
Doctor's sex	-0.0702	0.0360	3.81	0.0511	0.932	0.869	1.00
Doctor's age	-0.0293	0.0341	0.735	0.391	0.971	0.908	1.04
Doctor's seniority	0.00103	0.0555	0.000342	0.985	1.00	0.898	1.12
Doctor's nationality	0.321	0.0717	20.0	7.62E-06	1.38	1.20	1.59
Doctor's speciality	-0.0258	0.0578	0.200	0.655	0.975	0.870	1.09
Doctor's prior duration of service in current post	1.03	2.42	0.181	0.670	2.80	0.0243	323
Doctor's total work experience since graduation	-0.804	0.594	1.83	0.176	0.447	0.140	1.43
Total number of consultations by doctor	3.24E-05	4.34E-05	0.558	0.455	1.00	1.00	1.00
Type of clinic	-0.959	0.144	44.4	2.65E-11	0.383	0.289	0.508
Patient's sex	0.0348	0.0291	1.43	0.232	1.04	0.978	1.10
Patient's age	0.00542	0.000829	42.6	6.63E-11	1.01	1.00	1.01
Interactions							
Doctor's specialty * Type of clinic	0.130	0.0692	3.53	0.0603	1.14	0.994	1.30
Doctor's prior duration of service in current post * Doctor's total work experience since graduation	-0.266	1.22	0.0476	0.827	0.766	0.0700	8.39
Doctor's prior duration of service in current post * Doctor's age	-0.0321	0.0731	0.193	0.660	0.968	0.839	1.12
Doctor's total work experience since graduation * Doctor's age	0.0223	0.0173	1.68	0.195	1.02	0.989	1.06
Total number of consultations by doctor * Type of clinic	0.00053	4.34E-05	149	2.98E-34	1.00	1.00	1.00
Doctor's prior duration of service in current post * Doctor's total work experience since graduation * Doctor's age	0.0106	0.0367	0.0840	0.772	1.01	0.941	1.09

Most of the antibiotics were prescribed by doctors who were female (52%), were medical officers (85%), were expatriates (68%), were from OPS (82%), had worked in their specialty for less than five years (42%), had graduated more than ten years earlier (81%), and had attended to more than 75th percentile of the total number of patients included in the study (43%). Most of the antibiotic prescriptions were from the flu clinic (61%), and given to female patients (54%).

The association was only significant for doctor's nationality ($p<0.001$), type of clinic ($p<0.001$), and patient's age ($p<0.001$) (Table 2). The odds of being prescribed antibiotics were 38% more likely with expatriates than local doctors, 62% more likely in the general clinic, and increased by 1% for every additional year of age in patients. The only significant interaction was between type of clinic and total number of consultations by doctor ($p<0.001$) (Table 2).

The model chi-square statistic was 2000 with 17 degrees of freedom, and the model with 11 independent variables and 6 interaction terms was significant compared to a model without ($p=0$).

There were 771 consultations with antibiotic prescriptions in the one-month study period for signs and variety of antibiotics (Tables 3 and 4). The most frequently prescribed oral and topical antibiotics were amoxycillin (54%), and chloramphenicol 0.5% eye drop (32%) respectively.

The top three most frequently recorded positive signs in patients who had been prescribed oral antibiotics were tonsillopharyngeal inflammation, fever, and other local inflammation (including abscesses). Those for topical antibiotics were eye or conjunctival inflammation, eyelid inflammation, and other local inflammation.

Table 3. Recorded signs In patients prescribed oral antibiotics

Oral antibiotics	Number of consultations	Number of consultations with stated positive signs													Number of consultations with only normal signs stated and afebrile	Number of consultations with no data on examination findings stated
		Fever	Pharyngeal/Tonsillar inflammation without exudate or not specified	Pharyngeal/Tonsillar inflammation with exudate	Other local inflammation/swelling/redness (inc. boils, abscesses)	Exudate at any site, except at pharynx or tonsil	Lumps in neck or elsewhere	Soft tissue injury, inc. animal bites and burns	Other skin lesions, non-inflammed	Abnormal breath sounds	Abdominal tenderness	Abnormal urine dipstick findings	Painful ear examination	Mouth ulcers, Dental caries		
Amoxycillin	295	50	76	10	11	6	1	6	1	15	3	1	2	2	134	15
Azithromycin	3	1	1												2	
Co-amoxiclav	202	24	37	10	55	19	14	8	8	21	5	10		2	23	7
Cefalexin	16		5	2	1	1	2			3	2	6				
Cefuroxime	10	2	2							2	2	2			2	
Ciprofloxacin	4	1										1			2	
Metronidazole	4				2		1							1	1	
Doxycycline	2										1	1				1
Erythromycin	7	1	3	2	1										1	
Flucloxacillin	4				4		1									
Total	547	79	124	24	74	26	19	14	9	41	13	21	2	5	165	23

Table 4. Recorded Signs In Patients Prescribed Topical Antibiotics

Topical antibiotics	Number of consultations	Number of consultations with stated positive signs													Number of consultations with only normal signs stated and afebrile	Number of consultations with no data on relevant examination findings stated
		Inflammation of eye or conjunctiva	Subconjunctival haemorrhage	Inflammation of eyelid, inc. stye, lump, except eczema	Eczema of eyelid and/or surrounding skin	Eye discharge	Inflammation of ear canal	Ear discharge	Ear wax and otherwise normal ear examination	Abnormal appearance of ear drum but not perforation	Local inflammation/swelling/redness (inc. boils, abscesses). except eye, eyelid, ear	Exudate at any site, except at eye and eyelid	Soft tissue injury, including animal bites	Non-inflammed and non trauma skin lesions		
Betamethasone-neomycin eye/ear drop	1						1									
Chloramphenicol 5% ear drop	10						3	4	1	1					1	
Chloramphenicol 0.5% eye drop	71	40	1	20		12									2	8
Chloramphenicol 1% eye ointment	11	4		6		1										1
Dexamethasone & framycetin & gramicidin eye/ear drop	1						1									

Dexamethasone & neomycin & polymyxin Eye ointment	1				1											
Fusidic acid 1% eye drop	5	1		2		1									2	
Fusidic acid 2% cream	29						1	1			12	1	5	7	1	5
Fusidic acid 2% ointment	35										16	4	11	2		5
Gentamycin 0.3% eye drop	1						1									
Gentamycin 0.3% eye ointment	4	2		2		2										1
Oxytetracycline & polymyxin B eye ointment	37	20	1	13		2									2	2
Polymycin B & neomycin & hydrocortisone ear drop	15						7	4							2	3
Tobramycin 0.3% eye drop	3	2													1	
Total	224	69	2	43	1	18	14	9	1	1	28	5	16	9	11	25

There were 176 (23%) prescriptions of oral and topical antibiotics given to patients with only normal signs, most being oral (30% vs 5%). Overall, there were 48 (6%) antibiotic prescriptions given to patients without any signs recorded, most being topical (11% vs 4%).

DISCUSSION

The findings merely defined baseline data on antibiotic prescribing behaviour during public holiday service. They were not generalisable because the study period was selective for public holidays and there was no differentiation of patients in terms of diagnosis or presenting complaints; the regression coefficients therefore should not be used for predicting the odds of a patient being prescribed antibiotics. Comparison of findings with a study conducted on non-public holidays would reveal any difference in doctors' prescribing behaviour. Another confounder could be patients' health-seeking behaviour.

Nevertheless, an advantage of the selective study period was the ability to compare behaviour between different specialties. The healthcare set-up was such that only on public holidays were acute cases served concurrently in the community by doctors of different specialties; on other days, doctors from MHS, CHS, and the other health services attended to non-acute or selected cases only. In this study, there was no significant association between specialty and frequency of antibiotic prescribing, thus partially justifying the involvement of the different specialties for the public holiday service.

Recorded signs were explored instead of recorded diagnoses, because diagnosis coding using the International Classification of Diseases (ICD)-10 codes could be non-specific or misleading. For example, a coughing patient with normal chest findings but with incidental pustular tonsillitis, fever, and neck lumps could be coded with "acute upper respiratory infection, unspecified (J06.9)". Analysis then would be more accurate if the positive signs were used instead of the coded diagnosis.

The significantly higher prescribing frequency of antibiotics by expatriates suggests possible different training background, different rationales used when deciding to prescribe antibiotics, or higher sensitivity to detecting abnormal signs. It does not imply higher frequency of inappropriate prescribing; the study only identifies the doctor's nationality as a key variable in future studies on appropriateness of antibiotic prescribing.

Antibiotic prescribing was significantly more frequent in the general clinic, suggesting a significantly higher prescribing frequency to patients who presented with anything but flu. The study did not segregate between clinic types on the analysis of type of antibiotics prescribed against signs recorded (Tables 3 and 4), so the most common presentations in general clinic for which antibiotics were prescribed cannot be identified. Its significant interaction with total number of consultations suggests that the effect of clinic type was different at different values of the total number of consultations. This is difficult to explain as the latter alone did not have a significant association with frequency of antibiotic prescribing.

The significantly higher prescribing frequency of antibiotics to older patients suggests a lower threshold for prescribing antibiotics to them, whether appropriate or not, and/or that they were more ill at presentation. The elderly population is more susceptible to infection,[18] but inappropriate use of antibiotics would result in the additional risk of exposure to drug-resistant micro-organisms. Doctors should be discouraged from prescribing antibiotics to the elderly merely based on their ages.

While the study period for exploring recorded positive signs was short, thereby affecting accuracy, it was felt that the identity, rather than the relative position, of the top three signs would remain unchanged even if the period were longer. The study recommends evaluating inappropriate antibiotic prescribing in the most frequently recorded positive signs: tonsillopharyngeal inflammation; eye, eyelid or conjunctival inflammation; and other local inflammation (including abscesses).

The use of antibiotics in burns (Table 3), and subconjunctival haemorrhage (Table 4), as revealed by the study, is often not indicated,[19,20] and therefore calls for improvement in evidence-based practice. However, they could have merely co-existed with other more significant signs which indicated

the prescribing of antibiotics, or the actual presentation could had been worse than was recorded.

The study suggests that amoxycillin was the most frequently prescribed antibiotics for tonsillopharyngeal inflammation, and chloramphenicol for eye or conjunctival inflammation. These call for two other discrete investigations: whether any antibiotics were appropriate in such cases, and whether the choices of antibiotics were appropriate.

The absence of any data on physical examination findings on some patients who were prescribed antibiotics calls for improvement in doctors' recording practices. It occurred more frequently with topical antibiotics, suggesting possible indiscriminate prescribing practice, perhaps as prophylaxis, and possible reluctance on the doctors' part to record abnormal findings on skin or eye, if any, perhaps due to a need for more words or greater variety of words. It was also possible that they were prescribed at the end or after closure of consultations, in which case, re-opening notes or modifying entries, as required by the system, would be time- and effort-consuming, hence, the missing data.

Although assessment of appropriateness of each of the antibiotic prescriptions was beyond the scope of the study, those given to patients with only normal signs suggested likely inappropriateness. Prophylactic use would rarely be justified in general practice, but group interview studies could reveal the underlying reasons.

CONCLUSION

The study provided baseline data on frequency of antibiotic prescribing against various characteristics of doctors and patients. The study identified priority areas for research that may be important in minimising inappropriate prescribing of antibiotics: the use of antibiotics in the elderly, tonsillopharyngeal inflammation, eye or conjunctival inflammation, and some equivocal signs. It also uncovered areas for potential improvement in service: absence of recording of physical findings, and use of antibiotics in patients with normal signs only. While the findings are not generalisable, the revealing of the issues discussed should trigger heightened awareness of the need to assess antibiotic prescribing behaviour or induce self-evaluation of service amongst readers elsewhere, as inappropriate antibiotic prescribing is known to be a borderless problem.

REFERENCES

1. Hooton TM, Levy SB. Antimicrobial resistance: a plan of action for ocmmunity practice. Am Fam Physician. 200;63:1087–97.
2. World Health Organization. Fact Sheet No. 194. Antimicrobial resistance (updated April 2015). http://www.who.int/mediacentre/factsheets/fs194/en/. Accessed 06 August 2015.
3. Cadieux G, Tamblyn R, Dauphinee D, Libman M. Predictors of inappropriate antibiotic prescribing among primary care physicians. CMAJ. 2007;177:877–83.
4. Wang KY, Seed P, Schofield P, Ibrahim S, Ashworth M. Which practices are high antibiotic prescribers? A cross-sectional analysis. Br J Gen Pract. 2009;59:e315-20. DOI: 10.3399/bjgp09X472593. http://bjgp.org/content/bjgp/59/567/e315.full.pdf. Accessed 14 March 2016.
5. Van Duijn HJ, Kuyvenhoven MM, Tiebosch HM, Schellevis FG, Verheij TJM. Diagnostic labelling as determinant of antibiotic prescribing for acute respiratory tract episodes in general practice. BMC Fam Pract. 2007;8:55. DOI: 10.1186/1471-2296-8-55. http://bmcfampract.biomedcentral.com/articles/10.1186/1471-2296-8-55. Accessed 16 March 2016.
6. Huang N, Chou YJ, Chang HJ, Ho M, Morlock L. Antibiotic prescribing by ambulatory care physicians for adults with nasopharyngitis, uris, and acute bronchitis in Taiwan: a multi-level modeling approach. Fam Pract. 2005;22:160–7. http://fampra.oxfordjournals.org/content/22/2/160.full. Accessed 14 March 2016.
7. Tan WL, Siti R, Shahfini I, Zuraidah A. Knowledge, attitude and practice of antibiotics prescribing among medical officers of public health care facilities in the state of Kedah, Malaysia. Med J Malaysia. 2015;70:307–11.
8. Oeffinger KC, Snell LM, Foster BM, Panico KG, Archer RK. Treatment of acute bronchitis in adults. A national survey of family physicians. J Fam Pract. 1998;46:469–75.
9. Dosh SA, Hickner JM, Mainous AG III, Ebell MH. Predictors of antibiotic prescribing for nonspecific upper respiratory infections, acute bronchitis, and acute sinusitis. An UPRNet Study. Upper Peninsula Research Network. J Fam Pract. 2000;49:407–14.
10. Kho BP, Ong CMY, Tan FTY, Wee CY. Antibiotic prescribing for upper respiratory tract infections in Sarawak district hospitals. Med J Malaysia. 2013;68:136–40.
11. Majeed A, Moser K. Age- and sex-specific antibiotic prescribing patterns in general practice in England and Wales in 1996. Br J Gen Pract. 1999;49:735–6.
12. Vaccheri A, Bjerrum L, Resi D, Bergman U, Montanaro N. Antibiotic prescribing in general practice: striking differences between Italy (Ravenna) and Denmark (Funen). J Antimicrob Chemother. 2002;50:989–97. DOI: 10.1093/jac/dkf239. http://jac.oxfordjournals.org/content/50/6/989.full.pdf+html. Accessed 14 March 2016.
13. Steinman MA, Landefeld CS, Gonzales R. Predictors of broad-spectrum antibiotic prescribing for acute respiratory tract infections in adult primary care. JAMA. 2003;289:719–25.
14. Teng CL, Nurjahan MI, Hashim NA, Punithambigai P, Leong KC, Mihat O. Upper respiratory tract infections: to what extent is the management evidence-based? Med J Malaysia. 2003;58:159–66.
15. National Joint Registry. Differentiating Audit, Service Evaluation And Research. 2006 November. http://www.njrcentre.org.uk/NjrCentre/Portals/0/NRES%20defintion.pdf. Accessed 12 April 2016.
16. World Medical Association. WMA Declaration of Helsinki — Ethical principles for medical research involving human subjects. http://www.wma.net/en/30publications/10policies/b3/. Accessed 12 April 2016.
17. Peduzzi P, Concato J, Kemper E, Holford TR, Feinstein AR. A simulation study of the number of events per variable in logistic regression analysis. J Clin Epidemiol. 1996;49:1373–9.
18. Beeson PB. Alleged susceptibility of the elderly to infection. Yale J Biol Med. 1985;58:71–77.
19. Timmons MJ. Are systemic prophylactic antibiotics necessary for burns? Ann R Coll Surg Engl. 1983;65:80–82.
20. The College of Optometrists. Sub-conjunctival Haemorrhage. Clinical Management Guidelines. London, UK: The College of Optometrists; 2015. http://www.college-optometrists.org/en/utilities/document-summary.cfm/docid/6267166E-8BDD-4A05-ABF64B3DD4AD559A. Accessed 12 April 2016.