Antibiotic prescribing for patients with upper respiratory tract infections by emergency physicians in a Singapore tertiary hospital

新加坡一所高等醫院急症科醫生對上呼吸道感染病者處方抗生素的研究

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Objective: Despite the paucity of supporting evidence, the use of antibiotics in the management of upper respiratory tract infections (URTI) remains a persistent and worrying trend worldwide. This survey study set out to examine the antibiotic prescribing profile of emergency physicians for patients diagnosed with URTI at a local tertiary hospital. *Methods:* Patients seeking treatment for URTI at the emergency department in the year 2001 were identified by their ICD-9 code. The electronic medical records of a random sample of these patients were reviewed. Patients with the following documented findings were excluded: (a) a duration of more than 7 days between disease onset and date of consultation, (b) prior antibiotic usage or medical consultation, (c) presentation of purulent sputum and/or purulent nasal discharge, and (d) existing medical conditions requiring antibiotic treatment/prophylaxis. Chi-square and multivariate analyses were performed to assess the association of patient-related factors with antibiotic prescribing. *Results:* Of a random sample of 488 cases of URTI, inappropriate antibiotic prescribing was observed in 24% of cases (95% CI 20%, 28%). Significant associations were observed between antibiotic prescribing and month of consultation, patients' temperature and symptom of rhinorrhoea. *Conclusion:* A substantial proportion of emergency department patients with URTI received antibiotics despite the lack of evidence supporting the drugs' effectiveness. Appropriate interventions to promote evidence-based prescribing amongst emergency physicians are required to reduce the extent of inappropriate antibiotic prescribing as well as to ensure the longevity of antibiotic effectiveness. (*Hong Kong j.emerg.med.* 2005;12:70-76)

目的：儘管缺乏支持的理據，使用抗生素治理上呼吸道感染仍是全球性持續且擔憂的趨勢。是次調查研究試圖檢視一所當地高等醫院急症科醫生對診斷為上呼吸道感染病者處方抗生素的概況。**方法：**二零零一年期間因上呼吸道感染往急症室求診的病者由 ICD-9 編碼識別，審查這類病者電子醫療記錄的隨機抽樣樣本；並豁除記錄有以下情況的病者：（甲）由病發至求診日期間超過七天者，（乙）先前曾服用抗生素或求醫者，（丙）呈現膿性痰和／或化膿性鼻流液者，及（丁）現時的醫療情況需服用治療或預防性抗生素者。進行卡方及多元分析評估抗生素處方及與病者相關因素的聯繫。**結果：**在 488 名上呼吸道感染病者的隨機抽樣樣本中，不適當處方抗生素的個案有 24%（95% 置信區間為 20% ，28%）；並觀察到處方抗生素與求診月份、病者體溫及鼻液溢症狀有顯著的聯繫。**總結：**雖然缺乏證據支持藥物的效用，但急症室相當比例的上呼吸道感染病者被處方抗生素；這需要適當的介入以促進急症科醫生以「證據為本」地處方，從而減少不適當處方抗生素的程度及確保增長抗生素效能的壽命。

Keywords: Anti-bacterial agents, drug prescriptions, hospital emergency service, upper respiratory tract infections

關鍵詞：抗細菌劑、藥物處方、醫院緊急服務、上呼吸道感染

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Introduction

The high prevalence of antibiotic resistance amongst common respiratory pathogens has been well documented by international collaborations in many countries.[1-5] East Asian countries have observed similar trends.[6,7] In a recent report, the prevalence of antibiotic resistance in selected East Asian countries was found to be higher than some European countries and American states.[5]

The prevalence of antibiotic resistance amongst common respiratory pathogens in Singapore had similarly increased by more than 40-fold over the last two decades. Between 1977 and 1986, the prevalence of penicillin resistant *Streptococcus pneumoniae* was documented as 0.5%.[8] Ten years on, the prevalence of resistance increased to between 23% and 59%.[5,9] Although the rise could be due to differences in patient demographics, morbidity and clinical setting between the studies, there was likely to be a real increase in the prevalence rates.

The relationship between antibiotic usage and the development of antibiotic resistance has been well elucidated. In Spain, Baquero et al found a significant relationship between the volume of penicillin usage and the penicillin resistance rates.[10] Studies had associated prior antibiotic usage with an increased prevalence in the carriage of and infection by antibiotic resistant respiratory pathogens.[11-13] Reducing inappropriate antibiotic usage has consistently been proposed by many quarters as a means to mitigate the rising tide of antibiotic resistance.[5,10,14]

The inappropriate use of antibiotics for upper respiratory tract infections (URTI) is of particular concern in our efforts to control antibiotic resistance. Our emergency department attended to over 8,000 cases with URTI in the year 2001 alone. A recently updated Cochrane review of 9 trials involving 2,249 subjects by Arroll et al reaffirmed that the use of antibiotics for these conditions lacked supporting evidence.[15] The primary objective of this survey was to examine the antibiotic prescribing profile of physicians at the emergency department of the Singapore Changi General Hospital among patients with URTI. The study also attempted to determine patient-related factors that were associated with inappropriate antibiotic usage.

Materials and methods

The Changi General Hospital (CGH) is an 800-bed hospital serving a population of 750,000 residing at the eastern part of the island state of Singapore. At the emergency department, patients' medical records are captured and stored electronically. The department uses a modified version of the WHO International Statistical Classification of Diseases & Related Health Problems 9th revision (ICD-9) to classify the diagnoses of her patients. As a safeguard against inaccurate coding, emergency physicians are required to select the disease code and also enter their diagnoses into the computer system.

Approvals for the audit and publication of the results were gained from the emergency department of Changi General Hospital prior to the audit.

Patient sampling methods

All the patients with a primary diagnosis of upper respiratory tract infection, who were managed at the emergency department between 1st January to 31st December 2001, were identified by their disease code. The patients' identification number, date of visit and their diagnoses as entered by the attending emergency physicians were retrieved from the hospital databases. Those patients whose descriptions of diagnoses entered by the emergency physicians did not match the disease codes were removed. A random sample was retrieved from the resultant list of patients using a random sequence generated from a random number table.

The medical records of the sampled patients were retrieved from the electronic databases and reviewed. Patients whose medical records documented the following findings were excluded from the study: (a) a duration of more than 7 days between disease onset and date of visit; (b) prior antibiotic usage or medical consultation; (c) presentation of purulent sputum and/or purulent nasal discharge and (d) existing medical conditions requiring antibiotic treatment/prophylaxis.

The exclusion criteria were derived with modifications from the recent updated Cochrane review on antibiotic usage in common cold by Arroll et al.[15] Children younger than 12 years were also excluded. This was because Changi General Hospital did not have a paediatric department and the number of paediatric patients managed by the emergency department was small.

Types of data retrieved

The types of data that were retrieved from the patients' medical records included patients' age, gender, race, month and time of visit, documented signs, symptoms, pre-existing medical conditions and, prescribed antibiotic regime including the identity and dosage regime of the antibiotics prescribed. Data extraction was carried out independently and entered directly into an electronic data collection form. Continuous data such as patients' age and time of visit were grouped into nominal categories for ease of data collection and subsequent analyses.

Data analysis

Data analyses were carried out using the SPSS v.10 statistical software. The proportion of patients with a primary diagnosis of URTI who were prescribed antibiotics and its 95% confidence interval were derived from the data. Chi-square analysis was carried out on each variable to assess its association with antibiotic prescribing. This was followed by a multivariate logistic regression analysis of the data to further ascertain the extent of their association in relation to other factors. The outcomes were adjusted using all the variables (e.g. gender, age, presence of fever, etc.). Results of the multivariate analysis were presented in odds ratios with 95% confidence intervals. The frequency distribution of each variable was also calculated and presented.

Results

The emergency department attended to 8,148 cases of URTI in the year 2001. The medical records of a random sample of 700 cases were retrieved and from these, 212 cases were excluded according to the inclusion and exclusion criteria, leaving a final sample of 488 cases (Table 1). Of these 488 cases, 24% of them were prescribed antibiotics for their URTI. The three most commonly prescribed antibiotics included amoxicillin (42%), penicillin V (26%) and erythromycin (23%). Of the 117 antibiotic prescriptions dispensed, 87% of them lasted for more than 5 days.

Objective and quantifiable patient-related factors appeared to have a greater influence over physicians' decision to prescribe antibiotics (Table 2). Multivariate

Table 1. Characteristics of sample population and their antibiotic usage profile

Sample characteristics & antibiotic usage	Results*
Sample size (N)	488
Percentage of sample prescribed antibiotics	24% (95% CI 20%, 28%)
Patients' age	
12 - 24 yr	64%
25 - 44 yr	28%
45 - 64 yr	9%
Percentage with a documented medical history	17%
Asthma	11%
Hypertension	3%
Diabetes mellitus	2%
Type of antibiotic prescribed (N=117)	
Amoxicillin	42%
Penicillin V	26%
Erythromycin	23%
Erythromycin ethylsuccinate	5%
Sulphamethoxazole/trimethorpim	2%
Others	3%

*Figures after the decimal places were not included as values were rounded up. Summation of these values might not give 100%.

Table 2. Patient-related factors associated with antibiotic prescribing

Factors associated with antibiotic prescribing (% of population*)	Incidence of antibiotic prescribing	Unadjusted OR (95% CI)	Adjusted OR (95% CI)	P value
Age of patient				
45 - 64 yr (9%)	16%	0.7 (0.3-1.7)	0.5 (0.2-1.6)	0.248
25 - 44 yr (28%)	32%	1.7 (1.1-2.7)	1.7 (1.0-2.9)	0.063
12 - 24 yr (64%)	22%	Reference		
Month of visit				
Feb to Apr (23%)	26%	0.7 (0.4-1.3)	0.7 (0.4-1.3)	0.255
May to Jul (22%)	17%	0.4 (0.2-0.8)	0.4 (0.2-0.7)	0.004
Aug to Oct (25%)	17%	0.4 (0.2-0.8)	0.6 (0.3-1.1)	0.076
Nov to Jan (30%)	32%	Reference		
Gender				
Female (27%)	25%	1.1 (0.7-1.7)	0.9 (0.5-1.5)	0.669
Male (73%)	24%	Reference		
Race				
Indian (8%)	28%	1.1 (0.5-2.4)	0.9 (0.4-2.2)	0.813
Malay (26%)	21%	0.8 (0.5-1.3)	0.7 (0.4-1.2)	0.236
Others (10%)	20%	0.7 (0.3-1.5)	0.6 (0.3-1.4)	0.257
Chinese (55%)	26%	Reference		
Time of visit				
12 midnight to 8 am (17%)	26%	1.0 (0.5-1.7)	1.1 (0.6-2.0)	0.873
8 am to 4 pm (41%)	20%	0.7 (0.4-1.0)	0.8 (0.5-1.4)	0.432
4 pm to 12 midnight (42%)	27%	Reference		
Patients' body temperature				
Higher than 38.5°C (9%)	31%	2.1 (1.3-3.5)	1.8 (0.8-4.0)	0.158
Between 37.5-38.5°C (21%)	35%	1.8 (0.9-3.6)	2.2 (1.2-4.0)	0.010
Less than 37.5°C (69%)	20%	Reference		
Number of days since onset of symptoms				
Between 3-6 days (36%)	29%	1.5 (1.0-2.2)	1.6 (1.0-2.6)	0.055
Less than 3 days (64%)	21%	Reference		
Presence of rhinorrhoea				
Rhinorrhoea not documented (26%)	33%	1.8 (1.2-2.9)	1.9 (1.2-3.2)	0.011
Rhinorrhoea documented (74%)	21%	Reference		
Presence of sore throat				
Sore throat not documented (42%)	22%	0.8 (0.5-1.2)	1.0 (0.6-1.6)	0.892
Sore throat documented (58%)	26%	Reference		
Presence of cough				
Cough not documented (21%)	20%	0.8 (0.5-1.3)	0.9 (0.5-1.6)	0.618
Cough documented (79%)	25%	Reference		
History of fever				
History of fever not documented (36%)	17%	0.5 (0.3-0.9)	0.7 (0.5-1.3)	0.277
History of fever documented (64%)	28%	Reference		
Presence of medical history				
Presence of documented medical history (17%)	20%	0.7 (0.4-1.3)	0.7 (0.2-2.9)	0.592
No documented medical history (83%)	25%	Reference		
Presence of diabetes mellitus (DM)				
Presence of documented DM (2%)	22%	0.9 (0.2-4.4)	0.6 (0.07-4.4)	0.577
No documented DM (98%)	24%	Reference		
Presence of hypertension (HTN)				
Presence of documented HTN (3%)	31%	1.5 (0.5-4.3)	3.5 (0.7-19.0)	0.139
No documented HTN (97%)	24%	Reference		
Presence of asthma				
Presence of documented asthma (11%)	17%	0.6 (0.3-1.3)	0.9 (0.2-4.3)	0.925
No documented asthma (89%)	25%	Reference		

*Figures after the decimal places were not included as values were rounded up. Summation of these values might not give 100%.

analysis revealed patients who presented without symptoms of rhinorrhoea were more likely to be prescribed antibiotics (OR 1.9; 95% CI 1.2, 3.2). Physicians were also more likely to prescribe antibiotics to patients who presented with fever (OR 2.2; 95% CI 1.2, 4.0) during consultation. There was a trend among physicians to prescribe antibiotics for patients whose symptoms had lasted for more than 3 days (OR 1.6; 95% CI 1.0, 2.6; p=0.055).

The survey also found antibiotic prescribing to be associated with the different seasons in Singapore. Patients who consulted the emergency department during the dry season i.e. between the months of May and July, were less likely prescribed antibiotics (OR 0.4; 95% CI 0.2, 0.7).

The remaining patient-related factors were not significantly associated with antibiotic prescribing. The prescribing of antibiotics by emergency physicians did not appear to be influenced by the patients' medical histories, race and gender. Patients' subjective complaints of cough, sore throat, and a history of fever did not have an impact on the physicians' decision to prescribe antibiotic.

Discussion

The majority of this sample was made up of young healthy Chinese male patients between the ages of 12 and 24 years. This composition was reflective of the population residing in the eastern part of Singapore where the new housing estates had attracted many young couples to set up their home. The young population probably explained the higher incidence of asthma but lower rates of hypertension and diabetes mellitus. The higher percentage of male patients in the sample was not unexpected considering that the emergency department provided medical care to several military camps located in its vicinity.

Our survey of patients' medical records found that 1 out of every 4 patients (prevalence rate: 24%; 95% CI 20%, 28%) consulting at our emergency department for upper respiratory tract infection was prescribed antibiotics. Similar surveys conducted in other countries reported comparable prevalence rates of antibiotic prescribing for URTI patients. Stone et al surveyed 2.7 million visits to the emergency departments across the United States for URTI and reported antibiotics being prescribed for 35.8% of visits.[16] Antibiotic prescribing rates for URTI were similar in the community setting. The reported rates across different countries ranged between 17% and 52%.[17-22] Compared against the standard that Gonzales et al had estimated, i.e. the prevalence rate of URTI of bacterial aetiology to be 5%,[21] the prevalence of antibiotic prescribing in our emergency department was found to be inappropriate.

The survey found that emergency physicians were more likely to prescribe a course of antibiotic for patients if they did not present with rhinorrhoea and were documented during consultation to have fever. The patients' duration of symptoms was also found to be associated with antibiotic prescribing but this trend did not reach statistical significance. Other patient-related factors, especially symptoms reported by patients, were not significantly associated with the physicians' decision to prescribe antibiotics. The department's emergency physicians relied more on signs and symptoms they were able to measure and observe during consultation before deciding whether or not to prescribe antibiotics. This observation was especially obvious when we contrasted the influence of fever as documented during consultation and when reported by the patients. The objective confirmation of fever during consultation was significantly associated with antibiotic prescribing but not when reported by patients only.

The survey also observed that patients had a lower chance of being prescribed antibiotics during the dry season. Singapore receives maximum rainfall during the months of November to January when monsoon winds reach the island after crossing the South China Seas.[23] Local epidemiological surveys found the incidence of influenza A viral infections to exhibit annual seasonality. The incidence of influenza A viral infections was highest between the months of November and January and, between June and July. An association was also observed between influenza B virus trends and the amount of daily rainfall.[24,25]

Emergency physicians were probably responding to these seasonal trends, anticipating a higher incidence of secondary bacterial infections and prescribing antibiotics more readily during the rainy months.

While the intent of prescribing was inappropriate with respect to the physician's diagnosis, it was comforting to note that more than 80% of the prescriptions were written for narrow spectrum first-line antibiotics (penicillin V, amoxicillin and erythromycin) for community acquired respiratory pathogens. The types of antibiotics selected by emergency physicians were largely influenced by the strict antibiotic usage policy implemented by the emergency department. Junior physicians were required to seek prior approval from their seniors before antibiotics other than those listed in the department's formulary could be prescribed.

The retrospective nature of this survey had permitted investigation into documented factors only. Factors that were not documented might have influenced our emergency physicians and resulted in inappropriate antibiotic prescribing. Investigations by Dosh et al found a significant association between patients' expressed demand and the incidence of antibiotic prescribing.[18] Our survey found that patients aged between 25 and 44 years were more likely to be prescribed antibiotics, although this trend was not statistically significant (adjusted OR 1.7; 95% CI 1.0, 2.9; p=0.063). This group of patients was likely to be more knowledgeable and vocal about their healthcare needs and might have influenced physicians into prescribing antibiotics.

This limitation was however mitigated to some extent by our electronic medical record system whereby it was mandatory for physicians to enter specified clinical data into the system. The system also had a built-in mechanism to reduce inaccurate disease coding. In addition to selecting the appropriate disease code, physicians were required to enter their diagnoses into the system. In the selection of our survey sample, we had accorded priority to the diagnoses physicians had entered over their selected disease code.

The other deficiency of this study was the lack of data of the characteristics of the attending doctors. As the rank and experience level of the doctors were not documented on the medical records, we were unable to do any analysis of prescribing trend with respect to doctors' characteristics.

Upper respiratory tract infection is a common condition encountered by physicians in emergency departments and community clinics. It has been shown by studies that conclusive evidence is lacking in that antibiotics are useful in the management of URTI. The control of antibiotic prescribing needs to be enhanced and emergency departments are better positioned than community clinics to do so. Emergency departments should extend the same vigor they have dedicated in the development and enforcement of protocols for emergency cases, to the control of antibiotic prescribing for patients with URTI. After all, the clinical importance is probably similar.

There are several methods mentioned in the literature on interventions affecting doctors' prescribing patterns.[26-30] Some examples were distribution of educational materials to the physicians, educational teaching and meetings, influencing local opinion leaders to lead by examples and audit and feedback systems. All of them have been shown to be of weak effectiveness when used individually. A multi-prong approach using a few of them together was found to be more effective.[31] My department had implemented the audit and feedback system. Now with the results from this study, we have included the use of other interventions such as influencing the senior doctors and incorporating the importance of evidence-based antibiotic prescribing into our junior doctors' teaching sessions. With these multi-facet interventions, we expect to reduce the extent of inappropriate antibiotic prescribing as well as to ensure the longevity of antibiotic effectiveness.

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