

## Impact of a Training Intervention on Use of Antimicrobials in a Teaching Hospital- Experiences From Malaysia

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**Abstract:** A quasi-intervention study was conducted to identify the patterns of antimicrobial use and to assess the effectiveness of an interactive training programme on antimicrobial prescribing for physicians in medical wards of a tertiary care hospital in Pahang, Malaysia. The period of data collection was four months in each of the pre-intervention and the post-intervention investigations from March through June in 2008 and in 2009 respectively. A total of 429 patients' treatment charts were reviewed: 209 in the first and 220 in the second investigations. Patients aged 13 years to 95 years. From March through June, 2008, (pre-intervention), an investigation of antimicrobial use was conducted at medical wards of the hospital. A short, interactive training programme focussed on antimicrobial prescribing was then conducted for physicians in the studied hospital. The training materials, inter alia, "Guide to Good Prescribing", and "How to Investigate Drug Use in Health Facilities", were utilized for the educational intervention. A second investigation was conducted later on in the same medical wards of the hospital. The core indicators of antimicrobial prescribing practices, some of the related clinical outcomes of antimicrobials utilization for the treatment of admitted patients in medical wards were specifically focused. Common antimicrobial practice patterns were evident in the medical wards of the hospital, with the most commonly used antimicrobials were the combination preparation of amoxicillin with clavulanate (augmentin). Generic prescribing was 54.3% and the intravenous route was the preferred route of administration (57.3%). The mean number antimicrobials received by the studied patients were 1.8 ( $\pm$  0.9). The majority of them (53.6%) received two or more antimicrobials for their treatment. In post intervention phase, similar patterns of antimicrobial use were observed with a notable reduction in the mean number of antimicrobial agents used per patient (1.7  $\pm$  0.8). An interactive, focussed educational intervention programme, targeted at physicians, appears to have been effective in improving antimicrobial use in a medical wards of a tertiary care hospital in Malaysia.

**Key words:** Antimicrobials, use, intervention medical wards, hospital, Malaysia.

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### INTRODUCTION

Antimicrobials are one of the most common groups of drugs prescribed in hospitals. It has been estimated that up to a third of all patients receive at least one antimicrobial agent during hospitalization (Col and O'Connor, 1987; Kunin *et al.*, 1973; Achong, 1977; Kunin *et al.*, 1987; Levy, 1982). The extraordinary therapeutic effects of antimicrobials, the problems of resistant microorganisms, irrational prescribing, different untoward toxic-effects and high cost involved—up to 40% of a hospital's drug expenditure—are compelling reasons for concern about optimising and appropriate use of antimicrobials (Ballin *et al.*, 1974; Simmons and Stolley, 1974; Kunin, 1974; Liss and Batchelor, 1987; Sinclair, 1990; Grimwood, 1983; Counts, 1977; Caldwell and Cluff, 1974; Avorn *et al.*, 1987; Lionel and Herxheimer, 1982; Soumerai and Avorn, 1990; Davis *et al.*, 1992; Gutierrez *et al.*, 1994). These drugs are prescribed by various types of health care providers both in

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developed and developing countries sometimes without adequate knowledge about the use, and consequences of the use of these important therapeutic drugs (Col and O'Connor, 1987). The use of antimicrobials is influenced by a number of complex factors. In both developed and developing countries, antimicrobials are frequently inappropriately used with many consequences such as increase in bacterial resistance, adverse reactions and over expenditure (Achong, 1977; Kunin *et al.*, 1987; Levy, 1982; Ballin *et al.*, 1974; Simmons and Stolley, 1974; Kunin, 1974; Liss and Batchelor, 1987; Sinclair 1990; Grimwood, 1983; Counts, 1977).

Strategies for reducing the inappropriate use of antimicrobials are being explored in order to minimise adverse consequences and to maximise the efficiency of use of these drugs. A number of measures have been identified to influence the use of antimicrobials in hospital settings. Managerial and regulatory approaches may work in the short term, but by themselves may meet resistance from the prescribers. An educational strategy seems to be instructive, and it has been shown to be effective in modifying prescribing patterns of physicians thus use of antimicrobials (Kunin *et al.*, 1987; Lionel and Herxheimet, 1982; Soumerai and Avorn, 1990; Davis *et al.*, 1992; Gutierrez *et al.*, 1994; Avorn, 1983; Bexell *et al.*, 1996; Lews and Hassanein, 1970; Bauchner *et al.*, 1999; Grimshaw and Russell, 1993; Lomus *et al.*, 1998; Sanson-Fisher and Cockburn, 1993; Avorn, 1998; Kunin and Efron, 1977; Zwar *et al.*, 1999; Natsch *et al.*, 1998; Fraser *et al.*, 1997; Durbin *et al.*, 1981; Maswoswe and Okpara, 1995; Mc Gown and Finland, 1974).

This study was conducted in a well-established tertiary care hospital at Kuantan, Pahang, Malaysia. This hospital is the teaching hospital for the Faculty of Medicine, International Islamic University Malaysia and also act as a referral hospital for the secondary and primary level hospitals in Pahang State, Malaysia. A few studies (Rashid *et al.*, 1986; Karim and Haque, 1995; Hossain *et al.*, 1982) of antimicrobial use demonstrated that the use of these drugs was very often inappropriate even at the tertiary level of health care facilities and quite common in medical wards. The aim of this study was to discover the existing patterns of use of antimicrobials in medical wards of this hospital and to evaluate the impact of an educational intervention in improving prescribing indicators for antimicrobial agent utilization in general. Another objective of the study was to examine the determinants of antimicrobial usage. More precisely, the study evaluated the degree to which route, generic name and intervention are reliably related with the number antimicrobials used per patient.

## MATERIALS AND METHODS

Two investigations of antimicrobial use were conducted at the selected hospital in Pahang, Malaysia. The institutional Ethics Committee approved this study. A total of 429 patients' treatment charts were reviewed: 209 in the first and 220 in the second investigations.

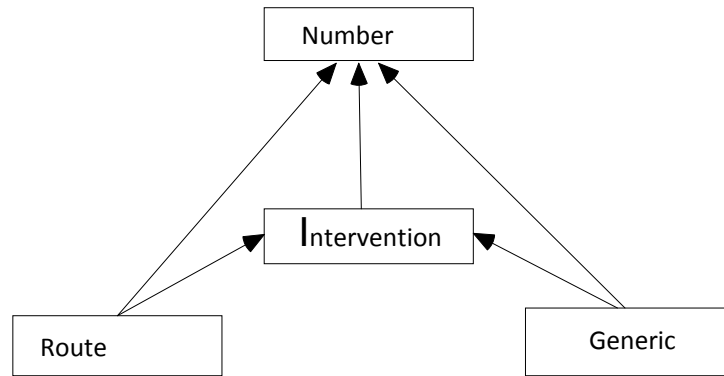
The period of data collection was four months in each of the pre-intervention and the post-intervention investigations from March through June in 2008 and in 2009 respectively. All admitted patients who received antimicrobials for their treatments were considered study subjects. The patients and their treatment files were identified from the drug supply register kept in each ward. The study instrument–data collection forms (which in addition to the general information of the patients contain the specific information such as name, dose schedule, route of administration, date of discontinuation and generic name of antimicrobials used, and information regarding laboratory investigations) were completed by examining the treatment files. Each patient was followed on a daily basis until his/her discharge from the hospital. After necessary processing, data were entered into the computer-based statistical programme—the SPSS, Version 17 for Windows for analysis.

The data derived from both investigation periods were analysed. The core indicators of antimicrobial prescribing practices, some of the related clinical outcomes of antimicrobials utilization for the treatment of admitted patients in medical wards of the hospital was specifically focused.

The training materials were, *inter alia*, Guide to Good Prescribing”, How to Investigate Drug Use in Health Facilities and Clinical Practice Guidelines were utilized for the educational intervention. The analyses were performed as a whole and for each of the selected investigation periods for selected variables. In addition to descriptive statistics such as frequency tabulations, mean, standard deviation and median, statistical tests such as Pearson Chi-square, and logistic regression tests were applied to determine statistically significant difference and/ or to adjust for pertinent variable as necessary.

To evaluate the determinants of number of antimicrobial usage per patient, the study applied a path analysis of the structural equation modelling, using the AMOS (version 16) model-fitting program. The study first tested the adequacy of the hypothesized path model, which contained the interrelationships among route of antimicrobial use, generic name and interactive educational intervention (Figure 1). Next, we assessed the relative strength of the independent variables on the basis of the magnitude of path coefficients. The hypothesized models were estimated using the covariance matrix derived from the data; thus, the estimation procedure satisfied the underlying statistical distribution theory, and yielding estimates of desirable properties. The study adopted maximum likelihood estimation in generating estimates of the path model. Once the interrelationships were estimated, we applied a set of conventionally accepted criteria to evaluate its goodness of fit. The measures, based on the criteria for deciding what constitutes a good fit model, assess the (1) consistency

of the hypothesized model with the empirical data, (2) reasonableness of the estimates, and (3) the proportion of variance of the endogenous variables accounted for by the independent variables.



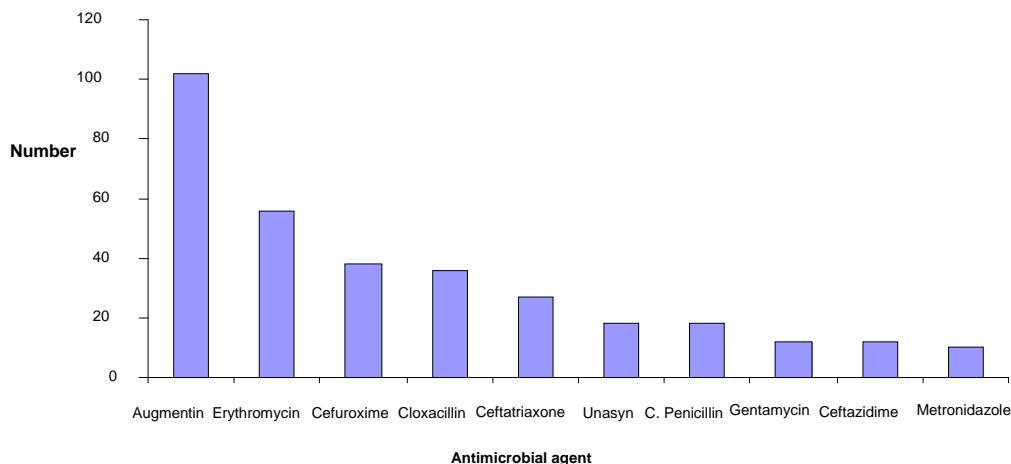
**Fig. 1:** The hypothesized Path Model of Number of Antimicrobial Usage.

To examine the impact of the educational intervention (which was a short interactive training for two consecutive working days targeted at the all physicians of the medical wards of the selected hospital) on extent of change of core prescribing indicators of antimicrobial agents and related clinical outcomes such as, mean duration of hospital stay were considered for comparison between before and after the educational intervention.

**Results:**

In the pre-intervention phase, the majority of the admitted patients were males (64.1%). The ratio of male to female was 1.8:1. The duration of their hospital stay ranged from 1 day to 30 days with the median of 4 days. There were 152 entities of different diseases identified and recorded in the patients’ treatment charts by the hospital’s physicians. In order, the ten most frequent diseases were: Pneumonia, COAD (Chronic Obstructive Airway Disease), UTI (Urinary Tract Infection), URTI (Upper Respiratory Tract Infection, Fever, Cellulitis, CCF (Congestive Cardiac Failure), Leptospirosis, Food Poisoning, Diabetes Mellitus. These ten most common diseases accounted for 58.8% of all diseases diagnosed among the patients included in this study, and pneumonia and other respiratory tract disease accounted for 38.3%.

There were 29 different antimicrobials used for their treatment. The study results showed that amoxicillin with clavulanate (augmentin), erythromycin, cefuroxime, ceftriaxone and ampicillin sodium with sulbactam sodium (unasyn) were the most frequently used antimicrobials across the medical wards of the hospital. The mean number of antimicrobial agents used per patient was 1.8(±0.9). The majority of the admitted patients (53.6%) received two or more antimicrobials in different combinations for their treatment; the intravenous route was the most preferred method (57.3%) used to administer the antimicrobials. The percentage of antimicrobials prescribed by generic name was 54.3%. Figure 2 shows the commonly prescribed antimicrobial agents.



**Fig. 2:** Commonly prescribed antimicrobial agents.

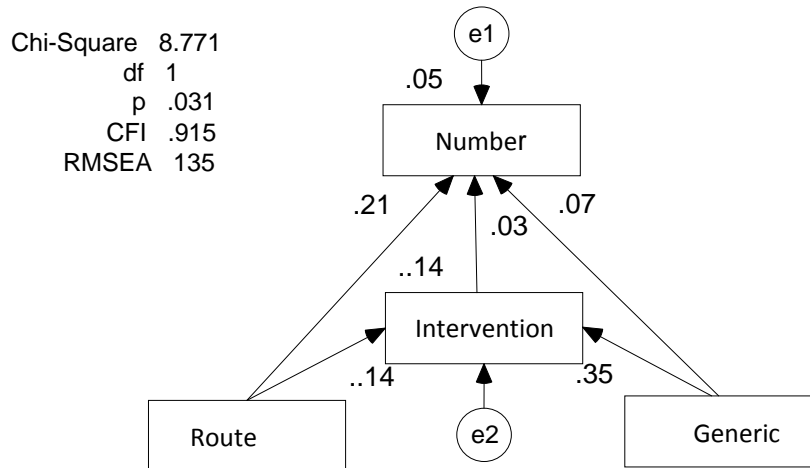
In post intervention phase, similar patterns of antimicrobial use were observed with a notable reduction of the mean number of antimicrobial agents used per patient ( $1.7 \pm 0.8$ ). Table 1 displays the comparison between pre and post intervention study findings for selected variables.

**Table 1:** Pre-post comparison for selected variables.

Variable	Pre-intervention period	Post-intervention period	p value
Age (Mean in year)	49.7 ± 19.4	46.2 ± 20.6	0.072
Gender: Male	64.1%	43.2%	< 0.001
Female	35.9%	56.8%	
Duration hospital stay (Day)	5.4 ± 5.5	6.2 ± 6.6	0.138
Number of antimicrobial (Mean)	1.78 ± 0.9	1.70 ± 0.8	0.393
Single drug	46.4%	50.5%	0.402
Polypharmacy	53.6%	49.5%	
Route: Intravenous	65.1%	46.4%	<0.001
Others	34.9%	53.6%	
Drug's name: Generic	26.3%	73.7%	<0.001
Trade	63.7%	36.3%	

However, based on multivariate analyses, the predictability of influences of selected independent variables such as age, gender, duration of hospital stay and generic name on the focused dependent variable- number of antimicrobial – is statistically inconsequential (Hosmer and Lemeshow Test:  $\chi^2 = 12.977$ ,  $df = 8$ ,  $p = 0.113$ ; Wald Test = 0.045, 1.647, 3.139, 0.167, 0.572 for age, gender, duration of hospital stay, generic prescription and intervention respectively; corresponding  $p = 0.832, 0.199, 0.076, 0.683, 0.450$  with  $df = 1$  ).

Figure 3 summarizes the results of path analysis of the interrelationships among route of administration of antimicrobials, generic name, intervention and number antimicrobials used per patient. The structural equation modeling yielded inconsistency of the hypothesized “correlational causal” relationships with the data, (relative  $\chi^2(df=1) = 8.771$   $p = .031$ ; RMSEA = .135; CFI = .915). Thus, there is no evidence to support the hypothesized relationships, and the fit indices did not satisfy their critical cutscores. The results, therefore, indicated an unfitted model and reflected that there are potential exogenous variable yet to be explored.



**Fig. 3:** Fit Indices and Standardized Coefficients of the Number of Antimicrobial Used per Patient Model.

In both the pre-intervention and the post -intervention survey nearly half of the patients received two or more antimicrobials in combination for their treatment and the intravenous route of administration of these drugs was preferred by the hospitals' physicians. The clinical outcomes such as duration of hospital stay of the patients in the post-intervention survey period were not markedly different from those during the pre-intervention survey period of the study but there was a substantial reduction in number of antimicrobials per patient in the post-intervention period compared with the pre-intervention period

**Discussion**

During the past two decades the extent of antimicrobial development has been such that it is not always easy to choose appropriate antimicrobials for the treatment of particular diseases (Williams, 1984). Many surveys have shown that inappropriate prescribing of antimicrobials and, hence inappropriate use of these drugs is widespread even in hospital practice (Cooke *et al.*, 1980; Buckwold and Ronald, 1979; Moss *et al.*, 1981;

Achong *et al.*, 1977; Roberts and Visconti, 1972). The inappropriate use of antimicrobials subjects patients to unnecessary adverse effects of these drugs, encourages the emergence and proliferation of antimicrobial resistant microorganisms and wastes of money (Levy, 1982; Kunin, 1974; Simon, 1987). Furthermore, within given situation the inappropriate prescribing habits of one physician can directly affect the patients of his/her colleagues through development of and/or cross infection by antimicrobial resistant microorganisms.

In this study the aim of conducting training with these selected training materials targeted at a particular group of physicians of a hospital was to improve the prescribing habits of physicians and thus appropriate use of antimicrobials. To have the comparability between two surveys certain issues such as periods of surveys, case-mix, antimicrobial rank by order of frequency, patients' details (age, sex, and nutritional status), hospitals and hospitals' physicians that might affect the outcome of the intervention were considered critically.

The pre-intervention and the post intervention surveys were carried out at the same period of the consecutive two years from March through June in 2008 and in 2009. The number and personal details such as age, gender of the studied patients who received antimicrobial treatment were similar between the pre-intervention and the post-intervention survey periods with predominance of male patients as appeared in other studies (Ashraf *et al.*, 1982; Rahman *et al.*, 1990; Nahar *et al.*, 1988). The physicians who usually wrote the prescriptions in each of the survey periods had a similar educational and training level. In particular, none of the physicians in the medical wards of the selected hospital was transferred or newly posted. As the medical wards of a selected hospital included in the study were of similar level by function and the hospital was government institutions, the availability of antimicrobials also expected to be similar in these medical wards although this was not measured. The most commonly used antimicrobials for admitted patients in the respective medical wards were similar in both the pre-intervention and the post-intervention survey periods. For evaluation of the educational intervention, the important prescribing indicators such as number, generic prescription and route of administration were focused with special attention. There are substantial decreases in number of antimicrobials per studied patient the post intervention period compared with the pre-intervention period. These finding are almost similar to other tertiary care hospital-based studies in Thailand and Bangladesh (Thumlikitkul *et al.*, 1998; Akter *et al.*, 2009)..

#### **Conclusion:**

An interactive, focussed educational intervention programme, targeted at physicians, appears to have been effective in improving antimicrobial use in a medical wards of a tertiary care hospital in Malaysia

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#### **Competing Interests:**

No competing interests exist.

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