



**INFLUENCE OF AN EDUCATIONAL INTERVENTION ON PRESCRIBING ERRORS
OF SECOND YEAR MEDICAL STUDENTS IN A TEACHING MEDICAL COLLEGE IN
NEPAL**

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ABSTRACT

Background: Writing a medical prescription requires knowledge, judgment and skill. Precise prescription writing decreases the number of prescribing errors and ultimately the number of adverse drug events. Present study focused on the influence of an educational intervention on the prescribing errors of second year medical students.

Methods: One hundred thirty-four students participated in the study after giving their consent. All the students (group A- pre-intervention group) were given a case for prescribing. After that, an interactive group demonstration was taken for them and a different clinical case was provided for them for prescribing (group B- post-intervention group). Cases for prescribing were selected from World Health Organization guide to good prescribing. Prior knowledge of prescribing was assessed for group A whereas impact of the educational intervention was observed on group B. Both group A and group B hand written prescriptions were evaluated by using a check-list based on Miller's and Mucklow *et al* assessment model. Chi square test (Yates corrected) and paired t test (two tailed) were applied by using EpiInfo 2000 and Excel 2007 to compare the findings. Level of significance (P value) was considered at 0.05. **Results:** The educational intervention showed positive significant influence on the students' prescribing errors. Prescribing errors which were significantly improved were prescriber's contact no, symbol \mathcal{R} , dosage form of medicine, strength of medicine, route of administration and total amount to be dispensed with improvement on all prescribing errors. Average number of errors per prescription also decreased significantly in group B (4 ± 1.3 Vs 2.1 ± 0.7 , $P=0.00000$). **Conclusion:** Education interventional program for medical students on prescription writing has significant role in improving prescribing errors.

KEYWORDS: Education, errors, intervention, prescription, students.

INTRODUCTION

A prescription is 'a written order, which includes detailed instructions of what medicine should be given to whom, in what formulation and dose, by which route, when, how frequently, and for how long'.^[1] So, a medical prescription is a prescriber's written document to the pharmacist to dispense a drug or drugs. It contains the information for a dispenser and a patient regarding the dispense and the use of a medicine, and it also serves as a legal document.^[2] Though different countries have their own rules and regulations for prescription writing, the most important criterion is that the prescription should be clear, and legible, and it should indicate correctly what medicine should be administered. World Health Organization (WHO) has published 'guide to good prescribing' for the training of medical students and the health practitioners. 'Guide to good prescribing'

has clearly mentioned the prescription elements which should not be missed during prescription writing to prevent health problems/harms which may result from poor prescription writing. The prescription elements include as follows; name and address of the prescriber, with telephone number; date of the prescription; name and address of the patient; age (for children and elderly); symbol \mathcal{R} , Name and strength of the drug; Dosage form and total amount; information for the package label (how much, how often, which route, any specific instructions or warnings) and prescriber's initials or signature.^[2]

Prescription errors are quite common and have negative health impact on number of patients^[3] which may result into 'adverse drug events' which are the health related problems/harms due to poor prescribing which can be prevented by the precise prescription writing.^[4] Poor

prescription can be indicated by prescription errors, under or overprescribing or inappropriate and irrational prescribing.^[5] Definition of a 'prescription error' includes 'a failure in the prescription writing process that results in a wrong instruction about one or more of the normal features of a prescription'. The 'normal features' can be defined as 'the identity of the recipient, the identity of the drug, the formulation and dose, and the route, timing, frequency and duration of administration'.^[4]

Medical students study basic medical sciences (anatomy, biochemistry, pathology, physiology, pharmacology microbiology and community medicine) in initial two years (pre-clinical years) and clinical sciences (medicine, surgery, gynecology and obstetrics, pediatrics, etc) in third, and fourth and half years. They spend another one year for compulsory internship in the hospital and are directly involved in prescription writing during their internship. They are taught basics of prescription writing which requires proper knowledge of pharmacotherapeutics and rational prescribing^[2, 6] during their preclinical years in the medical school. Findings in a study show that junior doctors are involved in for significant prescription writing and are most prone to prescribing errors.^[7]

Miller has developed four consequent stages of pyramid shaped model for assessment of students. First stage (base of pyramid) tests the 'knowledge (knows)', second stage assesses 'competency (knows how)', third stage evaluates 'performance (shows how)' and the fourth stage (top of the pyramid) assesses 'action (does)'.^[8] In preclinical academic setting, students are assessed for knowledge and competency. As per this model, performance and action are assessed in the clinical practice by doing prescription audits and finding prescription errors. Additionally, Mucklow *et al*^[9] has given more examples to assess prescribing skills based on Miller's model. So in present study students' knowledge and competency was assessed by asking to write prescriptions on different clinical conditions as per Miller's and Mucklow *et al* assessment models. This study focused on assessment of prescribing skills of second year medical students with and without an educational intervention and the impact of the educational intervention on prescription writing. Prescription writing skills and prescription errors were assessed based on prescription elements recommended by 'WHO guide to good prescribing'^[2] and Lofholm and Katzung, 2015.^[10]

METHODS

Ethical clearance was obtained from the Institutional Review Committee before conducting the study. Hundred and fifty second year medical students were informed about the study and the verbal consent was taken. Only 134 students gave their consent and participated in the study. In present study, students were given a case of 'dry cough' for prescription writing- pre-intervention group- group A/control group. An

interactive group demonstration class on prescription writing skill was taken by a subject teacher - a faculty who had master's degree in the related field. A case of 'stage I hypertension' was given for them for prescription writing (post-intervention group- group B). Existing knowledge of prescribing was assessed for group A whereas effect of lecture class was observed in group B. Both pre-intervention (group A) and post-intervention (group B) hand written prescriptions were evaluated by using a check-list and compared for twenty-one prescription elements which were prescriber's name, educational degree, medical council registration number, date of prescription, prescriber's contact number, patient's name, age, sex, address/contact, diagnosis, symbol \mathcal{R}_x , dosage form, name of the medicine, strength, frequency of administration, route of administration, total amount/quantity to be dispensed, direction for use, advice/instructions/ warnings, follow up/ refill information and prescriber's name or signature^[2,10] Errors were also categorized as errors of omission (absence) and errors of commission (incorrect information).^[11] Data were compiled and analyzed Excel 2007 and Chi square test (Yates corrected) and paired *t* test (two tailed) were applied (using EpiInfo 2000 and Excel 2007) to compare the findings. Level of significance (P value) was considered at 0.05.

The following cases were given for the students for prescribing.

Pre-intervention (group A)

"A 52-year old taxi-driver complains of a sore throat and cough which started two weeks earlier with a cold. He has stopped sneezing but still has a cough, especially at night. The patient is a heavy smoker who has often been advised to stop. Further history and examination reveal nothing special, apart from a throat inflammation." Prescribe for this patient.^[2]

Post-intervention (group B)

"A man, 45 years old suffers from bronchial asthma and uses salbutamol inhaler during attacks. A few weeks ago you diagnosed essential hypertension (systolic 140 mm of Hg and diastolic 98mm of Hg on various occasions)." Prescribe for this patient.^[2]

RESULTS

In group A and B, areas and pre- and post-intervention rates of prescription error were prescriber's contact no 70.2% Vs 28.4%, inclusion of Symbol \mathcal{R}_x incorrectly 71.6% Vs 63.7%, dosage form of medicine 15.4% Vs 2.9%, strength of medicine 25.4% Vs 23.9%, frequency of administration 7.5% Vs 6.0%, route of administration 76.1% Vs 11.9%, duration of administration 18.0% Vs 10.5%, total amount to be dispensed 52.2% Vs 29.8%, direction for use 40.3% Vs 23.9%, advice/ warning/ instruction 11.9% Vs 6.0% and follow-up/refill instruction 49.3% Vs 46.3% respectively (Table-1 and 2). Error of commission for Symbol \mathcal{R}_x was highest in both the groups. After the educational intervention, the

prescription errors which were significantly improved were prescriber's contact no, symbol \mathcal{R}_x , dosage form of medicine, strength of medicine, route of administration and total amount to be dispensed with improvement on

all prescribing errors (Table-3). Average number of errors per prescription in the both groups (4 ± 1.3 Vs 2.1 ± 0.7) with significant reduction in errors in post-intervention group (group B) has been shown in table 4.

Table 1: Prescription elements and errors in pre-intervention group (group A)

Elements	Written correctly N (%)	Written incorrectly- commission error (1) N (%)	Not-written- omission error (2) N (%)	Error (1+2) N (%)
Prescriber's name	134 (100)	-	-	-
Prescriber's qualification	134 (100)	-	-	-
Prescriber's registration no	134 (100)	-	-	-
Prescriber's contact no	40 (29.8)	-	-	94 (70.2)
Date of prescription	134 (100)	-	-	-
Patient's name	134 (100)	-	-	-
Patient's age and gender	134 (100)	-	-	-
Patient's address/contact no	134 (100)	-	-	-
Diagnosis	132 (98.5)	-	-	2 (1.5)
Symbol \mathcal{R}_x	38 (28.4)	96(71.6)	-	96 (71.6)
Dosage form of medicine	112 (83.6)	-	22 (15.4)	22 (15.4)
Name of medicine	132 (98.5)	2 (1.5)	-	2 (1.5)
Strength of medicine	100 (74.6)	30 (22.4)	4 (2.9)	34 (25.4)
Frequency of administration	124 (92.5)	6 (4.6)	4 (2.9)	10 (7.5)
Route of administration	32 (23.9)	-	102 (76.1)	102 (76.1)
Duration of administration	110 (82.0)	6 (4.4)	18 (13.6)	24 (18.0)
Total amount to be dispensed	64 (47.8)	2 (1.5)	68 (50.7)	70 (52.2)
Direction for use	80 (59.7)	-	54 (40.3)	54 (40.3)
Advice/ warning/instruction	118 (88.1)	-	16 (11.4)	16 (11.9)
Follow-up/refill instruction	68 (50.7)	38 (28.4)	28 (20.9)	66 (49.3)
Prescriber's signature	132 (98.5)	-	2 (1.5)	2 (1.5)

Table 2: Prescription elements and errors in post-intervention group (group B)

Elements	Written correctly N (%)	Written incorrectly (1) N (%)	Not-written (2) N (%)	Error (1+2) N (%)
Prescriber's name	134 (100)	-	-	-
Prescriber's qualification	134 (100)	-	-	-
Prescriber's registration no	134 (100)	-	-	-
Prescriber's contact no	96 (71.6)	-	38 (28.4)	38 (28.4)
Date of prescription	134 (100)	-	-	-
Patient's name	134 (100)	-	-	-
Patient's age and gender	134 (100)	-	-	-
Patient's address/contact no	130 (97.1)	-	-	4 (2.9)
Diagnosis	134 (100)	-	-	-
Symbol \mathcal{R}_x	62 (46.3)	72 (63.7)	-	72 (63.7)
Dosage form of medicine	130 (97.1)	2 (1.5)	2 (1.5)	4 (2.9)
Name of medicine	134 (100)	-	-	-
Strength of medicine	132 (98.5)	2 (1.5)	-	2 (1.5)
Frequency of administration	126 (94.1)	6 (4.4)	2 (1.5)	8 (5.9)
Route of administration	118 (88.1)	-	16 (11.9)	16 (11.9)
Duration of administration	120 (90.6)	8 (6.0)	6 (4.4)	14 (10.4)
Total amount to be dispensed	94 (70.2)	8 (6.0)	32 (23.8)	40 (29.8)
Direction for use	102 (76.1)	-	32 (23.9)	32 (23.9)
Advice/ warning/instruction	126 (94.0)	-	8 (6.0)	8 (6.0)
Follow-up/refill instruction	72 (53.7)	30 (22.4)	32 (23.9)	62 (46.3)
Prescriber's signature	134 (100)	-	-	-

Table 3: Positive impact of interactive lecture class on prescription elements and errors (improvement)

Elements	Errors (group A)	Errors (group B)	Improvement (A-B), N (%)	Chi square test- Yates corrected (P value)
Prescriber's contact no	94 (70.2)	4 (2.9)	90 (67.2)	62.2 (0.000)*
Diagnosis	2 (1.5)	-	2 (1.5)	-
Symbol \mathcal{R}_x	96 (71.6)	72 (53.7)	24 (17.9)	3.8 (0.049)*
Dosage form of medicine	22 (16.4)	4 (2.9)	18 (13.5)	5.4 (0.019)*
Name of medicine	2 (1.5)	-	2 (1.5)	-
Strength of medicine	34 (25.4)	2 (1.5)	32 (23.9)	14.4 (0.000)*
Frequency of administration	10 (7.5)	8 (6.0)	2 (1.5)	0.0 (1.000)
Route of administration	102 (76.1)	16 (11.9)	86 (64.2)	53.4 (0.000)*
Duration of administration	24 (18.0)	14 (10.5)	10 (7.5)	0.9 (0.321)
Total amount to be dispensed	70 (52.2)	40 (29.8)	30 (22.4)	6.0 (0.013)*
Direction for use	54 (40.3)	32 (23.9)	22 (16.4)	3.4 (0.064)
Advice/ warning/instruction	16 (11.9)	8 (6.0)	8 (6.0)	0.8 (0.364)
Follow-up/refill instruction	66 (49.3)	62 (46.3)	4 (3.0)	0.0 (0.862)

* $P < 0.05$ **Table 4: Number of prescription errors in group A and group B with the significant difference**

Prescription errors Group A, N=134 Mean \pm S.D.	Prescription errors Group B, N=134 Mean \pm S.D.	Paired 't' test- two tailed	P value
4 \pm 1.3	2.1 \pm 0.7	1.9	0.00000*

* $P < 0.05$ **DISCUSSION**

Present study focused on prescription writing skills of second year undergraduate medical students and the influence of an educational intervention on it. Out of twenty-one elements assessed in prescription writing, students made both errors of omission and commission on thirteen prescription elements mainly involving the drug related factors and the elements of the prescribing errors were prescriber's contact number, diagnosis, symbol \mathcal{R}_x , dosage form of medicine, name of medicine, strength of medicine, frequency of administration, route of administration, duration of administration, total amount to be dispensed, direction for use, advice/warning/instruction, follow-up/refill instruction. These findings were in agreement with previous findings.^[12, 13-15] From the results, it was evident that variation in the prescription errors in different elements was found to be 1.5% to 71.6%. Previous similar studies have found the prescribing errors up to 84.5%.^[13, 16, 17] The main prescribing errors in pre-intervention group were error of commission on symbol \mathcal{R}_x (71.6%) followed by error of omission on prescriber's contact number (70.2%) whereas error of commission on symbol \mathcal{R}_x (63.7%) was highest in post-intervention group.

Symbol \mathcal{R}_x has following meanings- an Egyptian symbol for eye of Horus (having healing power), an ancient symbol for the 'Jupiter or Zeus'- the 'Gods of healing and protection', 'Take Thou (Thou means 'you' in old english)' and/or 'Recipe (take)'.^[2] Majority of the students in present study had commission errors on writing the symbol. Similarly, data in previous study showed that students paid less attention to the inclusion of the symbol (55.6%) in prescription writing.^[13] Inclusion of the symbol \mathcal{R}_x verbatim is more accurate than inclusion

of Rx or RX or R_x to recall the history and also to pay respect to the many centuries-old medical fraternity. However, way of writing the symbol in a medical prescription may be a matter of discussion for uniformity in all medical universities and schools. Omission of prescriber's contact number in the prescription may have serious consequences. For example, whenever there is any query regarding medication in the prescription by the dispenser, contact number is essential. Similarly, if patient has any confusion related to the use of medicine/s or occurrence of untoward effect of a drug, prescriber's contact number is indispensable for the consultation and advice. Previous data showed that physicians received over 150 million calls per year from the pharmacists because of unclear prescriptions in United States.^[18] So inclusion of prescriber's phone number is very important as final responsibility of every prescription written lies on the prescribing doctor.^[19, 20]

Findings showed that drug related factors were more common areas of prescribing errors which may lead to higher incidence of adverse drug events. A systematic review involving data from 32 years (1982 to 2014) showed that the reported incidence of adverse drug events in adult patients requiring intensive-care-unit admissions to be from 0.37 to 27.4% and mortality rate 2 to 28.1%. Additionally, preventable events as per the study findings were 17.5 to 85.7% of total events.^[21] Another review showed that adverse events that needed intensive-care-unit admissions were up to 37.2% and preventability of the adverse events ranged from 17% to 76.5%.^[22] These are the figures for intensive care unit admissions which do not involve cases of all the hospital admissions of all age groups. So the figure for all the adverse drug events could be even higher. Now the

question is how to prevent prescribing errors and the adverse drug events so that patients' health care can be improved and cost for health care service can be minimized.

There was improvement in the errors of all prescription elements in post-intervention group with significant influence on majority of the factors. Similarly, findings showed significant decrease or improvement on average number of prescription errors in post-intervention group (4 ± 1.3 Vs 2.1 ± 0.7). Based on these data, an educational intervention is an effective way to improve the prescription writing skills of preclinical students. These findings have been substantiated by earlier studies in different settings.^[13, 23-25] So educational intervention program is essential for the medical students for the proper training on prescription writing even in the clinical years so that they can be competent enough for proper patient care through a medical prescription in their clinical practice after completion of their studies.^[26]

Limitations of the study include that even after educational intervention there was not 100% improvement in all the prescription errors. This may probably be explained by students' interest and concentration, their intellectual capability, teacher's experience and competency of lecture delivery and duration of lecture.^[13] Ross *et al*^[27] have suggested that only increasing the knowledge of prescription writing skills may not be sufficient enough for better prescription writing. Behavioral modification of a prescriber may supplement and increase the efficacy of an educational intervention. Data in the literature have shown that many factors such as marketing by pharmaceutical companies, stressful clinical situations, work overload, demanding patients, prescriber's competency and attitude^[28, 23, 24] which may lead to prescribing errors have not been considered in the study. So, present findings may not exactly represent the prescribing errors of real clinical situation as these findings are related to the controlled educational environment.^[9] However, present findings can predict the future competency and performance of the students and help design a competent model for better prescription writing with the consideration of the related findings in the literature and WHO's six-step model for rational prescribing.^[2, 13, 23, 24, 27]

CONCLUSION

Educational intervention is an effective way to decrease the number of prescribing errors in the medical students' prescribing. Inclusion of an educational training program on prescription writing and rational prescribing may help write the better prescriptions in their future clinical practice.

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