PRESCRIPTION WRITING IN PUBLIC AND PRIVATE HOSPITALS IN BENIN CITY, NIGERIA: THE EFFECTS OF AN EDUCATIONAL INTERVENTION

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ABSTRACT

Background
Writing a prescription is a vital part of the process of rational therapeutics; a badly written prescription could undermine a clinical consultation.

Objectives
To determine how far prescriptions meet accepted standards, identify factors underlying poor prescription writing, intervene by educational methods, and evaluate the effects of intervention.

Methods
Prescriptions (1,197) were collected retrospectively from 40 doctors (public and private hospitals). Handwriting was assessed using a rating scale. Intervention was by face-to-face education and group seminar in public hospitals, and face-to-face education only in private hospitals, with impact evaluation 4 to 6 weeks later. Non-parametric statistics were used to assess differences in means for pre- and post-intervention values.

Results
At baseline, more prescriptions from private hospitals had hospitals' addresses (p=0.005) and patients' ages (p=0.015); more from public hospitals were signed (p=0.001) and 20% of prescriptions were clearly legible. Post-intervention, more prescriptions from public hospitals were signed (p=0.017); more from private hospitals had the doses (p=0.04) and routes (p=0.05) of administration, and the intervention group in private hospitals wrote patients' ages more frequently than controls (p=0.05). Doctors who had group seminar wrote frequencies and routes of administration (p=0.03 and 0.04 respectively) more than those who had face-to-face education. Handwriting worsened (p=0.04, 0.02 in public and private hospitals respectively). Poor quality of prescriptions was blamed partly on heavy workload and non-availability of prescription order blanks.

Conclusions
Prescriptions lacked details and most were not clearly legible. Intervention resulted in modest changes, which in public hospitals were more significant among doctors who had group seminars.

Keywords: *Prescription writing; legibility; educational intervention*

The interaction between a doctor and patient usually culminates in the writing of a prescription order. The energies, skills and time put into making a diagnosis and formulating appropriate therapy could be wasted if adequate attention was not given to the details that ought to be included in a well-written prescription. A prescription order should clearly

communicate with a pharmacist/dispenser what therapy a particular patient is to get: how much of a specific medicine should be taken, how often and for how long. It should also clearly identify the prescriber, be signed in ink, and be dated.[1] The illegibility of the prescription or omission of any of these details in a prescription order could result in misinterpretation and medication errors.[2]

Because teaching in clinical pharmacology or therapeutics is not emphasized in medical schools[3,4], medical graduates do not have appropriate prescription-writing skills. The need to emphasize and promote the acquisition of prescription writing skills in medical undergraduates and interns has been highlighted.[5] Many intervention measures have focused on rational prescribing[6-9], but there is no known published work showing the effects of educational intervention on prescription writing among doctors in a developing country.

We set out to systematically assess prescriptions written by doctors in public and private hospitals. The main objectives were to determine to what extent written prescriptions meet accepted standards, to identify factors underlying poor prescription writing, intervene by educational means, and assess the impact of such intervention. This study provides scientific evidence for the quality of handwritten prescriptions in a developing country. It also highlights the applicability of educational methods in improving prescription writing among doctors in public and private sectors.

METHODS

The study was carried out in Benin City, Southern Nigeria. At the time of this study, the city had an estimated population of over 800,000 thousand within its 5-kilometer radius. The hospitals within the city included one Teaching hospital (with a total of 491 bed spaces, and an annual outpatients' attendance of over 88,000), a state-owned specialist hospital (with a 400 bed capacity), a psychiatric hospital, and five other public hospitals. In addition, there were 36 registered private hospitals (excluding clinics, maternities and primary health care centres). There was no National Health Insurance Scheme in place at the time of this study and patients had to pay in full for all their prescriptions. Ethical approval was obtained from the University of Benin Teaching Hospital Ethics Committee. The initial phase was a baseline survey, followed by an educational intervention. This was followed four-to-six weeks later by another survey to assess the impact of the educational intervention. The entire study took place over a period of 19 months, from January 2000 to July 2001.

Baseline Survey

Nine registered private hospitals were randomly selected from the total of 36 using a table of random numbers, and the list of registered private hospitals obtained from the State Ministry of Health. All the (8) public hospitals were surveyed. In each of these hospitals, a maximum of 5 doctors were randomized into the sample. For each doctor, 30 most recent prescriptions were sequentially picked, beginning from those prescribed on the day of (or closest to) the visit, and going backwards until (in all but 5 cases) 30 prescriptions were obtained. All prescriptions were assessed by one of the investigators (a senior resident in the Teaching Hospital who had spent 4 years in residency in internal medicine, and was in the third year of sub-specialty training in clinical pharmacology/therapeutics).

Prescriptions assessed were selected from general outpatient encounters. Each prescription was assessed for: hospital name and address; doctor's name, signature and address; patient's name, age, sex and address; the name(s) of drug(s) prescribed; and dose, dosing frequency, duration of administration and instructions for labelling. The legibility of each prescription was assessed using a rating scale from 0 to 4: 0-illegible; 1-barely legible; 2-moderately legible; 3-clearly legible; 4-print. The different scores for each prescription written by individual doctors were summed up and divided by the total number of prescriptions for that doctor, to obtain an average legibility score per doctor.

Educational Intervention

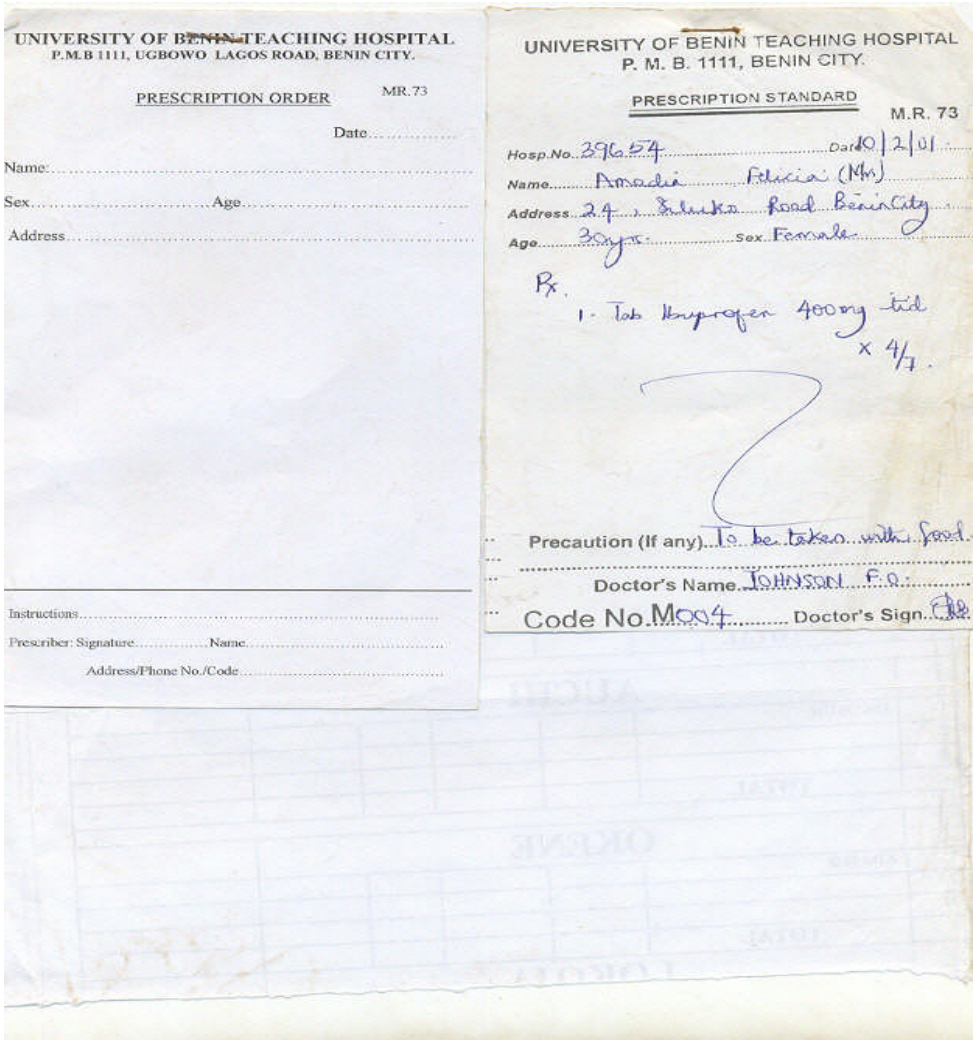
The public hospitals were randomized (by simple random sampling) into 3 groups, one control and 2 intervention groups, respectively. Each of the 2 intervention groups was further randomized (by simple random sampling) to have educational intervention by either face-to-face education or group seminar. Private hospitals were similarly

randomized into 2 groups; a control and intervention group, respectively. Face-to-face education was chosen for intervention among private practitioners because of the logistic problems associated with organizing a group seminar in this group. The same educational content was used for intervention in all cases and included:

A summary of the objectives of the study with an illustration of what a standard prescription order should be (as shown in figure 1).

- Highlights of the results of the baseline survey.
- The importance of completeness and legibility of prescriptions using specific examples of illegible prescriptions and of some medication errors, which had occurred as a result of lapses in prescription writing.

FIG. 1 A scanned copy of a prescription order blank alongside a sample prescription order used during the intervention



In addition, doctors in the intervention groups were asked to proffer reasons for poor prescription writing among doctors. All the reasons proffered by doctors in both public and private hospitals were documented and a synthesis is presented in the results. Face-to-face education lasted for 15-20 minutes, and the group seminars for 20-30 minutes: i.e., the time during which the investigator presented the educational material, excluding interruptions and time given for questions and comments. The group seminar sizes were seven and nine, respectively (including the 5 doctors selected into the study in each group; investigators excluded). The investigator who had assessed all the prescriptions conducted all the face-to-face education sessions. Both investigators (the other an Associate Professor of clinical pharmacology/therapeutics) conducted the group seminars.

Impact Evaluation

An impact evaluation was done within 4-6 weeks after the educational intervention. Prescriptions from both intervention and control groups were assessed as in the baseline survey. Data were analyzed using the SPSS software: non-parametric statistics (Mann Whitney and Wilcoxon tests) were used to assess differences in means for pre- and post-intervention values. Statistical significance was placed at a p value ≤ 0.05. A pre- and post-intervention analysis was used to compare doctors' prescriptions before and after educational intervention. The intervention group in private hospitals was further compared with the control group. It was not possible to compare intervention groups in public hospitals with controls because of significant attrition: this arose because of a down-sizing of the State public work force which affected the health sector.

RESULTS

The Sample

A total of 17 hospitals (8 public and 9 private) were randomized into the sample at baseline. One thousand one hundred and ninety seven prescriptions obtained from 40 doctors (25 and 15 each from public and private hospitals respectively) were assessed in the baseline survey. After repeated visits, less than 30 prescriptions were obtained for five doctors: 21 for one, 28 for another and 29 for three others, respectively. For eight doctors, just over 30 prescriptions were assessed. One hospital was dropped after the baseline survey because records of prescriptions were no longer kept. One doctor declined to participate in the educational intervention; some doctors were retired in a down-sizing of the work force that took place in the State; and a few others changed jobs within the period of the survey. Tables 1 and 2 describe the characteristics of the study population at baseline and at the intervention phase.

TABLE 1 The study population at the baseline survey

	Public Hospitals	Private Hospitals	Total
Number of hospitals selected for study	8	9	17
Total number of doctors selected	25	15	40
Total number of prescriptions	746	451	1197
No. of hospitals randomized into intervention/ control groups at the end of this phase	7	9	16•
No. of doctors randomized into intervention/ control groups at the end of this phase	18	13	31•

•One hospital and a total of 9 doctors were dropped
•No record of prescriptions in the hospital at intervention phase
•Non-consent; retirement and re-location of doctors

TABLE 2 The study population at the intervention phase

	Face-to-face			Group Seminar (public only)	Control			Grand Total
	Public	Private	Total		Public	Private	Total	
Number of hospitals	2	4	6	2	1	5	6	14
Number of doctors	3	5	8	8	1	8	9	25
Hospital drop-outs	1	-	1	-	1	-	1	2
Prescriber drop-outs	2	1	3	2	1	-	1	6•

•Re-deployment - 3 doctors; No records of prescriptions - 3 doctors

Prescription Order Blanks

Samples of prescription order blanks were available in 75% and 55.6% of all public and private hospitals, respectively. Some of these samples were retrieved from the archives, because they were not in regular use. No hospital had carbonated prescription order blanks. The hospitals' names were printed in all samples. The hospitals' addresses were printed in 33.3% and 40% of samples of prescription order blanks from public and private hospitals, respectively. Other details had to be written by prescribers. The provisions made for the inclusion of these details are shown in Table 3.

TABLE 3 Provisions made for the inclusion of various parameters in prescription order blanks in public and private hospitals

		Space provided for parameter in prescription order blank	
No.	Parameter	Public (%)	Private (%)
1	Name of hospital•	100	100
2	Address of hospital•	33.3	40
3	Date	100	90
4	Patient's name	100	70
5	Patient's sex	83.3	70
6	Patient's age	83.3	80
7	Patient's address	66.7	50
8	Doctor's signature	83.3	70
9	Doctor's name	33.3	20
10	Instruction to pharmacist/dispenser	16.7	10
11	Doctor's address/phone no.	0	0

•Pre-printed on prescription order blanks.

Prescription Writing and Effects of Intervention

Comparing the baseline parameters for public and private hospitals as shown in Table 4 (columns 3 and 6, respectively), significantly more prescriptions in private hospitals had the hospitals' addresses (p=0.005). Patients' ages were more frequently stated in prescriptions from private hospitals (p=0.015), but doctors' signatures were present in more prescriptions from public hospitals (p=0.001); these p values are not shown in the table. Table 4 further highlights the extent to which various required details were included in prescriptions 4 - 6 weeks after educational intervention.

TABLE 4 Proportions of prescriptions having the various required details at the baseline and post-intervention surveys*

Item	Details	PUBLIC Hospitals (%±SEM) +			PRIVATE Hospitals (%±SEM) ++		
		Baseline	4-6 weeks Post-intervention	p value^	Baseline	4-6 weeks Post-intervention	p value^
1.	Hospital address	25 ± 16.4	57.1 ± 23.5	0.18	88.3 ± 10.9	85.6 ± 11.2	0.18
2.	Date	94.7 ± 2.8	95.3 ± 3.9	0.72	98.6 ± 0.5	99.6 ± 0.2	0.14
3.	Patient's name	99.9 ± 0.1	100 ± 0	0.32	97.4 ± 1.9	100 ± 0	0.18
4.	Patient's sex	76.0 ± 13.8	98.7 ± 1.3	0.47	87.2 ± 5.7	96.9 ± 1.4	0.24
5.	Patient's age	41.2 ± 12.5	64.2 ± 15.9	0.08	62.4 ± 8.5	66.1 ± 7.8	0.77
6.	Patient's address	33.6 ± 16.2	69.1 ± 20.2	0.69	82.1 ± 8.6	90.5 ± 7.3	0.29
7.	Doctor's signature	99.3 ± 0.4	96.0 ± 4.0	1.38	69.2 ± 10.5	57.6 ± 12.7	0.08
8.	Doctor's name	16.8 ± 12.5	27.5 ± 19.5	0.07	9.2 ± 6.3	11.0 ± 7.3	0.32
9.	Doctor's address	0	0	-	11.1 ± 11.1	11.1 ± 11.1	1.0
10.	Dose	97.2 ± 1.2	96.3 ± 1.6	0.14	95.8 ± 1.7	93.8 ± 2.2	**0.04**
11.	Frequency	95.8 ± 1.5	96.9 ± 1.0	1.0	94.9 ± 2.1	96.1 ± 1.6	0.26
12.	Route	8.4 ± 2.3	7.2 ± 2.1	0.5	14.2 ± 2.8	20.6 ± 4.9	**0.05**
13.	Duration	93.1 ± 2.9	93.9 ± 4.4	0.5	85.8 ± 7.7	85.5 ± 3.5	0.86
14.	Instructions for labelling	0.9 ± 0.4	1.0 ± 0.4	1.14	14.0 ± 8.6	12.0 ± 4.2	0.37

***** Aggregate data irrespective of intervention method; + Intervention was by face-to-face education as well as group seminar for 2 different groups; ++Intervention was only by face-to-face education; ^P values using Wilcoxon Signed Ranks Test, comparing pre- and post-intervention values for public and private hospitals respectively.

In private hospitals, there was a statistically significant increase in the number of prescriptions that stated the dosages (p=0.04) and routes of administration of medicines (p=0.05). Doses of medicines prescribed were however often stated as how many tablets should be taken, and not specific amounts (for example in milligram or gram). There were no significant differences in pre- and post- intervention parameters in public hospitals. In both public and private hospitals only 20% of prescriptions were clearly legible at baseline. Legibility of handwriting worsened significantly following educational intervention (p=0.04, 0.02 respectively). Figures 2 and 3 are examples of poorly legible prescriptions, which were assessed during the survey.

FIG. 2 & FIG. 3 Scanned copies of two poorly written prescriptions from one of the hospitals surveyed

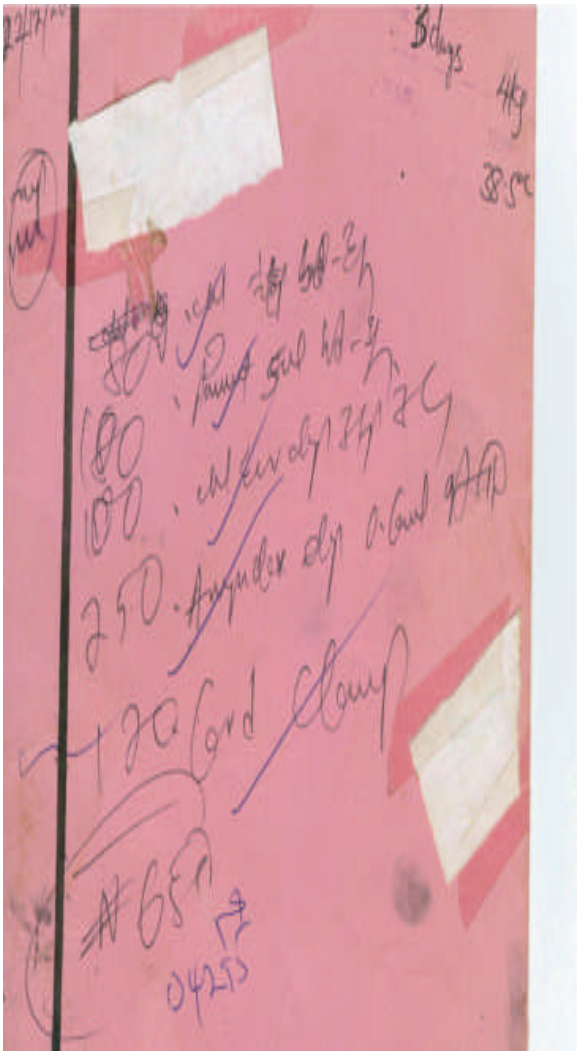


Table 5 highlights the degree to which doctors in the different intervention groups included the various details required in a prescription order. Significantly more doctors who had the group seminar wrote the frequency (p=0.03) and route (p=0.04) of administration of medicines prescribed than doctors who had face-to-face education. More doctors in private hospitals who had educational intervention wrote the ages of patients compared with controls (p=0.05).

TABLE 5 Post-intervention: degree of adherence by doctors in different intervention groups to details required in prescription orders

Item	Detail	PUBLIC		PRIVATE		
		Face-to-face (% ± SEM)	Group Seminar (% ± SEM)	Control (% ± SEM)	Face-to-face (% ± SEM)	Control (% ± SEM)
1.	Hospital address	0•	94.6 ± 5.4	100	94.0 ± 6.0	75.0 ±16.4
2.	Date	100	98.8 ± 1.3	80	99.4 ±0.6	99.6 ± 0.4
3.	Patient's name	100	100	93.3	100	100
4.	Patient's sex	100	100	93.3	98.7 ± 0.8	95.0 ± 3.2
5.	Patient's age	76.7 ± 23.3	85.8 ± 5.2	23.3	84.8 ± 9.2	52.8 ± 8.3
6.	Patient's address	66.7 ± 33.3	79.6 ± 13.8	100	98.0 ± 2.0	82.1 ± 10.7
7.	Doctor's signature	100	87.5 ± 35.4	100	49.6 ± 21.4	67.5 ± 15.9
8.	Doctor's name	0	60.8 ± 17.9	0	20.0 ± 20.0	12.5 ± 12.5
9.	Doctor's address	0	0	0	0	12.5 ± 12.5
10.	Dose	95.4 ± 2.4	98.0 ± 1.2	97.9	95.4 ± 1.3	91.3 ± 4.0
11.	Frequency	97.6 ± 1.3	99.5 ± 0.3	94.9	97.8 ± 0.9	94.3 ± 3.5
12.	Route	5.0 ± 0.7	12.5 ± 1.9	3.1	24.9 ± 4.4	15.5 ± 5.4
13.	Duration	99.3 ± 0.4	83.8 ± 7.9	94.9	95.4 ± 1.6	84.5 ± 5.7
14.	Instructions for labelling	0.1 ± 0.6	1.2 ± 0.4	0	5.9 ± 2.0	15.5 ± 5.5

•The hospitals' addresses were not stated in any prescription.

Reasons for Poor Prescription Writing

The summary of all the reasons adduced for poor prescription writing by the various doctors in the intervention groups in public and private hospitals is as follows (this is not in any order of frequency or importance):

1. A heavy workload, putting the doctors under pressure.
2. Prescription order blanks were not always available.
3. Some patients refuse to give true personal details such as age and address.
4. There is no need to take the trouble of writing detailed prescriptions when patients could get their drugs with or without them anyway.
5. Prescriptions ought to be 'mystified': they should not be easily read and understood by 'just anybody'.
6. Many doctors are ignorant of the standards required in a good prescription order.

DISCUSSION

The Baseline Survey

Non-availability of prescription order blanks does not encourage adherence to standards. This is further compounded by the lack of space for the inclusion of all the details required for patient and doctor identification (even when prescription sheets are available). It is remarkable that only one sample of prescription order blanks had

provision for the inclusion of doctor's addresses or phone number. This is similar to the findings reported in a survey in Sudan.[10]

Availability of properly designed prescription order blanks would probably have served as a reminder to prescribers to include the required details. Deficiencies in details required for patient and prescriber identification have also been reported in other studies.[11,12] The omission of dates in some prescriptions could be a reflection of the fact that some doctors do not appreciate the legal status of a prescription order. It also suggests that the usefulness of a dated prescription in monitoring drug therapy and in relation to requests for drug refills may not be fully appreciated.

Identification of patients' sexes is often overlooked. The inclusion of a patient's sex is especially important in the setting in which this survey was conducted, where the traditional names borne by many people do not in any way suggest their sex. A prescribing doctor should duly sign (in ink) every prescription order.[1] The omission of doctors' signatures is disturbing; especially as there is often more than one doctor who attends to patients in most practice settings. The fact that many doctors do not also include their names, phone numbers or addresses on their prescription orders would pose serious problems if there were need to verify the origin of a prescription, or to clarify any aspects of it. The provision of personalized stamps bearing prescribers' names and other identifying codes has been shown to be a useful and relatively cheap intervention to improve the quality of prescriptions.[13]

The omission of frequency of administration from some prescriptions can contribute to inappropriate medication use, with repercussions such as toxicities, treatment failures, and drug resistance. This omission assumes increased importance in settings where personnel to provide adequate patient counselling/monitoring are lacking. The absence of instructions for labelling or precautions to be taken in prescriptions has also been reported in another study.[10] It appears that doctors reserve the duty of stating precautions to be taken during medication use for the dispensing pharmacist. However, the prescribing doctor bears the ultimate responsibility for every prescription written, not the dispensing pharmacist.[14]

Legibility of Prescriptions

Illegible handwriting is a leading cause of medication errors.[13] Some studies suggest that doctors write less legibly than other professionals, whereas findings from other studies indicate that legibility of handwriting is normally distributed across populations, irrespective of profession.[15,16] In a similar study to ours handwriting was illegible in 10% of prescriptions surveyed, but prescription orders reviewed soon after an educational intervention showed no single order with illegible handwriting.[17]

The worsening of handwriting following educational intervention was puzzling. However, some explanation may be proffered. Since a heavy workload was one recurring reason that was given by doctors interviewed for poor quality of doctors' prescriptions, the 'down-sizing' of the work force in some hospitals within the city during the period of this survey, may have contributed to the worsening of handwriting by increasing the pressure on prescribers. Worsening of handwriting in these circumstances may also suggest that the doctors who were 'lost' at the intervention phase had significantly better handwritings than those who remained in the survey.

Unclear prescriptions result in over 150 million calls from pharmacists to physicians in the United States annually.[18] Figures 2 and 3 illustrate prescriptions which are not only unclear, but in which unacceptable abbreviations are used. A report from the National Coordinating Council for Medication Error Reporting and Prevention states that 15% of medication error reports are the result of illegible handwriting, misinterpreted abbreviations, and misunderstandings arising from leading and trailing zeros.[19]

There is increasing awareness and use of computers for the generation of prescriptions orders in some practice settings.[20,21] In developing countries however, handwritten prescriptions will (most probably) continue to be the main tools for communicating therapeutic intent for a long time yet. The need for prescriptions to be clearly legible can therefore not be over-emphasized. Computerized Physician Order Entry systems have advantages of clear legibility, accurate information on drugs, patient-specific information such as warnings on overdoses, drug interactions

and alerts on drug allergies, but they are expensive to introduce.[13]

In the meantime, measures must be taken to encourage doctors to write prescriptions legibly. The introduction of prescribing guidelines (and an initial audit of prescriptions, the results of which were widely disseminated in a hospital) is reported to have resulted in impressive changes in prescribing performance in a follow up prescription audit.[19]

Effects of Educational Intervention

It is possible that some changes resulting from the educational intervention may have been obscured by attrition in the numbers of doctors. The better response to educational intervention seen in private hospitals (evident in increased numbers of doctors who included the doses and routes of drug administration) could be due to the fact that doctors in private hospitals have fewer exposures to such educational sessions, and therefore responded more readily than their colleagues in public hospitals. This may give credence to the suggestion that familiarity with an intervention method reduces its effectiveness.[22]

Peculiarities of the group dynamics may explain the difference in the effects observed between the two intervention groups in public hospitals: the doctors who had group seminars left their duties for the duration of the seminar, which took place in a designated Seminar Room within the hospitals' premises, and gave full attention to the subject, without any interruptions. On the other hand, face-to-face education took place in doctors' respective clinics, while patients waited to be seen (in some instances there were interruptions).

These differences may explain why apparently better results were obtained from doctors who had the group seminars, contrary to previously reported findings in which face-to-face education yielded better results than group seminars.[7,23,24]

CONCLUSIONS

Prescription writing by doctors was less than satisfactory: several details that are required for the identification of patients as well as prescribers were absent, and the majority of prescriptions were not clearly legible. Educational intervention resulted in some statistically significant improvements in details required in prescriptions, and in our setting group seminars yielded more positive results than face-to-face education. This study supports existing evidence that prescription writing is less than satisfactory in public and private practice settings. The need for further research is also evident: to evaluate the effects of educational intervention in more strictly controlled settings, to employ a combination of intervention methods such as managerial and educational to improve prescription writing and evaluate the effects, and to assess the sustainability of changes arising from such interventions in the medium and long term.

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REFERENCES

1. British National Formulary. Guidance on Prescribing. British Medical Association and the Royal Pharmaceutical Society of Great Britain 2006;52:4.
2. WHO/DAP 1994. Guide to Good Prescribing. Geneva:52.
3. Avorn J. The Prescription as a Final Common Pathway. Int J Technol Assess Health Care 1995;11(3):384-390.
4. Nierenberg DW. Clinical Pharmacology Instruction for all Medical Students. Clin Pharmac Ther 1986; 40(3):483-486.
5. Al Khaja KA, Handu SS, James H, Mathur VS, Sequeira RP. Assessing Prescription Writing Skills of Pre-clerkship Medical Students in a Problem-based Learning Curriculum. Int J of Clin Pharmacology and Therapeutics 2005; 43(9):429-435.
6. Mc Gavock H. Improving the Rationality and Economy of Family Doctor Prescribing by Means of Feedback Interview: The 13-year N-Ireland Experience. 1989; World Health Organization Geneva DAP/89.
7. Avorn J, Soumerai SB. Improving Drug Therapy Decision through Educational Approach. N Engl J Med 1983;308:1457-1463.
8. Ray W, Shaffner W, Fiderspiel CF. Persistence of Improvement in Antibiotic Prescribing in

Office Practice. J Am Med Ass 1985;253:1774-1776.
9. Avorn J, Soumerai S, Taylor W, Wessels MR, Jaousek J, Weiner M. Reduction in Incorrect Antibiotic Dosing through a Structured Educational Order Form. Arch Intern Med 1988;148(8):1720-1724.
10. Yousif E, Ahmed AM, Abdalla ME, Abdelgadir MA. Deficiencies in Medical Prescriptions in a Sudanese Hospital. East Mediterr Health J 2006;12(6):915-918.
11. Desta Z, Abdulwhab M. Prescription Writing in Gondar Outpatient Teaching Hospital, Ethiopia. East Afr Med J 1996;73(2):115-119.
12. Irshaid YM, Al Homrany M, Hamdi AA, Adjepon-Yamoah KK, Mafouz AA. Compliance with Good Practice in Prescription Writing at Outpatient Clinics in Saudi Arabia. East Mediterr Health J 2005;11(5-6):922-8.
13. Boehringer PA, Rylander J, Dizon DT, Peterson MW. Improving the Quality of the Order-writing Process for Inpatient Orders in a Teaching Hospital. Q Manage Health Care 2007;16(3):215-218.
14. Keuhm SL, Doyle MJ. Medication Errors: 1977-1988. Experiences in Medical Malpractice Claims. N Engl J Med 1990;87(1):27-34.
15. Berwick DM, Winickoff DE. The Truth About Doctors' Handwriting: A Prospective Study. Br Med J 1995;313:1657-1658.
16. Lyors R, Payne C, Mc Cabe M, Fielder C. Legibility of Doctors' Handwriting: quantitative Comparative Study. Br Med J 1998;317(7162):863-4.
17. Meyer TA. Improving the Quality of the Order-writing Process for Inpatient Orders and Outpatient Prescriptions. Am J Health Syst 2000;57(Suppl 4): S18-22.
18. Institute for Safe Medication Practice. A Call to Action: Eliminate Handwritten Prescriptions Within 3 Years! 2000. A White Paper.
19. Kripalani M, Badanapuram R, Bell A. Audit on Inpatient Prescription Writing Guidelines. J Psychiatr Ment Health Nurs 2007;14(6):598-600.
20. Frank O, Kidd M. A Guide to Computer-generated Prescriptions. Aust Fam Physician 1996;25(9):1162-1163.
21. Evans KD, Benham SW, Gerrard CS. A Comparison of Handwritten and Computer-assisted Prescriptions in an Intensive Care Unit. Critical Care 1998;2:73-78.
22. Horgerzeil HV. Promoting Rational Prescribing: An International Perspective. Br J Clin Pharmac 1995;39:1-6.
23. Soumerai S, Quick J, Avorn J, Youssef T. Changing the Unchangeable: Principles and Experiences in Improving Prescribing Accuracy. World Pediatrics and Child Care 1987;3:387-391.
24. Soumerai SB, Mc Laughin TJ, Avorn J. Improving Drug Prescribing in Primary Care: A Critical Analysis of the Experimental Literature. The Milbank Q 1989;67(2):268-305.