

## Study of prescription errors related to wrong dose above and wrong dose under

Mirza Tasawer Baig<sup>1\*</sup>, Mohammed Sualeh<sup>1</sup>, Ali Akbar Sial<sup>1</sup>, Zafar Alam Mahmood<sup>2</sup>, Sikandar Khan Sherwani<sup>3</sup> and Mirza Ghazanfer Baig<sup>4</sup>

<sup>1</sup>Faculty of Pharmacy, Federal Urdu University, Karachi, Pakistan

<sup>2</sup>Colorcon Limited, Dartford, Kent, England

<sup>3</sup>Department of Microbiology, Federal Urdu University, Karachi, Pakistan

<sup>4</sup>Iqra University, Karachi, Pakistan

**Abstract:** Studies on prescription errors found in handwritten prescription and computerized prescription and correlation of their rate of occurrence in both the schemes with pharmacist's intervention was conducted to evaluate the occurrence of three types of prescription errors. This study would prove to be a tool to establish an appropriate reporting system for prescription errors. It will also help to evaluate the factors behind irrational way of prescribing. The assessment of prescription by handwritten and software/Electronic Health Record aided prescription would help to evaluate the potential harms and to improve prescribing practice in Pakistan. The government of Pakistan may take far-reaching steps on the basis of this study to facilitate the public health. A cross sectional quantitative and qualitative comparative study was conducted in 50 pharmacy/medical stores from 18 towns of Karachi. Data collection was done by quantitative and qualitative methods. The study was conducted and 400 prescriptions were collected. The results exhibited very much alarming condition and are indicating strong need of consideration of health-care facility in Karachi, Pakistan. Being included in the list of developing countries, at far lowest side, Pakistan is spending very less amount in provision of health-care facility. The intervention of pharmacist in the health-care system was found only 23%, which is indicating frightening condition. This percentage is mostly due to in-patients' prescription evaluation, otherwise the intervention of pharmacist is lesser. Computerized system is capable to do the process of screening in very small interval of time that makes the work more resourceful. However, still there are chances of medication errors that appeared due to flawed computer interface, inappropriate communication with other systems, and lacking adequate judgment supports. Human errors cannot be ignored and these contributed to some extent to medication errors through lack of experience, insufficient knowledge, interruptions and typing errors that may enter wrong data of patient or may identify wrong patient through its I.D. There is still remains a chance that a medication error can occur in any situation.

**Keywords:** Electronic health record, pharmacist, prescription errors, medication errors.

**Received:** April 10, 2012 **Accepted:** July 25, 2012

\***Author for Correspondence:** baigurdu@hotmail.com

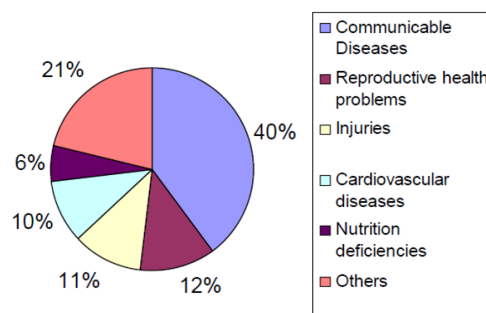
### INTRODUCTION

In developing countries, the consideration to the health is negligible due to lack of funding in this sector. This causes the more chances of increase in mortality rate. Similarly in Pakistan, being 3<sup>rd</sup> world country, the public sector is very less developed and is not pacing with the population growth rate. Enduring poverty has further depreciated the health sector of Pakistan. In a study, Pakistan Population Assessment 2003, it has been revealed that the poverty line at 35.2%, with 39.8% in rural and 31.7% in urban areas<sup>1</sup>. According to the studies on Human Development by United Nations Development Programme (UNDP), it is reported that Pakistan is ranked at 144 under in the list of low human development countries<sup>2</sup>. According to the World Bank report, the Burden of Disease<sup>3</sup> is given in figure 1.

While looking at the worse condition of health sector, it is found that with respect to health sector and social indicators, Pakistan is not pacing with other developing countries of SARC and its region<sup>4</sup>.

According to WHO statistics, the Government of Pakistan is investing less than 2% of the total government expenditure going to health<sup>5</sup>. The lack of proper investment in health sector is resulting in

decline of health condition in the country. The professionals in the health care system are also suffering from lack of confidence of their secure future. All these factors are contributing to induce various errors in the medication cycle comprising of three stages which includes; (a) Prescribing (b) Dispensing and (c) Administering.



**Figure 1:** Burden of disease

### Prescription

The prescription is a medication order well thoughtout to be the most significant therapeutic operation between patient and prescriber. It is, in fact, an order of treatment plan from a prescriber to pharmacist/dispenser for the proper therapeutic effects to cure the patient's complains. Each patient

has an inimitable prescription, delegating an explicit medication plan for an unambiguous patient for a specific time period to treat his/her disease/disorder.

The word Prescription has been taken from Latin language and comprises of two words "Pre" and "Scribo". The literal meaning of "Prescription" is "written before" or "Written before the application medication"<sup>6</sup>.

A prescription is a written medication order that is essentially from a registered prescriber to pharmacist/dispenser/druggist in the interest of patient medication treatment. All written orders are not considered as prescription. For example if a layman sends a request for a syrup bottle of a drink, it will not be a prescription. In the same way if a physician send a written order to nurse in the hospital ward for issuance of a dose of a salt to a patient; it will not be taken as a prescription. Therefore a prescription must fulfill all the criteria that are discussed in the above text and must follow the proper format.

Practically, prescription writing requires various steps, starting from taking patient history, and a result of all these steps is a prescription<sup>7</sup>. For an appropriate prescription, the prescriber must have definite medical schooling. However the drug literature provided to prescriber also aided to some extent<sup>8</sup>. There are two thoughts are prevailing that explain the basis of apt prescribing in different ways<sup>9</sup>. According to the first thought, the information that is endowed by the medical schools and through the programs of continuing medical education, scientific seminars, research articles published in journals, drug literature provided by the marketing field force of drug manufacturing pharmaceutical industries, workshops and symposia, help in writing of proper prescription. On the other hand, second thought explains that the more practice of a physician made him/her to prescribe off-label drugs too, like metronidazole is being prescribed in the cases of gum infections.

#### **Prescribing errors**

The prescribing errors are not only due to carelessness on the part of healthcare professional, but mostly due to speed and complex medication cycle; the ratio of healthcare facility provider to the patient also influence the burden and quality of prescribing. During this study it is pragmatic that in Pakistan, as the public sector is regretful in providing health facilities, the number of visits of patient per physician in government hospitals is more than 250, which is too high.

There is variety of terms used to define prescription error. It may be defined as the failure in the treatment process that may lead to the potential harm to the patient. It may also be considered as the

irrational selection of drugs for a patient. It may occur due to the wrong dose; wrong diagnoses limited knowledge of prescribed drugs. In the study of General medical council, United Kingdom, it has been revealed that one in twenty prescription item had exhibited prescription error of some kind. People aged above seventy five years are facing more errors in their prescription<sup>10</sup>.

It is observed that in routine medical practice, most of the errors in prescription are due to lack of taking patient history and if in case patient having some sort of allergies, it may prove to be even lethal. In Pakistan a number of such cases are observed due to penicillin<sup>11</sup> hypersensitivity among the population. One of the cases in prescription error might be the shortage of time as the prescriber often start writing prescription at the end of consultation and the patient may had started to discuss some other complains. Research work exhibits that for a successful and rational prescribing practice, the consideration must be given to the consultation time<sup>12</sup>.

In this study, one of the General Physicians explained the reasons that sometimes elderly patients do not communicate properly and also put out of sight to inform about missing of their drug doses. In some cases patients changed their doses without consulting their pharmacist or Physician and adjust by their self a dose that they deem to be fit. Although, they have been wrong, and their justification of dose is based on the side effects of the drugs that they had to face, during drug administration. They reduce their dose, which causes decrease in potency also and the side effects that are the normal indicators of drug action, are decrease. In this condition, patient considers that he/she is taking correct dose, which is wrong and baseless justification. For example Patients suffering from Parkinson disease, would have to take Sinemet (Levodopa+Carbidopa) which also induce some side effects like dizziness, fatigue, hypertension, abdominal distress, dark urine, palpitation etc. The patients, who are taking Sinemet, reduce their dose by themselves to decrease the side effects. But this practice made not only the dose as ineffective, but may also cause the normal dose of the drug as ineffective in future and such patients would have to take larger dose in future for therapeutic effects. During this study, another Physician shared the experience that some patients change the dose of methotrexate as daily, suffering for the carp of arthritis, whereas they were prescribed it as weekly.

These errors can be reduced by apposite patient counseling by pharmacist. For that reason the intervention of pharmacist is vital to perk up the healthcare system. It will not only trim down the

escapable hospital stay but also throw in pharmacoeconomy.

In the cosmopolitan city like Karachi, Pakistan it is our quandary that we have no strong regulatory authority for selling of antidepressants and that is why people get such drugs and misused or abused them. This practice may also alter their other treatment plan for their diseases / disorder. Patients taking such drugs, hide to inform their physician about the use of such drugs. However, due to some drug-drug interaction and lacking of proper information about misuse of such drugs, made the physician incapable of prescribing proper dose.

In developed countries, the various studies show that on an average, a prescriber each year passes 13,000 prescriptions. Among these 5,000 are written during the process of consultation with the patient while the remaining 8,000 are the repetition cases<sup>13-16</sup>. These figures are being increased due to development of new drugs each year. To cope with new development, number of procedures is being adopted to rationalize the prescribing practice<sup>17-19</sup>.

Prescription errors are very common<sup>20</sup>, however among these a number of errors occurred are harmless for the patient but on the other hand they may be found to be potentially lethal. These errors may be overcome with the proper intervention of pharmacist which are the custodian of drugs and have greater knowledge of drugs. The pharmacists are well aware of legal implications related to the consequences of prescription errors<sup>21-24</sup>. They are focused person to influence the practicing behavior of the prescriber but their role is not accepted in the health care system and required their proper placing<sup>25-27</sup>. The prescription error can be reduced or omitted by developing strong coordination between the prescriber and the pharmacists<sup>28-32</sup>. Patient care has risen to the vanguard since the report "To Err is Human"<sup>33</sup>. A number of reviews on different stages of medications<sup>34-42</sup>, prescription errors<sup>43</sup> or dispensing errors<sup>44</sup> have been published to improve patient care.

#### **Types of prescription errors**

During this study, the medication errors found in prescriptions are classified as 11 types. This classification was established after analyzing the prescribing errors in the prescriptions during this study. Therefore this elaborated classification helped deep analysis of prescribing errors.

These types of errors are defined in the following;

##### a) Type-1 Errors

These are the errors related to prescribing wrong drug. These may arise due to prescribing wrong drug, similar drugs with different brands, drugs belonging to same group, or due to drug-drug interaction.

##### b) Type-2 Errors

These are the errors due to prescribing wrong route of administration. Particularly these were observed in the prescriptions in cases of prescribing parenteral dosage forms.

##### c) Type-3 Errors

These are due to omission of route of administration in prescriptions.

##### d) Type-4 Errors

These are due to prescribing wrong strength of dosage form that is not available in the market.

##### e) Type-5 Errors

These are related to prescribing wrong-dose, below the recommended daily dose. These errors contribute to fewer efficacies and increase the cost of medication. These must be considered to promote Pharmacoeconomy and to reduce preventable hospital stay.

##### f) Type-6 Errors

These are related to prescribing wrong-dose, above the recommended daily dose of drug. These errors induce toxicities due to over-dose and contributed to potentially harmful effects in patients.

##### g) Type-7 Errors

These errors are due to illegible writing in prescriptions. These type of errors are the major source of other type of errors too. They also contribute to dispensing errors at pharmacies/medical stores. Clear writing is significant for rational prescribing. This type of error is prevented in electronic prescriptions.

##### h) Type-8 Errors

These errors are due to use of non-standard terminology by prescriber. These also contribute to dispensing errors. Food and Drug Administration (FDA) has also prohibited the use of non-standard terminology.

##### i) Type-9 Errors

These are due to omission of signature and particulars of prescriber, due to which co-ordination among health-care providers is not possible. These are necessary for proper follow-ups and knowledge transfer among health-care professionals.

##### j) Type-10 Errors

These are due to omission of duration of medication course for the drugs prescribed. These are always overlooked and no sufficient study has been conducted yet for these types of errors. However, these errors are contributing to antibiotics resistance and drug addiction.

##### k) Type-11 Errors

These are due to inappropriate information of patients on prescriptions. Along with age, gender, name, contact, there must be weight of patients on

prescriptions for rational dispensing. It would help Community Pharmacist to evaluate the proper dose of drug.

For the sake of elaborated analysis, this study was conducted to evaluate the Type-V and Type-VI errors, which are related to the wrong dose of medication and are ignored in the practice of prescription writing. During study a random sample of 400 prescriptions was collected from various areas of Karachi and then analyzed and presented with the help of suitable statistical tools for understanding the prevalence of these errors in a much developed metropolitan city, Karachi.

### MATERIALS AND METHODS

A cross sectional Quantitative and Qualitative comparative study was conducted in 50 Pharmacy/Medical Stores from 18 towns of Karachi, during the months from January, 2011 to October, 2011. Data collection was done by quantitative and qualitative methods.

For the collection of quantitative data, the prescriptions were taken in the form of photocopy and/or scanned copy. The patients/presenters of prescription were satisfied about the significance of the study and concealing their information in private. Sometimes the presenter of the prescription allowed having their original prescription and most of the cases photo copy/Scan copy of the prescription was collected. In this study 400 (manual+computerized printed) prescriptions were collected either in the form of photo copy or scanned copy.

The most difficult task was obtaining electronic prescriptions of in-patients, as not in all hospitals this facility is available. During study it was also revealed that only Agha Khan, Liaquat National hospital, Indus hospital, Abbasi Shaheed hospital National Institute of Cardio Vascular Diseases, Tabba Hospital and Shaukat Umar Memorial Hospital are using some sort of Information Technology support. Some sort of software that is providing the facility of electronic prescription. The electronic health record (EHR) is still not observed in any of the above hospitals in complete scenario. However to some extent, the electronic health record is observed in Indus Hospital and somehow in Agha Khan Hospital. Therefore to get the electronic prescription screen shots were taken and their printouts were studied. After collecting information the data was studied and analyzed so that it may be presented in the tabular and graphs can be drawn. The information was feed in the Microsoft excel file which then exported in SPSS 17 and the various statistical tools were applied.

### RESULTS

During study 80.5% of the prescriptions were Hand-Written while 19.5% were written with the aid of some sort or software which is categorized in this study as electronic prescriptions.

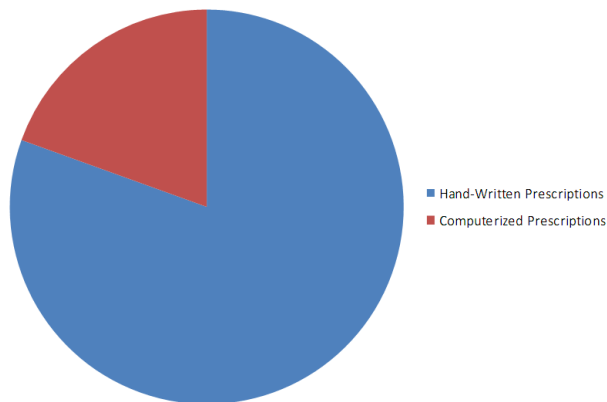


Figure 2: Graphical Presentation of Percentage of Prescriptions on basis of category.

Table 2: Frequency and Percentage of Prescriptions on basis of category.

Prescriptions	Frequency	Percentage
Handwritten	322	80.5
Computerized /Electronic	78	19.5

Table 3: Frequency and Percentage of Type-5 Errors (related to wrong under-dose).

Type-5 Error	Frequency	Percentage
Wrong Dose (under-dose) Related Errors	22	5.5
No Wrong Dose (under-dose) Related Errors	270	67.5
Not Clear Prescriptions	108	27

#### Type-6 errors (related to wrong over-dose)

Errors related to wrong-dose, i.e. overdose were found to be 11.75%, while 27% of prescriptions were not clearly understandable.

#### Type-5 errors (related to wrong under-dose)

In 5.5% cases, the dose prescribed was lesser than the standard dose of drug. While in 27% prescriptions, the dose was not evaluated due to certain factors like writing, non-availability of patient weight and age information etc.

### DISCUSSION

Through this study, the results obtained are very much alarming and are indicating strong need of consideration of health-care facility in Karachi, Pakistan.

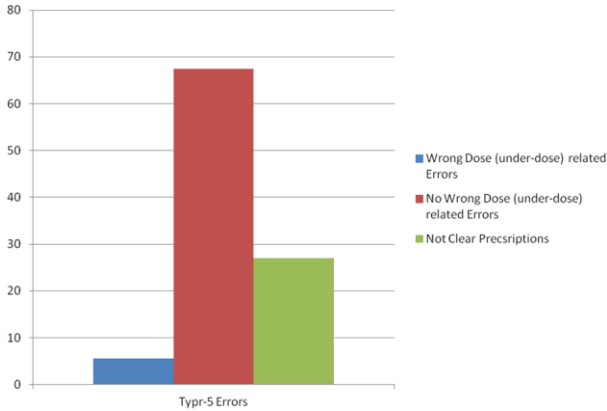


Figure 3: Graphical presentation of percentage of type-5 errors.

Table 4: Frequency and percentage of type-6 errors (related to wrong over-dose).

Type-6 Error	Frequency	Percentage
Wrong Dose (Over-dose) Related Errors	47	11.75
No Wrong Dose (Over-dose) Related Errors	245	61.25
Not Clear Prescriptions	108	27

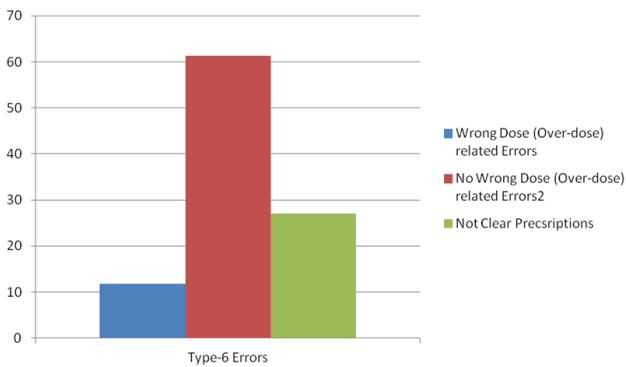


Figure 4: Graphical presentation of percentage of type-6 errors.

Being included in the list of developing countries, at far lowest side, Pakistan is spending very less amount in provision of health-care facility. The errors related to wrong dose were of two classes; first class is when the dose prescribed was less than the recommended daily dose and the second was the over-dose. In both the cases the main cause of the dosing errors was lack of measuring the weight of patient for prescribing proper dose. The prescriber were even not aware with the fact that the weight of patient is the key element (or BSA in case of cancer therapy) for the rational dosing. During study, it was also observed that there was no enough consideration for renal and hepatic patients, in adjustment of dose.

The prescriber were found to practice the average dose prescribing, that is printed on the drug pack, with respect to age groups. However, in situations where some sort of computer software was used for writing prescription, the dose calculation are on the basis of body weight.

During study, some of the medication errors found are highlighted as:

- Doctor prescribed tab Cefuroxime 250mg bid. However in case of antibiotic, in order to achieved the therapeutic level, they should followed the accuracy of timing that's why dose should be given in hourly bases rather than b.i.d, t.i.d, q.i.d.
- Doctor prescribed tab Bromocriptine with the dose of 1.25mg b.i.d, while the actual dose of Bromocriptine is 7.5mg bid. Bromocriptine advice to lactating mother in order to increased the lactation. If patient take this under dose, this will not produced their therapeutic effect. Therefore should be taking according to the appropriate dose which is 7.5mg b.i.d.
- Doctor prescribed in this prescription tab Diclofenac sodium 5mg/oral t.i.d., while the actual dose of Diclofenac sodium is 50mg/oral t.i.d. In order to achieved the exact therapeutic level and to their beneficial effect it is necessary the drug should be administered according to their appropriate dose otherwise it will not beneficial.
- Doctor prescribed inj. Voren 50 mg I.M. stat but the actual strength of inj. Voren is 75mg. However, inj. Voren does not come in 50mg strength. This strength is only available in tablet dosage form rather than parenteral, the actual strength for inj. Voren is 75mg which provide the actual beneficial therapeutic effect.
- Doctor prescribed two drugs i.e Ranitidine 150mg and Ulsanic (Sucralfate) 1gm which are belong to the same group that is Histamine H<sub>2</sub> receptor antagonist. The co-administration of Sucralfate with Ranitidine, the absorption of the latter may be reduced but this effect is not seen if Sucralfate is taken after an interval of 2 hours, so caution should be advice in above case.
- Doctor prescribed tab Acetaminophene (panadol) and CAC-1000. The prolong use of cac1000 with panadol may lower the amount of panadol passed in urine which could cause the level of this drugs in your blood to rise.
- Doctor prescribed tab Bromazepam (Laxotinal) 6mg q.i.d. but the actual dose of Laxotinal 1.5 to 3mg up to three times daily in normal outpatient therapy, the prolong use of overdoses may lead

to increased sedation, confusion, loss of consciousness and slow reflexes. In severe cases especially in hospitalized patients, the dose may be increased up to 6-12 mg two to three times daily and the overall treatment generally should not be exceed more than 8-12 weeks. But this manual prescription purely related to outpatient rather than the hospitalized patient.

- Doctor prescribed Ciprofloxacin with Antacid. However administration of both together, it will hinder the efficacy of ciprofloxacin. There must be an interval of at least 2 hours after intake of ciprofloxacin for taking antacids and 6 hours before the next dose of ciprofloxacin. Iron and zinc preparations also contributed to hinder the efficacy of ciprofloxacin.

### CONCLUSION

The use of computerized system/ electronic prescriptions is seems to be as the way that benefits all the participators of medication process that are the three P's:

- (a) Prescriber
- (b) Pharmacist
- (c) Patient

Computerized system is capable to do the process of screening in very small interval of time that makes the work more resourceful. The utilization of CPOE, EMARS, CIS, BAR-CODING and other medical technology have shown evidences of a decrease in medication errors. However, still there are chances of medication errors that appeared due to flawed computer interface, inappropriate communication with other systems, and lacking adequate judgment supports. Human errors cannot be ignored and these contributed to some extent to medication errors through lack of experience, insufficient knowledge, interruptions and typing errors that may enter wrong data of patient or may identify wrong patient through its I.D. There is still remains a chance that a medication error can occur in any situation.

### Limitations of the study

The study was conducted in Karachi, where healthcare facility is comparatively established as compared to other cities of Pakistan and particularly Sindh province. In this city, the provision of advanced health-care facility is available to larger population of the city. All the prescriptions collected from various pharmacy shops and/or medical stores situated in better-class localities in Karachi. Before study, it was an assumption that medication errors would be lesser due better condition of the facility and less involvements of quarks as prescriber.

However the countryside areas of Karachi are not included in the study for collection of prescriptions. Therefore the results are showing relatively better condition. But the other cities of Sindh province would show more alarming results, as there are severely bad situation of health-care and this facility is not available for larger population proportion. In addition, there are mostly quarks are practicing and due their little knowledge, the population is more vulnerable to medication errors.

### REFERENCES

1. SPDC. Social Development in Pakistan, Annual Review 2001: SPDC; 2001.
2. UNDP. Human Development Report: UNDP; 2003.
3. Siddiqi S, Inaam H, Larik Z. A critique of MCH Policy in Pakistan: Implications for the future, 2003, Consultative Workshop on MCH, Jan, 2003.
4. World Bank. Raising a Healthier Population in Pakistan: World Bank; 2003
5. UNICEF, 2008 Report. Countdown to 2015: Maternal, newborn and child survival. New York
6. Oscar WB. "Practical Materia Medica And Prescription Writing; pp 24.
7. Aronson JK. Editors' view. A prescription for better prescribing. *Br. J. Clin. Pharmacol.*, 487.
8. Geoffrey MA and Joel L. Strategies for improving prescribing practice. *Can. J. Med. Sci.*, 1996; 154: 7.
9. David JW. Medication Errors. *J. R. Coll. Physicians Edinb.*, 2007; 37: 343-346.
10. Monasse AP. Repeat prescriptions in general practice. *J. R. Coll. Gen. Pract.*, 1974; 24: 203-207.
11. Murdoch JC. The epidemiology of prescribing in an urban practice. *J. R. Coll. Gen. Pract.*, 1980; 30: 593-602.
12. Drury MVW. Repeat prescribing-a review. *J. R. Coll. Gen. Pract.*, 1982; 32: 42-45.
13. Secretaries of State for Social Services, Wales, Northern Ireland and Scotland. Promoting etter health (Cm249). London: HMSO, 1987.
14. Harris CM, Jamman B and Woodman E. Prescribing- a suitable case for treatment. Occasional paper 24. London: Royal College of General Practitioners, 1984.
15. Harris CM, Fry J, Jamman B, Woodman E. Prescribing-a case for prolonged treatment. *J. R. Coll. Gen. Pract.*, 1985; 35: 284-287.
16. Van Zwanenberg TD, Grant GB, Gregory DA. Can rational prescribing be assessed? *J. R. Coll. Gen. Pract.*, 1987; 37: 308-310.
17. Jones DR. Errors on doctor's prescriptions. *J. R. Coll. Gen. Pract.*, 1978; 28: 543-545.
18. Brahams D. Legal liability and the negligent prescription. *Practitioner* 1984; 228: 444-445.
19. Austin R, Parish P. Prescribing in general practice. *J. R. Coll. Gen. Pract.*, 1976; 26: 24-31.
20. Austin R and Dajda R. Ancillary-written prescription errors. *J. R. Coll. Gen. Pract.*, 1980; 30: 417-419.
21. Gregory DA. Prescription writing by general practitioners. *Br. Med. J.*, 1987; 295: 478.
22. Taylor RJ. Towards better prescribing. *J. R. Coll. Gen. Pract.*, 1978; 28: 263-270.
23. Shulman JI, Shulman S and Haines AP. The prevention of adverse drug reactions - a potential role for pharmacists in the primary care team? *J. R. Coll. Gen. Pract.*, 1981; 31: 429-434.

24. Taylor RJ. Pharmacists and primary care. *J. R. Coll. Gen. Pract.*, 1986; 36: 348.
25. Knox JDE, Lawson JAR and McDevitt DG. Prescribing audit in general practice: an evaluation of a health centre formulary. Report to Scottish Home and Health Department. Dundee: University Department of General Practice, 1988.
26. Hamley JG, Brown SV and Crooks J. Duplicate prescriptions: an aid to research and review. *J. R. Coll. Gen. Pract.*, 1981; 31: 648-650.
27. British Medical Association and the Pharmaceutical Society of Great Britain. British national formulary. Number 10 (1985). London: BMA, 1985.
28. Baker RJ, Nelder JA. The GLIM system. Oxford: Numerical Algorithms Group, 1978.
29. Horder J, Bosanquet N and Stocking B. Ways of influencing the behaviour of general practitioners. *J. R. Coll. Gen. Pract.*, 1986; 36: 517-521.
30. Institute of Medicine: To err is human: building a safer health system Washington, DC: National Academy Press ed.; 1999.
31. Krahenbuhl-Melcher A, Schlienger R, Lampert M, Haschke M, Drewe J, Krahenbuhl S: Drug-related problems in hospitals: a review of the recent literature. *Drug Saf* 2007, 30:379-407.
32. Ghaleb MA, Barber N, Franklin BD, Yeung VW, Khaki ZF and Wong IC. Systematic review of medication errors in pediatric patients. *Ann. Pharmacother.*, 2006; 40:1766-1776.
33. Wong IC, Ghaleb MA, Franklin BD and Barber N. Incidence and nature of dosing errors in paediatric medications: a systematic review. *Drug Saf.*, 2004; 27: 661-670.
34. Maidment ID, Lelliott P and Paton C. Medication errors in mental healthcare: a systematic review. *Qual. Saf. Health Care*, 2006; 15: 409-413.
35. Miller MR, Robinson KA, Lubomski LH, Rinke ML and Pronovost PJ. Medication errors in paediatric care: a systematic review of epidemiology and an evaluation of evidence supporting reduction strategy recommendations. *Qual. Saf. Health Care*, 2007; 16:116-126.
36. Moyen E, Camire E and Stelfox HT. Clinical review: medication errors in critical care. *Crit. Care*, 2008; 12: 208.
37. Evans J. Prevalence, risk factors, consequences and strategies for reducing medication errors in Australian hospitals: a literature review. *Contemp. Nurse*, 2009; 31: 176-189.
38. Snijders C, van Lingen RA, Molendijk A and Fetter WP. Incidents and errors in neonatal intensive care: a review of the literature. *Arch. Dis. Child Fetal Neonatal Ed.*, 2007; 92: F391-F398.
39. Van den Bemt PM and Egberts TC de Jong-van den Berg LT, Brouwers JR: Drug-related problems in hospitalised patients. *Drug Saf.*, 2000; 22: 321-333.
40. Lewis PJ, Doman T, Taylor D, Tully MP, Wass V and Ashcroft DM. Prevalence, incidence and nature of prescribing errors in hospital inpatients: a systematic review. *Drug Saf.*, 2009; 32: 379-389.
41. James KL, Barlow D, McArtney R, Hiom S, Roberts D and Whittlesea C. Incidence, type and causes of dispensing errors: a review of the literature. *Int. J. Pharm. Pract.*, 2009; 17: 9-30.