

Survey on Prescription Errors in Four Different Divisions of Bangladesh

By

Prethula Areefin

16146019

A thesis submitted to the Department of Pharmacy in partial fulfillment of the
requirements for the degree of
Bachelor of Pharmacy (Hons.)

Department of Pharmacy
Brac University
January 2020

© 2020. Brac University
All rights reserved.

Declaration

It is hereby declared that

1. The thesis submitted is my own original work while completing degree at Brac University.
2. The thesis does not contain material previously published or written by a third party, except where this is appropriately cited through full and accurate referencing.
3. The thesis does not contain material which has been accepted, or submitted, for any other degree or diploma at a university or other institution.
4. I have acknowledged all main sources of help.

Student's Full Name & Signature:

Prethula Areefin

16146019

Approval

The project titled “Survey on Prescription Errors in Four Different Divisions of Bangladesh” submitted by Prethula Areefin (16146019) of Spring, 2016 has been accepted in partial fulfillment of the requirement for the degree of Bachelor of Pharmacy (Hons.) on 23rd January 2020.

Examining Committee:

Supervisor:

Dr. Md. Aminul Haque

Assistant Professor, Department of Pharmacy

Brac University

Program Coordinator:

Dr. Hasina Yasmin

Professor, Department of Pharmacy

Brac University

Departmental Head:

Dr. Eva Rahman Kabir

Professor and Chairperson, Department of Pharmacy

Brac University

Ethics Statement

The study does not involve any use of animals.

Abstract

Prescription error is one of the most common reasons that implement a negative impact in the treatment procedure of a patient which is quite common in our country. In the current study, 120 prescriptions were randomly collected from four different divisions Dhaka, Barishal, Khulna and Rangpur. Different errors of those prescriptions were analyzed based on WHO guideline for an ideal prescription. Errors including missing of date, lack of patient's previous history, illegible handwriting, drug-drug interaction, therapeutic duplication, devoid of special instruction for drug administration etc. were identified which is a serious threat to the proper ailment of a patient. Among four divisions less error was found in case of Dhaka whereas the rate of prescription error was alarming for other three parts of Bangladesh. These might be due to the lack of specialized doctors in other cities. This study can provide an insight to the regulatory body so that they can address this problem and take necessary steps to improve the conditions.

Keywords: Prescription error; Treatment strategy; Drug-drug interaction; Special instruction; Precautions; Doctor-patient relationship.

Dedication

Dedicated to my parents and my brother.

Acknowledgement

I would like to thank the Almighty Allah, for blessing me with all the necessary capabilities, immense strength and patience to complete this project. My journey with working on the project was a blissful one and I could come this far because of the earnest support of some people who have been concerned with this research.

At first, I would like to express my heartiest gratitude towards my supervisor, **Dr. Md. Aminul Haque** (Assistant Professor, Department of Pharmacy, Brac University) for his constant guidance and inspiration that encouraged me to work on this project. Working with him helped me to learn various new things, gather a new experience and I will always remain indebted for his helpfulness. I would also like to thank our respected chairperson, **Dr. Eva Rahman Kabir** (Professor and Chairperson, Department of Pharmacy, Brac University) for her valuable support. Then, I would like to acknowledge my family, specially my brother and my friends for their unconditional love, motivation and eagerness to help. Without their prayers, I would not have reached here.

Finally, I would like to thank the hospitals, clinics and medical centers from where I collected my samples. The entire process of accomplishing this project has given me an urge to develop myself and work more in the future.

Table of Contents

Declaration.....	ii
Approval	iii
Ethics Statement.....	iv
Abstract.....	v
Dedication	vi
Acknowledgement.....	vii
Table of Contents	viii
List of Tables	xi
List of Figures.....	xii
List of Acronyms	xiii
Chapter 1 Introduction.....	1
1.1 Prescription	1
1.2 Types of prescription	1
1.2.1 Compounded prescription	1
1.2.2 Non compounded prescription	2
1.3 Parts of a prescription	3
1.3.1 Date of the prescription.....	3
1.3.2 Prescriber (physicians) information	3
1.3.3 Patient information.....	4
1.3.4 Superscription	5
1.3.5 Inscription	5
1.3.6 Subscription	6
1.3.7 Signatura	7

1.3.8 Prescriber's signature.....	8
1.4 Criteria of a valid prescription	9
1.5 Prescription error	9
1.5.1 Use of inappropriate abbreviations	10
1.5.2 Drug interaction	11
1.5.3 Similar drugs name	12
1.5.4 Strength of the prescribed drugs	12
1.5.5 Skipping the dosage form	12
1.5.6 Absence of patient's previous history.....	13
1.5.7 Missing of diagnosis	13
1.5.8 Illegible handwriting	14
1.5.9 Drug duplication of same therapeutic class	15
1.6 Types of prescription errors	15
1.6.1 Error of omission	15
1.6.2 Error of commission	16
1.7 Rational prescribing	16
Chapter 2 Methods	18
2.1 Design of the study	18
2.2 Collection of data	18
2.3 Estimation of end results	18
2.4 Statistical investigation.....	19
Chapter 3 Results.....	20
3.1 Categorization by the errors found in the prescription	20

3.1.1 Missing of date.....	20
3.1.2 Prescriber's information.....	23
3.1.3 Lack of patient's information.....	23
3.1.4 Devoid of patient's previous history.....	25
3.1.5 Improper abbreviation.....	28
3.1.6 Illegible handwriting.....	29
3.1.7 Absence of diagnosis	31
3.1.8 Drug interaction	34
3.1.9 Non-existence of special instructions	37
3.2 Prescription of four divisions without any error	40
Chapter 4 Discussion	43
Chapter 5 Conclusion	48
Chapter 6 Future research directions	50
References.....	51

List of Tables

Table 1: Percentage of prescriptions without date of four different divisions.....	22
Table 2 : Percentage of prescriptions that lacks patient's information.....	24
Table 3 :Percentage of prescriptions showing devoid of patient's previous history.....	27
Table 4 :Percentage of prescription with improper abbreviations.....	28
Table 5 : Percentage of prescriptions with illegible handwriting.....	30
Table 6 : Percentage of prescriptions representing the absence of diagnosis.....	33
Table 7 : Percentage of prescriptions having drug interactions.....	36
Table 8 : Percentages of prescriptions missing the required special instructions.....	38
Table 9 : Percentage of prescriptions without any errors in four different divisions.	41

List of Figures

Figure 1: The symbol in prescription.....	5
Figure 2: The eye of Horus (Batta & Singh, 2018b).....	5
Figure 3: Parts of an ideal prescription.....	8
Figure 4: Flowchart of steps for rational prescribing (Katzung, n.d.)	17
Figure 5: Representative prescription without date.	21
Figure 6: Percentage of prescriptions without date of four different divisions.	22
Figure 7: Representative prescription lacks age and gender.....	24
Figure 8: Percentage of prescriptions that lacks patient's information.	25
Figure 9: Representative prescription that is devoid of patient history.	26
Figure 10: Percentage of prescriptions devoid of patient's history.....	27
Figure 11: Percentage of prescriptions with improper abbreviations.	29
Figure 12 : Representative prescription of illegible handwriting.....	30
Figure 13 : Percentage of prescriptions with illegible handwriting.....	31
Figure 14 : Representative prescription without diagnosis.....	32
Figure 15 : Percentage of prescriptions representing the absence of diagnosis.....	33
Figure 16 : Representative prescriptions with drug-drug interaction and therapeutic duplication.	35
Figure 17 : Percentage of prescriptions having drug interactions.....	36
Figure 18 : Representative prescriptions not having special instructions.....	38
Figure 19 : Percentages of prescriptions missing the required special instructions.	39
Figure 20 : Representative prescription with all the necessary information.....	40
Figure 21: Percentage of prescriptions without any error in four different divisions.....	42

List of Acronyms

WHO	World Health Organization
PPIs	Proton Pump Inhibitors
NSAID	Non-Steroidal Anti-Inflammatory Drug
DDIs	Drug-Drug Interactions
ACE Inhibitors	Angiotensin- Converting Enzyme Inhibitors

Chapter 1

Introduction

1.1 Prescription

Control and treatment of diseases needs a proper drug utilization. An effective treatment plan with the proper application of medicines can cure or refine a patient's health complications. For a patient, a prescription is the basic way in treating various diseases, given by the physicians which demonstrates a route to get rid of diseases and starts to step ahead and lead a healthy life. Prescription can be stated as, the basic written guideline and a specific order which is provided by a registered physician that incorporates the treatment strategy, medications, proper diagnosis and evaluation of a patient's condition. The word prescription originated from the Latin word, "praescriptus" that essentially translates into "to write before", this term dissociates into two words, "prae" and "scribere" which means "before" and "to write" respectively (Hameed & Limited, 2015a). A prescription is a communication bridge among a patient, a pharmacist and a physician (Ha & Longnecker, 2010).

1.2 Types of prescription

Two types of prescription are there:

1. Compounded prescription
2. Non compounded prescription

1.2.1 Compounded prescription

Compounded prescription is also called extemporaneous prescription. Direct name of the drug is not written in this type of prescription. Rather, the ingredients of the drug are listed according to which the pharmacist needs to do the dispensing. These kind of medications are prescribed in special cases which meets the patient's requirements in individuals as such combinations or

amount of ingredients are not available in the market (Dooms & Carvalho, 2018). Different types of ingredients are used to form a medicine. For example:

- Active ingredients which will give the therapeutic effect.
- Additives: Different types of additives are used to formulate medicament. Additives make the drug more palatable to the patients. In syrups or suspension for children different coloring and flavoring agents are used to give the medicine a soothing texture which attracts the patient to take medicine in proper time. On top of that, additives help to maintain the stability of the drug and also can elevate the action of the drug according to its necessity.
- Vehicles: Vehicles or solvents are used to dissolve, extract or suspend the solutes. Isopropyl alcohol and water are used in different preparations to formulate a drug. Besides, solvent can also act as reaction medium if needed.

However, these pharmacy compounded drugs lack the quality control tests to ensure the efficacy and safety of the drugs (Gudeman, Jozwiakowski, Chollet, & Randell, 2013).

1.2.2 Non compounded prescription

In this type of prescription, the prescribed drugs are already compounded by the pharmaceutical companies in different dose and dosage form that are available in the market. In addition, the prescribed medicaments can be written either with its generic or non-proprietary names with indicating the strength of drugs that is needed for an individual patient. Now a days, non-compounded prescription is the most common way and it is used widely in the world (Gudeman et al., 2013).

1.3 Parts of a prescription

An ideal prescription needs to have some basic information both about the patient and the prescriber. Different parts of prescription include:

1.3.1 Date of the prescription

While writing the prescription, it is very necessary to mention the date. It helps to reduce the misuse of the prescription. Additionally, date of the prescription can also assist the next visiting of the patients. Thus, it will keep a record about the patients visit in the doctor's chamber. It is important to write the date in the prescription on every visit of an individual patient (Sumana, 2015). Moreover, it determines the legitimacy for a specific time period of the prescription. Hence, after a certain period of time the prescription will become invalid by which it can minimize the misuses. Besides, unnecessary refill of the prescription can also be avoided. If the date is missing then it becomes difficult to check the patient again for the doctors. Even the pharmacists also face problems in case of identifying old prescriptions and further refilling of the prescription, if needed (Mohammad, Muhammad, & Khan, 2015). Furthermore, "The Drug Abuse Control Amendments" discusses that for controlled drugs no prescription is allowed to dispense or renew after 6 months from the date it is written ("Remington: The science and practice of pharmacy," 1996).

1.3.2 Prescriber (physicians) information

Prescribers information is one of the major components that must be incorporated in a prescription. This information comprises of full name, qualification, department, chamber or office address, contact number, registration number etc. (Dyasanoor & Urooge, 2016). It is essential to mention the qualification with expertise in particular department so that patients can clearly understand to choose the right doctor that is required for individual treatment. For example, if any patient faces any problem related to digestive system then he or she should consult with a gastroenterologist instead of going to a cardiologist or other specialists. That is

why, it is an important reason to mention the department along with qualifications. In WHO guidelines it is demonstrated that, this information generally remains pre-printed on the form. Apart from full name, qualification and department, contact number of the prescriber and the chamber is also important for both patient and the pharmacist to contact with the prescriber in case of any query or emergency (T. P. G. M. de Vries, R. H. Henning, H. V. Hogerzeil, 2000).

1.3.3 Patient information

The basic information that a prescription needs to have is the necessary details for whom it has been prescribed. This is termed as “Patient Information”. The patient information is a compilation of a patient’s identifying characteristics such as: name, age, sex or gender. Additional information includes date of birth and address of the patient. Initially, the name is important in order to identify the patient. Missing of this information results in the inability to contact the patient when an emergency may appear (Mohammad et al., 2015) . After that, it is required to mention age which helps in treatment procedure for the physician. Besides, age can also help to ensure the correct strength of the drug that is necessary to prescribe for an individual patient. For example: dose of drugs for a child is completely different from dose for adults (T. P. G. M. de Vries, R. H. Henning, H. V. Hogerzeil, 2000). Then, gender of the patient makes a pivotal difference between male and female which provides both the physician and pharmacist to monitor the patient for treatment management in the future. However, if the patient’s information is missing then it becomes very problematic for the pharmacist in order to dispense the drug especially, when more than one patient comes in the pharmacy (Mohammad et al., 2015).

1.3.4 Superscription

Superscription basically indicates the R sign in the prescription. This sign is derived from the Latin word, “recipe” which means “take”. According to the WHO guideline of prescription, it is said that after R sign the prescriber should write the name of the drug with its accurate strength that is needed to be prescribed for the patients.



Figure 1: The symbol in prescription

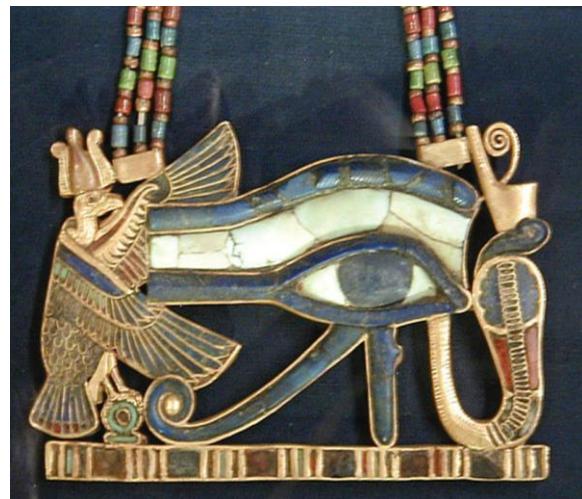


Figure 2: The eye of Horus (Batta & Singh, 2018b).

The appropriate symbol is Rx (Figure 1) not Rx (T. P. G. M. de Vries, R. H. Henning, H. V. Hogerzeil, 2000). There is a history behind the symbol which was the eye of Horus (Figure 2) an Egyptian God who almost lost his eye but another God healed it. From that time in mythology it is believed that early recovery of the patients is possible by considering that symbol as prayer to the God of healing, Jupiter (Batta & Singh, 2018a). Besides, Rx represents the symbol of practice. Absence of this symbol makes the written paper null and void and that will not be considered as prescription by law (Mohammad et al., 2015).

1.3.5 Inscription

Inscription is the medication part of the prescription. It is called the body of the prescription which adds the name of the medications along with its strength. Moreover, the inscription also contains the dosage form of the medication, whether the prescribed drug is syrup, suspension, tablet, capsule, injectables (intravenous, intramuscular, subcutaneous) etc. (Mohammad et al.,

2015). According to WHO guideline, it is stated that the drug name should be written in generic or non-proprietary, because a patient may have to expense unnecessarily if a specific brand name is mentioned. Hence, it is highly encouraged to write the generic name of the drugs. Likewise, for a pharmacist it is also easy to dispense the drug which is convenient for the patient as well as to keep finite stock of drugs. Thus, this can prevent the misuse of the drugs. However, in special cases it is allowed to use the brand name of the drugs (T. P. G. M. de Vries, R. H. Henning, H. V. Hogerzeil, 2000). The medication in the inscription part can be written in many ways such as:

- The proprietary product name along with its quantity that is needed for a patient in treatment.
- An official preparation according to Pharmacopeia with its required quantity.
- As a special formula where it is essential to notify the name of each ingredients, plus its quantity (Hameed & Limited, 2015b).

1.3.6 Subscription

The dispensing directions to the pharmacists are called the subscription. The subscription includes designated dosage forms such as tablets, suspension, syrup, suppositories, injectables etc. Besides, subscription also comprises of number of dosage units that is needed to be given to the patient according to the instructions written in the prescription by the physician (“Remington: The science and practice of pharmacy,” 1996). Along with this, the prescriber must write the duration of the medication that should be taken by the patient. It will help the pharmacists to dispense drug according to the mentioned amount which can reduce both the misuse of drugs and money of the patients (Hameed & Limited, 2015b). In the prescription writing guideline of WHO, it is mentioned that the abbreviations must be used as per the standard which is known and understandable to the pharmacists (T. P. G. M. de Vries, R. H. Henning, H. V. Hogerzeil, 2000). It is very much essential to write the proper instructions about

medicaments in order to have a correct dispensing. Inappropriate use of abbreviations and improper directions will mislead the pharmacists which will result in the dispensing of the wrong medicines. Therefore, the patients will suffer the most and it will create a miscommunication among the physicians, pharmacists and the patients.

1.3.7 Signatura

The directions about how to take prescribed drugs to get an effective treatment for the patients is clearly instructed by the physician or the pharmacist, is the signatura part of the prescription. This word is written as “signa or sig” which means “mark thou”. The directions can be written in English or Latin terms, or a mix of both as well (“Remington: The science and practice of pharmacy,” 1996). Signatura includes the amount of the drug that is necessary to take. This is the ‘dose’ of drug. Besides, the dose interval which means the frequency and the timing of taking medicines will be mentioned there in the prescription. In addition, another important dose instruction is the duration of the medicine, that is how long a patient needs to take that drug in order get the proper therapeutic action. While prescribing the medicines especially for antibiotics it is very much essential to indicate the duration. As a result, it can ensure the expected therapeutic effect and also can abstain the patient from antibiotic resistant (Manchanayake, Bandara, & Samaranayake, 2018). Along with that signatura also includes the instructions for the route of administration of the prescribed drugs. Some examples of signa are: o.d means once a day, proton pump inhibitors (PPIs) should be taken half an hour before meal, analgesics must be taken after meal etc. instructions for a patient that is required to be followed for the treatment purpose. Moreover, a pharmacist also needs to write the instructions which can help the patient to take medicines correctly. It is also the responsibility of a pharmacist to write these instructions provided on the prescription in labelling of the medicines after dispensing. Besides, a pharmacist must add some extra information regarding the medicines like the date of expiry, storage instruction etc. on the labelling (“Remington: The

science and practice of pharmacy," 1996). Thus, it becomes easier and comfortable for a patient to follow the proper guideline for medicaments and get an effective treatment. It is very important to write the proper signatura in the prescription because oral instruction given by the physicians or pharmacist is difficult to remember for the patient. As a result, medication error may occur. According to the WHO guideline, it is noted that the use of abbreviation such "as directed" or "as before" is prohibited. Furthermore, if the prescriber writes "as required" then it is mandatory to mention the maximum and the minimum dose along the dose interval for that particular drug (T. P. G. M. de Vries, R. H. Henning, H. V. Hogerzeil, 2000).

1.3.8 Prescriber's signature

Signature of the prescriber is one of the essential parts of the prescription. This signature makes the piece of paper original and valid. By this signature, a pharmacist gets the authentication about the prescribed drug. Hence, the misuse of the drugs can be avoided. Besides, the prescriber's signature must be given handwritten.

Contact No.	Dr. X E.N.T Department XYZ Medical Centre 345 Wolf Street, NY	DEA No.	Prescriber's information
Patient's information	Name : Mr. A Sex : Male Age: 37 years	Date : 25.06.19	
Superscription			Date of prescription
Indication	Paracetamol (tablet) 500 mg Omeprazole (capsule) 20 mg Ebastine (tablet) 10 mg	→ Take 1 tablet after meal once in a day → Take 2 tablets before meal twice a day (at morning and night) → Take 1 tablet once in a day (at night)	Signature
SubscriptioN	Refill: No refill	Signature :	Prescriber's signature

Figure 3: Parts of an ideal prescription.

Figure 3 demonstrates that an ideal prescription should have all the mentioned parts.

1.4 Criteria of a valid prescription

Since the world has advanced, usage of Latin words in a prescription has been out of practice and current languages are applied instead. Due to this, it is necessary to compose a prescription by utilizing a proper choice of abbreviations. The prescription should also carry the complete orders of medication from the physicians. The writing which contains a prescription is generally known as “prescription order”. It is a legal documentation that gets authorization by the signature of the registered prescriber. A prescription should be well written, clear, comprehensible and devoid of any irrelevant information. Besides, the contents of the prescription should be noted by inerasable ink so that people who are unauthorized cannot alter the genuine writing. In addition, a prescription can be either handwritten or computerized. Mainly the typed prescriptions are preferable by today’s standard because it is unlikely to possess all the flaws of a handwritten one. There are many benefits of a typed prescription such as: this one is easily readable and understandable; a complete record is present in the electronic database and less time consuming to prepare. All the ideal parts should be present in a prescription. Moreover, the prescription should be self-explanatory, distinctive and free from errors to ensure a safe guideline for treatment purpose (A. Kumar et al., 2019).

1.5 Prescription error

Error of prescription means an undesired or wrong list of medications, absence of some primary information of patient, their history of diseases, diagnosis etc. Prescription error is an unwanted and unfortunate reality of healthcare sector. Due to the malpractice, the probability of effectiveness of treatment reduces as well as it increases the risk of many health-related complications for patient. Errors give chances to rise drug interactions, unnecessary medications, irrational use of antibiotics, adverse effect, toxicity of drugs in the body etc. which

can ultimately cause life threatening situations for the patient. Besides, excessive and unnecessary prescribing medicines also results in wastage of patient's money. A pharmacist can play a major role in identifying the prescription error. Therefore, a computerized review with an order entry system of the prescription is needed to prevent the errors. For safety medication it is also important to check the list of drugs written in the prescription manually by the pharmacists (Shrestha & Prajapati, 2019). Some possible errors of prescription that can be commonly found includes:

- Lack of drug information
- Non-existent diagnosis of diseases which might not need any medication or not properly diagnosed
- Unnecessary drugs listed in prescription
- Indecipherable handwriting
- Therapeutic duplication
- Use of inappropriate abbreviations
- Absence of previous health history of patients
- Ignorance of present history of medications
- Improper combinations of drugs (Sultana et al., 2015)

1.5.1 Use of inappropriate abbreviations

In maximum number of prescriptions, use of improper abbreviations lead to prescription error. As a result, a pharmacist faces confusion that leads to dispense wrong drugs and patient's health may deteriorate by taking wrong medicaments. For example: a short term like "IN" must be avoided because it could be error prone and patient may fail to understand that IN indicates "injection". Hence, misconception can be eliminated. Similarly, if a prescriber writes 'l' then it can be misunderstood as 1 whereas actually it indicates 'liter'. That is why for liter the abbreviation 'L' must be used. This small misinterpretation by the patient may become the

reason of taking improper treatment. On the other hand, there are some abbreviations that has more than one meaning. For instance: “d” can represent both daily and days. Thus, it is better to write the full form and to avoid the shortcuts while writing the prescription. If any prescriber wants to use short forms then only the standard abbreviations are highly recommended (Samaranayake, Dabare, Wanigatunge, & Cheung, 2014).

1.5.2 Drug interaction

Patients are suffering from various kinds of diseases along with multiple complications. A single patient can have two or more types of health complications. To treat these kind of patients, only mono therapy medication is not enough. Different class of drugs are prescribed for treatment purposes to get proper therapeutic action. When multiple class of drugs are prescribed there lies a high chance of interaction among the drugs. Not only drug-drug interaction but also drug food interaction and drug disease interaction can occur. The clinical or pharmacological response of co-administration of multiple drugs or medication which gives further effect beyond that expected therapeutic action is called drug- drug interaction (Triplitt, 2006). Drug interfering with the absorption, distribution, metabolism, excretion process of another drug creates pharmacokinetic interactions. On the other hand, drugs acting on same site, receptor and physiologic system can cause pharmacodynamic interactions (Tragni et al., 2013). Drug interaction may have synergistic effect as well as antagonistic and idiosyncratic effect (Triplitt, 2006). For example, beneficial effect include combination of amoxicillin and clavulanic acid (Crowther, Holbrook, Kenwright, & Kenwright, 1997). On the contrary some harmful effects due to drug interaction such as, the antihypertensive effect of ACE inhibitors can be weakened by NSAIDs (Polónia, J. 1997), simultaneous use of ciprofloxacin and theophylline can lead to a rise in plasma theophylline concentration, with parallel to cardiac and gastrointestinal adverse effects (Batty, Davis, Ilett, Dusci, & Langton, 1995), increased gastrointestinal bleeding also occur when selective serotonin reuptake inhibitors (SSRIs) such

as citalopram are taken concurrently with NSAIDs etc. (Köhler, Petersen, Mors, & Gasse, 2015), (De Jong, Van Den Berg, Tobi, & De Jong-Van Den Berg, 2003). These kinds of effects are really undesired for a patient and can be life threatening as well. Therefore, it is truly a necessity to check the patient history of medications and diseases before prescribing a new drug to avoid drug-drug or drug disease interaction.

1.5.3 Similar drugs name

There are different drugs that can have similar kind of names available in the market. For example: prednisone and prednisolone; digoxin and digitoxin etc. Besides, this scenario is very frequent in case of brand names of various drugs (Lambert, Lin, & Tan, 2005). While writing the prescription these kinds of similar names should be avoided because it may cause spelling mistake and create confusion for the patients. As a result, a patient can misinterpret the name of the medicines which will lead to medication error. It is the responsibility of a prescriber to exclude such confusing and misapprehending names of the drugs in the prescription.

1.5.4 Strength of the prescribed drugs

One drug is available in many strengths. For example: paracetamol tablets are available in 250 mg, 500 mg etc. A patient may need 250 mg tablet to get the proper therapeutic action. Now if that patient is given 500 mg then it will cause overdose and can lead to toxicity. For this reason, it is essential to write the strength in prescription along with drug name to ensure patient safety (Dyasanoor & Urooge, 2016).

1.5.5 Skipping the dosage form

There are many dosage forms that are accessible in the market. It is very important to mention the dosage form of the medicaments. Both pediatrics and geriatrics patient require liquid dosage forms which is easier for them to consume. While prescribing any medicine a prescriber must keep this in mind to mitigate the error and to ensure better and comfortable treatment procedure to the patients. Therefore, necessary dosage forms that will be effective for the

patient needs, to be mentioned properly. Besides, the dosing instruction along with the dosage forms can be written in block capital letters so that it can remain highlighted in the prescription and might easily catch the eye of the patients (Manchanayake et al., 2018).

1.5.6 Absence of patient's previous history

A patient comes to a doctor for getting treatment for a specific health condition. It can be a common scenario that the same patient may already have some other diseases. Now if a single patient has two or more diseases at a time, then the patient needs to take all the medicines accordingly. In that case, different medicines are prescribed which may cause contraindication or more serious problem. For example, a patient is suffering from severe allergic condition and to treat this the physician needs to prescribe steroids. On the contrary, this same patient cannot take steroids as he is already suffering from avascular necrosis for long time .In this condition, if he takes steroid then the other condition will deteriorate very badly (Chan & Mok, 2012). Therefore, it is compulsory to know the patient's previous history of both diseases and medicines before giving any other drugs. It is the responsibility of the patient to tell the previous history of illness and medicines to the physician and the physician should also ask about the patient history as well. In this way, the errors can be lessened and can ensure a safe practice of treatment for the patient. Otherwise, it may induce drug interaction, contraindication, side effects, adverse effects etc. which can be fatal for the patients.

1.5.7 Missing of diagnosis

Diagnosis is an essential part which is to be done properly before starting the treatment procedure. It is the ground work for the treatment. Generally, when a patient comes to see a doctor, the first and foremost thing is to ask the problem to the patient. To begin with, the weight, blood pressure etc. is the primary diagnosis that is necessary to be checked. After that, the complications or symptoms that the patient is suffering needs to identified. For example, a patient may have fever for 5 days with cold and cough or may suffer from stomach pain for 7

days etc. All of this diagnosis must be mentioned in the prescription before prescribing the medicine. It is very important to write the diagnosis correctly because actual diagnosis is directly connected with the effective prescribing of the drugs. In some cases, it may happen that a patient does not need medicines, rather proper rest and some home-made remedies can cure the condition. Non-existence of actual diagnosis may give rise to unnecessary prescribing of medicine which will have a negative impact in the patient's health. However, missing of diagnosis may also increase the prescribing of wrong medicine. On the other hand, it is not quite possible to remember the symptoms and other related health issues of every patient. Inscribed diagnosis helps to check the patient in next call and it is easier to continue the treatment procedure. Furthermore, it also shows the link between the diagnosed diseases and prescribed drugs which reduces the error of prescription as well as the error of medication. Proper mentioning of diagnosis of a patient also helps to review the prescription and treatment process as well (Alegria et al., 2008), (Nickless & Davies, 2016).

1.5.8 Illegible handwriting

Usually it is highly recommended that the prescription should be computerized. The entire prescription must be prepared in typed form, except the signature of the prescriber. However, handwritten prescription is also acceptable. The prescription must be written in a very neat and clean way. It should be readable and understandable to the pharmacists and the patients as well. Indistinct handwriting may cause difficulties to understand the strength, name of the drug, special instructions and other essential information in the prescription which must be followed by the patient. On the other hand, pharmacists might make mistakes to dispense the drug and misinterpret the dose, strength, duration of the prescribed drugs like patients and give chance to increase the irrational use of the drug. Thus, it can fail to give the proper therapeutic effect or can cause unintended effect which is harmful for the patient health.

1.5.9 Drug duplication of same therapeutic class

Another common type of error seen in the prescription is the duplication of the similar drug that belongs to the same therapeutic class. For instance, a prescriber may give paracetamol and aceclofenac at a time for a patient. Both aceclofenac and paracetamol belongs to the same therapeutic class “Non-steroidal Anti-Inflammatory Drugs (NSAIDS)”. It can cause similar pharmacological action in the body. Therefore, it is unnecessary to prescribe multiple drugs of same therapeutic class. These duplications of drugs can cause overdose and toxicity to the patient which ultimately can be fatal for the patient. Some other examples may include, prescribing of azithromycin and levofloxacin, aspirin and ibuprofen, paracetamol and aspirin, etc. at a time. This type of combination of similar category of drugs is generally an unwanted error of the prescription (Wetterneck et al., 2011). For this reason, it is highly recommended to avoid such kind of prescribing of drugs that may increase the health complication in the patients. However, in some special case a doctor may prescribe similar multiple drugs of same therapeutic class. In such complicated cases, the patient should be monitored regularly as duplication of same drugs can be harmful to the health.

1.6 Types of prescription errors

There are two types of errors that may occur in the prescription. These are:

1. Error of omission
2. Error of commission

1.6.1 Error of omission

Missing of essential information in the prescription is termed as error of omission. This consists of errors like wrong specification of drugs, absence of dosage forms, missing of strength, inappropriate quantity of drugs which is unwanted. Besides, it also includes inaccurate route

of administration as well as the violation of legal requirements of prescription writing (Ni, Siang, & Noor Bin Ramli, 2002).

1.6.2 Error of commission

Writing of wrong information is referred as error of commission. It involves prescribing wrong drug or irrational indications of drug, incomplete dosage regimen, wrong strength of drugs, incorrect patients name. In addition, drug-drug interaction is also considered as error of commission (Ni et al., 2002). Error of commission is more dangerous because it can be life threatening for the patients. For example: if the strength of a drug is prescribed as 500 mg but to treat a patient it is necessary to prescribe 1000 mg or if a patient requires 250 mg, then it becomes completely high or low dose than needed. Thus, it can create toxicity inside the patient due to overdose or it can fail to give proper therapeutic effect.

1.7 Rational prescribing

The rational method of writing a prescription depends on different but equally important factors. The initial task for prescription writing is to carefully identify and determine the patient's main problem. A prescriber can go to the next step only if the cause of health issue is examined and completely cleared. After the identification of the patient's problem, the process of investigating the major cause is to be started through a proper diagnosis. Besides, along with the diagnosis it is imperative to check the previous history of both diseases and medications (J. K. Aronson, 2004). Once the current problem is diagnosed, then the prescriber should focus on the pathophysiology of the disease and drug related to it that can be used in the treatment purpose. By noting both the past history and present condition, a proper and effective therapeutic plan is to be formed which is suitable for the pathophysiological condition of an individual and that will not affect the patient using multiple drugs for more than one conditions. According to the condition of the patient, appropriate drugs are to be prescribed with proper

dose regimen. In addition, if a patient possesses any previous condition like renal impairment then it is compulsory to incorporate drugs with correct dose adjustments (if needed) in the prescription (Maxwell, Cascorbi, Orme, & Webb, 2007). Furthermore, the prescriber must provide all the necessary information regarding the treatment plan and should give a vivid idea about it. Finally, future monitoring is highly recommended and should summon the individual for a follow up. In case of any emergency, patients should have the scope to contact with prescriber (Katzung, n.d.). The steps of rational prescribing are given below:

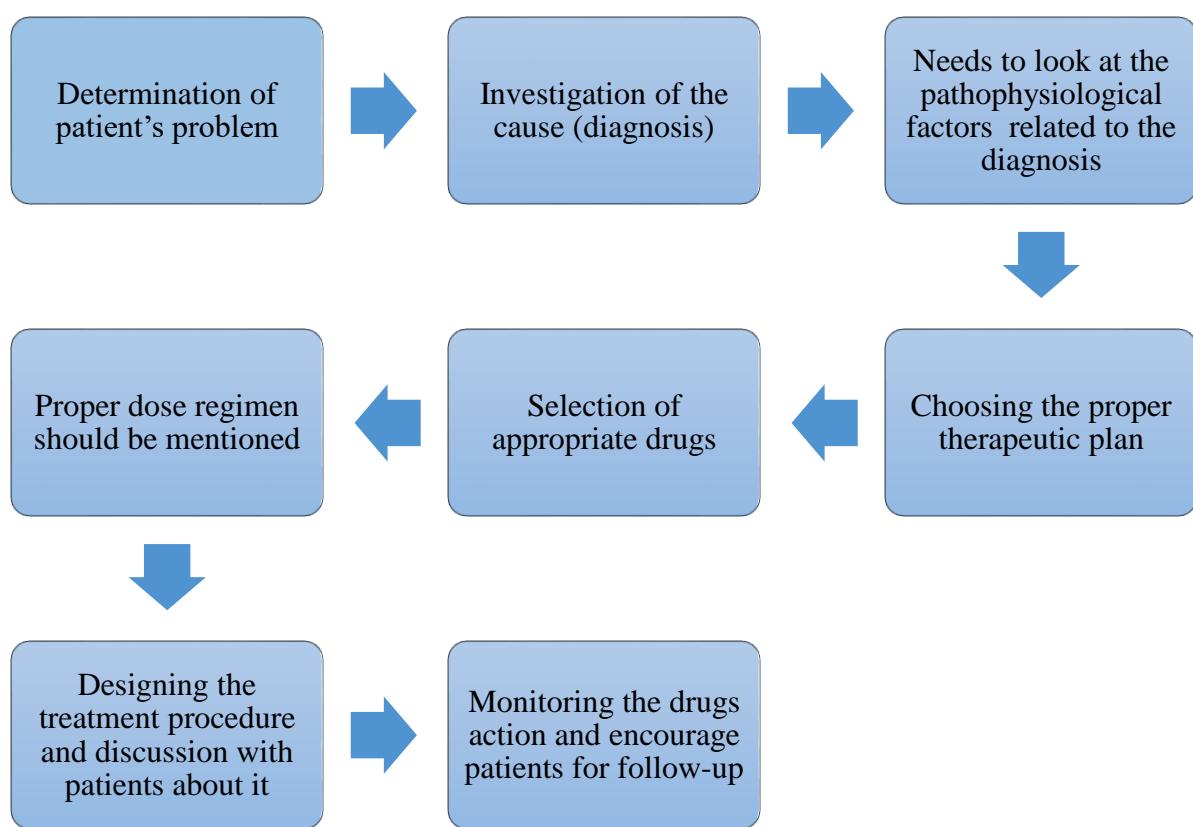


Figure 4: Flowchart of steps for rational prescribing (Katzung, n.d.).

Chapter 2

Methods

2.1 Design of the study

The whole study was conducted by collecting samples from different places. Then, the samples were examined properly to find all possible dimensions regarding the errors of prescription which will also demonstrate the associated risks related to the patients' health. With this main aim, a feasible comparison in between different regions of a country can be established.

2.2 Collection of data

All the prescriptions were collected randomly by visiting to the different hospitals, clinics and medical centers. The major target was to incorporate the sample from two or more divisions of Bangladesh. Therefore, four divisions were chosen to conduct the study from where the samples (the prescriptions) were gathered. This includes Rangpur, Khulna, Barishal and the capital of Bangladesh Dhaka city. From each division 30 prescriptions were collected; in total the study was carried out by working on 120 prescriptions. Besides, all the information that are associated with the patients and the doctors along with the hospitals, medical centers and the clinics were kept confidential. The names or any other personal information regarding the physician or the patients was not revealed. Moreover, all the data was taken of recent times from January 2019 to December 2019.

2.3 Estimation of end results

At the end of the study, the main goal was to present the errors that were found after the analysis of the collected prescriptions (Ridley, Booth, Thompson, & Society, 2004). The errors were classified into 9 categories through which the data were evaluated. These included the legibility of the writing in the prescriptions along with all the core parts of an ideal prescriptions which

helped to draw out the major errors from the pilled-up prescriptions (J. Kumar, Chandra, & Sinha, 2017). Besides, the findings were also represented in tabular forms and graphs as well. The entire investigation also portrayed the comparison among the four divisions and can differentiate that in each division how many and what errors are prevalent. In addition, the 9 categories of error included the drug- drug interactions (DDIs) mentioning some of the duplication of the drugs of same therapeutic class. To assess the patient's information, prescriber's information etc. WHO recommendations and guidelines for prescription writing were followed (T. P. G. M. de Vries, R. H. Henning, H. V. Hogerzeil, 2000).

2.4 Statistical investigation

All the findings about the errors were shown in percentages as well as in numerical values with the help of the column chart by using the Microsoft Excel 2016.

Chapter 3

Results

3.1 Categorization by the errors found in the prescription

In total, there are 120 prescriptions of the four different divisions (Dhaka, Barishal, Khulna and Rangpur) of Bangladesh. All the prescriptions that were collected from the four different divisions of Bangladesh are analyzed by the errors that a prescription may have. The errors along with the percentage of each individual divisions are given below in the tabular and graphical form.

3.1.1 Missing of date

Date is an essential part of a prescription. It is needed to minimizes the misuse of the drugs. Besides, it also tells about the next follow up of the patients to visit the prescribers. In many prescriptions it is seen that the instruction for follow up is written. For example: come after 7 days or 1 month etc. For this reason, it is necessary to have the date in prescriptions. Mentioning of date is required in every visit to keep the traceability and record of both the patient's information, duration of taking prescribed medicines and for the next follow up as well. In addition, if a patient faces any problem after taking the medications then the date work as an indicator for the prescriber that when the treatment was started. Likewise, this also helps to report the adverse drug reactions (if any) of the prescribed medicines (Ms, Shahaibi, Said, Tg, & Hr, n.d.).

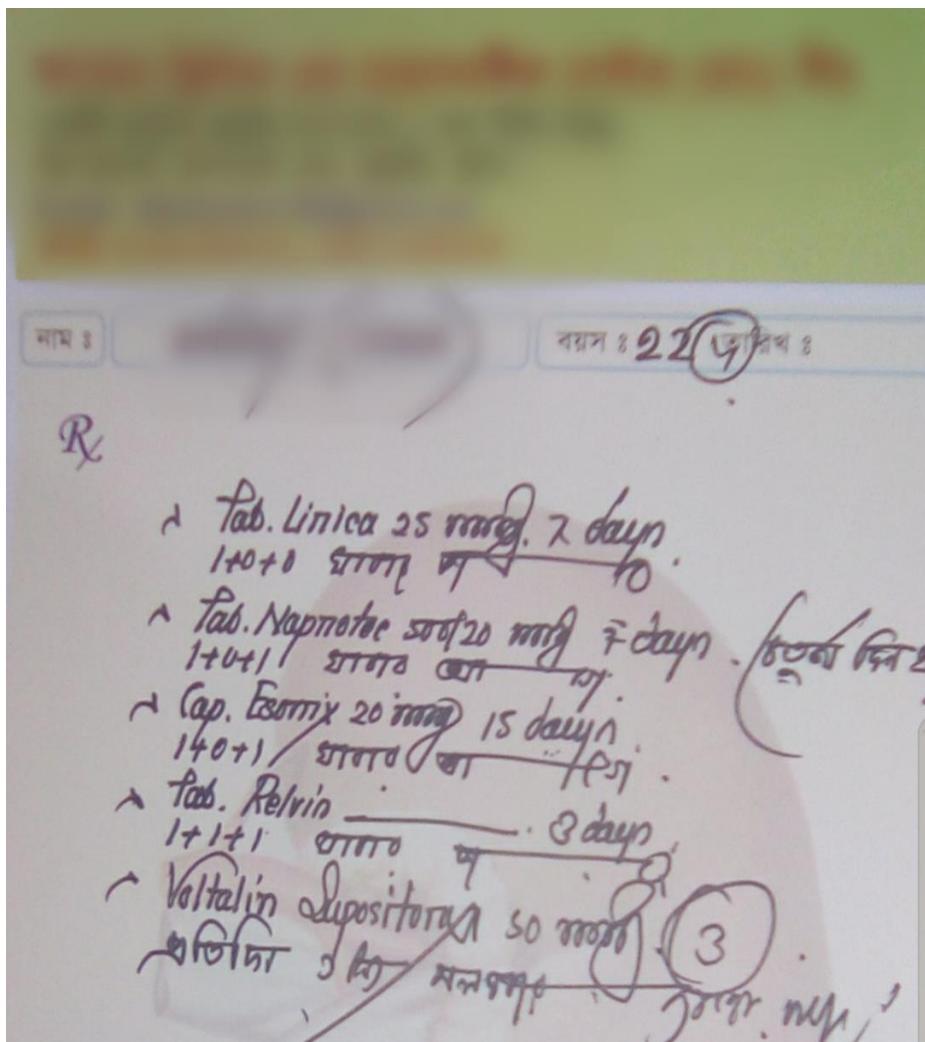


Figure 5: Representative prescription without date.

(Doctor's and patient's information were blurred to maintain the confidentiality)

In this survey, 30 prescriptions were collected from Dhaka division. Among them, there was no error of missing the date. On the contrary, among 30 prescription from Rangpur division 7 were found without date. Besides, 3 prescriptions from Khulna and 2 prescriptions from Barishal was found without date. All the data are shown below in the tabular form (Table 1) which also contains the percentage of error in missing the date of each divisions.

Table 1: Percentage of prescriptions without date of four different divisions.

Divisions	No. of prescriptions	No. of prescriptions without date	% of prescription without date
Dhaka	30	0	0
Barishal	30	2	6.666666667
Khulna	30	3	10
Rangpur	30	7	23.33333333

The graphical representation (Figure 6) showed that the percentage of error in missing of date is highest for the Rangpur division which is 23.33 %. However, it was found that the Dhaka had 0 %. That means no prescription were found without date. Besides, 6.67 % and 10 % were obtained from Barishal and Khulna division respectively.

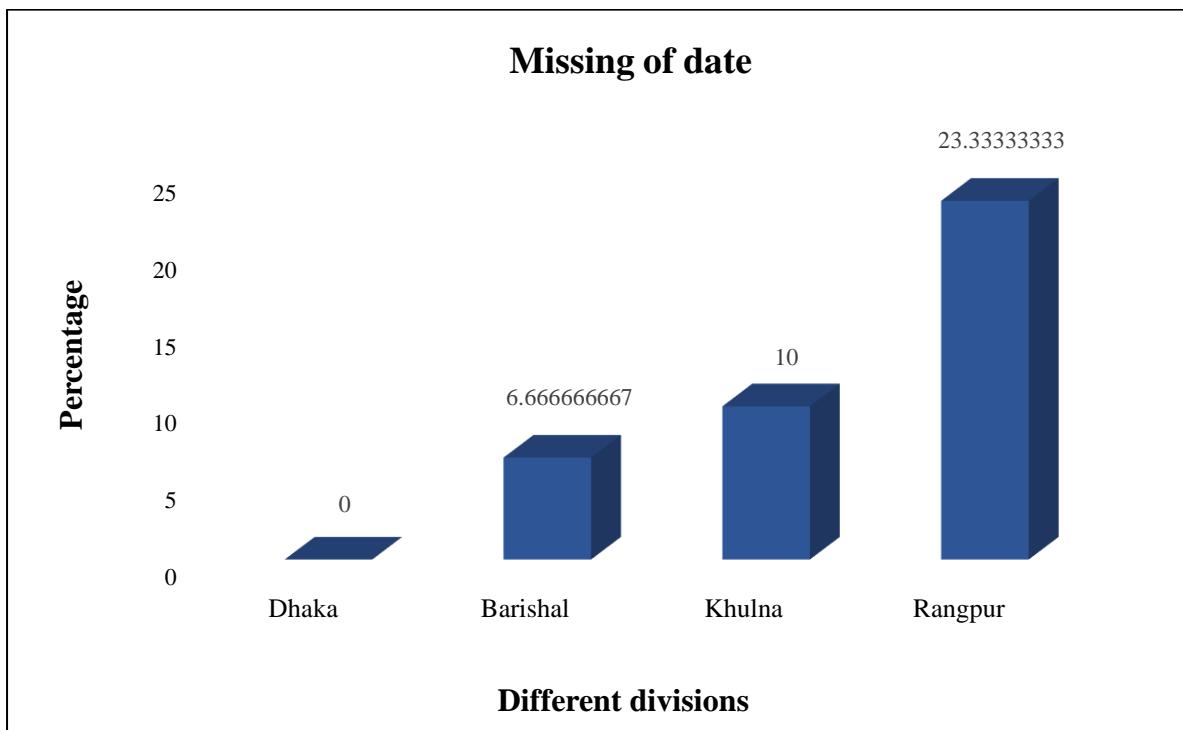


Figure 6: Percentage of prescriptions without date of four different divisions.

3.1.2 Prescriber's information

Another important part of the prescription is the information about the prescriber. Without the prescriber's name, designation, qualifications etc. the prescription becomes invalid. Proper information of the prescriber gives the legal authorization to the physicians to prescribe drugs (Kothari, Joshi, & Buch, 2018). With this, the pharmacists and the patients get the authentication of the prescription. In this way, the irrational use of the drugs including the controlled ones can be reduced. From this study, it was found that all the prescriptions of four different divisions (Dhaka, Barishal, Khulna and Rangpur) has proper prescriber's information which includes name, designation, qualifications, address, contact number and registration number.

3.1.3 Lack of patient's information

An ideal prescription must contain the proper information about a patient which includes the name, age and gender of the patient. Name of the patient gives an identity to the prescription that belongs to the individuals. Besides, along with name the age and gender of the patient should be mentioned. Age is needed to differentiate between pediatric and geriatric patients. The dose of the drugs depends on the age of the patient. Moreover, in case of children mostly liquid dosage forms are prescribed. Again, pediatric patients have the under developed organs. That is why, it is necessary to look after the age before prescribing the drugs to get proper therapeutic action. On the other hand, gender of patient also has influence in prescribing drugs. In some cases, for drugs like dabigatran, methylphenidate etc. may varies and require dose adjustments for male and female patients (Lind, Euler, Korkmaz, & Gustafsson, 2017). Thus, the age, gender of the patient must be mentioned in the prescription to ensure the proper therapeutic effect and also it can help in dose adjustments if necessary.

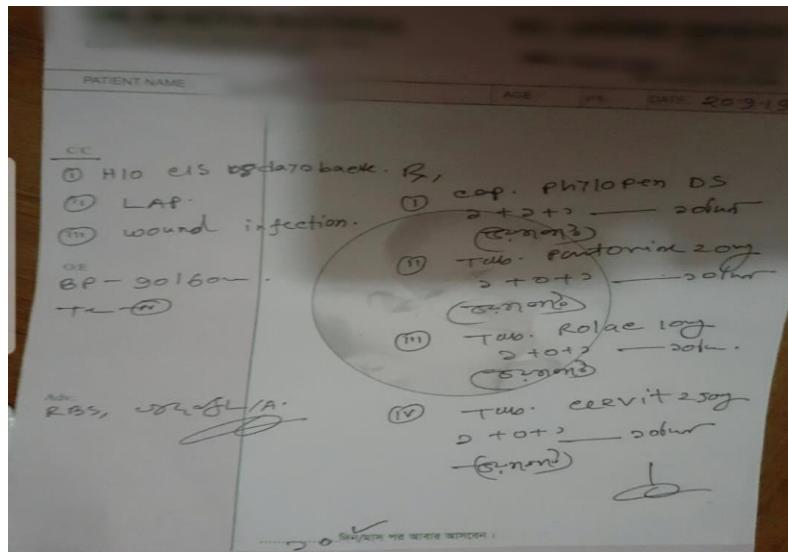


Figure 7: Representative prescription lacks age and gender.

(Doctor's and patient's information were blurred to maintain the confidentiality)

Among the 120 prescriptions, some of the prescriptions contained only the name of the patients. In some of them, gender was not found. Again, some prescriptions were found which lacked the age of the patient. After the evaluation of all the prescriptions, it was found that in Khulna 8 prescriptions out of 30 had inadequate information regarding the patients. Also, similar scenarios were detected from Rangpur and Dhaka divisions in which 6 and 4 prescriptions did not include necessary patient's information respectively. In contrast, Barishal division had the least amount of errors in this category where only 2 out of 30 prescriptions carried such mistakes. Here, the data is depicted below (Table 2) for the above-mentioned error.

Table 2 : Percentage of prescriptions that lacks patient's information.

Divisions	No. of prescriptions	No. of prescriptions lacking patient's information	% of prescriptions lacking patient's information
Dhaka	30	4	13.33333333
Barishal	30	2	6.66666667
Khulna	30	8	26.66666667
Rangpur	30	6	20

The graphical illustration (Figure 8) represents the percentage of error of prescriptions from the four divisions which lacks patient's information. According to the statistics of the graph, it can be seen that the percentage of error in Dhaka and Rangpur divisions stood at 13.33 % and 20 % respectively. Furthermore, the percentage of error for Barishal division was found in the least which is 6.67 %. Conversely, the division of Khulna showed an unfortunate elevation, surpassing all the other divisions at a percentage of 26.67 %. It can be stated that this division had the highest rate of error in this category compared to the other three divisions.

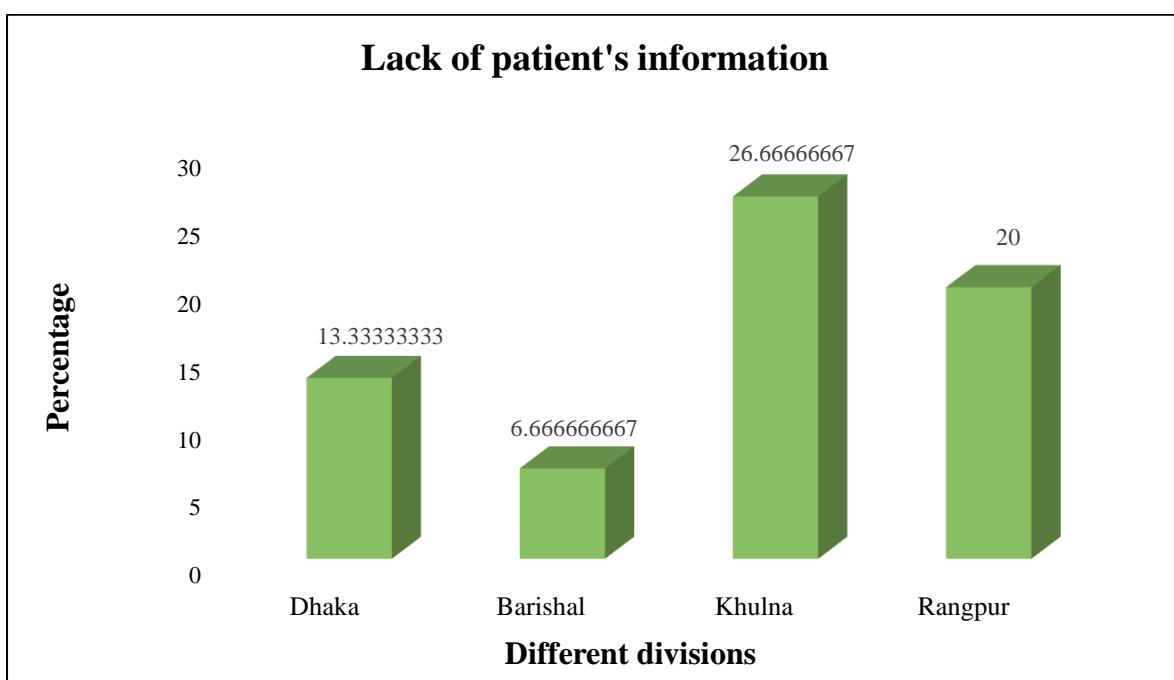


Figure 8: Percentage of prescriptions that lacks patient's information.

3.1.4 Devoid of patient's previous history

For any prescription, it is essential to have a complete history of previous diseases along with the past medication. The previous history is required to treat current ailments because a patient may possess one or more diseases that can create conflict with an existing one. Similarly, drugs that were prescribed for the former health conditions can also contradict with the new medication. If the patient history is unknown to the prescriber, it can cause moderate to severe damage for the patients' health. Patients history also include the body weight and blood

pressure that should be measured before prescribing any medicines. Body weight is important for prescribing the proper dose of the drugs. For example, drug for type 2 diabetes thiazolidinediones may cause weight gain in a patient which is dose dependent. Even in the treatment procedure for 1 year with this medication weight can be increased by 1 to 4 kg in a patient (Medici, Mcclave, Miller, & Miller, 2016), (Domecq et al., 2015) .Without knowing a patient history, a prescriber should not prescribe any drug. For example, if a person has been prescribed with non-selective beta blocker without knowing that he or she have asthma already then it can create dangerous situation for the patient, as beta blocker will cause bronchospasm which will adverse the condition of the asthma patient.

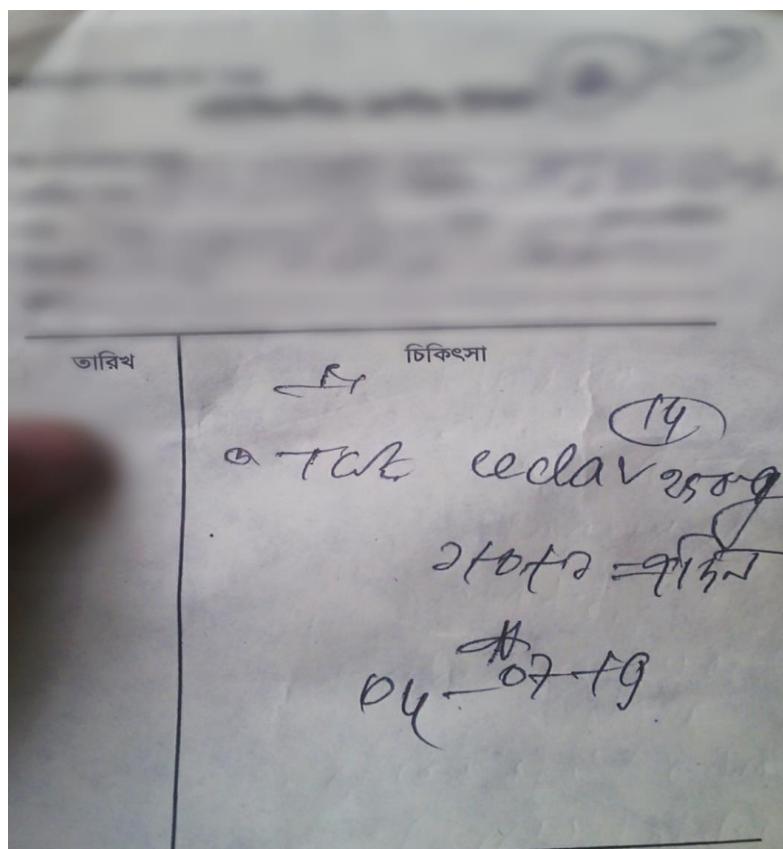


Figure 9: Representative prescription that is devoid of patient history.

(Doctor's and patient's information were blurred to maintain the confidentiality).

From the investigation of data, it was found that a vast number of prescriptions was devoid of patient's previous history. Here, Barishal division had the maximum number of errors at a

striking amount of 22 prescriptions out of 30 whereas in Dhaka only 5 out of 30 prescriptions were found that made this division stand at the least position to have this error. Besides, for Rangpur and Khulna division it was found that 14 and 9 prescriptions had this error respectively. The data is given below in a tabular form (Table 3):

Table 3 :Percentage of prescriptions showing devoid of patient's previous history.

Divisions	No. of prescriptions	No. of prescriptions devoid of patient's history	% of prescriptions devoid of patient's history
Dhaka	30	5	16.6666667
Barishal	30	22	73.3333333
Khulna	30	9	30
Rangpur	30	14	46.6666667

The percentage of errors are shown with the help of a bar diagram. Among the four divisions, 16.67 % was found to have this error in Dhaka division which was the lowest one. In addition, Khulna and Rangpur had 30 % and 46.67 % of errors. On the other hand, Barishal stood in the most adverse position with the error of 72.33 % in respect to all other divisions.

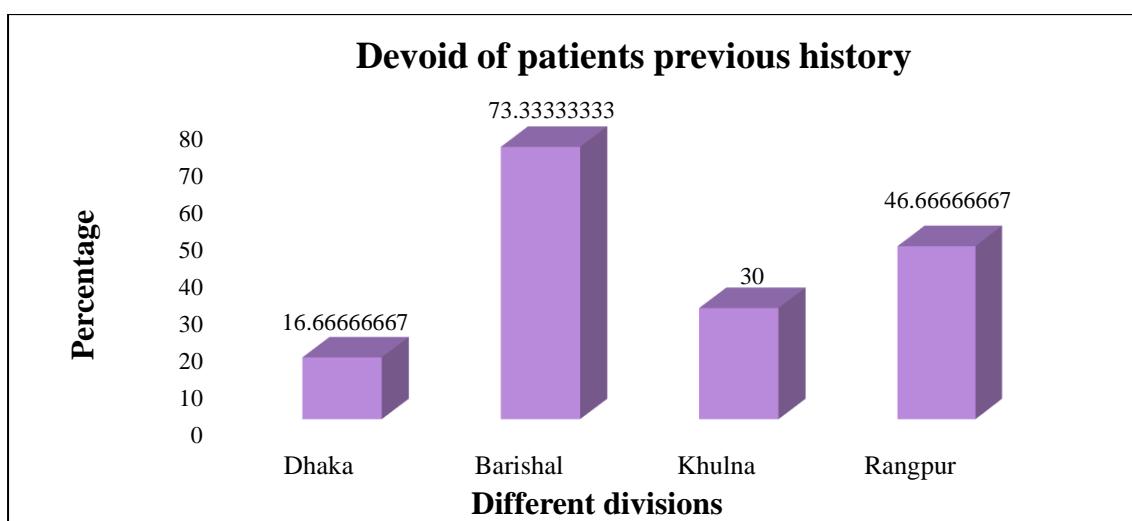


Figure 10: Percentage of prescriptions devoid of patient's history.

3.1.5 Improper abbreviation

In some of the prescriptions it was seen that for syrup the prescriber wrote ‘sy’. However, for syrup generally ‘syp.’ is used as a short form. Another incorrect abbreviation was found in case of suppository. It was written ‘su’ instead of supp. which indicates suppository.

After evaluation of the data, it was discovered that there was no use of improper abbreviation in any prescriptions of Dhaka city. The number of prescriptions that included inappropriate abbreviations for both Rangpur and Barishal divisions was found to be same that is, 5 out of 30 prescriptions respectively. However, 7 prescriptions contained unsuitable abbreviations in Khulna Division which was not desirable. Therefore, it is essential to use the proper abbreviation while prescription writing. Now, the data is incorporated into the following (Table 4) that consist of wrong abbreviations mentioned in the prescriptions.

Table 4 :Percentage of prescription with improper abbreviations.

Divisions	No. of prescriptions	No. of prescriptions with improper abbreviations	% of prescriptions with improper abbreviations
Dhaka	30	0	0
Barishal	30	5	16.6666667
Khulna	30	7	23.3333333
Rangpur	30	5	16.6666667

Through this bar diagram (Figure 11), the rate of error has been evaluated. To begin with, the diagram gave a detailed description of the four divisions in which, Dhaka had no such error. Then Barishal was next in the list that had a percentage of 16.67 % which was also shared by Rangpur. After that, the highest percentage is seen in case of Khulna with a rate of 23.33 % error that exceeded the other divisions.

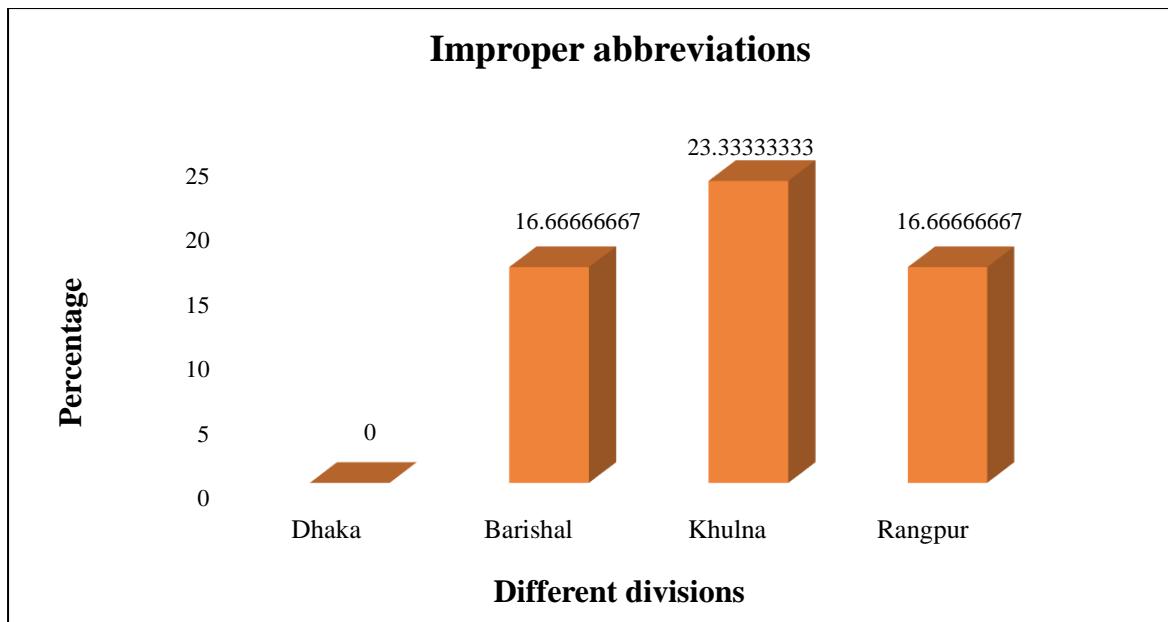


Figure 11: Percentage of prescriptions with improper abbreviations.

3.1.6 Illegible handwriting

Handwriting is an important parameter in case of hand written prescriptions. If any prescription is not properly readable due to indecipherable handwriting, then the patient as well as the pharmacist can misinterpret the name, strength or dose of the prescribed drug. As a result, a patient might take drug of different strength which is not appropriate for him or her. Thus, an effective therapeutic action cannot be confirmed. This can cause overdose of the drugs which can lead to enhance the toxicity and also may give less pharmacological action. Consequently, the same mistake can take place in the dispensing procedure by pharmacists because of the misunderstanding of the amount, strength, name, dose of the prescribed drugs. Therefore, indistinct handwriting can give misinformation which induces the chances of irrational use of drugs that is ultimately harmful for the health of the patients. If the handwritten prescription is not safe to use then the way of communication between the doctors and the patients must be changed. In this case, it is compulsory to provide the computerized prescription by the doctors so that chances of error due to poor handwriting can be reduced (Berwick & Winickoff, 1996).

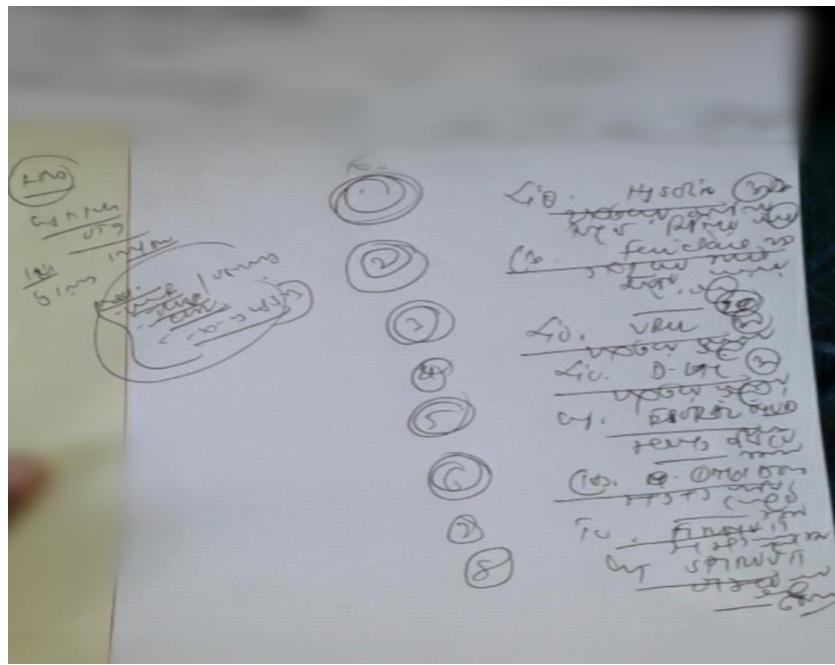


Figure 12 : Representative prescription of illegible handwriting.

(Doctor's and patient's information were blurred to maintain the confidentiality).

After analyzing of all the prescriptions from four different divisions, it is seen that (Table 5) the minimal amount of error in prescriptions were found in Dhaka division at a numerical value of 10 out of 30. It was outpaced by Khulna division with the error of 12 prescriptions. Then, 12 out of 30 prescriptions in Rangpur had unreadable handwriting. Finally, the most unappealing scenario is seen in case of Barishal division that was comprised of 22 number of errors out of 30.

Table 5 : Percentage of prescriptions with illegible handwriting.

Divisions	No. of prescriptions	No. of prescriptions with illegible handwriting	% of prescriptions with illegible handwriting
Dhaka	30	10	33.333333
Barishal	30	22	73.333333
Khulna	30	12	40
Rangpur	30	13	43.333333

Now, a graphical demonstration (Figure 13) was made from the above data (Table 5) to show the rate of prescription error (in percentage) of all the four divisions which also gave a comparative study. Firstly, 73.33 % error was found for Barishal division which was the highest error among all. That means, the patients of this division could be major victims of this misinterpretation due to the poor handwriting. Secondly, Rangpur took the next position with 43.33 % error. Thirdly, 40 % error was found in Khulna division. Lastly, Dhaka was placed in the safest position among all with a percentage of 33.33 %.

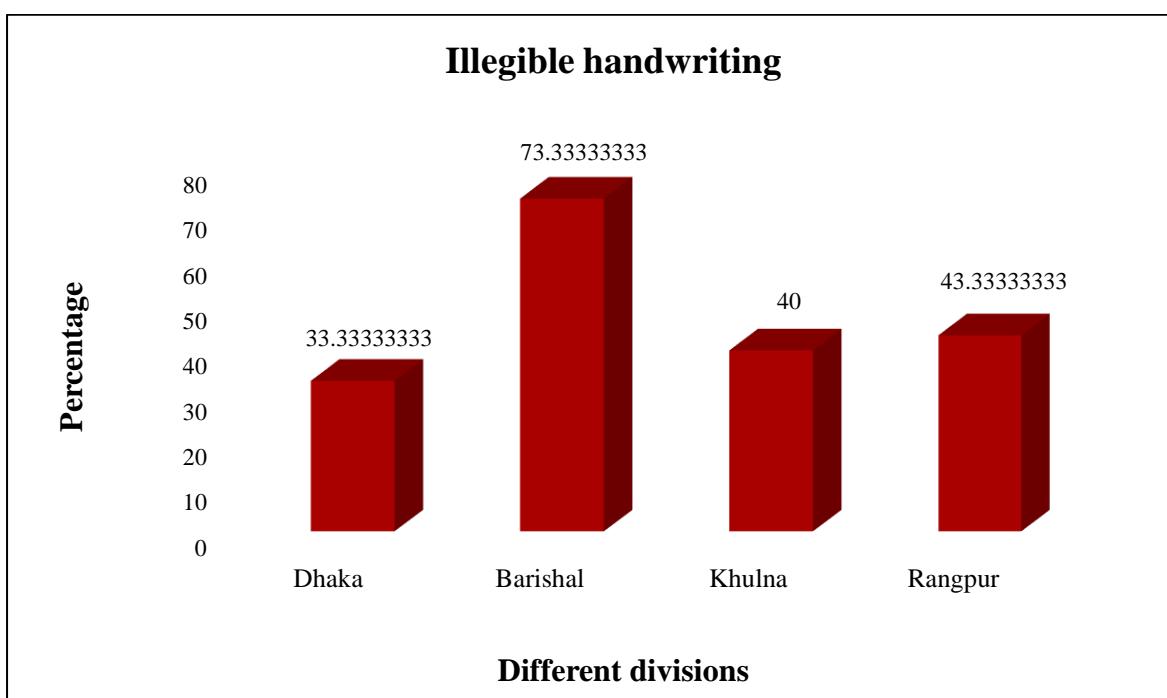


Figure 13 : Percentage of prescriptions with illegible handwriting.

3.1.7 Absence of diagnosis

Diagnosis is vital part should be mentioned in a proper way in the prescriptions. It can be called the pre requisite of prescribing medicines. A drug must be related to the pathophysiology of the diseases otherwise the prescribed medicine will not be a right option for the treatment of the patient (J. K. Aronson, 2006). It is very important to check a patient with all needed diagnostic test. The medicines should be prescribed by consulting to the test reports. For instance, because of ischemic heart disease, ventricular rate may become fast which can be

controlled by treating with digoxin. On the other hand, hyperthyroidism may also increase this ventricular rate in atrial fibrillation in which prescribing the same the drug is totally wrong. Therefore, to identify the reason behind the disease it is mandatory to do proper diagnosis first (Jeffrey K Aronson, 2012).

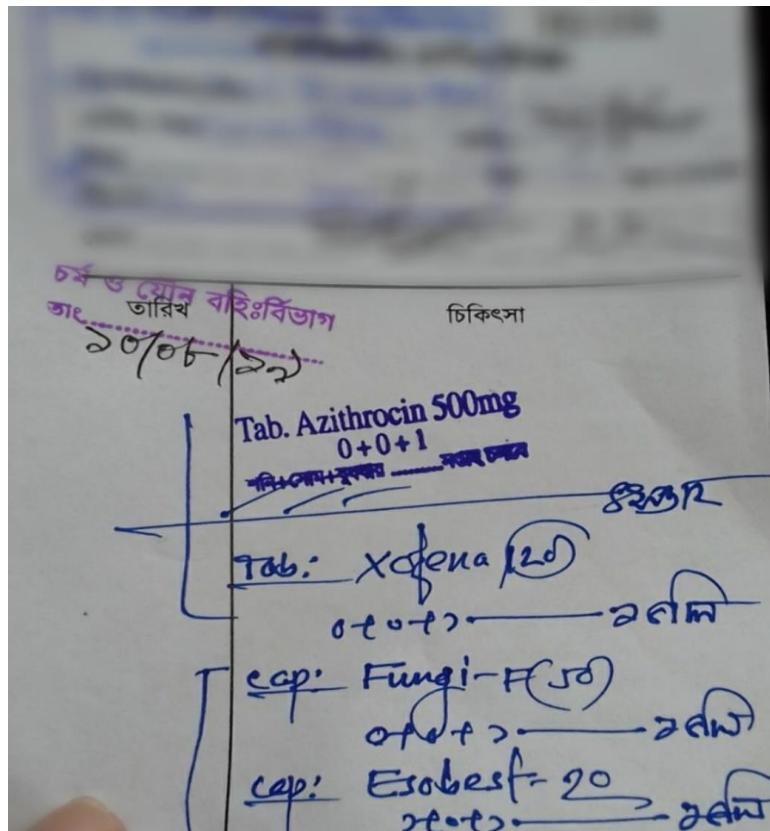


Figure 14 : Representative prescription without diagnosis.

(Doctor's and patient's information were blurred to maintain the confidentiality).

From the table given below (Table 6), it can be stated that the four divisions had different amount of errors, with Dhaka being the lowest at a number of 10 out of 30 prescriptions. It is overtaken by Rangpur division which stood at a number of 13 out of 30 prescriptions. The next one is Khulna division that was found to have one more error than Rangpur. However, Barishal was in the worst position with an error at an astounding number of 21 out of 30 prescriptions.

Table 6 : Percentage of prescriptions representing the absence of diagnosis.

Divisions	No. of prescriptions	No. of prescriptions excluding diagnosis	% of prescriptions excluding diagnosis
Dhaka	30	10	33.333333
Barishal	30	21	70
Khulna	30	14	46.666667
Rangpur	30	13	43.333333

A graphical depiction (Figure 15) gives the proper insight of absence of diagnosis in four specific divisions. Here, the error of prescriptions in Barishal was found terribly higher than the other divisions with 70 %. The division of Rangpur and Khulna was nearly similar with the rate of 43.33 % and 46.67 % respectively. At the end, Dhaka division stayed at the lowest rate of error in prescriptions at 33.33 % that held the absence of diagnosis.

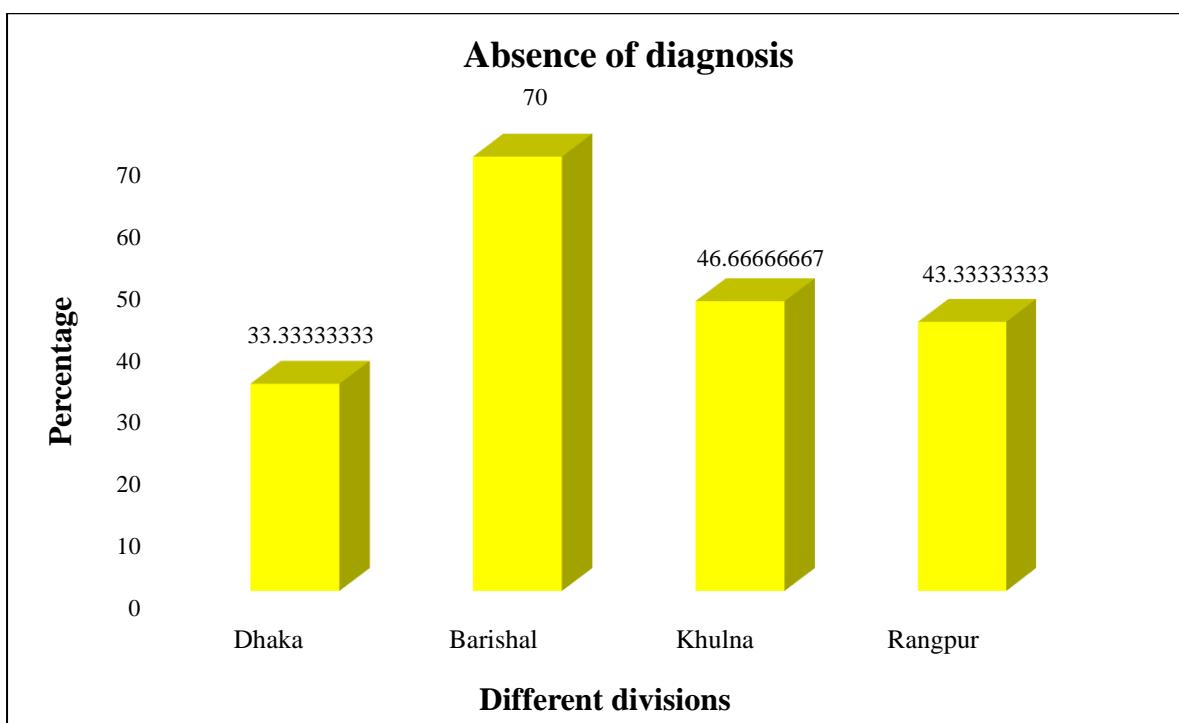


Figure 15 : Percentage of prescriptions representing the absence of diagnosis.

3.1.8 Drug interaction

In a prescription, multiple drugs are prescribed by the prescriber. As a result, the chances of drug interaction increase. Drug interaction is one of the major errors that can be seen in the prescription. It can be life threatening for the patient. Minimizing the drug interaction generally comes under the responsibilities of a healthcare professionals (Triplitt, 2006). In this survey, some drug- drug interactions (DDIs) were found while investigating of the prescriptions. For example, metformin and furosemide was prescribed together. However, metformin may decrease the level of furosemide. In some prescription, celecoxib and diclofenac Na was given to the same patient. Both the drugs together can increase the serum potassium level in the body which is not safe for the patients (Rathish et al., 2016). Another combination of prescribed drugs was found which includes the antifungal agents and glucocorticosteroids. Antifungal agents like voriconazole, fluconazole was prescribed with steroids like dexamethasone, methylprednisolone that counters the action of each other. Voriconazole has enzyme inhibitory effect. On the contrary, methylprednisolone and dexamethasone is metabolized by CYP3A4, that is inhibited by the voriconazole. As a result, the plasma concentration of these glucocorticosteroids may increase (Li, Zhu, Chen, Li, & Qi, 2019). All these factors should be kept in the mind of a prescriber before prescribing the drugs. These interactions can add complications in the patients' health. Additionally, many duplications of drugs were seen while assessing the prescription. For instance, in a single prescription paracetamol and aceclofenac; paracetamol and diclofenac Na; naproxen and paracetamol; ketorolac and ibuprofen; paracetamol and ibuprofen etc. such pairs were found to coexist in a prescription. This type of duplication can cause severe GI irritations as well as bleeding also (Mellemkjær et al., 2002). Furthermore, presence of benzodiazepines like clonazepam and opioid analgesics like tramadol was found in the prescription. Opioid analgesics has effect in the CNS depression whereas clonazepam also induce the CNS depression. Therefore, it can be said that this two class of

drugs will give an additive effect on the body if prescribed together (Hersh, Pinto, & Moore, 2007). All the above discussed interactions and duplication of the drugs found in the prescription is an unwanted error which ultimately give negative impact on patient's health.

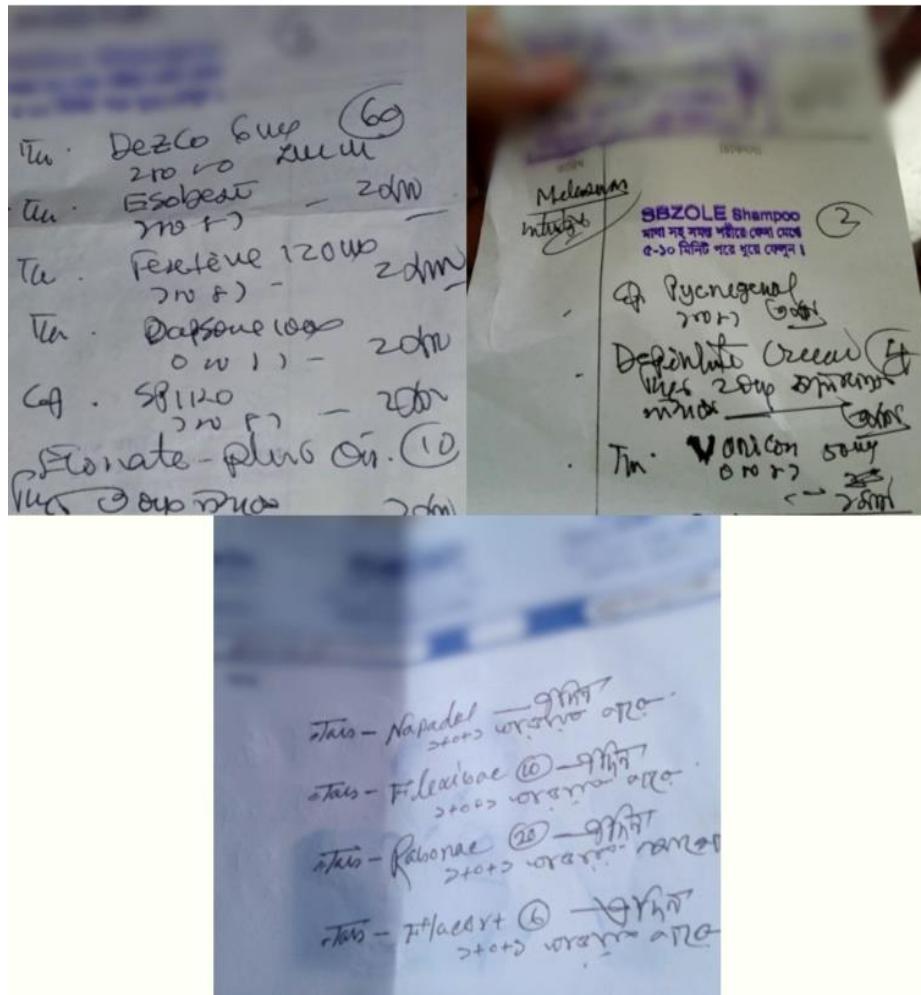


Figure 16 : Representative prescriptions with drug-drug interaction and therapeutic duplication.

(Doctor's and patient's information were blurred to maintain the confidentiality).

In the four divisions, it was found that out of 30 prescriptions Rangpur was in the highly risk zone having the highest number of prescriptions with drug interaction of 11. On the other hand, both the Barishal and Khulna had similar number of errors that is, 9 out 30 prescriptions respectively. Moreover, in Dhaka it is seen that out of 30 only 4 prescriptions were obtained with the drug interactions. The data was arranged in the (Table 7) given below where it showed the number of errors of prescription of four division along with the percentage of error.

Table 7 : Percentage of prescriptions having drug interactions.

Divisions	No. of prescriptions	No. of prescriptions having drug interactions	% of prescriptions having drug interactions
Dhaka	30	4	13.33333333
Barishal	30	9	30
Khulna	30	9	30
Rangpur	30	11	36.66666667

Now, the percentages of errors of four different divisions regarding the drug interaction was presented in the form of bar diagram. In the graph (Figure 17), the highest and lowest rate of errors can be differentiated as well as a total comparison as whole can be discussed along with the individual percentage of each divisions. It can be said that, both the Barishal and Khulna division were positioned with the same percentage of 30 % error. Besides, the least percentage was owned by the Dhaka division with a percent error of 13.33 %. On the other side, Rangpur showed the highest column in the figure 17 with an error of 36.67 % drug interaction.

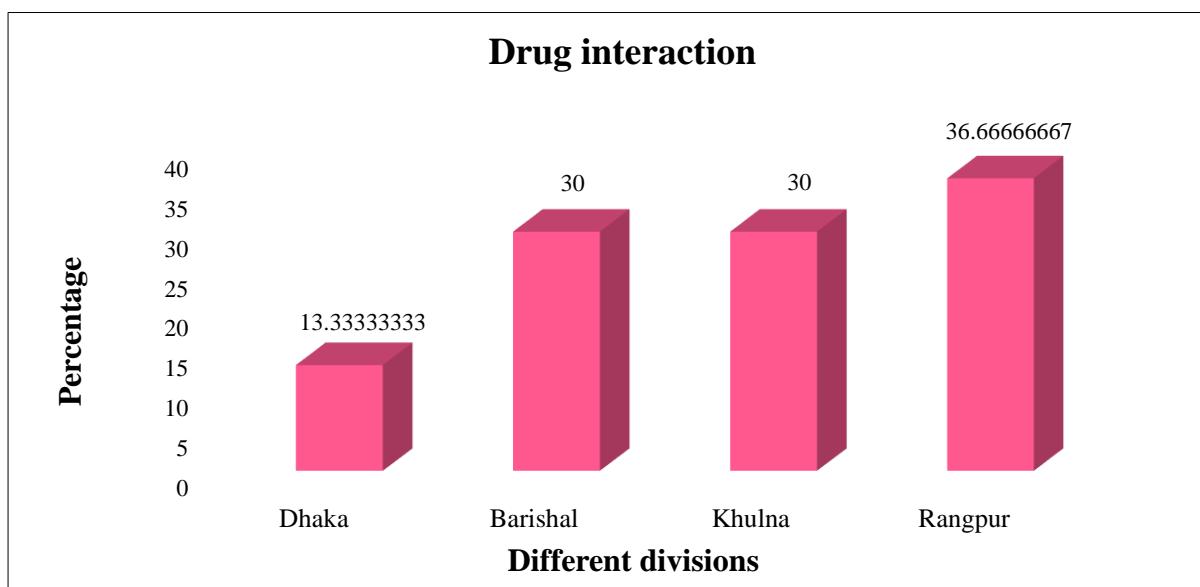


Figure 17 : Percentage of prescriptions having drug interactions.

3.1.9 Non-existence of special instructions

Special instructions in the prescription mainly refers the safety of taking medicines. Some drugs may give best pharmacological actions if taken in an empty stomach and before meal. On the contrary, some drugs should be taken with or after meal to get the best therapeutic action. In this prescription analysis, it was found that a certain number of prescriptions lacks the special instructions. Among these, the most commonly prescribed drugs were analgesics and PPIs which do not have any instructions for intake. The analgesics is supposed to be taken with food to avoid GI irritation and it is best to take PPIs at least half an hour before a meal. Besides, a prescriber should keep in mind that if a patient has peptic ulcer or any GI irritations then with analgesics, PPI should be prescribed to reduce the side effects. All these special instructions in the prescription should be mentioned properly in order to ensure better safety and effectiveness of the drugs for the patients. Moreover, in some prescription prednisolone was prescribed to the patients. There was no instruction of taking prednisolone mentioned in those prescriptions. Prednisolone is a glucocorticoid which acts in an effective way when taken with food because in empty stomach, it is not very friendly with our GI system. However, in case of enteric coated tablet of prednisolone it is not compulsory to have it after the meal (Alhabet & Rogers, 1989). Also, glipizide and metformin were prescribed without any instructions in some of the prescriptions. To ascertain the accurate pharmacological effect, it is necessary to take glipizide half an hour before meal which can give best action of glucose deposition and reduce blood glucose level. According to a research it is stated that, optimal insulin release is seen better if glipizide is taken before meal (Del et al., 2012). In addition, metformin can give GI side effects which can be avoided by taking it after meals (Sambol et al., 1996).

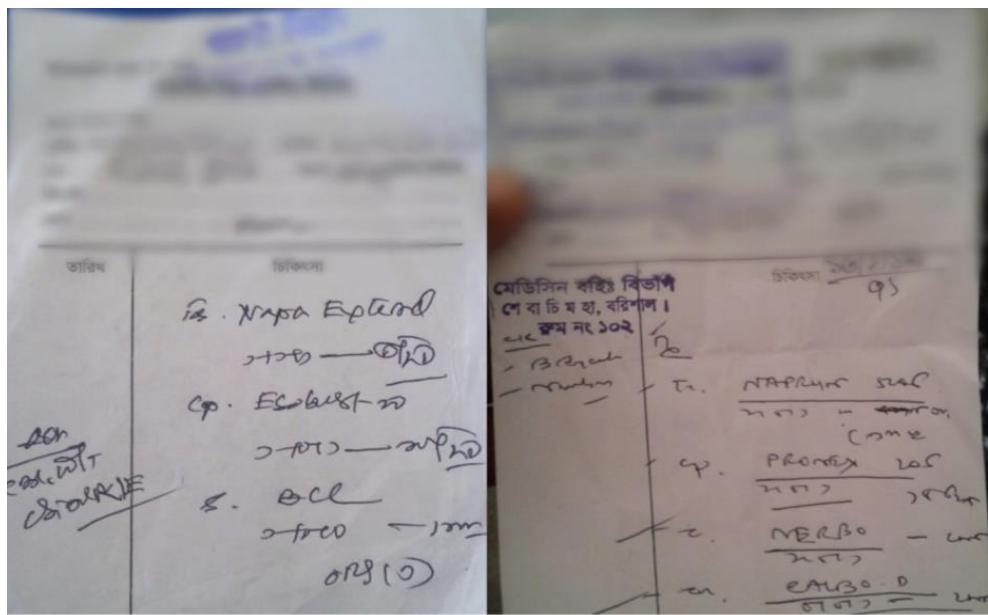


Figure 18 : Representative prescriptions not having special instructions.

(Doctor's and patient's information were blurred to maintain the confidentiality).

If it is analyzed in the ascending order then, from low to high number of errors were seen in the order of Dhaka < Khulna < Barishal < Rangpur division. All the four division was studied with 30 prescriptions individually. After the study, it was found that from Dhaka 8 prescriptions were written without special instructions that was required for the betterment of the patient. Likewise, for Khulna, Barishal and Rangpur it was noticed that 10,11 and 12 prescription had the deficiency of possible special instructions in the prescriptions (Table 8).

Table 8 : Percentages of prescriptions missing the required special instructions.

Divisions	No. of prescriptions	No. of prescriptions missing special instructions	% of prescriptions missing special instructions
Dhaka	30	8	26.6666667
Barishal	30	11	36.6666667
Khulna	30	10	33.3333333
Rangpur	30	12	40

A graphical analysis was also done to show the percentages of missed special instruction and to make a comparison of these errors found in the prescription among the four divisions of Bangladesh. From the graph (Figure 19), it is clearly seen that non-existence of special instruction was highest for the Rangpur division with a percentage of 40 % error. The opposite situation is for the Dhaka division that had the least percent of error with 26.67 %. However, both Khulna and Barishal division was found to be in medium place with 33.33 % and 36.67 % error respectively that had the insufficiency of the special instructions needed to be mentioned properly in the prescription.

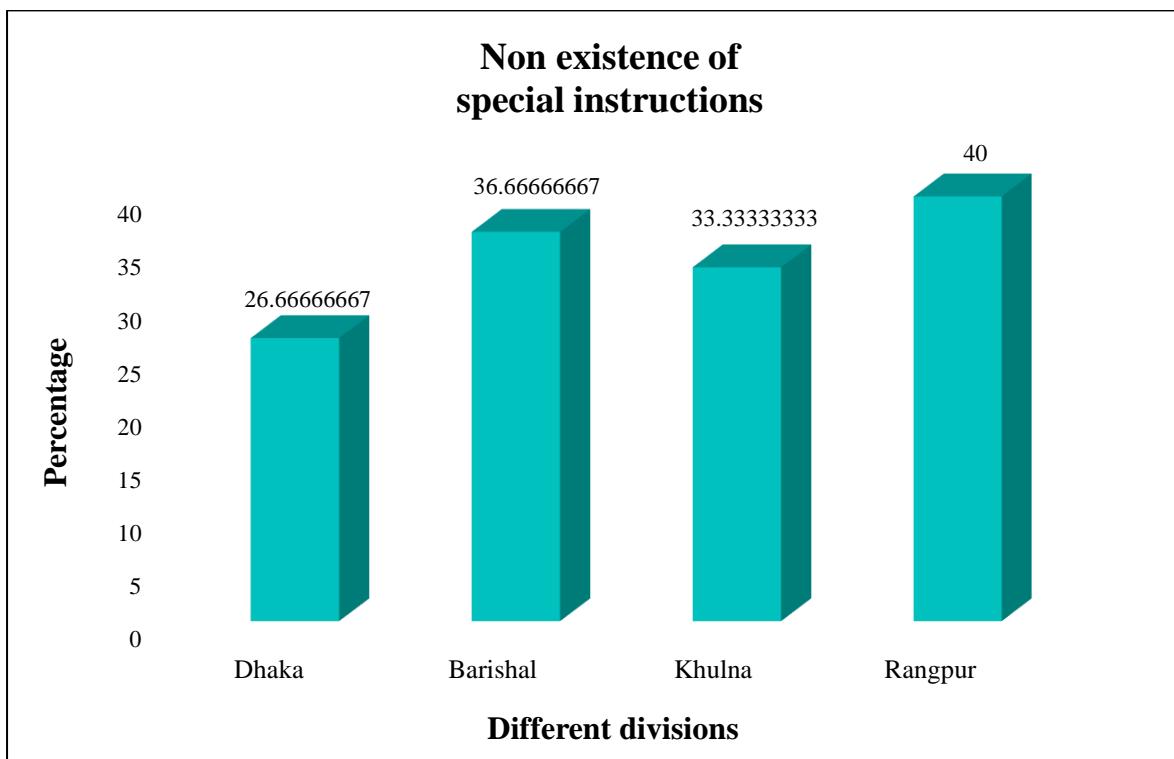


Figure 19 : Percentages of prescriptions missing the required special instructions.

3.2 Prescription of four divisions without any error

Very few numbers of prescriptions appeared to be appropriate where no errors were found. These prescriptions include all the necessary parts of an ideal one. Moreover, some of them were computerized and printed copy in which the diagnosis, past history of disease and medications etc. mentioned in a standard way.

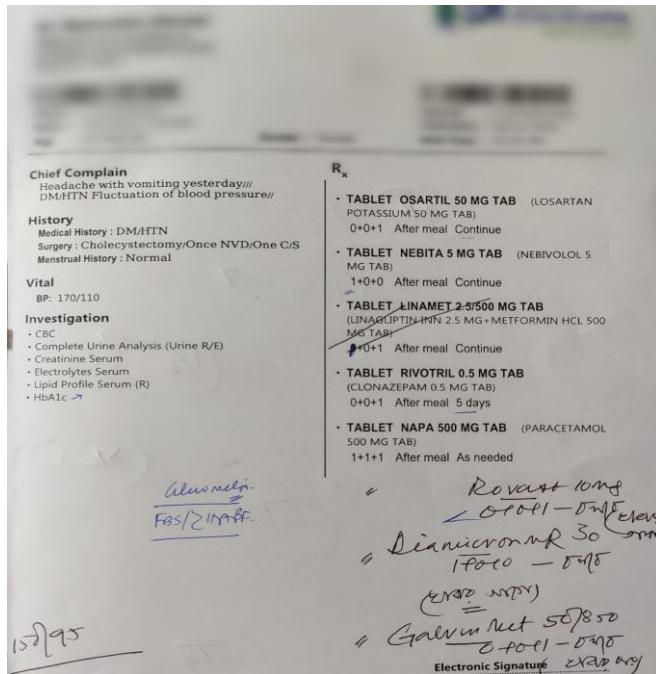


Figure 20 : Representative prescription with all the necessary information.

(Doctor's and patient's information were blurred to maintain the confidentiality).

Among all the four divisions, the Dhaka city stands in the better position compared to the other three divisions in which 9 prescriptions out of 30 is perfectly written. On the other hand, the worst condition is in Barishal division where only 1 prescription do not have any of the above discussed errors. In addition, the scenario of Rangpur and Khulna division is also an unfortunate one. Out of 30 prescriptions, only 2 and 3 were found following proper format from Khulna and Rangpur respectively that avoids all the possible errors. The data is given in the following (Table 9) with the percentage.

Table 9 : Percentage of prescriptions without any errors in four different divisions.

Divisions	No. of prescriptions	No. of proper prescriptions	% of proper prescriptions
Dhaka	30	9	30
Barishal	30	1	3.333333333
Khulna	30	2	6.666666667
Rangpur	30	3	10

In this graphical presentation (Figure 21), it is observed that only 3.33 % prescription has the proper format which do not include any of the errors in Barishal division. That means, the people of this division are in high risk of having inappropriate or ineffective treatment. Besides, in case of Khulna and Rangpur 6.67 % and 10 % of total prescriptions were found in the standard form. However, Dhaka containing 30 % proper prescriptions showed a better situation compared to the others. Overall, all the four divisions are in danger because maximum number of these prescriptions carry mistakes of various types and this causes an inevitable hinderance in the sound treatment of the patients.

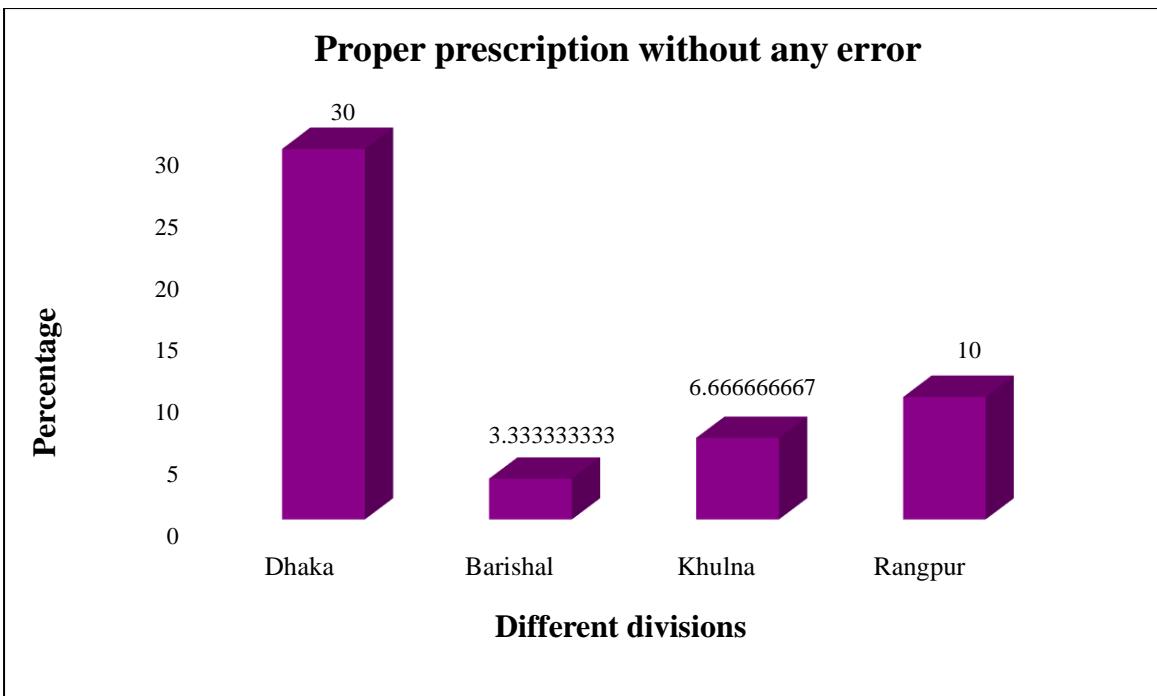


Figure 21: Percentage of prescriptions without any error in four different divisions.

Chapter 4

Discussion

Prescription is the crucial part of a treatment process. It works as a guidance through which a patient's treatment is followed. This guidance is delivered by the prescriber which should be safe, effective and rational so that it can improve any patient's health. There should be minimal scope of deterioration in the patient health abiding by the prescriptions. However, errors are possible in any steps of the prescription. The scenario of Bangladesh is an unfortunate one in this case. The prescription lacks a proper format. Very few hospitals and clinics in the city follow the correct practices of prescription writing. This study was completed to find out the current situation of healthcare sector, especially in the treatment procedure by analyzing individual prescriptions of four different divisions (Dhaka, Barishal, Khulna and Rangpur) of the country. Errors that have been found from the collected prescriptions was categorized into several parts from which the percentages of various errors were presented for each division individually.

To begin with, date in the prescription is the first part from where the investigation of the errors was started. After the analysis of 120 prescriptions from all four divisions, the percentage of missing the date in the prescriptions of four individual divisions was found. In Rangpur division missing of date can be seen in maximum number (Table 1) with more percentage than the other divisions (Figure 6). Missing of date in the prescription actually fails to keep the record of the prescribing date, starting date of the medications, next follow up visit etc. Thus, it can create difficulties in the treatment process.

Then, the prescriber's information must be given properly in the prescription. This information must include the qualifications, designation, registration number, address, contact number etc. which are the proof of originality of the prescription. With the prescriber's information, the

misuse of the drugs can be controlled and authentic prescriptions can be identified. While scrutinizing the prescriptions of four divisions of Bangladesh, it was found that all of them had the prescriber's information mentioned in the prescriptions.

The next part is the patient's information which must contain the name of the patient, gender and age. Name of the patients show that a particular prescription is needed to be followed by that particular patient. Age and gender are necessary for prescribing the appropriate drugs because the dose, strength and also the dosage forms varies from a person to person. According to Zhong & Rocca (2013) it is stated that, with the rapidity of age the widespread use of drugs increases and the commonly prescribed drugs differ according to gender and age (Diane E. Handy, Rita Castro, 2011). In this study it was found that Khulna division has the highest number of prescriptions (Table 2) which lacks the patient's information along with its percentage (Figure 8) among all the four divisions. Thus, while prescribing the drugs chances of error is more probable for Khulna region.

The patient's previous history is an important part of the prescription that is to be written by the prescriber. Situations may arise that a particular patient already had some health issues which can interact with the presently diagnosed disease or newly prescribed drugs. For example, if any patient had renal insufficiency then the prescriber must keep this condition in mind and should avoid those drugs for which the kidney needs to function properly. Even in such cases, the dose adjustment is necessary for safe prescription otherwise the previous condition may worsen. That is why, it is obligatory to know a patient's previous history before prescribing to ensure safe and accurate medication. This study shows that among all the four division, the least number of prescriptions (Table 3) without patients' history is for Dhaka city. On the other hand, Barishal division with the maximum percentage (Figure 10) possess the poor situation which indicate that those patients are treated in an unsafe way.

Besides, improper abbreviation mentioned in the prescription create difficulties for the patients to follow the instructions. Due to this, the patients might get confused and take wrong medications. It was found that, the prescriptions of Khulna division bear more incorrect abbreviations (Table 4) along with its percentage (Figure 11). Therefore, these patients have greater chances to misunderstand the commands which results in taking inappropriate dose, strength or dosage forms.

Another error that was common in the prescriptions is poor handwriting. Very few hospitals and clinics in Bangladesh maintain the modern electronic method where a prescription is typed and a digitally printed copy is given to the patient. Illegible handwriting increases misinterpretation which ultimately ends up by making mistake. These misunderstandings may include wrong name of the drugs, inaccurate dose and strength, incorrect instructions etc. For example, a prescriber wrote 50 mg but due to poor handwriting, a patient misinterpreted and started taking 5 mg which actually failed to give proper therapeutic action as the dose is lower than the required dose. This study signifies that, the most wrong interpretation can be made by the patients of the Barishal division which holds more percentage of prescriptions with indecipherable handwriting (Figure 13 and Table 5).

Moreover, to get the proper and effective treatment it is necessary to ensure accurate diagnosis of the diseases and suggest appropriate medicines against that disease. Faulty diagnosis will result in prescribing incorrect drugs which is risky for the patients. Before prescribing any type of medicines it is the responsibility of the prescriber to identify the actual one and treat accordingly. In this category of error, the situation of Bangladesh is not satisfactory. According to the study, the scenario of the four divisions is quite poor where the prescriptions do not have proper diagnosis. Among them, Barishal showed the highest number of prescriptions without diagnosis (Table 6) with inflated percentage (Figure 15). This increases the risk of getting unfit treatment for the patient.

Another most important category of prescription error is the drug interaction. Drug interaction is actually the interaction of one drug to other that can give additive effect or can antagonize the effect of each other. The drug interaction can be harmful for the patients as well as it can be life threatening in some adverse situations.

To add with, therapeutic duplication also results in additive effect that ultimately turn out to give unwanted adverse reactions. Prescribing multiple drugs of same therapeutic class will give more side effects in the patients that can create severe health complications. This study demonstrated that, drug interaction and therapeutic duplication is present in all the four divisions of Bangladesh (Table 7). The maximum percentage of prescription contains drug interaction in the Rangpur division (Figure 17).

In addition, special instruction is another part of the prescriptions that is given for the patients which helps to take the right drugs in right time. For any oral administration of drugs, the effect of food can have both beneficial and harmful on the absorption and metabolism of the drug. Therefore, it is necessary to specify the instructions of intaking different drugs prescribed by the physicians (Deng et al., 2017) . From this analysis, four different divisions in Bangladesh were observed to lack proper instructions regarding the intake of drugs which may results in ineffectiveness or undesirable therapeutic actions in patient. Rangpur has the most significant percentage of prescriptions in which the required special instructions are absent (Table 8 and Figure 19). The other three divisions are also in serious danger as the patients are not getting rational prescribing of drugs.

Overall picture of Bangladesh is not that good in the treatment process. There is the presence of all types of error in the prescriptions. Comparing among the four divisions, Dhaka has the better scenario where the errors are less. It was found that, the percentage of proper prescriptions in Dhaka is more than other division (Table 9 and Figure 21). However, without any error the number of prescriptions of other three districts (Barishal, Khulna and Rangpur)

was very poor. Therefore, it is very clear that the treatment procedure is not up to the mark and the patients are not in safe hands.

The prescription error give rise to the irrational use of drugs which has some negative consequences in the healthcare sector as well as in the economy of the country. At first, the irrational use of drugs is creating drug dependency among the patients. Now a days, people are becoming more dependent on taking the medicines even if it is a common cough and cold. Thus, psychologically the patients now believe that “there is a pill for every ill”. Besides, inappropriate prescribed drugs increase the misuse of drugs which can give rise to addiction as well, such as sedatives. Along with that, overuse or misuse has a potential impact on arising new health complications in patients. This results in the wastage of resources, shortage of medicines, high treatment expenditure and thus having a bad impact in the economy of the country. According to WHO, it is said that proper use of medicine can increase the cost effectiveness by 50 % to 70 % (Hogerzeil et al., 2001). In addition, the impact of improper use of drugs is also decreasing the quality of the treatment and drug therapy. As a result, risk of adverse drug reactions and antibiotic resistance are increasing day by day. Without proper diagnosis, antibiotics are prescribed which is making the bacteria resistant to the drugs. Moreover, multiple antibiotics are prescribed unnecessarily to a single patient. For instance, levofloxacin and azithromycin; ciprofloxacin and azithromycin; cefuroxime and ciprofloxacin etc. were prescribed. This irrelevant prescribing of antibiotics is elevating resistance day by day. Thus, it will be very much difficult to treat infections and people are forced to stay without treatment which can lead to untimely demise.

Chapter 5

Conclusion

The main aim of the study was to show the current situation of the healthcare sector focusing on the writing of the prescriptions. Overall findings among the four regions of Bangladesh demonstrated that, there is an ambiguous practice of prescriptions which are given to the patients for their treatment purpose. This ultimately results in harmful effect for the patients and entire medical sector as well. From this investigation, awareness regarding the prescription errors can be raised amongst the healthcare professionals. The effects of such errors of the prescriptions can be mitigated through general awareness by modern medias. Most of the prescriptions need to be more refined in the aspect of Bangladesh. The traditional method of writing a prescription by hand has been an outdated concept in the modern times, because handwritten prescriptions can be undecipherable and time consuming which is essentially degrading healthcare sectors. The remedy for this is the concept of electronic prescriptions that can have a positive impact upon the sector. Lack of proper details in a prescription leads to misinterpretation and miscommunication between a prescriber and patient. A patient can be identified with past ailments and more recent ones through the details in a prescription and if it has less details then the patient will receive improper treatment. Hence it is essential to include necessary information in the prescription. Such problems are usually visible because of inadequate training of the healthcare professionals in Bangladesh. Very small number of professionals in medical sectors truly understand the importance of proper training and satisfactory facilities. If the future healthcare professionals are trained and well informed then the common errors in prescription writing can cease to exist and sustain a rapid development in medical sectors and for patient welfare. The art of prescription writing should be included in education curriculum for the upcoming healthcare professionals. Additionally, the prescribers should report about the medication errors to ensure a sound treatment and to oversee

that such errors do not repeat. From this study, it has been noticed that due to providing incorrect prescriptions patients are suffering from different complications such as adverse drug reactions, increasing of antibiotic resistance, toxicity due to drug overdose, synergistic and antagonistic effect because of drug-drug interaction, drug food interaction or drug disease interaction. In order to avoid and remove these unintended effects, dose adjustment, proper time and route of administration is necessary and the drug dependency among the patients is to be minimized as well. According to these findings, the overall health sector of Bangladesh is declining day by day. Thus, it is high time that all the professionals should come together and unite to harness a positive change for the welfare of the people.

Chapter 6

Future research directions

In this study, the prescription errors of only four divisions out of the entire Bangladesh was analyzed thoroughly. In future, such errors can be investigated from different hospitals, clinics and other medical centers including both government and non-government ownership covering all the other divisions, districts, villages to bring out the overall conditions in the health sector. Besides, a comparison can be conducted with respect to the international standard which can bring out the loopholes and work accordingly to upgrade the healthcare sectors in Bangladesh.

References

- Al-habet, S. M. H., & Rogers, H. J. (1989). Effect of food on the absorption and pharmacokinetics of prednisolone from enteric-coated tablets *. 5, 423–426.
- Alegría, M., Nakash, O., Lapatin, S., Oddo, V., Gao, S., Lin, J., & Normand, S. L. (2008). How missing information in diagnosis can lead to disparities in the clinical encounter. Journal of Public Health Management and Practice : JPHMP, 14 Suppl, 1–16. <https://doi.org/10.1097/01.phh.0000338384.82436.0d>
- Aronson, J. K. (2004). Rational prescribing, appropriate prescribing. British Journal of Clinical Pharmacology, 57(3), 229–230. <https://doi.org/10.1111/j.1365-2125.2004.02090.x>
- Aronson, J. K. (2006). Editors' view: A prescription for better prescribing. British Journal of Clinical Pharmacology, 61(5), 487–491. <https://doi.org/10.1111/j.1365-2125.2006.02649.x>
- Aronson, Jeffrey K. (2012). Balanced prescribing – principles and challenges. 2(Table 2). <https://doi.org/10.1111/j.1365-2125.2012.04413.x>
- Batta, A., & Singh, B. (2018a). Rational approach to prescription writing : A preview. (July). <https://doi.org/10.4103/0028-3886.236960>
- Batta, A., & Singh, B. (2018b). Rational approach to prescription writing: A preview. Neurology India, 66(4), 928–933. <https://doi.org/10.4103/0028-3886.236960>
- Batty, K., Davis, T., Ilett, K., Dusci, L., & Langton, S. (1995). The effect of ciprofloxacin on theophylline pharmacokinetics in healthy subjects. British Journal of Clinical Pharmacology, 39(3), 305–311. <https://doi.org/10.1111/j.1365-2125.1995.tb04453.x>

Berwick, D. M., & Winickoff, D. E. (1996). The truth about doctors' handwriting: a prospective study Mizspellin and Medline. 313(December).

Chan, K., & Mok, C. (2012). Glucocorticoid-Induced Avascular Bone Necrosis: Diagnosis and Management. The Open Orthopaedics Journal, 6(1), 449–457.
<https://doi.org/10.2174/1874325001206010449>

Crowther, N. R., Holbrook, A. M., Kenwright, R., & Kenwright, M. (1997). Drug interactions among commonly used medications: Chart simplifies data from critical literature review. Canadian Family Physician, 43(NOV.), 1972–1981.

De Jong, J. C. F., Van Den Berg, P. B., Tobi, H., & De Jong-Van Den Berg, L. T. W. (2003). Combined use of SSRIs and NSAIDs increases the risk of gastrointestinal adverse effects. British Journal of Clinical Pharmacology, 55(6), 591–595. <https://doi.org/10.1046/j.0306-5251.2002.01770.x>

Del, G., El, Á., Lagunillas, T., Algodón, E., Totora, F. L. A., & B, F. C. (2012). Influence of Food Intake on the Absorption and Effect of glipizide in Diabetics and in Healthy Subjects. 111(270), 1979.

Deng, J., Zhu, X., Chen, Z., Ho, C., Him, F., & Kwan, S. (2017). A Review of Food – Drug Interactions on Oral Drug Absorption. Drugs. <https://doi.org/10.1007/s40265-017-0832-z>

Diane E. Handy, Rita Castro, J. L. (2011). Age and Sex Patterns of Drug Prescribing In a Defined American Population. NIH Public Access. Bone, 23(1), 1–7.
<https://doi.org/10.1161/Circulationaha.110.956839>

Domecq, J. P., Prutsky, G., Leppin, A., Sonbol, M. B., Altayar, O., Undavalli, C., ... Murad, M. H. (2015). Drugs Commonly Associated With Weight Change : A Systematic Review

- and Meta-analysis. (January), 1–8. <https://doi.org/10.1210/jc.2014-3421>
- Dooms, M., & Carvalho, M. (2018). Compounded medication for patients with rare diseases. *Orphanet Journal of Rare Diseases*, 13(1), 1–8. <https://doi.org/10.1186/s13023-017-0741-y>
- Dyasanoor, S., & Urooge, A. (2016). Insight into quality of prescription writing - an institutional study. *Journal of Clinical and Diagnostic Research*, 10(3), 61–64. <https://doi.org/10.7860/JCDR/2016/18011.7472>
- Gudeman, J., Jozwiakowski, M., Chollet, J., & Randell, M. (2013). Potential risks of pharmacy compounding. *Drugs in R and D*, 13(1), 1–8. <https://doi.org/10.1007/s40268-013-0005-9>
- Ha, J. F., & Longnecker, N. (2010). Doctor-patient communication: A review. *Ochsner Journal*, 10(1), 38–43. <https://doi.org/10.3329/jbcps.v32i2.26036>
- Hameed, A., & Limited, A. L. (2015a). Index Academic Sciences Analysis Of Parts Of Prescription In Common Practice * Safila Naveed , Asra Hameed. (March).
- Hameed, A., & Limited, A. L. (2015b). Index Academic Sciences Analysis Of Parts Of Prescription In Common Practice * Safila Naveed , Asra Hameed. (January).
- Hersh, E. V, Pinto, A., & Moore, P. A. (2007). Adverse Drug Interactions Involving Common Prescription and Over-the-Counter Analgesic Agents. 29, 2477–2497.
- Hogerzeil, H. V, Barnes, K. I., Henning, R. H., Kocabasoglu, Y. E., Moller, H., Smith, A. J., ... de Vries, T. P. G. M. (2001). World Health Organization Essential Drugs and Medicines Policy Geneva.
- Katzung, B. G. (n.d.). Basic & Clinical Pharmacology.
- Köhler, O., Petersen, L., Mors, O., & Gasse, C. (2015). Inflammation and depression:

- Combined use of selective serotonin reuptake inhibitors and NSAIDs or paracetamol and psychiatric outcomes. *Brain and Behavior*, 5(8), 1–12. <https://doi.org/10.1002/brb3.338>
- Kothari, N., Joshi, A., & Buch, J. (2018). Evaluation of out - patient prescriptions in rural part of central Gujarat. <https://doi.org/10.4103/jfmpc.jfmpc>
- Kumar, A., Jain, S., Dangi, I., Chowdary, S., Choubitker, O., Pandey, K. K., & Pawar. (2019). Ideal drug prescription writing. *World Journal of Pharmacy and Pharmaceutical Sciences*, 8(March), 634–654. <https://doi.org/10.20959/wjpps20193-12989>
- Kumar, J., Chandra, S., & Sinha, H. K. (2017). *IJBCP International Journal of Basic & Clinical Pharmacology Original Research Article* Prescription errors in a tertiary care government hospital of eastern India : a preinterventional prospective study. 6(3), 533–537.
- Lambert, B. L., Lin, S. J., & Tan, H. (2005). Designing safe drug names. *Drug Safety*, 28(6), 495–512. <https://doi.org/10.2165/00002018-200528060-00003>
- Li, M., Zhu, L., Chen, L., Li, N., & Qi, F. (2019). voriconazole and glucocorticoids Assessment of drug – drug interactions between voriconazole and glucocorticoids. 9478. <https://doi.org/10.1080/1120009X.2018.1506693>
- Lind, L. K., Euler, M. Von, Korkmaz, S., & Gustafsson, K. S. (2017). Sex differences in drugs : the development of a comprehensive knowledge base to improve gender awareness prescribing. 1–8. <https://doi.org/10.1186/s13293-017-0155-5>
- Manchanayake, M. G. C. A., Bandara, G. R. W. S. K., & Samaranayake, N. R. (2018). Patients' ability to read and understand dosing instructions of their own medicines - A cross sectional study in a hospital and community pharmacy setting. *BMC Health Services Research*, 18(1), 1–8. <https://doi.org/10.1186/s12913-018-3252-1>
- Maxwell, S. R. J., Cascorbi, I., Orme, M., & Webb, D. J. (2007). Educating European (junior)

- doctors for safe prescribing. *Basic and Clinical Pharmacology and Toxicology*, 101(6), 395–400. <https://doi.org/10.1111/j.1742-7843.2007.00141.x>
- Medici, V., Mcclave, S. A., Miller, K. R., & Miller, K. R. (2016). Common Medications Which Lead to Unintended Alterations in Weight Gain or Organ Lipotoxicity. <https://doi.org/10.1007/s11894-015-0479-4>
- Mellemkjær, L., Blot, W. J., Sørensen, H. T., Thomassen, L., McLaughlin, J. K., Nielsen, G. L., & Olsen, Ø. H. (2002). Upper gastrointestinal bleeding among users of NSAIDs: A population-based cohort study in Denmark. *British Journal of Clinical Pharmacology*, 53(2), 173–181. <https://doi.org/10.1046/j.0306-5251.2001.01220.x>
- Mohammad, I. S., Muhammad, H., & Khan, S. (2015). Significance of Prescription Elements and Reasons of Prescription Errors in South Punjab , Pakistan. 33(4), 668–672. <https://doi.org/10.5829/idosi.wasj.2015.33.04.131>
- Ms, N., Shahaibi, A., Said, L. S. Al, Tg, K., & Hr, C. (n.d.). Identifying Errors in Handwritten Outpatient Prescriptions in Oman. 4(4), 267–272. <https://doi.org/10.4103/0975-1483.104371>
- Ni, K. M., Siang, C. S., & Noor Bin Ramli, M. (2002). Noncompliance with Prescription Writing Requirements and Prescribing Errors in an Outpatient Department. *Malaysian Journal of Pharmacy*, 1(2), 45–50.
- Nickless, G., & Davies, R. (2016). How to take an accurate medication history. *Pharmaceutical Journal*, 296(7886), 105–107.
- Polónia, J. (1997). Interaction of antihypertensive drugs with anti-inflammatory drugs. *Cardiology*, 88 (Suppl. 3), 47-51.
- Rathish, D., Bahini, S., Sivakumar, T., Thiranagama, T., Abarajithan, T., Wijerathne, B., ...

- Siribaddana, S. (2016). Drug utilization , prescription errors and potential drug-drug interactions : an experience in rural Sri Lanka. *BMC Pharmacology and Toxicology*, 1–9.
<https://doi.org/10.1186/s40360-016-0071-z>
- Remington: The science and practice of pharmacy. (1996). Trends in Pharmacological Sciences, Vol. 17, p. 175. [https://doi.org/10.1016/s0165-6147\(96\)90065-6](https://doi.org/10.1016/s0165-6147(96)90065-6)
- Ridley, S. A., Booth, S. A., Thompson, C. M., & Society, C. (2004). Prescription errors in UK critical care units. 1193–1200.
- Samaranayake, N. R., Dabare, P. R. L., Wanigatunge, C. A., & Cheung, B. M. Y. (2014). The Pattern of Abbreviation Use in Prescriptions: A Way Forward in Eliminating Error-Prone Abbreviations and Standardisation of Prescriptions. *Current Drug Safety*, 9(1), 34–42.
<https://doi.org/10.2174/1574886308666131223123721>
- Sambol, N. C., Brookes, L. G., Chiang, J., Goodman, A. M., Lin, E. T., Liu, C. Y., & Benet, L. Z. (1996). Food intake and dosage level, but not tablet vs solution dosage form, affect the absorption of metformin HCl in man. *British Journal of Clinical Pharmacology*, 42(4), 510–512. <https://doi.org/10.1111/j.1365-2125.1996.tb00017.x>
- Shrestha, R., & Prajapati, S. (2019). Assessment of prescription pattern and prescription error in outpatient Department at Tertiary Care District Hospital, Central Nepal. *Journal of Pharmaceutical Policy and Practice*, 12(1), 1–9. <https://doi.org/10.1186/s40545-019-0177-y>
- Sultana, F., Rahman, A., Paul, T. R., Sarwar, M. S., Islam, M. A. U., & Rashid, M. (2015). Prescribing pattern and prescription errors: a study at a tertiary care hospital of Bangladesh. *Bangladesh Pharmaceutical Journal*, 18(1), 20–24.
<https://doi.org/10.3329/bpj.v18i1.23509>

Sumana, M. . (2015). Prescription analysis of drugs used in outpatient department of dermatology at tertiary care hospital. *Asian Journal of Biomedical and Pharmaceutical Sciences*, 05(46), 22–24. <https://doi.org/10.15272/ajbps.v5i46.675>

T. P. G. M. de Vries, R. H. Henning, H. V. Hogerzeil, D. a. F. (2000). Guide to Good Prescribing. 142.

Tragni, E., Casula, M., Pieri, V., Favato, G., Marcobelli, A., Trotta, M. G., & Catapano, A. L. (2013). Prevalence of the Prescription of Potentially Interacting Drugs. *Plos One*, 8(10), 1–9. <https://doi.org/10.1371/journal.pone.0078827>

Triplitt, C. (2006). Drug interactions of medications commonly used in diabetes. *Diabetes Spectrum*, 19(4), 202–211. <https://doi.org/10.2337/diaspect.19.4.202>

Wetterneck, T. B., Walker, J. M., Bloksy, M. A., Cartmill, R. S., Hoonakker, P., Johnson, M. A., ... Carayon, P. (2011). Factors contributing to an increase in duplicate medication order errors after CPOE implementation. *Journal of the American Medical Informatics Association*, 18(6), 774–782. <https://doi.org/10.1136/amiajnl-2011-000255>