

Evaluation of Prescribing Pattern and Errors among Elderly
Outpatients in Bangladesh by using AGS Beers criteria

By

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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
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February, 2020

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Declaration

It is hereby declared that

1. The thesis submitted is my/our 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.
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Approval

The thesis titled “Evaluation of Prescribing Pattern and Errors among Elderly Outpatients in Bangladesh by using AGS Beers criteria” submitted by KM Fahim Mahmud (15146067) of Spring, 2015 has been accepted as satisfactory in partial fulfillment of the requirement for the degree of Bachelor of Pharmacy (Hons) on 27th of February, 2020

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Ethics Statement

The study does not involve any kind of animal trial and human trial.

Abstract

The purpose of this research was to assess the prescribing pattern and evaluate potentially inappropriate medications (PIMs) use among elderly outpatients in Bangladesh by using American Geriatric Society Beers criteria 2019.

This was a retrospective cross-sectional analysis of the elderly outpatients' (65 years and older) prescriptions collected from urban and rural areas of Bangladesh. In this study, 600 prescriptions of elderly outpatient (age \geq 65) were collected. Data analysis was done by Python software and prescriptions were evaluated by Beers criteria 2019 to identify potentially inappropriate medicines.

PIMs were detected in 136 prescriptions (22.7%). The most commonly prescribed PIMs were NSAID (8.30%), clonazepam (4%) and amitriptyline (2.8%). The results identified high prevalence of PIMs in geriatric outpatients in both rural and urban areas of Bangladesh. Future research using other parameters and approaches for rationing the use of PIMs in geriatric communities is necessary to observe the prescribing method in Bangladesh.

Keywords: Potentially inappropriate medications; Beers criteria; Elderly outpatient; Python.

Dedication

Dedicated to my parents and my supervisor, Easin Uddin Syed

Acknowledgement

First of all, I would like to thank Almighty Allah, our creator, most gracious, most merciful. Enormous praise and gratitude to Almighty Allah for giving me the necessary assistance, patience and virtues to complete this project. Moreover, this study would not have been possible without the continuous support of the people recognized herewith.

I would like to express my gratitude, veneration and appreciation to my supervisor, Easin Uddin Syed, Lecturer, Department of Pharmacy, Brac University for motivating, guiding and conferring me with his valuable insight, experienced knowledge and suggestions throughout the project. He continually and persuasively conveyed a spirit of adventure in regard to research and an excitement in regard to teaching. This work would not have been completed without his continuous instructions and versatile knowledge.

Lastly, I would like to thank my family and friends for being with me, supporting me and encouraging me to work hard in every phase of thesis journey. Without their prayers and unconditional love, I would not have come this far.

Table of Contents

Declaration.....	ii
Approval	iii
Ethics Statement.....	iv
Abstract.....	v
Dedication	vi
Acknowledgement	vii
Table of Contents	viii
List of Tables	x
List of Figures.....	xi
List of Acronyms	xii
Chapter 1 Introduction.....	1
1.1 Error in Prescription.....	1
1.2 Effects of Polypharmacy and Inappropriate Medication	2
1.3 Global Prevalence of PIMs in Elderly Patients	3
1.4 PIMs Use among Elderly Patient in Bangladesh	4
1.5 Identifying Potentially Inappropriate Medication in Elderly	6
1.6 Guidelines and Criteria to Evaluate Prescriptions	7
1.7 Development of Beers Criteria as a Guideline	9
1.8 “AGS Beers Criteria 2019” to Identify PIMs	11
1.9 Advantages of Beers Criteria	13

1.10	Objectives.....	14
1.11	Purpose of the Study.....	14
Chapter 2 Methodology.....		15
2.1	Data Sources and Study Sample	15
2.2	Data Analysis.....	15
2.3	Statistical Analysis.....	16
Chapter 3 Result		17
Chapter 4 Discussion		28
Chapter 5 Conclusion		32
Chapter 6 Future Directions.....		33
References.....		34

List of Tables

Table 1: Socio-demographic characteristics of patients.....	18
Table 2: Frequency of major diagnosis and comorbidities observed in the study	21
Table 3: Categories of potentially inappropriate medications according to Beers criteria	24
Table 4: Frequency of the prescriptions of PIMs	25

List of Figures

Figure 1: Socio-demographic characteristics of patients	19
Figure 2: Major diagnosis and comorbidities observed in the study	22
Figure 3: Categories of potentially inappropriate medications and their percentage.....	24
Figure 4: Percentage of the use of individual PIM.....	26

List of Acronyms

PIM	Potentially inappropriate medication
ENT	Ear, nose and throat
HHD	Hypertensive heart disease
UTF	Urinary tract infections
RD	Respiratory diseases
HF	Heart failure
KD	Kidney disease
RA	Rheumatoid arthritis
OC	Other comorbidity
DM	Diabetes mellitus
NSAID	Nonsteroidal anti-inflammatory drug

Chapter 1

Introduction

Prescription refers to a patient being ordered in writing by a health care professional. It is one of the important footsteps toward patient governance. The term prescription comes from the origin of Latin "pro" before and the meaning of "letter" (Banerjee & Bhadury, 2014). Almost all doctor-patient experiences conclude with the writing of a prescription (Kumar et al., 2012). Appropriate prescription writing is an important part of healthcare, through which a doctor can affect the health and well-being of the patient (Kumar et al., 2012).

1.1 Error in Prescription

A prescription error can be defined as "a failure in the prescription writing process resulting in a misguided instruction about one or more of a prescription's usual features" (Fadare et al., 2013). Prescription errors usually occur due to the careless attitude and haste exhibited during prescription writing by certain health professionals. Whether 'omission errors' or 'commission errors' are prescription errors. A prescription with missing essential information is an 'omission error,' whereas a prescription with incorrectly written information is a 'commission error. Most prescriptions are omission errors which represent irregularities in the form of dosage, strength, or regimen, and also illegible prescriptions (Ni et al., 2002). Prescription errors account for 70 percent of the medication errors that may cause adverse effects (Velo & Minuz, 2009). There are several different approaches to classifying defects in the drug. One approach is to base the classification, such as prescribing, transcribing, dispensing, administering or monitoring, on the stage in the sequence of medication use. Another way is to identify the types of mistakes that exist, such as inappropriate dosage, dose/duration, route of administration or individual. Another approach classifies errors according to whether they arise from errors made when

planning actions or from errors in performing well planned actions (action-based errors are called "slips" or memory-based errors are called "lapses" (Lesar et al., 1997)

1.2 Effects of Polypharmacy and Inappropriate Medication

The ability to write suboptimal or unreasonable prescription may lead to therapeutic failure and also to the waste of resources, adverse clinical effects and economic loss to both patients and the community. Medication error in the case of elderly people is common all over the world due to polypharmacy and multimorbidity. Polypharmacy is the use of a large number of medicinal products, commonly considered as five or more. As the population is getting older, polypharmacy has become a significant risk factor for poor elderly results.

Polypharmacy in elderly people generally occurs due to three variables: socioeconomic factors, health factors and access to health care. With the rise in the use of numerous medications, the likelihood of negative health outcomes such as increased healthcare costs, ADEs, drug interactions, non-adherence to prescription, reduced functioning status, and geriatric syndromes decreases. Older patients are particularly susceptible to drug failures, including complicated health conditions and taking multiple medications. Of example, they may have a real need for more medicines; but, they are often casualties of a 'prescription avalanche,' they have raised risks of drug-drug and drug-disease reactions, and they often experience excessive use of medicines (United Nations, 1994). Both nations will plan their health, social and economic structures for the current and potential generational aging of their populations, according to the 1999 United Nations Initiative (Maxwell & Webb, 2006). Older adult people are growing rapidly in numbers globally, in both developed and developing countries, and numerous neurological and degenerative diseases are highly prevalent among this age group. Clinicians devote more of their time managing prescription dosage regimens in elderly patients, and understanding of geriatric medication, clinical pharmacology, and clinical pharmacy have

become important in day-to-day clinical practice. Nonetheless, geriatrics, clinical pharmacy and particularly clinical pharmacology lack specialists (Al Odhayani et al., 2017). There is increasing evidence of therapeutic agent efficacy in elderly patients and expanded use of pharmacological interventions, effective marketing campaigns and self-medication. All of these causes contribute to increased use of medications by older people, a high prevalence of polypharmacy and, therefore, a high prevalence of errors in prescription. In the European Project AgeD in Home Care (ADHOC), 22 percent of older adults (65 +) in European home care reported polypharmacy (defined as nine and more drugs). Good and healthy yet cost-effective use of drugs and good quality of life of older citizens must be assured. US tests have shown that suboptimal substance use and medication failures have a major impact on health and the national economy (Burton et al., 2007; Hanlon et al., 2001).

1.3 Global Prevalence of PIMs in Elderly Patients

Medicines are the tools for combating the disease process but can also cause serious harm if misused and depending on the medicine's pathophysiological factors and pharmacological properties, this occurrence can be as harmful as death. Sir William Osler said "One of the physician's first task is to persuade the people not to take medicine. A drug monitoring system is very poor in developing countries and it is very easy to buy any drug with or without prescription. This inappropriate way of dispensing medicines is one of the key elements in the promotion of the irrational use of medicine. The World Health Organization defines rational use of medicine as 'where patients receive medicines that suit their clinical needs, in doses that meet their own individual requirements, for an adequate period of time, and at affordable prices. More than 50% of all drugs administered, dispensed, or marketed around the globe are somehow ineffective and at the same time, 50% of patients fail to take sufficient medicines (Oliver, 2002).

Irrational use of drugs may arise in various forms but the most common types are self-medication and drug prescription by pharmacists. Besides, drug quality and inappropriate use of antibiotics are a growing concern in a number of countries. From the point of view of public health this situation needs special attention because the majority of the population becomes more susceptible to high healthcare costs owing to these malpractices, adverse medication response, allergic reactions, chemical toxicity, essential illness exacerbation or prolongation, antibiotic resistance and most critically unproductive and dangerous diagnosis. Antibiotic resistance increases treatment costs and the poor often have to choose between going untreated and spending huge amounts of money on drugs. Bangladesh is the seventh most populous country in the world and the country's population is expected to nearly double by 2050 (Streatfield & Karar, 2008). In 2011 the ratio of physicians to the population in Bangladesh was 1:3600 (Saha & Hossain, 2017). This critical scarcity of registered physicians creates a communication gap between physicians and patients which makes pharmacies a major location for finding solutions to health problems. In developing countries such as Bangladesh people rely more on pharmacies because of their convenience, Shorter waiting periods, lower costs, credit access and convenient opening hours. Here some product dealers also provide health care to chronic disease victims, also treating minor non-serious trauma.

1.4 PIMs Use among Elderly Patient in Bangladesh

Irrational use of drugs is a global problem, particularly in emerging and transnational countries. Irrational prescription is a frequent finding in countries like Bangladesh. Frequently found excessive use of drugs per patient (polypharmacy) (Jyrkkä et al., 2009) , improper use of antimicrobials, over injection and vitamin use. On the other hand, it was proposed that deceptive product promotion, lack of information on medication use and poor drug supply were the main causes behind unreasonable prescribing (Butler, 1958). Irrational use of drugs leads to a reduction in drug therapy quality, the cost of excess therapy, increased risk of adverse

reactions and resistance emergence (Bhartiy et al., 2008). The prescribed drug costs huge amounts of money, causing problems in developing countries. Irrational and illegal substance use is a common occurrence in Bangladesh. The International Legal Substance Usage Network (INRUD) has developed a compilation of legal prescription metrics (Ghei, 1995). The differences in prescription patterns between rural and urban areas are quite significant. Across rural areas, a multitude of factors leads to these issues, including a declining population, economic stagnation, physician and other healthcare professionals' shortages, a disproportionate number of disabled, disadvantaged and under-insured people, and high rates of chronic disease. Many village doctors have no specific professional training to provide modern health care services.

Although the health sector in Bangladesh has undergone policy innovations and changes in health care over the past 40 years, many rural people are still deprived of care provided by professionally trained health care providers. While the government has taken measures to understand rural people's need to provide reliable, quality health care to all, inadequate transportation infrastructure and lack of access to formally trained health care providers make health care unattainable for many rural populations. Hence, owing to their easy access and reliable health services at times of need, these informal health care providers have become the sole provider for vulnerable and underserved people in rural areas. The incidence of polypharmacy among prescribers in Bangladesh needs to be investigated. The Bangladesh International Center for Diarrhoeal Disease Research (ICDDR, B) has embarked on a report to understand the nature of prescribers' health services. To prescribe drugs for a patient the prescriber must achieve license from the respective authority of Bangladesh. There are significant numbers of unauthorized prescribers practicing in Bangladesh who are mostly found in the rural area (Chouduri et al., 2018). They do not hold any standard degrees in medical or health care services. They are unlicensed prescribers who are not authorized to practice

medicine according to the law of Bangladesh. They still practice base on their basic health care knowledge and experience. Nevertheless, inappropriate medication is common and ignored phenomena in both rural and urban area. Prescription mistakes are a disgraceful fact in hospitals. Approximately 30 percent of inpatient complications are related to prescription errors. Mistakes may occur at any point of the treatment cycle, from choosing medication to administering the drug. Errors can occur at any stage of the treatment process, from drug selection to drug administration. Numerous studies have shown that patients are harmed by medication errors, most of which are due to prescription errors (Barber & Dean, 1998). Errors in the medication are more common due to polypharmacy. The majority of errors are due not only to imprudent behavior on the part of health care providers, but also to the speed and complexity of the cycle of medication use, combined with faulty systems, processes and conditions that lead to errors or failure to prevent them. There are several researches were done to study the prescription pattern of urban area over rural area, private health care sectors, medicines use, prescription error in the context of Bangladesh.

1.5 Identifying Potentially Inappropriate Medication in Elderly

Identifying risk factors for medication-related errors have proven important in ensuring greater safety for patients and health professionals. For example, they can be identified by analyzing medical prescriptions, which allows for preventive actions to reduce adverse events occurring. Medication mistakes may trigger major health problems, with significant economic and social consequences that, in some manner, directly affect the lives of patients and the health professionals and organization, as well as prolonging the hospitalization time and impacting the care (Bates et al., 1995; Nuckols et al., 2014). Studies showed the potential of significantly reducing serious errors through the introduction of this program, including enhanced guidance for professional decision making. The results of this study thus align with those of other studies

into the enhancement of patient safety and the elimination of risk factors for such circumstances (Bright et al., 2012; Devine et al., 2010; Gimenes et al., 2009).

1.6 Guidelines and Criteria to Evaluate Prescriptions

Prescription mistakes are major sources of drugs being used irrationally. Illegal prescription is dangerous and can result in an inadequate diagnosis, illness prolongation, medical pain, and higher medication costs. Nevertheless, the safe and effective prescribing of pharmaceutical drugs in the elderly continues to pose a major challenge. While elderly people are estimated to be responsible for half of overall drug usage, fewer than 5% of randomized controlled trials have been designed for people over 65 years of age. Despite limited evidence available to direct prescribing for the aged, the prescribers tend to rely on research for younger topics available (Zaveri et al., 2010). In addition, elderly people constitute a heterogeneous population due to various factors, such as co-morbidities, inter-individual variation in the aging process and inter-individual differences in pharmacokinetic and pharmacodynamic adjustments related to age. Clearly, the excessive use of medications in this population is expected to be strong. The use of medications and polypharmacy is highly prevalent in elderly people, leading them not only to harmful opioid responses but also to drug interactions, higher treatment expenses, and enforcement failures. Improved incidence of adverse reactions in the elderly and more serious reactions are identified. Patient research due to adverse drug reactions show that older people are more likely to be hospitalized as a consequence of adverse drug reactions, and only half of these reactions are preventable. It is important to identify the trend of insufficient use of drugs in this population in order to avoid adverse reactions in the elderly (Blandford, 1978).

Several requirements for the identification of PIMs were developed. Such guidelines can be clear medication standards and Older People's Screening Guide, including implied criteria dependent on populations such as the Medication Appropriateness Inventory. There are certain popular criteria for assessing prescription, such as Beers criteria: The Beers Criteria for

Potentially Inappropriate Use of Medicines in Older Adults also referred to as the Beers, provides recommendations for health care professionals to further improve the safety of administering medical drugs to older adults (Maerz et al., 2019). We emphasize the prescription of excessive drugs. It aims to decrease the issues with polypharmacy, drug interactions and harmful drug reactions, thus growing the risk-benefit ratio of treatment regimens in at-risk people. DUE criteria: It is an ongoing, systematic, criteria-based drug use assessment system that will help ensure that medicines are used appropriately (at the individual patient level). If therapy is considered inappropriate, in order to optimize drug therapy, interventions with providers or patients will be necessary (Hsu, 1993). A DUE is specific to the drug or disease and can be organized to evaluate the real process of prescribing, distributing or administering a drug (indications, dose, drug interactions, etc.). DUE is the same as Drug Use Review (DUR) and synonymous terms are used. MUE criteria: It is similar to DUE but emphasizes improving patient outcomes and individual quality of life; it is, therefore, highly dependent on a multidisciplinary approach involving all professionals dealing with drug therapy. An MUE will assess clinical outcomes (cured infections, decreased lipid levels, etc.) (Phillips et al., 1996). PRISCUS criteria: The LACE index was used to predict the readmission risk among patients included in the study (Hien et al., 2016). In order to identify PIMs, the patient's medication list was compared against three main criteria: the 2015 Beers, PRISCUS, and STOPP criteria. PIM-Taiwan criteria: Potentially inappropriate criteria are a significant instrument for stopping ADRs, but the drugs mentioned in the PIM-Taiwan criteria would be one of the main determinants of PIM incidence and their capacity to detect PIMs (Chang et al., 2018). The revised PIM-Taiwan could recognize more PIMs than the older variant. START and STOPP criteria: START and STOPP criteria are new for identifying potentially inappropriate drugs in elderly people, including drug and drug interactions, drugs that increase the risk of falling, and drugs that duplicate therapy (Rios, 2015). PIM criteria: There are three sets of PIM criteria

identified high percentages of older adults who were prescribed at least one PIM in the ambulatory care setting. PIM prevalence estimated from the PIM-Taiwan criteria ranked among the three sets of criteria.

1.7 Development of Beers Criteria as a Guideline

Beers criteria are the specific method most commonly used to classify PIMs in the elderly. Beers criteria have recently been used to identify PIM in ambulatory settings as well as in hospitalized elderly people (Momin et al., 2013) With the continual addition of new medicines to the market, a need for frequent updates of such tools is warranted (Fick et al., 2003). For new medicines constantly being brought to the market, there is a need for frequent updates of such tools. As a result, the American Geriatrics Society (AGS) revised the Beers guidelines in 2019 using an evidence-based approach after Dr. Beers passed away in 2009. The 2019 Beers guidelines categorized PIMs into three groups that included medications to be avoided among aged people in general, drugs that surpassed the recommended dose and drugs to be avoided with particular comorbidity. The latest version of the Beers standards has seen several major changes such as the addition of new medicines and the elimination of drugs that are no longer in use. For the medicines to be used with care in the aged, a new category of PIMs is also added (Van Der Hooft et al., 2005).

Criteria for safe use of medication in older adults for people over the 65-year age. These criteria were first published in 1991 and were constantly revised and updated. In addition to benzodiazepines, amiodarone, amitriptyline, cimetidine, clonidine, disopyramide, indomethacin, ketorolac, meperidine, methyldopa, and many antihistamines, antispasmodics and muscle relaxants were included in the Beers criterion or inventory. Named after Dr. M.H. Beers, the main author of the original 1991 guidelines (Sharma et al., 2020). Since then, systematic efforts to teach physicians about the standards and use them in quality assurance operations have had significant effects on older adults ' quality of care. There has been a

decrease in the use of many medicines included in the Beers Criteria, others have been removed from the market and the distinctive factors that should be implemented when prescribing for older adults are improved. However, the Beers Criteria were implemented and adopted not without problems. Many clinicians misunderstand the purpose of the criteria, erroneously believing that all uses of the listed drugs are judged by the criteria as being widely inappropriate. Health systems have often reinforced this belief by implementing quality assurance programs and promoting decision-making processes which indirectly make any use of such medications problematic. Drug-related issues, including adverse drug reactions, drug-to-drug interactions, drug-to-drug interactions, polypharmacy, and other complications, are common, but prescribing choices may have preventable results. These issues are especially common among geriatric patients who tend to be at higher risk for complications associated with the medication.

The most comprehensive clarification of the Beers Criteria for Potentially Inappropriate Medication (PIM) Use in Older Adults was released by the American Geriatrics Society (AGS) of 2012 (Salbu & Feuer, 2017). The initial Beers Criteria published in 1991 focused specifically on nursing home residents, and later updates in 1997 and 2003 incorporated extended criteria of treatment in all clinical settings for older adults. The latest document is based on a comprehensive, systematic review of the published literature on drugs and their usefulness and potential risks versus advantages in older adults, and not just expert opinion. The listing divides medicinal products into three: 1) prevent prescribing in older adults; 2) discourage serious drug-disease or drug-syndrome interactions; and 3) use responsibly in older adults. It also incorporates and acknowledges specific exceptions for using PIMs, e.g. in palliative or end-of-life care cases (Musante, 2012). The AGS aims to undertake systematic reviews and report on new data facts and guidelines. The aim of the Beers Criteria is to improve the effectiveness and protection of geriatric patients of the pharmacy procedures. The AGS

acknowledged that the Beers Criteria should never be used to take precedence over professional judgment and individualized treatment. AGS will not support the usage of the Beers Criteria to mark medical items as "never suitable" for older people. This is especially notable since medicines with common properties, such as strong anticholinergic and antimuscarinic effects, are classified as potentially inappropriate medicines by the Beers Criteria (Ags et al., 2012). OAB's effective treatment is difficult, and while clinical therapy can mainly be used, the use of these types of medications remains an important part of the management of patients who are properly chosen.

Nonetheless, based on both the expert opinion and current empirical facts, the Beers Criteria agree that under certain conditions PIMs may be acceptable for joint decision-making between the prescribing clinician and the patient. The risks and adverse events due to the use of PIMs are important. According to the Panel Survey on Medical Expenditures 2000/2001, the total estimated health costs associated with using PIMs were \$7.2 billion (Lai, 2018). Adverse drug outcomes (ADEs) have been shown to be avoidable in primary care environments in 27 percent of situations and in long-term care settings in 42 percent. Harmful drug reactions can contribute to a wide variety of negative outcomes for older adults. An additional 99,628 emergency hospitalizations for older adults were needed from harmful medication reactions between 2007 and 2009. However, review of several national data sets found that of an overall 177,504 emergency room visits for harmful substance incidents in older adults, half is due to drugs deemed "potentially unsafe for use in older adults" under the 2003 edition of the Beers Criteria (Blanco-Reina et al., 2014; Boya et al., 2014).

1.8 “AGS Beers Criteria 2019” to Identify PIMs

While older adults, here identified as those ≥ 65 years of age, actually account for about 13 percent of the total U.S. population, they consume more than 30 percent of all prescription drugs. National data indicate that average prescriptions continue to increase, with dramatic

rises particularly in older adults. In 2007-2008, more than 76 percent of people aged 60 or over used two or more prescription medicines and 37 percent used five or more medications. For several fundamental reasons the potential risks associated with drugs in this older population may be greater. Changes in physiological activity attributable to either natural aging or underlying illness may render prescribing in this demographic more difficult. Furthermore, older adults and those with serious comorbidities are often exempt from clinical trials that are used to evaluate and authorize prescription drugs. Therefore, it is unclear in many situations that the potential benefits of pharmacological intervention really outweigh potential risks. In 2004, Curtis and associates performed a retrospective cohort study for outpatient medications from a reimbursement archive for a large national pharmacy benefits provider. Of the 765,423 patients over the age of 65, 21% had at least one prescription for a drug of interest under the 1997 Beers Criteria, more than 15% had prescriptions for two different medicines on the registry and 4% had prescriptions for three or more medications. In 32 percent of subjects were identified as inappropriate prescribing based on the 2003 Beers Criteria. Polypharmacy tended to increase the risk, with those taking more than five medications being 3.3 times the chance from reporting to receiving a prescription. Of those receiving inappropriate prescriptions, due to an adverse drug event, 49 percent were admitted to the hospital. The idea of preventing PIMs and enhancing skillful risk assessment has become important in geriatric prescribing practice despite the complexities and future threats (Gnjidic et al., 2011; Goodlin, 2005; Guaraldo et al., 2011). Through time many measures have been established to improve the quality of care given to older adults. The systematic review for the 2012 revision of the Beers Criteria which validated the method was enhanced. After three years 2015 revision was presented.

There are seven key principles that drive the effective use of the parameters of AGS 2015 Beers: The AGS 2015 Beers Criteria for drugs are probably unacceptable but definitely inappropriate, Read the explanatory statement and recommendations for each criterion, The

aforementioned caveats and guidance are important, Consider why herbal items are included in the AGS 2015 Beers Criteria and change the strategy accordingly, Optimal use of the AGS 2015 Beers Criteria includes recognizing possibly unsafe medicines and providing alternative non-pharmacological and pharmacological treatments where applicable, The AGS 2015 Beers Criteria should be the starting point for a systematic framework to define and enhance the appropriateness and protection of drugs and Exposure to drugs included in the Beers Criteria of the AGS 2015 should not be overly limited by previous authorization regulations and/or provision of health plans (Simonson, 2016).

At the time of the 2019 update, the inter-professional panel of experts in geriatrics responsible for the AGS Beers Criteria(R) listed more than 40 potentially problematic drugs or groups of pharmaceutical items generally grouped on five lists: Two draft lists of potentially inappropriate medicinal products for most older adults or those with specific health conditions, One draft list describes certain medicinal products that should only be used with considerable care, Another draft report identifies specific drug formulations that may result in dangerous "food-drug" interactions; and a final draft list defines certain medicines that should be prevented or dosed appropriately for elderly people with poor kidney functions. This update was intended to make it a more efficient and appropriate tool (American Geriatrics Society 2015 Beers Criteria Update Expert Panel, 2015).

1.9 Advantages of Beers Criteria

The Beers Criteria are an essential set of evidence-based recommendations specifically tailored to older adults (65 and older) in all care settings, except for hospice or palliative treatment. This list of potentially inappropriate medicines (PIMs) provides guidance on how to optimize the choice of medicines in older adults (Shu et al., 2019). Multiple factors related to the suitability and overall quality of prescribing drugs: Avoidance of inappropriate medicines,

appropriate use of indicated medicines, monitoring for side effects and drug levels, avoidance of drug-drug interactions, patient involvement, and patient values integration. Therefore, the use of unsafe pharmaceutical drugs can be prevented using the 2019 Beers guidelines, which is one of the essential therapeutic resources that physicians, pharmacists and health care providers can use carefully. Criteria for drugs can be used by the physicians as a criterion when administering the medications to the geriatric community (B.T. et al., 2017)

1.10 Objectives

This study is designed to analyze the out prescription of elderly outpatients from twelve districts of Bangladesh including the rural and urban communities. The objectives of the study are to evaluate the prescription pattern in urban and rural areas of Bangladesh for geriatrics and to identify potentially inappropriate medications using Beers Criteria 2019 (Fixen, 2019).

1.11 Purpose of the Study

The purpose of this study was to examine the prescribing trends of drugs in Bangladesh's urban and rural environment. Several types of research have been done to study urban prescription patterns over rural areas, private and public health care sectors, use of medicines, Bangladesh prescription error (Biswas et al., 2014). Nevertheless, this analysis is intended to examine the disparity in the prescribing trend and PIM use among elderly patients.

Chapter 2

Methodology

The research was carried out in Bangladesh on outpatients from a different areas (rural and urban) of Bangladesh. Before the start of this report, ethical approval had been received from the research ethics committee of the respective hospitals, clinics or doctor's chambers. All the patients included in this analysis have received consent.

2.1 Data Sources and Study Sample

This was a cross-sectional study. The sample size was targeted by using confidence levels and margins of error (P. Hunter, 2017). In total 600 prescriptions of orderly people (age ≥ 65 years) were collected and all the participants were out-patients from communities and 12 different districts of Bangladesh. These prescriptions were collected at random from hospitals, diagnostic centers and the personal chamber of doctors. The information obtained from the prescriptions included demographic characteristics of patients (age, sex, and area), prescribed drugs and doses, certification of prescribers and diagnosis of patients. The data collection process was carried out with prior authorization from the relevant authorities. Concerning patient, hospital, medical center sensitive information was handled with care and hostility was preserved. The patient's privacy was the priority as well as it was properly preserved thoroughly.

2.2 Data Analysis

All the data from the individual prescription was compiled in a datasheet and categorized for further use. Moreover, the data were divided into five age groups and other demographic characteristics including sex, communities, and area. In addition, the comorbidities, drugs and their doses were observed. After that, the potentially inappropriate medications (PIM) were identified from the prescriptions and evaluated according to "American Geriatrics Society

Beers Criteria (2019)” (Fick et al., 2019). The PIMs were categorized to measure their causes to be inappropriate and their risks mentioned in the “Beers Criteria”. After that, the prescription pattern of prescribers along with the demographic characteristics of patients and the percentage of PIMs were studied to reach the findings.

2.3 Statistical Analysis

The data was computed using Python 3.7.3 (The Python Software Foundation, 2019); library: NumPy (Stewart & Stewart, 2014), SciPy (Hill & Hill, 2016), Matplotlib (J. Hunter et al., 2010). This programming language was also used to generate graphical data from numerical data. The results are presented as frequencies and percentages.

Chapter 3

Result

During the study period, 600 prescriptions of elderly people (age ≥ 65) were screened randomly. The prescriptions were collected from different districts and communities of Bangladesh. The collected prescriptions were mostly belonged to general physicians (44.51%), cardiologists (15.38%), orthopedists (4.6%), internists (8.93%), urologists (5.29%), ENT specialists' (3.53%), gynecologists (1.60%). internists (9.93%), dentists' 0.05%, ophthalmologists' 0.24%, neurologists' 1.49%, psychiatrists' 0.35%, and general surgeons' 1.33%). dermatologists 0.23%), pediatricians (0.90%), infectious disease specialists (0.42%) and neurosurgeons' (0.77%).

Those data were analyzed with certain parameters including Socio-demographic characteristics of Patients, category of PIMs, frequency of PIMs, major diagnosis, and comorbidities observed in the study. After that, the prescriptions were evaluated according to the “Beers Criteria” for the identification of potentially inappropriate medication and the impact of demographic conditions in individual prescriptions.

Table 1: Socio-demographic characteristics of patients

Characteristics	Number of Males n = 277 (46.17%)	Number of Females, n = 323 (53.83%)	Total, n = 600
Age Range			
65-70	135 (22.5%)	156 (26%)	291
71-75	54 (9%)	71 (11.83%)	125
76-80	55 (9.17%)	35 (5.83%)	90
81-85	22 (3.67%)	42 (7%)	64
86-91	11 (1.83%)	19 (3.17%)	30
Communities			
Urban	226 (39.33%)	192 (32%)	418
Rural	85 (14.17%)	97 (16.17%)	182
Districts			
Dhaka	99 (16.5%)	120 (20%)	219
Khulna	5 (0.83%)	4 (0.67%)	9
Madaripur	4 (0.67%)	20 (3.33%)	24
Mymensingh	28 (4.67%)	31 (5.17%)	59
Natore	38 (6.33%)	33 (5.5%)	71
Rajshahi	8 (1.33%)	11 (1.83%)	19
Rangpur	31 (5.17%)	32 (5.33%)	63
Bogra	24 (4%)	9 (1.5%)	33
Tangail	10 (1.67%)	19 (3.17%)	29
Sylhet	14 (2.33%)	26 (4.33%)	40
Jossre	2 (0.33%)	3 (0.5%)	5
Brahmanbaria	14 (2.33%)	15 (2.5%)	29

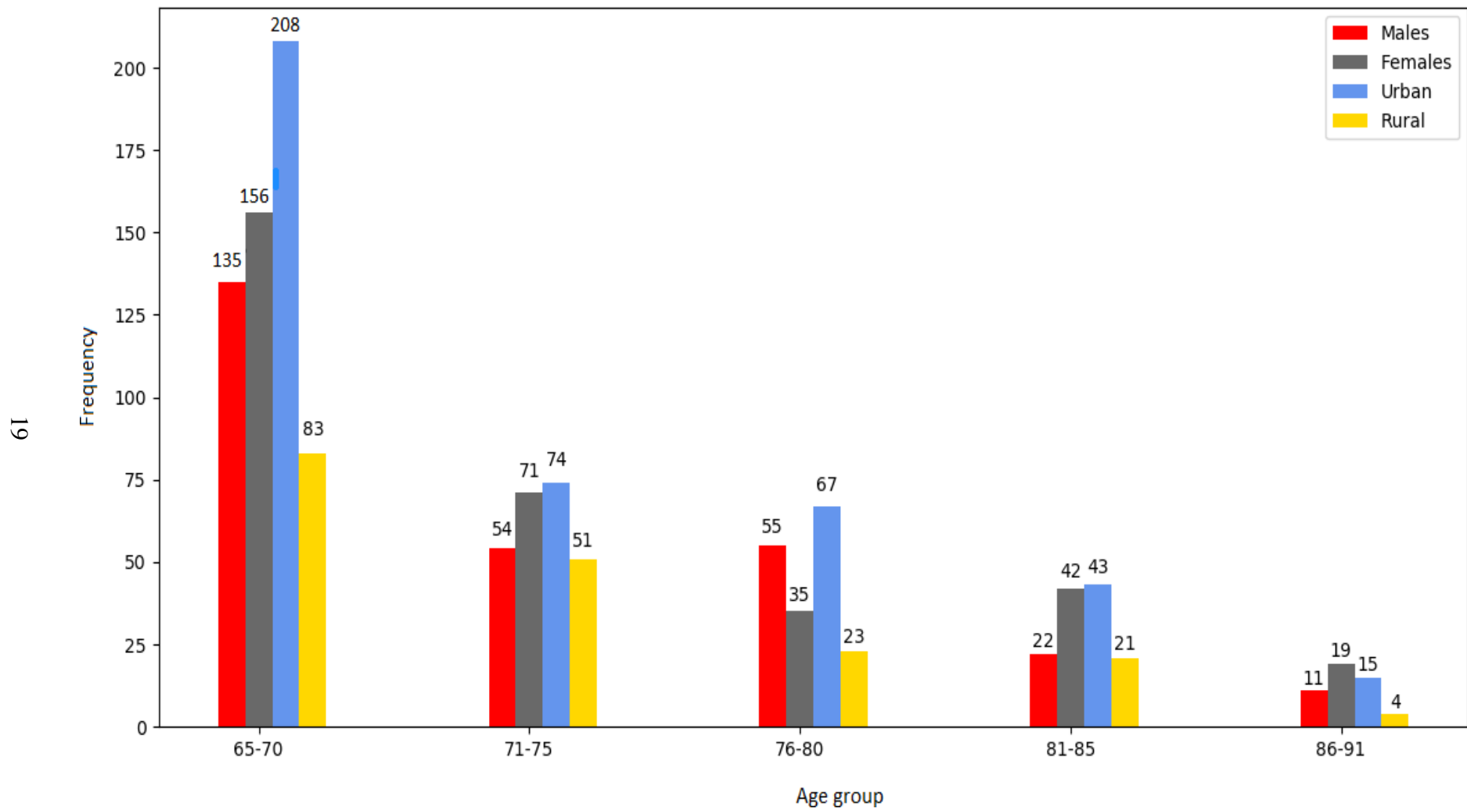


Figure 1: Socio-demographic characteristics of patients.

Table 1 represents socio-demographic characteristics and comparison of the concentration of patients distinguished by their gender which is established in the context of Bangladesh. To evaluate 600 samples, this table portrays four demographic characteristics: Age (≥ 65), community, district of participants and prescribing qualification of prescribers.

In addition, those characteristics are further classified by different parameters. The participants were divided into five age groups. Age distribution of the patients was analyzed and it was found that 48.5 % of the prescription was in the age group of 65-70 years, followed by 20.83% in the age group 71-75 years, 15% in 76-80 years, 10.67% in 81-85 years and 5% in the age group more than 90 years. The figure 1 also portrays the demographic differences along with the age groups. The samples were collected from 12 different districts of Bangladesh. The maximum amount of prescription was collected from Dhaka (36.5%) and remaining are from Khulna (1.5%), Madaripur (4%), Mymensingh (9.8%), Natore (11.83%), Rajshahi (3.17%), Bogra (5.5%), Tangail (4.83%) Sylhet (6.7%), Jossre (0.83%), Brahmanbaria (4.83%) and Rangpur (10.5%).

Furthermore, the participants were categorized based on the development of their living area among those twelve districts. In this category (Communities) it was found that 69.77% of samples were collected from an urban community where 226 of the participants were males and 192 participants were females. On the other hand, 30.33% of samples were collected from the rural community consists of 85 male and 97 female participants.

Table 2: Frequency of major diagnosis and comorbidities observed in the study

Diagnosis	Frequency (n)	Percentage (%)
Anxiety	7	1.17%
Bacterial infection	11	1.83%
Bone and joint infection	7	1.17%
Respiratory diseases	77	12.83%
Chronic kidney disease	29	4.83%
Constipation	6	1%
Diabetes mellitus	84	14%
Fever	5	0.83%
Osteoporosis	27	4.50%
Hypercholesterolemia	5	0.83%
Hypertensive heart disease	65	10.83%
Hypertensive heart disease + Diabetes	30	5%
Hypertensive heart disease + Renal Disease	17	2.83%
Hypertensive heart disease + Heart Failure	14	2.33%
Hypertensive heart disease + Other Comorbidity	17	2.83%
Osteoarthritis	9	1.50%
Joint pain	11	1.83%
Hypothyroidism	4	0.67%
Peptic Ulcer	66	11%
Peptic Ulcer + Infection	3	0.50%
Rheumatoid arthritis	41	6.83%
Rheumatoid arthritis + Kidney Disease	10	1.67%
Rheumatoid arthritis + other comorbidity	2	0.33%
Urinary tract Infections	16	2.67%
Others	37	6.17%
Total =	600	100%

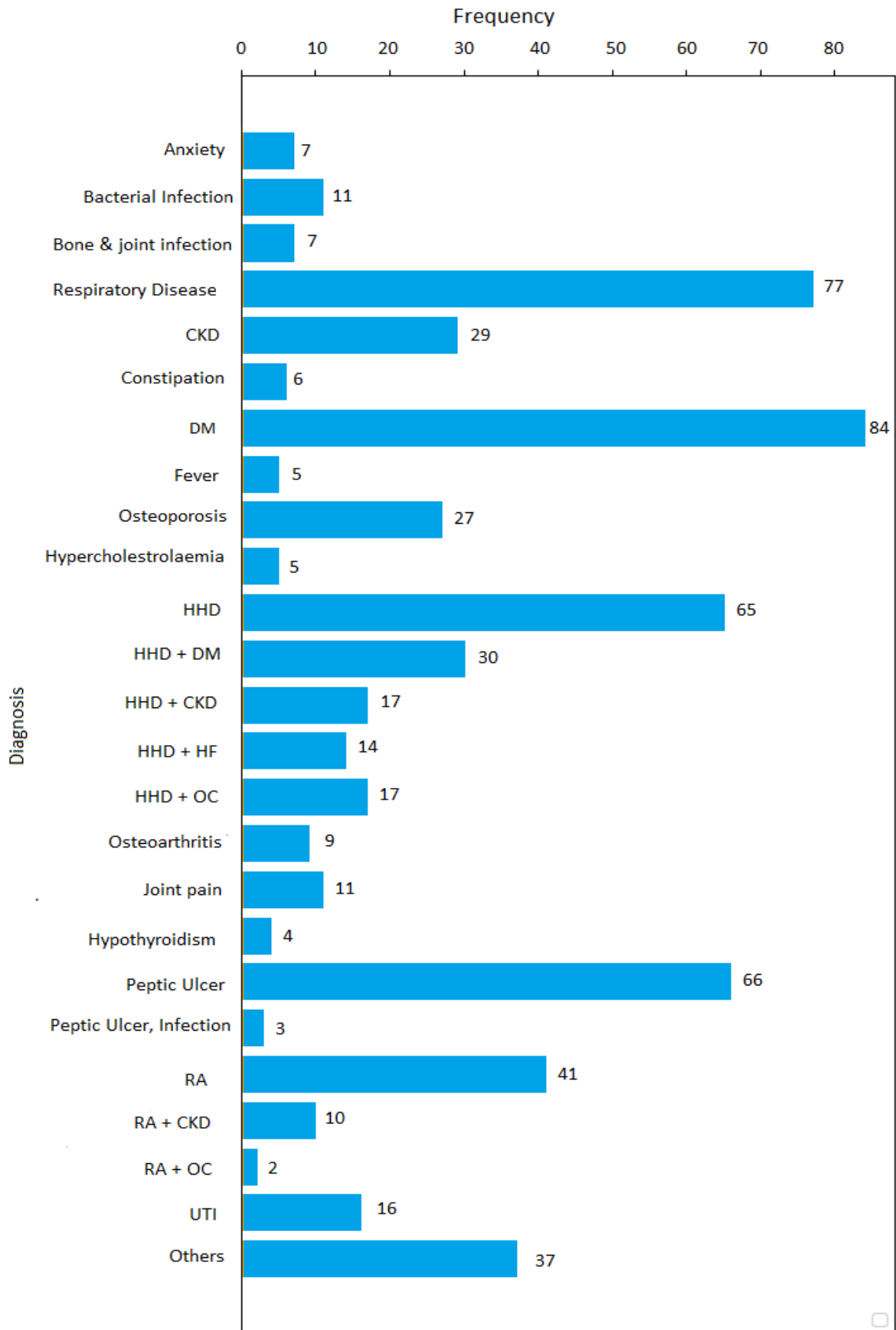


Figure 2: Major diagnosis and comorbidities observed in the study.

During the study, up to 36 major diagnoses and comorbidities have been observed. Table indicates that 84 patients were diagnosed with diabetes mellitus (14%) followed by 77 patients with respiratory diseases (12.83%), 65 patients with hypertensive heart disease (10.83%), 66 patients with peptic ulcer (11%), 16 patients with urinary tract infection (2.67%), 41 patients with rheumatoid arthritis (6.83%), 29 patients with chronic kidney disease (4.83%), 11 patients with joint pain (1.83%), 9 patients with osteoarthritis (1.50%), 11 patients with bacterial infection (1.83%), 27 patients with osteoporosis (4.50%), 5 patients with hypercholesterolemia (5%), 7 patients with bone and joint infection (1.17%), 7 patients with anxiety (1.17%), 6 patients with constipation (1%), 5 patients with fever (0.83%), 4 patients with hypothyroidism (0.67%).

Furthermore, multiple comorbidities in a single patient were found. 30 cases of HHD + DM (5%), 17 cases of HHD + RD (2.83%), 14 cases of HHD + HF (2.33%), 16 cases of HHD + OC (2.83%), 3 cases of peptic ulcer + infection (0.50%), 10 cases of RA + KD (1.67%), 2 cases of RA + OC (0.33%). There were total 37 cases of other comorbidities (6.17%) in a small number individually consisting skin infection (3 cases), vaginal infection (6 cases), vertigo (7 cases), pain and inflammation (4 cases), gingivitis (2 cases), glaucoma (3 cases), hemorrhage (1 case), *helminthiasis* (1 case), hepatitis B (3 case), herpes labialis (1 case), insomnia (1 case), loin pain hematuria (1 case), melisma (1 case), migraine (1 case), neonatal conjunctivitis (1 case). Figure 2 also shows a comparison between the frequency of major diagnoses and comorbidities during the study.

Table 3: Categories of potentially inappropriate medications according to Beers criteria

Category of PIM	No Prescriptions (n)	Percentage (%)
Category A	116	19.33%
Category B	11	1.83%
Category C	6	1.00%
Category D	3	0.5%
Total =	136	22.7%

Category A: Drugs that generally should be avoided in older adults.

Category B: Drugs to be avoided due to drug-drug interaction.

Category C: Drug to be used with caution in older adults.

Category D: Drug to be avoided in combination with specific comorbidity.

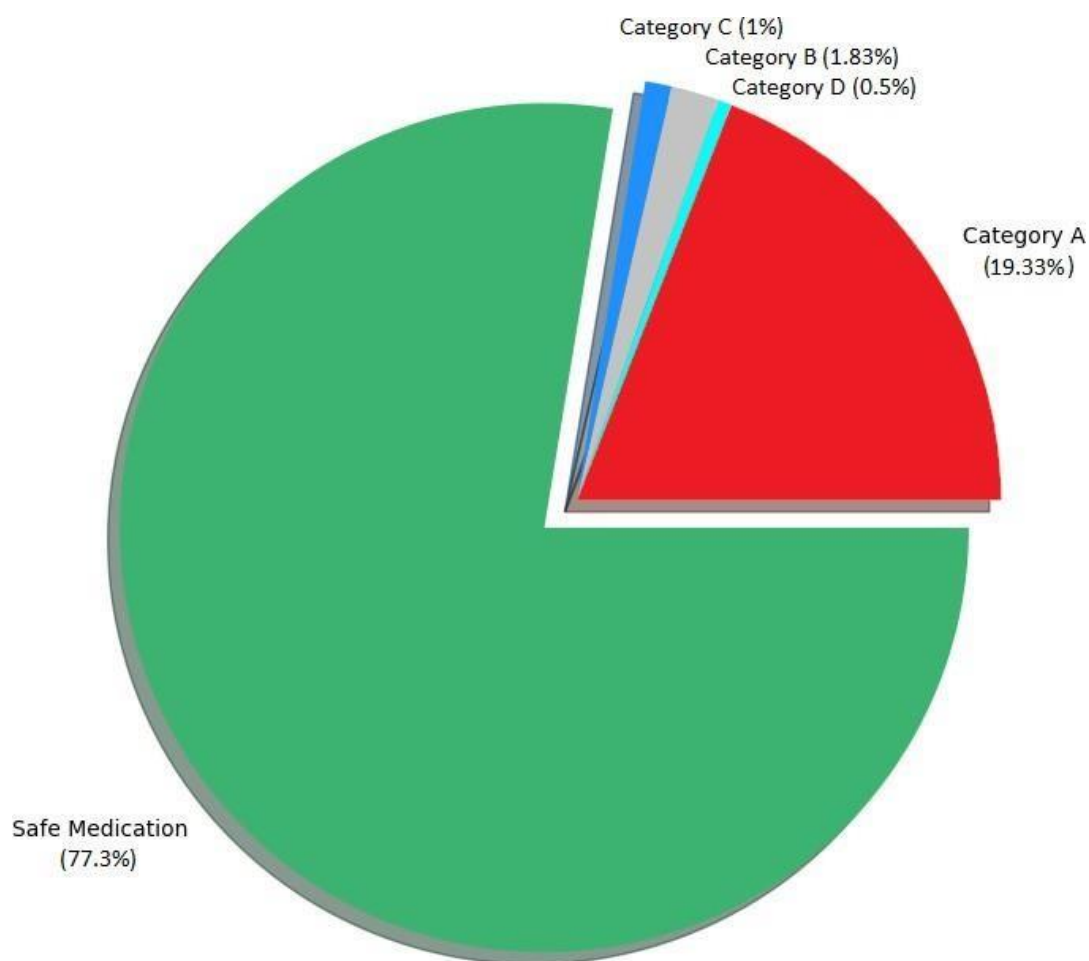


Figure 3: Categories of potentially inappropriate medications and their percentage.

Table 3 represents the number of prescriptions in which the drugs of those four categories were observed. PIMs from category A were found in 116 prescriptions, drugs of category B were found in 11 prescriptions, drugs of category C and category D were found in 6 and 3 prescriptions respectively. On the other hand, figure 3 indicates the percentage of safe medications and drugs of these four categories. It was observed that 22.7% of prescriptions were containing potentially inappropriate drugs according to Beers criteria which should be avoided or prescribed considering certain parameters in the older adults. The percentages of prescriptions containing inappropriate drugs of each category are 19.33% for category A (red portion), 1.83% for category B (gray portion), 1% for category C (blue portion) and 0.5% for category D (cyan portion). 77.3% prescription was found safe during the study.

Table 4: Frequency of the prescriptions of PIMs

PIM	Frequency (n)	Percentage (%)
NSAIDs	50	8.30%
Amitriptyline	17	2.80%
Clonazepam	24	4%
Diazepam	4	0.67%
Diphenhydramine	1	0.17%
Dimenhydrinate	2	0.33%
Doxazosin	7	1.17%
Digoxin	9	1.50%
Glyburide	10	1.67%
Imipramine	1	0.17%
Metoclopramide	3	0.50%
Nortriptyline	2	0.33%
Promethazine	8	1.33%
Prazosin	4	0.67%
Terazosin	11	1.83%
Total =	153	25.50%

The drugs prescribed in each prescription was evaluated according to “American Geriatrics Society Beers Criteria (2019)” for potentially inappropriate medication use in older adults and found that 136 out of 600 patients were taking one or more PIMs. Table 4 outlines the total amount of PIMs (153 drugs) and the frequency of individual PIM. It was found that 50 patients (8.30%) were prescribed NSAIDs which were diclofenac sodium (12 patients), ibuprofen (15 patients), naproxen (18 patients), mefenamic acid (2 patients), sulinadac (3 patients). Nevertheless, amitriptyline was found in 17 (2.80%) prescriptions afterwards, clonazepam in 24 prescriptions (4%), diazepam in 4 prescriptions (0.67%), diphenhydramine in 1 prescription (0.17%), dimenhydrinate in 2 prescriptions (0.33%), doxazosin in 7 prescriptions (1.17%), digoxin in 9 prescriptions (1.50%), glyburide in 10 prescriptions (1.67%), imipramine in 1 prescription (0.17%), metoclopramide in 3 prescriptions (0.50%), nortriptyline in 2 prescriptions (0.33%), promethazine in 8 (1.33%), prazosin in 4 (0.67%), terazosin in 11 (1.83%) prescriptions.

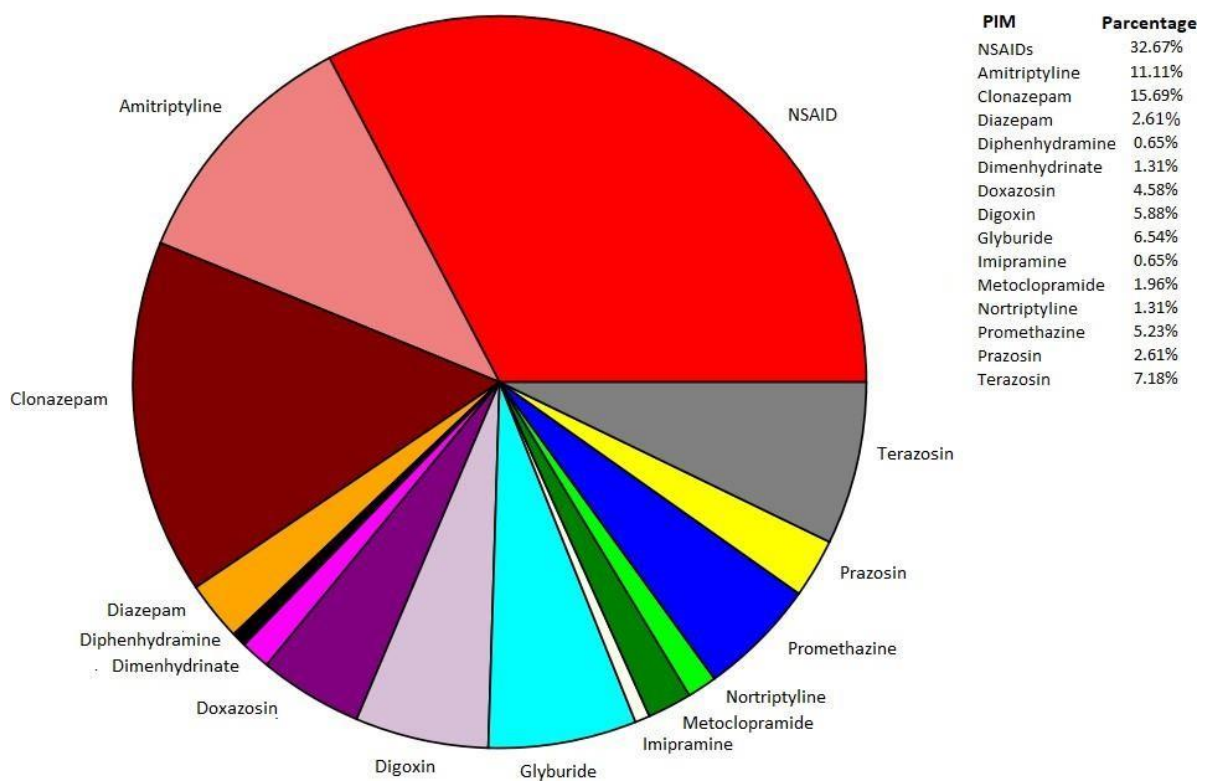


Figure 4: Percentage of the use of individual PIM.

Overall, 25.50% of medications were found containing single or multiple PIMs among the 600 samples which should be avoided in older adults. Figure 4 portrays the aggregated ratio of identified PIMs and their individual percentages. In this pie chart, 15 different colors represent 15 different PIMs. It shows that the most prescribed PIM is NSAIDs (32.67%) followed by clonazepam (15.69%), amitriptyline (11.11%), terazosin (7.18%), glyburide (6.54%), digoxin (5.88%), promethazine (5.23%), doxazosin (4.58%) and the percentage of other PIMs were below 3% individually.

Chapter 4

Discussion

This study found a high prevalence of PIM use in the prescriptions of orderly outpatients in Bangladesh. Among the 600 prescriptions evaluated, 136 (22.67%) were on at least one PIM. After screening the prescriptions, the top three PIMs at admission were NSAIDs (8.30%), clonazepam (4%) and amitriptyline (2.80%).

Optimal medication is important for care for elderly people. A secure prescribing approach for the elderly must include the assessment as to whether a medication is needed or not, the option of the best drug, the evaluation of a dosage and timetable acceptable for the medical state of the individual, testing for efficacy and risk, advising the patient about the possible side effects and reasons for obtaining treatment. Polypharmacy and inadequately prescribed drugs cause numerous adverse events and that could be life-threatening at times. Side effects are grave consequences of inadequate prescriptions (Fanon et al., 2019; Silvestre et al., 2019). Multimorbidity makes polypharmacy common in elderly people (Salive, 2013). The most common comorbidities observed in this study were diabetes mellitus (84%), respiratory diseases (12.83%), hypertensive heart disease (65%), peptic ulcer (11%), and rheumatoid arthritis (6.83%). However, there were 100 prescriptions, which indicated multimorbidity. A study in Bangladesh also observed this common diagnosis among elderly people (Khanam et al., 2011; Sara et al., 2018). In our study, it was found that 250 prescriptions had more than five drugs. Furthermore, there were nine prescriptions with more than 10 medications listed.

For older adults, the PIMs included in the Beers Criteria, those should be excluded from the medication list of elderly patients because they are therapeutically inadequate or present an exceptionally high risk of adverse consequences, such as delirium, internal bleeding and fall-related injury. Some PIMs are available with safer alternative medicines or non-pharmaceutical therapies (Patterson et al., 2014). This research established many PIM-related demographic

and clinical characteristics including age, sex, region and the total number of drugs utilized. It was found that 136 out of 600 patients were taking one or more PIMs and in total 153 PIMs were found. Most widely used PIMs found in this study were NSAIDs (8.30%), clonazepam (4%), amitriptyline (2.8%), terazosin (1.83%), glyburide (1.67%), and digoxin (1.5%). In this study, those were considered typical in inappropriate prescriptions. Several studies also found those drugs to be prescribed to elderly patients. These medications were also shown to be administered to elderly patients in several trials (Carvajal et al., 2008; Charbonnier et al., 2018).

This study is the first to examine the prevalence and types of PIMs among orderly outpatients of different districts in Bangladesh. We have collected 600 prescriptions from rural and urban to identify the error in their prescription pattern according to Beers Criteria (2019). In this report, it was observed that 22.67% of medications contained improper drugs that were similar to another Bangladesh study found 18.25 percent of inappropriate medicines (Deye et al., 2016).

It is reiterated that the age sex, area and community play an important role in providing social and affective care for aged adults, especially in meeting the needs of the elderly. Prescribing practices also have a significant impact on public health (Davari et al., 2018). During this time of research, 600 prescriptions obtained from 12 Bangladesh districts including urban and rural areas. The sum of the sample is not adequately effective enough to reflect the whole scenario of Bangladesh. This report can provide a general idea since it is not practical to perform an analysis of the whole population. Prescribers should be more responsible and careful in the medical sector and prescribing rational drug use (Holt et al., 2010). This study suggests the several factors contribute to the appropriateness and overall quality of prescribing drugs such as avoidance of ineffective medicines, correct use of specified medicines, alternative medicines, and control of side effects and doses of medication, prevention of drug-drug interactions, patient participation, and patient integration.

The Beers Criteria is a guideline for health care professionals to assist enhance the safety of prescribing medicines to older adults. They emphasize the prescription of unnecessary medicines. This helps to decrease the issues of polypharmacy, drug interactions, and adverse drug reactions, thus enhancing the risk-benefit ratio of drug regimens in individuals at risk. The prescription of potentially inappropriate medications for elderly patients (PIMs), according to Beers Criteria, it is strongly linked to the triggering of adverse reactions to medication and hospitalizations and, when associated with the presence of comorbidities and polymedication, exposes elderly patients to a high risk of death (Nobili et al., 2011). There are other tools to evaluate prescription such as START and STOPP criteria, PRISCUS criteria, DUE criteria, MUE criteria, PIM-Taiwan criteria and more. AGS Beers Criteria (2019) was chosen to evaluate prescriptions during the study period as it has a unique set of evidence-based guidelines specifically tailored to older adults (65 years of age and above) in all treatment environments, except in hospice or palliative care. This list of potentially inappropriate medicines (PIMs) with their doses and risk factors provides guidance on how to optimize drug selection in older adults. In fact, it can be used to meet a range of healthcare needs such as Clinicians: The criteria are an excellent tool to be used when beginning, raising or transferring drugs, or when simply carrying out a thorough drug analysis for geriatric patients, Health systems: Criteria can be a resource for developing clinical decision support systems; People: The guidelines can be an educational tool for informing people who want to know more about their medication's possible risks and benefits.

There are certain drawbacks to the present study. First, this is cross-sectional research of small sample size, and data was obtained for a short time. Secondly, it could not determine the specified daily doses of PIMs for all samples, as well as the duration of these medications, was undefined. The follow-up reports and any adverse drug events were available. Finally, the requirements of Beers Criteria have been questioned because they do not recognize all the

reasons of possibly improper prescribing and sometimes classify acceptable medication as unacceptable. In fact, the guidelines concentrate only on administering harmful pharmaceutical items and not on the possible under prescribing of approved medications and other risk management issues, such as supervision and reporting (Patients, 2005).

Chapter 5

Conclusion

Based on the results and the discussion, the study concludes that there is an alarming rate of inappropriate prescriptions considering 22.67% of elderly patients were given one or more PIMs. Inappropriate use of drugs leads to the development of toxicity and organ damage. It is important to address the standard of prescriptions written in Bangladesh. Education and supervision are needed to improve the quality of services and to create responsibility for the good of the general population, particularly among the vulnerable. Giving importance in the healthcare sector and the use of modern medicine are in significant lack of formally trained practitioners. It is necessary to draw attention and create awareness among prescribers and people about the rational use of medicine. The health condition of elderly people is more vulnerable and needs continuous care. Inappropriate medication can cause serious harm or may lead to death. Moreover, Prescribers should give up their business mindset and be committed to healthcare service. Nevertheless, the number of prescribers is insufficient, the respective authority should strictly monitor the prescription method & validity of their license to prescribe. Prescribers should act responsibly and be aware of PIMs and their risk factors for elderly people. It is essential that the prescribers provide due attention and be more careful about prescribing appropriate medicines. Additionally, Bangladesh's policymaker particularly the Bangladesh Drug Administration needs to develop appropriate regulatory policies and ensure their compliance. Furthermore, the Medical & Dental Council of Bangladesh (BM&DC) must also take action against quacks to prevent patient maltreatment.

Chapter 6

Future Directions

Further study with a wider set of data will provide more inferences and evidence about the prescribing method and errors in Bangladesh. The data can be broadly evaluated by other parameter Firstly, Proper diagnosis and follow up report should be monitored to clarify the consequences of PIM use and the health condition of elderly patients to achieve more accurate result. Secondly, the prescription error can be studied based on prescribers' degrees which can be helpful to find the effects of education level in healthcare system. Thirdly, Samples can be evaluated by physicians' respective field of practice. Finally, we can add more parameters like area of the patient to observe the effects of social and cultural aspect on prescription methods.

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