INCIDENCE AND TYPES OF MEDICATION ERRORS IN THE MANAGEMENT OF INPATIENTS WITH CHRONIC CARDIAC FAILURE AT MUHIMBILI NATIONAL HOSPITAL DAR-ES-SALAM

By

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CERTIFICATION

The undersigned certify that they have read and hereby recommend for acceptance by Muhimbili University of Health and Allied Sciences a dissertation entitled "**Incidence and Types of Medication Errors in the Management of In-patients with Chronic Cardiac Failure at Muhimbili National Hospital Dar es Salam**," in (Partial) fulfillment of the requirement for the degree of Master of Pharmacy in Hospital and Clinical Pharmacy of Muhimbili University of Health and Allied Sciences.

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DECLARATION AND COPYRIGHT

I, **Abdulhalim M. Mzale**, solemnly declare that this **dissertation** is my own original work and that it has not been presented and will not be presented to any other university for a similar or any other degree award.

Signature: ..... Date: ……

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DEDICATIONS

I dedicate the results of this study to my Father, Ambassador Muhammed Mzale, my Mother Neema Mussa Maissara, my daughter Manal and to my lovely wife Nadya Aboud. Thank you!

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LIST OF ABBREVIATIONS

ADE - Adverse drug events

CRF - Case Report Form

CVD - Cardiovascular diseases

CHARM - Candesartan in Heart failure: Assessment of Reduction in Mortality trial

COPERNICUS - Carvedilol Prospective Randomized Cumulative Survival trial

CCF - Chronic cardiac failure

CCP - Comprehensive chemistry panel

CHF - Congestive Heart Failure

ECHO - Echocardiogram

ECG - Electrocardiography

HF - Heart failure

HIV - Human immunodeficiency virus

IOM - Institute of Medicine

JAMA - Journal of the American Medical Association

LVSD - Left ventricular systolic dysfunction

ME - Medication errors

MERIT - Metoprolol CR/XL Randomized Intervention trial

MNH - Muhimbili National Hospital

NYHA - New York Health Association

RCT - Random Clinical Trials

RALES - Randomised Aldactone Evaluation Study trial

SSA - Sub Sahara Africa

WHO - World Health Organization

SUMMARY

Background: Chronic cardiac failure (CCF) is one of the major causes of high morbidity and mortality in Tanzania. Patients with CCF often have other diseases and require adequate multiple drug treatment, which is important for optimum prognosis. Medication error (ME) is a common problem facing hospitals both in developed and developing countries. The likelihood of ME to occur during the management of CCF is high due to high number of medicines, which must be taken at the same time and this may lead to poor treatment outcome.

Aim of the study: The main aim of the study was to determine the types and frequencies of medication errors among patients with CCF admitted at Muhimbili National Hospital (MNH).

Methodology: This was a prospective observational study that included 100 adult male and female patients with the diagnosis of CCF at medical wards at MNH. Observations were made on admission, post admission, during hospital stay and on discharge. Information was extracted from eligible patients' medical records, drug charts, laboratory test results and personal interview with patients. The obtained information was recorded in case report form (CRF). After reviewing and recording data from medical records, the investigator examined drug treatment prescribed by the intern, resident or specialist and noted the type of ME committed. Any new changes by another prescriber during the hospital stay were also examined. Upon receiving laboratory results, the investigator re-examined the cases for potential drug and abnormal electrolyte interaction. On discharging, the investigator examined prescriptions and also interviewed patients on types of non pharmacological advices given to them by hospital staff. Specially designed check list, patients' interviews and drug charts were used to determine drug administration errors. The ability of a block pharmacist to detect prescription errors was determined from medication issued for each patient according to patient file.

Results: During a follow up of 201 person days, 71 patients were observed with medication error (incidence rate, 35 per 100 person days of observation). Most of medication errors were due to prescription errors (80.2%), followed by dispensing error (16%) and lastly by drug administration error (4%). Most frequency of ME were observed during hospital stay (40%), followed by admission (25%). Among commission errors potential drug and drug interaction, 81 (22.7%) and potential drug and abnormal electrolyte interactions 80 (22.4%) were the most common. Potential drug and abnormal electrolyte interaction was the major error undetected by block pharmacist contributing to 45%, followed by inappropriate starting dose (23.1%) and drug of choice appropriate to the condition not written (23.7%). The mean duration of hospital stay was shorter for those without medication error (mean days 6.75 95%CI 5.1 8.45) compared with those with medication error and those with errors (mean days 11.2 95%CI 8.87 13.5).

Patients discharged with symptom had more ME (93.1) compared to those without symptoms (58%) and the association was significant (P = 0.001).

Conclusion: From the study, it can be concluded that the incidence of medication error is fairly high. Controlling for such errors may lead to improvement in patient care. The pattern of ME suggests that prescription errors were the major type of error. Of these prescription errors, errors leading to drug and drug interactions and drug with abnormal electrolyte interactions are the most common. Clinicians at MNH need to consider laboratory results while treating these patients. Producing laboratory results on time may be necessary to avoid these interactions.

CHAPTER ONE

INTRODUCTION

1.1. Overview of chronic heart failure

Chronic cardiac failure (CCF) is the leading cause of hospitalization in developing countries for the elderly (60 years and above) [1]. In developed countries, the mean age of patients with heart failure is 75 years old. In developing countries, two to three percent of the population suffers from heart failure.

CCF is a complex clinical syndrome that can result from any structural or functional cardiac or non-cardiac disorder that impairs the ability of the heart to respond to physiological demands for increased cardiac output. Chronic heart failure is characterised by progressive symptoms such as exertional breathlessness and fatigue, and signs of fluid retention as well as signs associated with the underlying cardiac disorder. CCF may arise as a consequence of a myocardial, valvular, pericardial, endocardial or electrophysiological problem (or some combination of these) [2].

In developed countries, the underlying process leading to CCF is dominated by coronary heart disease [3]. In developing countries and most particularly those of Sub Sahara Africa (SSA), non-ischaemic causes of heart failure are dominant, with hypertensive heart disease, rheumatic heart disease, and cardiomyopathy accounting for over 75% of cases [4-5]. However, ischemic cardiomyopathies also seem to be growing in this setting [5]. That cardiac involvements in human immunodeficiency virus (HIV) infection, cor pulmonale, and pericarditis contribute to over 20% of cases of heart failure in SSA reflects the continuing impact of HIV and tuberculosis on heart disease on the continent [6-7]. Earlier reports from SSA highlight the major importance of rheumatic valvular diseases among causes of heart failure. However, recently published data favor hypertension as the dominant cause of heart failure in this part of the world [15**][8].**

Lessons from the changing epidemiology of CCF in developed countries suggest that the burden of this disease will dramatically increase over the first half of this century.

Compared to foreign studies, CCF in Africa tends to occur at a much younger age with most cases recorded around the 5th and 6th decade [8]. This young age reflect the major contribution of rheumatic valvular disease to heart failure, but could also be accounted for by the early onset and severity of hypertension among Blacks. Although CCF management has benefited from major advances in the recent years, case fatality among people with heart failure remains high worldwide. Hospital case fatality among those with CCF in Africa ranges from 9% to 12.5%. This consistent death rate ranks CCF among the major causes of death of cardiovascular origin in Africa.[9]

Management of CCF may be problematic due to various medication errors committed by practitioners during admission, hospital stay and discharge. Preventing the occurrence of ME may be critical in optimizing therapy for patients with CCF.

1.2. Overview of medication errors

Occurrence of medication errors (ME) is a problem in all hospitalized patient population [10], mostly due to their potential grave effects and the fact that they are preventable cause of patient harm. Medication error is defined as any preventable event that may cause or lead to inappropriate medication use or patient harm. Medication errors can also be defined as any error in the prescribing, dispensing or administration of a drug, irrespective of whether such errors lead to adverse consequences or not [10-11]. Medication error occurs when health-care providers choose an inappropriate method of care or the health providers choose the right solution of care but is executed incorrectly. Medication errors are often described as human errors in healthcare [11].

The incidence of medication errors is indeterminate; valid comparisons of different studies on medication errors are extremely difficult because of differences in variables, measurements, populations, and methods and thus many medication errors are probably

undetected. Yet, occurrence of mediation error is a common problem of health concern in both developing and developed countries and it has been reported to be attributed to many factors including level of knowledge and experience of health workers, workload and many other factors [12]. The magnitude of medication errors remains a big challenge in hospital settings. Recently, Naoual and colleagues reported occurrence of medication errors to a tune of 10% in patients who were admitted at a medical intensive care unit [13]. Medication errors can have harmful consequences to patients. The same study reported a significant percentage of serious ME, highlighting the importance of reducing these preventable errors so as to optimize patient care.

1.3. Types of Medication Errors

There are many types of medication errors but for simplicity attention has been given to prescribing errors, dispensing errors, and medication administration errors, which we hypothesize to be common in our setting [14].

1.3.1. **Prescribing error**

Prescribing errors may be defined as the incorrect selection of drug or drug regimen for a patient. Such errors may include dose, indication, or prescribing of a contraindicated drug. Lack of knowledge of the prescribed drug, in terms of its recommended dose, clinical use, and of the details of the patient's clinical condition commonly contribute to prescription errors [14]. Prescription errors are divided into two types; omission (neglected or disregarded errors) and commission errors (error due to inadequacy; should not have been committed). For the purpose of this study, only the serious commission errors were taken into account.

1.3.2. Dispensing errors

In this study, dispensing errors occurred when block pharmacist dispensed medication despite the presence of prescription errors. Dispensing errors usually occur at any stage of the dispensing process from the receipt of the prescription in the pharmacy to the supply of a dispensed medicine to the patient. Dispensing errors include wrong drug, wrong patient, and selection of the wrong strength or product [14]. This aspect of this error was not investigated in the study.

1.3.3. Administration errors

Administration errors occur when a discrepancy occurs between the drugs received by the patient and the drug therapy intended by the prescriber. Drug administration has long been associated with one of the highest areas in nursing practice, with the 'five rights' (giving the right dose of the right drug to the right patient at the right time by the right route) being the cornerstone of nursing education. Drug administration errors largely involve errors of omission where the drug is not administered for variety of reasons. Other types of administration errors include an incorrect administration technique and the administration of incorrect or expired preparation [14].

Table 1.1.List of other different types of medication errors which have been reported in admitted and out patients [15]

SN	Type of error	Definition
1.	**Omission error**	The failure to administer an ordered dose to a patient before the next scheduled dose, if any. Assuming there is no prescribing error.
2.	**Timing error**	Administration of medication outside a predefined time interval from its scheduled administration time
3.	**Dosing error**	Administration to the patient of medication not authorized by a legitimate prescriber for the patient. This would include, for example, a wrong drug, a dose given to the wrong patient, unordered drugs, and doses given outside a stated set of clinical guidelines or protocols.
4	**Route of administration error**	Inappropriate procedure or improper technique in the administration of a drug.

1.4. Medication errors in chronic heart failure

A study by Rixt et al [16] investigated the effect of a discharge service by a clinical pharmacist on the occurrence of discrepancies and prescription errors in a population of heart failure patients. The percentage of patients with one or more discrepancies or prescription errors has been lowered by almost a half (68% vs. 39%). The ability of a block pharmacist at Mwaisela ward to detect prescription errors in patients with CCF is examined. International studies show that supervision of and providing heart failure patients with information at the time of discharge as well as post discharge support reduces the number of readmissions and improves the patient's quality of life [17-18]. Percentages of non pharmacological advices given to patients at discharge are examined during the study. It was not possible in this study to measure the number of readmissions caused by incorrect medicine use because it was considered unethical to leave discrepancies uncorrected during the check up at the outpatients' clinic.

Assessing the scope of medication errors as they pertain specifically to CCF is difficult. Data are extremely limited, well-designed clinical trials are scarce, and the information is often anecdotal. Despite these shortcomings, the available information does suggest reason for concern in the cardiovascular patient. On the basis of the available studies in cardiovascular patients, it is suggested that a significant degree of morbidity and mortality may be preventable. A study by Michael at al [19] commented that of all events of ME, 90% were derived from individuals with complicated cardiovascular diseases (CVD) such as heart failure that had more complicated drug regimens. The study suggests that pharmacist intervention decrease the risk of ADE and ME in outpatient with CVD. In a recent study of medical inpatients, drugs for treating coronary heart disease and CCF, including diuretics, nitrates, angiotensin converting enzyme inhibitors, and calcium channel blockers, were associated with fatal adverse drug events [20]. Specifically linked to administrative errors were vasoactive drugs, with the most common error being the wrong infusion rate [21]. Digoxin has also been associated with medication errors and cardiac arrest among hospitalized patients. Several factors have

been linked with digoxin toxicity, including aging related changes in renal function, body mass, and polypharmacy [22].

1.5. Pharmacological therapies for chronic heart failure

The treatment of heart failure aims to relieve symptoms, improve exercise tolerance, reduce the incidence of acute exacerbations and reduce mortality.

1.5.1. Angiotensin converting enzyme inhibitors

Angiotensin converting enzyme (ACE) inhibitors were first shown to be effective in CCF in the 1980s. Since then, many Randomized controlled trials (RCTs) have confirmed their benefit on mortality and morbidity, in patients with chronic heart failure, LVSD, heart failure or both after MI and in patients with asymptomatic LVSD [23]. Meta-analysis of these and other major trials has shown that in patients with chronic heart failure treatment with an ACE inhibitor reduces relative risk of mortality by 23% and admission for heart failure is reduced by 35% [24].

1.5.1.1. Mechanism of action of ACEIs

ACEIs block formation of Angiotensin II and inhibit bradykinin metabolism that lead to decrease aldosterone level and fluid retention. Increase vasodilation reduce both preload and afterload. In addition to improving symptoms and exercise tolerance, they slow progression of heart failure and prolong survival. In addition, ACEIs have prophylactic value post-MI because they oppose "remodeling" that can lead to heart failure [25].

1.5.2. Beta blockers

Beta blockers produce benefit in the medium to long term. In the short term they can produce decompensation with worsening of heart failure and hypotension. They should be initiated at low dose and only gradually increased with monitoring up to the target dose. Many RCTs have been undertaken with beta blockers in patients with heart failure. In the MERIT-HF and COPERNICUS trials a consistent, approximately one third reduction in total mortality was seen with bisoprolol, extended release metoprolol succinate and carvedilol [26-27].

1.5.2.1. Mechanism of action of Beta blockers.

A full understanding of the beneficial action of beta blockade is lacking, but suggested mechanisms include attenuation of the adverse effects of high concentrations of catecholamines (including apoptosis), up-regulation of beta receptors, decreased heart rate, and reduced remodeling through inhibition of the mitogenic activity of catecholamines.[28]

1.5.3. Angiotensin receptor blockers

Angiotensin II type 1 receptor blockers (ARBs) block the biological effect of angiotensin II, mimicking the effect of ACE inhibitors. Unlike ACE inhibitors they do not produce cough as a side effect and should be used in patients who cannot tolerate an ACE inhibitor due to cough. In CHARM Alternative, in which 2,028 patients intolerant of an ACE inhibitor were randomised to placebo or candesartan, ARB treatment led to a relative risk reduction of 23% in the primary composite outcome of cardiovascular death or hospitalisation for CHF in patients receiving candesartan [29].

1.5.3.1. Mechanism of action of Angiotensin receptor blocker

The angiotensin II AT_1 receptor blockers (ARBs, eg, losartan, candesartan, etc) produce beneficial hemodynamic effects similar to those of the ACE inhibitors. However, large clinical trials suggest that the angiotensin receptor blockers should only be used in patients who are intolerant of ACE inhibitors (usually because of cough). [28]

1.5.4. Aldosterone antagonists

Aldosterone produces many adverse extra renal effects, for example on vascular function and myocardial fibrosis. The RALES trial demonstrated that adding the aldosterone antagonist spironolactone to an ACE inhibitor reduced all cause mortality by 30% and cardiac mortality by 31%.The frequency of hospitalisation for worsening heart failure was 35% lower in the spironolactone group than in the placebo group [30].

1.5.4.1. Mechanism of action of Aldasterone antagonist

Competitively inhibits aldosterone by blocking its stimulation, this also causes sodium reabsorption, potassium excretion. It also reduces aldosterone stimulation ammonia genesis throughout the nephron. [25]

1.5.5. Loop diuretics

In the majority of patients with heart failure, fluid retention occurs, causing ankle oedema, pulmonary oedema or both and contributing to the symptom of dyspnoea. Loop diuretic treatment relieves oedema and dyspnoea. A meta-analysis has demonstrated a 75% reduction in mortality and a 63% improvement in exercise capacity [31].

1.5.5.1. Mechanism of action of loop diuretic

They reduce venous pressure and ventricular preload. This results in reduction of edema and its symptoms, and reduction of cardiac size, which leads to improved pump efficiency. [28]

1.5.6. Cardiac glycosides

Digoxin, the most used cardiac glycosides, is 65–80% absorbed after oral administration. Once present in the blood, all cardiac glycosides are widely distributed to tissues, including the central nervous system [28]. A Cochrane review has shown a 64% improvement in symptoms and a 23% reduction in hospitalisation for patients receiving digoxin (digitalis). Digoxin did not improve survival. Evidence of benefit must be weighed against the possibility of an increase in sudden deaths associated with digoxin. The risk of digoxin toxicity is increased by hypokalaemia. In patients with heart failure and atrial fibrillation a beta blocker is preferred for control of the ventricular rate, though digoxin may be used initially while the beta blocker is being introduced [32].

1.5.6.1. Mechanism of action of Cardiac glycosides

Cardiac glycosides increase contraction of the cardiac sarcomere by increasing the free calcium concentration in the vicinity of the contractile proteins during systole. [25]

1.5.7. Hydralazine and isosorbide dinitrate

The combination of hydralazine and isosorbide dinitrate (H-ISDN) was shown to reduce mortality in patients with heart failure before ACE inhibitors were introduced. It was found to be less effective than an ACE inhibitor in a subsequent head-to-head comparison with enalapril [33]. Hydralazine and isosorbide dinitrate have been shown to reduce symptoms and the risk of death and hospital admissions for heart failure when added to standard treatment in African-Americans with NYHA class III or IV CHF. In Caucasian patients the main indication for H-ISDN is intolerance of an ACE inhibitor and ARB due to renal dysfunction or hyperkalaemia. Vasodilator adverse effects are common and, rarely, hydralazine can cause a lupus-like syndrome [34].

1.5.7.1. Mechanism of action of Hydralazine

Unknown but acts directly on smooth muscle cells to cause vasodilatation. It reduces blood pressure causing reflex tachycardia and increase cardiac output [25].

1.5.7.2. Mechanism of action if Isosorbide dinitrate

It is converted to nitric oxide that act on smooth muscle causing vasodilatation and reduces both preload, after load and oxygen demand [25].

1.6. Statement of the problem

Heart failure is a chronic, progressive disease characterized by frequent hospital admissions and high mortality rates [35]. The primary goals of improving disease management in patients with heart failure are optimization of the pharmacological therapy and improving adherence to medication and lifestyle. Medication such as angiotensin converting enzyme inhibitors and β-blockers are well established in the treatment of CCF to reducing mortality [36]. Despite pharmacotherapy, outcomes for patients remain poor and frequent hospitalizations remain necessary [37]. For example, in USA, the proportional of hospitalisation is much higher in African Americans, Hispanics and Native Americans compared to Caucasian Americans and has largely been attributed to lack of preventive health care or substandard treatment [38] .In Tanzania, a report by the Ministry of Health ranked congestive heart failure among the top ten diseases contributing to high adult morbidity and mortality[39]. Managing CCF is a challenge because this syndrome is irreversible, requires multiple therapies, treatment is for life and deals with adult patients with poor drug adherence. This syndrome is usually associated with other diseases such as kidney failure, anemia, hypertension, diabetic mellitus and upper respiratory infection [40]. The complexity of management of this syndrome creates a high possibility of ME to occur while treating these patients [41]. ME is not a new problem to the healthcare team [42-43] and there are studies that have investigated the adverse effects of ME that lead to death [44]. In Tanzania very few studies have been done on ME and to best of our knowledge there is no study that associated medication errors with treatment outcome, duration of hospital stay or errors committed by different clinical ranks among inpatients suffering from CCF.

Therefore, this study determined the extent of occurrence of ME in treatment of patients with CCF at the Muhimbili National Hospital in Tanzania. That study also characterized the common medication errors commonly encountered at MNH.

1.7. Rationale

The ratio between medical care givers and the population in developing country like Tanzania is very high. Clinicians are usually overwhelmed by overcrowded patients. Qualities of services provided tend to decrease with minimum doctor patient time. Luck of equipments and low salary further diminishes morale. All the mentioned factors could lead to development of ME in our clinical settings. Optimizing drug therapy can only happen when these errors are pin pointed and recommendations made by the study are established appropriately. This study determined the extent of medication errors within the whole patient care team (prescriber, pharmacist and nurse). Results showed where specific interventions should be implemented to optimize drug therapy and improve the quality of life of these patients.

1.8. Research questions

1.8.1. What types of medication errors are most common in patients admitted at MNH with CCF?

1.8.2. What are the frequencies and incidence of medication error among hospitalized chronic heart failure patients at admission, post admission, during hospital stay and at discharge?

1.8.3. What is the incidence of medication error among hospitalized chronic heart failure patients admitted at MNH?

1.8.4. Do medication errors have an effect on duration of hospital stay?

1.8.5. Does the occurrence of medication error influence treatment outcome?

1.8.6. Is there an association between medication errors and treatment outcome?

1.8.7. Is there an association between commission of medication errors and the rank of attending clinicians?

1.8.8. Do patients with CCF receive non pharmacological life changing advices and what kind of advices?

1.9. Objectives

1.9.1. Broad objective

To determine the incidence, frequencies and types of medication errors among inpatients admitted with chronic heart failure at MNH.

1.9.2. Specific objectives

1.9.2.1. To investigate the types of medication errors in patients admitted at MNH with CCF.

1.9.2.2. To determine the frequencies of medication error among hospitalized chronic heart failure patient at admission, post admission, during hospital stay and at discharge.

1.9.2.3. To determine the incidence of medication error among hospitalized chronic heart failure patients admitted at MNH.

1.9.2.4. To determine the association between medication errors and the duration of hospital stay.

1.9.2.5. To determine the association between medication errors and admission outcome.

1.9.2.6. To determine the association between commission of medication errors and the rank of attending clinicians.

1.9.2.7. To determine whether non pharmacological advice is given to these patients and what kind of advice.

1.10. Hypothesis

Medication errors are common in patients admitted with chronic heart failure and are associated with poor treatment outcome.

CHAPTER TWO

METHODOLOGY

2.1. Study design and setting

This study was a prospective observational study conducted at Mwaisela medical ward at Muhimbili National Hospital (MNH) from the end of March to the beginning of June, 2012. MNH is situated in Dar es Salam. It gives service to population of about 2,497,940 Tanzanians living in Dar es Salam. Referred patients from hospitals, all over Tanzania are attended at MNH.

Mwaisela Medical ward at MNH is divided into units according to the type of disease. Each unit has consultants, specialists (cardiologist in the case of cardiovascular diseases), residents, interns and nurses. So patients admitted for chronic heart failure are usually managed by the cardiovascular diseases unit.

2.2. Study population

This study included 100 adult males and females at MNH diagnosed with the CCF at Mwaisela medical wards.

2.3. Sample size calculation

The sample size was calculated using the formula for estimation of prevalence/incidence. In estimating the sample size (n), three values are used;

2.3.1. Margin of error (e) on the estimate, this study was 0.1 = ±10%

2.3.2. Confidence level (95% confidence)

2.3.3. Proportion (or percentage) of the sample that have (or was expected to develop) the condition of interest was 68% taken from study by Rixt et al [16].

$$N = \frac{(Z^2 \times P \times q)}{E^2}$$

Whereby:

Z (standard normal déviation) =1.96,

P (proportion) = 0.68

q (1-P) = 0.32 and

e (error margin) = 0.1

Therefore, the minimum sample size was calculated to be 84 plus 10% of those who refused to participate in the study gave 93, so up to 100 patients were recruited in this study.

2.4. Personnel for data collection.

The principal investigator in collaboration with three research assistants performed the data collection. Research assistants only recorded data from as they appeared in patient's file, only chief investigator examined the data to determine the presence of medication errors. The personnel recruited as research assistants had a degree of pharmacy (intern pharmacist) but were not employees of Mwaisela medical ward. Under supervision and support of the principal investigator, these intern pharmacists were recruited and trained on the main objectives of the study, importance of each variable and how to use the data collection tool.

Nurses on call did not participate on data collection but were given consent forms present on annex III to recruit participants. They were not made aware that they were also subjects of investigation.

2.5. Ethical considerations

Ethical clearance was requested from the MUHAS ethical review committee before commencement of the study (see ANNEX I). Permission to conduct the study was sought from MNH Authority, head of Internal Medicine Department and head of Cardiology Unit. Patients with chronic heart failure were told about the purpose and importance of the study together with the risks and benefits of participating in the study.

Those who understood and voluntarily agreed to participate were invited to sign an informed consent agreement form and were included into the study. The CRF was filled anonymously i.e no names were mentioned. The respondents were assured that the information collected would be used for the purpose of the study only and not otherwise and would be kept confidential. Only investigators accessed this information, which is protected by password on the computer.

This study was a non invasive study and presented no risk for ethical violation.

2.6. Inclusion criteria

Those patients whose diagnosis was confirmed by the cardiovascular diseases unit were included in the study.

2.7. Exclusion criteria

Those, whose diagnosis of CCF was ruled out by the unit team plus those who refused to sign a consent form were excluded from the study.

2.8. Study procedures

2.8.1. Patient selection and recruitment

As shown by the diagram below; the flow of patients with CCF from emergency department to Mwaisela medical ward where they were enrolled according to inclusion and exclusion criteria of the study.

Once admitted at Mwaisela medical ward, patients were reviewed by admitting clinician and divided into corresponding units based on their diagnosis. The investigator followed up on those patients with the diagnosis of CCF to see if the first diagnosis was confirmed after general or major ward rounds. Only confirmed patients were recruited in the study. Hundred patients were recruited; this was the minimum expected sample size of our study.

Participants were conveniently selected regardless of their age, gender or underlying causes of CCF. They were recruited as they were admitted following the inclusion and exclusion criteria of this study. The nurses on call were provided with a list of patients whose diagnosis of CCF was confirmed together with consent forms and instructed enroll them in the study. Once the consent forms were signed, the investigator or assistants used a special designed case report form (CRF) to extract data on admission (patient history, symptoms and prescription). The investigator assigned a unique reseach number to the consenting patient which was used as the number of their own personal CRF.

2.8.2. Assessment

2.8.2.1. Assessment of prescriber's prescription habits

Prescribers at MNH recorded all the information about patients as history, examinations and diagnosis in their medical files. Treatments are written on prescription slips that are sent together attaches with medical files to the block pharmacist for dispensing. The investigator took the information on the slips as they appeared and used a tool for prescription analysis present on ANNE IV to detect commission errors.

2.8.2.2. Assessing the ability of block pharmacist to detect commission errors after receiving both patients' and prescription slips.

The block pharmacist viewed the patients' files and examined treatment on prescription slips before dispensing. Using a red pen, the block pharmacist ticked on the slips indicating that there was no error on treatment and drugs should be dispensed. Once the required drugs were dispensed, together with patients' files and a copy of prescription slips are sent to the nurse station. The investigator took copies of prescription slips to see whether they were ticked as a go ahead for dispensing or any remarks to the prescriber to make changes on treatments. The investigator observed to see which commission errors the investigator failed to detect.

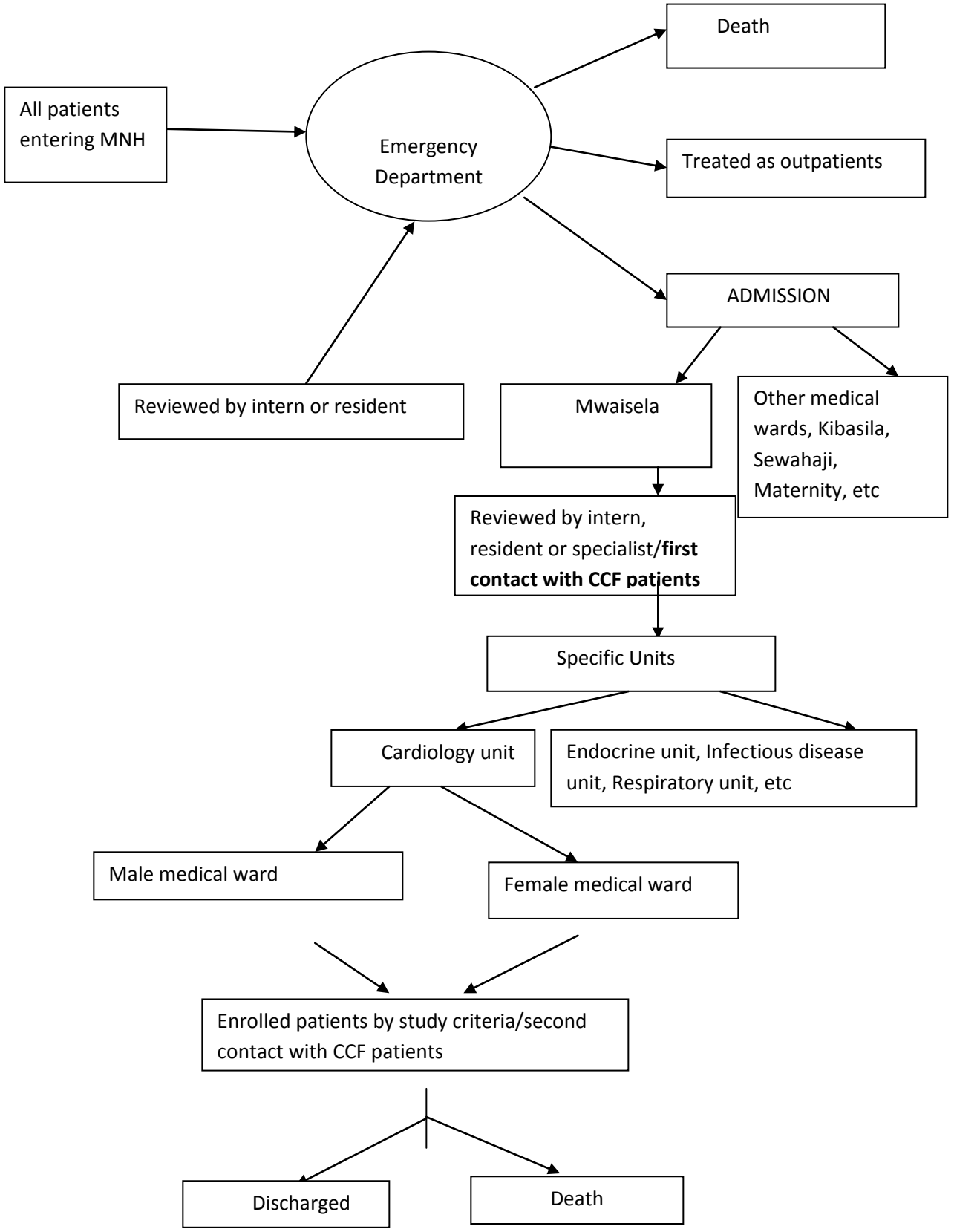
2.8.2.3. Assessing drug charts to detect drug administration errors

Nurses supplied drugs to the patients as specified by prescriber on prescription and record all data of drugs administration on the drug charts. The investigator observed drug charts for any error in drug administration.

2.8.2.4. Assessing the non pharmacological concealing given to patients by nurses or prescribers at discharge.

During discharge, a prescriber wrote a discharge summary on which a prescriber directed nurses on non pharmacological interventions needed to be given to patients. The investigator checked the discharge summary for any written advices and asked patients to confirm if those advices were really given.

Figure 2.8.1: Flow of patients at MNH



2.8.3. Data collection and examining

Every new prescription written was examined to see if any prescription errors were committed. The same was done in every visit (admission, post admission, hospital stay and discharge) made by investigator. Tools for examining prescription errors are present in every data collecting tool for every visit in CRF (see ANNEX IV). These tools also helped the investigator to identify a specific type of prescription error made. In the case of the same prescriber making the same error on different visit, the investigator did not consider that as a new occurrence.

During the hospital stay, the investigator followed up the progress of patients by collecting subjective and objective prognostic information from the patients and their medical records. These records were kept at nurses' station and were always available for the investigator. Any changes on the management was recorded on CRF and using the hospital stay tool (see annex IV), the investigator examined any new prescription, test results and how they influenced management.

The investigator checked the dispensing records (formal MNH prescriptions slips signed by block pharmacist once drugs were dispensed) and compared with the prescribed medicines to confirm whether the drugs dispensed were appropriate or needed a block pharmacist to react by proposing changes to be done by the physician. If the prescription contained a prescription error and the block pharmacist dispensed as written, the investigator recorded that as a dispensing error. Commenting by red pen on prescription slips or patients' medical records before dispensing was considered as appropriate action by the block pharmacist.

Using the hospital stay tool present on CRF (see annex IV), the investigator observed drug charts for determining drug administration errors. The investigator examined the drug charts to see if drugs were administered accordingly with the prescriptions. Any doubts were confirmed by asking patients themselves.

The investigator checked the discharge sheet and recorded date of discharge, management outcome, discharge prescription and non pharmacological advices given to the patients on how to live with chronic heart failure. A tool was used to identify the type of advice given.

Are life modification advices given: Y/N, if Y, what kind:

1- alcohol reduction
2- Smoking
3- Dietary changes
4- Home Daily Weight Monitoring
5- Physical activity
6- Stress reduction
7- Drug adherence

Each participant had more than two prescriptions. Reasons behind this were at medical wards the admitting doctor was usually an intern, the next visit, a cardiology unit passed to review the patient, during the hospital stay tests (CCP, ECG, ECHO) were done and results reviewed. These results influenced on the management and lastly during the discharge of the patients there were usually modifications in prescription so as to encourage better adherence. At all different levels, prescription changed and needed to be examined and followed up.

Every prescription was signed by the prescriber. From the list of prescribers provided by Mwaisela Management, the investigator was able to identify the rank of the prescriber. This information helped the investigator to determine how many prescriptions were written by interns, residents and specialists and later associate with medication errors committed by different ranks.

2.8.4. Clinical staff

The study involved clinical staffs present at cardiology unit during the study. This included intern doctors, residents, block pharmacists and nurses. The study observed what clinical staffs were doing and no data was directly collected from them. All the staffs were rotating according to employees' Muhimbili rotation schedule. The length of data collection (about 2 and half months) allowed only two rotations and that gave a total of 4 intern pharmacists plus their supervisor, 8 intern doctors, 8 residents and 12 nurses from male and female medical wards.

2.9. Data quality control

For the captured data to be reliable and valid during the study measures were taken in order to ensure consistence of data quality. This included translation of the consent form from English to Kiswahili with similar meaning in back translation. As the study targeted different participants with different levels of education, Swahili was used during interviewing the patients and English by investigator to examine errors.

2.10. Study variable

Discrete qualitative data as frequencies of ME in different visits were collected using a tool for recording and examining presence of errors. Analysis of rates was used to calculate incidence of the study as a quantitative binary outcome of two independent groups (with ME and without ME). Continuous binary outcome was observed in the study between the two independent groups in connection with duration of hospital stay. Data was also observed in this study between different ranks of clinicians in association with their commission of error.

The main outcome measures were frequencies of specific medication errors of different types of errors.

2.11. Data management and analysis

Patients were assigned a unique research number. This number was used as a reference to open up special research file (CRF). All the data was transcribed on CRF for each patient and later entered on SPSS software.

Data was analysed using Stata software version 16. Data was summarized using appropriate standard summary statistics. Categorical data was analysed using parametric and non parametric tests where appropriate for example chi square test. T-test and fisher exact test were used to test for associations. Duration of hospital stay between those with ME and those with none was compared.

CHAPTER THREE

RESULTS

3.1. Base line characteristics

A total of 100 inpatients of different age groups were included in the study in which 54% of them were female. Married patients contributed more than 50%, followed by single patients. Among reasons for such high percentage within married patients may be due to stress that could easily progress to hypertension and luck of sufficient funds to regularly purchase medicines that could easily have led to poor drug adherence. A total of 73 patients were previously admitted due to chronic heart failure complications with more than 50% admitted twice as indicated on the table below. This study showed that chronic heart failure patients had high morbidity. Choices of pharmacological therapy have influence on morbidity, for example drugs as digoxin is well known to reduce morbidity despite the fact that has no effect on mortality. During the study, we found out that majority of patients (45%) before admission had a week or more of exacerbation of symptoms. This delay time before admission may have had a negative effect on treatment outcome as it could present a possibility of worsening the heart failure with its complications. Awareness of heart beat and dyspnea at rest were the major reasons for admission among patients with chronic heart failure as indicated on the table below. This may be due to the fact that most admitted patients had chronic heart failure secondary to hypertension (67%) and rheumatic heart disease (23%).

Table 3.1: Base line characteristics

SN	ITEAM	N(%)
1	**Marital status**	
	Single	16(16%)
	Married	70(70%)
	Widowed	6(6%)
	Divorced	8(8%)
2	**Number of previous admissions**	
	Once	25(34%)
	Twice	42(57.5%)
	Three times	5(7%)
	Four times	1(1.3%)
3	**Duration of exacerbation of symptoms before admissions**	
	One day ago	3(3%)
	Two days ago	6(6%)
	Three days ago	24(24%)
	Five days ago	22(22%)
	Seven days ago or more	45(45%)
4	**Admitting symptoms**	
	Fever	17(3.3%)
	Awareness of heart beat	91(17.4%)
	Headache	48(9.2%)
	Dyspnea at rest	94(18%)
	Lower limp edema	68(13%)
	Orthopnea	81(15.5%)
	Ana sacra	32(6.1%)
	As cites	31(5.9%)
	Abdominal pain	35(6.7%)

3.2. Incidence of medication error

During a follow up of 201 person days, 71 patients were observed with medication error. The incidence of medication error in this study was 0.35 or 35 patients with at least one medication error per 100 person days of observation.

3.3. Frequencies of medication error

Most of medication errors were due to prescription errors (80.2%) throughout all the visits, followed by drug dispensing errors and lastly by drug administration errors as indicated at table 3.1. Admission was where most of prescription errors occurred; this may be due to the fact that admitting clinicians were mostly interns.

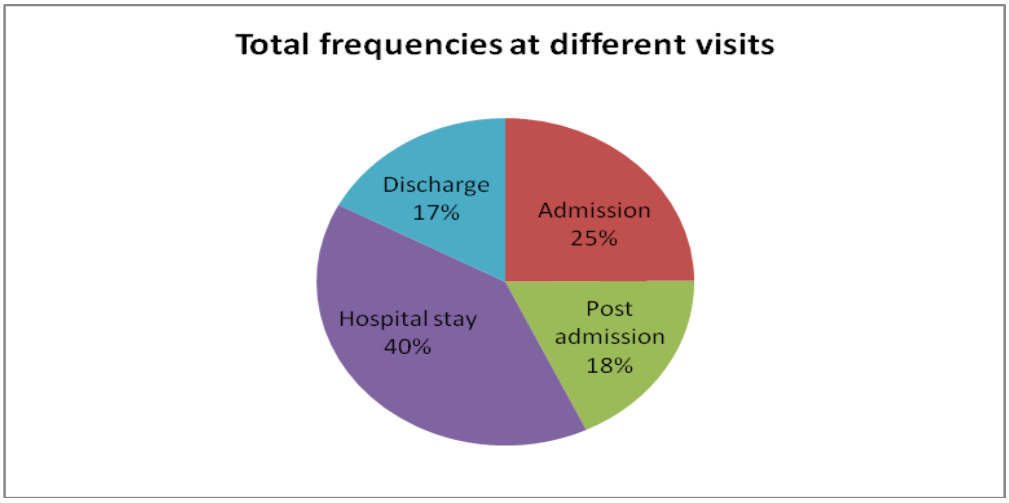
Table 3.3: Frequencies of medication errors at different visits

	visits					
	***Adm.**	**Post Adm.**	****Hosp. stay**	**Discharge.**	**Total**	**%**
Prescription errors	110	80	91	76	357	80.2
Drug administration error	0	0	17	0	17	4
Drug dispensing error	0	0	71	0	71	16

Admission** ****Hosp.: Hospital

As indicated below, frequencies of medication errors were mostly observed during hospital stay compared to other visits.

Figure 3.3: Total frequencies of medication error at different visits



3.4. Types of medication errors.

Commission errors were the errors of interest in our study. Most common commission errors observed in the study were potential drug and drug and drug and abnormal electrolyte interactions with the least common being potential drug and disease interactions as indicated on figure 3.4.1.

Figure 3.4.1: Commission errors

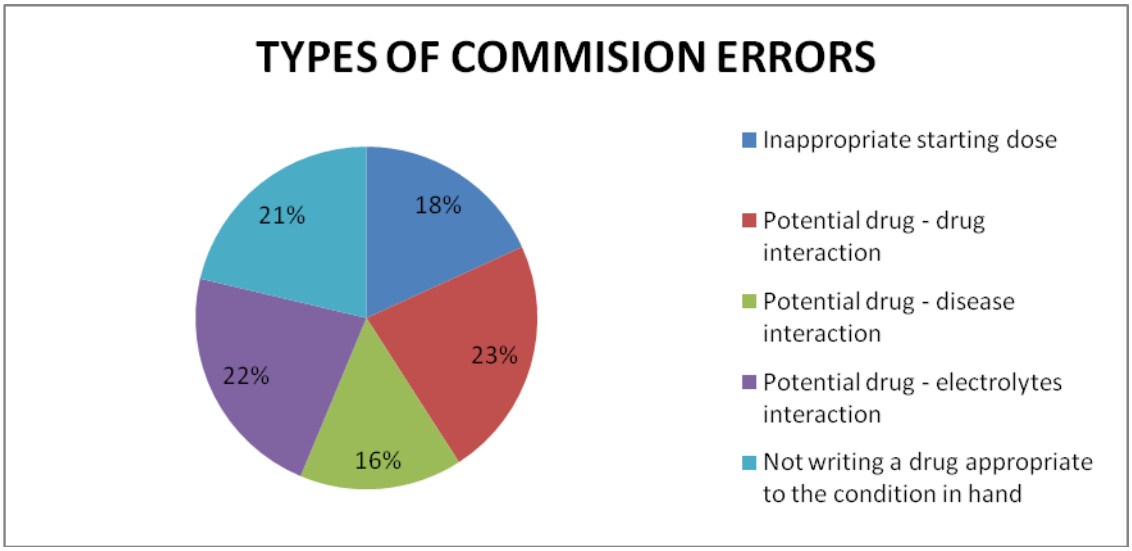


Table 3.4.1: Elaboration on specific type of commission errors

SN	Specific type of error	Elaboration	Drugs involved
1	Inappropriate starting dose	Due to adverse effects such as postural hypotension, some drugs are given at lower starting doses and increased weekly up to normal doses. Chronic heart failure patients taking ACEI are advised to lie in bed so as to avoid falling down.	beta blockers as carvedilol (3.125mg) and ACEI as captopril (6.25-12.5mg)
2	Potential drug and drug interactions	Two or more drugs were written together that could have lead to harmful consequences. digoxin with spironolactone or ACEI in hyperkalemic patient with no reduction in dosage or measures to change the condition. digoxin with loop diuretics in hypokalemic patients with no addition of potassium supplements or dosage adjustments.	digoxin with spironolactone or ACEI in hyperkalemia digoxin with loop diuretics in hypokalemia

3	Potential drug and disease interactions	Cases of drugs written contraindicated to conditions or diseases kidney disease with spironolactone without withdrawal it. digoxin in renal failure without dose adjustment verapamil and dialtizem in patients with mitral valve prolapsed who rarely require medications and if medication is needed, the drug of choice is propranolol 20mg once daily tramadol as a derivative of narcotic should not have been used in patients with chronic constipation.	kidney disease with spironolactone digoxin in renal failure without dose adjustment verapamil and dialtizem in mitral valve prolapsed tramadol in chronic constipation.
4	Potential drug and abnormal electrolyte interactions	a drug was written that had a potential of causing toxicity due to high or low presence of certain electrolyte. hyperkalemic patients are given digoxin, spironolactone or/and ACEI with no measures taken to correct the condition. hypokalemic patient is given digoxin or loop diuretics without	ACEI and hyperkalemia digoxin or loop diuretics in hypokalemia

		dose reduction or measures to correct the condition could lead to toxic effects as arrhythmia.	
5	Not writing a drug appropriate to the condition at hand	cases of drug of choices not written to appropriate condition not writing ACEI, beta blockers and spironolactone antagonist when the patient with CCF is conscious and stable and no contraindications are present. not writing statins for hypercholesteronic patients loop diuretics for those with edema phosphodiesterase inhibitors reduces pulmonary pressure. digoxin is considered as a drug of choice when CCF is accompanied with atrial fibrillation.	 Captopril, Carvedilol and spironolactone antagonist statins in hypercholesteromia loop diuretics in edema phosphodiesterase inhibitors in pulmonary edema/hypertension digoxin and atrial fibrillation

Table 3.4.2: Specific commission errors

Medication errors	**N (%) of ME**	**Indication for mentioned drugs**
Inappropriate starting dose		
ACEI	56(86.1%)	Chronic cardiac failure
Beta blocker	9(13.8%)	Chronic cardiac failure
Use of drugs with interaction potential		
Digoxin and Spironolactone	27(33.7%)	Chronic cardiac failure and hyperkalemia
Digoxin and ACEI	31(38.3%)	Chronic cardiac failure and hyperkalemia
Digoxin and Loop diuretics	14(17.3%)	Chronic cardiac failure and hypokalemia
Digoxin and macrolide	7(8.6%)	Chronic cardiac failure and kidney disease
Spironolactone and macrolide	2(2.47%)	Chronic cardiac failure and kidney disease
Use of drugs with drug disease interaction potential		
Digoxin and kidney disease	16(29.1%)	Chronic cardiac failure
Spironolactone and kidney disease	19(34.5%)	Chronic cardiac failure
Beta blocker and asthma	4(7.4%)	Chronic cardiac failure
Tramadol and constipation	6(11%)	Chronic cardiac failure
Verapamil and MVP	5(9.1%)	Chronic cardiac failure
Dialtizem and MVP	5(9.1%)	Chronic cardiac failure
Use of drugs with drug abnormal electrolyte interaction potential		
Digoxin and *hyperkalemia	15(18.7%)	Chronic cardiac failure
Digoxin and **hypokalemia	12(15%)	Chronic cardiac failure
ACEI and hyperkalemia	20(25.3%)	Chronic cardiac failure
Spironolactone and hyperkalemia	13(16.3%)	Chronic cardiac failure
Loop diuretics and hypokalemia	6(7.5%)	Chronic cardiac failure

Loop diuretics and ***hyponatremia	14(17.5%)	Chronic cardiac failure
Drug of choice appropriate to condition not written		
ACEI	25(32.8%)	Chronic cardiac failure
Beta Blocker	17(22.3%)	Chronic cardiac failure
Phosphodiestarase inhibitor	19(25%)	Chronic cardiac failure and pulmonary
Spironolactone	8(10.1%)	oedema
Digoxin	3(3.9%)	Chronic cardiac failure
Loop diuretics	2(2.6%)	Chronic cardiac failure and atrial
Statins	2(2.6%)	fibrillation
		Chronic cardiac failure and oedema
		Chronic cardiac failure and hypercholesterolemia

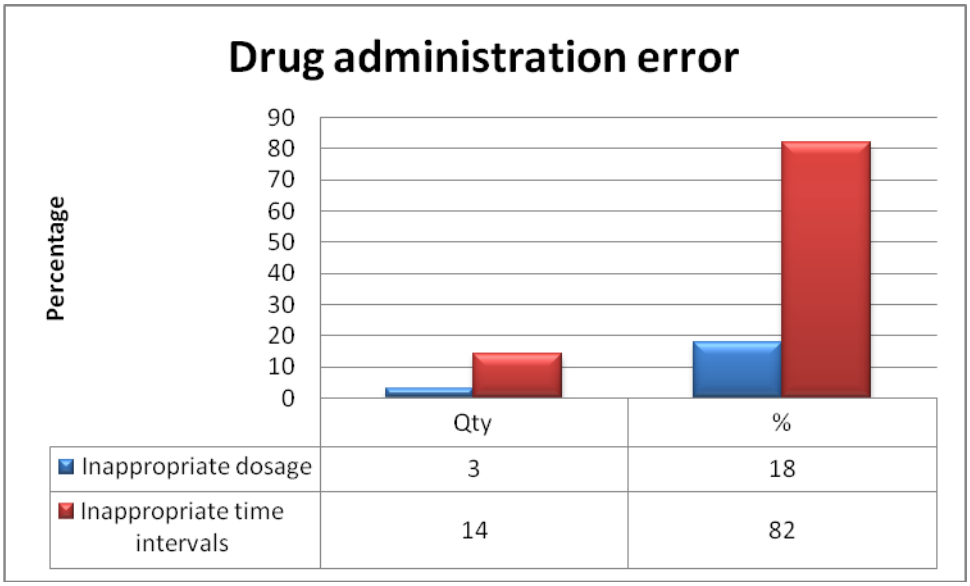
* Hyperkalemia value: > 6 meg/l **Hypokalemia value: < 3 meg/l

***Hyponatremia value: < 135 meg/l

3.5. Drug administration errors

Errors associated with dosing time intervals was most common among other type of drug administration error as indicated on figure. These cases were observed during the study when a nurse gave a right drug but at different time intervals from that indicated by the clinicians. For example, drugs such as isosorbide mononitrate and hydralazine that are usually prescribed three times daily are given two times daily. The least type of drug administration error as indicated on the figure was due to inappropriate dosage error. Inappropriate dosage error was observed when a nurse gave a patient another dosage different form the one indicated by the clinician. For example, a clinician increases the dosage of isosorbide mononitrate from 10mg to 20mg in patient with resistant HTN crisis but the nurse still gave the previous dosage.

Figure 3.5: Drug administration errors



3.6. Ability of block pharmacist to detect errors

Drug dispensing error contributed only 16% of the total frequencies of medication errors. However, the study showed that there was 100% inability of a block pharmacist to detect the five types of commission errors present in all the 71 patients with medication errors. Table 3.6 shows the amount of commission errors not detected during the hospital stay visit with error 4 dominating among others.

Table 3.6: Ability of block pharmacist to detect commission errors

	Error 1*	**Error 2****	**Error 3*****	**Error 4^**	**Error 5^^**
Total error	65	81	55	85	76
Amount not detected by block pharmacist	15	11	7	40	18
Percentage not detected	23.1%	13.6%	12.7%	45.5%	23.7%

1*: Inappropriate starting dose 2**: Potential drug and drug interactions 3***: Potential drug and disease interactions 4^: Potential drug and abnormal electrolyte interactions5^^: Not writing a drug appropriate with the condition at hand.

3.7. The association between medication errors and the duration of hospital stay.

The study showed the mean duration of hospital days of patients with medication error was significant higher (P = 0.011, 95%CI 5.1 8.45; two sided t test) compared to those without medication error. Table 3.7 shows the association between medication errors and duration of hospital stay.

Table 3.7: Association between medication errors and duration of hospital stay

Group	No. of patients	Mean days of stay	[95% Conf. Interval]
Without medication error	29	6.75	5.1 8.45
With medication error	71	11.2	8.87 13.5
P = 0.011			

3.8. The association between medication errors and treatment outcomes

In the entire treatment outcomes observed from the study, proportions of patients with medication errors were more than those without. ME on mortality was 82% as indicated on table 3.8a. By observing the table below, there may be an association between patients who were alive and those who died in term of medication errors, however the association was not significant (P value = 0.502). While comparing between patients who were discharged with symptoms and those without in tern of medication errors, we found it to be statistically significant as indicated below on table 3.8b.

Table 3.8a: Admission outcome

Admission outcome	Without medication error	With medication error	Total
death	2 (18.2%)	9(82%)	11
alive	27(30.3%)	62(70%)	89
Total	29	71	100
P value = 0.502			

Table 3.8b: Admission outcome

Admission outcome	Without medication error	With medication error	Total
Discharge with symptoms	2(7%)	27(93.1%)	29
Discharge without symptoms	25(42%)	35(58%)	60
Total	27	62	89
P value = 0.001			

3.9. The association between commission of medication errors and the rank of attending clinicians.

The results from our study suggested interns contributed to more than 50% of medication errors followed by residents and lastly specialists. Using the Pearson chi square test, this study compared the overall proportions of commission errors in different clinical ranks and found out that the difference was statistically significant as indicated on table 3.9a. This study suggested that specialists (cardiologists) are less likely to commit prescription errors compared to both intern and residences.

Table 3.9a: Commission of medication error by different clinical ranks

Clinician ranks				
Medication error	**Interns**	**Residents**	**Specialists**	**Total**
no	52 (50.5%)	33 (32%)	18 (17.5%)	103
yes	129 (58.4%)	89 (40.3%)	3 (1.4%)	221
Total	181	122	21	324
P value = 0.000				

The study went further to investigate different ranks of clinicians in relation to specific types of commission errors made. The results were the same as the overall; most errors were committed by interns, then residents and lastly specialists. The highest percentages (>60%) of commission errors committed by interns were with error 7 and 8 while the highest percentages (>40%) among residents were with error 9 and 11 as indicated on table 3.9b.

Table 3.9b: Commission of specific types of errors by different clinical ranks

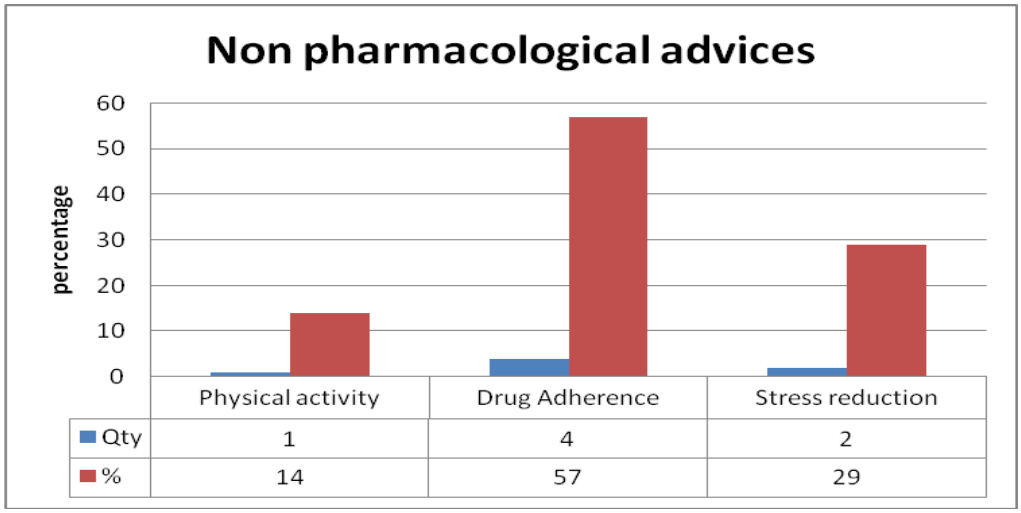
	Clinician ranks			
Commission error	**Interns(181)**	**Residents(122)**	**Specialists(21)**	**Total**
Error 1*	41 (64.1%)	23 (36%)	0	64
Error 2**	50 (62%)	30 (37%)	1 (1.23%)	81
Error 3***	26 (53.1%)	23 (47%)	0	49
Error 4^	48 (59.3%)	32 (40%)	1 (1.23%)	81
Error 5^^	45 (58.4%)	31 (40.3%)	1 (1.3%)	77
Total	210 (59.6%)	139 (39.5%)	3 (0.85%)	352

1*: Inappropriate starting dose 2**: Potential drug and drug interactions 3***: Potential drug and disease interactions 4^: Potential drug and electrolyte interactions5^^: Not writing a drug appropriate with the condition at hand.

3.10. Non pharmacological advice.

Majority of patients show that they did not receive non pharmacological management advices on how to live with chronic heart failure. Only 7.87% received advices while the remaining 92.13% did not. The range between the two percentages is extremely wide indicating luck of proper counseling. The highest percentage was drug adherence as figure 3.11 shows.

Figure 3.10: Types of non pharmacological advices



CHAPTER FOUR

DISCUSSION

This study investigates the occurrence of different types of medication errors in patients admitted with chronic heart failure at MNH. The incidence of medication error in this study is high (35 per 100 person days). This means that on average 35% of patients admitted at MNH with chronic heart failure would have at least one medication error. This incidence is fairly high. If this study was to be conducted hundred times, the incidence would fall between the range of 30% and 41%. This shows a fairly good precision in conducting this study. A study by Daniel R. [45] on adverse events in hospitals estimates 9.6% or 69 per 1000 person days of hospitalized patients experienced adverse events during their hospital stays. Comparing to the other study, our study has a higher incidence of medication errors. The term "adverse event" describes harm to a patient as a result of medical care, such as infection associated with use of a catheter. While our study observes clinic personnel as they commit errors, this study concentrates on medical events that occur as a result of errors such as hypoglycemic, hypotension, dizziness, cardiac arrhythmia, etc. The high percentage in our study could be because most errors studied have potential to cause harm and not necessarily resulting in harming patients.

Our study observes that 80.2% of all medication errors were due to prescription errors. A study by Rixt et al [16] investigates the effect of a discharge service by a clinical pharmacist on the occurrence of prescription errors observes 68% errors in a population of heart failure patients. These percentages are not far apart, mostly due to the fact that both studies are designed to capture the common type of medication errors which is prescription errors.

For the purpose of optimizing drug therapy, this study takes into account the potential serious type of prescription errors (commission errors) and other types of medication errors such as drug administration and drug dispensing errors. The block pharmacist at Mwaisela is responsible for dispensing drugs after gone through patients' files. The percentage of prescription errors not detected by the block pharmacist in this study is

extremely high as no measures are taken by the block pharmacist in correcting any of commission errors. In a study done by Rixt et al [16], 29% of prescription errors are detected by clinical pharmacist. The high value in our study suggests that block pharmacist at Mwaisela medical wards have inadequate knowledge in pharmacological management of chronic cardiac failure as no corrective action were taken on the 5 types of commission errors.

Drug administration errors are also observed in this study. Our results suggest that most administration errors were due to drugs not given at appropriate time intervals (82.4%). This was mostly due to the nurses' daily routine of giving drugs twice a day. Therefore, most drugs which required dose frequency of more than twice daily (12 hourly) could easily lead to an error. In a study by Karen McBride et al [46] inappropriate time intervals was only 26%. The wide range of differences between the two percentages may be due to the fact that our clinical settings in developing countries are poorly equipped with both equipments and human resources. The study shows that inappropriate dosage error is 17.6%, mostly due to regular changes of prescriptions by clinicians. Patients may not respond well, so an increase or decrease of dose may be required and the changes are sometimes missed by nurses. Proper communication and documentation should be done between clinicians and nurses to reduce drug administration errors.

Drugs as ACEIs and Beta Blockers are considered drug of choices at all different stages of CCF. In our study, 21.3% of patients with medication errors are not prescribed with the drug of choice and 33% of all cases among them are due to ACEI, and other 86.1% cases of those who don't receive drug of choice, receive inappropriate starting dose of ACEIs. This percentage of events is almost the same as in the study by Abdulla Asali et al [47] that conclude only 68.3% of heart failure patients are prescribed with ACEI. This finding could suggest that the importance of ACEIs in CCF management is not clearly understood among clinicians, especially interns and residents. This calls for immediate training and supervision. In large trials, ACEIs are clearly been found to improve survival, functional capacity and to reduce the need for hospitalization when given to CCF patients. Despite the importance of these drugs, a study by CONSENSUS Trial

Study Group [48] concludes that these drugs are underutilized and, when used, the correct dose is not prescribed.

The percentage of patients who are not prescribed with drugs of choices is 21.3%. Among these patients, 22.3% of cases are due to beta blockers and other 14% cases of those who are not prescribed with drugs of choices receive inappropriate starting dose. This percentage of events is lower than in the study by Abdulla Asali et al [47] that concludes 51.6% of CCF patients are prescribed β-blockers, and the majority of those are not on the recommended target dose. This could mean that clinicians at Muhimbili National Hospital are aware of the importance of beta blockers on treating CCF. Beta blockers are found to reduce mortality and frequency of hospital admissions when given to stable patients with CCF at all different stages unless contraindicated. A study by Waagstein et al [49] shows that β-blockers improve left ventricular ejection fraction by 25% in CCF patients.

Aldosterone receptor antagonists as Spironolactone are used in CCF alongside ACEIs at low dose of 25mg daily [50]. A side effect of using this drug is hyperkalemia and this could be the reason why some clinicians avoid using it. In our study, patients who do not have hyperkalemia and who are prescribed with ACEI, 10.1% of them are not prescribed spironolactone. In a Randomized Aldosterone Evaluation Study (RALES) by Pitt at al [51] reports the beneficial effects of aldosterone receptor blockade on progressive chronic heart failure when used alongside ACEIs. Significant hyperkalemia is rare, which is attributed to the relatively low dose of spironolactone used of 25mg daily. Clinicians at Muhimbili National Hospital may refrain from using this drug due to the fact that most of laboratory tests are not available on time to aid them during prescribing.

Appropriate starting dose is an important concept in chronic heart failure management. The British National Formulary [50] states that chronic heart failure medications such as beta blockers and ACEIs should be started on lower doses due to their adverse events. The dose can then be increased weekly slowly. This study shows 18.2% of all commission errors are due to inappropriate starting doses. This could be that clinicians

at MNH are not aware of the potential danger of starting a drug like carvedilol and captopril on high dose. During the study, more than 5% of patients receiving high dose of ACEIs (Tablet Captopril 25mg once daily or more) with loop diuretics fell on their way to the bathroom due to the postural hypotensive effect. Proper and precise training is required to educate clinicians on the importance of appropriate dose at right time.

Pulmonary arterial hypertension (PAH) is among the illnesses associated with CCF. A study by Weissman et al [52] shows that phosphodiesterase type-5 inhibitors (sildenafil and tadalafil) reduce the increase in pulmonary vascular resistance and cause vasodilatation in CCF patients. However, our study observes that 25% of all patients with pulmonary hypertension are not managed with phophodiesterase inhibitor. These findings may indicate lack of awareness of many clinicians to phosphodiesterase inhibitors as preventive against life threatening pulmonary hypertension for patients with pulmonary edema. Journals presentations should be arranged by the cardiology units to educate both interns and residents on the importance of these drugs.

Potential drug interactions (drug and drug, drug and disease, drug and abnormal electrolyte) can cause serious adverse reactions and innumerable harm. In our study, we observe 97.5%, 29.1% and 33.7% of all potential drug and drug interactions, potential drug and disease interactions and potential drug and abnormal electrolyte interactions respectively are as a result of digoxin involvement alone. These high percentages of digoxin inappropriate use in our study suggest that clinicians give more priority to a drug that reduce morbidity but not mortality. A study by the Digitalis Investigation Group [53] found that digoxin decreased the need for admissions, but did not reduce mortality when given to patients with chronic heart failure. There seem to be false notion that implies digoxin is the drug of choice in CCF. It is only preferred when CCF is accompanied with atrial fibrillation. Digoxin is usually used as an add-on therapy [38] when a patient with CCF does not respond with all other heart failure medications.

The highest percentage of potential drug and drug interactions (38.3%) is a result of digoxin and ACEI interaction. Under normal conditions digoxin (0.25mg per day) and ACEI (25mg per day) may not cause digitalis toxicity. Cleant et al. [55] shows a 20%

increase in the mean serum digoxin level of a group of patients suffering from CCF after the addition of captopril to the treatment regimen. This increase is not enough to exceed the upper limit of 2.0ng/ml. Nevertheless, a kidney impairment and electrolyte imbalance may be sufficient factors for this combination to cause cardiac toxicity. A study by Meng-Ting et al [55] provides empirical evidence that a digoxin–loop diuretic interaction increases the risk of hospitalization for digoxin intoxication in CCF patients. The risk was particularly high for concomitant use of digoxin with a combination of loop diuretics (Furosamide) and potassium-sparing diuretics (Spironolactone). Our study shows potential drug and drug interaction in 17.3% as a result of digoxin and loop diuretics interactions and 33.7% in digoxin and spironolactone interactions. The combined use of digoxin and loop diuretics should be avoided if possible. These percentages further show the inappropriate use of digoxin at Muhimbili National Hospital.

Most cases of potential drug and abnormal electrolyte interactions are due to hyperkalemia. This study shows that of all potential drug and abnormal electrolyte interactions, 70.5% are as a result of hyperkalemia. This again could be due to the fact that laboratory tests are not available on time to aid clinicians on prescribing or clinicians do not pay attention to laboratory results. A study by Omalhassan Amir et al [56] reports that Cardiac patients receiving ACEIs concomitantly with potentially interacting drugs (digoxin, sprinolactone) are at high risk of experiencing hyperkalemia. Old age, renal disease, hepatic disease, and receiving large number of medications are factors that may significantly increase the vulnerability towards this adverse outcome; thus, frequent monitoring is advocated.

During the study, the investigator could not be present at all sites at discharge to capture all the verbal non pharmacological advices given to patients. Therefore, written advices by clinicians are also considered. This could have effect on the results as some advices may have been given but not written or vice versa. Non pharmacological treatment reduces both mortality and morbidity [57]. Our study reports that only 7% of patients receive non pharmacological advices and among them, 57% receive drug compliance

advices. This overall percentage is very low and could mean that hospital staffs do not take non pharmacological management as part of treatment in these patients. Other reasons may be lack of staff motivation and low ratio between staff and patient at Mwaisela. A study by Cline et al [58] shows that long term compliance in patients with CCF is poor, with overall non-compliance rates ranging from 42% to 64%. This is almost the same as in our study. There is a sudden need to create awareness for both patients and hospital staff on the importance of non pharmacological management of CCF patients.

A study done by Moura et al [59] concludes that medication errors as drug and drug interactions prolong duration of stay at the intensive care unit. Our study also suggests that those patients with medication errors have higher means of 11 versus 7 days of hospital stay compared to those in whom medication error did not occur. Therefore, medication errors could be one of the reasons of overcrowded medical wards and increase financial spending at MNH. Another reason may be due to delaying time before admission as shown by this study that almost half of patients stayed at home for a week or more as their symptoms got worse. For a chronic disease as CCF, the delayed time could give rise to complications that may be difficult to treat. Another reason may be due to long duration antibiotics drug regimens (benzyl penicillin plus gentamycin injections for 6 weeks) in patients with mild to severe rheumatic heart disease and another reason may be due to how the disease responds to drugs as in the cases of drug resistant hypertensive patients that required long term treatment before the blood pressure returned to normal.

In a study done by Monica et al [60] concludes that medication errors are not only prevalent, but are associated with serious harm and even death. Although the difference of medication error on mortality was not significant, the study observed a higher tendency of errors in mortality. This study was not designed to capture mortality, so no strong conclusions can be drawn. When it came to compare between those discharged with symptoms and those without in term of medication errors, the results show high percentages of medication errors in those with symptoms and the difference between

them is statistically significant. Medication errors could be one of the factor effecting treatment outcome, others might have been patients delay admissions until their symptoms got worse, severity of diseases, delay tests (ECHO, ECG, Complete chemistry panel and full blood picture) which limit the clinicians from prescribing and lack of enough space to accommodate all patients which put pressure on clinicians to discharge patients with their symptoms to make room for others who are in worse conditions.

The results of this study also suggest that junior clinicians make more errors than senior clinicians. Most of errors are made by interns and residents compared to specialists (cardiologists).This could be due to the fact both of them are students and still need more training in the optimum management of patients with CCF. However, the results of this study on this objective cannot be generalized due to a small sample size of clinicians investigated. At Mwaisela medical ward, interns and residents rotate at particular unit such as cardiology for a period of two months. This study took 71 days and involved four medical wards at Mwaisela which means that 8 interns and 8 residents were investigated. This sample of clinicians is too small to generalize the conclusion of this objective. There is a scarcity of published data on this particular topic which further support the need for further research.

There are some limitations that are observed during the study. Due to the absence of enough research assistances, the chief investigator could not be present all the time a patient was discharge and so was impossible to capture all the verbal non pharmacological advices given to patients. Therefore the investigator interviewed patients that were considered for discharge and when that was not possible the investigator checked clinician's discharge summary to see if in fact the advices were written or not. The results on the association between commission of medication errors and the rank of attending clinicians cannot be generalized. The sample size of both interns and residents are too small to make a general conclusion. The same can be said on the result of the ability of block pharmacist to detect medication errors. Mortality was a rare outcome in the study; a bigger sample size is needed to investigate the effect of medication errors on mortality. Lastly, the investigator followed up on drug

administration error and drug dispensing error only during the hospital stay. Since this visit was the longest for most patients, the investigator had enough time to examine the ability of block pharmacist to detect prescription errors and to observe the routine of nurses as they provided medications. The length of time between admission and post admission could be a day or several hours. During this time, a prescription could be changed by a senior clinician without drugs being dispensed or administered. Therefore, the investigator could not rely on these two visits to get valuable data for the two mentioned types of medication error

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1. CONCLUSION

From the study, it can be concluded that the incidence of medication error is fairly high. Of all 100 recruited patients, 71% have at least one medication error. Controlling for such errors may lead to improvement in patient care. The pattern of ME suggests that prescription errors were the major type of error. Of these prescription errors, errors leading to drug and drug interactions (23%), drug with abnormal electrolyte interactions (22%) and drug of choice appropriate to the condition not written (21%) are the most common. On time or complete unavailability of laboratory results could be one of the sources of ME. About 25% of patients in this study do not have test results despite of being ordered by prescriber. The high percentages of errors committed by interns (58.4%) and residents (40.3%) compared to specialists are due to the fact that they are the ones who are most of the time present at the clinical wards. Therefore, proper supervision from specialist could be a contributing factor to the occurrence of errors. Clinicians at MNH need to consider laboratory results while treating these patients. Producing laboratory results on time may be necessary to avoid these interactions.

This study shows that clinical pharmacist is very effective in reducing medication. The results of this study show that the hypothesis of the study to be true; medication errors were common in patients admitted with chronic heart failure and were associated with poor treatment outcome.

5.2. RECOMMENDATIONS

The patterns of medication errors suggest the need to improve rational drug therapy at MNH. Appropriate drugs should be given for appropriate conditions for example some drugs with proven clinical benefits appear to be rarely prescribed such as sildenafil for pulmonary hypertension. Appropriate starting and maintenance doses for example ACEIs (captopril) and beta blockers (carvedilol) and drugs should also be given at appropriate time intervals throughout dosage regimen. A high number of potential medication errors are found. Some of these are minor and unlikely to have serious consequences, and some are of great significance and may represent only the tip of iceberg.

The study highlights the need to pay more attention to drug interactions, drug administration, the need for more involvement of clinical pharmacist in patient care. This study help to reduce dispensing errors by 30% on hospital stay alone. The study also highlights importance of raising awareness on non pharmacological management in chronic heart failure patients. Further comprehensive studies of medication error on other chronic diseases are necessary to anticipate the scale of problem. Further studies involving clinicians to find out their opinions on current practice should be undertaken so as to gather useful information for optimizing pharmacological therapy and eventually lead to development of new national guidelines on CCF management.

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7.1. ANNEX I

MUHIMBILI UNIVERSITY OF HEALTH AND ALLIED SCIENCES
DIRECTORATE OF POSTGRADUATE STUDIES

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Ref. No. MU/PGS/SAEC/Vol. VI/191

15th March, 2012

Mr. Abdulhalim M. Mzale,
MSc. Hospital & Clinical Pharm.
MUHAS.

RE: APPROVAL OF ETHICAL CLEARANCE FOR A STUDY TITLED "DETERMINATION OF TYPES AND FREQUENCIES OF MEDICATION ERRORS IN THE MANAGEMENT OF IN-PATIENTS WITH CHRONIC CARDIAC FAILURE AT MUHIMBILI NATIONAL HOSPITAL DAR ES SALAAM"

Reference is made to the above heading.

I am pleased to inform you that, the Chairman has on behalf of the Senate approved ethical clearance for the above-mentioned study.

Thus ethical clearance is granted and you may proceed with the planned study.

Prof. Z. Premji
DIRECTOR, POSTGRADUATE STUDIES

/emm

c.c. Vice Chancellor, MUHAS
c.c. Deputy Vice Chancellor – ARC, MUHAS
c.c. Dean, School of Pharmacy

7.2. ANNEX II

MUHIMBILI UNIVERSITY OF HEALTH AND ALLIED SCIENCES

DIRECTORATE OF RESEARCH AND PUBLICATIONS, MUHAS

INFORMED CONSENT FORM

Research no: ……

Title: Incidence and types of medication error in the management of in patients with chronic heart failure at Muhimbili National Hospital Dar es salam.

Foreword

Greetings! I am……..working on this research project with the aim determining the incidence and **types of medication error in the management of in patients with chronic heart failure at Muhimbili National Hospital Dar es salam.**

Purpose of the Study

The goal of the proposed study is to optimize treatment of patients with chronic heart failure through appropriate drug therapy. This is important in improving quality of life and reducing mortality among these patients. In Tanzania, a report by the Ministry of Health ranked congestive heart failure among the top ten diseases contributing to high adult morbidity and mortality. Managing chronic heart failure is a challenging problem that requires adequate knowledge on pharmacological management and good communication between all the hospital care team. The complexity of management of this syndrome creates a high possibility of medication error to occur while treating these patients. Medication error is not a new problem to the healthcare team and there are studies that have investigated the adverse effects of medication error that lead to death. This study will investigate the management of these patients from admission, hospital stay until discharge. We hope that results from the proposed study will show the magnitude of the problem of medication errors at different levels and recommend

measures to reduce such errors. The study will also look into non pharmacological advice given to these patients and what kind of advice to modify their everyday lives.

How to participate

The interviewer will ask you some questions regarding your health and medications that you have taken. The investigator will use your medical records in your file to determine the progress of management. Forms and check lists will be filled by the investigator. This will done after signing at the end of this informed consent form.

Risks

We do not expect any harm during the course of your participation. No blood will be taken during this process. Moreover there is no any medication or immunization provided so we do not expect any harm will happen to you because of joining this study.

Confidentialiy

We would like to assure you that all the information that you will provide will remain confidential and will be used for research purpose only.no one will be allowed to see or go through your answers except the principle investigator only.

Consent

I have read and understood the explanation of the study. I accept for my child to be examined and participate in the study.

Signature of the Participant/Guardian.....

Signature of the investigator .....

Date.....

For more information or clarification you may contact one of the Doctors mentioned below,

Mr. Mzale A , 0773328007

Dr. Minzi O, 0785892009

Dr. Sasi P, 078436275

7.3. ANNEX III

MUHIMBILI UNIVERSITY OF HEALTH AND ALLIED SCIENCES

DIRECTORATE OF RESEARCH AND PUBLICATIONS, MUHAS

INFORMED CONSENT FORM (FOMU YA MAKUBALIANO)

Nambari ya mshiriki ……

Hali ya matibabu ya wagonjwa waliolazwa na maradhi ya moyo kwenye hospitali ya taifa ya muhimbili, Dar es salaam, Tanzania.

Utangulizi

Habari! Jina langu ni……..Nafanya kazi katika huu utafiti wenye lengo la kuchunguza hali ya matibabu ya wagonjwa waliolazwa na maradhi ya moyo kwenye hospitali ya taifa ya muhimbili, Dar es salaam, Tanzania**.**

Malengo ya utafiti

Madhumuni ya utafiti huu ni kuboresha matibabu ya wagonjwa wanaosumbuliwa na maradhi ya moyo. Wizara ya afya ilitoa ripoti dhidi ya maradhi kumi yanayosababisha vifo zaidi vya watanzania. Maradhi ya moyo yalikuwa miongoni ya orodha hiyo. Matibabu ya maradhi haya yanahitaji ujuzi pamoja na mawasiliano mazuri baina ya kada zote zinazofanya kazi mahospitalini. Imesibitishwa kwamba kuna makosa ambayo yanafanyika wakati wa matibabu. Baadhi ya makosa hayo husababisha ucheleweshaji wa kupata nafuu na hata vifo vya wagonjwa.Utafiti huu una lengo kuu la kuangalia hali ya matibabu ya wagonjwa waliolazwa na maradhi ya moyo kwenye hospitali ya taifa ya muhimbili tokea mapokezi ya wagonjwa kwenye wodi, wakati wanapokuwa wodini na wanapopewa ruhusa. Tunaimani kwamba matokeo ya utafiti huu yataonesha wapi kwenye matatizo ili mbinu mbali mbali zitumike kukosowa makosa hayo na kuboresha huduma yote kwa jumla. Pia kuna lengo la kuangalia Ushauri wanaopewa wagonjwa jinsi vipi wafanye mabadiliko katika maisha yao kupunguza makali ya maradhi hayo.

Jinsi ya kushiriki

Mtafiti atakuuliza maswali kuhusu afya yako na atatumia kumbukumbu zako za hospitali ili kutambua maendeleo ya matibabu. Sehemu zote za maswali zitajazwa na mtafiti mwenyewe. Hii itafanyika mara baada ya wewe kukubali na kusaini mwisho wa fomu hii.

Madhara

Hatutegemei utafiti huu kuwa na madhara yoyote kwako. Utafiti huu hautahusika na kuchukua damu au vipimo vyovyote. Zaidi hakuna dawa au kinga yoyote utakayopewa. Hivyo hakuna mahara yoyote yatayokupata wewe kwa kushiriki katika utafiti huu.

Utunzaji wa Siri

Tunapenda kukuhakikishia kwamba,maelezo yote utakayotoa na yatayochukuliwa kwenye kumbukumbu za hospitali itakuwa siri na yatatumika kwa utafiti tu.Hakuna mtu yoyote atakaye ruhusiwa kusoma majibu na kumbukumbu zako isipokuwa mtafiti mkuu na wasaidizi wake tu.

Nani wa kuwasiliana

Kama una swali lolote kuhusu utafiti huu unaweza kuwasiliana na watu wafuatao:

Mr. Mzale A, 0773328007

Dr. Minzi O, 0785892009

Dr. Sasi P, 078436275

Kukubali

Nimesoma na kuelewa madhumuni ya utafiti huu na nimekubali kushiriki katika utafiti huu.

Sahihi ya Mshiriki : .....

Sahihi ya Mtafiti/Mtafiti msaidizi……..

Tarehe…….

7.4. ANNEX IV

TITTLE OF RESERCH: INCIDENCE AND TYPES OF MEDICATION ERRORS IN THE MANAGEMENT OF INPATIENTS WITH CHRONIC CARDIAC FAILURE AT MUHIMBILI NATIONAL HOSPITAL

DAR-ES-SALAM

By: Mzale A, MPharm student in Hospital and Clinical Pharmacy,

Registration. No: HD/MUH/T.141/2010

Supervisor: Dr. Minzi OMS, MPharm, MSC, PhD, Unit of Pharmacology & Therapeutics, School of Pharmacy, MUHAS.

Co-supervisor: Dr. Sasi P, MD, MMed, PhD, Department of Clinical Pharmacology, School of Medicine, MUHAS.

I- PATIENT INFORMATION AND MEDICAL HISTORY

I-I Identification:

1. Visit No _____ Date _____/____/201___

2. Full Name_____

3. Address:_____

1-II Demography:

5. Date of birth: _____/_____/_____

6. Sex ☐ F ☐ M

7. Marital status ☐ Single ☐ Married ☐ Widowed ☐ Divorced

1-III Other information:

8. Duration of current exacerbation: …….

9. Number of previous hospital admission: …….

1-III: Current symptoms check list

Symptom	No	Yes	Remark	Symptom	No	Yes	Remark
Fever	☐	☐		Awareness of heartbeat	☐	☐	
Jaundice	☐	☐		Fatigue	☐	☐	
Cough	☐	☐		Headache	☐	☐	
Nausea & Vomiting	☐	☐		dyspnea at rest	☐	☐	
LL oedema	☐	☐		Orthopnea	☐	☐	
Anasarca	☐	☐		exercise intolerance	☐	☐	
Ascites	☐	☐		Abnorminal pain	☐	☐	

Other symptoms _____

_____

_____

_____

1-IV Past medical history

Past medical problem	No	Yes	Not recall	Specify status/ Organ/s involved	When?
DM	☐	☐	☐		
KD	☐	☐	☐		
ARRHYTHMIASIS	☐	☐	☐		
ASTHMA	☐	☐	☐		
HIV/AIDS	☐	☐	☐		
ANEMIA	☐	☐	☐		
DCM	☐	☐	☐		
Hx of drug allergy	☐	☐	☐		
RHD	☐	☐	☐		
LIVER DISEASE	☐	☐	☐		
HTN	☐	☐	☐		
Smoking	☐ Current smoker	☐ Ex-smoker	☐ Never smoked		
Significant alcohol intake©	☐	☐			

Key: DM= Diabetic Mellitus , KD = Kidney Disease, DCM = Dilated Cardiomyopathy,

RHD = Rhematoid heart disease, HTN = Hypertension.

© Significant alcohol intake is defined as follows. Hard liquor > 2 days/week or > 3 bottles of beer>

3 days/week or local alcohol > 2days/week the past one month.

Other Past Medical Problems:

1._____ 4. _____

2. _____ 5._____

3. _____ 6. _____

1-V Drug History

8. List medications currently taken including their dosage.

SN	DRUG	DAILY DOSE	START DATE	STOP DATE	ON GOING DOSE
1					
2					
3					
4					
5					

9. Is the patient compliance to the above medications ☐ No ☐ Yes

1- If no indicate the reason

☐ Expensive drugs ☐ Drugs not available ☐ Patient forgets ☐

Prefers herbal drugs ☐

Others: …….

2-I: ADMISSION

(Note: The following forms will be filled. Information from this section will be used together with the admission **checklist to analyse for errors during admission.)**

Date: ……

Diagnosis	**Treatment**	**Information on prescription**		
Diagnosis 1) _____ 2) _____ 3) _____ **Other Diagnoses** _____ _____ _____ **Vital signs** **Temp: _____°C** **BP: _____/_____mmHg** **PR:_____b/min** **RR: _____breaths/min**	**Treatment offered today** 1-…….. …… 2-…… …… 3-…… …… 4-…… …… 5-…….. …….. 6-…… …….. 7-…… …….. 8-…… …….. 9-…… …….. 10-…… …….. 11-…… ……		**No**	**Yes**
		Signature or no. of prescriber.		
		Specify level **1-Intern 2-Residence** **3-Specialist 4-Super specialist**		
		Action taken since admission		
		Are all drugs available for patient at pharmacy? **If no, indicate which drugs are out of stock from treatment offered below.** **No: 1,2,3,4,5,6,7,8,9,10,11**		
		Laboratory parameters ordered **If yes, indicate** **1- CCP** **2- ECG** **3- ECHO** **4- FBP** **5- Other:**		
		Laboratory results available **If yes indicate:** **1.2.3.4.5.**		

ADMISSION

I- PRESCRIPTION EXAMINATION

SN	**A1: Error of Commission: PRESENT / UBSENT, if present which kind of error.**	**Circle**
1.	Starting dose (lower doses in the case of beta blockers ACEI)	**Yes/No**
2.	Drug - drug interaction	**Yes/No**
3.	Drug - disease interaction	**Yes/No**
4.	Drug – lab parameter interaction	**Yes/No**
5	Not writing a drug related to the condition in hand	**Yes/No**

A2: Comment on errors:

……
……
……
……
……

ADMISSION

6. If there is drug and drug interaction in prescription, specify :

SN	Drug		Interactions	Circle
1.	ACEIs	1	Alcohol	Yes/No
		2	ARB	Yes/No
		3	heparin,	Yes/No
		4	Diuretics	Yes/No
		5	Digoxin	Yes/No
		6	NSAID	Yes/No
2.	Beta blockers	7	Rifampicin	Yes/No
		8	Antidiabetics	Yes/No
		9	cardiac glycosides	Yes/No
		10	Corticosteroids	Yes/No
3.	ARB		Same as ACEIs	Yes/No
4.	ALDOSTERONE ANTAGONISTS	11	NSAID,	Yes/No
		12	ARB	Yes/No
		13	clarithromycin, erythromycin	Yes/No
		14	Rifampicin	Yes/No
		15	cardiac glycosides	Yes/No
5.	Diuretics		ACEIs,	Yes/No
		16	ARB	Yes/No
		17	NSAID	Yes/No
		18	Antidiabetics	Yes/No
		19	cardiac glycosides	Yes/No
6.	DIGOXIN		ACEIs,	Yes/No
		20	ARB	Yes/No
		21	Gentamycin	Yes/No
		22	trimethoprim, macrolide	Yes/No
			Beta blockers	Yes/No
		23	Calcium channel blocker	Yes/No
		24	Corticosteroids,	Yes/No
7.	ISOSORBIDE DINITRATE	25	ACEIs,	Yes/No
		26	ARB	Yes/No
		27	Diuretic	Yes/No
		28	beta blocker	Yes/No
		29	NSAID	Yes/No
8.	Dobutamine	20	Digoxin	Yes/No

ADMISSION

7. Is there drug and disease interaction in prescription, Y/N, if yes comment:

SN	Drug	No	Interaction	Circle
1.	**ACEIs**	1	Angio-oedema	**Yes/No**
		2	Renal impairment	**Yes/No**
2.	**Beta blockers**	3	asthma,	**Yes/No**
		4	heart block	**Yes/No**
		5	hypotension,	**Yes/No**
		6	diabetic meliitus	**Yes/No**
3.	**ARBs**	7	Angio-oedema	**Yes/No**
		8	Renal impairment	**Yes/No**
4.	**ALDOSTERONE ANTAGONISTS**	**9**	**renal impairment**	**Yes/No**
		10	**high potassium**	**Yes/No**
		11	Gynaecomastia	**Yes/No**
5.	**Diuretics**	**12**	**Dehydration,**	**Yes/No**
		13	**hypotension,**	**Yes/No**
6.	**DIGOXIN**	**14**	Bradycardia	**Yes/No**
		15	Heartblock,	**Yes/No**
		16	kidney failure.	**Yes/No**
7.	**HYDRALAZINE AND ISOSORBIDE DINITRATE**	**17**	lupus-like syndrome	**Yes/No**
8.	**Dobutamine**	**18**	**CNS disturbance**	**Yes/No**
		19	**Cerebral hemorrhage**	**Yes/No**
		20	**Atrial fibrillation**	**Yes/No**
9.	**Morphine and derivatives**	**21**	**Respiratory depression**	**Yes/No**
		22	**Constipation**	**Yes/No**
		23	**CNS disturbance**	**Yes/No**

2-II: POST ADMISSION

1. ELIGEBILITY

1. Is the patient suffering from acute heart failure ☐ No ☐ Yes
2. Is the diagnosis of chronic heart failure confirmed by the unit team ☐ No ☐ Yes
3. Has the patient agreed to sign the consent form ☐ No ☐ Yes

The patient is eligible for the study only if an answer of Q1 is N, Q2 and Q3 is Y.

POST ADMISSION

(Note: The following forms will be filled. Information from this section will be used together with the post admission checklist to analyse for errors during post admission.)

Date: …… Visit no: ……

Diagnosis	**Treatment**	**Information on prescription**		
Diagnosis 1) _____ 2) _____ 3) _____ **Other Diagnoses** _____ _____ _____ **Vital signs** **Temp: _____°C** **BP: _____/_____mmHg** **PR:_____b/min** **RR: _____breaths/min**	**Treatment offered today** 1-…….. …… 2-…… …… 3-…… …… 4-…… …… 5-…….. …….. 6-…… …….. 7-…… …….. 8-…… …….. 9-…… …….. 10-…… …….. 11-…… ……		**No**	**Yes**
		Signature or no. of prescriber.		
		Specify level **1-Intern 2-Residence** **3-Specialist 4-Super specialist**		
		Action taken since admission		
		Are all drugs available for patient at pharmacy? **If no, indicate which drugs are out of stock from treatment offered below.** **No: 1,2,3,4,5,6,7,8,9,10,11**		
		Laboratory parameters ordered **If yes, indicate** **1- CCP** **2- ECG** **3- ECHO** **4- FBP** **5- Other:**		
		Laboratory results available **If yes indicate:** **1.2.3.4.5.**		

POST ADMISSION

I. POST ADMISSION PRESCRIPTION EXAMINATION

SN	**A1: Error of Commission: PRESENT / UBSENT, if present which kind of error.**	**Circle**
1.	Starting dose (lower doses in the case of beta blockers ACEI)	**Yes/No**
2.	Drug - drug interaction	**Yes/No**
3.	Drug - disease interaction	**Yes/No**
4.	Drug – lab parameter interaction	**Yes/No**
5	Not writing a drug related to the condition in hand	**Yes/No**

A2: Comment on errors:

……
……
……
……
……
……

POST ADMISSION

6. If there is drug and drug interaction in prescription, specify :

SN	Drug		Interactions	Circle
1.	ACEIs	1	Alcohol	Yes/No
		2	ARB	Yes/No
		3	heparin,	Yes/No
		4	Diuretics	Yes/No
		5	Digoxin	Yes/No
		6	NSAID	Yes/No
2.	Beta blockers	7	Rifampicin	Yes/No
		8	Antidiabetics	Yes/No
		9	cardiac glycosides	Yes/No
		10	Corticosteroids	Yes/No
3.	ARB		Same as ACEIs	Yes/No
4.	ALDOSTERONE ANTAGONISTS	11	NSAID,	Yes/No
		12	ARB	Yes/No
		13	clarithromycin, erythromycin	Yes/No
		14	Rifampicin	Yes/No
		15	cardiac glycosides	Yes/No
5.	Diuretics		ACEIs,	Yes/No
		16	ARB	Yes/No
		17	NSAID	Yes/No
		18	Antidiabetics	Yes/No
		19	cardiac glycosides	Yes/No
6.	DIGOXIN		ACEIs,	Yes/No
		20	ARB	Yes/No
		21	Gentamycin	Yes/No
		22	trimethoprim, macrolide	Yes/No
			Beta blockers	Yes/No
		23	Calcium channel blocker	Yes/No
		24	Corticosteroids,	Yes/No
7.	ISOSORBIDE DINITRATE	25	ACEIs,	Yes/No
		26	ARB	Yes/No
		27	Diuretic	Yes/No
		28	beta blocker	Yes/No
		29	NSAID	Yes/No
8.	Dobutamine	20	Digoxin	Yes/No

7. Is there drug and disease interaction in prescription, Y/N, if yes comment:

SN	Drug	No	Interaction	Circle
1.	**ACEIs**	1	Angio-oedema	**Yes/No**
		2	Renal impairment	**Yes/No**
2.	**Beta blockers**	3	asthma,	**Yes/No**
		4	heart block	**Yes/No**
		5	hypotension,	**Yes/No**
		6	diabetic meliitus	**Yes/No**
3.	**ARBs**	7	Angio-oedema	**Yes/No**
		8	Renal impairment	**Yes/No**
				Yes/No
4.	**ALDOSTERONE ANTAGONISTS**	**9**	**renal impairment**	**Yes/No**
		10	**high potassium**	**Yes/No**
		11	Gynaecomastia	**Yes/No**
5.	**Diuretics**	**12**	**Dehydration,**	**Yes/No**
		13	**hypotension,**	**Yes/No**
6.	**DIGOXIN**	**14**	Bradycardia	**Yes/No**
		15	Heartblock,	**Yes/No**
		16	kidney failure.	**Yes/No**
7.	**HYDRALAZINE AND ISOSORBIDE DINITRATE**	**17**	lupus-like syndrome	**Yes/No**
8.	**Dobutamine**	**18**	**CNS disturbance**	**Yes/No**
		19	**Cerebral hemorrhage**	**Yes/No**
		20	**Atrial fibrillation**	**Yes/No**
9.	**Morphine and derivatives**	**21**	**Respiratory depression**	**Yes/No**
		22	**Constipation**	**Yes/No**
		23	**CNS disturbance**	**Yes/No**

2-III: HOSPITAL STAY
Current laboratory parameters: CCP AND FBP

Parameters	Inc.	Dec.	Remark	Parameter	Inc	Dec	Remark
K	☐	☐		ALT	☐	☐	
Na	☐	☐		ALP	☐	☐	
Ca	☐	☐		AST	☐	☐	
TG	☐	☐		HDL	☐	☐	
Cl	☐	☐		Platelets	☐	☐	
Urea	☐	☐		Hgb	☐	☐	
PO4	☐	☐		Neutrophils	☐	☐	
Uric acid	☐	☐		Lymphocytes	☐	☐	
Albumin	☐	☐		Monocytes	☐	☐	
Creatinine	☐	☐		Eosinophils	☐	☐	

Other laboratory parameter _ECG:_____

_____

_ECHO:_____

_____

HOSPITAL STAY

(Note: The following forms will be filled. Information from this section will be used together with the hospital stay checklist to analyse for errors during hospital stay.)

Date: …… Visit no: ……

Diagnosis	**Treatment**	**Information on prescription**		
Diagnosis 1) _____ 2) _____ 3) _____ **Other Diagnoses** _____ _____ _____ **Vital signs** **Temp: _____°C** **BP: _____/_____mmHg** **PR:_____b/min** **RR: _____breaths/min**	**Treatment offered today** 1-…….. …… 2-…… …… 3-…… …… 4-…… …… 5-…….. …….. 6-…… …….. 7-…… …….. 8-…… …….. 9-…… …….. 10-…… …….. 11-…… ……		**No**	**Yes**
		Signature or no. of prescriber.		
		Specify level **1-Intern 2-Residence** **3-Specialist 4-Super specialist**		
		Action taken since admission		
		Are all drugs available for patient at pharmacy? **If no, indicate which drugs are out of stock from treatment offered below.** **No: 1,2,3,4,5,6,7,8,9,10,11**		
		Laboratory parameters ordered **If yes, indicate** **1- CCP** **2- ECG** **3- ECHO** **4- FBP** **5- Other:**		
		Laboratory results available **If yes indicate:** **1.2.3.4.5.**		

HOSPITAL STAY

I. HOSPITAL STAY PRESCRIPTION EXAMINATION

SN	**A1: Error of Commission: PRESENT / UBSENT, if present which kind of error.**	**Circle**
1.	Starting dose (lower doses in the case of beta blockers ACEI)	**Yes/No**
2.	Drug - drug interaction	**Yes/No**
3.	Drug - disease interaction	**Yes/No**
4.	Drug – lab parameter interaction	**Yes/No**
5	Not writing a drug related to the condition in hand	**Yes/No**

A2: Comment on errors:

……
……
……
……
……

HOSPITAL STAY

6. If there is drug and drug interaction in prescription, specify :

SN	Drug		Interactions	Circle
1.	ACEIs	1	Alcohol	Yes/No
		2	ARB	Yes/No
		3	heparin,	Yes/No
		4	Diuretics	Yes/No
		5	Digoxin	Yes/No
		6	NSAID	Yes/No
2.	Beta blockers	7	Rifampicin	Yes/No
		8	Antidiabetics	Yes/No
		9	cardiac glycosides	Yes/No
		10	Corticosteroids	Yes/No
3.	ARB		Same as ACEIs	Yes/No
4.	ALDOSTERONE ANTAGONISTS	11	NSAID,	Yes/No
		12	ARB	Yes/No
		13	clarithromycin, erythromycin	Yes/No
		14	Rifampicin	Yes/No
		15	cardiac glycosides	Yes/No
5.	Diuretics		ACEIs,	Yes/No
		16	ARB	Yes/No
		17	NSAID	Yes/No
		18	Antidiabetics	Yes/No
		19	cardiac glycosides	Yes/No
6.	DIGOXIN		ACEIs,	Yes/No
		20	ARB	Yes/No
		21	Gentamycin	Yes/No
		22	trimethoprim, macrolide	Yes/No
			Beta blockers	Yes/No
		23	Calcium channel blocker	Yes/No
		24	Corticosteroids,	Yes/No
7.	ISOSORBIDE DINITRATE	25	ACEIs,	Yes/No
		26	ARB	Yes/No
		27	Diuretic	Yes/No
		28	beta blocker	Yes/No
		29	NSAID	Yes/No
8.	Dobutamine	20	Digoxin	Yes/No

HOSPITAL STAY

7. Is there drug and disease interaction in prescription, Y/N, if yes comment:

SN	Drug	No	Interaction	Circle
1.	**ACEIs**	1	Angio-oedema	**Yes/No**
		2	Renal impairment	**Yes/No**
2.	**Beta blockers**	3	asthma,	**Yes/No**
		4	heart block	**Yes/No**
		5	hypotension,	**Yes/No**
		6	diabetic meliitus	**Yes/No**
3.	**ARBs**	7	Angio-oedema	**Yes/No**
				Yes/No
		8	Renal impairment	**Yes/No**
				Yes/No
4.	**ALDOSTERONE ANTAGONISTS**	**9**	**renal impairment**	**Yes/No**
		10	**high potassium**	**Yes/No**
		11	Gynaecomastia	**Yes/No**
5.	**Diuretics**	**12**	**Dehydration,**	**Yes/No**
		13	**hypotension,**	**Yes/No**
6.	**DIGOXIN**	**14**	Bradycardia	**Yes/No**
		15	Heartblock,	**Yes/No**
		16	kidney failure.	**Yes/No**
7.	**HYDRALAZINE AND ISOSORBIDE DINITRATE**	**17**	lupus-like syndrome	**Yes/No**
8.	**Dobutamine**	**18**	**CNS disturbance**	**Yes/No**
		19	**Cerebral hemorrhage**	**Yes/No**
		20	**Atrial fibrillation**	**Yes/No**
9.	**Morphine and derivatives**	**21**	**Respiratory depression**	**Yes/No**
		22	**Constipation**	**Yes/No**
		23	**CNS disturbance**	**Yes/No**

HOSPITAL STAY

8. If there is a drug laboratory parameters interaction, comment:

SN	Drug	No	Interactions	Circle
1.	Digoxin	1	High K	Yes/No
		2	Low K	Yes/No
		3	High Ca	Yes/No
		4	Low Mg	Yes/No
2.	ACEIs	5	CrC	Yes/No
		6	High K	Yes/No
3.	Diuretics	7	Low K	Yes/No
		8	High Uric acid	Yes/No
		9	Low Na	Yes/No
4.	Sprinolactone	10	CrC	Yes/No
		11	High K	Yes/No

HOSPITAL STAY

II- DISPENSING BY BLOCK PHARMACIST

A. Did the block pharmacist detect any of the any prescription errors? Y or N,

If Y, What type of errors were identified by block pharmacist?

1-Error of Omission : 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11
2-Error of Commission: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13

III- ADMINISTRATION ANALYSIS

The investigator will observe the drug charts.

i- Is there a wrong drug error Y / N
If yes, which drug(s) on treatment offered: 1.2.3.4.5.6.7.8.9.10.11

ii- Is there a wrong dosage error Y / N
If yes, which drug(s) on treatment offered: 1.2.3.4.5.6.7.8.9.10.11

iii- Is there a wrong route error Y / N
If yes, which drug(s) on treatment offered: 1.2.3.4.5.6.7.8.9.10.11

iv- Is there wrong frequency error Y / N
If yes, which drug(s) on treatment offered: 1.2.3.4.5.6.7.8.9.10.11

2-VIII: HOSPITAL DISCHARGE

(Note: The following forms will be filled. Information from this section will be used together with the discharge checklist to analyse for errors during discharge.)

Date: …… Visit no: ……

Diagnosis	**Treatment**	**Information on prescription**		
Diagnosis 1) _____ 2) _____ 3) _____ **Other Diagnoses** _____ _____ _____ **Vital signs** **Temp: _____°C** **BP: _____/_____mmHg** **PR:_____b/min** **RR: _____breaths/min**	**Treatment offered today** 1-…….. …… 2-…… …… 3-…… …… 4-…… …… 5-…….. …….. 6-…… …….. 7-…… …….. 8-…… …….. 9-…… …….. 10-…… …….. 11-…… ……..		**No**	**Yes**
		Signature or no. of prescriber.		
		Specify level **1-Intern 2-Residence** **3-Specialist 4-Super specialist**		
		Action taken since admission		
		Are all drugs available for patient at pharmacy? **If no, indicate which drugs are out of stock from treatment offered below.** **No: 1,2,3,4,5,6,7,8,9,10,11**		

2-VIII-2. HOSPITAL DISCHARGE symptoms

Symptom	No	Yes	Remark	Symptom	No	Yes	Remark
Fever	☐	☐		Awareness of heartbeat	☐	☐	
Jaundice	☐	☐		Fatigue	☐	☐	
Cough	☐	☐		Headache	☐	☐	
Nausea & Vomiting	☐	☐		dyspnea at rest	☐	☐	
LL oedema	☐	☐		Orthopnea	☐	☐	
Anasarca	☐	☐		exercise intolerance	☐	☐	
Ascites	☐	☐		Abnorminal pain	☐	☐	

Other symptoms _____

_____

_____

_____

HOSPITAL DISCHARGE
I. ADMISSION OUTCOME

A: Admission outcome

1. **Death**
2. **Discharged with heart failure related symptoms**
3. **Discharged without heart failure related symptoms**

B: If dead, what is the date of death: ……../……../……..

C: If alive, what is the date of discharge: ……../……../……..

II. DISCHARGE PRESCRIPTION EXAMINATION

SN	**B1: Error of Commission: PRESENT / UBSENT, if present which kind of error.**	**Circle**
1.	Starting dose (lower doses in the case of beta blockers ACEI)	**Yes/No**
2.	Drug - drug interaction	**Yes/No**
3.	Drug - disease interaction	**Yes/No**
4.	Drug – lab parameter interaction	**Yes/No**
5	Not writing a drug related to the condition in hand	**Yes/No**

B2: Comment on errors:

……
……
……
……
……

HOSPITAL DISCHARGE

6. If there is drug and drug interaction in prescription, specify :

SN	Drug		Interactions	Circle
1.	ACEIs	1	Alcohol	Yes/No
		2	ARB	Yes/No
		3	heparin,	Yes/No
		4	Diuretics	Yes/No
		5	Digoxin	Yes/No
		6	NSAID	Yes/No
2.	Beta blockers	7	Rifampicin	Yes/No
		8	Antidiabetics	Yes/No
		9	cardiac glycosides	Yes/No
		10	Corticosteroids	Yes/No
3.	ARB		Same as ACEIs	Yes/No
4.	ALDOSTERONE ANTAGONISTS	11	NSAID,	Yes/No
		12	ARB	Yes/No
		13	clarithromycin, erythromycin	Yes/No
		14	Rifampicin	Yes/No
		15	cardiac glycosides	Yes/No
5.	Diuretics		ACEIs,	Yes/No
		16	ARB	Yes/No
		17	NSAID	Yes/No
		18	Antidiabetics	Yes/No
		19	cardiac glycosides	Yes/No
6.	DIGOXIN		ACEIs,	Yes/No
		20	ARB	Yes/No
		21	Gentamycin	Yes/No
		22	trimethoprim, macrolide	Yes/No
			Beta blockers	Yes/No
		23	Calcium channel blocker	Yes/No
		24	Corticosteroids,	Yes/No
7.	ISOSORBIDE DINITRATE	25	ACEIs,	Yes/No
		26	ARB	Yes/No
		27	Diuretic	Yes/No
		28	beta blocker	Yes/No
		29	NSAID	Yes/No
8.	Dobutamine	20	Digoxin	Yes/No

HOSPITAL DISCHARGE

7. Is there drug and disease interaction in prescription, Y/N, if yes comment:

SN	Drug	No	Interaction	Circle
1.	**ACEIs**	1	Angio-oedema	**Yes/No**
		2	Renal impairment	**Yes/No**
2.	**Beta blockers**	3	asthma,	**Yes/No**
		4	heart block	**Yes/No**
		5	hypotension,	**Yes/No**
		6	diabetic meliitus	**Yes/No**
3.	**ARBs**	7	Angio-oedema	**Yes/No**
				Yes/No
		8	Renal impairment	**Yes/No**
				Yes/No
4.	**ALDOSTERONE ANTAGONISTS**	**9**	**renal impairment**	**Yes/No**
		10	**high potassium**	**Yes/No**
		11	gynaecomastia	**Yes/No**
5.	**Diuretics**	**12**	**Dehydration,**	**Yes/No**
		13	**hypotension,**	**Yes/No**
6.	**DIGOXIN**	**14**	bradycardia	**Yes/No**
		15	Heartblock,	**Yes/No**
		16	kidney failure.	**Yes/No**
7.	**HYDRALAZINE AND ISOSORBIDE DINITRATE**	**17**	lupus-like syndrome	**Yes/No**
8.	**Dobutamine**	**18**	**CNS disturbance**	**Yes/No**
		19	**Cerebral hemorrhage**	**Yes/No**
		20	**Atrial fibrillation**	**Yes/No**
9.	**Morphine and derivatives**	**21**	**Respiratory depression**	**Yes/No**
		22	**Constipation**	**Yes/No**
		23	**CNS disturbance**	**Yes/No**

C: Are life modification advices given: Y/N, if Y, what kind:

1- alcohol reduction
2- Smoking
3- Dietary changes
4- Home Daily Weight Monitoring
5- Physical activity
6- Stress reduction
7- Drug adherence