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AN ANALYSIS OF EXPIRED MEDICINES MANAGEMENT SYSTEM AT HEALTH FACILITIES IN CHIPINGE DISTRICT MANICALAND PROVINCE, JANUARY - DECEMBER 2021

BY

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Abstract

Expired medicines kept in hospitals for long are a threat to human beings, animals and the environment and this is most commonly the result of inadequate knowledge among Health Care Workers (HCW) manning the medicine stores. An analytic cross sectional study was done in at public health facilities registered with the Ministry of Health and Child Care to compile an inventory of expired medicines from January 2021 to December 2021 and classify them according to class. The study also intended to observe the attitude and levels of knowledge of health care workers towards the disposal of expired medicines through informant interviews from the registered facilities and a health facility checklist. SPSS 22.0 was used for data analysis. These workers 25 males and 24 female consisted mostly of nurses (76%) and few doctors (8%). Only 6% officers from the pharmacy department. Forty (80%) of the sampled respondents had a system for tracking expiry dates of medicines. However only 13 respondents (26%) had a system for tracking expired medicines awaiting disposal whilst 36 participants were not aware of the system. Nurse aides were noted to be responsible for stock management in 51% of the facilities, whilst nurse and pharmacy technicians contributed 38% and 10% respectively. Thirty-two percent of entries of expired medicines into the expired medicines register were anti-infective medicines and the this was followed by anti-retrovial medicines at 27% and resuscitation medicines at 20%. The majority of medicines came from the national pharmacy (80%) and 16% came from private suppliers. On the facility checklist, it was noted 96% of facilities had the updated protocols and policy manuals for disposal of short-dated and expired medicines and 91 % had a register of medicines. Seventeen (35%) of the facilities kept institutional records for an acceptable period of time whilst 23% indiciated that they did surveys for short dated medicines. The district pharmacy was noted no have a shortage of adequate space, resulting in ripple effect on medicine storage in peripheral health facilities. Sex was noted to have a weak connection to having a system for tracking expired medicines ($p = 0.242$). It was also noted that that there was a weak association between availability of a policy and procedure manual for disposal of expired medicines and availability of a system for tracking expired medicines awaiting disposal ($p = 0.559$). There was also a significant association between the health worker who does stock management and availability of a system for tracking expired medicines awaiting disposal ($p =0.022$). The researcher recommended the ministry to train all incoming nurses on medicine stock management and discouraged this task from being seconded to auxiliary officers. There is also a strong need to improve medicine ordering such that short-dated medicines should not be delivered to facilities.

Keywords - Expired medicines, Stock Management, Disposal.

Declaration

I declare that this dissertation is my original work except where sources have been cited and acknowledged. The work has never been submitted nor will it ever be submitted to another university for the award of a degree.

-Brian Makumbe---------- ------ 29/11/2021

Student's Full Name Student's Signature

-Dr E. Mugomeri----------

Main Supervisor's Full Name Main Supervisor's signature

Copyright

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I would like to appreciate my academic supervisor Dr E Mugomeri, and field supervisor,Dr T Dhliwayo for their unwavering support in this research.

Dedication

I dedicate this research to my wife, Rejoice who encouraged me throughout my studies.

Lists of abbreviations

AUREC	Africa University Research, Ethics Committee
ARV	Anti-retroviral therapy
ATC	Anatomical therapeutic and chemical classification
CDH	Chipinge District Hospital
DHE	District health executive
DMO	District medical officer
DPM	District Pharmacy Manager
EMA	Environmental Management Agency
FDA	Food and Drug Administration authority
HCW	Health Care Workers
HIV	Human Immunodeficiency Virus
LMICs	Low and Medium Income Countries
MCAZ	Medicine Control Authority of Zimbabwe
MOHCC	Ministry of Health and Child Care
PMD	Provincial Medical Director
UCCZ	United Church of Christ
WHO	World Health Organization

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CHAPTER 1INTRODUCTION

1.1 Introduction

In this chapter, inventory of expired medicines was introduced by giving some background on dangers of storing expiring medicines, poor disposal methods and the reason why it is essential to carry out this study. Objectives of the study, as well as the reasons for choosing the study setting and population were also presented in this chapter.

Expired medicines kept for long in hospitals are a potential threat to humans, animals and the environment (Bashaar, 2017). In most cases this is as a result of inadequate knowledge among the staff manning medicine stores. This study seeks to conduct an inventory of expired medicines. Inventory refers to all the medicines held by entity for the purpose of transferring to the next level in the supply chain. Expired medicines are stocked in an inventory for transparency of disposal.

Improper drug disposal is not only associated with environment contamination (Sanchez et al, 2011) and food chain toxicity (Oaks et al, 2004), but pose a risk for abuse, wasted resources, antimicrobial resistance (Levy, 2002) and accidental poisoning. Sink, toilets, rubbish bins are the most commonly used but unfriendly routes drug disposal.

1.2.1 Background to the study

A major waste category, whose management is a complex and troublesome issue with regards to the worldwide population growth rate, is expired medicines. A

medicine past the expiry date are potentially toxic substance which cannot be used and must be disposed.

Expired medicines represent the major segment of medical waste. This proportion is sadly growing progressively. This is because medicines available on the market have grown in numbers exponentially and all of the pharmaceutical products are not consumed and large quantities remain unused or become expired. Expired medicines are a huge burden due to wastage of potentially useful medications as well as the costs associated with disposal of those medications

Table 1. 1 Distribution of health facilities in Chipinge District

Responsible authority	Number of hospitals	Number of registered clinics	Number of health posts/ unregistered clinics
Government	1	8	2
Rural District Council	0	27	2
Mission	2	1	2
Private clinics	0	7	3

Chipinge District Hospital a 172 bedded institution, offering supervisory and referral support in Chipinge District, Manicaland Province serving a population of 394 000 people. This is the referral center for the 53 facilities in the district and the district has 2 other secondary facilities which complement the district hospital. The district also has 43 registered primary level health facilities which are registered to provide for public primary health care services. These are manned by nurses. At the bottom of the tie are satellite clinics and health posts which are manned by primary care nurses.

The District Pharmacy Manager at the hospital is responsible for doing stock management for all the 56 health facilities in the district. Part of the duties also includes collection of medicines from facilities and disposing them after all procedures have been done. This is done with assistance from nurse in charges at the clinics, 4 pharmacy technicians and 1 dispensary assistant. Medicines are disposed at Erin Estate in Nyanga. Two of the pharmacy technicians are stationed at Mt Selinda mission hospital and St Peters mission hospitals, which have a capacity of 172 and 80 beds respectively. All the 3 hospitals in Chipinge district are secondary level facilities with functional operating theatres.

1.2.2 Monitoring and Evaluation of medicine management

This is a process which is led by the district pharmacist and involves both a physical and an electronic system. Even though both systems capture the same data their do not interact in the implementation despite being expected to produce the same results. This assists in data triangulation of information concerning medicines.

1.2.2.1 Paper based Medicine Information System

The old system is the physical system involving the use of registers into which medicines are requested on paper documents and copies are shared with the user and the other is submitted to the National Pharmacy for filing and analysis. On reception of the medicines other registers are completed and these will be different from the ones used to dispense the medicines. Data triangulation can be used to check for discrepancies in the data.

All medicines in shelves as the requirement with government protocols are marked by stock cards. Stock cards are document specific registers on which transactions with individual medicines are logged. Stock cards record dated unit inflows,

dispensations and the actual quantities available. The also indicate maximum and minimum stock for a particular drugs and indicate when to request or ask for redistribution.The expiry date is also quoted on the medicine stock card to assist with early trouble shooting and decision making concerning medicines in stock. Medicines are dispensed using the first in first out protocol to prevent medicine expiries. The stock card has to be next to the medicines it is dictating.

It is protocol that all medicines in stock expired and unexpired be physically verified every month. This is done through an at least monthly physical count where the additions and subtractions for each monthly are verified by a physical count of the medicines.Medicines are also audited by both internal and external auditors to check for compliance with government protocol and give advice on improved medicine monitoring.

1.2.22 Electronic-Medicine Information System

Medicines are also monitored electronically by the electronic Medicine Information Systems (eMIS). This is an electronic version of the medicine information system, recently introduced by the government. Its use started in Chipinge District in 2020 and currently it is being piloted to track priority commodities in only secondary level facilities which are Chipinge District Hospital, St Peters Mission hospital and Mt Selinda Hospital. The priority commodities include Covid19 medicines and materials.

The eMIS offers advantages against the old paper based system despite having its own list of short comings. First, the eMIS has a backup that means data cannot be lost and can only be accessed at a click of a button. This system doesn’t need storage space for files and few employees will be needed to sort out the data and the data

self-arrangeswhen it is entered into the system. This provide advantages for most facilities from low and medium income countries who have a chronic shortage of infrastructure to store documents and dispose institutional records prematurely.

The Zimbabwean law requests that records be stored for at least half a decade before they can be disposed. They cannot be destroyed but only through the elements of the environment.

On the other side of the coin e-MIS is difficult and expensive to set. Clinician need to be trained to use the system and it might be worse in the transition period when both systems might need to be used further burdening the clinicians who will be overwhelmed. E-MIS relies on properly functioning internet systems which will not result in service delivery relying on availability of network. This might present a challenge in regions lie Chipinge Zimbabwe where internet coverage is not that widespread. An electronic system use IT gadgets which are expensive to buy, maintain and replace in cases of damages.

1.2.3The Chipinge Scenario

Chipinge internet connectivity is poor resulting in some areas being serviced by network providers from Mozambique. Such areas include ward 28 – 30. eMIS in such regions would be impractical. Chipinge terrain is uneven which further worsens the signal transmission.

The majority of workers in Chipinge are elderly and are struggling with basic android devicesand introducing as system using IT devices will make their life hell.

1.3Problem Statement

Facilities in Chipinge District have loads of expired medicines which are still to be disposed. For instance, at Chipinge District Hospital, medicines occupying 12 cubic meters have been accumulating since 2014 when the last disposal of expired medicines was done. Infrequent requests for disposal of drugs remain a challenge as records at the institution indicated that the last request to dispose expired medicines was done in 2015. Stocking expired medicines at a health institution put patients at risk of using expired medicines when these are recycled or contaminate unexpired medicines.

1.4 Purpose of the study

To investigate factors affecting the management of expired medicines in Chipinge District, Manicaland Province, January 2021 to December 2021

1.5 Objectives

1.5.1 Broad objective

To analyze the systems whichmanages expired medicines in Chipinge District, Manicaland, Province, January 2021 – December 2021.

1.5.2Specific objectives

The specific objectives were to:

a) compile an inventory of expired medicines in Chipinge District, Manicaland Province from January 2021 to December 2021.

b) Assess the stock management of expired drugs awaiting disposal at health facilities in Chipinge District, Manicaland Province.

c) Assess the attitude of medicine stores personnel towards the stocking of expired medicines in Chipinge District, Manicaland Province.

1.6Research Questions

Which medicines expired the most among the medicines used in Chipinge District from January 2021 to December 2021?

Are expired medicines in Chipinge District, Manicaland province stored according to the accepted standards for medicine storage?

How knowledgeable is staff on the disposal of expired medicines and what is their attitudes towards disposal of expired medicines in Chipinge, Manicaland, January 2021 to December 2021.

1.7 Significance of the study

Despite the clearly laid out protocols, there is very little research on the classification of expired medicines in Zimbabwe. This is especially true of institutional medicine expiries. This dissertation aimed to add to the body of knowledge available of medicine disposal. Compiling an inventory of expired medicines would identify classes at risk of expiring and this can assist in coming up with strategies to avert such expiries.

1.8 Delimitation

The availability of records from health facilities and systems in place to capture events proved to be an asset in the capturing of health information. The study focused on registered public health facilities and excluded private and unregistered health facilities.

1.9 Limitation

Anecdotal evidence showed that the quantities of expired medicines declared by the hospital were an underestimation as some of the waste is not documented. This is commonly true for individual medicines expiries.

The study could have been done over a wide geographical area. However this could not be done because of resource constraints. There was also limited time to do the study as a result of academic schedules.

Despite the fact that an institutional inventory of medications obtained by direct observation has been shown to be reliable than recall methods, some weaknesses were realized from this study. It is difficult to extrapolate the study findings to other parts of the country considering the different settings.

CHAPTER 2 LITERATURE REVIEW

2.1 Introduction

The amount of expired medicines in national stores and public health facilities in low-income countries is too significant to ignore. The time taken before expired medicines in storage are disposed is also worrisome. In Uganda expired medicines were held for up to six years,(Nakyanzi, 2017). However, there is little research on this aspect in Zimbabwe. This chapter will focus on the framework for stock management including the classification of expired medicines. Previous researches and their findings will also be targeted in this chapter.

2.2 Theoretical Framework

The conceptual framework is going to be explained using the flow chart dictated by thedirectorate of pharmacy services in Zimbabwe. The conceptual framework analyses the inputs, processes and outputs of medicine stock management at institutional level.

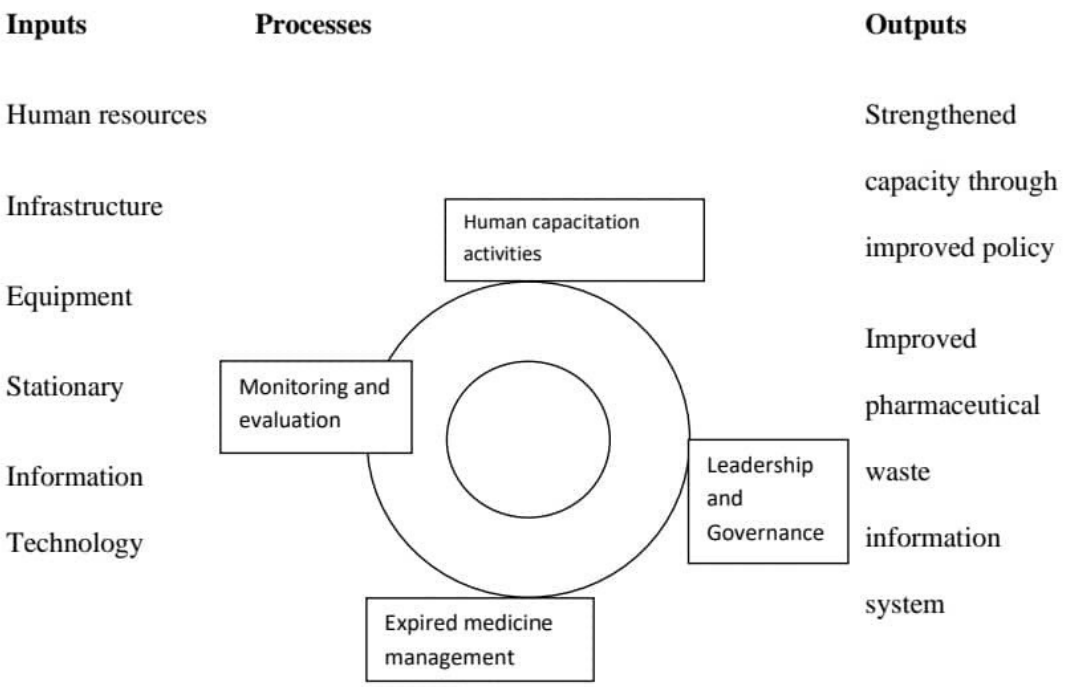

Figure 2. 1 Inputs, processes and outputs of medicine disposal

Source: Alhadlaq (2014)

2.3 Governance of medicines management

After analysing the Ugandan perspective Kamba et al (2017) encouraged low and middle income countries to: (i) strengthen public systems for medicines' management, to improve inventory control and the reliability of procurement forecasts; (ii) reduce stress on central medical stores, through liberalization and reimbursement schemes; (iii) strengthen the regulation of drug donations especially from systems parallel to ministry of health;(McGregor , 1996) (iv) explore the salvage of officially expired pharmaceuticals, through re-analysis and possible shelf-life extension; (v) strengthen the enforcement of regulations on safe drug disposal; (vi) invest in an infrastructure for such disposal, perhaps based on ultra-high-

temperature incinerators; and (vii) include user accountability for expired pharmaceuticals within the routine accountability regimes followed by the public health sector.

2.4 Classes of expired medicines

The most common classes of drugs expiring are anti-infective medicines, analgesics and cardiovascular medicines. A study conducted at a tertiary hospital in Dar es Salam, Tanzania by Ebrahim et al (2019), identified the existence of medications wastage at medical wards. The most commonly wasted categories of medicines were those commonly utilized by patients; anti-infective medicines 18.9%, cardiovascular medicines (8.9%), and the other categories were 23.7% of the total medicines dispensed. The common factors contributing to medicines wastage as identified by the study were, excess supply of medicines for a patient (44%), pilferage (26.5%), patient death, and change/stop of medicines.

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2.5 Storage of expired medicines

Expired medicines are considered by most practitioners as obsolete and note serving any purpose. However, these medicines can be tested for their efficacy and have their shelf life extended if found to be effective. In Zimbabwe shelf life extension can only be done for bulk expiries and safety confirmed by the medicine control authority. If found to be unsafe they will need to be destroyed. At health facilities, medicines awaiting destruction need to be stored safely. They should be stored the same way as potent medicines.

Thus these expired medicines are stored unsafely, sometimes left to be exposed to the environmental conditions. This risks altering the chemical elements in the medicines and chemicals such as glutaraldehyde or containing pressurized chemicals might automatically combust.

Improperly storing these medicines puts the community at risk through exposure to recycling (Mugerwa, 2008). Improperly stored medicines are at risk of being recycled and being dispensed to the unsuspecting public. Also medicines lost this way hinder the medicine accounting processes because they are difficult to account for.

Anecdotal evidence show that most of the expired medicines in LMICs are stored in storerooms in which unexpired medicines are also stored with the 2 commodities sometimes mixing. The management of these medicines is done by the pharmacist. Proper management of expired medicine is poor and this is worse where municipal waste is not managed adequately (WHO, 2020). Ebrahim (2019) also did a visual inspection of pharmacy stores at 5 hospitals in Tanzania using a checklist and noted only 2 hospitals had fulfilled the desirable storage conditions one hospital 100% and the other one 82%, while the remaining 2 hospitals had only fulfilled 65% of the

storage conditions. The WHO (2020) noted that most third world countries have a critical shortage of infrastructure and this is also true for Zimbabwe and this might results in expired medicines being mixed in the same store room with safe and dispensable medicines.

2.5 Relevance of the Theoretical Framework to the study

The reasons behind the delayed disposal of expired medicines can be classified on a scale from human related factors to governance issues. Generally the challenge involves the capacitation of health workers to pay attention to near expiring medicines and routinely destruction of expired medicines (Basudde and Kalangala, 2016)

2.5.1. Governance of medicine disposal

Many countries have poor enforcement of regulations on safe drug disposal. The policy is clear on the safe precautions of medicine disposal however this is difficult to follow in public health system because of the impracticality of disposal.

Kamba et al(2017) in his study in Uganda noted that some of the medicines destroyed are still safe for consumption however the technology to prove their safety is little. He emphasized that all countries should be able to extend the useful lives of some medicines after efficacy and safety testing. This helps save money and the environment. However, such shelf-life extension or drug salvage is only feasible where there is sufficient capacity for pharmaceutical analysis. In most low-income countries, any consideration of this intervention will have to be accompanied by discussion of investments in analytical infrastructure.

The majority of medicine disposal methods are beyond the reach of most organizations except high temperature incineration which is a challenge in

Zimbabwe considering the unavailability of such resources. Taru and Kuvarega (2005) also indicated the unavailability of incinerators when they did a study on solid waste management at Parirenyatwa Hospital. In Manicaland,incinerators located ongovernment premisesare unsuitable for disposal for expired medicine resulting in health facilities resorting to private suppliers. This ends up being expensive on an already burdened system. The regulations are clear but the system is too complacent to enforce their safe disposal. These countries delay disposing the drugs because there is inadequate infrastructure such as high-temperature incinerators to dispose these expired medicines.

2.5.2 Health Worker Competency

Pharmacists and pharmacy stores personnel have limited knowledge regarding the management of drug-based waste including expired medicines (Bungau, 2018). This means that there will be a lag in the disposal of expired medicines. Some hospitals do not have a pharmacist and the ones which have pharmacists have high attrition rates for this cadres. This leaves such facilities with newly trained pharmacists whose professional knowledge might be limited (Kumar, 2015). These cadres also have communication challenges with clinicians resulted in disjointed medicines flows (Trap et al, 2016)

Competency of medicine stores officers in most cases is brought under questioning as the seasoned practitioners overlook common medicine stock management practices such as accepting donor medicines within 3 months of their expiry (Nakyanzi, 2017) and failing to return medicines before their expiry. Health workers need to be trained on stock management and disposal of expired medicines.

Stockpiles of expired pharmaceuticals may also build up as a result of poor forecasts of future demand. Efficient stocking may be made difficult by deficiencies in the

management of a supply chain or by poor coordination between a national supply system and medicals staff offering health services.

2.5.3 Leadership

Sometimes LMIC are often the dumping grounds for medicines that are about to expire. In such moments government ministries find it difficult to deny medicine donations. This overwhelms the systems and mass expiries are inevitable(Kamba et al, 2017). All this happens when systems have been put in place to regulate the importation of medicines under the agreed recommendations. In Zimbabwe policy prescribe that donated medicines can only be accepted when they have passed though the medicine control organization. Its policy that all incoming drugs should be safe and more than 6 months from expiry. Any medicines less than 6 months can be sent back to the supplier. The greatest challenge arises from donated medicines from the church related institutions. This is especially true in emergencies. Many health systems have no choice but to rely, at least in part, on drug donations from high-income countries and vertical supplies from development agencies. During civil emergencies and periods of severe political instability, health systems may have to rely almost entirely on drug donations.

Kamba et al(2017) proceeded to note that, donated pharmaceuticals often mismatch the pharmaceuticals that are needed. International guidelines require that drug donations are responsive to the health needs of the recipient country and that the drugs involved have a shelf-life of at least one year on arrival. However, drugs that are already past their expiry dates have often been dumped in low- or middle-income regions and many past donations have been so large or so unwanted that they could not be used entirely before their expiry dates.

Some countries face high costs of disposing expired medicines when charged by regulators or when they incinerators. This acts as a deterrent to medicine disposal as they will be avoiding these expenses(Hai, 2020).

2.5.4 Service Delivery and unplanned disease patterns

When health care workers have adequate knowledge about medicine segregation, they adhere to proper storage and disposal policies. There is need for more supervision and support in the implementation of stock management to avoid expiry. Changing trends of medicines especially in regions that are gradually eliminating endemic diseases such as malaria will result in difficulties in forecasting needs (WHO 1999). This will lead to mass expiries as well, that might inundate the disposal system. (Sophia, 2020). Ebrahim (2019) noted changes in disease patterns to be responsible for medicine expiries in medicine stores in Tanzania. Kerina Tull (2018) also noted that changing patterns of outbreak prone diseases such malaria can cause expiries of medicines.

2.6 Medicine Disposal in Zimbabwe

Bergen et al (2015) applauded national innovations to provide a free and safe method for the disposal of unwanted and expired medicines. This stopped drugs from being dumped in landfill and waterways. He did an audit which showed that over 600 tonnes of medicines can be returned through the program.However, salbutamol, insulin and furosemide are the most commonly discarded medicines. Hoarding and non-adherence to treatment contribute to waste.

Incineration is the most common method for medicine disposal in Zimbabwe, in part because it significantly reduces the volume of the waste. However, most hospitals in

Zimbabwe have single phase incinerators which are prone to incomplete combustion. This leads to incomplete combustion releasing environmental pollutants into the atmosphere. Also, most incinerators have broken down leading to high incineration costs in private incinerators. Sometimes medical wastes find it way to dumpsites such as Pomona in Harare.

2.7 Classes of medicines used in Chipinge hospitals

2.7.1 Anatomical and Therapeutic Classification

Drugs are classified in a number of ways, in pharmacology it is classified by its chemical activity and conditions that its treat. Classification is based on therapeutic (drugs treating particular disease), pharmacologic classification (mechanism of action on a molecular tissue and body system), chemical action, amalgamated and legal (controlled substances, drug schedules and teratogenic risks).

In this research, the Anatomical Therapeutic Chemical (ATC) classification system was used to classify medicine. The ACT was created by WHO in 1976, were by the active substances are divided into different groups according to the organ or system on which they act and their therapeutic, pharmacological and chemical properties. Drugs are classified in groups at five different levels. The purpose of ATC system is to serve as tool for drug research as to improve quality of drug use.

ATC 1st level - The system has fourteen main anatomical or pharmacological groups (1st level). The ATC 1st levels are shown in the figure.

ATC 2nd level - Pharmacological or Therapeutic subgroup

ATC 3rd& 4th levels - Chemical, Pharmacological or Therapeutic subgroup

ATC 5th level - Chemical substance

Medicinal substances are classified according to their main therapeutic use on the basic principle of only one ATC code for each medicinal product as defined by route of administration and in some cases strength.

In many ATC main groups, pharmacological groups have been assigned on the 2nd, 3rd and 4th levels allowing drugs with several therapeutic uses to be included, without specifying the main indication. For example, calcium channel blockers are classified in the pharmacological group C08, which avoids specifying whether the main indication is coronary heart disease or hypertension. All classes of medicines are used in the district.

2.7.2 The Medicine and Allied Substances Control Act classification

The MASCA provided for the formation of the Medicine Control Authority of Zimbabwe whose function is to regulate the registration and use of medicines among other duties. In order to ensure that each medicine is supplied after an appropriate diagnosis, there is capacity to monitor its safety profile, rational and ethical use the channels of availability are classified into nine categories as follows.

Table 1.2 Medicines and Allied Substances Classification

Class of drugs	Brief description
Dangerous drugs and narcotics	These are governed by the Dangerous Drug Act (15:02). It includes opiates and their products. Examples include morphine, Pethidine and hemp
Prescription preparations	This refers to medicines supplied only after production of a prescription from a registered medical practitioner. Possession is restricted to pharmacists, medical or dental practitioners and veterinary surgeons.
Prescription preparations (tenth schedule)	These are supplied after production of a prescription however they can aslo be

	supplied in the absence of a prescription for less than 3 days. They are chronic medicine preparations. Examples include hydrochlorothiazide for hypertension.
Specially restricted preparations	Possession of these medicines is restricted to pharmacists from central and research hospitals only. These medicines are not allowed for self-prescriptions by medical practitioners. Prescriptions should be dispensed once only and should be counter signed by the medical superintendent for the hospital when they are satisfied that the medicine serves the best interest of the patient. Examples include cytotoxic drugs for chemotherapy.
Pharmacist initiated medicines	These medicines can only by pharmacists or their subordinates.
Pharmacy medicines	The medicines can also be stocked and dispensed by pharmacists or their subordinates under their supervision.
House hold remedies	These can be sold from supermarkets or general dealers who meet local requirements and hold a shop license. No specialized skills or permits are needed to stock them.
Veterinary medicines (general dealer)	These can be stocked and supplied by general dealers who hold a permit issued by the Medicine Control Authority of Zimbabwe. Examples include herbicides sold in retailers. These permits are renewed annually.
Prohibited drugs	Drugs that have been abolished such as Thalidomide are included in this group.

2.8.1 Nature of services offered at secondary level facilities

The secondary level facilities officer all the services expected of such a facility which include supporting and supervising primary health centers. Services offered by the district hospital are shown in table 1.3 below.

- Reproductive maternal and neonatal and child health services

The facility offers family planning services. Both long term and short-term family planning services are offered by trained providers. However surgical options` availability depend on the availability of trained physicians. Preconception counselling and pharmacotherapy is also offered at the institution. The hospital has a separate family and child health department where antenatal services are offered. In the maternity ward, antenatal complications are managed including delivery services. Delivered babies are also managed along with their post-natal parents. Complicated cases are also offered caesarian sections in the on-site operating theatre.

- Adolescence and child health services with a one stop center for survival of gender-based violence

The one stop center which is a part of the out-patients department targets survivors of gender-based violence. In this center there in integration of health, legal as well as enforce activities so that a holistic service is offered. This department is donor funded with 3 NGOs assisting the direct service delivery human resources.

- Accident and emergency unit with a separate clinic for non-emergent consultations

The casualty has two high dependency unit beds and offers resuscitation activities and serves as the entrance port into service delivery for emergency patients. The

separate out-patient department also has an integrated chronic care clinic which offers a one stop treatment to HIV positive patients as well as diabetic, hypertensive and psychiatry patients.

- Operating theatre

The operating theatre supports the admitting wards and offers both minor and major theatre services. The majority of major services are the caesarian delivery services even though bowel wall surgery is performed. Minor services include evacuation of uteruses, manipulation under anesthesia and removal of foreign bodies.

- Admission wards including isolation ward for communicable diseases
- Clinical laboratory with four main disciplines, these include blood bank, hematology, microbiology and clinical chemistry
- Dispensing pharmacy. The dispensary dispenses medicines for clients seen within the hospital.
- Pharmacy stores

The hospital has at least 200 square meters for storage of medicines. Medicines for the use by the hospital and clinics are dispensed for this storeroom. Expired medicines are also brought to this storeroom for safe keeping awaiting disposal.

- Sixteen body capacity mortuary
- Dental unit

2.8.2 Services offered at Primary level facilities

Clinics meanwhile offer a proportion of the services offered by the hospitals. This include consultations for common conditions and basic emergence obstetric and neonatal services.

Chipinge District relies heavily on medicines from the national pharmacy. It also receives donated medicines and most of these are antibiotics, analgesics and antiretroviral medicines. These medicines are the prescription only preparations used to treat HIV disease and related opportunistic infection such as tuberculosis. Other classes of drugs are also used on a lower scale and these include the opioids drug and pharmacist-initiated medicines. Over the counter medicines are rarely stocked as well**.**

Health facilities also receive money which is used to source medicine which will be in short supply from.

2.9 Governance of medicines management at district level

As prescribed by the Public Health Act (2005) the District Medical Officer is the accounting officer responsible for all health services in the district. He does this with the help of the district health executive (DHE). The DHE is a 10 member committee comprised of heads of department of key departments. The district pharmacy manager is the focal person responsible for medicine management in the DHE on behalf of the accounting officer. This involves calculating need of medicines based on sue and disease trends, medicines are then requested from different suppliers using this information. After dispensing the medicines the pharmacy manager then compiles an acquittal of these medicines and writes reports to the accounting officer. The pharmacy manager is also responsible for supervising medicine management at all health facilities in the district and these include unregistered health facilities as well.

At clinic level the nurse in charge is the accounting officer responsible for medicine stock management. The nurse assigns an officer to do the duties under nurse`s direction. The duties of the medicine stores officer are as follows;

- Receives, unpacks, checks and allocates medicines held in stock to different users
- Does monthly physical counts and attends to discrepancies where necessary.
- Maintains inventory management systems and processes issues and returns.
- Attends to internal and external requests for medicines and sundries
- Writes medicine reports and shares with supervisors where necessary
- Receives, unpacks and checks medicines received and where required, notifies relevant contact
- Participates in cyclic and annual stock takes and perform random stock checks as required.
- Maintains order and cleanliness of the store and assists with disposal of damaged and/or obsolete items.

2.10 Key activities of the District to promote good medicine management

The district health executive performs routine visits to all prescribing facilities for support of health services delivered offered in the district. The executive provides supervisory services to health care workers at all health facilities during these visits. Mentorship is also provided for need areas. When training gaps are identified, training meetings for need clinicians are arranged. It is during these visits that the pharmacist assist clinics recognize their medicine requirements. Clinics then submit their medicine requirements to the National Pharmacy which deliver medicines once per quarter.

Other sources of medicines include privately sourced medicines when clinics buy their own medicines from private pharmaceutical suppliers. 5 of the health facilities in Chipinge have missionaries as responsible authorities and these can donate medicines to their clinics directly from the donors. Facilities routinely report on medicines availability giving the medicine status.

2.11 Risks of stocking expired medicines

Regardless of good pharmacy practice medicines will invariably expire in the hands of the pharmacy. This is currently on a rise due to increase in the number of medicines being used as well as an improved life expectancy of the population.

Anecdotal evidence also shows that expired medicines kept for long are at risk of being dumped into the environment. This environmental pollution results in poisoning in scavengers animals and birds. This pollutes the food chain. It also results in anti-microbial resistance.

Expired medicines can also be dispensed to unsuspecting patients putting them at risk of severe adverse events and anti-microbial resistance (Ihekwereme, 2017). This was also noted in Zimbabwe when Auditor General (2015) implicated 3 provincial hospitals in dispensing expired antiretroviral drugs to patients. These institutions would disburse these medicines without approval from the Medicine Control Authority of Zimbabwe. The medical control authority is approved to increase the shelf life of medicines beyond their documented life span after testing.

This contributes to antimicrobial resistance as efficacy of the medicines is reduced. Expired medicines stored for long periods in warehouses destabilize and can ignite

spontaneously. Examples of these medicines include alcohol-based cough syrups and medicines in aerosols cans. Medicines that use corrosives substances such as glutaraldehyde and acids can also explode spontaneously.

2.12 Regulations on disposal of expired medicines

Regulatory authorities are worried about loads of expired medicines in facilities. Regulatory agencies such as the Food and Drug Administration Agency (FDA) and Environmental Management Association (EMA) all insist that expired medicines should not be stored for long rather they should be disposed immediately. The World Health Organization (WHO), has discouraged the flushing of waste into sew as it contaminates and advocated for high temperature incineration.

In Zimbabwe medicines should be disposed twice per year. In the public system concurrence to dispose medicines expired at public institutions is granted after request have been submitted by the pharmacist to the ministry of finance. The pharmacist also lays out justification for the expiries.

2.13 Methods of Disposal of Expired Medicines

High temperature incineration, with temperatures in excess of 1200 degrees Celsius, is the most common method of medicine disposal most commonly used in Zimbabwe. Constraints in funding for disposal of waste pharmaceuticals necessitate cost-effective management and methods. The main way to achieve this is to sort the material to minimize the need for expensive or complicated disposal methods. This is commonly used for solids, semisolids, powders, anti-neoplastics and controlled substances. However, it is expensive. Other methods accepted for medicine disposal in Zimbabwe include;

- Returning to manufacture
- Landfill
- Medium temperature incineration
- Sewer
- And burning in open containers

2.13.1 Return to donor or manufacturer

Wherever practical the possibility of returning unusable drugs for safe disposal by the manufacturer should be explored; particularly drugs which present disposal problems, such as antineoplastic. For unwanted, unrequested donations, especially those that arrive past or unreasonably near their expiry date it may be possible to return them to the donor for disposal. This is also true for medicine that are at risk of expiring.

2.13.2 Landfill

Landfill means to place waste directly into a land disposal site without prior treatment or preparation. Landfill is the oldest and the most widely practiced method of disposing of solid waste world-wide. Two types are recognized;

- **Engineered landfill**

Such a landfill has some features to protect from loss of chemicals into the aquifer. Direct deposit of pharmaceuticals is second best to discharging immobilized pharmaceutical waste into such a landfill. This method is highly ineffective as medicines have a high risk of leaching and contaminating water sources. Some chemical compounds are stable so they can poison those who use the land after reclamation many years later.

- **Highly engineered sanitary landfill**

In this method the landfill is purposively planned out. Properly constructed and operated landfill sites offer a relatively safe disposal route for municipal solid wastes, including waste pharmaceuticals. The top priority is protection of the aquifer. An appropriate landfill consists of an evacuated pit isolated from watercourses and above the water table. Each day's solid waste is compacted and covered with soil to maintain sanitary conditions. The term "safe sanitary landfill" refers to such a site that is adequately situated, constructed and managed.

2.13.3 Waste immobilization by encapsulation

Encapsulation involves immobilizing the pharmaceuticals in a solid block within a plastic or steel drum. Drums should be cleaned prior to use and should not have contained explosive or hazardous materials previously. They are filled to 75% capacity with solid and semi-solid pharmaceuticals, and the remaining space is filled by pouring in a medium such as cement or cement/lime mixture, plastic foam or bituminous sand. For ease and speed of filling, the drum lids should be cut open and bent back. Care should be taken to avoid cuts to hands when placing pharmaceuticals in the drums. Once the drums are filled to 75% capacity, the mixture of lime, cement and water in the proportions 15:15:5 (by weight) is added and the drum filled to capacity. A larger quantity of water may be required sometimes to attain a satisfactory liquid consistency. Steel drum lids should then be bent back and sealed, ideally by seam or spot welding. The sealed drums should be placed at the base of a landfill and covered with fresh municipal solid waste. For ease of movement, the drums may be placed on pallets which can then be put on a pallet transporter. Encapsulation of antineoplastic drugs requires a slightly different technique

2.13.4 Waste immobilization by inertization

Inertization is a variant of encapsulation and involves removing the packaging materials, paper, cardboard and plastic, from the pharmaceuticals. Pills need to be removed from their blister packs. The pharmaceuticals are then ground and a mix of water, cement and lime added to form a homogenous paste. Worker protection in the form of protective clothing and masks is required as there may be a dust hazard. The paste is then transported in the liquid state by concrete mixer truck to a landfill and decanted into the normal urban waste. The paste then sets as a solid mass dispersed within the municipal solid waste. The process is relatively inexpensive and can be carried out with unsophisticated equipment. The main requirements are a grinder or road roller to crush the pharmaceuticals, a concrete mixer, and supplies of cement, lime and water. The approximate ratios by weight used are as follows: • Pharmaceutical waste: 65% • lime: 15% • cement: 15% • water: 5% or more to form a proper liquid consistency

2.13.5 Sewer

Some liquid pharmaceuticals, e.g. syrups and intravenous (IV) fluids, can be diluted with water and flushed into the sewers in small quantities over a period of time without serious public health or environmental affect. Fast flowing watercourses may likewise be used to flush small quantities of well-diluted liquid pharmaceuticals or antiseptics. The assistance of a hydro-geologist or sanitary engineer may be required in situations where sewers are in disrepair or have been damaged. This method might appear to be cheaper and easy to set up in disposing off liquid formulations however it has it challenges, firstly it can pollute warm sources downstream and disturb the balance of the ecosystem. Secondly, this method can only dispose small quantities of medicine.

2.13.6 Burning in open containers

Pharmaceuticals should not be destroyed by burning at low temperature in open containers, as toxic pollutants may be released into the air. Paper and cardboard packaging, if they are not to be recycled, may be burnt. Polyvinyl chloride (PVC) plastic however must not be burnt. While burning pharmaceutical waste is not advocated as a method of disposal, it is recognized that it is not infrequently used. It is strongly recommended that only very small quantities of waste pharmaceuticals be disposed of in this way.

- **Medium temperature incineration**

In emergency situations the responsible authorities may consider it acceptable to treat expired solid form pharmaceuticals using a two-chamber incinerator that operates at the minimum temperature of 850°C, with a combustion retention time of at least two seconds in the second chamber. Many older municipal solid waste incinerators are medium temperature incinerators and the use of these facilities is encouraged as an interim measure, rather than less safe options, such as inadequate discharge to a landfill. In this case, it is recommended that the pharmaceutical waste is diluted with large quantities of municipal waste (approximately 1:1000). Such incinerators are not designed to incinerate halogenated compounds safely. The very low halogen content in most pharmaceuticals is likely to result in negligible halogen content in the combustion gases. Such practises have been shown to release chlorofluorocarbons which damage the ozone layer.

- **Novel high temperature incineration**

Industries which use high temperature technology, such as cement kilns, coal fired thermal power stations or foundries usually have furnaces that operate at temperatures well in excess of 850°C, have long combustion retention times and disperse exhaust gases via tall chimneys, often to high altitudes. Several features of

cement kilns make them suitable for pharmaceutical disposal. During burning the cement raw materials reach temperatures of 1450°C while the combustion gases reach temperatures up to 2000°C. The gas residence time at these high temperatures is several seconds. In these conditions all organic waste components are effectively disintegrated. Some potentially dangerous or toxic combustion products become adsorbed into the cement clinker product or are removed in the heat exchange equipment. This is the most common type of disposal method used in Zimbabwe (MOHCC, 2016)

2.13.7 Chemical decomposition

If an appropriate incinerator is not available, the option of chemical decomposition can be used in accordance with the manufacturer's recommendations, followed by landfill. This method is not recommended unless chemical expertise is readily available. Chemical inactivation is tedious and time consuming, and stocks of the chemicals used in treatment must be made available at all times. For disposal of a small quantity of antineoplastic drugs this method may be practical. However for large quantities, for example, more than 50 kg of antineoplastic, chemical decomposition is not practical, as even small consignments need to be treated through repeated application of this method. This method is requires scientists to be properly trained before it can be instituted because it can be dangerous if done improperly.

The rates of pharmaceutical expiry in the supply chain need to be reduced and the disposal of expired pharmaceuticals needs to be made both timely and safe. Countries need to improve inventory control and strengthen the regulations for medicines donations. There is also need to explore the possibility of officially expired pharmaceuticals, through re-analysis and possible shelf-life extension. The

Medicines Control Authority (MCAZ) needs to strengthen the enforcement of regulations on safe drug disposal and advocate for the government to invest in an infrastructure for such disposal, perhaps based on ultra-high-temperature incinerators. (Kamba 2017)

Summary

Medicine disposal at primary and secondary level facilities is guided by clearly documented protocols. There are focal persons at all levels of care and this is coordinated by the District Pharmacy Manager. Previous researches have been done the overstocking of expired medicines and it reasons for levels of knowledge have been noted to be the most common cause of overstocking.

CHAPTER 3 METHODOLOGY

3.1 Introduction

This chapter shows how the actual research was done. The sampling methods, study designs, study area, study population and procedures for collecting data which were used for analysis will be discussed here.

3.2 Study design

A facility based analytic cross sectional study design was used through self-administered questionnaire, desk reviews, and a health facility check list applied by researcher. This research design explored the attitude of health care workers towards the storage and disposal of expired medicine. This design was flexible so that unanticipated responses were obtained through probing the respondents.

Researcher visual inspections were done in medicine store-rooms and registers involved in medicine stock management. Health facility management books were also analyzed for information pertaining to the issue.

3.3 Study area

The study will be conducted at 3 hospitals and 41primary health centers in Chipinge district, Manicaland Province. Chipinge District Hospital is the referral center for all the 41 primary health facilities and 3 hospital this include two mission hospitals and three mission clinics. Private estates also run 10 clinics which takes care of the

workers as well as surrounding community thus they supplement the government medicine supply. Medicines are supplied by the National Pharmacy to all the facilities in the district. All clinics are allowed to supplement their medicine complement by purchasing directly from private suppliers.

3.4 Study population

The population comprise of all workers involved in the stock management and disposal of expired medicines. The district has 1 pharmacist, 4 pharmacy technicians and one dispensary assistant. The hospital executives are responsible for allocating resources to be used in medicine disposal. The nurses at rural health facility level are the focal persons responsible for medicine stock management and they are under the direct supervision of the district pharmacist.

3.5 Sampling

Total population purposive samplingwas used. All officers from the district who are involved in the stock management and disposal were interviewed.

3.6 Inclusion and exclusion criteria

Inclusion criteria

- Health care workers working in Chipinge district involved in medicine disposal

Exclusion criteria

- People not working in medicine disposal and those in private or unregistered facilities were excluded from the study.

3.7 Data collection tools

A variety of data capturing tools were used by the researcher to get more information during the study.

3.7.1 Key informant interview

Key informant interviews were conducted to obtain vital information about the community attitude towards disposal of medicines. This was used to asses risk perception. These key informants are service providers and enforcers of public health and pollution issues in the area will be given semi-structured interviews to get wide range of information. All interviews were guided interviews and data was collected by writing down answers during the interview as well as recording the interview.

A questionnaire was used to collect and record data or information from key informants. This tool will enquire on expired medicines storage and disposal. It will also assess the risks of exposure to expired medicines to humans, animals and the environment. Both open ended and closed ended questions were included in the questionnaire. The questionnaire was adapted from Martin Kampamba, 2007.

3.7.2 Direct observations

A checklist was adapted from the Zimbabwe Ministry of Health and Child Care health facility support and supervision checklist to be used in direct observations to check on availability of commodities and resources in the disposal of expired medicines. Information was collected of disposal processes in their natural setting. Through the observations the area around the waste disposal site and medicines store rooms landfill site and accessibility of the dumpsite by humans in regards to possible

scavenging. Expired medicines systems and practices were observed from the store rooms that is the source of expired medical to the disposal sites where issues of waste sorting, handling and disposal could be established.

3.7.3 Inventory register

A register adapted from the ministry of health expired medicine register will be used to capture information on expired medicines.

3.8 Data Quality Assurance

Pre-test of the data collection instrument was conducted at 2 facilities in neighbouring district, Chimanimani in order to check the applicability of the instrument and make necessary adjustments. These samples were not included in the final analysis. The data collected was checked for completeness, consistency, and accuracy before entry to statistical software for analysis. The data were also cleaned for inconsistencies and missing values after entry to SPSS.

3.8 Data analysis

SPSS version 22 was used for capturing data and generation of means, frequencies, proportions, odds ratios and their corresponding 95% confidence intervals. Qualitative data was analysed thematically.

3.8 Ethics approval

- The researcher was granted authority to conduct the research by the PMD Manicaland
- Ethical clearance was sort from AUREC
- Written informed consent was obtained from all participants

- Safety of data was used to maintain privacy of participants

Summary

This research intended to analyze the classes of medicines expiring in Chipinge District in 2021 and their frequencies. Factors affecting health facility stock management of expired medicines would be explored as well. The study population would be health care workers doing stock management who would be based at health facilities.

CHAPTER 4DATA ANALYSIS AND PRESENTATION

4.1Introduction

Of the target 50 participants therewas 98% (n = 49) response by health care workers and 44 of the targeted 46 health facilities managed to consent to participating in the study. The inventory of expired drugs from the 44 facilities was alsoanalysed. This chapter focuses on data analysis and the presentation of the study findings. The study uses frequency and percentages, chi-square to measure association of dependent and independent variables and logistic regression analysis to draw conclusions

4.2Study participants

4.2.1 Participants background

The mean age is 42 years old and twenty five of the 49 participants were male.

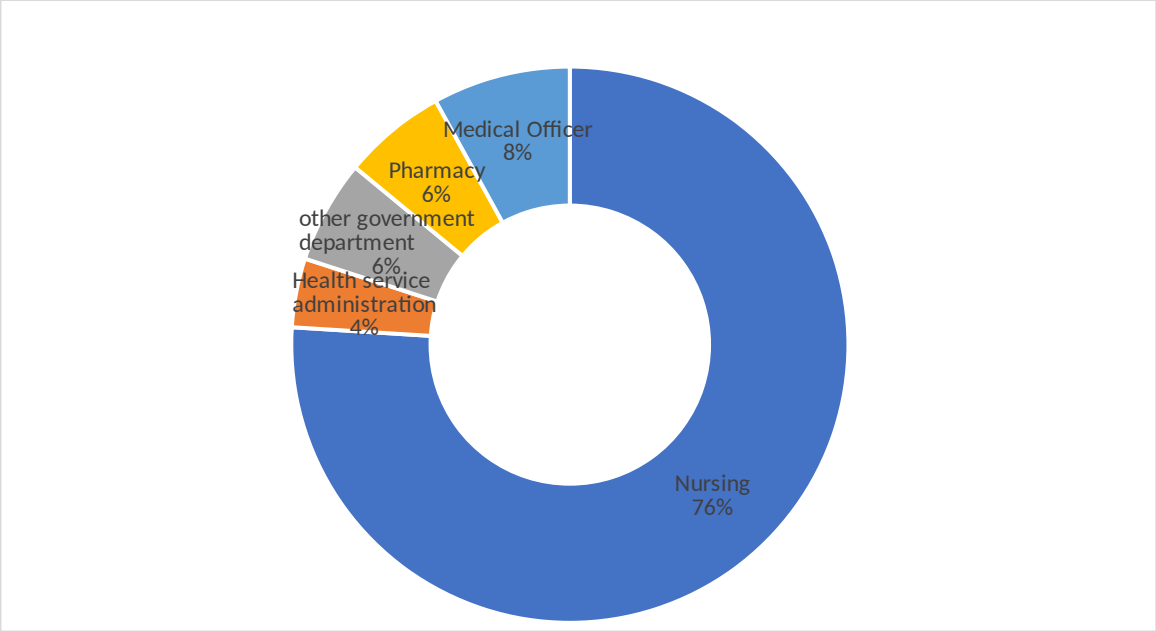

Figure 4. 1 Background of respondents

The age was normally distributed with a minimum age of 24 years and the maximum age of 57 years old. The mean age was 42 years. The majority (38) of the 49 participants had a nursing background, followed by doctors constituting just below a tenth of the frequency (8%). Pharmacy and other government department each constituted 65 of participants. The other government departments participating in the study included 3 uniformed forces manned clinics. There were only 2 administrators included in the study.

There was a significant positive relationship between duration of service and age of HCW, $r(47) = 591$, $p = .01$

4.3 Health care worker indicators

Table 4. 1 Frequency table for health care workers indicators

Variable	Possible responses	Frequency n(%)
Sex	Male	25 (51)

	Female	24 (49)
Training background	Nurses	38 (78)
	Doctors	4 (8)
	Pharmacists	3 (6)
	Uniformed forces	3 (6)
	Administrators	1 (2)
How frequent do you send information of expired drugs to the District Medical Officer	Monthly	4 (8)
	Quarterly	3 (6)
	Half years	6 (12)
	Yearly	36 (74)
How frequent do you send short dated/expired medicines to the district	Monthly	4 (8)
	Quarterly	8 (16)
	Half yearly	2 (4)
	Yearly	35 (72)
Do you have a system for tracking expiry dates of medicines	Yes	40 (82)
	No	9 (18)
Do you have a system for tracking expired medicines awaiting disposal	Yes	13 (26)
	No	36 (74)
Who is responsible for stock management at your work station	Nurse	19 (38)
	Nurse aid	25 (51)
	Pharmacy/ Technician	5 (10)

The majority of respondents (74%) agreed to seldomly sending information to the district on expired medicines. Only 4 of the 49 respondents submitted information

timeously, quarterly. The other respondent s submitted information of expired medicines quarterly (6%) and half yearly (12%).

The picture was constant with short dated medicine which you would expect to be send to other facilities for redistribution. Short-dated medicines are medicines you would expect to have a life span of less than 3 months before expiry. Seventy-two percent of facilities reported of short-dated medicines yearly whilst 4% only reportedly monthly.

Knowledge of a system to track for expiry dates was noted in 40 of the 49 of the participants. This system was noted to be uniform in all facilities and this included the documentation of expiry dates on stock cards and documenting the expiry dates on documents during medicine ordering procedures. Only 18% of HCW were not aware how a system to track expiry dates would be implemented in the clinics.

The picture deteriorated with the tracking of expired medicines awaiting disposal. It was noted that only 13 health care workers could demonstrate a tracking system for expired medicines awaiting disposal.

Lastly, the stock management of medicines was largely under the responsibility of the nurse, nurse aid and pharmacy technician or pharmacist. It was noted that in 19 facilities nurses were responsible for stock management whilst the nurse aid was responsible in 25 facilities and the pharmacist or pharmacy technician were responsible in 5 facilities.

4.4 Human resource capacitation on medicine stock management

Table 4. 2 Period of last training of respondents of disposal of expired medicines

When participants were last trained on disposal of expired medicines	Frequency n(%)

4.5 Communication regarding expired medicines

How frequent do you send information on expired medicines

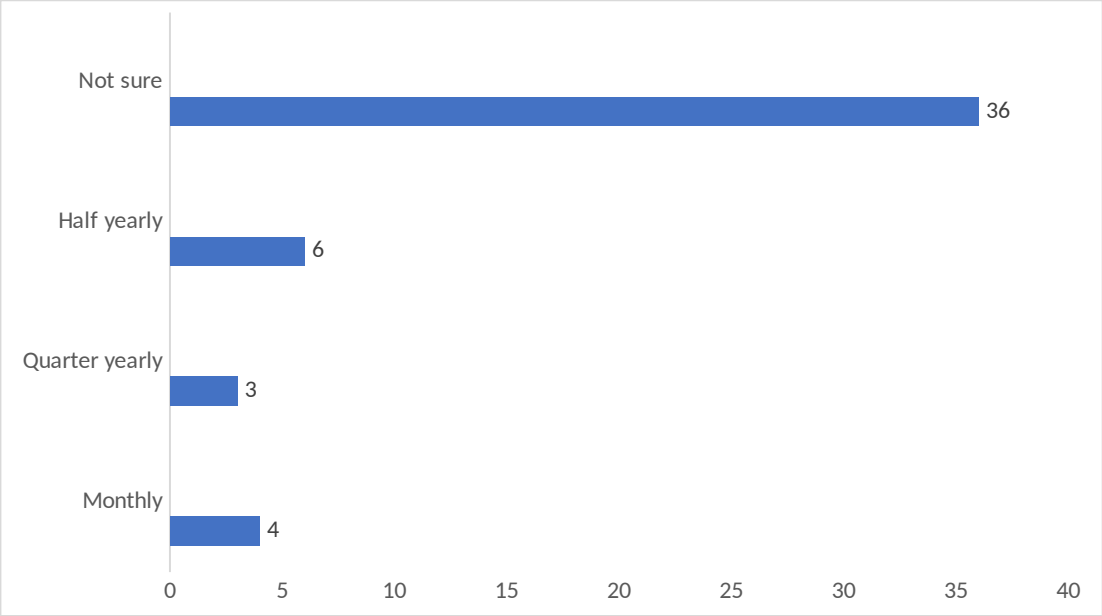

Figure 4. 2 Frequency of updating supervisor on expired medicines

Even though 90% (n= 40) facilities had guideline documents outlining the procedure for the disposal of drugs only 13 clinicshad a system for monitoring expired medicines awaiting disposal procedures.

4.5Inventory of expired medicines

4.5.1Quantities of expired medicines

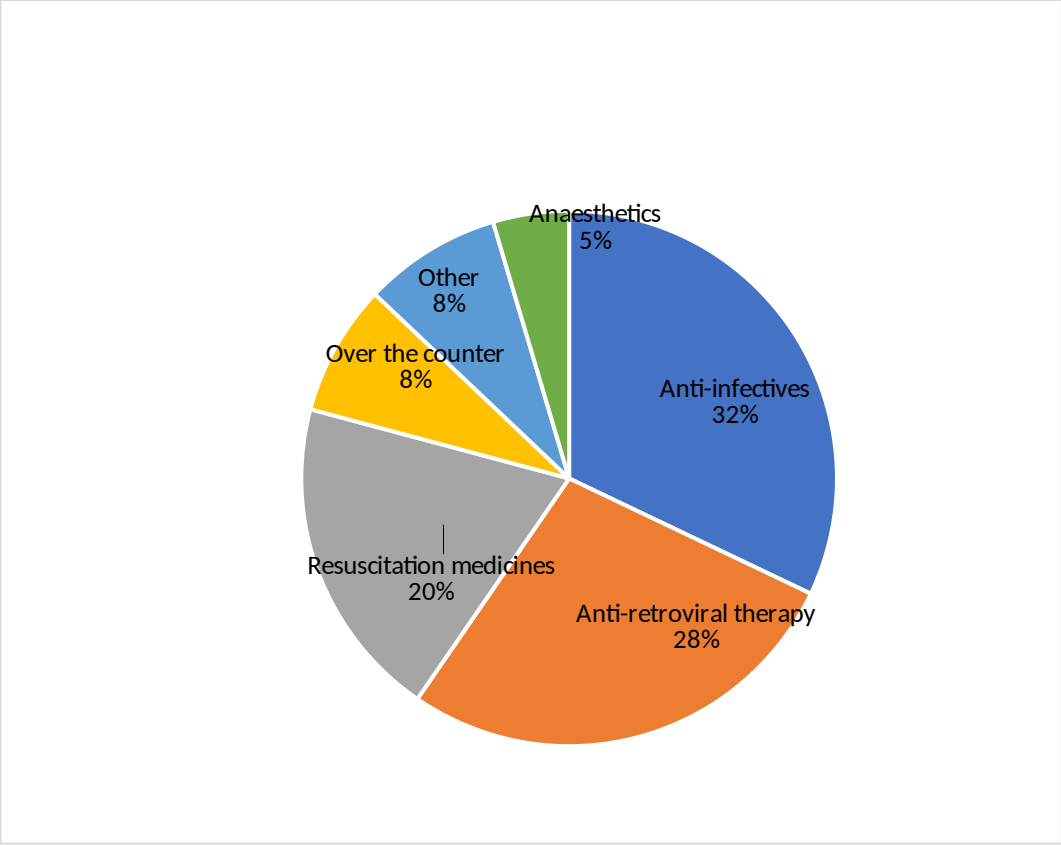

Figure 4. 3 Proportion of expired medicines by ATC classification

The first level of Anatomical Therapeutic Chemical classification was used to classify the medicines and a column of resuscitative medicines was added to classify emergency medicines. Thirty-two percent of entries of expired medicines into the expired medicines register were anti-infective medicines and the this was followed by anti-retrovial medicines at 27% and resuscitation medicines at 20%. It was also noted that 60% of the expired anti-infectives, all the ART and only 10% 0f the resucitation medicines had been sourced from the central pharmacies.The majority of expired medicines are sourced from the national pharmacy. This contributed four-fifths of the expired medicines consignement.

4.5.2 Source of expired medicines

Table 4. 3 Source of expired medicines

Source of expired medicines	Frequency n(%)
National pharmacy	191(80)
Private suppliers	38(16)
Other donors outside the ministry	12(5)

4.5.3Proportion of expired medicines that have been forwarded to district stores for disposal

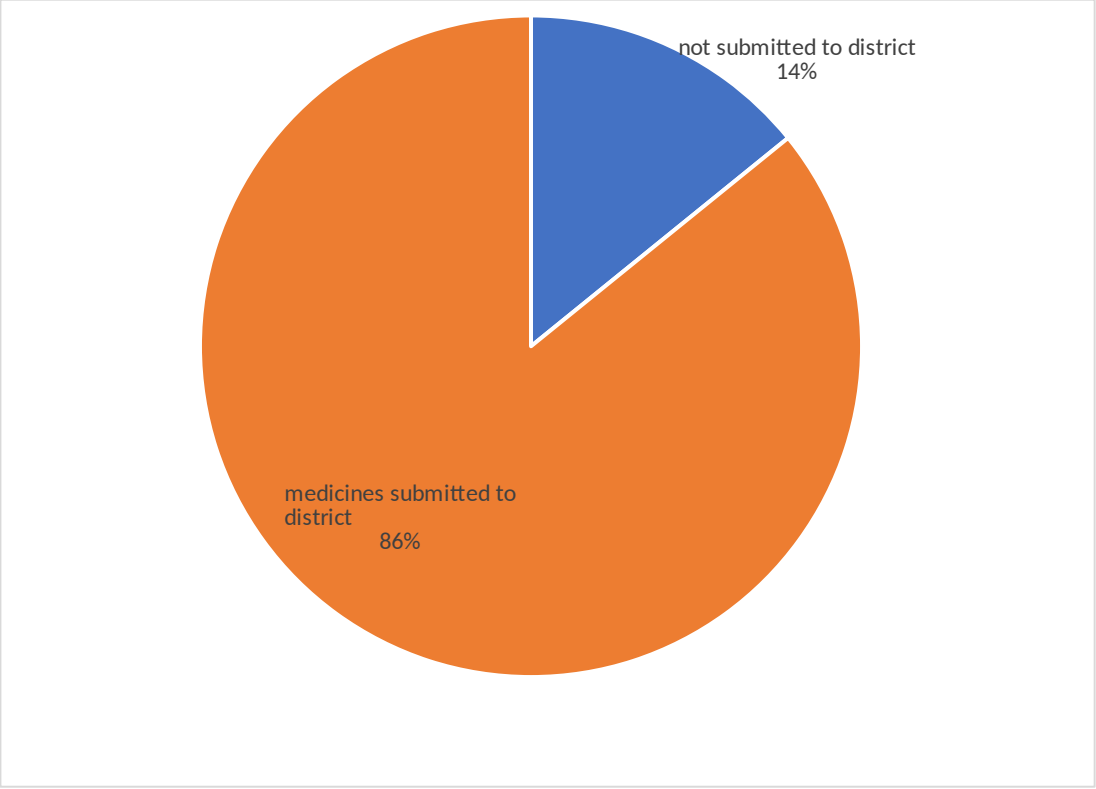

Figure 4. 4 Proportion of medicines collected from health facilities

Only 14% of expired medicines at the clinics had not been submitted to the district stores for disposal.

4.6Health Facility check list findings

Table 4. 4 Health facility check list findings

Variable	Frequency	
	Yes n(%)	No n(%)
The facility has an updated policy and procedure manual for short-dated and expired medicines	42 (96%)	2 (4%)
Register of expired medicines is available	40 (91%)	4 (9%)
Records are kept for an acceptable period according to government regulation	15 (35%)	29 (65%)
Facility has surveys for short-dated medicines as indicated in medicines register	10 (23%)	34 (77%)
Expired medicines are stored safely and separate from edible medicines	13 (30%)	31(70%)

4.7 Factors affecting timely collection of expired medicines

Chi-squared tests were done to determine the factors related to the timely collection of short-dated and expired medicines from the facilities. The p-Values were tabulated

Table 4. 5 p-Values for factors related to the timely collection of short-dated and expired medicines from health facilities

Type of medicines	.874
Background training of officer doing stock management	.557
Amount of medicines in need of being acted upon	.045*
Availability of extra storage space at the institution	.025*
Source of medicines	.007*

*significant

This showed that the type of medicines had no association with when short-dated medicines would be send to the district for redistribution or disposal. The same was also true of the background training of the officer responsible for medicine stock management.

However there was a significant association between the source of medicines and when they would be collected. This relation improved with privately sourced medicines and deteriorated with medicines from the national pharmacy supplies. There was also a significant association between timely medicine collection and redistribution and the amount of medicines in store and the availability of extra storage to store medicines.

4.8 Factors dependant on presence of standard operating procedures at health facilities

The lambda values were calculated to determine the whether the availability of standard operating procedures and policy documents and independent variables had an effect on a number of dependant variables;

Table 4. 6 Factors resulting from availability of standard operating procedures

Dependant variable	Lambda value
Register for expired medicines is available	.667*

Type of medicine in expired medicines register	.124
Source of medicine in the medicine expired	.311
Duration of keeping records	<.001

*significant

Cross tabulation was done and the lambda value of .667 for availability of an expired medicines register indicate that facilities that have an updated policy and procedure manual for disposal of expired medicines have a 67% chance to have a register of expired medicines. This is a strong association. It shows that most facilities that have an updated policy and procedure manual for disposal of expired medicines are likely to have a register of expired medicines (42 vs 1). On the contrary, facilities that do not have an updated policy and procedure manual for disposal of expired medicines are unlikely to have a register of expired medicines (1 vs 5).

However the duration for which facility records were kept at health facilities has a very weak dependence on whether the facility had standard operation procedure manuals and policies for medicines stock management. This meant that availability of standard operating procedures had a weak relationship with how long records were kept at the facility.

4.9 Assessment of basic stock management practices

4.9.1 Effect of health worker sex of basic management practises

Table 4. 7 Effects of sex on health worker performance on expired medicines awaiting disposal

	Do you have a system for tracking expired medicines awaiting disposal		
	Yes	No	OR

What is your sex	Male	7	18	1.167
	Female	6	18	0.857
Total		13	36	49

Table 4. 8 Chi-squared tests comparing performance based on gender differences

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	5.478[a]	4	.242
Likelihood Ratio	5.544	4	.236
Linear-by-Linear Association	.019	1	.890
N of Valid Cases	49		

*significant

Pearson correlation was run comparing the relationship between sex of health care workers and the stock management practises. Since the p-value is more than our chosen significance level α = 0.05, we can conclude that there is a weak association between the gender of health practitioners and medicine management practises. Both sexes have comparable skills of medicine management. ($X^2(4) = 7.649$, $p = 0.242$), The odds of getting either of the good medicine stock management control was insignificant for both sexes. CI 95% 0.240 – 3.055, OR 1.167, p = .242.

4.10 Relationship between having a system to track expired medicines awaiting disposal and having a policy and procedure manual for stock management

Relationship between having a system to track expired medicines awaiting disposal and having a policy and procedure manual for stock management

Table 4. 9 Significance of SOPs to having a system to track expired medicines

	Do you have a system for tracking expired medicines awaiting disposal		
	Yes	No	OR
yes	12	31	1.935

The facility has an updated policy and procedure manual for disposal of expired medicines	no	1	5	0.517
Total		13	36	49

Table 4. 10 Chi-square tests comparing availability of SOPs and a system to track expired medicines

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.341[a]	1	.559		
Continuity Correction[b]	.008	1	.928		
Likelihood Ratio	.371	1	.542		
Fisher's Exact Test				1.000	.490
Linear-by-Linear Association	.334	1	.563		
N of Valid Cases	49				

Since the p-value is more than our chosen significance level α = 0.05, we can conclude that there was a weak association between availability of a policy and procedure manual for disposal of expired medicines and availability of a system for tracking expired medicines awaiting disposal. OR = 1.935, 95% CI = 0.204 – 18.328, $X^2(1)= .341$, p = 0.559.

4.11.1 Significance of the health care worker performing stock management

Table 4. 11 Significance of worker performing medicine management

		Do you have a system for tracking expired medicines awaiting disposal		
		Yes	No	OR
who is responsible for stock management	Nurse	7	7	15.615
	nurse aid	6	19	0.767
	pharmacy technician	0	10	
Total		13	36	49

Table 4. 12 Chi-squared tests comparing effect of HWC on stock management

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	7.649[a]	2	.022
Likelihood Ratio	9.734	2	.008
Linear-by-Linear Association	7.487	1	.006
N of Valid Cases	49		

Since the p-value is less our chosen significance level α = 0.05, we can conclude that there is an significant association between the health worker who does stock management and availability of a system for tracking expired medicines awaiting disposal. ($X^2(2) = 7.649$, p = .022, 95% CI = 1.231 – 18.975, OR = 4.833)

4.11.2 Significance of experience of basic management practises

Table 4.13 Significance of work experience on basic stock management practices

		Do you have a system for tracking expired medicines awaiting disposal		
		yes	No	Total
How long have been working completed years	you less than 3 years	2	13	15
	in 3 years - 10 years	7	13	20
	more than 10 years	4	10	14
Total		13	36	49

Odds Ratio

less than 3 years	0.32
3 years - 10 years	1.37
more than 10 years	1.16

Therefore the odds of having a system to track for stored expired medicines awaiting disposal are higher in health care workers who have served more than 3 years but less than 10years (1.37), however the odds were noted to be lowest in newly

recruited HCW (0.32). Lower odds (1.16) were also noted in workers who had spent more than 10 years.

4.12 Significance of work experience

Table 4. 14 Significance of work experience

		Do you have a system for tracking expiry dates in pharmacy medicines		
		yes	No	Total
How long have been working completed years	you less than 3 years	9	6	15
	in 3 years - 10 years	16	4	20
	more than 10 years	13	1	14
Total		38	11	49

Odds ratio	
less than 3 years	0,17
3 years - 10 years	1,27
more than 10 years	5,65

Table 4. 15 Chi-squared tests showing significance of work experience

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	.007	2	.100
N of Valid Cases	49		

a. 3 cells (50.0%) have expected count less than 5. The minimum expected count is 3.14.

The odds of having a system that checks for expiry medicines on medicines in use gradually increases as HCW spend more time in the health delivery system (p = .007). It is higher among clinicians who have served for more than 10 years and least amongst the newly recruited cadres.

4.12Effect of human resource capacitation on basic management practises

Table 4. 16 Effect of human resource capacitation on basic management practices

		Do you have a system for tracking expiry dates		
		Yes	no	Total
How long ago were you trained on disposal of expired medicines	1 year - 3 years	6	0	6
	more than 3 years	4	4	8
	I do not remember	28	7	35
Total		38	11	49

Table 4. 17 Chi-squared tests showing effect of human resource capacitation on basic management practices

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	5.345[a]	2	.069
Likelihood Ratio	6.070	2	.048
Linear-by-Linear Association	.057	1	.812
N of Valid Cases	49		

a. 3 cells (50.0%) have expected count less than 5. The minimum expected count is 1.35.

4.13 Effect of human resource capacitation on tracking of expiry dates

Table 4. 18 Effects of human resource capacitation on tracking of expiry dates

		Do you have a system for tracking expiry dates		
		Yes	No	Total
How long ago were you trained on stock management	6 months - 1 year	6	0	6
	1 year - 3 years	2	0	2
	more than 3 years	5	4	9
	I donot remember	25	7	32
Total		38	11	49

Analysis of the medicines ordering forms at clinic also indicated that mentorship by the pharmacist when they visit for supportive visits improved tracking of expiry dates on nurses who had not been formally trained.

4.14 Relevance of experience compared to training needs

Table 4. 19 Relevance of experience to compared to training needs

		How long have you been working in completed years	How long ago were you trained on stock management
How long have you been working in completed years	Pearson Correlation	1	.358*
	Sig. (2-tailed)		.012
	N	49	49
How long ago were you trained on stock management	Pearson Correlation	.358*	1
	Sig. (2-tailed)	.012	
	N	49	49

*. Correlation is significant at the 0.05 level (2-tailed).

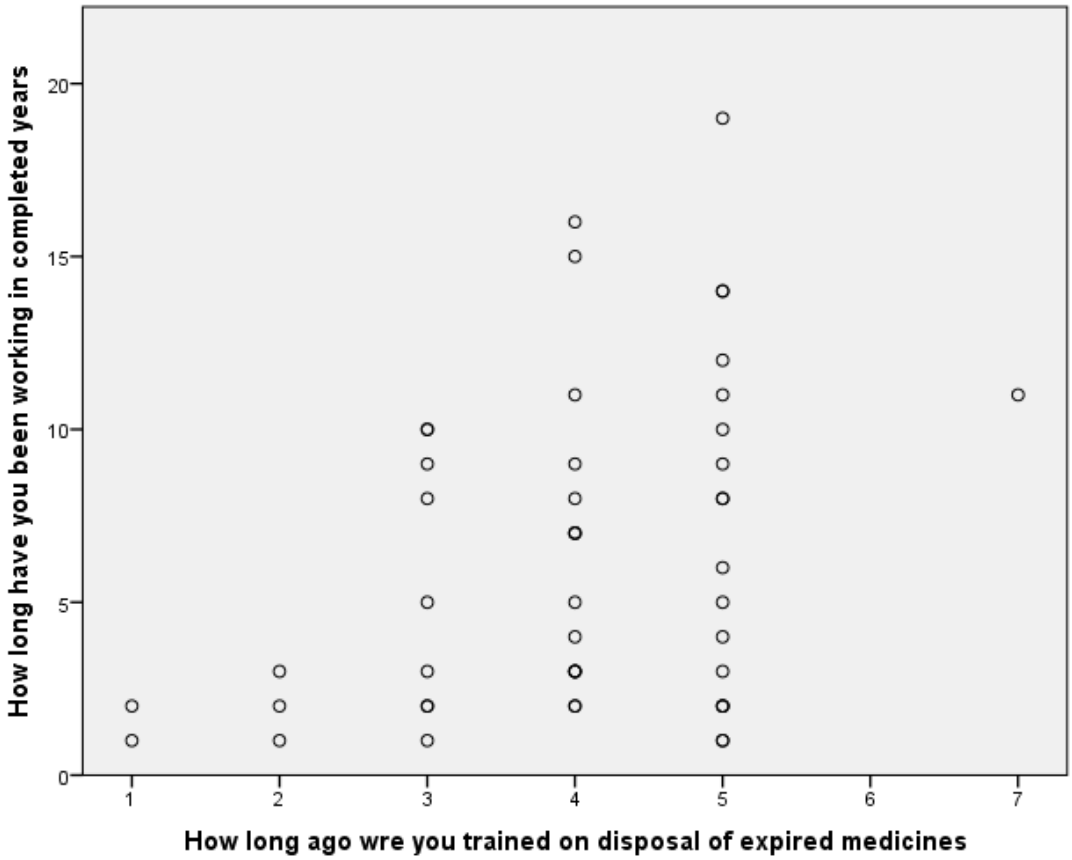

Figure 4. 5 Relationship between clinician experience and duration of employment

Work experience and human resource capacitation have a linear relationship (r = 0.358, p = 0.012).

The direction of the relationship is positive (human resource capacitation and years of experience are positive correlated), meaning these variables tend to increase together. The magnitude off the association is approximately moderate (.3 <I rI<.5)

However when the same was done comparing work experience and age, it was noted a very strong positive relationship with a very strong association. (r = 0.559, p < 0.001).

Table 4. 20 Correlation between staff duration of employment and age of workers

		How long have you been working in completed years	What is your age
How long have you been working in completed years	Pearson Correlation	1	.591**
	Sig. (2-tailed)		.000
	N	49	49
What is your age	Pearson Correlation	.591**	1
	Sig. (2-tailed)	.000	
	N	49	49

**. Correlation is significant at the 0.01 level (2-tailed).

4.15 Effect of work experience on performance

An independent samples t-test was conducted to compare how long someone had been working in completed years and whether they separated expired and unexpired medicines. There was not a significant difference between those safely storing expired medicines (M = 7.38, SD = 5.51) and those not safely expired medicines (M = 5.83, SD = 4.26), t(47) = - 1.6, p = .30.

It was also noted that having a system for tracking medicine expiries was closely related to how frequent short dated or expired medicines are acted on with a significance of .229.

4.16 Quality observations

The district hospital medicine stores was noted to have a critical shortage of space. This resulted a ripple effect with facilities failing to send medicines for storage at the main medical stores. Therefore all facilities had to store expired medicines onsite awaiting collection for disposal.

The situation is tender at the district hospital where the expired medicines are kept needed urgent attention it was noted some hospital records and expired medicines were exposed to the agents of the environment. A challenge has been noted with regards to storage of medicines.

CHAPTER 5SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter summarizes the study findings and discuss whether study objectives where met and gives conclusions of hypothesized phenomena. Recommendations will also be postulated for policy makers.

5.2 Discussion

5.2.1 The Participants

This study can be used as a proxy to study the demography of health care workers in the study setting. In a literature review by Habib (2018) it was noted there is a male predominance in medicine management which was the opposite of observations from this investigation. However is also noted the difficulties facing women to venture into the health workforce. This has made it difficult for many organizations to achieve the sustainable development goal on gender equality. This study however noted the improvement as twenty five of the 49 participants were male. This reflects a 1:1 ratio for gender distribution.

On age distribution the study contradicts with the study by Rypicz et al (2016) who did a study on Polish nurses. In the study the age of Chipinge district respondents was normally distributed with a minimum age of 24 years and the maximum age of 57 years old. The mean age was 42 years. The majority (38) of the 49 participants had a nursing background, followed by doctors constituting just below a tenth of the frequency (8%). Pharmacy and other government department each constituted 65 of

participants. However Rypicz noted that experienced workers who are more senior tend to perform poorly ability to work decreases with age (r_s = -0.324, p < .000) and with seniority (r_s = -0.257; p < .000)., and they contributed this to the aging process. However this study noted a linear positive correlation between performance in medicine stock management and levels of seniority at worker. The odds of having a system that checks for expiry medicines on medicines in use gradually increases as HCWs spend more time in the health delivery system (p = .007) with OR 5.67 for workers employed for more than 10 years compared to OR 0.17 for employees less than 3 years.Despite being to a certain extent, this partially agrees with Rypiz who suggested that health care worker performance decreases with duration in performance. A decrease in performance could be extrapolated from these figures to suit the finding by Rypicz if the upper limit of the age had been adjusted. This can be inferred because the population in Chipinge is generally younger population compared to Poland community where Rypicz did his research.

5.2.2 Expiry patterns

The study results came out as anticipated in terms of the drug expiry patterns with prescription medicines such as ant-infective medicines, antiretroviral therapy and medicines contributing the most expiries. Thirty-two percent of entries of expired medicines into the expired medicines register were anti-infective medicines and the this was followed by anti-retrovial medicines at 27% and resuscitation medicines at 20%. However it also included resuscitation medicines in the expiries as well. The study partially agrees with Ebrahim et al who analysed expiring medicines in a facility based cross sectional study in 2016 and noted the most expiries being anti-infective medicines (36.4%), pain killers (21.4%)and cardiovascular at 11%. Unfortunately these study findings are also in contradiction with Bergen et al who

only identified cardiac and anti-diabetic medicines as the main classes of expiries in sampled Australian health facilities.

The study also noted that donated drugs were also more likely to expire compared to privately sort medicines. This agrees with McGregor who noted that for 5 years starting 1992, 60% of the medicines received by 2 third world countries were not needed resulting in gross expiries. Chipinge is at risk of this challenge because the 5 church related health facilities receive some of their medicines directly through their responsible authorities increasing the risks of unmonitored medicine donations. It was also noted that 60% of the expired anti-infectives, all the ART and only 10% 0f the resucitation medicines had been sourced from the central pharmacies.The majority of expired medicines are sourced from the national pharmacy. This contributed four-fifths of the expired medicines consignement. About donated medicines expiring Pinheiro (2008) said that the inappropriateness of drug donations comes primarily from a myriad of origins including industry surpluses, free medical samples, drugs collected by independent organizations or returned to pharmacies for disposal. The challenge is that some drugs arrive unsorted and labelled in languages unknown to the professionals in the field resulting in them expiring. Expired drugs on time of arrival and drugs close to expiry comprise a large proportion of donations from nongovernmental organizations, corporations, pharmaceutical industries and associations. Facilities may face challenges turning these donations down. This practice may be defended by a sad assertion that making use of expired, partially degraded drugs is better than having none at all. This might suggest a possible explanation why medicines from the national pharmacy and donors contributed 80% and 5%, respectively.

5.2.3 Timely collection of medicines

This study showed that there was a significant association between the source of medicines and when they would be collected. This relation improved with privately sourced medicines and deteriorated with medicines from the national pharmacy supplies. This idea was generalized by Solomon et al (2020) when he argued that lack of reliable transportation can hinder medicine transportation. He goes on to advise that improving the availability of transport between rural health centres and district hospitals, and between the district and central hospitals, could help overcome the transportation barriers to health care.

5.2.4Availability of protocols

Standard operating procedures for disposal for short dated and expired medicines were found in 92% of facilities and this agrees with the recommendation by Manocha et al (2020) who argued that it improved medicine stocking. However, there was a weak relationship between availability of SOPs for medicine disposal and the actual disposal of the medicines as shown by the fact only 33% of facilities with Standard operating procedures actually used them. Availability of standard operating procedures does not translate to their use especially when health practitioners are not trained on their use. Francis et al (2010) also noted standard operating procedures improved the documentation rate of numerous prompted and non-prompted items, independent of whether these items had a high SOPs improved the documentation rate of numerous prompted and non-prompted items, independent of whether these items had a high (for example, Glasgow Coma Score: 91.5% versus 95.7%) or a low documentation rate during the period before implementation of protocols (for example, allergies: 6.2% versus 18.7%). Prompted items were more frequently documented than non-prompted items, both before and after the introduction of SOPs. Prompted items were more frequently documented than non-

prompted items, both before and after the introduction of SOPs. The opposite was also noted however, when weak association between availability of a policy and procedure manual for disposal of expired medicines and availability of a system for tracking expired medicines awaiting disposal. ($X^2(1) > .341$, $p = 0.559$) was noted.Francis et al (2010) recommended that developing SOPs is an effective tool to improve the quality of PCRs and the rate of completion of documentation items. Check boxes on PCR forms seem to have an important impact as they prompt the initial assessment, treatment and documentation of the actions taken during an EMS call. Consequently, SOPs and check boxes may serve to improve the transition of important information to emergency department staff, and thus contribute to improved patient care.

5.2.5 Officer responsible for stock management

It was noted that the odds of better medicines stock management were 4 times better at 95% CI if stock management was done by a nurse compare to a facility where the stock management was done by a pharmacist. There was a weak association between availability of a policy and procedure manual for disposal of expired medicines and availability of a system for tracking expired medicines awaiting disposal. ($X^2(1) > .341$, $p = 0.559$). This was worsened by the fact that all pharmacy technicians enrolled in the study had less than one year of experience and the odds of a health worker who had more than 3 years having a system to follow expired medicines awaiting disposal was more than twice the odds of HCW who had spent less than 3 years.

Bhayana et al (2016) in his study on health workers in New Dehli noted nurses (76%) had significantly ($P < 0.01$) better knowledge over doctors regarding the methods of drug disposal, whereas both doctors (63%) and nurses (64%) knew

significantly ($P < 0.05$) more than pharmacists about type of formulations not to be incinerated. These findings partially agrees with results from the study. Even though a weak association was noted between availability of poly and standard operating protocols for expired medicines and the actual implementation of the protocols ($p = 0.559$) there a very strong relationship between the officer doing stock management and availability of a system for tracking expired medicines awaiting disposal ($p= .022$).

5.2.6Training of HCW of stock management

It was noted in the study that most clinicians lacked knowledge for stock management. The pharmacist are the medicines stock management mentors therefore but they were not comfortable discussing medicine destruction issues thus the study agrees with Manzini et al (2019) who noted poor management skills amongst the pharmacists. It is unfortunate that the training of pharmacists relies of principles and theory of pharmacy practice but just summarizes the principles of management, tutoring and mentorship.

5.2.7 Levels of knowledge

The majority of participants indicated knowledge on the need for disposal of expired medicines they only a few had adequate levels of knowledge. This agrees with Kahsay (2020) who noted that almost half of the sample population were unaware of proper disposal practices. The study also showed that the few knowledgeable HCW were reluctant to follow the correct procedures.

The odds of a nurse being trained on medicine stock management in the past 3 years was very low as more than half of them were not sure when they were trained on medicine stock management. This was associated with health care workers not updating the district office of their medicine stock statuses thus study agrees with

findings by Mardani, Griffiths and Vaismoradi (2020) that nurses who are not involved in stock management of medicines prescribe poorly. This Therefore, they should be empowered and more involved in medicines management initiatives in the healthcare system.

5.2.8 Acceptance of expired medicines

The Zimbabwe guidelines on disposal of expired medicines advice that wherever practical the possibility of returning unusable drugs for safe disposal by the manufacturer should be explored; particularly drugs which present disposal problems, such as antineoplastic. They also advise that unwanted, unrequested donations, especially those that arrive past or unreasonably near their expiry date it may be possible to return them to the donor for disposal. This was however noted to be easier said than done as the opioids from the mission health facilities were received despite being short dated.

5.2.9 Qualitative observations

The district hospital medicine stores was noted to have a critical shortage of space. This resulted a ripple effect with facilities failing to send medicines for storage at the main medical stores. Therefore all facilities had to store expired medicines onsite awaiting collection for disposal.This agrees with Sophia (2020) who noted that mass expiries overwhelm the disposal system.

5.3 Conclusion

From the discussion we can conclude that the findings from this study agree to a large extent with researches that have been done prior. Even though there has been a gender balance in the sample of health care workers participating in the study, an improvement in medicine management skills was noted with improved job

experience in contrary to previous studies. It was also noted that more of the expiries were anti-infective medicines while there were contradictions between analgesics, cardiac and resuscitation medications. It was also noted that the availability of standard operating procedures does not translate implementation of protocols especially if there is little or no training of officers.

5.4 Implications

The findings from this research indicate an equal level of performance between male and female health care workers in the disposal of expired medicines. This study also calls for policy makers to allocate more resources to sensitize all incoming staff on the protocols for disposal of expired medicines. The fact that more than a quarter of the expired medicines were anti-retroviraldrugs indicate the degree of attention allocated to these medicines. Health care workers consider them as donated medicines, however the government would have procured them and even their disposal would need to be funded further burdening the medicine budget.

5.5 Recommendations

- There is a need to continue promoting gender equality in the workplace. This will facilitate reaching the sustainable development goals by the country. If this recommendation is applied by the ministry of health gender quality will be maintained in the workplace.
- There is a strong need by the ministry to sensitize and train all incoming nurses on the need to prioritize medicine stock management. Medicine stock management should not be done by nurse aiders at clinic level. All newly recruited nurses should be continuously supported and mentored on good medicine management practices.

- The medicines supplied by the national pharmacy are ordered in such a manner that clinics end up overstocking on medicines. The medicine pulling system should be strengthened and facilities should only be given medicines that they would have requested. They is also a strong need to monitor closely donated anti-infective medicines
- Considering the high proportion of anti-retroviral therapy medicines there is a strong need to do another study identifying reasons for such a tremendous figure.
- Considering that donated medicines are more likely to expire especially if they do not come in through the normal systems and or have been supplied through the distribution approach, there is a strong need to involve the district pharmacy manager in the distribution of donated medicines.

5.6 Suggestions for further research

Considering the high proportion of expired ARVs, there needs to be an exploration why this is as such.These expired medicines will need to be further stratified according to category and the expiry patterns analysed.

The expired medicines were analyzed over a short period of time. There is a strong need to repeat the research over a long period of time and also analyze the medicine supplies from the 3 sources.

REFERENCES

Ayele, Y. Mamu, M., (2018), Assessment of knowledge, attitude and practice towards disposal of unused and expired pharmaceuticals among community in Harare city, Eastern Ethiopia, *Journal of Pharmacy Policy and Practice*, 2(2), 123-130.

Francis R. C., Schmidbauer, W., Spies, C.D., Sörensen, M., Bubser, F., Kerner, T,. (2010). Standard operating procedures as a tool to improve medical documentation in preclinical emergency medicine. *Journal of Emergency Medicine*, 27(5), 350-354.

Bhayana, K., Rehan, H.S., Arora, T., (2016). Comparison of the knowledge, attitude, and practices of doctors, nurses, and pharmacists regarding the use of expired and disposal of unused medicines in Delhi. *Indian Journal of Pharmacology.* 48(6), 725-728.

Rypicz, L., Witczak, I., Rosińczuk, J., Karniej, P., Kołcz, A., Abdullah A., (2021). Factors affecting work ability index among polish nurses working in hospitals - A prospective observational survey. *Journal of Nursing Management,* 29(3), 468 – 476.

Bashaar, M., Vijay, T., Mahomed, A., Fahad, S., Mohammad , (2017). Disposal practices of unusused and expired pharmaceuticals among the general public in Kabul, *Biomedcentral Public Health*, 17(45), 123 – 143.

Brandon, T., Bodkyn, C., Gupta, C., Avram E. (2020). Access to WHO Essential Medicines for Childhood Cancer Care in Trinidad and Tobago: A Health System Analysis of Barriers and Enablers. *Pubmed Central Journal of Global Oncology*. 34(3), 439 – 448.

Kofi, B., Mensah, A., Mensah, V., Bangalee V., (2021). Evaluating essential medicines for treating childhood cancers: availability, price and affordability study in Ghana. *Biomedical Centre Cancer*, 21(6). 127 – 130.

Nakyanzi, J., Kitutu, F., Oria, H., Kamba P., (2010). Expiry of medicines in supply outlets in Uganda: Lessons from the Field. *World Health Organization Bulletin*. 88(2), 154–158.

Pakoyo, K., Munanura, E., Balikuna, S., Bruhan, K. (2017), Threats posed by stockpiles of expired pharmaceuticals in low- and middle-income countries: A Ugandan perspective, *Bulletin of the World Health Organisation*. 95(8), 594-598,

Sophia, I., (2020) Comparative Study of Pharmaceutical Waste Disposal in Ethiopia, Kenya, Sudan and Uganda September, *Transforming the supply chain*, 11(1), 40-59

Government Gazette, Public Health Act, (Chapter 15:17), General Notice 66/2018. McGregor A. International drug-donation guidelines revised. *Lancet*.:34 (11), 116-121

Trap, B., Ladwar, D.O., Oteba, M.O., Embrey, M., Khalid, M., Wagner, A. K., Supervision, Performance Assessment, and Recognition Strategy (SPARS) - a multipronged intervention strategy for strengthening medicines management in

Uganda: method presentation and facility performance at baseline. *Journal Pharmacy Policy and Practise*. 9(1), 31 -34

Sanchez, W., Sremski, W., Piccini, B., Palluel, O., Maillot-Maréchal, E., Betoulle, S., (2011). Adverse effects in wild fish living downstream from pharmaceutical manufacture discharges. *Journal of Environment International*.. 37(8), 415-425

Oaks J.L., Gilbert M., Virani, M.Z., Watson, R.T, Meteyer, C.U., Rideout B.A., (2007), Diclofenac residues as the cause of vulture population decline in Pakistan. *Journal of Nature*.427(697), 630–633

Levy S.B., (2002). Factors impacting on the problem of antibiotic resistance. *Journal of Antimicrobial Chemotherapy;* 49(1), 25–30.

Guidelines for safe disposal of unwanted pharmaceuticals in and after emergencies. Geneva: World Health Organization; 1999.

APPENDICES

APPENDIX 1

Form for Health Care Worker

Questionnaire No ----------

How are you? My name is Brian Makumbe. I am a Masters of Public Health student from the Africa University. I am carrying out a study on an inventory of medicines expiring at 3 Hospitals in Chipinge District, Manicaland Zimbabwe from January 2021 to December 2021. The purpose of the research is to identify factors that affect the disposal of expired medicines at health institutions. This will assist in coming up with an effective management program. Your participation in the study is voluntary. Information collected from you is confidential. If you agree please sign below

Participant's signature_____ Date_____

Questionnaire number ……..

Part A: Socio-Demographic data

- Sex (Observe) M [ ] F [ ]
- What was your age at last birthday? …….
- Where do you work?

MOHCC		Other government departments		PVO	Other
Clinician	Admin				Specify

How long have you been working there in completed years? [ ]

a) Human resource capacitation

How long ago were you trained on each of the following?

Question	<6 months ago	6/12 – 1 year	1 -3 years	➢ 3 years	Don't remember
Medicines stock management					
Disposal of expired medicines					

b) Resources and equipment

Question	Yes	No
How frequent do you send your expired medicines for disposal		

c) Communication

Question	Yes	No
Are you notified when you are about to receive expired medicine?		
Do you have a system for monitoring progress of expired drugs awaiting disposal?		

Governance

Who is the dedicated cadre for stock management?

Adapted from Sukumar

APPENDIX 2 Facility Checklist for Chipinge

The Checklist to be used in assessment of Expired Medicine Stock Management

Policies and Procedures	YES	NO	Comments
The facility has an updated policy and procedure for manual for disposal of expired medicines			
Staff have been inservices of the policies and procedures for stock management of expired medicines			
Register of expired medicines is available			
Register of expired medicines is up to date			
Records are kept for an acceptable period according to government regulation			
Board of survey for expired medicines committee is available			
Board of survey for expired medicines is function			
Expired medicines are stored safely and separate from edible medicines			
Expired medicines are labelled in shelf			
Concurrences to dispose expired medicines are received and auctioned accordingly			
Hospital Medicines and Therapeutics Committee is functional			

Adapted from facility MOHCC support and supervision checklist

APPENDIX 3 Inventory of expired medicines

Date of entry in expiry register	Name of Medicine	Source of medicine	Strength	Batch number	Quantity	Date of Expiry	Date of final disposal (if disposed)	Method of Disposal

APPENDIX 4

AFRICA UNIVERSITY RESEARCH ETHICS COMMITTEE (AUREC)

P.O. Box 1320 Mutare, Zimbabwe, Off Nyanga Road, Old Mutare-Tel (+263-20) 60075/60026/61611 Fax: (+263 20) 61785 website: www.africau.edu

Ref: AU2317/22 17 January, 2022

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AFRICA UNIVERSITY RESEARCH ETHICS COMMITTEE (AUREC)

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Ref: AU2317/22 17 January, 2022

BRAIN MAKUMBE
C/O CHANS
Africa University
Box 1320
Mutare

RE: AN INVENTORY OF MEDICINES EXPIRING AT 3 HOSPITALS IN CHIPINGE DISTRICT, MANICALAND PROVINCE, ZIMBABWE FROM JANUARY 2021 TO DECEMBER 2021

Thank you for the above titled proposal that you submitted to the Africa University Research Ethics Committee for review. Please be advised that AUREC has reviewed and approved your application to conduct the above research.

The approval is based on the following.
a) Research proposal
b) Data collection instruments
c) Informed consent guide

- **APPROVAL NUMBER** AUREC 2317/22
  This number should be used on all correspondences, consent forms, and appropriate documents.
- **AUREC MEETING DATE** NA
- **APPROVAL DATE** January 17, 2022
- **EXPIRATION DATE** January 17, 2023
- **TYPE OF MEETING** Expedited
  After the expiration date this research may only continue upon renewal. For purposes of renewal, a progress report on a standard AUREC form should be submitted a month before expiration date.
- **SERIOUS ADVERSE EVENTS** All serious problems having to do with subject safety must be reported to AUREC within 3 working days on standard AUREC form.
- **MODIFICATIONS** Prior AUREC approval is required before implementing any changes in the proposal (including changes in the consent documents)
- **TERMINATION OF STUDY** Upon termination of the study a report has to be submitted to AUREC.

AFRICA UNIVERSITY
RESEARCH ETHICS COMMITTEE (AUREC)
APPROVED
P.O. BOX 1320, MUTARE, ZIMBABWE

Yours Faithfully

MARY CHINZOU –
ASSISTANT RESEARCH OFFICER: FOR CHAIRPERSON
AFRICA UNIVERSITY RESEARCH ETHICS COMMITTEE

Ministry of Health & Child Care
Chipinge District Hospital
P.O. Box 200
Chipinge

Tel: +263-227-2901/2946, Cell: +263-776-094 241

2 September 2021

To : Makumbe Brian, MPH STUDENT, AFRICA UNIVERSITY

REF : PEMISSION TO CONDUCT ACADEMIC RESEARCH AT CHIPINGE DISTRICT HOSPITAL

This letter serves to confirm to inform you that permission had been granted for you to conduct academic research under the Africa University Masters of Public Health Program at Chipinge District Hospital

You can proceed with your research studies, and best wishes.

Regards

DR.O. MATEKENYA

Medical Superitendant

Chipinge District Hospital

MBChB - UZ

MINISTRY OF HEALTH & CHILD CARE
CHIPINGE DISTRICT HOSPITAL
DISTRICT MEDICAL OFFICER
02 SEP 2021
P.O. BOX 200, CHIPINGE
ZIMBABWE