COLLEGE OF COMPUTING AND INFORMATICS TECHNOLOGY

DRUG EXPIRY MONITORING AND CONTROL SYSTEM

By

CS19-2

DEPARTMENT OF COMPUTER SCIENCE

SCHOOL OF COMPUTING AND INFORMATICS TECHNOLOGY

A Project proposal submitted to the School of Computing and Informatics Technology

For the Study Leading to a Project Report in Partial Fulfillment of the

Requirements for the Award of the Degree of Bachelor of Science in Computer Science

Of Makerere University

Supervisor

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APPROVAL

This document is approved by our supervisor.

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ABSTRACT

This proposal is for a group of computer science students at CoCIS, Makerere University for the final year project. It is about developing an information system that will be used to track drug life span (expiry date), drug distribution and drug destinations as from NMS to the several public health and private-not-for-profit health facilities in order to reduce the rate of drug expiry in Uganda.

Chapter 1
1.0 INTRODUCTION
1.1Background
Of recent Ministry of health destroyed between 1200 to 1500 tons of expired drugs, worth billions of shillings. The exercise saw National Medical Stores picking expired drugs from a total of 6619 government and private non-profit facilities across the country.

The expiry of medicines in the supply chain is a serious threat to the already constrained access to drugs in developing countries [2]. The government authorized the National Drug Authority (NDA) to spend Shs960 millions to destroy 1,500 metric tons of expired human and veterinary medicines. Health Minister Jane Ruth Aceng gave a nod after NDA board chairman, Dr Medard Bitekyerezo, on March 28, 2018 sought authorization for the agency to re-allocate money from its 2017/18 budget to incinerate pharmaceutical waste from public, private and private-not-for-profit health facilities [3].

Mr. Moses Kamabare, the general manager of the National Medical Store (NMS) said while there have been cases of drug stock outs, other drugs are also getting expired all the time. He was quoted saying, "We do not know which items are expired and what volume is expired. We expect that when we pick these items from the health facilities, we shall possibly have an idea of the different types of drugs that have expired." [2]

1.2 Problem statement
This project aims at improving tracking of expiry of drugs that are supplied with in Uganda. National Drug Authority (NDA), National Medical Stores (NMS) and Joint Medical Stores (JMS) have established systems and procedures to accomplish their functions over the years but has fallen short of ways to reduce the quantity of drugs that expire within the countries boundaries. Furthermore, there are no specified guidelines on how to ascertain the quantity and location of expired drugs in the country. Recently they had to appeal to local distributers to hand over the expired products to the District Health Officers (DHOs) process that took Shs960 million – an amount we believe is too much. With this project, drug distribution will be a transparent process and tracking of extent of expiry and planning of ways to reduce expiry rates, an easy venture. It will be easy to track the life span of a supplied drug as well its extent of distribution in the country in real time.

1.3 Objectives
1.3.1 Main objectives
To reduce the quantity of drugs that expire within Uganda and provide a clear understanding of the extent of drug expiry within the country at any time.

1.3.2 Specific objectives
- To track all fundamental transaction involving exchange of drugs allover Uganda.
- To map all locations that have drug in the country

- To keep track of the expiry dates of drugs no matter how many hands they go through.
- To provide functions that can aid in drug distributions planning and a data management system for analysis and research.

1.4 Scope

We shall consider drugs that we have been identified to be expiring most and these include antivirals like ARVs for HIV-positive adults, niverapine syrup for babies exposed to HIV/ Aids, aluvia syrup for HIV-positive babies and antimalarials like lumartem, antibiotics like amoxicillin, and paracetamol.

1.5 Significance

- There will be clear understanding of the extent of distribution of each specified type of drug and a better estimate of the extent of expiry of each specific drug.
- There will also be functions in the system that will aid in drug distribution pattern, planning and optimization of supply stocks.
- It will be easy to identify the health units with expired drugs and the quantity they are estimated to possess.
- The data that will be collected from the distribution patterns and exchange of drug from distributers to several public health centres will be helpful in making further research and will contribute to National Health statistics.
- Since the system will be in place to detect the expiry dates, this information will be used to re-allocate the distribution to deter the expiry before it happens.

Chapter 2

2.0 LITERATURE REVIEW

2.1 Introduction.

In the recent years the government has laid down structures for drugs disposal rather deterring/minimizing the rate of the drug expiry. The amount of expired medicines across the country was estimated to be 1,200 to 1,500 tons by Feb 2018 statistics. This is why the Ministry of Health has embarked on a drive to dispose of expired and unwanted medicines as reported by the Observer [4]. From analysis most of the expired drugs are from the public health centres and private not-for-profit facilities. The ministry disposed of expired medicines and other unwanted health supplies from 6,619 health facilities, both government owned and private not-for-profit (PNFP) health facilities as by Diana Atwine, the permanent Secretary Ministry of Health.

2.2 Drugs Distribution Chain in Uganda by NMS.

NMS carries out the following major activities to perform its role; Customer Delivery, Supply Chain Planning, Receipt & Storage of Supplies, Warehouse Management, Inventory Management, Customer Order Processing & Delivery, Transport, Route Planning. [6] Before delivering drugs, NMS designs distribution schedules for each financial year that it follows to deliver drugs to the various public health facilities. This however, does not take into account the changing consumption rates by each health facility.

In need to capture customer feedback NMS developed an NMS Smart Care which is a set of tools that offers different channels through which Public Health Facilities and the general public are able to send feedback to NMS based on their convenience. NMS Smart Care further gives NMS visibility on deliveries made in real time, when the delivery was made, who received the supplies and if there are any issues related to the delivery. Below are the channels that can be used to access NMS Smart Care.

1. NMS Smart Care APP (found in Google Play Store for android devices) and online - http://smartcare.nms.go.ug for sending feedback to NMS
2. NMS LMD APP (Found in Google Play Store for android devices) and online - http://dmt.nms.go.ug/ to know where NMS is delivering in real time.
3. SMS to 6090 (SMS to this short code is free of charge)
4. Live Chat – http://www.nms.go.ug

2.3 Current Drugs Expiry monitoring in Uganda

In 2012 the Uganda Ministry of Health put in place the national guidelines on the redistribution and prevention of expiry and handling of medicines and health supplies to provide a harmonized framework for the redistribution and prevention of the expiry of medicines in Uganda.

Medical supplies do have limited shelf lives. Standard treatment guidelines, laboratory testing protocols, and morbidity patterns change at times, therefore it can be expected that some

medicines may not be used before expiry. Health workers can limit stock expiry by closely monitoring expiry dates and taking the appropriate action to redistribute stock when necessary. This part describes the procedures for redistribution of medicines and health supplies and how to write off expired supplies.[1]

As a general rule, any item expiring in three months' time is short dated. However, some slow-moving items can also be included in that category, for example praziquantel tablets, or items which are only available in large units. At times, it is obvious even before three months prior to the expiry date that the item will not be used. [1]

When doing the monthly physical count, you will notice items that are short dated. It is extremely important to take immediate action to avoid any item's expiration on the shelf. Allowing three months for redistribution is a short time, and the process must begin immediately.

AT THE HEALTH FACILITY

Steps to take at the health facility include;

- Making a note of any item expiring within three months (or longer, for slow-moving items)

- Calculating how many units will be issued and used by your facility before the item expires.

From that figure you can see how much you need to redistribute

Steps to take include the following;

1. Alert the HSD(Health Sub-district) or the district about any stock that cannot be used before expiry or that you have too much of.

2. Hand over the items to the district or HSD supervisors for redistribution. Be sure to fill in a requisition and issue voucher to go with the stock and keep a copy for the facility. A member of the health unit management committee should be present during the handover.

3. On the stock card, fill in under the losses and adjustments column the quantity sent to the district store and note the reason.

AT THE District Health Office(DHO)

The DHOs should coordinate the redistribution:

• Make an extra effort to redistribute excess supplies received by some facilities following kit supply. Although the kit is revised regularly, excess stock will occur and often it will be the same items that are overstocked.

- Check with other districts that might make use of the short-dated or excess stock.

The solutions and efforts that are being taken to reduce the expiry rate are still insufficient as seen below;

When asked, Moses Kamabare, the General Manager National Medical Stores (NMS), an entity that is mandated to procure and supply drugs to public health facilities across the country said they were not sure of what exact medicines had expired as they were yet to collect them from facilities. "We are not sure," he said, "They might be supplies like syringes, gauze or gloves. Medicines expire because they have an expiry date. Everything that has an expiry date is prone to expire and we just can't have 100% consumption." [5].

Some of the medicines that were found expired included a HIV drug - Nevirapine syrup that had been supplied to Komamboga Health Facility in October 2016. Of the 810 bottles supplied, 599 bottles had expired before use by November 2016. Also, according to the report, NMS had supplied 36 units of a laboratory reagent HumaCount to Kisugu Health Center III but only one unit was used and the rest expired a few months later [5].

The above information portrays that less of the details is being tracked by the distributors due to shortages of drugs that occur at some health centres yet others have excess which after expires in bulks. The sole individuals responsible for knowing the expiry details of the drugs supplied are not actually sure about such details and measures to undertake.

2.4 RELATED SYSTEMS

2.4.1 SMS based drug monitoring systems.

The Novartis Company developed the SMS-based system for anti-malarial drugs in sub-Saharan Africa. The technology was developed to prevent stock-out of antimalarial drugs in remote areas by taking advantage of the present availability of mobile phones network coverage even in rural areas. The system automatically sends weekly SMS text messages to mobile phones at public health facilities requesting information on their updated stock levels. The major challenge for the effectiveness of this system is that the remote health centers are served by the district hospital where the automated drug monitoring and ordering system is not in place. Thus, even if the SMS from the remote health center will be received will be difficult to be processed since even the district level can get out of stock without notification. This can be considered as a call up on development of information system for drug monitoring and management at the hospital level. [9]

2.4.2 Failure Mode Effects Analysis (FMEA) Tool.

For year 2010, total value of drugs disposed was RM 8,575.50 due to expired or spoiled items returned from wards. The main reason was due to the failure of nurses to check the stock regularly. They only do the checking upon ordering of new stock from Pharmacy department. FMEA tool was selected by the Management to solve this problem. [8]

In this system, pharmacy staff will go to the wards once a month to check stock of drugs kept at ward level. After the implementation of the new process, RPN was calculated again and it was found that the value was between 3 to 8 which was considered as low. Monitoring of compliance was done using ward check form based on storage condition, par level, labeling and packaging and non- conformances for spoilt and expired items. Compliance in term of drug storage was 100% and labeling compliance was 97.2%.[8]

However, the compliance on par level was only 81.9% and in term of expiry date validity, the compliance was 96.5%. Based on FMEA , it was found that the main reason for expired/spoiled drugs is because of insufficient checking of ward stocks. Corrective actions are ongoing to improve further the process of supply by re-designing a new form of ward checking, re-modifying indenting process of ward stocks via the HITS system and conducting training and awareness. After implementing the new system, the value of drug disposed was RM 3,060.78 which was 94% lower. Therefore, the study has shown remarkable results in reducing the amount of drug disposal which will help the organization to reduce the risk to patients and avoid wastage. [8]

2.5 THE PROPOSED SYTEM

National Medical Stores still faces high rates of drug expiry and with no clear information of which drugs have expired, what quantity has expired and which health facility has the expired drugs. This gap we have highlighted from the research is clear that NMS does not currently use any information system to keep track of these details so that they can be retrieved any time they are needed, hence our proposed solution is to have a system to track and manage drug distribution from NMS to the several public health and private-not-for-profit health facilities which will help reduce the rate of drug expiry and wastage of money spent on purchasing large sums of drugs.

Chapter 3
3.0 METHODOLOGY
3.1 Data collection
We shall use secondary data to design the system.

Purpose of data collection and what information is required

We shall have to collect all inventory related information about drugs the moment they are registered in the country. This is to act as the backbone data for an information system. It will be an initiation of an electronic representation of a registered drug bulk. Each kind of drug will be assigned a unique code that will distinguish it from all the rest.

Some of the vital information collected about the drug will be the drug name, expiry date, lifespan of the drug, where it is supplied, when it was supplied.

The information we need is likely to have been collected by NMS, Uganda.

3.2 Design
Data flow Diagrams

We shall model the data in form of data flow diagrams to ensure that we all have a solid understanding of how data is transformed over the course of the system executions.

Architectural Design

We shall design a client server architecture because the server will monitor the activities of the other nodes (supporting the subsystem, client applications).

Class Diagrams

When it comes to programming, the specific relationship between the several entities needs to be clearly stated or declared and this will be aided by use of such tools. In this we will be able to break down the processes under the distribution of drugs and have them under a program.

Entity Relationship Diagrams

This will be the best way to conceptualize the system bounds by highlighting all the component there of and how the interact to make up a single unit. We decide on the level of interaction among entities and establish the required multiplicities.

Use case Diagrams

In order to understand the users and what the they require from the system; team members will agree on the acceptable functions of users and describe them by use cases.

Threat Modelling

We shall discuss the security requirements of the system and identify credible threats and mitigation strategies to implement to safe guard the system from attacks and breakdown due to undetected errors.

3.3 Implementation

Databases

We shall implement the database schemas for the input data and also retrieve information for the several system users by having them only the specific information they need in the system and this will be reached to by using software like MYSQL. The information on the various entities will be stored in the system. Use of environments like PHP will be used to have the databases on the internet browsers and recording keeping on the cloud rather than on physical media.

Coding

We shall conceptualize each drug inform of an electronic representation which can now be updated according to what goes on with the physical drug itself. Each drug will be uniquely identified in the system with a unique code generated according to predetermined criteria. Furthermore, the expiry date of each drug bulk will stay in continuous count mode to keep users alert about the expiry times and on addition, the location of the drugs will also have to be known a kept within the system.

We will use input devices to enter the information and store it in databases that may be implemented in MySQL or SQL lite. We shall use Class models to implement the electronic representation of the drugs using object-oriented languages which may include, Java, Java Script, python or C#.

3.4 Testing

Accuracy

We shall carry out unit and black box testing for the system to ensure that it works properly. We decide on the testing criteria to follow and a required performance level on which validate the system.

Security

We shall use data encoding and encryption, regular expressions to implement the security requirements that are required.

3.5 Deployment

Packaging

By arranging and grouping system files and library resource, we shall make portable executable files to run on the most common software environments.

Guide-lines

The guide-lines will be made to guide the users on how to install and use the system successfully.

3.6 Maintenance

System logging

By keeping a regular update of how the system is being, we shall be able to handle complex abnormalities and also to trace the system faults.

System Updates

At this point we shall further provide updates for system functions as a way of improving on the system wholesomely.

REFFERENCES

[1] Daily Monitor *Monday 12, February 2018*

[2] NCBI article on Expiry of drugs in supply outlets in Uganda by *Josephine Katabaazi Nakyanzi Freddy Eric Kitutu Hussein Oria, and Pakoyo Fadhiru Kamba* February, 2018

[3] Daily Monitor Friday, 26th May 2018

[4] The Observer February 13, 2018

[5] allAfrica 06, MARCH,2018

[6] https://www.nms.go.ug/index.php/departments/stores-and-operations

[7] http://www.health.go.ug/docs/MOMHSM_2012.pdf.

[8] http://www.iosrjournals.org/iosr-jpbs/papers/Vol7-issue3/H0734756.pdf.

[9] https://core.ac.uk/download/pdf/86430706.pdf

APPENDICIES

Appendix 1: Project Plan

The project will be worked according to the following plan.

Activity	Period(weeks)
Data collection	1
Data Analysis	1
Design	3
Implementation	5
Testing	2
Deployment	1

Appendix 2; Places to be visited

NMS, Uganda Headquarters, Nsamizi Rd, Entebbe.

NDA, Secretariat office Kampala
P. O Box 23096, Kampala, Uganda
Plot 19 Lumumba Avenue (opposite TWED plaza)

Appendix 3: The Distribution schedule of NMS

NMS MEDICAL LOGISTICS
Passionate about your Life

Client Services Direct Lines (Head Office)
Toll Free (MTN)/AIRTEL: 0800 200 015/0800 300 333
Tel: 0414 320 089/0417 104 000
Email: sales@nms.go.ug
SMS: Send to 6090

FY2018/19 NATIONAL MEDICAL STORES DELIVERY SCHEDULE (UPDATED)

ZONE	DISTRICTS	CYCLE	ORDER DEADLINE	DELIVERY END DATE	ARV/KITS/TB REPORTING PERIOD
ZONE 1	Abim, Amolatar, Amudat, Amuria, Budaka, Bududa, Bugiri, Bugweri, Buikwe, Bukedea, Bukwo, Bulambuli, Busia, Butaleja, Butebo, Buvuma, Buyende, Iganga, Jinja, Kaabong, Kaberamaido, Kapelebyong, Kaliro, Kamuli, Kapchorwa, Katakwi, Kayunga, Kibuku, Kotido, Kumi, Kween, Luuka, Manafwa, Mayuge, Mbale, Moroto, Mukono, Nabitaluk, Nakapiripirit, Namayingo, Namisindwa, Namutumba, Napak, Ngora, Pallisa, Serere, Sironko, Soroti, Tororo	CYCLE 1	28-Jun-18	14-Aug-18	APR-MAY
		CYCLE 2	29-Aug-18	08-Oct-18	JUN-JUL
		CYCLE 3	23-Oct-18	30-Nov-18	AUG-SEP
		CYCLE 4	14-Dec-18	08-Feb-19	OCT-NOV
		CYCLE 5	22-Feb-19	04-Apr-19	DEC-JAN
		CYCLE 6	18-Apr-19	31-May-19	FEB-MAR
ZONE 2	Buhweju, Bukomansimbi, Bushenyi, Butambala, Gomba, Ibanda, Isingiro, Kabale, Kalungu, Kanungu, Kiruhura, Kisoro, Kyotera, Lwengo, Lyantonde, Masaka, Mbarara, Mitooma, Mpigi, Ntungamo, Rakai, Rubanda, Rubirizi, Rukiga, Rukungiri, Sheema, Sembabule	CYCLE 1	25-Jul-18	23-Aug-18	MAY-JUN
		CYCLE 2	18-Sep-18	17-Oct-18	JUL-AUG
		CYCLE 3	12-Nov-18	10-Dec-18	SEP-OCT
		CYCLE 4	21-Jan-19	18-Feb-19	NOV-DEC
		CYCLE 5	15-Mar-19	12-Apr-19	JAN-FEB
		CYCLE 6	13-May-19	12-Jun-19	MAR-APR
ZONE 3	Buliisa, Bundibugyo, Bunyangabo, Hoima, Kabarole, Kagadi, Kamwenge, Kakumiro, Kasese, Kassanda, Kibaale, Kiboga, Kikuube, Kiryandongo, Kyankwanzi, Kyegegwa, Kyenjojo, Masindi, Mityana, Mubende, Ntoroko	CYCLE 1	02-Aug-18	30-Aug-18	MAY-JUN
		CYCLE 2	26-Sep-18	24-Oct-18	JUL-AUG
		CYCLE 3	20-Nov-18	02-Jan-19	SEP-OCT
		CYCLE 4	29-Jan-19	25-Feb-19	NOV-DEC
		CYCLE 5	25-Mar-19	23-Apr-19	JAN-FEB
		CYCLE 6	21-May-19	19-Jun-19	MAR-APR
ZONE 4	Adjumani, Agago, Alebtong, Amuru, Apac, Arua, Dokolo, Gulu, Kitgum, Koboko, Kole, Kwania, Lamwo, Lira, Luweero, Maracha, Moyo, Nakasongola, Nebbi, Nwoya, Omoro, Otuke, Oyam, Pader, Pakwach, Yumbe, Zombo	CYCLE 1	08-Aug-18	06-Sep-18	JUN-JUL
		CYCLE 2	02-Oct-18	31-Oct-18	AUG-SEP
		CYCLE 3	26-Nov-18	09-Jan-19	OCT-NOV
		CYCLE 4	04-Feb-19	04-Mar-19	DEC-JAN
		CYCLE 5	29-Mar-19	30-Apr-19	FEB-MAR
		CYCLE 6	27-May-19	26-Jun-19	APR-MAY
ZONE 5	Kampala, Kalangala, Nakaseke, Wakiso	CYCLE 1	16-Aug-18	10-Sep-18	JUN-JUL
		CYCLE 2	11-Oct-18	02-Nov-18	AUG-SEP
		CYCLE 3	04-Dec-18	11-Jan-19	OCT-NOV
		CYCLE 4	12-Feb-19	06-Mar-19	DEC-JAN
		CYCLE 5	08-Apr-19	03-May-19	FEB-MAR
		CYCLE 6	06-Jun-19	28-Jun-19	APR-MAY

PLEASE SUBMIT ALL YOUR EMHS, LAB, ARV AND TB ORDERS TOGETHER BEFORE THE ORDER DEADLINE DATE

HEAD OFFICE: Plot 4-12 Nsamizi Road Entebbe, Email: sales@nmsrro.go.ug
GULU OFFICE: Mak-kweri House, Kitgum Road, 2nd Floor, Rm 009, 0776 744 204/0776 687 711
KABAROLE OFFICE: Retreah Tourist Hotel, Kaposse Road, 1st Floor, Rm 107, 0780 121 820/0700 206 846
MBALE OFFICE: Bugisu Cooperative Union, Republic St., 2nd Floor Rm 202, 0773 971 652/0782 208 948
MOROTO OFFICE: Homeland House Plot 32, Lia Street, 0782 016 286/0777 822 010
ARUA OFFICE: KKT Plaza, Plot 16-22 Duka Road, Room A109, 0783 622 222/0786 016 236
HOIMA OFFICE: Uganda Kolping Society, Kwenturma Road, 0776 141 488/0774 324 232
KAMPALA OFFICE: ESAMI House, Bombo Road, 0782 265 555/0774 540 225
MBARARA OFFICE: UKA Building, Stanley Road, 3B, 0776 787 000/0703 430 098
SOROTI OFFICE: Gweri Road, Plot 448, (Opposite Stanbic Bank), 1st Floor, 0772 613 366/0783 663 030