A STUDY TO ASSESS THE FEASIBILITY OF HDA APP; A DRUG INFORMATION AND VERIFICATION SYSTEM INTENDED FOR IMPLEMENTATION IN UGANDA

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DECLARATION

I hereby declare that the work contained in this proposal is my original work and has never been submitted to any university or institution of higher learning for any academic qualifications. The exception of where academic work attributed by other scholars and researchers has been exclusively acknowledged in the references section.

Signature.....

Date.....19/12/18.....

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APPROVAL

This research Proposal has been submitted to Kampala International University School of Pharmacy with my approval as the supervisor.

Signature.....

Date.....

DR. TUSIIMIRE JONANS (PhD)

DEDICATION

This research is dedicated to my family for their great love and dedication towards my studies. I also dedicate it to my beloved son Israel Jireh Muwanguzi for his patience that has enabled me to concentrate on this work.

ACKNOWLEDGEMENT

I thank the almighty God for the grace he has given me to finish this work.

Special gratitude to my dearest friend Mrs. Muwanguzi Pauline for the continuous and endless support towards the accomplishment of this proposal.

I also wish to acknowledge all the support of my supervisor Dr. Jonans Tusiimire who has enabled me to reach this far.

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ABREVATIONS

MHSDMU	Medicines and Health Service Delivery Monitoring Unit
LC	Local Council
HSD	Health Sub District
HCW	Health Care Worker
HC	Health Centre
GOU	Government of Uganda
DHO	District Health Officer
OPD	Out Patients' Department
NDA	National Drug Authority
PSU	Pharmaceutical Society of Uganda
CAO	Chief Administrative Officer
RDC	Resident District Commissioner
HFVS	Health Facility Verification System
HAD	Health Directory and Authentication
AHPC	Allied Health Professional Council
TV	Television
HF	Health Facility
MP	Member of Parliament
HW	Health Worker
UMDPC	Uganda Medical and Dental Practitioners Council
USAID	United States Agency for International Development
MoH	Ministry of Health
FP	Facility Profile
APP	Application
DIVS	Drug Information and Verification System
ID	Identity card
PHC	Primary Health Care

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ABSTRACT

Background: The Health Directory and Authentication App (HDA App), is an m-Health innovation designed to provide offline information and verification for all medicines, health facilities and health professionals (HPs) by the general public/consumers. The App, which is composed of 2 systems i.e. Drug Information and Verification System (DIVS) and Health Facility Verification System (HFVS), is aimed at improving quality and safety of health care services in Uganda, by **promoting** rational medicine use (RMU) through an improved access to patients' medicine information while **reducing** professional misconduct, prevalence of illegal health workers and facilities, unsafe medicines (expired, recalled, banned etc.) on the market and potentially substandard/counterfeit drugs. HDA App is also intended to **improve** public - government collaboration in implementing regulatory functions through an inbuilt feedback mechanism.

Study aims: In this work, a feasibility study of the DIVS was conducted aimed at **1)** developing a working prototype out of the HDA concept, **2)** assessing the level of acceptability and usability of the DVIS and **3)** elucidating the challenges which may be associated with its future implementation and use.

Study methods: Study participants were key informants who included health professionals, IT specialists and patients in a) public health facilities (n = 17; 22%), b) private facilities (n = 21; 25%), c) non-government organizations (n = 20, 22%), d) regulators i.e. health professional councils and National Drug Authority (n = 11; 10%) and e) professional associations (n = 2; 3%) and the general public/patients (n = 16; 18%). This qualitative study involved use of an introductory video, a hands-on demonstration of the App using the developed prototype and both open and closed ended questions in a researcher-guided interview using a questionnaire. SPSS version 20 was used for data analysis.

Findings revealed that the developed HDA App prototype was interoperable, allowing synchronization with other existing health sector systems. The DVIS component of the App was found to be feasible to develop and implement in Uganda, with a high potential of acceptability among patients and health workers. 70% of the study population needed but couldn't readily access

medicine information, HPs and medicine leaflets were the main sources of medicine information as reported by 43% and 20% of respondents respectively. The system's reliability, security, timeliness and data exhaustiveness were also assessed. The study revealed the potential for the DIVS to solve a number of health sector challenges.

Conclusions and recommendations: Given the relevance of the HDA App innovation to the health sector and its potential to improve medicine regulation, government support should be sought to patent it and to facilitate a pilot study in collaboration with relevant regulatory bodies.

CHAPTER ONE: INTRODUCTION

1.1. Background

In 2016, a challenge was given to all pharmacy students in Uganda to come up with an innovation against counterfeit medicines, in a competition organized by the Uganda Pharmaceutical Students' Association (UPSA) with support from National Drug Authority (NDA) and pharmaceutical society of Uganda (PSU).

The health directory and authentication application (HDA App) concept emerged as the best and since then, it has progressively been modified to address on addition to counterfeit medicines, other unsafe medicines, e.g. recalled, expired, banned, etc. on the market, illegal health workers, professional misconduct in the health sector among others. Feedback mechanisms have been incorporated to enhance public - government collaboration for a sustainable safe health care system in Uganda.

HDA App was composed of 2 major divisions/systems. The Drug Information and Verification System (DIVS) and the Health Facility Verification System (HFVS).

The DIVS was designed to provide offline consumer level information and verification about all human and veterinary medicines legally sold in Uganda in an attempt to reduce the prevalence of unregistered medicines, counterfeits, substandard and other medicines on the market including expired, recalled and banned medicines among others. By providing patients' medicine information for each drug, the DIVS was intended to improve rational medicine use while the feedback mechanism was aimed at improving Government – Public collaborations.

Main components of the DIVS included; 1) a list of all medicines in Uganda, and patients' information for each; 2) medicine verification service based on batch numbers which provides instant safety status notifications and/or warnings 3) a feedback mechanism (e-forms and a call centre) for the public to communicate to authorities/government about their medicines and medicine outlets or services being rendered to them.

Since 2016, the concept featured on several platforms which included Hult Prize Regional competitions 2018 in Nairobi Kenya, social impact award Uganda finalist, national conference on

antimicrobial resistance 2017 and the Uganda Pharmaceutical Symposium 2017, National council for higher education exhibition 2018. The concept also received strong endorsements from officials at Kampala International University, National Drug Authority and health professional councils in Uganda; including a forum of Registrars from all professional councils in Uganda.

In spite of the positive reception from all relevant stake holders, it is paramount to conduct a systematic study to validate the feasibility of actualizing the concept (prototype development), to identify the actual level of acceptability of the DIVS and the possible challenges which may arise during implementation and use of the system; as an initial step towards the implementation of the project.

1.2. Statement of the problem

The government through different Drug Regulatory bodies is mandated to ensure the availability of safe, efficacious and quality medicines and subsequently their Rational Use.

Amidst all resources invested, the public continues to unsuspectingly consume unregistered and/or counterfeit/substandard medicines whose prevalence is at over 26%, with 90% of these medicines containing low amounts of active ingredients and predominantly present in unregistered markets, among unlicensed health workers & facilities (Almuzaini, Choonara, & Sammons, 2013). The use of substandard/counterfeit medicines coupled with persistently increasing irrational medicine use practices like self-medication, poor adherence to treatment and poor dispensing practices among patients and health workers (Bonabaana & Iryna, 2013), still pose a major public health risk.

With the growing coverage of mobile technology (NITA-U, 2018), there was need for an affordable, reliable innovative solution to; (1) provide a consumer level medicines' verification mechanism for patients to safeguard themselves from potentially substandard/counterfeit drugs, (2) improve rational medicine use by providing medicine information and patients' counselling and (3) a feedback mechanism to improve public – government collaboration in implementing regulatory functions.

1.3. Purpose of the Study

The feasibility study of the DIVS was aimed at converting the DIVS Concept into a working prototype and subsequently use it to conduct a systematic assessment of the factors which would affect acceptability of the system by the regulators, health workers, pharmaceutical manufacturers/distributors and the general public. The results were to provide a need and readiness assessment as part of prior planning strategy of the DIVS. Absence of this step was a barrier to successful implementation of mHealth services in Uganda (Kiberu, Mars, & Scott, 2017).

1.4. Study Objectives

1.4.1. Main Objective

To study the feasibility of the Drug Information and Verification System (DIVS) in Uganda.

1.4.2. Specific Objectives

1. To develop a prototype of the DIVS
2. To determine the level of acceptance of the DIVS
3. To identify the challenges which may arise during implementation and use of the DIVS and possible recommendations

1.5. Research Questions

i. How could the concept of DIVS be converted into a working prototype?
ii. To which extent would the DIVS be accepted by the government, pharmaceutical manufacturers/distributors, health professionals and the general public?
iii. Which challenges would arise during implementation and use of the DIVS?

1.6. Justification of the study

Uganda has trialed several e-Health and m-Health solutions to address healthcare challenges. Most were donor funded, operated in silos and lacked sustainability. Various barriers had been

identified. Evidence had shown that e-Health implementations in Uganda had lacked prior planning stages, which is an essential step, for example strategy and need readiness assessment. Future research should address these shortcomings prior to introduction of e-Health innovations (Kiberu et al., 2017).

The high prevalence of counterfeits and substandard medicines on Uganda's market, coupled with the increasing prevalence of other potentially un-safe medicines i.e. un-registered, recalled, banned and expired medicines; and their irrational use relative to inadequate patients' information about medicines, was evidently an existing public threat.

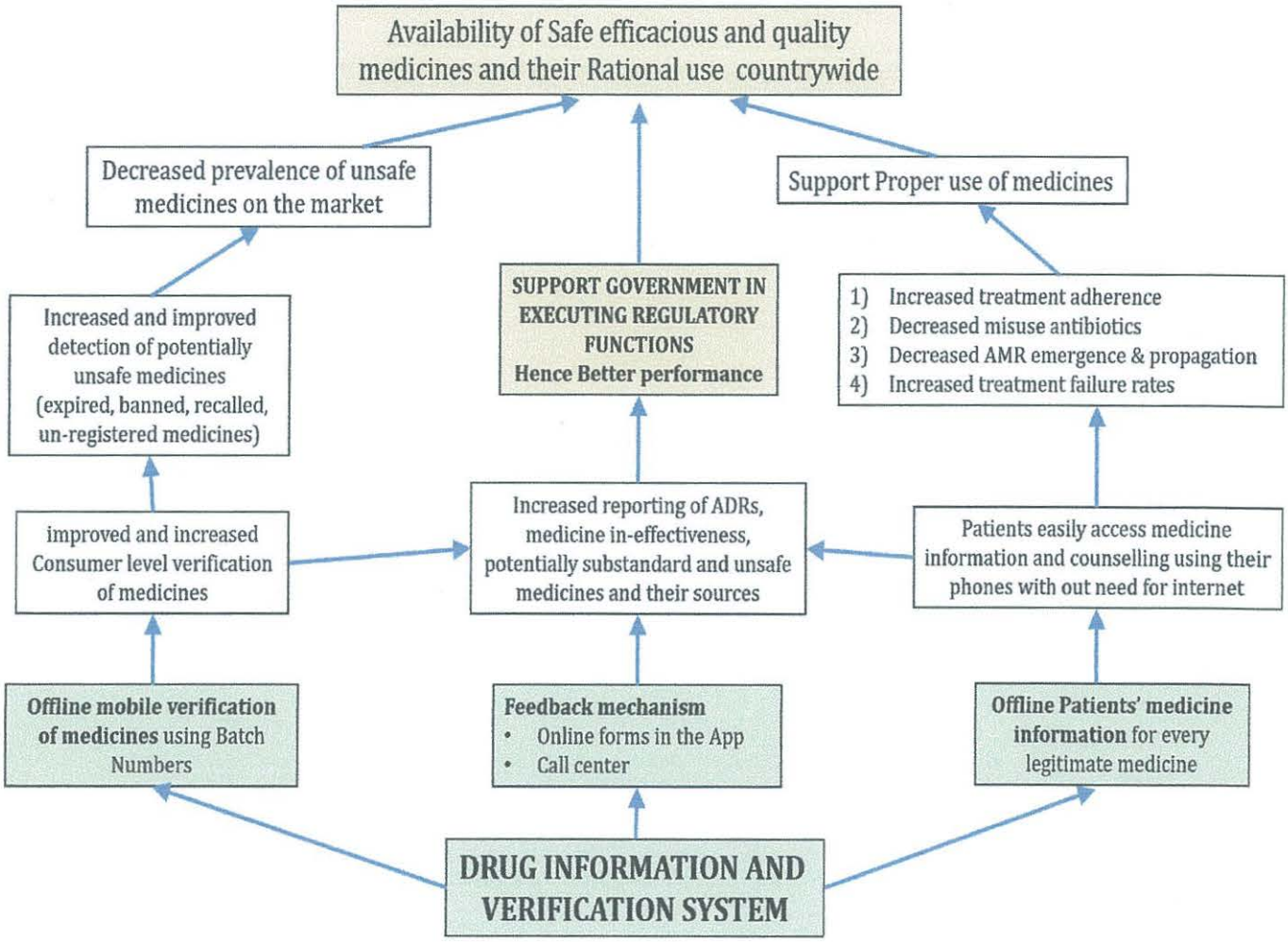
The DVIS had shown potential to solve the challenges which justified the need for a systematic study to validate the assumptions and concepts about the system, and identify the challenges which may affect before an implementation, use of the DVIS.

1.7. Scope of the study

The qualitative feasibility study involved key informants from Uganda's health care located in Kampala.

1.8. Conceptual frame work of DIVS

Figure 1. 1 Solution tree of DIVS Concept



CHAPTER TWO: LITERATURE REVIEW

2.1. Introduction

The World Health Organization (WHO) defines e-Health as the use of information and communication technologies (ICTs) for health WHO, 2018.

Most developing countries, including Uganda, have embraced the use of e-Health and m-Health applications as a means to improve primary healthcare delivery and public health for their populace. In Uganda, the growth in the information and communications technology industry has benefited rural communities and also created opportunities for new innovations, and their application into healthcare has reported positive results, especially in the areas of disease control and prevention through disease surveillance (Kiberu et al., 2017).

Advancement of mobile technologies such as smartphones and PC tablets has given a great impact on healthcare systems. Mobile technology offers innovative approaches to address complex health concerns. mHealth is used to refer to clinical and public health activities involving mobile devices such as smartphones (Jusoh, 2017). According to World Health Organization (WHO), mHealth has the ability to transform the delivery of health services all over the world and bring about a paradigm shift in healthcare delivery processes (WHO, 2011).

Below is a review of literature about the prevailing challenge of counterfeit/substandard medicines in Uganda, other un-safe medicines on the market (recalled, expired, banned etc.) and irrational medicine use; and challenges to be considered when developing mHealth interventions.

2.2. Counterfeits, substandard medicines, other unsafe medicines (Expired, recalled, banned and unregistered medicines) and irrational medicine use in Uganda

A Counterfeit or Falsified medicine is one which is deliberately and fraudulently mislabelled with respect to identity and or source. Counterfeiting can apply to branded and generic products and such may contain the correct ingredients, the wrong ingredients, no active ingredients, insufficient ingredients or fake packaging (i.e., misleading about its origin or authenticity).

Substandard medicines are defined as genuine medicines which have failed to pass the quality measurements and standards set for them by the official pharmacopoeias. Such include; amounts of active ingredients, dissolution tests, among others. **Unregistered/unlicensed** medical products are those that have not undergone evaluation and/or approval by the national or regional regulatory authority for the market in which they are marketed/distributed or used, subject to permitted conditions under national or regional regulation and legislation (WHO, 2017).

The prevalence of substandard/counterfeit antimicrobials is high throughout Africa and Asia in lower income countries and lower middle-income countries. In Uganda, over 24%, which implies that almost 1 out of every 3 drugs issued on the market is likely counterfeited/substandard. Inadequate amounts of active ingredients was the largest problem identified, where 93.3% of all counterfeit/substandard drugs characteristically contained low amounts of active ingredients. 64% of counterfeit/substandard medicines were present in unlicensed markets i.e. unregistered facilities and health workers (Almuzaini et al., 2013). The public should therefore be sensitised to avoid health services and medicines from unlicensed health facilities and health workers is essential to avoid counterfeits.

Even after registration and licensing, medicines are continuously inspected for quality standards. Random sampling and testing is used to validate presence of acceptable amounts of active ingredients among other physical chemical properties like dissolution profile, disintegration profile etc. as stipulated in the pharmacopoeia.

When identified during post market surveillance, counterfeit and substandard medicines are recalled and relevant steps taken are based on the class of drug recall, weather A, B or C. If such information is missed by the health workers or patients, patients face the risks associated with using the unsafe medicines. Through media and social media platforms the public is notified to avoid use of recalled medicines.

Even with the right prescriptions, patients who consume counterfeit/substandard medicines are at risk of the dangers of under-dosing. Under-dosing of antimicrobials can enhance the survival of more resistant parasites and hence emergence of antimicrobial resistance (AMR) a state in which

microorganisms which were once killed by a given antibiotic, can no longer be killed anymore by the same or related antibiotic following antimicrobial defensive adaptations against the medicines.

Other AMR contributing factors include poor infection prevention and control, self-medication, misuse of antibiotics, poor adherence to treatment especially not completing prescribed doses, frequent use of under dose antibiotics as the case may be when using counterfeit medicines.

"In Africa, drug counterfeiting is a huge concern. According to the World Health Organization, up to 30 percent of all drugs taken by patients in the developing world aren't authentic. This illegal activity drains approximately $75 billion from the pockets of legitimate pharmaceutical companies. More importantly, fake drugs threaten the lives of the patients who believe the medications they're taking are real" (Jenni Spinner, 2012). According to WHO, (2017), counterfeit drugs comprise of 16.9% antibiotics, 19.6 antimalarial drugs, and 6.8% cancer medicines, among others.

With these findings, the percentage of drugs identified and publicly announced by National Drug Authority, are possibly just a fraction of what Ugandans are consuming from the black market of unregistered drugs.

The dangers of unregistered, Falsified and substandard drugs cannot be over emphasized. These may contain toxic doses of dangerous ingredients and cause mass poisoning. They also encourage drug resistance, threatening the health of populations today and in the future. Poor-quality medicines compromise the treatment of chronic and infectious diseases, causing disease progression, drug resistance, and death. As chronic diseases increase in low- and middle-income countries, so does the need for reliable medicines.

Besides the growing threat of unregistered counterfeits and substandard drugs, the country still faces another major challenge of irrational medicine use, which has greatly compromised the quality of health care services.

Irrational use of medicines is a major problem worldwide. It is estimated that half of all medicines are inappropriately prescribed, dispensed or sold and that half of all patients fail to take their medicine properly. The overuse, underuse or misuse of medicines results in wastage of scarce resources and widespread health hazards (WHO, 2007).

Pharmacists have the potential to improve therapeutic outcomes and patients' quality of life within available resources, and must position themselves at the forefront of the health care system (Bonabaana & Iryna, 2013). The World Health Organization recommends a ratio of one pharmacist per 10,000 people. Uganda currently has about 800 trained pharmacists for a population of 45 million people, a ratio of 1 pharmacist: 56,000 people which is far below what is recommended. The ministry of health in its strategic plan is to have at least one pharmacist for every 20,000 Ugandans in the next 10 years (New Vision, 2014).

2.3. Common Challenges facing design, implementation and use of mHealth solutions

There are several categories of mhealth challenges which may affect mHealth innervations and these should be considered when designing mHealth solutions; summarized in the table below (Gurupur & Wan, 2017).

Usability challenges could be as simple as size of the cell phone screen, the font size or type on that screen, colour combinations used to display necessary information, or efficacy of an individual to use cell phones for more than phone calls. ISO 9241 defines usability as "the effectiveness, efficiency and satisfaction with which a specified user can achieve the specified goals of a particular environment" (Gurupur & Wan, 2017)

The main components of usability: learnability; efficiency; memorability; low error rate, and satisfaction. Usability characteristics include: time to learn; satisfaction; time taken to recover from errors, and speed of performance. In the "beauty of simplicity", one of the key factors towards a user-cantered design would be to keep it simple. For example, if a user has to browse through ten different hyperlinks to explore important information that is three links deep, the design may not be considered user centric. Information that is necessary for the user must be readily available without requiring too much effort. Therefore, adopting the principle of simplicity is essential for mHealth applications, and this is a critical challenge that needs to be overcome (Gurupur & Wan, 2017).

Other challenges that need to be addressed are summarized in the table 2.1 below

Table 2. 1 Categories of mHealth challenges

Challenge	Key components	User definition
1. Usability	User interface design	Keeping the user interface simple, using the right font type and size, and improving user satisfaction
	Trust worthy design	The user interface design must be simple enough to be trust worthy
	Learnability	The mobile application must be easy to learn
2. System integration	Interoperability	Must be able to exchange required information with systems developed by other vendors
	System design	The associated system design must be scalable and allow integration with other systems
3. Data security and privacy	Confidentiality	Confidentiality of patient data to ensure HIPAA compliance
	Data storage	Data must be stored in a secure location
	Data access	Data must be accessed through secure transmission channels
4. Network access	Availability	Availability of wireless networks
	Speed and strength	The available wireless network must be strong enough to transmit and receive data
5. Reliability	Accuracy of the result	The result provided must be accurate enough to help the patient
	NDA approval	NDA approval is required for adoption in Uganda

Sustainability of mhealth projects in Uganda

As in other developing countries, most e-Health initiatives in Uganda are donor funded and often remain a proof-of-concept wherein technology is demonstrated within a limited context. The majority of such initiatives tend to remain as small or medium-sized ICT projects or have stalled or stagnated with the stoppage of donor funding. This has been attributed to lack of local ownership and accountability, support and funding. Poor coordination and communication, and a lack of proper e-Health implementation frameworks, are also cited as major challenges to sustainable e-Health programs (Kiberu et al., 2017).

e-Health readiness assessment in relation to physical infrastructure, technology equipment, user and managers' skills, policies, regulations and guidelines should be undertaken prior to implementing any e-Health system.

Three factors – all part of readiness – have been identified as hindrances to adopting telemedicine in Uganda: lack of knowledge and skills, lack of policy and resistance from healthcare workers. There is need for evidence of the impact of, and readiness for, e-Health systems before further investment of resources in development and implementation of such systems. Failure of e-Health projects has been attributed to poor initial planning and research design, insufficient computing skills, lack of change management and lack of technology readiness. It has been recommended that policy and healthcare managers undertake adequate planning and make better use of their resources for successful and sustainable e-Health projects. There is no evidence in literature of e-Health readiness assessment having been conducted prior to implementation of any e-Health projects in Uganda (Kiberu et al., 2017).

CHAPTER THREE: METHODOLOGY

3.1. Study design and method

An exploratory and qualitative study involving key informants.

3.2. Study area and Population

The study was conducted in Kampala for central Uganda and Iganga for eastern Uganda.

Study participants were key informants who included health professionals, IT specialists and patients in a) public health facilities (n = 17; 22%), b) private facilities (n = 21; 25%), c) non-government organizations (n = 20, 22%), d) regulators i.e. health professional councils and National Drug Authority (n = 11; 10%) and e) professional associations (n = 2; 3%) and the general public/patients (n = 16; 18%).

3.3. Data collection method

Pre-arranged meetings were organized with respondents. Either an oral or video overview introduction of the DIVS was done, followed by a hands on trial using the prototype. Questionnaires with both semi structured, open and closed ended questions, were filled by respondents with or without help of the researcher.

3.4. Ethical considerations

Written permission from relevant authorities was sought to meet respondents were necessary Participants were given a right to participate voluntarily and to withdraw at any point without penalty.

In order to cater for Informed consent, all participants received full information about the study and its objectives. Consent was confirmed with a signature on the consent form and those who refuse to consent were excluded.

The study was carried out under maximum confidentiality. Names and contacts shall be captured for only those who wished to receive feedback about the study, after their expressed interest.

3.5. Limitation of the study

Limited time and insufficient funds. Respondents gave feedback based on short video and brief demonstration of the system using the prototype. No respondent had prolonged experience with DIVS at the time of the data collection.

3.6. Pre-tests

Data collection tools were pre-tested from KIU among students and staff before the actual data collection process. Necessary adjustments were made on the questionnaires.

CHAPTER FOUR: RESULTS

4.1. Prototype of the DIVS

The DIVS is composed of two sections. 1) The medicines' list and medicine information on the first tab of the main user interface and 2) the batch verification section on the second tab as shown in figures 4.1 and 4.2 below respectively.

HDA Application is interoperable or compatible, hence can allow sharing of information and services with other platforms with in Uganda's health care system.

4.1.1. Medicines' list and medicine information section

Figure 4. 1: Main User - Interface of the DIVS

The main Page of HDA App is composed of 3 tabs as shown in figure 4.1.

1. Drugs – list of drugs, with medicine information.

2. Verify – middle tab for Medicine batch verification

3. Facilities – list of all registered health facilities in Uganda, with more details under each facility which make up the HFVS.

Navigating from one tab to the next is by swiping or clicking.

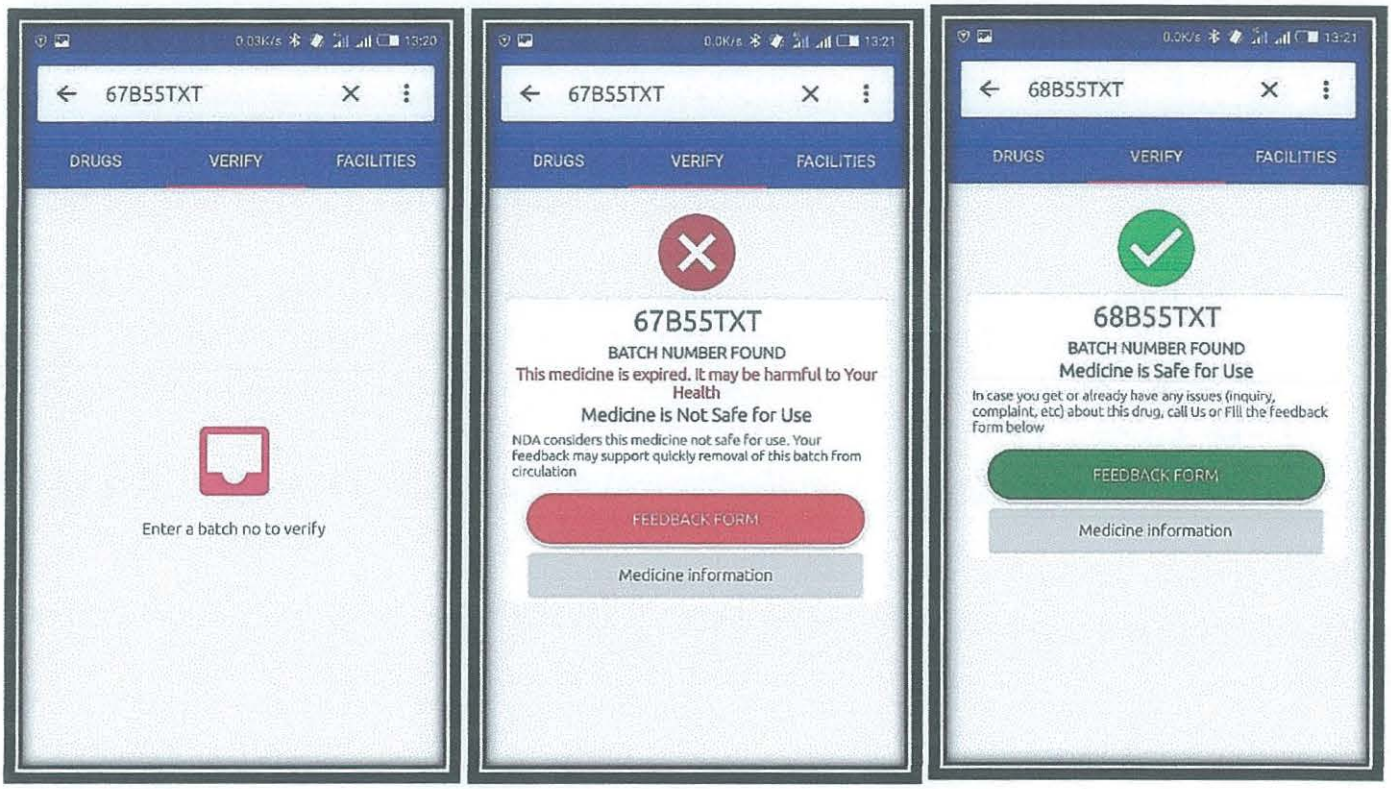
During prototype testing, dummy content and not genuine medicine information was used.

On the main list, each medicine was identified by; Brand name, Generic name(s), Medicine strength, Country of origin and Local Technical Representative (LTR)

Medicines' Information is to be prepared by a multi-disciplinary team of health professionals, and is to be delivered in a language that is so simple for people with no medical background to understand.

4.1.2. Batch Verification Section

Figure 4. 2 Showing the user interfaces of the Batch Verifier



The **VERIFY** tab was designed for the general public to verify the status of the medicines using medicine batch numbers.

Once Batch Number is typed, RED or GREEN responses are retrieved.

GREEN: for batch numbers registered with NDA and still have No officially Known queries.

RED: For batch numbers already registered with NDA but have queries which render the medicines potentially harmful to consumers/patients. Such queries include but not limited to; Banned, Expired, Recalled

RED X also applies to batch numbers which are not registered with NDA.

Proposed Batch numbers acquisition process: local manufacturers where to submit batch numbers through one selected individual, main pharmacist in-charge or related technical person

while importers through either the Company's country manager, pharmacist in charge – local technical representative (LTR) or related technical person. Submissions where to be made through a special online form under each company's profile account. Details of proposed Security measures where discussed with respondents but not described in this report.

4.1.3. Feed Back Forms

RED Feedback form button is for the public to report queried batches. Patient enters facility name and date of purchase while patient's name and contacts are captured automatically, to facilitate case-follow up.

GREEN feedback form button is to capture feedback about medicines whose registered batch numbers have no officially known queries.

Such feedback may include; Ineffective medicines, Changes in physical attributes e.g. color; Adverse Drug Reactions (ADRs) and feedback to Manufacturers e.g. preferred formulation, price etc.

The feedback forms where partially developed at the time of the feasibility study. Feedback for both green and red responses can be submitted offline and as soon as the phone is connected to internet, the messages are delivered to HDA Project and eventually channeled to the concerned body.

4.1.4. Challenges faced during prototype development

1. Limited Time
2. Limited experience in developing a project of a similar kind
3. Limited funds
4. Limited man-power hence a lot of multitasking that would eventually compromise quality service and time to finish the project

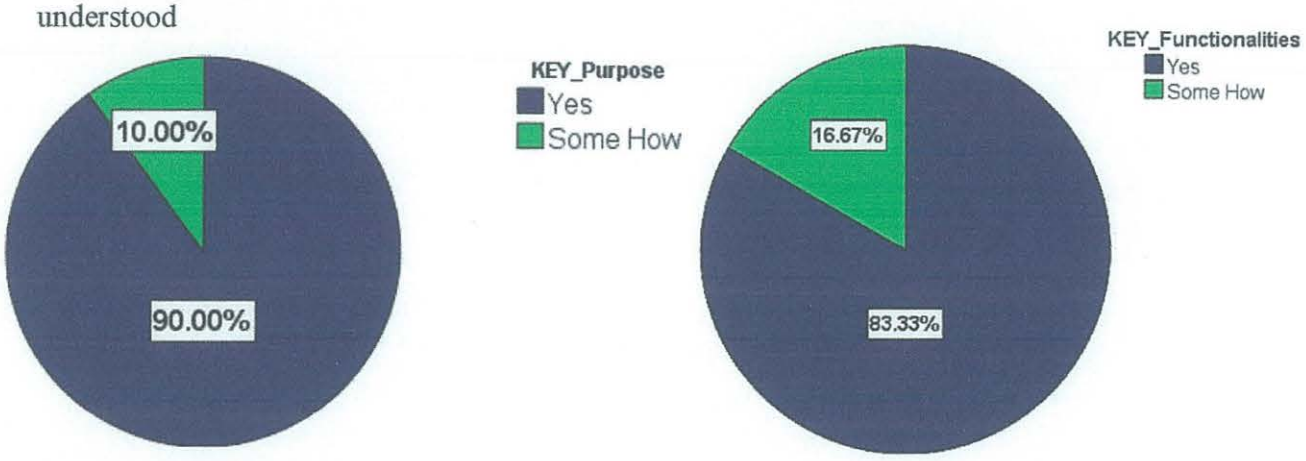
4.2. Assessing Usability and Acceptability of the DIVS

4.2.1. Usability Assessment using Learnability and User Interface design

This was based on respondents' Ease to understand the Purpose; Functionalities; Simplicity of use and Time taken to accomplish a given task using the prototype.

4.2.1.1. Understanding of Purpose and functionalities of DIVS

Figure 4. 3 showing responses about whether **a)** purpose and **b)** function of the DIVS were understood



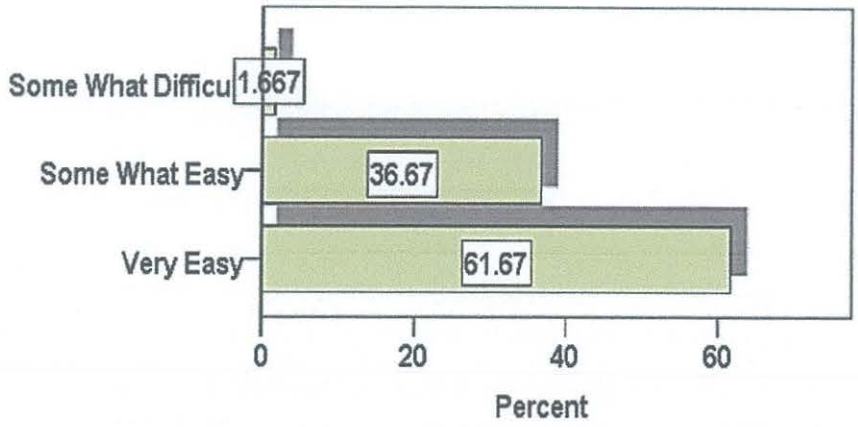
Following a brief overview of the how the DIVS works, All Respondents easily understood its purpose and functions based on the User Interface.

The functionalities where understood clearly by 83% while 16.67% somehow understood the functionalities

None of the respondents failed to understand either the purpose or the functionalities of DIVS.

4.2.1.2. Simplicity of Using DIVS

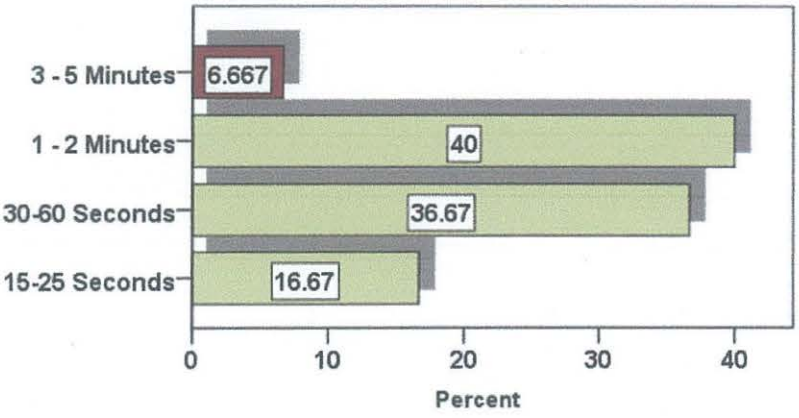
Figure 4. 4: Showing opinions about simplicity of Use of DIVS



61.7% of the respondents found the system very easy to use, while 37% somewhat easy. Only 2% found it difficult to use

4.2.1.3. Time taken to perform a given task using DIVS

Figure 4. 5: Time taken to perform a given task using DIVS



40% of the respondents needed 1 – 2 minutes while 37% needed less than a minute.

A few 16.7% could perform a task in with 15 - 25 seconds.

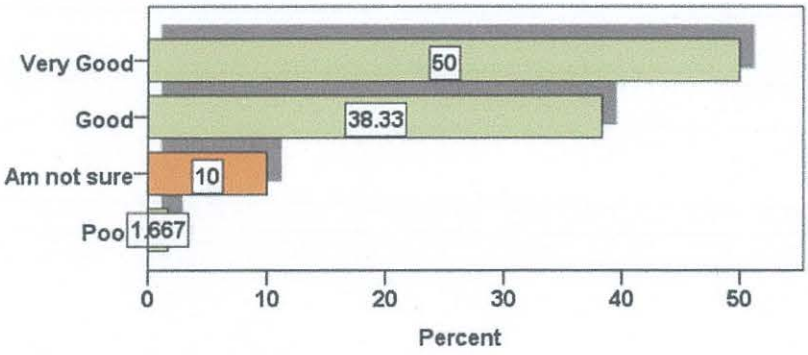
4.2.2. Acceptability assessment using Reliability, Security, Data privacy of the Data acquisition process; Necessity and Effectiveness of the DIVS

The acceptability of the DIVS was assessed using opinions about the proposed process/method designed to acquire batch numbers of all medicines in the country. The process was assessed in terms of its reliability, timeliness, exhaustiveness, data security and privacy,

4.2.2.1. Reliability of DVIS

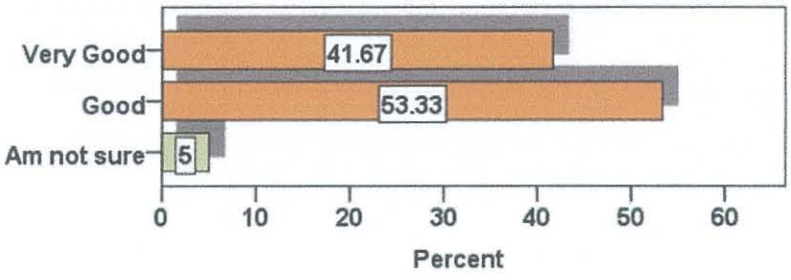
Figure 4. 6: Ranking the process designed to obtain batch numbers in terms of its Reliability.

12% of the respondents doubted the reliability of the proposed process through which batch numbers were to be obtained (ranking 10% not sure and 2% poor), while 50% and 38% ranked it to be very good and good respectively.



4.2.2.2. Data Security and privacy

Figure 4. 7: Ranking the process used to obtain Batch Numbers in terms of data security and privacy.

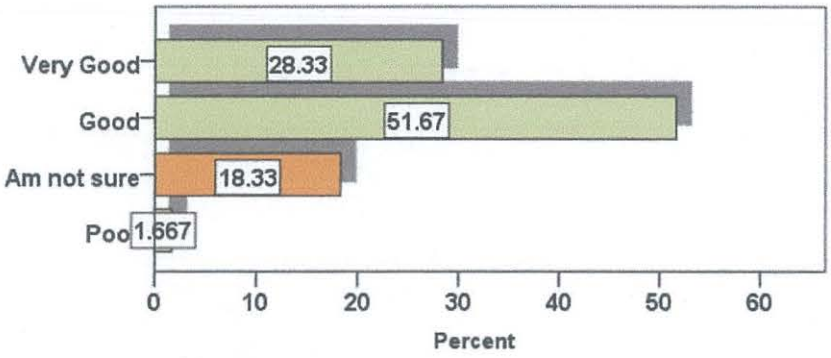


Only 5% were not sure whether the process used to obtain batch numbers guaranteed data security and privacy. 41.7% and 53% ranked the process to be "very good" and "good" respectively in terms of ensuring data security and privacy of batch numbers.

4.2.2.3. Timeliness and exhaustiveness

a) Exhaustiveness

Figure 4. 8: Ranking the process designed to obtain batch numbers in terms of its potential to exhaust all batch numbers needed for the DIVS.

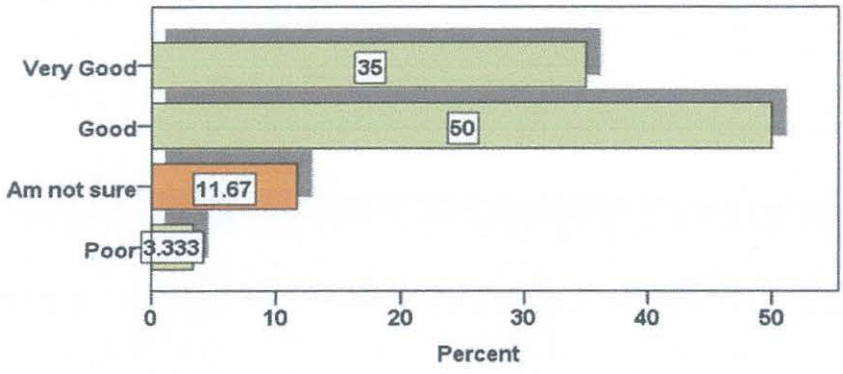


18% of the respondents were not sure whether the designed batch number acquisition process would exhaust all medicines' batch numbers in the country. 80% agreed, with 28% and 51% ranking it to be very good and good respectively.

b) Timeliness

Figure 4. 9: Ranking the process designed to obtain batch numbers in terms of its potential to enable timely acquisition of batch numbers.

12% of the population where not sure whether the designed process would enable timely acquisition of batch numbers while 3% ranked the process to be poor in the same regard.

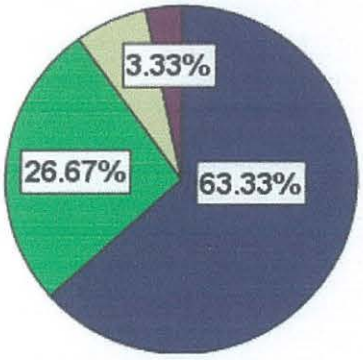


85% of the population highly ranked the process to be efficient in providing batch numbers on time.

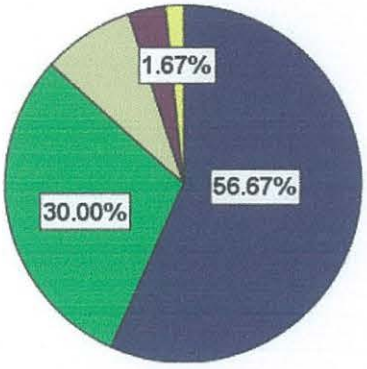
4.2.2.4. Necessity of the DVIS to Uganda's Health care system

Figure 4. 10: Showing perceived importance of the DIVS to **a)** Health professionals, **b)** The General public and **c)** The government.

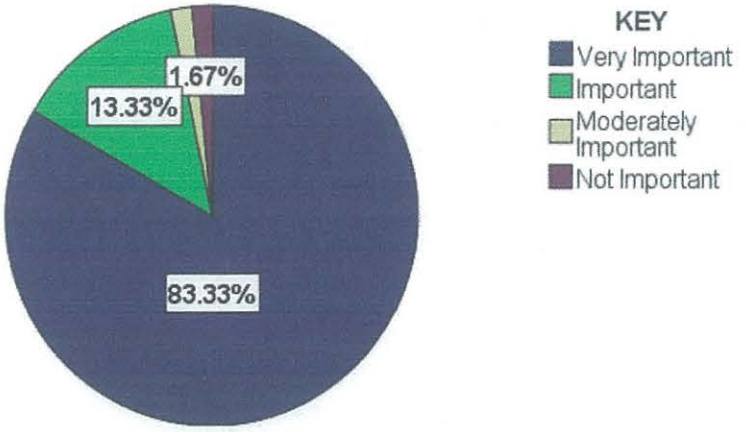
a) Importance of DIVS to Professionals



b) DIVS importance to General Public



c) Importance of DIVS to Government



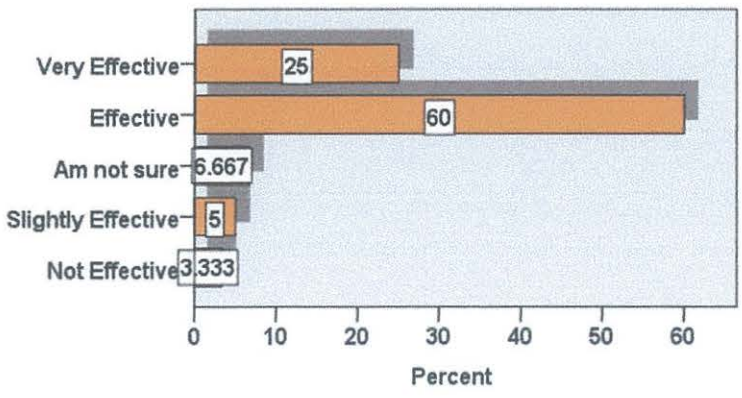
The DIVS was generally very important to the government, health professionals and the general public.

83% of respondents ranked the system as very important to the government, to health professionals 63% and then to the general public 57%.

4.2.2.5. Potential effectiveness against some challenges in Uganda's legal supply chain i.e. prevalence of Un-registered drugs, banned drugs, expired drugs and recalled medicines still on sale.

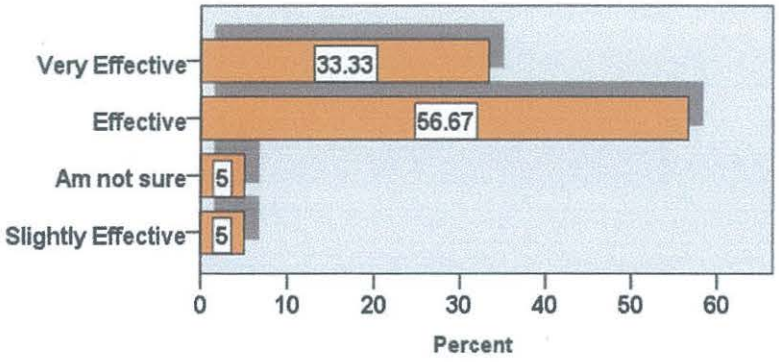
Figure 4. 11: Showing Potential effectiveness of DIVS against **a)** Un-registered drugs, b) Banned drugs, **c)** Expired drugs and **d)** Recalled medicines.

a) Un-registered Drugs



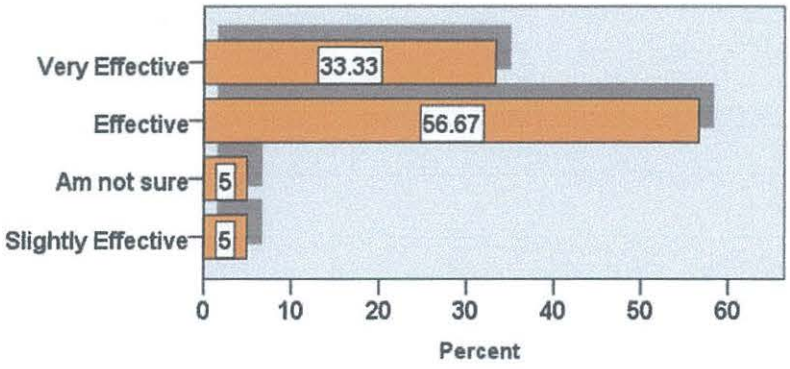
Unregistered medicines, 85% observed that the DIVS has a potential for being effective against un-registered medicines (60% ranking it effective, 25% ranked it very effective). 7% where not sure, 5% slightly effective while 3% not effective at all.

b) Banned Drugs



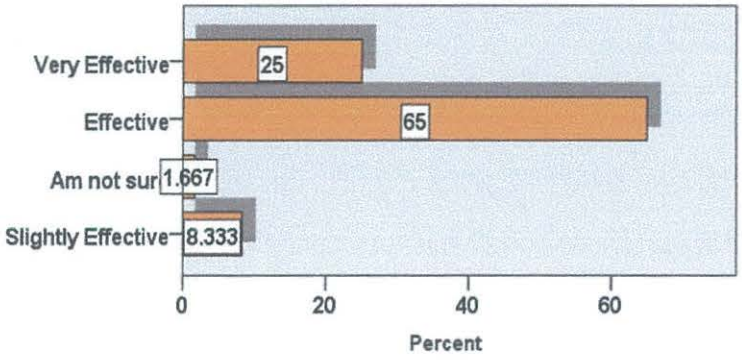
Against banned medicines, 90% observed the DIVS to be a potentially effective solution against banned medicines, 5% where not sure while 5% observed that it would slightly be effective.

c) Expired Drugs



Against expired medicines, 90% of the respondents observed that the DIVS may be potentially effective against banned medicines, 5% where not sure while 5% observed that it would slightly be effective.

d) Recalled Drugs

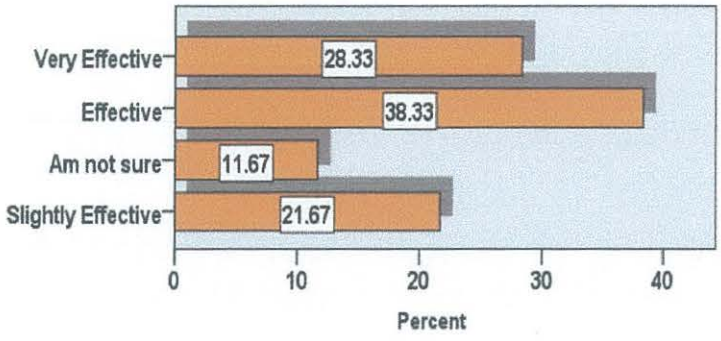


Against recalled on the market, majority of the respondents (90%) observed that the DIVS would be effective while 2% where not sure. 8% observed a potentially slight effectiveness against recalled medicines.

4.2.2.6. Potential effectiveness of patients' "feedback and batch verification" against substandard and counterfeit medicines

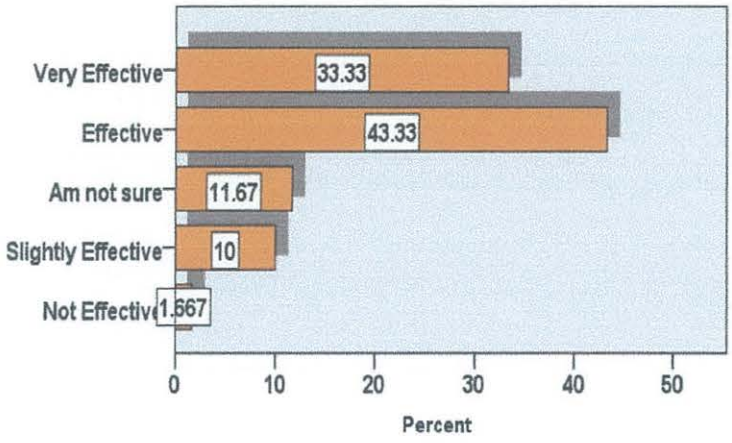
Figure 4. 12: Showing opinions about the Potential Effectiveness of patients' "feedback and batch verification" against substandard and counterfeit medicines.

a) Substandard Drugs



Although 66% observed patients verification of medicines followed by feedback to effective (38% effective + 28% very effective) against substandard medicines. 12% were not sure about its effectiveness while 22% viewed the approach to be slightly effective.

b) Counterfeit Medicines

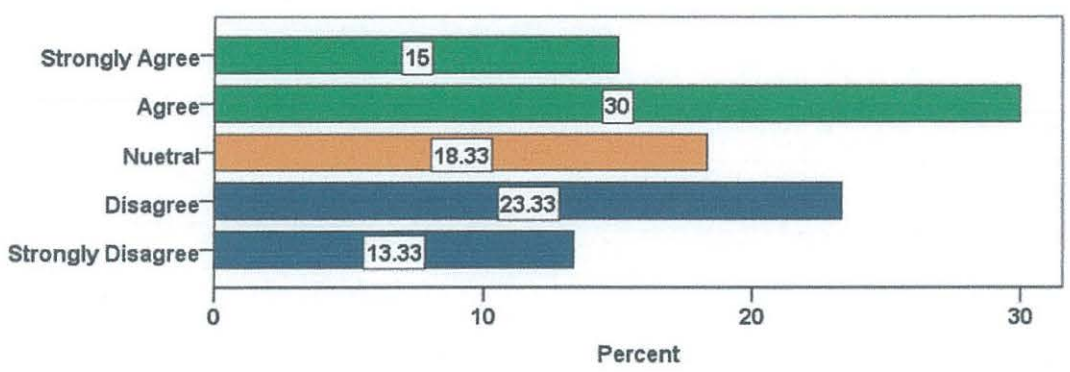


Majority of respondents (76%) were sure that medicine verification by patients followed by feedback to government regulatory authorities was a potentially effective solution against counterfeit medicines. 12% were not sure while 10% where sure that the approach was slightly effective.

4.2.2.7. Potential Effectiveness of medicine information in DIVS to reduce self-medication and adherence to treatment

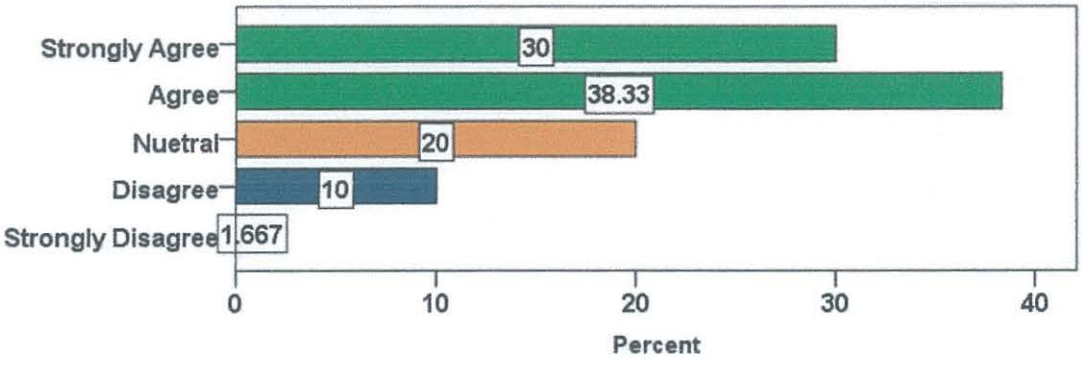
Figure 4. 13: Showing potential effectiveness of medicine information provided in DIVS to **a)** Reduce self-medication and **b)** Adherence to treatment.

a) Reduce self – medication



Less than half (45%) of the respondents agreed that providing medicine information using the DIVS would reduce self-medication. 18.33% were neutral while 36% disagreed about its effectiveness to reduce self-medication.

b) Adherence to treatment

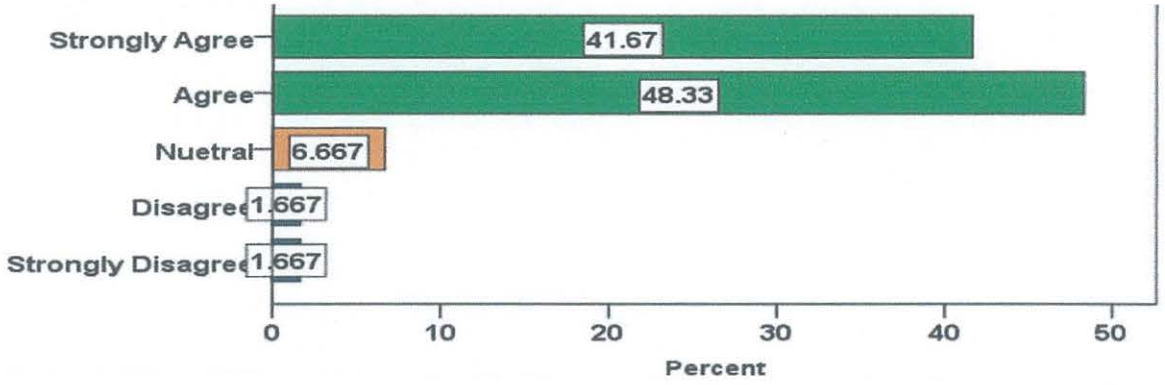


68% agreed that improving access to medicine information will improve adherence to treatment, 20% were neutral while 11% disagreed.

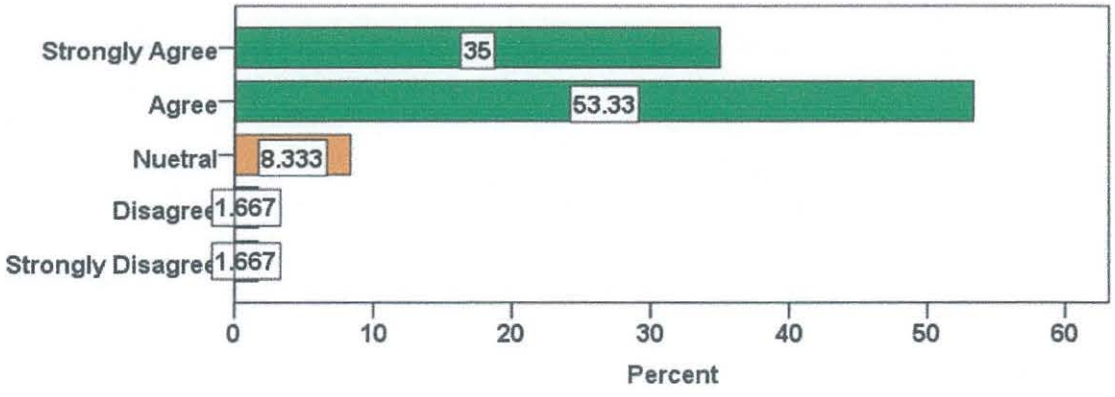
4.2.2.8. Potential Effectiveness of the Batch Verification component to improve the Drug Recall System and compliance to registration and licensing

Figure 4. 14: Showing opinions about the potential Effectiveness of the Batch Verification component to improve **a)** the Drug Recall System and **b)** Compliance to registration and licensing.

a) Improve the Drug Recall System



b) Improve compliance to registration and licensing

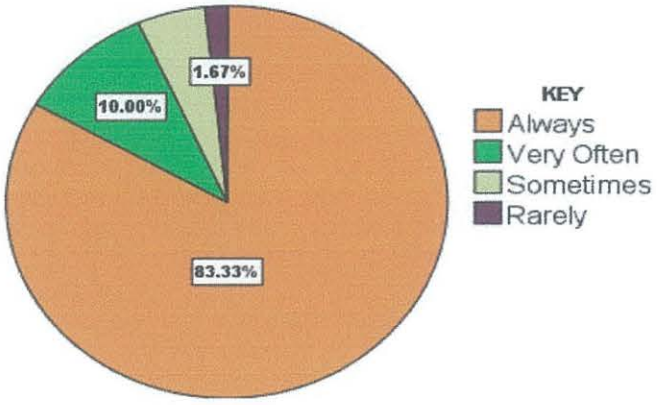


From the figure 4.15 (a) and (b) above, over 90% of the respondents agreed that the DIVS had potential to improve both the drug recall system and medicines registration and licensing. Only 7% were neutral about the opinion while the number of respondents who disagreed was less.

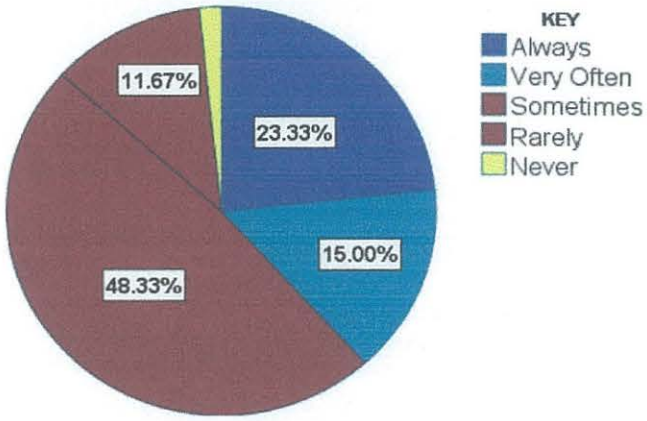
4.2.2.9. The need for medicine information, whether the need is met and the Current sources of such information.

Figure 4. 15: Showing a) People's need for medicine information, b) Whether they always get such information, c) Current sources of such information and d) Preferred sources of medicine's information.

a) Desire to know more information about their medicines



b. Whether they always get such Medicine information



a) Current Sources of Medicine Information

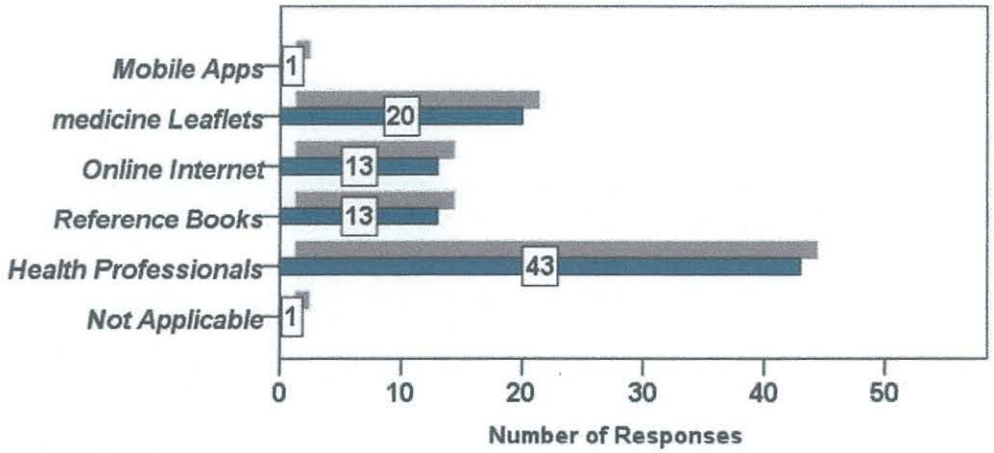


Figure 4.17a indicates that 83% of the population "always" needed medicine information, 10% "very often" needed information about their medicines and less than 2% had "less or no need" for such information.

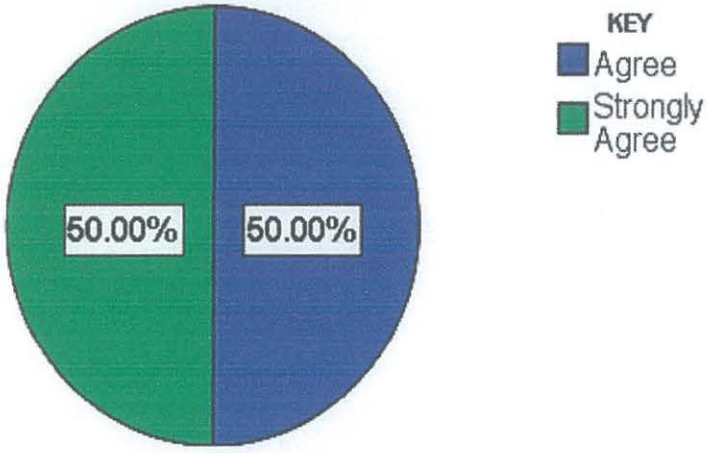
Whether the need for medicine information was always met, figure 4.17b indicates that only 23% always got the medicine information they needed while only 15% often got the medicine information when needed. Majority of the respondents (over 60%) either sometimes, rarely or never got information about their medicines whenever needed.

From figure 4.17c, most common source of medicine information was health workers/professionals (43%), followed by medicine leaflets (20%) then internet and reference (books each with 13%) and finally internet or mobile applications.

4.2.2.10. Potential effectiveness of public's feedback mechanism to support performance of regulatory Bodies and to support Public - Government Collaboration in Ensuring presence of safe medicines and their safe use

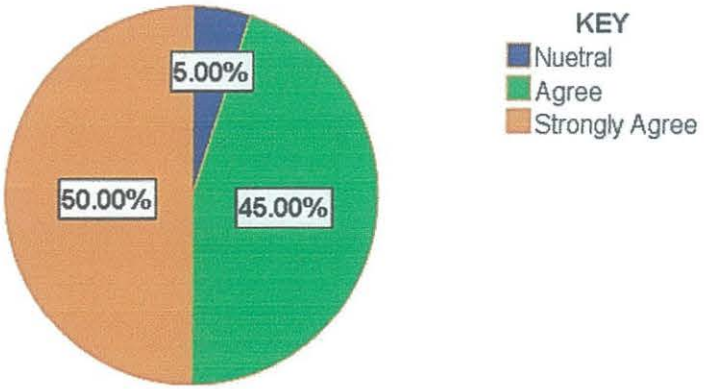
Figure 4. 16: Potential effectiveness of public's feedback mechanism to **a)** support performance of regulatory Bodies and **b)** Public - Government collaboration in ensuring presence of safe medicines and their safe use.

b) Support performance of regulatory Bodies



According to figure 4.16a, all respondents (100%) agreed that the feedback mechanism in the DIVS has a potential to support performance of regulatory bodies. From Figure 4.16b, 95% also agreed that the DIVS has potential to improve public government collaboration in ensuring presence of safe medicines and their safe use. Only 5% were neutral about this benefit.

c) Public - Government Collaboration in Ensuring presence of safe medicines and their safe use



4.3. Challenges which may arise during implementation and use of the DIVS and possible recommendations

4.3.1. Challenges which may be associated with implementation and use of the DIVS

Table 4. 1: Showing respondents' opinions about Challenges which may be arise during the implementation and use of the DIVS

	Challenge	Frequency
1	Limited number of smart phones' users which implies a limited population covered	34
2	Limited skills/knowledge on how to use smart phones/systems due to low literacy levels	15
3	None	6
4	Limited internet access hence limited population covered	6
5	Limited or inadequate publicity/sensitization	6
6	High data charges for downloading or regular update of the systems	4

7	Limited electricity coverage hence no battery charge on phones	4
8	Displaying outdated data due to a delay in acquiring data or customers' inability to update their apps on time.	4
9	Poor cooperation from manufacturers and distributors to submit batch numbers	3
10	Failure to have all medicines (brands) and their information in the system leaving out key information and literature	3
11	Encroachment into the system by Hackers	3
12	Poor attitudes towards personal health care and a low tendency to acquire related information	2
13	Limited collaboration from professional councils and regulatory bodies	2
14	Language barrier	2
15	Limited or lack of understanding of medical terminologies	2
16	Encourage self-medication	2
17	Challenge of Verifying validity of information received from patients, Health professionals etc. e.g. feedback claims/comments, batch numbers	1
18	Data inaccuracy i.e. batch numbers and medicine information	1
19	De-campaigning of the system by Unregistered drugs' dealers	1
20	Prevailing poor dispensing practices e.g. denying patients batch numbers or medicine names	1

The limited number of smart phones

4.3.2. Recommendations to improve or reduce challenges that may face HFVS during implementation and use

Table 4. 2: Showing respondents' suggested recommendations to improve the DIVS features and to mitigate some of the challenges in table 4.1 above.

	Recommendations made	Frequency (f)
1	No recommendation made	42
2	Translate to local languages	7
3	Introduce a digital phones version to cater for non-smart phone users	4
4	Lab equipment	3
5	Establish the project as an independent NGO functioning in collaboration with Government	3
6	Ensure timely review and updates of Data through synchronizing databases	2
7	Icons alongside name (features) for easy identification of tasks	2
8	Separate the system into 2 i.e. DIVS App & HFVS App	1
9	Modify notifications. Not all registered drugs are safe due to factors like storage conditions, patient state etc.	1
10	Add user review sections	1
11	Strengthen database security from manipulators for the purpose of data integrity and reputation of the service	1
12	Include "indications" under medicine information	1
13	Include "replies" for patients after they've submitted feedback information	1
14	Unknown/rare abbreviations should be avoided	1

15	Remove or minimize ads	1
16	Auto loud reader	1
17	Include home page	1

70% (N = 42) of the study respondents had no recommendations to make.

Most common recommendations included Translation of medicine information in to local languages to solve the challenge of language barrier (N = 7); to introduce a digital phones version to cater for non-smart phone users (N = 4); and to establish the project as an independent NGO functioning in collaboration with Government and non-government organizations for better operationalization and sustainability (N = 3).

Other recommendations are as shown in table 4.2 above.

CHAPTER FIVE: DISCUSSION AND RECOMMENDATIONS

5.1. Prototype of the DIVS

The design objectives included a user friendly user interface that allows easy navigation through all the components of the DIVS with minimal steps and challenges.

Results from the feasibility assessment indicated that this was achieved, as reflected in subsection 5.2 the results below.

Feedback forms were to be further improved using study recommendations in table 4.3.2.

5.2. Assessing the usability and acceptability of the DIVS

5.2.1. Usability assessment using learnability and user interface design

The user interface design easily portrayed the purpose and function of the DIVS. Majority of the respondents (over 98%) found it very simple to use App and could perform a task within 2 minutes or less. This implies that a simple user centered design with adequate potential of a better user-satisfaction was achieved.

Based on the parameters assessed (purpose, function, simplicity and time-taken), the DIVS may likely face limited usability related challenges. Simplicity implies better acceptability (Gurupur & Wan, 2017).

5.2.2. Acceptability assessment using reliability, security, data privacy, necessity and effectiveness of the DIVS

The percentage of the study population which doubted the batch numbers' acquisition process (ranked it to be "poor" or "not sure") in terms of reliability, security, data privacy, exhaustiveness and timeliness was significant i.e. 12% (10% + 2%), 5%, 20%, and 14% for reliability, data security and privacy, exhaustiveness and timeliness respectively.

From the views obtained, total dependency on National Drug Authority (NDA) as the only source of Batch numbers, registered medicines' list and updates about batches (Batch notifications) is relevant and will promote reliability, data security and privacy, exhaustiveness and timeliness.

Although NDA uses batch numbers during post market surveillance, batch numbers are not captured in isolation. This presented a need to design a suitable approach to bridge the gap. As a solution to this, a new method was proposed and designed, for integration into NDAMIS (National Drug Authority Management Information System), to support online submission of Batch numbers before an import license is issued and then verifying them at the port of entry before approval for distribution in Uganda. Once batch numbers are verified, they are automatically added to NDAMIS database and auto synchronized in the DIVS Database. At that instantly, anyone who uses the updated version of the App is able to use those batch numbers to find information about their medicines.

5.2.2.1. Potential effectiveness against some challenges in Uganda's legal supply chain i.e. prevalence of Un-registered drugs, banned drugs, expired drugs and recalled medicines still on sale.

According to figure 12, approximately 90% of the respondents agreed that the DIVS has a potential of being effective against unregistered, banned, expired and recalled medicines. About 10% of the respondents expressed doubt about the potential effectiveness with reasons which included a limited number of people using the App due to limited publicity and technological inadequacies like limited internet and lack of smart phones. Poor dispensing practices involving non-disclosure of medicine identification information including names and batch numbers, among others were also mentioned.

From the study results, the perceived level of effectiveness against unregistered, banned, expired and recalled medicines by government, general public and health care professionals may increase the acceptability of the DIVS.

5.2.2.6.Potential effectiveness of patients' "feedback and batch verification" against substandard and counterfeit medicines

Verification of medicines by patients followed by feedback to government was observed to be an effective approach against both counterfeits and substandard medicines by majority of respondents 76% and 66% respectively.

A significant percentage of respondents (12%) were not sure while 22% and 10% for both substandard and counterfeits respectively were confident that the approach may slightly be effective. Most common reason especially among health professionals and patients was that generally, government regulatory bodies rarely act on public feedback concerns and the same tendency will likely manifest when handling feedback responses from the public about potentially substandard and counterfeit medicines.

5.2.2.7.Potential Effectiveness of medicine information in DIVS to reduce self-medication and adherence to treatment

Self-medication and poor adherence to treatment depends on several factors among which is limited information, for which the DIVS is designed.

The high percentage of respondents who disagreed (36%) and those who were neutral/not sure about its effectiveness against self-medication reasoned that other factors on addition to providing medicine information need to be addressed e.g poor attitudes towards personal health care, social economic status among others.

5.2.2.8.Potential Effectiveness of the Batch Verification component to improve the Drug Recall System and compliance to registration and licensing.

From the study results, the DIVS has a potential to improve medicines registration and licensing and the medicine recall system hence strengthening Uganda's medicine supply chain and ensuring safety of medicines on market.

5.2.2.9.The need for medicine information, whether the need is met and the Current sources of such information.

It was evident that according to figures 4.17a, b and c, majority of the population (93%) always needed medicine information but only 38% always or often accessed it whenever needed.

Since the study was among main health workers, with a few patients (18%) involved, it is possible that the percentage of the general population who always or often get medicine information whenever needed is much less than 38%.

From figure 4.17c, the main source of information about medicines were health professionals, considering the current challenge of illegal health workers, professional misconduct, poor dispensing practices among others, patients might be seeking information from already compromised sources hence they never or rarely get the information when needed.

Figure 4.17c also revealed that less than 2% use mobile Apps for medicine information which presents an opportunity of a gap to be filled by DVIS of HDA.

The High percentage of people who desire who desire but do always obtain medicine information, those who obtain information from less reliable sources and the absence of a mobile application to fill the existing gap collectively present an opportunity which may promote acceptability of the DIVS.

5.3. Challenges which may arise during implementation and use of the DIVS and possible recommendations

5.3.1. Challenges which may be associated with implementation and use of the DIVS

Technological Inadequacies: Most commonly mentioned challenges included technological inadequacies like limited number of smart phone users hence a limited population covered (N = 34), Limited skills/knowledge of smart phone/apps usage due to low literacy levels (N=15) and limited internet access/its affordability (N=10). These findings are synonymous with Kaberu et. al. (2017) as hindrances to adopting e-health services in Uganda.

According to the National Information Technology Authority-Uganda survey report, approximately 80% of adults who do not own a mobile phone have a plan to own one within the next 2 years hence a growing smart phone coverage is expected in the future (NITA-U, 2018).

Administrative challenges: these included limited collaboration from professional councils, national drug authority and other regulatory bodies hence a cause for un-necessary bureaucracies delayed decision making. This posed a need for well-defined partnerships and memoranda of understanding with regulatory bodies to minimize the obstacles.

Operational challenges: These included poor cooperation from manufacturers and importers when asked to submit batch numbers; difficulty in verifying authenticity and accuracy of information submitted especially batch numbers and patients' feedback; and Data inaccuracy i.e. batch numbers and medicine information. Both challenges posed a need to depend on the National drug authority for verified batch numbers. A proposed approach to achieve this has been elaborated under section 5.2.2.

Social economic factors: included poor attitudes towards personal health care among patients characterized by less concern about medicines' information and safety language barrier, self-medication, and limited participation due to inadequate publicity.

5.3.2. Recommendations to improve the DIVS

Table 5. 1: Showing the status/comment for each of the recommendations made for the DIVS

	Recommendations made	**Freq (f)**	**Comment**
1	No recommendation made	42	Not applicable
2	Translate to local languages	7	Adopted
3	Introduce a digital phones version to cater for non-smart phone users	4	Reserved for further discussions

4	Lab equipment	3	Reserved for further discussions
5	Establish the project as an independent NGO functioning in collaboration with Government	3	Reserved for further discussions
6	Ensure timely review and updates of Data through synchronizing databases	2	Synchronizing data-bases with partner government regulators.
7	Icons alongside name (features) for easy identification of tasks	2	To be adopted and will be included.
8	Separate the system into 2 i.e. DIVS App & HFVS App	1	Rejected. Costs outweigh the benefits.
9	Modify notifications. Not all registered drugs are safe due to factors like storage conditions, patient state etc.	1	Adopted. Discussions and consultations to modify notifications to be conducted.
10	Add user review sections	1	Rejected. May be misused to manipulate patients.
11	Strengthen database security from manipulators for the purpose of data integrity and reputation of the service	1	To be adopted prior to implementation
12	Include "indications" under medicine information	1	Rejected. May promote self-medication
13	Include "replies" for patients after they've submitted feedback information	1	Adopted.
14	Unknown/rare abbreviations should be avoided	1	Adopted
15	Remove or minimize ads	1	Adopted

16	Auto loud reader	1	Adopted
17	Include home page	1	Adopted

The recommendations were either adopted, rejected or reserved for further discussions/consultations as indicated in the table 5.2 above.

From the recommendations obtained during the study, the following were adopted and are to be incorporated into the DIVS before implementation. These include; (1) Translation to local languages (2) introduction of an Auto loud reader both intended to minimize the challenge of language barrier and low literacy levels; (3) data base synchronization to ensure timely review and updates of Data; and (4) to Modify notifications since Not all registered drugs are safe due to factors like storage conditions, patient physiological state among others.

Recommendations subjected to further discussions and conclusions included (1) Introduction of a digital phones version to cater for non-smart phone users; (2) Inclusion of lab equipment on the list of items and to (3) Establish the project as an independent NGO functioning in collaboration with Government.

Other recommendations were rejected and these included (1) Separate the system into 2 i.e. DIVS App & HFVS App and (2) to Include "indications" under medicine information since it may encourage self-medication.

Refer to figure 5.1 for a Summary of the status/comments applied to each of the recommendations.

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APPENDIX I: BUDGET

Table 3. 1. Estimated Budget for the Feasibility Study of the DIVS

	Item	Description	Cost Estimates
a)	Prototype development	Mobile App, Dashboard and database development	1,000,000
b)	Stationary	Copies of proposal, dissertation, questionnaires and letters	300,000
c)	Transport and coordination (Airtime and vehicle expenses)	• To and from Kampala • Communication with and coordination of target groups	300,000
d)	Facilitation of meetings with respondents	Interviews and briefing sessions	500,000
e)	3 Mobile phones	For user experience studies	450,000
f)	Internet Data	Literature review, prototype development and testing	50,000
Total			**2,600,000**

APPENDIX II: WORK PLAN

Figure 3. 1. Work plan for the feasibility study of DIVS

TIME IN MONTHS (2018)

ACTIVITY	May	June	July	August	September	October	November	December
Proposal writing and presentation								
Prototype development								
Development of data collection tools and pre-testing								
Writing to the concerned offices for permission to access study respondents								
Data collection process								
Data analysis, report writing and submission								

3. **Gender:**
☐ Male
☐ Female

4. **Age:**
☐ 18 – 25
☐ 26 – 35
☐ 36 – 46
☐ 47 and above
☐ Prefer Not to say

5. **Highest level of education**
☐ Primary
☐ Secondary
☐ Diploma
☐ Degree
☐ Masters
☐ PhD

6. **Are you a**
☐ Health worker
☐ Non health-worker
☐ Student (Health care/medical)
☐ Student (Non Health care/medical)

7. **If you are a health, which health worker/student category do you belong?**
☐ Pharmacy
☐ Medicine
☐ Nursing
☐ Medical lab
☐ Other (specify): _____

8. **Place of work**
☐ Public facility
☐ Private facility
☐ NGO
☐ Regulatory body/association
☐ Others
☐ Not working

QUESTIONS ABOUT THE PROTOTYPE

Following the video description of the system, and the hands on demonstration using the prototype, please answer the following;

9. **Based on this introduction, did you understand the Application's, (tick as appropriate)**

	1 (YES)	2 (Some How)	3 (No)
Purpose			
How it works			

10. **How simple is it to use the app?**
☐ Very Easy
☐ Somewhat Easy
☐ Somewhat Difficult
☐ Very Difficult

11. **How easy is it to memorize the steps when using the Application?**
☐ Very Easy
☐ Somewhat Easy
☐ Somewhat Difficult
☐ Very Difficult

12. **What time does it take you to verify a batch number or obtain medicine information?**
☐ 15 – 25 seconds ☐ 30 – 60 seconds ☐ 1 – 2 minutes ☐ 3 – 5 minutes

13. **How would you rank the method/process used to obtain Batch numbers (from manufacturers/importers) in terms of Security, Exhaustiveness, Reliability and Timeliness.**
1 (Very poor); 2 (Poor); 3 (am not sure); 4 (Good); 5 (very Good)

	Item	Rank
a)	**Secure** (Minimum risks for manipulation)	
b)	**Exhaustive** (Has potential to exhaust all batch numbers for drugs)	
c)	**Reliable** (can be trusted for accurate/truthful information)	
d)	**Timely** (Enables timely capture and update of batch numbers)	

14. **What improvements would you recommend to the App to make it more useful or simpler to use? (Any features to remove or add?)**

.....

.....

15. **To what extent will the system be of importance to;** (fill in the number corresponding to your choice)

1. Very Important
2. Important
3. Moderately Important
4. Slightly Important
5. Not Important

	score
a) Health workers	
b) General public	
c) Government/regulators	

16. **In your Opinion, what "level of effectiveness" should be expected from this Information and Verification system towards controlling the sale/use of the following categories of unsafe medicines?** Use any choice below

1. Not Effective; 2. Slightly Effectiveness; 3. Am not sure; 4. Very Effective; 5. Extremely Effective

	CATEGORY	RANK
a	**Unregistered medicines** (sold without a valid license from NDA)	
b	**Expired medicines**	
c	**Recalled medicines** (Recalled from the market by NDA after establishing reasons for being unsafe)	
d	**Banned medicines** (medicines prohibited from being sold to the public due to their dangers to humans/environment)	

e	**Substandard medicines** (registered medicines which do not meet their expected standards as per the pharmacopeia)	
f	**Counterfeit medicines** (aka. falsified medicines are those which are mislabeled with respect to their identity, source/origin and/or composition)	

17. **Do you think unsafe medicines are a public threat to Uganda's health care system?**

☐ Yes ☐ Somehow ☐ No

18. **Is it important for a patient to receive all the following information about their medicine? (Medicine description, administration** [dose, frequency, duration, route of administration], **interactions, precautions during use, storage, Pharmacist's advice [as relates AMR, Self-medication, under/incomplete dosing etc.])**

☐ Definitely
☐ Very Probably
☐ Probably
☐ Possibly
☐ Probably Not
☐ Definitely Not

19. **To which extent do you agree that providing <u>offline mobile medicine information</u> service will help to?**

a. Strongly Disagree; 2. Disagree; 3. Neutral; 4. Agree; 5. Strongly Agree

a)	Reduce Self-medication	
b)	Improve adherence to treatment	
c)	Reduce treatment failure rates	
d)	Reduce emergency and propagation antimicrobial resistance	

20. **To which extent do you agree that providing <u>offline mobile batch verification</u> service will help to?**

a) Reduce prevalence of Un-Registered medicines	
b) Reduce accidental/intentional sale or use of expired, Banned or recalled medicines	
c) Improve efficiency of the national *drug recall system*	

d) Increase compliance with *registration & licensing* requirements for all medicines	

21. To what extent do you agree that providing feedback by the public to the regulatory bodies using the App will help to

a) Support regulatory bodies in performing regulatory functions (post market surveillance, general inspections, pharmacovigillance, etc.)	
b) Improve public collaboration with regulatory bodies in ensuring presence of safe medicines and their rational use.	

22. As a patient/caretaker, do you always desire to know more information about your medicines?

☐ Always ☐ Very Often ☐ Sometimes ☐ Rarely ☐ Never

23. If No, Why?

.....

24. If yes, do you always get such information?

☐ Always ☐ Very Often ☐ Sometimes ☐ Rarely ☐ Never

25. If yes/sometimes, how or from where do you get the information?

.....

.....

26. In your assessment, what challenges may be associated with using the App as a source of medicine information and verification?

.....

.....

27. As a patient, which kind of feedback would you commonly desire to give to Manufacturer/Importer/Drug Regulator about their medicines/products?

.....

.....

.....

28. **As a Manufacturer/Importer/Drug Regulator, which kind of feedback information about medicines would you be interested in from the public?**

.....

.....

.....

29. **According to your company structure, which office/person would be most suitable to submit batch numbers of drugs being manufactured/imported for the Ugandan market?**

- ☐ Marketing manager
- ☐ Production pharmacist
- ☐ Country manager
- ☐ General Manager
- ☐ other

KAMPALA INTERNATIONAL UNIVERSITY

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Tel: 0200923534
www.kiu.ac.ug

Office of the Dean School of Pharmacy

17 October 2018

permission granted to conduct the research at AHPC
31.10.2018

THE ALLIED HEALTH PROFESSIONALS' COUNCIL
RECEIVED

TO;

THE REGISTRAR,

Allied Health Professionals' Council (AHPC)

Dear Sir/Madam:

RE: MUWANGUZI DANIEL (BPH/0069/143/DU)

The above named student is in year four semester two pursuing a Bachelor of Pharmacy degree in the School of Pharmacy at Kampala International University Western Campus (KIU-WC).

As part of the requirements for the degree, the student is conducting a research study entitled: ***"A feasibility study of the Drug Information and Verification System (DIVS) in Uganda"***. The research project has been approved by the School's Research Committee. The student will work under direct supervision of an academic staff of the School.

Kindly offer him the necessary assistance to conduct this important research. For any additional information, please contact the undersigned.

KAMPALA INTERNATIONAL UNIVERSITY SCHOOL OF PHARMACY
18 OCT 2018

Thank you for your assistance.

Dr. Jonans Tusiimire BPharm, MSc, PhD
DEAN – SCHOOL OF PHARMACY

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17 October 2018

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KAMPALA INTERNATIONAL UNIVERSITY
18 OCT 2018
DEAN SCH OF PHARMACY

The Student is allowed to carry his research at this Teaching Place and accord him all the assistance.

MOST AT RISK POPULATIONS INITIATIVE (MARPI)
22 OCT 2018
KAMPALA
P.O.Box 71 TEL: 0200923534

Dr. Jonans Tusiimire BPharm, MSc.
DEAN – SCHOOL OF PHARMACY

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KAMPALA INTERNATIONAL UNIVERSITY
18 OCT 2018
DEAN SCH OF PHARMACY

COMPANY PHARMACIST / PHARMACIST IN-CHARGE
KPI(1996)LTD P O BOX 7551 KAMPALA UGANDA

Thank you for your assistance.

Dr. Jonans Tusiimire BPharm, MSc,
DEAN – SCHOOL OF PHARMACY