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Improved integrated care2x hospital management information system with national health insurance fund system

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IMPROVED INTEGRATED CARE2X HOSPITAL MANAGEMENT INFORMATION SYSTEM WITH NATIONAL HEALTH INSURANCE FUND SYSTEM

Abel Haule

A Dissertation Submitted in Partial Fulfilment of the Requirements for the Degree of Master's in Information and Communication Science and Engineering of the Nelson Mandela African Institution of Science and Technology

Arusha, Tanzania

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ABSTRACT

The advancement of technology observed today has led to the development of many Health Management and Information Systems (HMIS), which are cost-effective, reliable, scalable and flexible. However, the Integrated Health Management and Information System (iHMIS) plays a crucial role in the dissemination of information, which helps in decision-making. The care2x HMIS in Tanzania lacks a module to exchanges data between Care2x HMIS and the National Health Insurance Fund (NHIF) claims management system. The absence of this module in Care2x has effect in patients' waiting time, the accuracy of submitted claims, the time used in processing claims, and costs incurred in printing claims forms. This study aimed at improving health services by developing an integrated data exchange module between Care2x HMIS and NHIF claim management system, with Arusha and Kilimanjaro selected as the case study due to the presence of a large number of health facilities.

Furthermore, the integrated data exchange module was developed by using PHP, HTML, CSS and JavaScript programming languages. The developed module reduces patient waiting time, cost in processing claims and increase accuracy in processing claims. Additionally, this study digitized the NHIF form, thus reducing paperwork and human resource in filling forms. Further, the developed integrated data exchange module enabled NHIF personnel to verify claims before processing payment. The viability of this study is to enhance health service in health facilities.

DECLARATION

I, Abel Haule, do hereby declare to the Senate of Nelson Mandela African Institution of Science and Technology that this dissertation is my own original work and that it has neither been submitted nor being concurrently submitted for degree award in any other institution.

Abel Haule	21/03/2019
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The above declaration is confirmed

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(Supervisor 1)	Date

Dr. Anael Elikana Sam	22/03/2019
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CERTIFICATION

The undersigned certify that they have read and found the dissertation acceptable by the Nelson Mandela African Institution of Science and Technology.

22/03/2019

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DEDICATION

Mr. and Mrs. Patrick Zachariah Haule to you my beloved parents, I dedicate this work for showing me the light of the world through education.

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LIST OF ABBREVIATIONS AND SYMBOLS

ALMC	Arusha Lutheran Medical Centre
CHF	Community Health Funds.
CSS	Cascading Style Sheet.
GoT-HoMIS	The Government of Tanzania, Hospital Management Information System.
HMIS	Health Management Information System.
HTML	Hypertext Markup Language
ICT	Information and communication Technology
IDEM	Integrated Data Exchange Module
KNTH	Kibong'oto National Tuberculosis Hospital
LUICO	Lutheran Investment Company
LUICO	Lutheran Investment Company
MoHCDEC	Ministry of Health, Community Development, gender Elderly and Children.
MoHSW	Ministry of Health and Social Welfare
MVC	Model View Controller
NHIF	National Health Insurance Fund
PHP	Hypertext Preprocessor
PORALG	President’s Office,Regional Administration and Local Government
VPN	Virtual Private Network
WHO	World Health Organization

CHAPTER ONE

INTRODUCTION

1.1 Background Information

Health information is the foundation of decision making to all health institutions and important to the development and implementation of health system policy. It is the base of health research, health education/awareness, institution governance and service delivery (WHO, 2008). The growth of Information and Communication Technology (ICT) has contributed to the increase in productivity in many sectors. The advancement of technology, lower price of broadband connectivity, development and deployment of ICT tools has resulted in the adoption and usage of electronic services in every sector (Noor-Ul-Amin, 2013). Consequently, the health sector has introduced several Health Management Information Systems (HMIS) to assist in conducting and improving health services among health institution and increase patient satisfaction.

Health Management Information System (HMIS) refers to a system that captures, stores, manages and transfers data among health facilities (Almunawar and Anshari, 2011). It also plays a great role in monitoring and evaluation, supporting patients and health facilities. The use of HMIS increases timeliness and accuracy of patient care, reduces of patient waiting time, increases patient satisfaction, and enables practitioners to serve a great number of patients in a short time. The HMIS contributes to the improvement of report submission, better decision-making, monitoring and evaluation of health sector activities and the management of patient information (Mutale *et al.*, 2013).

Globally, the use of ICT has contributed to the improvement of health services conducted in several health facilities. The adoption of ICT in health issues increased the involvement of patients in their own health progress (Talebian *et al.*, 2014). The usage of HMIS includes; data storage, sharing of information among health institution as well as communication between patients and practitioners. There is a complex HMIS that combines several functionalities including self-care, forms for communication and data processing. This kind of system helps patients to fill the form by describing their problem/sickness in their geographical location then send to the respective practitioners before going to the hospital

(Talebian *et al.*, 2014). Examples of HMIS which are mostly used in Tanzania include; PatientOS, OpenMRS, OpenEMR, HospitalOS, HOSxP and Care2x.

Care2x is a free open source software which has been used in several countries to support health activities in health facilities. It was started as "care2002" project in 2002, which was then changed to care2x in 2013 and the first version (version1.1) was released in 2014 . The latest version that is used in a health institutions recently is version 2.7. It also has the ability to be customized according to the requirements of the specific healthcare facilities. Furthermore, its security is 80% thus making it capable of handling healthcare matters in the respective institution (Gödert and Latorilla, 2017).

The use of HMIS is recognized by the Tanzanian government through Tanzania National eHealth Strategy 2013-2018. The strategy aimed at integrating ICTs in health sector so as to transform healthcare delivery by enabling information access and supporting healthcare operations, management, and decision making (MoHSW, 2012) . To implement this strategy, the Ministry of Health, Community Development, Gender, the Elderly and Children (MoHCDGEC) came up with the Guidelines and Standards for Integrated Health Facility Electronic Management Systems of 2016, which aimed at improving quality of health facility operations while enhancing revenue collection, management of medicines and other medical supplies in both public and private health facilities (MoHCDGEC, 2016) .

To improve health services in Tanzania cost-sharing schemes were introduced in parallel with the introduction of medical insurance schemes as a tool to overcome the challenge of unaffordable medical expenses (Kumburu, 2015). In 1993, the government of Tanzania formulated health insurance policy, which fostered to the establishment of National Health Insurance Fund (NHIF) in 2001 with the objective of insuring health-care services to both public and private sector employees (Ministry of Health, 2003). It requires an individual to register and get insurance card, which involves cost-sharing between the government and an individual. The scheme improves health services and enables a large number of people to get health services. NHIF coverage is growing at a high rate and as of 30 June 2015, it stood at 3 237 434 beneficiaries (NHIF, 2015). The increase in a number of NHIF beneficiaries pushed NHIF administration to develop claims management system to assist on the management of members and claims verification.

The efforts shown by the government of Tanzania in using ICT tools, drive many health facilities to start using electronic HMIS. The most popular HMIS used in Tanzania are Care2x, AfyaPro, OpenMRS System, PatientOS System, OpenEHR and Specification-Based System. Care2x is one among HMIS that are mostly used in Tanzania, being implemented in more than 15 private health facilities. An example of hospitals that use Care2x is Haydom Lutheran Hospital is one of the hospitals which serves seven districts in four regions and provides access to health care to more than 900 000 people in Tanzania. In addition, GoT-HoMIS is the HMIS managed by the Tanzania government and have been implemented in more than 170 health facilities owned by the government (PORALG, 2017) .

Despite the fact that most of the hospitals are using HMIS and have dedicated desk for NHIF insured patients but there are few challenges in the health sector still faces some few challenges. The presence of NHIF form in hard copy, which is used for recording patient details results into patients' long waiting time on queues. Consequently, long waiting time lowers patients' satisfaction with the hospital services (Huang, 1994). Through the use of paper-based forms in recording patient information, the hospital manages to serve a few numbers of people in a given time. In such a condition, serving a large number of patients requires a large number of human resource and consumption of papers, which is costly. Moreover, human errors are unavoidable which sometimes reduce the accuracy of the patient data. Furthermore, submission and reporting of the patient records which were done on paper then submitted to NHIF offices physically. Therefore, this study developed a module for integration of the Care2x hospital system and the NHIF system that will computerize NHIF treatment form to reduce waiting time of NHIF insured patient at admission, to reduce time spent by doctors to attend NHIF insured patients and automate the process of submitting NHIF treatment form to NHIF for verification.

1.2 Research Problem

During the process of filling the NHIF treatment forms, admission personnel have to verify the validity of the patient's NHIF identification card, through the Care2x system. The system will return an authorization code if verification is successful then the patient will be ready for registration and admission. For a new patient, the admission personnel, have to fill patient information in the Care2x system and then fill the same information in the NHIF treatment

form manually, which is a double work. Despite of higher technology used in care2x, data are steel exchanged in low level between care2x and NHIF system. This is a repetition of work, which leads to long waiting time. This study therefore intends to solve the problem by developing an Integrated Data Exchange Module (IDEM) to exchange data between care2x HMIS and NHIF claims management system.

1.3 Objectives

1.3.1 General Objective

To develop an Integrated Data Exchange Module (IDEM) for Integration of Care2x Hospital System with National Health Insurance Fund System to reduce waiting time of NHIF insured patient at admission, time spends by a doctor to attend NHIF insured patient and automate the process of submitting NHIF treatment form to NHIF office for payments verification.

1.3.2 Specific Objectives

Specific objectives were:

(i) To review Care2x HMIS and NHIF system and analyze requirements for integrated data exchange module.

(ii) To design and develop integrated data exchange module for Care2x HMIS that will automate filling and submission of NHIF claim forms.

(iii) To test and validate the developed integrated data exchange module.

1.4 Research Questions

(i) To what extent non-integrated HMIS and NHIF claims management system affect patient waiting time?

(ii) What are the requirements for developing a module for Integrating a Care2x HMIS and NHIF system ?

(iii) What are the designs requirements and data exchange format for integration module for Care2X HMIS and NHIF system?

(iv) How to validate the developed mobile application ?

1.5 Significance of the Study

(i) The significance of this module will be of interest to the NHIF team and all hospital users of care2x.

(ii) The development of IDEM will minimize human resource and cost incurred in buying and printing NHIF forms.

(iii) The module will reduce the patient waiting time for health services.

(iv) The module will increase accuracy in filling forms

(v) The IDEM will reduce human errors (such as those due to handwriting), which were the results of the usage of paper-based forms in recording patients claims.

(vi) The module will facilitate, timely submission of NHIF treatment form to the NHIF offices for payment processin

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

The previous chapter discussed the background of the study, research problem, objectives, research questions and significance of the study. This chapter presents the review of the main concept regarding care2x and the exchange module. It also describes the related research works on HMIS. The chapter gives highlight on the identification of the general requirements for the development of IDEM for care2x and NHIF claim management system.

2.2 Adoption of Care2x in Tanzania

The advancement of technology has led to the development of many HMIS, which are cost-effective, reliable, scalable and flexible. The health sector was facing several challenges in conducting healthcare services including lack of data storage tool, reporting problems, information sharing, loss of patients' data and long patient waiting time. Through the use of paper-based forms in recording patients details/information, the government was investing a lot of money on buying resources to accomplish the recording process and other activities which could be done using ICT tools to minimize the cost (Mutale *et al.*, 2013). Nevertheless, the manual process of recording patient's details has contributed to the increase in patient waiting time and loss/damage of data since the data were recorded and stored in papers. To minimize the challenges the ICT tools were the best solution to improve healthcare services.

The adoption of ICT tools in healthcare has contributed to the improvement of healthcare services and operation such as storage and management of patient's data. HMIS improves information flow within health institutions without altering the task of health-care practitioners (El Azami *et al.*, 2012). This resulted in the reduction of tasks done by health-care practitioners, hence minimizing patients' waiting time. Care2x is one among of the HMIS which is designed to integrate different information systems in health care. In Tanzania, the trend of using Care2x is very promising and a lot of customization has been done to accommodate the Tanzania healthcare environment. Many modules have been developed including the NHIF claim management system specifically for member

verification. There are several health facilities which are using Care2x in Tanzania including Machame Hospital, St. Elizabeth Hospital, Arusha Lutheran medical centre, Makiungu hospital, Kibong'oto hospital and Mbeya referral hospital (Omary, 2015) .

2.3 System Integration in Tanzania

System integration in Tanzania is considered as an important approach in conducting several activities both in public and private sectors. System integration involves joining/combining different subsystems or components to work as one large system. However, integration of HMIS plays a crucial role in managing health services and workflow in the health facilities. Systems integration facilitates local decision-making through, a supply of information among health sector departments in a timely and accurate manner. On the other hand, HMIS improves the allocation of resources, assist management of activities among health institutions and improve efficiency within the public sector. For better improvement of health care services, several systems have been integrated to minimize cost, human errors, resources while increasing patient satisfaction and timely reporting. For instance, in Tanzania, there is a module for discharge letter which was integrated with care2x to assist on recording discharge information (Wambura *et al.*, 2017) .

Scott *et al.* (2016) on their study of measuring the operational impact of digitized hospital records showed that there is benefit gained through the use of digitized records such as access of information from multiple locations, better preparation of ward rounds, improvement of patients handover and improvement of timeline for patients events. The study concluded that digitized medical records can be implemented without negative impacts on health facilities operation (Scott *et al.*, 2016).

2.4 Adoption of Care2x in Other Countries

Information communication technology has played a big role in advancing and improving health services. Healthcare information system has been identified as a better solution to the challenges associated with health issues (Matta-Machado *et al.*, 2017; Mutale *et al.*, 2013). Further, HMIS help in reducing medical errors, increase the quality of health services and improve practitioners efficiency. Care2x is one among HMIS which is used worldwide to improve health care services and management. In developing countries like India Care2x has

been modified to suit the work-flow of their hospitals and later added reporting module to assist in providing reports (Khan *et al.*, 2017).

In Albania, Care2x is considered as a national open source HMIS where it is used to manage 100 000 patients per year in the Mother Teresa Hospital (Hillenius, 2014). It helps in managing the health centre's workflow. It is mainly used to store, report and manage patient information within the hospital. Despite being the national HMIS, but it still lacks integrated module for data exchange between care2x with other HMIS.

In addition many other countries like Kenya, Uganda, India, Albania have adopted and customized care2x for management of health information based on their environment to improve healthcare services.

2.5 Related Work

Several research studies have been done on the usage of HMIS like care2x. Care2x has been customized according to the requirements of the specific health institution. Several studies on the development of modules and customization of care2x have been done to assist the health sector in providing healthcare services.

The study conducted by Khan *et al.* (2017) showed that Care2x was customized and deployed successfully in two premiere client hospitals in India. Care2x was customized according to the requirements of information workflow in the Indian hospitals. It reduces data redundancy, which was a major problem in several health facilities in India. In addition, it was customized purposely for managing patient information and information sharing. The study described the architecture of care2x which is based on the Model View Controller (MVC) that makes it easier for customization to accommodate low cost HMIS solution (Khan *et al.*, 2017). However, the study did not consider the exchange of information between care2x and other HMIS.

In addition, Kanagwa *et al.* (2016) customized Care2x and deployed it in more than 200 health facilities in Uganda. Helecare2x was the module customized in care2x in order to assist in improving healthcare services. It was distributed in health facilities in Uganda to improve management of patient information including; patient data, insurance record as well as critical medical information. There were challenges in health facilities in Uganda as the

process of generating reports was consuming time, leading to delay in submitting reports to the respective authorities. Development of Helecare2x module assisted in the auto-generation of reports and submission to the relevant authorities. The study concluded that Care2x is a mature product and helped to reduce the use of paper and improve workflow in health facilities. The limitation of this customized Care2x was limited to outpatients management only (Kanagwa *et al.*, 2016) .

In AIC Kijabe hospital there were some few challenges in providing healthcare services. The challenges includes, servers bieng unable to cope with the load put on them and Microsoft Access database that was used in registering patient was slowing down. Also, there were in need of open source HMIS to combine Microsoft access databases to support billing in laboratory, pharmacy, store, and supplies. Due to these challenges, the hospital sought to find an open source software that assisted in solving all of the issues. They decided to use care2x since it is an open source and it is manageable. Thereafter the healthcare services were improved and all the registration challenges were covered by the use of care2x. However, the study did not consider the integration of care2x with other HMIS (Drury and Dahlman, 2005).

Betuel *et al.* (2017) conducted an experiment to analyze the performance of a virtual private network (VPN) on information exchange between HMIS. The VPN is considered as a better way of connecting to a private local area network at a remote location. It fits well in exchange of information among health facilities. In Tanzania, the exchange of patient information between facilities that are using care2x was done manually because care2x does not have such functionality. The study focuses on analyzing the performance of a VPN instead of developing the module to assist the exchange of patient information among care2x users. Moreover, this study was based on data exchange between homogeneous systems only (Care2x to Care2x) rather than Care2x and other systems (Betuel *et al.*, 2017).

The study done by Wambura *et al.* (2017) described the development of a discharge letter module to assist in communicating information of patients hospital visit, treatment and care plans to the next caregiver and hospital. A discharge letter module in Care2x was developed specifically for exchanging information with the patient and other healthcare providers. The use of paper-based in recording patient discharge information was challenging. Human errors

in recording patient information and delay in providing service were identified as the challenges. The discharge letter module in care2x helps to reduce handwriting-based human errors (prescription information, omitted diagnosis and undocumented pending test results) and enhance good communication between inpatient and outpatient caregivers in following the progress of patient (Wambura *et al.*, 2017). However, the information exchange is done by printing information from the system and submitted in paper-based manner to the intended user. This module does not support electronic data exchange between hospitals and other health-care providers.

However, NHIF claim management system in Tanzania has been integrated with the care2x to support NHIF member verification during provision of health services. The integrated module was only for verifying membership of the patient in NHIF. However, this module has some challenges including; difficulties in recording patient details, as well as submitting and reporting patient claims. All of the challenges are due to the use of paper-based mechanisms in recording patients' details in NHIF form, which are, then submitted to the NHIF offices physically. This contributes to patients' long waiting time for health care services and delay in processing payment (NHIF, 2017).

The study conducted by Panaviwet *et al.* (2014) showed that long waiting time is often a problem encountered by most of the patients and it is the major cause of their dissatisfaction with the hospital services. They designed an appointment system for the outpatient department to solve a problem of patients long waiting time caused by lack of effective appointment. Simulation model used to evaluate the appointment system showed that average waiting time could be reduced by 37% to 44% as compared to the previous status (Panaviwat *et al.*, 2014) .

2.6 Research Gap

The provided related works on the care2x and associated innovations focus on the management, manipulation of data, and sharing of patient information. There were several challenges that the health sector in Tanzania was facing especially in providing health services and satisfying patients. While many customizations have been done in Care2x in Tanzania and modules have been developed, there is yet no module developed for integrating the care2x HMIS and the NHIF claims management system. Therefore this study developed

an IDEM for Integrating Care2x Hospital System and NHIF system. This will help to reduce the patient waiting time, reduce paper work, reduce time spent in filling claims forms, increase accuracy in filling claims form and improve management of claim information.

CHAPTER THREE

MATERIALS AND METHODS

3.1 Introduction

The previous chapter discussed the related research works on the HMIS and integration of Care2x. This chapter discusses the materials and methods used in the developing an IDEM. The study explores more on the research case study area, sampling technique, data collection methods and data analysis methods. Additionally, this chapter presents the requirements needed for the development of the exchange module, design and development approach.

3.2 Research Case Study Area

This study was conducted at the Arusha and Kilimanjaro regions in Tanzania. These two regions are located in the northern zone of Tanzania with 1260 health facilities in total (MoHCDGEC, 2018). In this zone, there are more than 9 health facilities which are using Care2x. The target groups were healthcare institutions which that use the Care2x HMIS, the Care2x technical service providers (LUICO) and the NHIF office. The motive for selecting northern zone for this study is because it has a large number of health facilities compared to any other zone. Moreover, Arusha and Kilimanjaro regions were selected due to the fact that they have a large number of hospitals which are using HMIS such as Care2x. Hospitals that were involved in this study are Arusha Lutheran Medical Centre (ALMC) and Kibong'oto National Tuberculosis Hospital (KNTH) from Arusha and Kilimanjaro regions respectively.

KNTH started as the centre for the medical treatment of people who have a chronic illness in 1926. In 1956 KNTH became a national tuberculosis hospital. The hospital is located in the Siha district of Kilimanjaro region, near Kilimanjaro National Park. In KNTH four (4) doctors and two (2) nurses involved in processing claims and patient registration who were users of Care2x were interviewed by using a structured questionnaire.

Arusha Lutheran Medical Centre (ALMC) started providing health services in 2008 in order to meet health services needs in Arusha. It is located at the centre of downtown Arusha at 54 Father Babu Road. In ALMC four(4) doctors and two (2) nurses involved in processing

claims and patient registration who were users of Care2x were involved in data collection to obtain their views and opinion on the requirements for integration module.

NHIF is a government parastatal established in June 2001 by parliament act No. 8 of 1999 (Kumburu, 2015). It has more than 3 586 679 beneficiaries, also manages the Community Health Fund (CHF) with a total of 9 573 906 beneficiaries thus bringing the total size of beneficiaries for both NHIF and CHF to 13 160 585 as of December 2016. This is equivalent to 27% of the total Tanzania population. From NHIF, one IT official was interviewed to obtain information about claims management system.

3.3 Sample Size and Sampling Technique

The study involved a total of 15 respondents from different areas whereas 12 respondents were the physicians from two health facilities, two technical persons from LUICO and one IT specialist from NHIF headquarter office. Random purposeful sampling technique was used in selecting representative hospitals based on the experience in using Care2x. Furthermore, this technique was also employed to get eight (8) representative doctors and two nurses from each hospital.

3.4 Data Collection Methods

Data were collected from the study area in the period of January to March 2018. The study employed document review, interview and questionnaire as tools for data collection.

Questionnaire: Questionnaire were distributed to doctors and nurses to gather information about their experience in filling claims form and using Care2x. Open-ended questions, close-ended questions, multiple choices questions and scale questions were used.

Interview: Structured interview with interview guide questions were conducted to technical team from LUICO to gather information about their experience in customizing and managing Care2x. Furthermore, we interviewed IT specialist from NHIF who is managing claim management system in order to understand claims submission flow and the challenges.

Document review: During the study we reviewed different document including Care2x documentation, Care2x database structure, “standards and guidelines for electronic data

exchange between NHIF and service providers" and "Integration API for electronic data exchange with health service providers".

3.5 Data Analysis Methods

During data collection both qualitative and quantitative data were obtained from literature review, questionnaire and interview done at the study area. Data were analyzed by using google sheet.

3.6 Architectural Design

Designing is an important task when preparing for the development of any system, particularly in integrating systems. This section describes the requirements needed for the development of IDEM between Care2x HMIS and NHIF claim management system. Requirements analysis is discussed in this section to explore more on both functional and non-functional requirements. Additionally, the section provides description on the design of the proposed solution using conceptual framework, decision logic, use case diagrams and data flow diagrams .

3.6.1 Requirements Analysis

Requirement analysis involves determining the requirements of the proposed integrated module. It involves both functional and non-function requirement for development of data exchange module. Functional requirements express what the data exchange module will provide to Care2x users while non-function requirements describe the properties of the system.

(i) Functional Requirements

(a) Automatic generation of claim forms.

(b) Automatic filling claim forms.

(c) Claims information must be pulled from care2x.

(d) Generated list of claims must contain only discharge patients folio(s)

(e) Claim mandatory information must be validated before submission

(f) User must be able to view pending claims

(g) User must be able to view claim detail for each folio

(h)Claims must be confirmed before submission

(i) Only confirmed claims must be submitted

(j) User must be able to generate report of submitted claims

(k) User must be able to export report of submitted claims

(ii) Non-Functional Requirements

(a)The module must consume minimal amount of memory with less response time.

(b) The module must provide accurate claims data

(c) The module must run in any web browser.

(d) The module must be easily customizable and low-cost solution

(e) Secure authentication for all module users.

(f) The module must be easy to learn and operate

3.6.2 Architectural System Design

The design of the development of exchange module involves the use of four diagrams including; conceptual framework, use case diagram, decision logic, database schema, data flow diagrams.

3.6.3 Conceptual Design

The general architecture of integrated Care2x HMIS and NHIF claims management system has five actors; registrar, doctor, pharmacist, laboratory technician and accountants. Information provided by these actors are the key input in claims processing. Registrar

interacts with integration module during registration and admission in NHIF member verification. Accountant creates bills for the patient, which is the main input in claim processing. Accountant interacts with integration module during processing claims. The interaction of actors with integrated Care2x and NHIF claims management system is shown in Fig. 1.

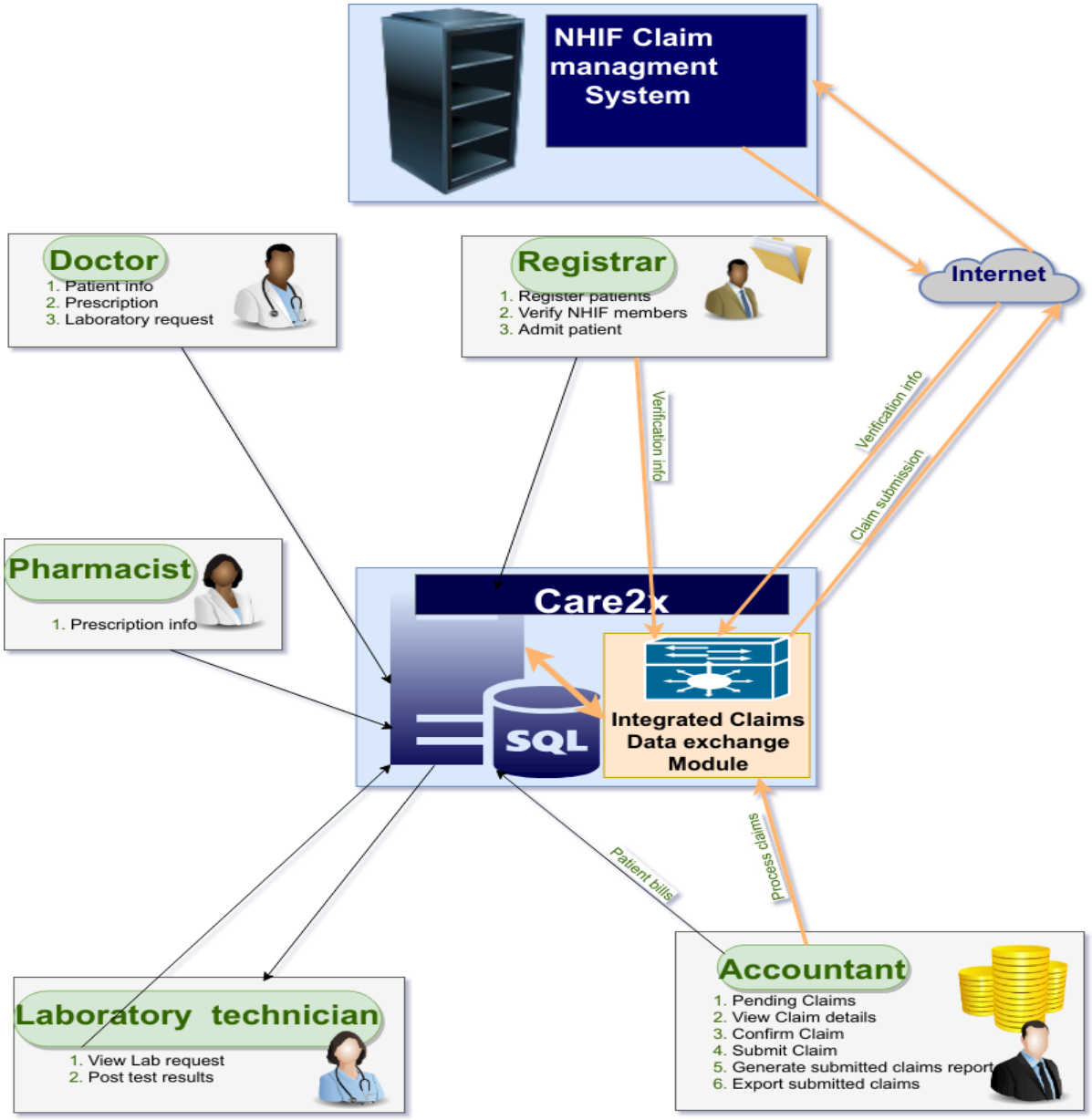

Figure 1: Conceptual framework of Integrated Care2x and NHIF claim management system

3.6.4 Decision Logic

(i) NHIF Member Verification Decision Logic

The flowchart diagram in Fig. 2 describes the logical decision involved during registration and admission of patients. The diagram demonstrates how the NHIF member is verified.

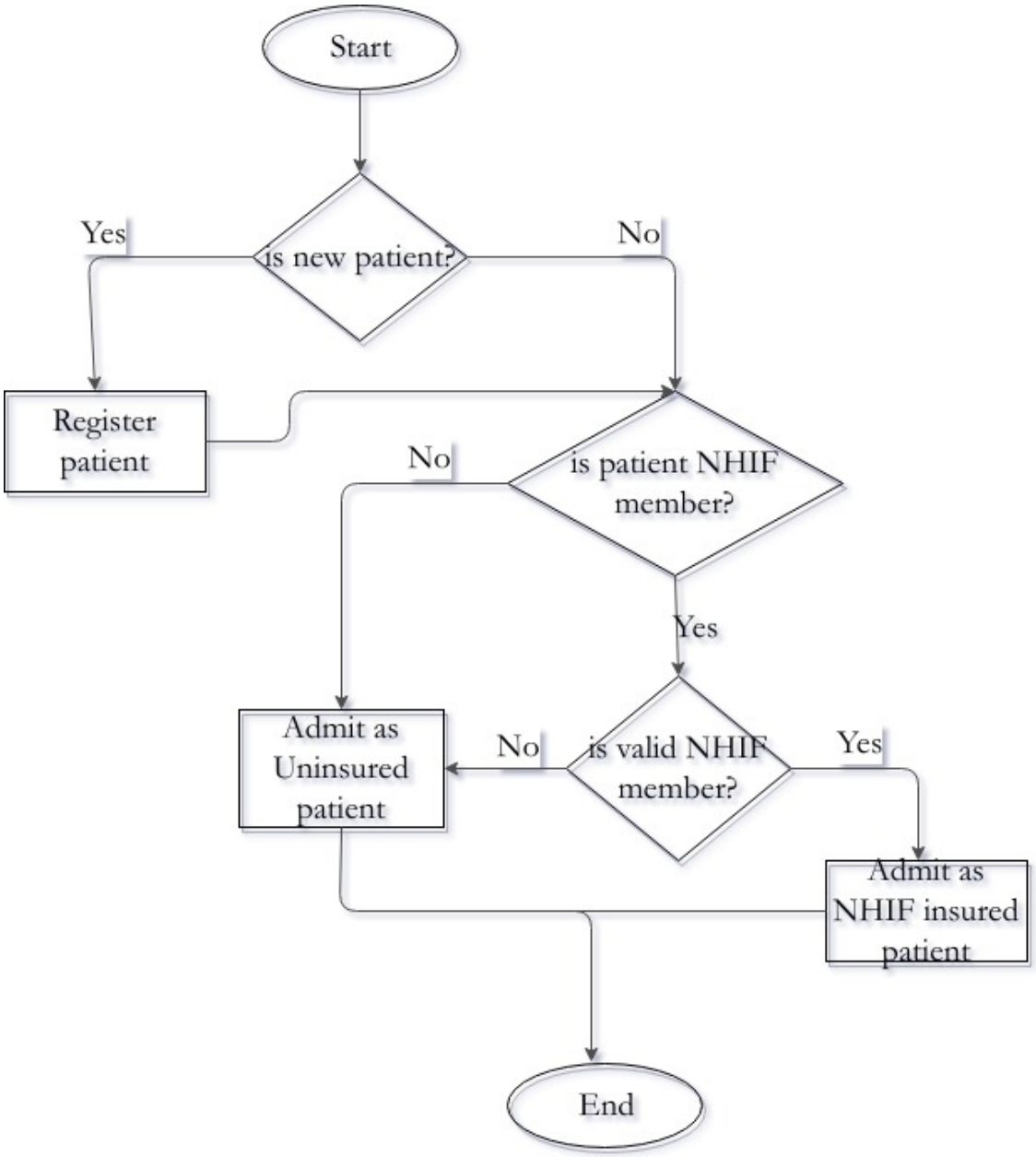

Figure 2: NHIF member verification

(ii) Claim Submission Decision Logic

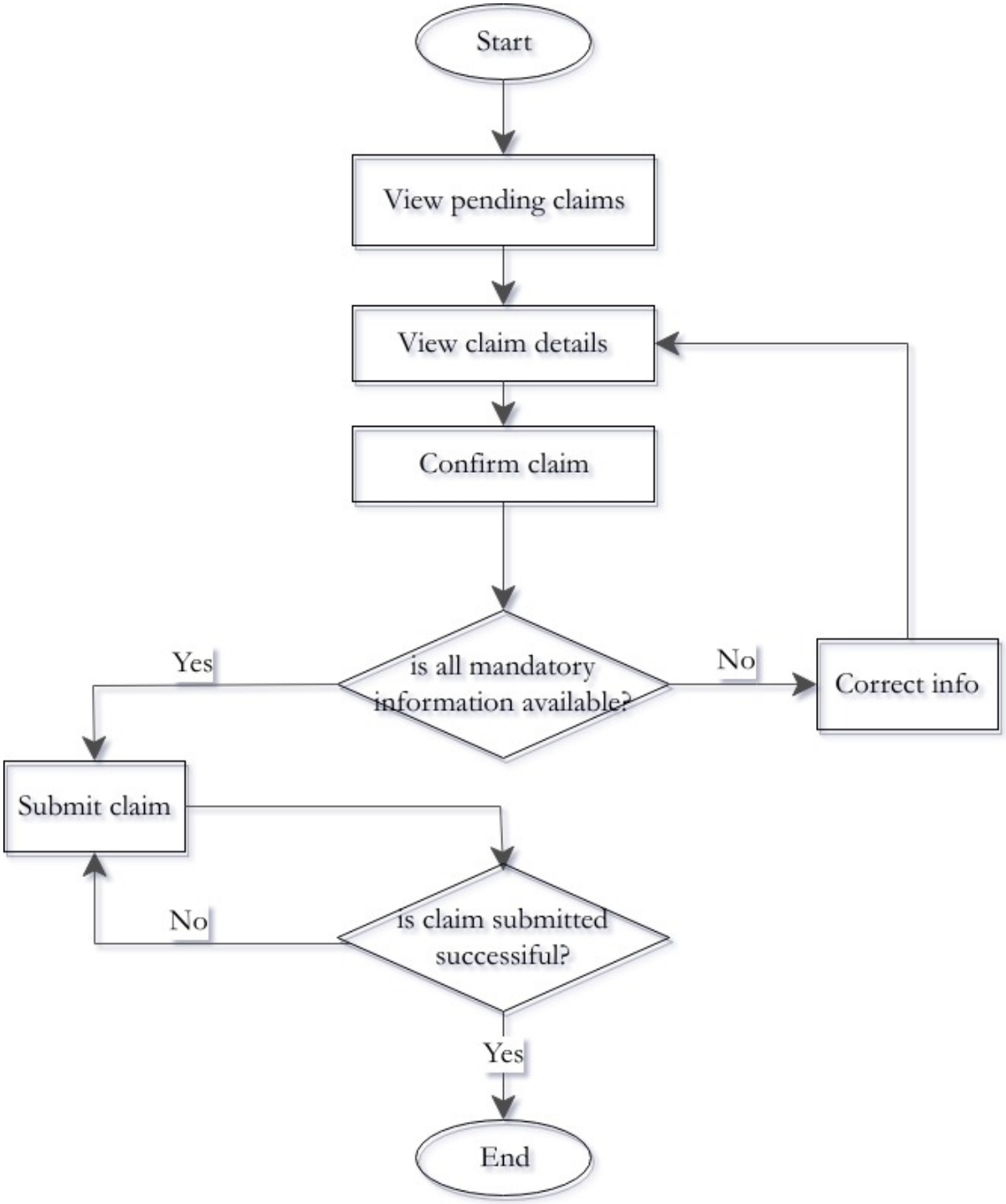

Figure 3: Claim submission decision logic

The flowchart diagram in Fig. 3 describes the logical decision involved during confirmation and submission of claims to NHIF. The diagram demonstrates how the NHIF member is verified.

3.6.5 Use Case Diagram

Use case diagram is the visualization of how system users will interact with the system (Aleryani, 2016). This study used use case diagrams to present how care2x HMIS users will interact with the integrated claims data exchange module. The users are categorised based on their role they perform in the system. The following are actors interacting with the integrated claims data exchange module.

(i) Doctor
(ii) Pharmacist
(iii) Laboratory technician
(iv) Registrar
(v) Accountant

Doctor, pharmacist and Laboratory technician does not interact directly with Care2x, however, information entered by them are used by the integrated claims data exchange module. Registrar and Accountant interact directly with the integrated claims data exchange module as shown in Fig. 4.

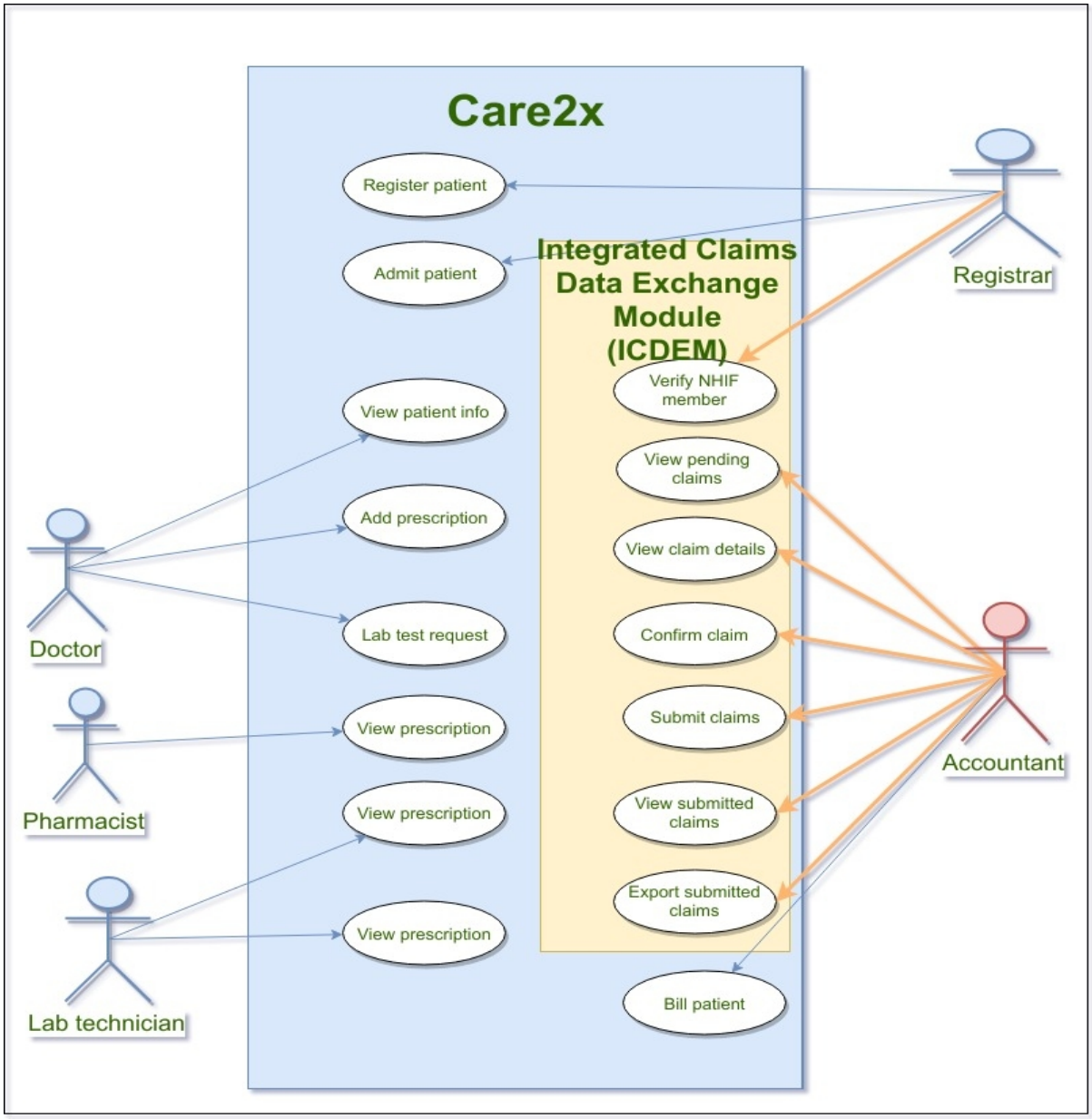

Figure 4: Use case diagram for integrated Care2x and NHIF claim management system

Table 1: Use case requirement description

REQUIREMENTS	DESCRIPTION
Verify NHIF member	The module must verify members before being registered or admitted as NHIF insured patient
View Pending Claims	The Module must generate the list of pending claims of a given range of date. The system must compute the amount which is claimed for each folio.
View Claim details	The claim processing personnel will be able to view the details of the claim. This view will be similar to the paper-based claim form.
Confirm Claim	The claim processing person will confirm the claim ready for submission
Submit Claim	Only confirmed claim will be submitted to NHIF.
Generate submitted claims report	The module will generate a report of submitted claims
Export submitted claims	The system will export a report of claims submitted in form of Potable Document File (PDF), excel and Comma Separated Values (CSV)

3.6.6 Data Flow Diagram

Data flow diagram is the method with visualization used for modelling the flow of data in the system (Coleman, 2013) . In the data flow diagram process, external entity, data store and data flow are used as a graphical representation. Data flow diagram shows the manipulation of input through the system process and its output. There are different levels of data flow diagram including level 0 (context diagram), level 1 and level 2. In this study data flow diagram level 0 and level 1 present flow of information of the proposed solution.

(i) Context Diagram

Context diagram presents the interaction of external entities with the system. Context diagram is the overview system representation. Figure 5 shows how external entities will interact with the integrated claims data exchange module.

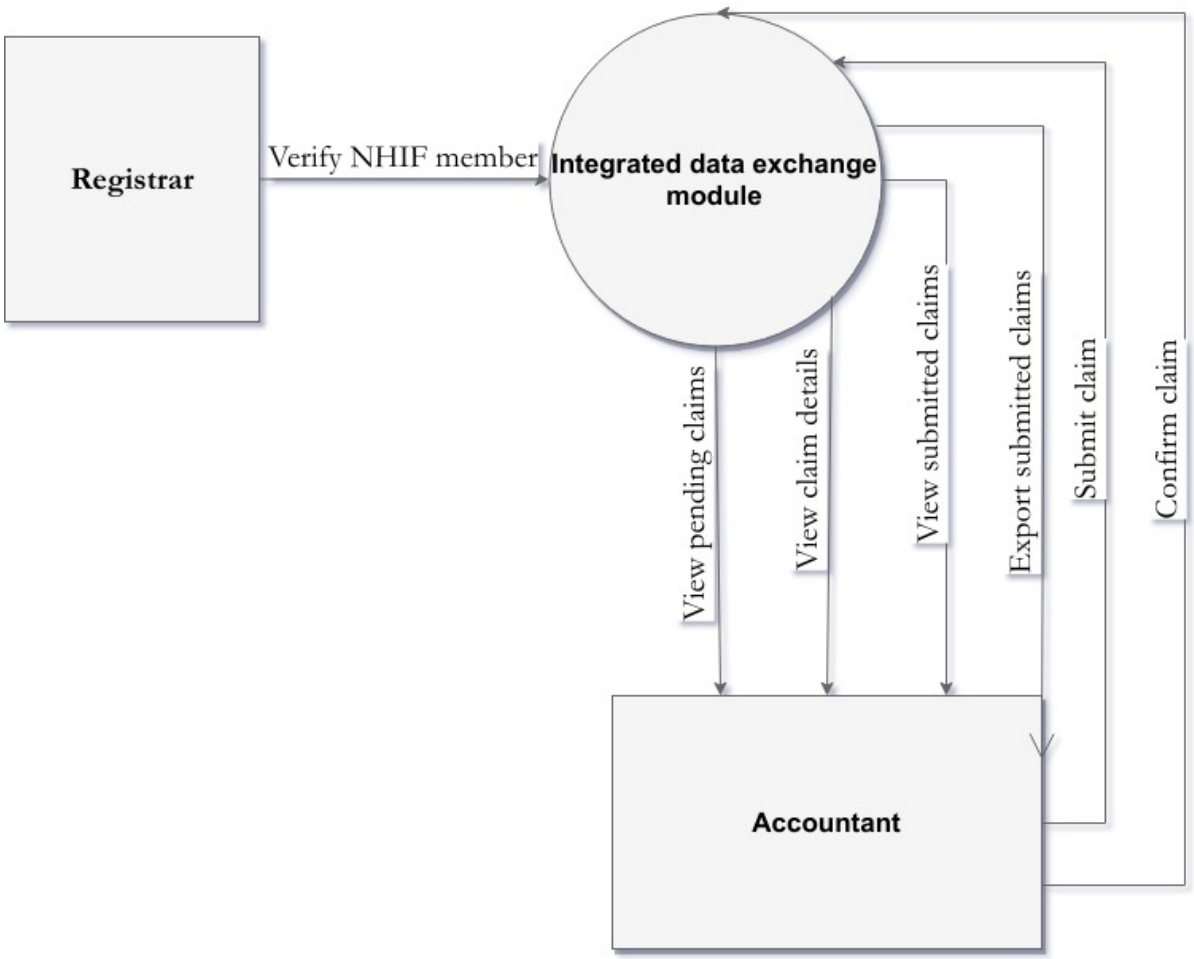

Figure 5: Context diagram for data exchange module

(ii) Data Flow Diagram Level 1

Data flow diagram level 1 presents the decomposition of the system process into sub-processes. When a context diagram decomposes into system processes it requires data store and data flow to link them. Figure 6 presents the data flow diagram level 1 for the integrated claims data exchange module.

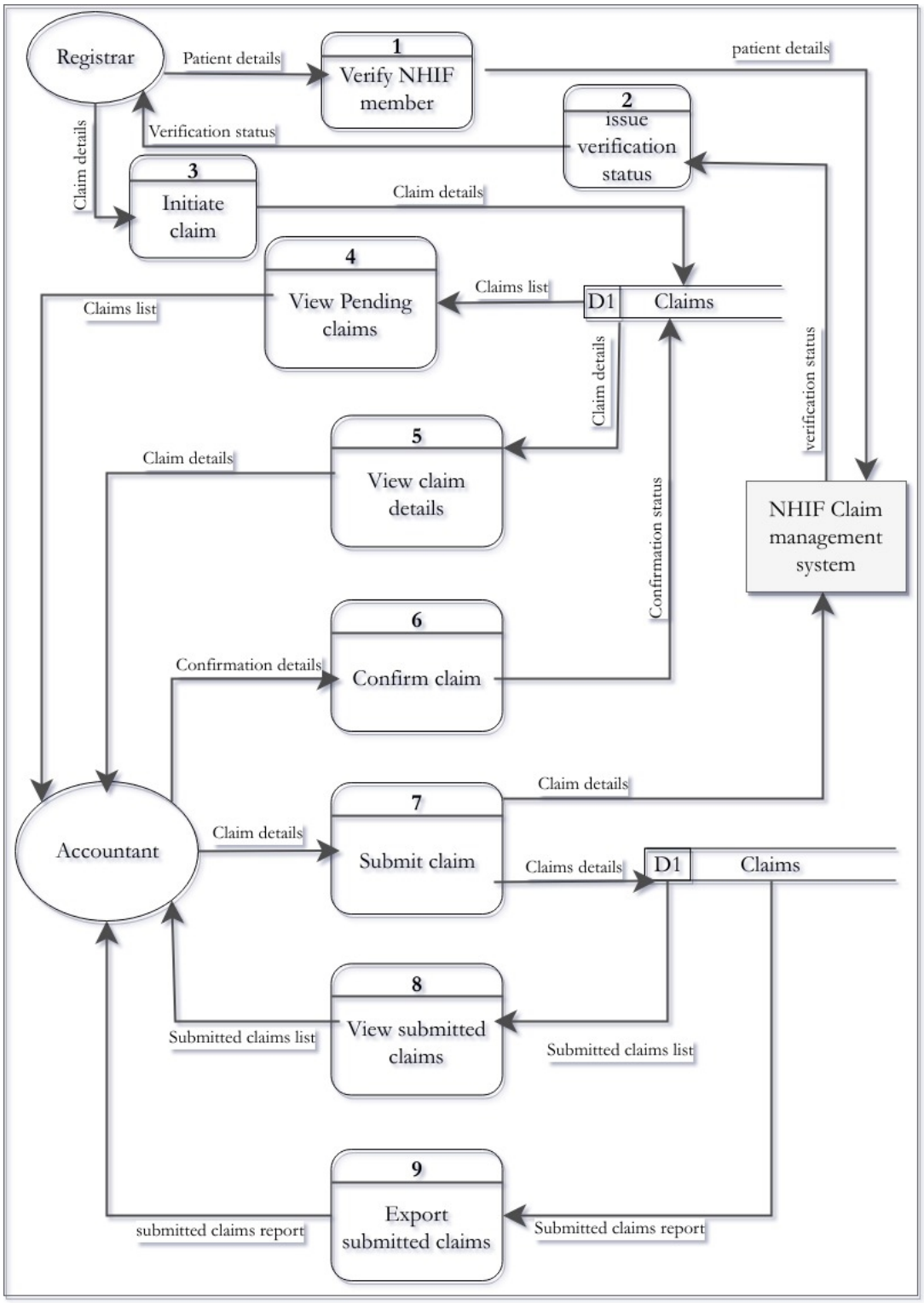

Figure 6: Data flow diagram level 1

3.6.7 Database Schema

This is the logical presentation of database created by database management system. It provides graphical view and structure of the database architecture. Database schema presents the logical diagram that comprises with table, fields and the relationship among the tables (Klett, 2011). The database schema of the integrated claims data exchange module is presented in the Fig. 7. New table(care_nhif_claims) where created in care2x database to store claim details. Furthermore care_person and care_tz_drugandservices where modified by adding practitioner_number and nhif_code fileds respectively.

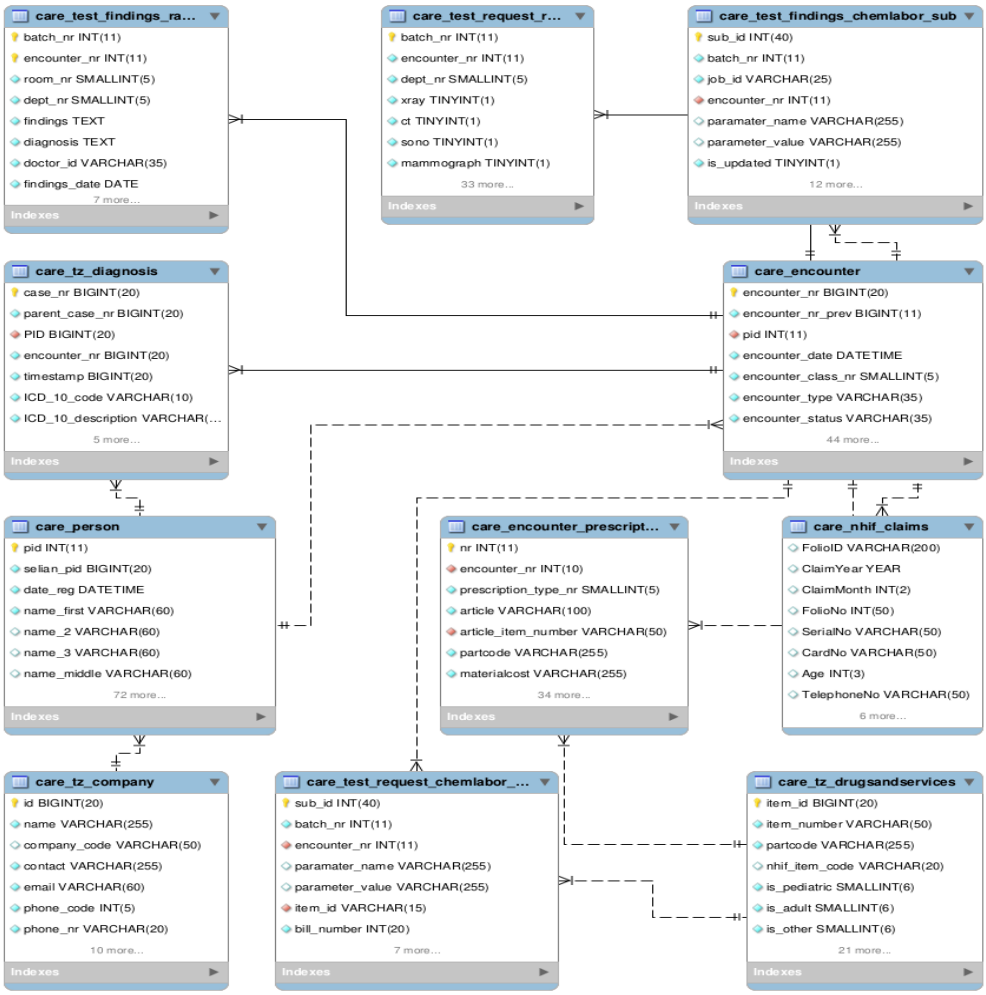

Figure 7: Database schema for integrated claims data exchange module

3.7 Development Approach

The development of exchange module based on the user requirements. However, system development life cycle (SDLC) was considered as the guideline for the development of the proposed solution. Prototyping is the one of the SDLC approaches, was adopted in the development of the exchange module. It is the development approach which has the ability to accommodate user requirements after development. This approach was chosen because it reduces the time for development as well as its ability to involve user to assess the end product before its implementation. The major advantage of the prototyping is the accommodation of user feedback, which contributes to a better solution.

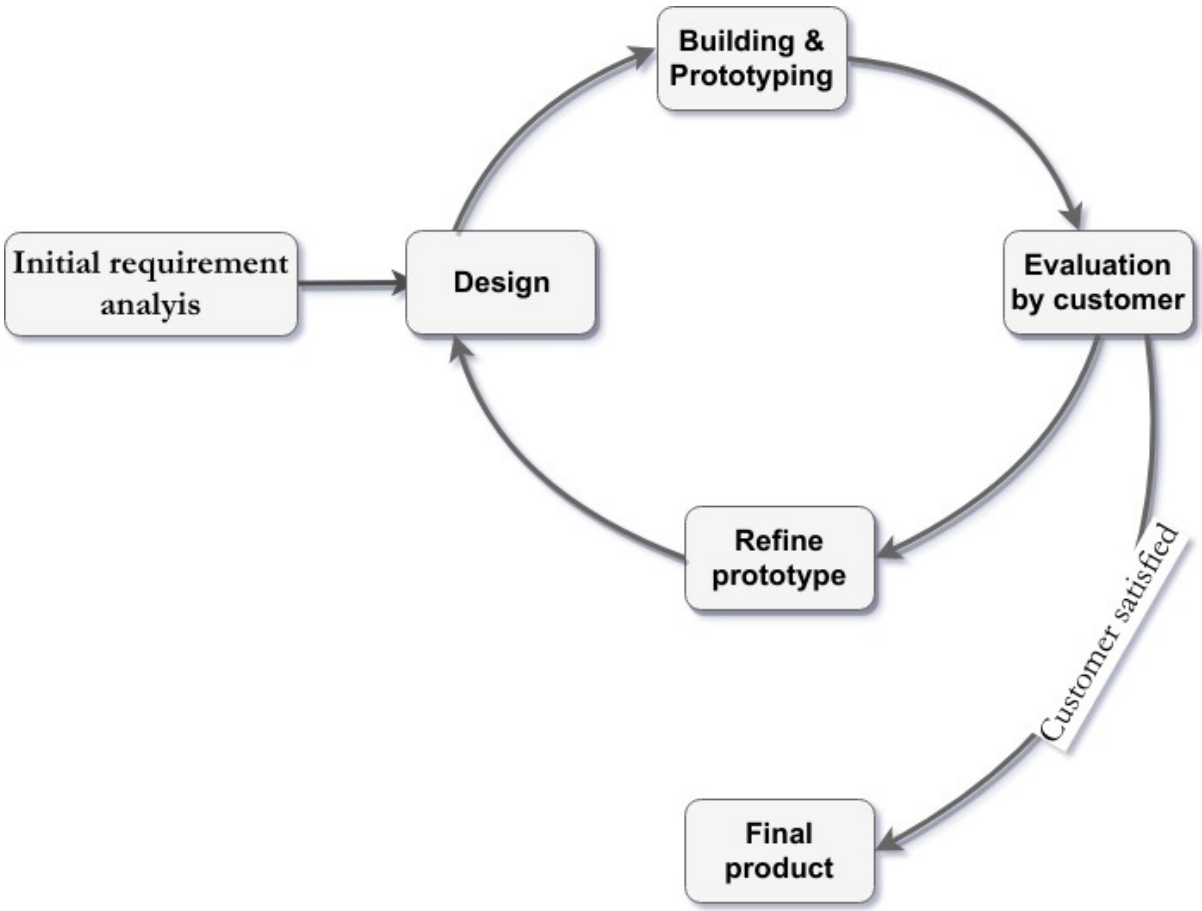

Figure 8: Prototype model

3.7.1 Tools and Technologies Used

(i) HTML5 and CSS were used to format the module interface

(ii) PHP were used to connect client and server

(iii) Scripting language: JavaScript

(iv) NetBeans as integrated development environment

(v) MySQL were used for database manipulation

(vi) Apache as a web server

3.7.2 Other Requirements for Operating Environment

(i) Internet connection

(ii) Operating system: Linux and window

(iii) A web browser: Mozilla and google chrome

3.8 Assumptions and Dependencies

(i) All web based application users have knowledge on using computers

(ii) There is good internet connection that enables users to access the system with minimum response time.

(iii) There is good internet connection that enables data exchange between Care2x HMIS and NHIF claim management system.

3.9 Conclusion

This chapter presented the materials and methods used in the study. It provides description on the case study area during field work. Also the chapter discussed the important requirements needed for the development of the exchange module. Both functional and non-functional requirements were discussed. In addition, the chapter detailed the hardware and software requirements for the development. Moreover, the chapter presented the design of the proposed solution as well as the development process and its implementation.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Introduction

The previous chapter presented the required materials and methods for the development of the data exchange module, design, development approach and implementation. This chapter presents results and discussion obtained from the case study area. It also discusses the results obtained from the developed exchange module and the results from testing.

4.2 Overview of the Existing System

The interviews conducted at ALMC and KNTH hospitals were meant to understand the existing claim processing system and how it works. The study revealed that there are some difficulties in filling claim form such as searching drug and services codes in the printed book which consume a lot of time. On the other hand, claim form were filled twice, in the system and in paper which will then be submitted to the NHIF.

However, the study found that NHIF spent a lot of money in printing claim forms. Since claim forms are filled in hard copy, some forms are incomplete/wrongly filled which lead this claim to be rejected by NHIF. For example, at Kibong'oto National Tuberculosis Hospital in 2016 out of 3499 claims submitted, 207 of them were incomplete or wrongly filled.

Due to the challenges revealed by respondent, most of them agreed into the development of data exchange module between Care2x and NHIF claim management system to increase accuracy in filling forms, reduce patient waiting time and time spent in filing claim forms.

4.3 Research Case Study Area Results and Discussion

During data collection, the study gathered all views of the respondents regarding the development of the integrated data exchange module. The respondents were asked to which extent the developed data exchange module will reduce patient waiting time, paperwork, workload done by a physician, reduce time in filling claims forms and increase accuracy in

filling forms. The criteria for assessment was based on the scale s*trongly agree, agree, neutral, disagree and strongly disagree*. The results have presented in the following tables.

4.3.1 Responses for Integrated Care2x and NHIF Claim Management System Reduce Patient Waiting Time

The study found that 67% strongly agreed that the proposed data exchange module will help to reduce patient waiting since all the recording of a patient will be done over the system thus reduce queue and increase patient satisfaction. Thirteen percent agree, 13% disagree and 7% strongly disagree. Majority of the respondent strongly agree that the module will reduce patient waiting time.

Table 2: Responses for Integrated Care2x and NHIF claim management system reduce patient waiting time

	Frequency	Percent	Cumulative frequency
Strongly agree	10	67	67
Agree	2	13	80
Neutral	0	0	80
Disagree	2	13	93
Strongly disagree	1	7	100

4.3.2 Responses for Integrated Care2x and NHIF Claim Management System Reduce Time Spent in Filling Form

The process of filling forms consume a lot of time. During data collection, the study found that the majority of respondents (87%) agreed that if data exchange module developed, it will reduce time spent in filling claims form while 13% of respondents disagree.

Table 3: Responses for Integrated Care2x and NHIF claim management system reduce time spent in filling form

	Frequency	Percent	Cumulative frequency
Strongly agree	9	60	60
Agree	4	27	87
Neutral	1	7	93
Disagree	1	7	100
Strongly disagree	0	0	100

4.3.3 Responses for Integrated Care2x and NHIF Claim Management System Increase Accuracy in Filling Claim

The process of filing claim forms in paper results in wrongly/inaccurate data which will be rejected when submitted to the NHIF. About 73% of respondents strongly agreed that the development of data exchange module will increase accuracy in filling forms. On the other hand, 13% agreed, 7% neutral and 7% disagree.

Table 4: Responses for Integrated Care2x and NHIF claim management system increase accuracy in filling claim

	Frequency	Percent	Cumulative frequency
Strongly agree	11	73	73
Agree	2	13	87
Neutral	1	7	93
Disagree	1	7	100
Strongly disagree	0	0	100

4.3.4 Responses for Integrated Care2x and NHIF Claim Management System Reduce Work Load Done in Filling Claim Form

The workload is the result of the usage of paper in filing claim forms. The majority of respondents (80%) strongly agreed that the data exchange module will reduce workload done in filling a form. However, 13% of respondents agreed, and only 7% were neutral.

Table 5: Responses for Integrated Care2x and NHIF claim management system reduce work load done in filling claim form

	Frequency	Percent	Cumulative frequency
Strongly agree	12	80	80
Agree	2	13	93
Neutral	1	7	100
Disagree	0	0	100
Strongly disagree	0	0	100

4.3.5 Responses for Integrated Care2x and NHIF Claim Management System Improve Claims Data Management

Claim data management included how information is stored, retrieved and data mined. The majority of respondents (80%) strongly agreed that the data exchange module will improve claims data management. However, 20% of respondents agreed as shown in the Fig. 9 .

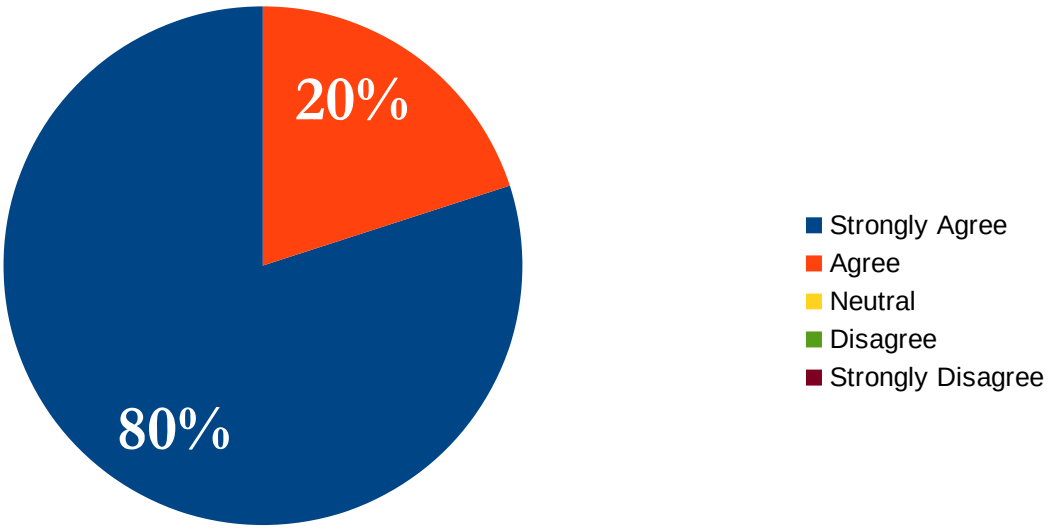

Figure 9: Responses for Integrated Care2x and NHIF claim management system improve claims data management

4.4 Document Analysis

4.4.1 System Interoperability

After review of Care2x documentation, database structure and the system codes, standards and guidelines for electronic data exchange between NHIF and service providers and Integration API for electronic data exchange with health service providers documents we have discovered that, the two systems share information in very low level which have impact in patient care (Pinsonneault *et al.*, 2017) . Furthermore, In this study were noted the following information are missing in Care2x.

(i) Practitioner number (License number given by Medical Council of Tanganyika) which will be used to identify health practitioner who treated the patient.

(ii) NHIF codes for drugs, investigation, surgery and services which are used as reference of service during processing claim.

(iii) Folio Id is unique number which identify batch of claims submitted to NHIF .

(iv) Folio Item ID - is unique value which identify specific item claimed .

(v) Folio-No - is similar to serial numbers of folios.

(vi) Visit type - type of visit of a patient like normal visit or emergency visit.

(vii) Re-feral number – a reference number given to patient transferred from one hospital to another.

(viii) Different version of International Classification of Diseases (ICD) where NHIF system use ICD-9 while Care2x uses ICD-10. Mapping will be done between ICD-9 and ICD-10

4.4.2 Data Exchange Structure

Integration API for Electronic Data Exchange with Health Service Providers document showed that the data exchange structure is JavaScript Object Notation Syntax (JSON). Claim can be submitted online to NHIF by creating a Jason payload. This payload can contain one or more folios (At least one folio) and associated details (Zunke and D'Souza, 2014) . The information required in submitting claims to NHIF system are shown in

Appendix 3 Folio Information, Appendix 4 Folio Disease Information and Appendix 4 Folio Item Information .

4.4.3 Security for data exchange

The security was taken in account when developing API in NHIF system in which each health facility provider has a username and password which are used to login. After successful login in NHIF system the system generates a token which will be valid for specific time. Generated token is used to make connection between HMIS and NHIF system during data exchange. In Care2x we implement using Role-Based Access Control (RBAC) in which user can perform specific task based on the assigned role.

4.5 Developed Integrated Data Exchange Module

The developed system improve integration of Care2x Hospital System with the National Health Insurance Fund system. The system integrates Care2x with NHIF verification claim system. The developed integrated data exchange module had several functionalities that reduce workload in filing claim forms, improve patient verification which reduces patient waiting time, reduce cost in processing claim form and increase accuracy in processing claims. The functionalities of the developed integrated data exchange module include; view pending claims, view claim details, confirm the claim, submit claims, view submitted claims, and export report of submitted claims. The system allowed a user to log in Care2x by providing their authenticity details. Figure 10 presents the login page

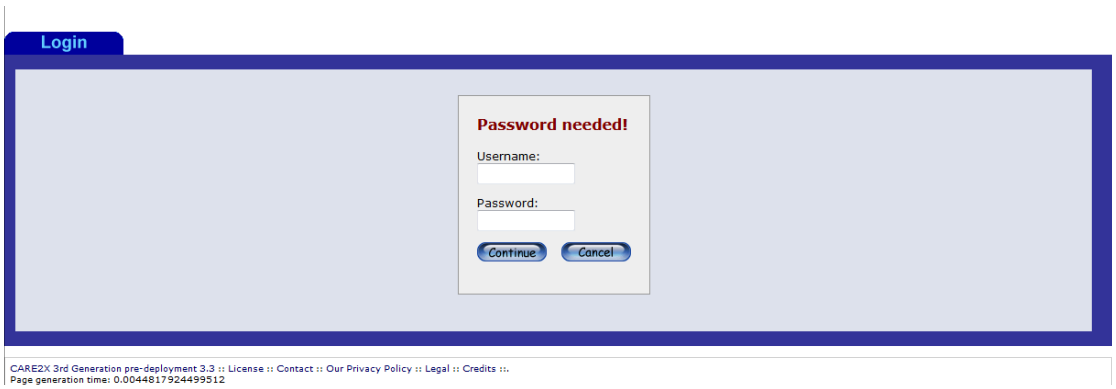

Figure 10: login page

4.5.1 Care2x Dashboard

The following interface displayed a Care2x homepage that consists of several modules which improve health services in the hospitals. Once a user logged in, the Care2x home page displayed as shown in Fig. 11 that allowed user to access the NHIF claim module.

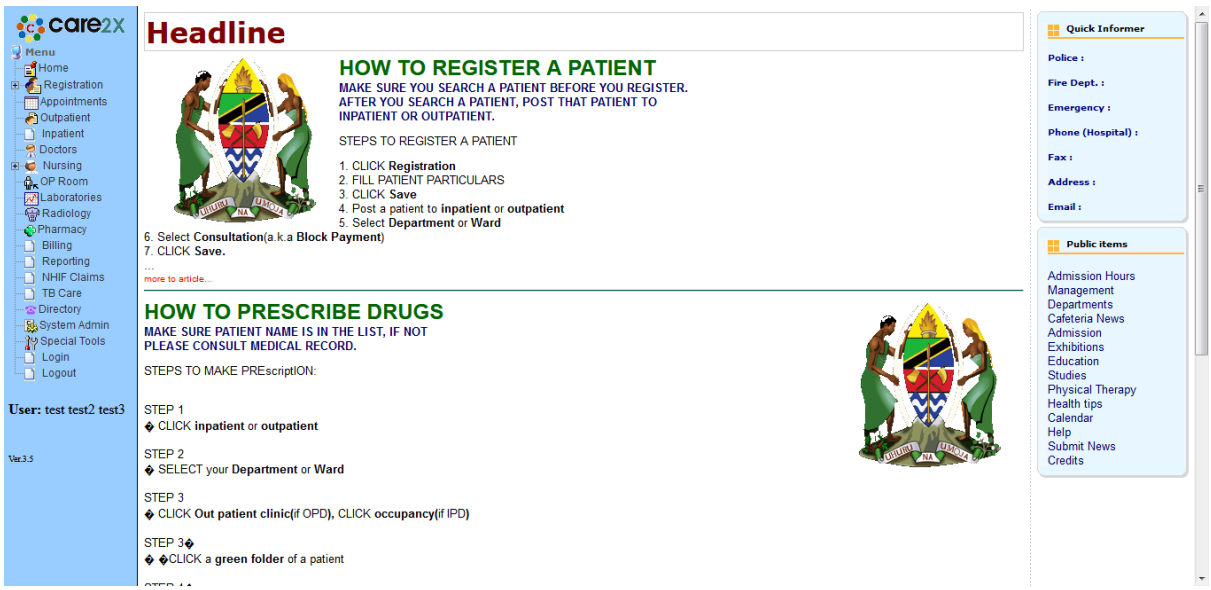

Figure 11: Care2x dashboard

4.5.2 Integrated Claims Data Exchange Module Dashboard (NHIF claims)

Figure 12 presents the NHIF claims page that consists of the pending claim outpatient, pending claim inpatient and claim report forms. These forms reduce workload done by a physician in filling hard copy forms.

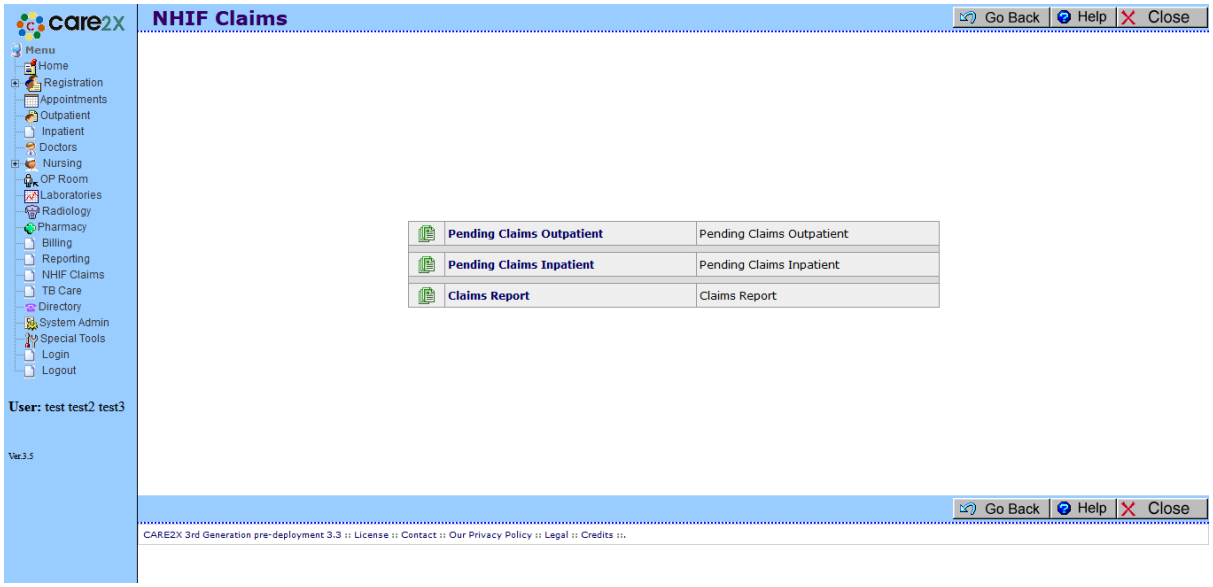

Figure 12: Integrated claims data exchange module dashboard (NHIF claims)

4.5.3 NHIF Pending Claims

The following figures show pages for pending claims of outpatients and pending claims for inpatients. The below pages allowed a user to filter the list of pending claim forms. The pending claims forms can be filtered in daily, weekly, monthly and year bases. Figure 13 presents NHIF pending claims for outpatients while Fig. 14 present NHIF pending claims for inpatients.

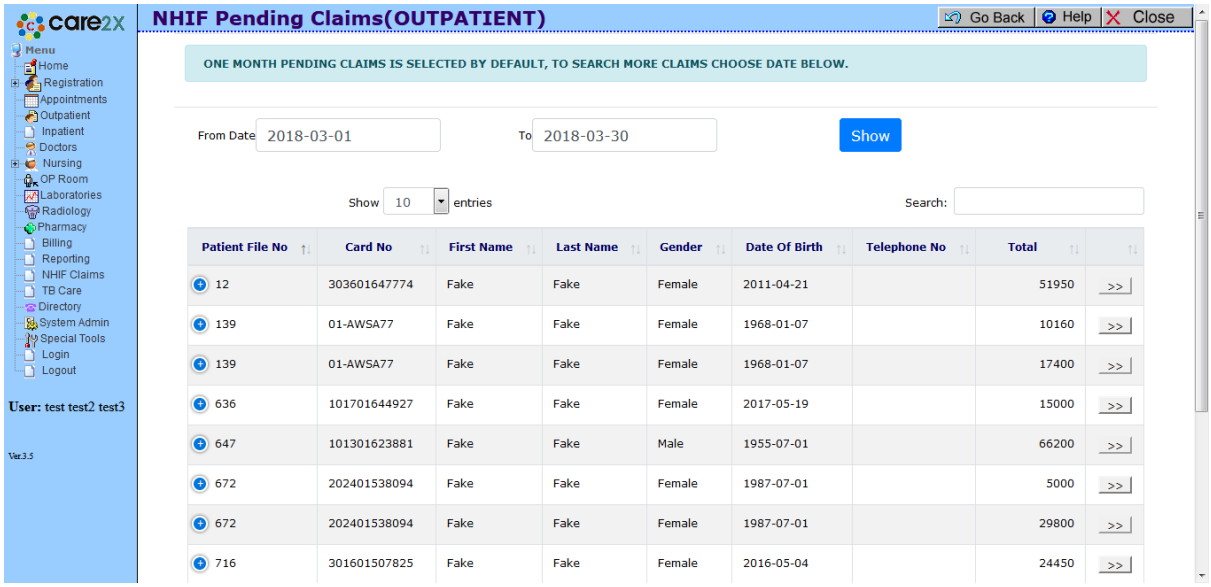

Figure 13: List of NHIF pending (claims outpatient)

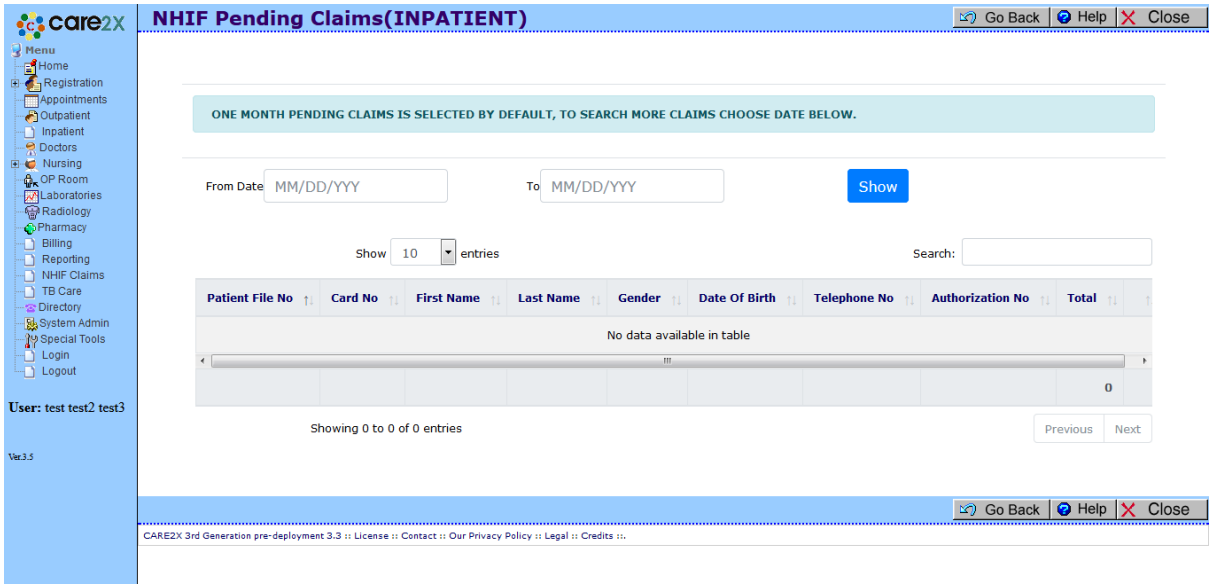

Figure 14: NHIF pending claims (Inpatient)

4.5.4 View Claim Details

The developed integrated data exchange module digitized patient claim form which reduced paperwork. NHIF pending claims display details that should be filled throughout patient treatment. Figure 16 shows claim form details.

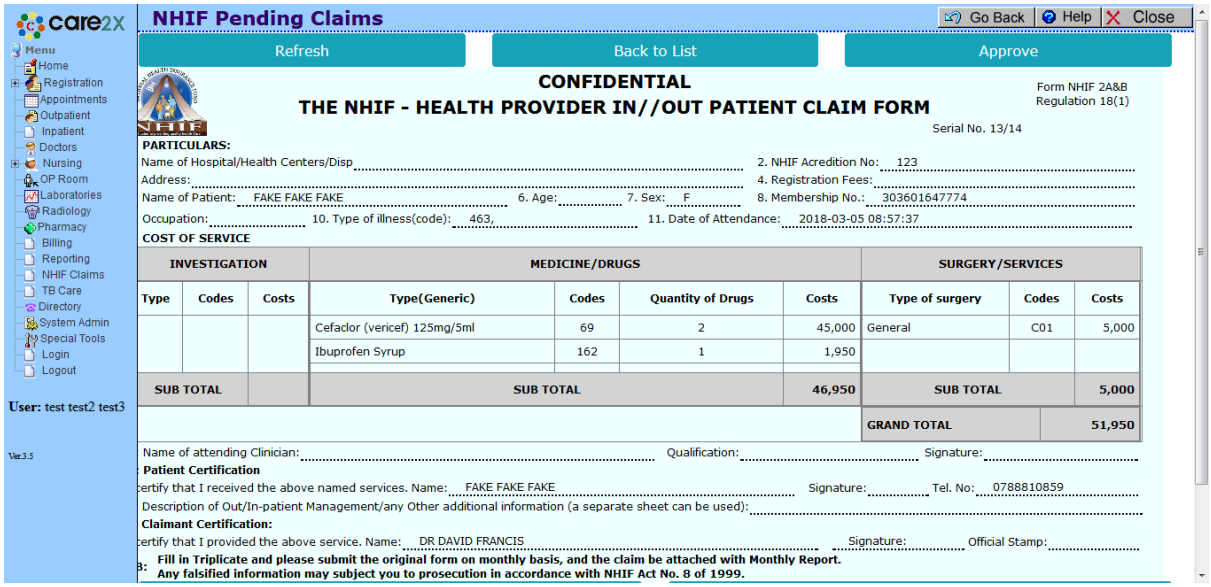

Figure 15: View claim details

4.5.5 Approve and Submit Claim Form

The developed integrated data exchange module allow user to approve claims which are well filled by a physician. The following figure 16 presents the results of the successful approved form. However, after claim form approved, user submit claims to NHIF system for verification and payment.

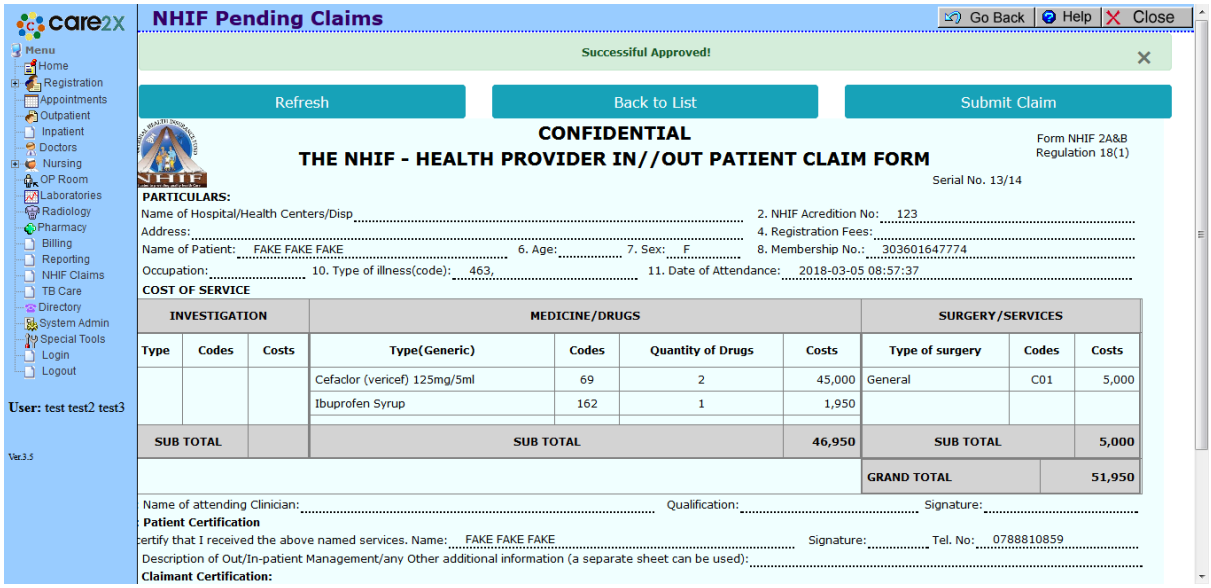

Figure 16: Approve and submit claim form

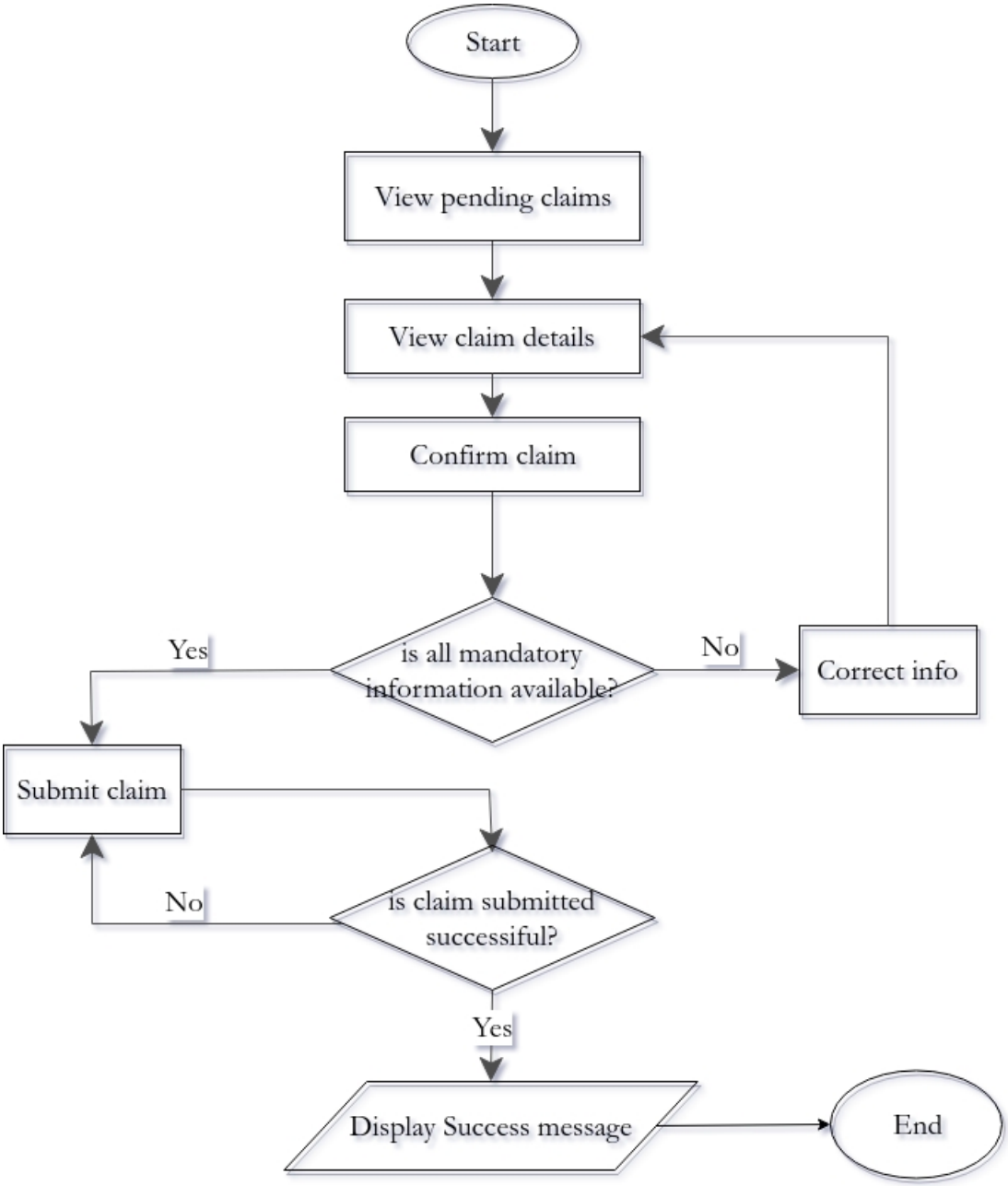

Figure 17: Algorithm for submitting claims

4.5.6 NHIF Claim Report

Claims reports on admitted patients, inpatients and outpatients can be retrieved through the developed data exchange module. By default, the module generates current month claims report automatic, for more reports the user can choose date /month/year of his preference to retrieve the report. Reports were exported in CSV format.

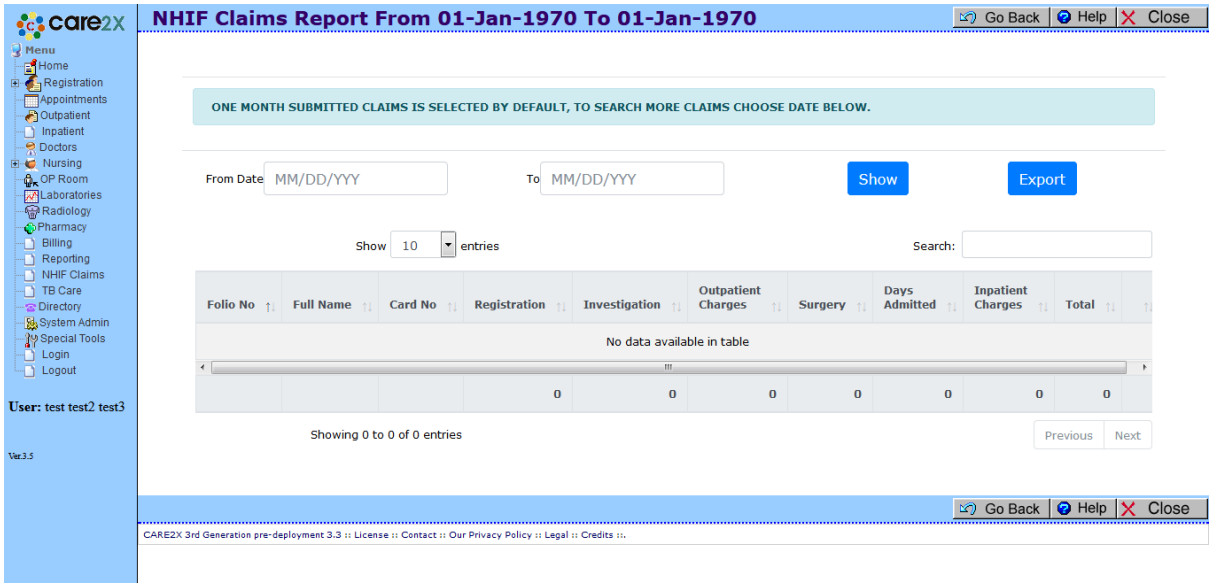

Figure 18: Export submitted claims report

4.6 Validation

This is the process of confirming if the user requirements are met (Svindland and Regan, 2001). The developed integrated data exchange module managed to comply with all requirements of the system. During implementation of the system several testing procedure were into account to check the validity of the system. The following were the testing procedure involved in the implementation of the data exchange module.

4.6.1 Unit Testing

This is the process of testing each unit/components of the system in order to validate that each components performs as designed thus met user requirements (Runeson, 2006) . On this study unit testing was done during the whole process of system development. Each functionality/component were tested individually before integration to determine if each component works properly.

4.6.2 Integration Testing

This is the process of testing system functionalities by combining components of the system in one group. It is an extension of unit testing whereby two or more units which pass to unit

testing are combined then tested. Integration testing was done to determine if all integrated components work properly.

4.6.3 System Testing

This is the stage of testing whereby the complete and integrated system is tested to determine if the system compliance with the specified requirements (Runeson, 2006). During the implementation of the developed integrated data exchange module, the whole system was tested to check if all functionalities are working properly and meet specified user requirements. For instance, the complete module was tested to check if it can be accessed remotely.

4.6.4 System Evaluation

In this study system evaluation base on evaluating user acceptance of the developed integrated data exchange module. The evaluation enables to identify some design variation that could be implemented to improve the developed system in the future.

4.6.5 User Acceptance Testing

This is the process of testing that involves users of actual software (Otaduy and Diaz, 2017). The developed integrated data exchange module was presented to Kibong'oto hospital. Users of the system at Kibong'oto hospital tested the module. During the testing process user of the module were able to login to a module to verify member of NHIF, the verification process was done successfully to allow a patient to continue with the treatment process.

Thereafter, a doctor was able to view a list of admitted patient, request lab test and view tested result posted by a lab technician. Afterwards, a doctor was able to provide a prescription according to the patient results from lab then post the prescription to the pharmacist. On the other hand, the pharmacist managed to view patient prescription and provided the medicine to the patient. Then, the registrar discharged the patient through the system. Thereafter, the accountant continued with other data exchange operations including; viewing pending claims, view claims details and approve submitted claim. Lastly, the accountant was able to view and export report in CSV format.

However, users were provided with a questionnaire to give their views on the developed integrated data exchange. The results and the analysis of the collected user views are presented as per bellow Fig.19. The majority 68% strongly agree on the good performance of the developed module, 20% agree, 7% were neutral and 5% disagree.

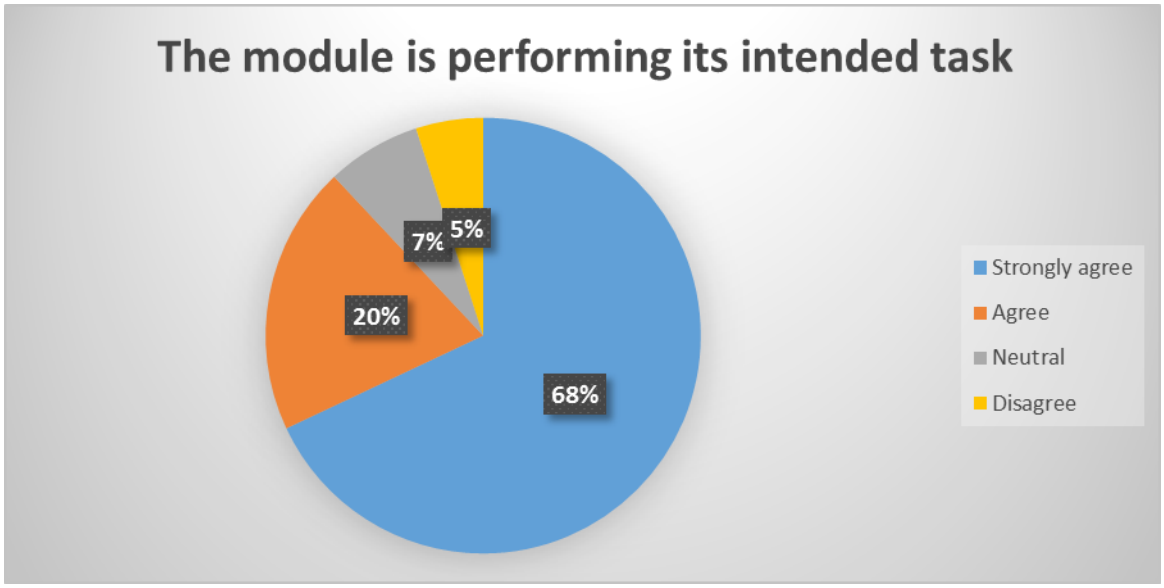

Figure 19: Module perfomance

4.7 Conclusion

This chapter has presented the discussion of the results obtained from the research case study area. The provided requirements analysis of the study aimed at developing integrated data exchange module to reduce paperwork, reduce patient waiting time, reduce time spent in filling claim form, improve the accuracy of the filling claim form and help in verifying members of NHIF. Further, this chapter has presented the development, testing and validation of the integrated data exchange module.

The following chapter provides the conclusion of the whole study, recommendation, future work and contribution of the study.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

The previous chapter presented the results and discussion of the whole study, development and testing of the exchange module. This chapter discusses the general conclusion of the study, recommendation, study contribution and future work.

5.2 Conclusion

The use of ICT tools in providing health services has resulted in the improvement of health service and patients satisfaction. HMIS is one among systems that are used in hospitals to improve provided services. The use of paper in feeding patients details is expensive in terms of printing claim forms and consumption of time during the process of filing claim forms. On the other hand, the use of paper increases the workload to the physician and sometimes it results in a wrongly filled claim form. Despite the usage of HMIS like Care2x but still, there are challenges that health sector face when providing services.

The study aimed at improving health services by developing an integrated data exchange module between Care2x and NHIF claim management purposely to reduce the use of paper, reduce the workload of physicians from a specific hospital who were required to submit a claim form in hard-copy to NHIF office. Additionally, the exchange module enabled NHIF personnel to verify claims before processing payment.

The developed integrated data exchange module was able to minimize resource when providing health services. For instance, the human resource was minimized since only one person was able to process and submit monthly claims in a single day compared to the previous manual process which was done in two weeks by two people.

5.3 Recommendations

The study offers a further extension on the development integration module between Care2x and other insurance company claim management systems which were not implemented due to

the scope and time limitation. Thus, reduce workload done by practitioners in filling claims form and increase accuracy in the submitted claim. Additionally, the developed solution can be extended to the development of a central database that combines all insurance company to have common claim management system that will enable easy retrieval of claims information and reduce payment process.

5.4 Research Contributions

This research study has a great impact on the hospital which uses Care2x and the NHIF. The research contribution includes.

(i) The study provided a cost-effective technological solution that can be used by Health providers in submitting claims to NHIF instead of using paper.

(ii) The use of open source in the development of the exchange module significantly minimizes time consumption in feeling claim forms and waiting time for a patient.

(iii) The study provided the integrated data exchange module that reduces errors in filling forms.

(iv) The architecturally designed integration between Care2x and NHIF (data exchange module) that reduce workload for a physician.

(v) The research study can be used as a framework in developing other integration data exchange module with other HMIS.

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APPENDICES

Appendix 1: Questionnaire for Doctors

The Nelson Mandela African Institution of Science and Technology

Research Tittle: Improved Integrated Care2x Hospital System with National Health Insurance Fund System

Questionnaire for Doctors

This questionnaire is part of research conducted by Abel Haule a masters student of Nelson Mandela African Institution of Science and Technology (NM-AIST) aiming to Improve Integration of Care2x Hospital System with National Health Insurance Fund System. The goal of this research is to reduce the patient waiting time and claims processing cost and time by automating the submission of claims form, claims summary and improving NHIF members verification.

The purpose of research is to develop a care2x module that will integrate care2x with NHIF claims verification system. The module will digitize patient claims form and improve patient verification which will reduce patient waiting time, reduce cost in processing claims and increase accuracy in processing claims.

We need your consent to complete this questionnaire for completion of the study and improving health services in your facility.

1. Health facility Information

a) Name of Health facility : .....

b) Level of health facility(*Please put tick in the box for appropriate level*)

Dispensary ☐

Health center ☐

District hospital ☐

Regional Referral Hospital ☐

National Referral Hospital ☐

c) District.....

d) Region.....

2. How long have used Care2x System.....(years)

3. Please tick one box to indicate whether you agree or disagree about the following statement about integrated Care2x and NHIF claims management system will have effect in the following

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Reduce patient waiting time	☐	☐	☐	☐	☐
Reduce time you spent in filling claim forms	☐	☐	☐	☐	☐
Increase accuracy in filling claim forms	☐	☐	☐	☐	☐
Reduce work done in filling claim form	☐	☐	☐	☐	☐

4. How do you get diagnosis, drugs and services codes provided by NHIF used to fill in claims forms.

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5. What challenges you face in finding diagnosis, drugs and services codes

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6. What are challenges you face in filling NHIF patient claims forms.....

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If you have any questions about the study, please feel free to call Abel Haule at +255755370289 or email him at haulea@nm-aist.ac.tz .

Appendix 2: Questionnaire for Practitioner who Involve in Processing Claims

The Nelson Mandela African Institution of Science and Technology

Research Tittle: Improved Integrated Care2x Hospital System with National Health Insurance Fund System

Questionnaire for Practitioner who involve in processing claims

This questionnaire is part of research conducted by Abel Haule a masters student of Nelson Mandela African Institution of Science and Technology (NM-AIST) aiming to Improve Integration of Care2x Hospital System with National Health Insurance Fund System. The goal of this research is to reduce the patient waiting time and claims processing cost and time by automating the submission of claims form, claims summary and improving NHIF members verification.

The purpose of research is to develop a care2x module that will integrate care2x with NHIF claims verification system. The module will digitize patient claims form and improve patient verification which will reduce patient waiting time, reduce cost in processing claims and increase accuracy in processing claims.

We need your consent to complete this questionnaire for completion of the study and improving health services in your facility.

1. Health facility Information

a) Name of Health facility : .....

b) Level of health facility(*Please put tick in the box for appropriate level*)

Dispensary ☐

Health center ☐

District hospital ☐

Regional Referral Hospital ☐

National Referral Hospital ☐

c) District.....

d) Region.....

2. When your facility stated using Care2x System.....(years)

3. Please tick one box to assess the extend to which integrated Care2x and NHIF claims management system will

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
reduce patient waiting time	☐	☐	☐	☐	☐
reduce cost in processing claims	☐	☐	☐	☐	☐
Increase accuracy in processing claims	☐	☐	☐	☐	☐
Reduce work done in processing claim form	☐	☐	☐	☐	☐

4. Which way you use to process claims

a) NHIF system ☐

b) Paper based system ☐

c) Manual system ☐

d) Other explain .....

.....

.....

5. What can be done to improve processing claims

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6. How many employees are involved in processing claims.....

7. Claims submission information for 2016

	Number of Claims submitted	Number of Claims accepted	Number of Claims Rejected
January			
February			
March			
April			
May			
June			
July			
August			
September			
October			
November			
December			

8. Claims submission information for 2017

	Number of Claims submitted	Number of Claims accepted	Number of Claims Rejected
January			
February			
March			
April			
May			
June			
July			

	Number of Claims submitted	Number of Claims accepted	Number of Claims Rejected
August			
September			
October			
November			
December			

9. Number of Books of Claims forms used for 2016..... and 2017 .....…

10. What are challenges you face in processing and submitting claims

.....

.....

.....

.....

If you have any questions about the study, please feel free to call Abel Haule at +255755370289 or email him at haulea@nm-aist.ac.tz .

Appendix 3: Folio Information

FieldName	Description	Data Type	Corresponding field in care2x
FolioID	Primary Key for a folio of visit	GUID	Not available
FacilityCode	The Code of a facility Submitting the Claim	Text	Facility_code
ClaimYear	Year in which claims are submitted	int	Not available – this will depend on current date when processing claims
ClaimMonth	Month of which claims are submitted	int	Not available - this will depend on current date when processing claims
FolioNo	A unique sequential number	int	Not available – new field will be added and will be generated when processing claims.
CardNo	Number of NHIF Beneficiary's Cards	text	membership_nr
FirstName	Card holder's First Name	text	Name_first
LastName	Card holder's Last Name	text	name_middle and Name_last
Gender	Card Holder's Gender	Text	sex
DateOfBirth	Card Holder's Date Of Birth	Date	date_birth
TelephoneNo	Card holder's telephone number	Text	phone_1_nr and phone_2_nr
PatientFileNo	Patient's File number as recorded by the Hospital or other health facility	Text	pid
Authorization No	Authorization number issued during member verification	Text	nhif_auth_no
AttendanceDate	The date that the patient attended for service	Date	encounter_date
PatientTypeCode	IN PATIENT or OUTPATIENT	Text	ecnounter_class_nr
DateAdmitted	If patient was admitted then the admission date otherwise null	Date	Lowest encounter_date for a given visit(encounter_nr)
DateDischarged	If patient was admitted then the discharge date	Date	discharge_date

FieldName	Description	Data Type	Corresponding field in care2x
	otherwise null		
PractitionerNo	The Registration number of the medical practitioner attending the patient as registered by the Medical council of	Text	Not available – will be added in care_personell
CreatedBy	User who Created the Entry in the HMIS	Text	Not available - new database table (care_claims) will be added. User who create a claims.
DateCreated	The Date the entry was created	Date	Not available – new field will be added in care_claims table

Appendix 4: Folio Disease Information

FieldName	Description	Data Type	Corresponding field in care2x
FolioDiseaseID	Primary Key for a folio of visit	GUID	Similar to encounter_nr modification is required
FolioID	The ID of the folio associated to this disease	GUIN	Not available
DiseaseCode	Disease code as identified by WHO(Currently ICD 9)	Text	Mapping is required between ICD 9 and ICD 10 (ICD_10_codes)
CreatedBy	User who Created the Entry in the HMIS	Text	doctor_name
DateCreated	The Date the entry was created	Date	diagnosis_date

Appendix 5: Folio Item Information

FieldName	Description	Data Type	Corresponding field in care2x
FolioItemID	Primary Key for a service or item issued to the patient. This could be a medicine,procedure, surgery,or consumables	GUID	Not available
FolioID	The ID of the folio associated to this Item or Service Issued	GUID	Not available
ItemCode	Item Code used to identify each Item or Service in NHIF Database	Text	Not available – mapping is required between the items available in drug and services table in care2x and those used by NHIF.
ItemQuantity	Number of Items Claimed	Int	total_dosage
UnitPrice	Price for each Item	Decimal	unit_price_1
AmountClaimed	Sub Total (ItemQuantity * UnitPri ce)	Decimal	Not available - Will be calculated in the codes
ApprovalRefNo	If the service requires Approval then supply the Approval reference number issued to the patient to get this service.	Text	Not available – will be added in care_encounter_prescription table
CreatedBy	User who Created the Entry in the HMIS	Text	prescriber
DateCreated	The Date the entry was created	Date	prescribe_date

RESEARCH OUTPUTS

Output 1: Published Paper

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Towards Data Exchange between Health Information System and Insurance Claims Management System

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***Abstract*—**The advancement of technology observed today has led to the development of many Health Information Systems (HIS) which are cost-effective, reliable, scalable and flexible. Moreover, integrated Health Information System (iHIS) plays a crucial role in the dissemination of information, which helps in decision-making. The care2x HIS in Tanzania does not have a module for exchanging data between Care2x HIS and the National Health Insurance Fund (NHIF) claims management system. The absence of this module in Care2x has resulted into long waiting time for a patient, inaccuracy of the data submitted in claim forms, the consumption of time when processing claims, delay in processing payment and the high costs incurred in printing claims forms. In this paper, we used both qualitative and quantitative methods to gather the requirements for the development of the module. Interviews, questionnaire and document review were employed in data collection. The requirements were gathered with the help of 12 practitioners and one Information Technology (IT) specialist from NHIF headquarters. The results showed that the integration of the data exchange module is very potential in solving the present challenges. The data exchange module between Care2x HIS and NHIF Claims management System will increase the accuracy of claims submitted and reduce the cost for printing claims forms and time spent in filling and processing claims.

***Index Terms*—**Hospital Information System, Data Exchange, System Integration, Care2x.

I. Introduction

The rapid development of Information and Communication Technology (ICT) has led to the usage of Health Information Systems (HIS) in health care facilities to manage, store, protect and share medical information [1]. The use of hospital management systems is recognized by the Tanzania government through Tanzania National E-health Strategy 2013-2018. The strategy was aimed at integrating ICT in health so as to transform healthcare delivery by enabling information access and supporting healthcare operations, management, and decision making [2]. To implement this strategy, the Ministry of Health, Community Development, Gender, the Elderly and Children came up with the Guidelines and Standards for Integrated Health Facility Electronic Management Systems of 2016 aiming at improving quality of healthcare operations while enhancing revenue collection, management of medicines and other medical supplies in both public and private health facilities [3].

The efforts shown by Tanzania government in using ICT tools drive many health facilities to start using electronic health management information systems. The most popular HIS used in Tanzania include GoT-HoMIS, Care2x, AfyaPro, OpenMR, PatientOS, and OpenEHR. Care2x is an open source hospital information system which can be customized according to the requirements of the health facility. It was implemented in more than 15 private health facilities. Tanzanian government through the President's Office – Regional Administration and Local Government (PO-RALG) also manages The Tanzania Hospital Management Information System (GoT-HoMIS), which has been implemented in more than 170 health facilities owned by the government [4].

For the improvement of health services in Tanzania cost-sharing schemes were introduced in parallel with the introduction of medical insurance schemes as a tool to overcome the challenge of unaffordable medical expenses [5]. In 1993 the government of Tanzania formulated health insurance policy, which fostered to the establishment of National Health Insurance Fund in 2001 with the objective of ensuring healthcare services to both public and private sector employees [6]. NHIF coverage is growing at a high rate and as of 30th June, 2015 it stood at 3,237,434 beneficiaries [7]. The increase in the

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number of NHIF beneficiaries pushed to the NHIF administrative to develop claims management system to assist on the management of members and claims verification.

Despite the adoption of HIS in several hospitals, and the NHIF having their own claim management information system, the NHIF patients are still handled manually and their records stored in hard copies. The NHIF print hard copy forms and submit them to the health facilities throughout the country to be filled manually by health practitioners as they attend the patients. While these information systems can be integrated and simplify the process, it is not yet so. This paper therefore reports on an on-going study that aims to integrate Care2x HIS with the NHIF claim system so as both systems can exchange required data and reduce the workload to the practitioners. The aim of this study is to analyse the requirements for development of module for data exchange between Care2x hospital system and the NHIF claim management system that will computerize NHIF patient claim form with intention to reduce patient waiting time, time spent by doctors to attend NHIF insured patients and automate the process of submitting NHIF treatment form to NHIF for verification.

II. Related Works

The advancement of technology has led to the development of many health information systems which are cost-effective, reliable, scalable and flexible. The main goal of HIS is to improve information flow within health institutions without altering task to health-care practitioners [8].

The study conducted by Panaviwet *et al.* [9] showed that long waiting time is often a problem encountered by most of the patients and it is the major cause of their dissatisfaction with the hospital services. They designed an appointment system for the outpatient department to solve a problem of patients long waiting time caused by lack of effective appointment. Simulation model used to evaluate the appointment system showed that average waiting time could be reduced by 37 to 44 percent as compared to the previous status.

In Albania, Care2x is considered as a national open source health information system where it is used to manage 100,000 patients per year in the Mother Teresa Hospital [10]. It helps in the management of health centre's workflow. It is mainly used to store, report and manage patient information within the hospital. Despite being the national health information system, it lacks a module for data exchange between care2x and other health information systems.

In addition, Kanagwa *et al.* [11] customized Care2x and deployed in more than 200 health facilities in Uganda. Helecare2x was the module customized in care2x in order to assist in improving healthcare services. It was distributed in health facilities in Uganda to improve management of patient information including; patient bio-data, insurance record as well as critical medical information. Development of Helecare2x module assisted in the auto-generation of reports and submission to the relevant authorities. The study concluded that Care2x is a mature product and helped to reduce the use of paper and improve workflow in health facilities. The weakness of this customized Care2x was that, it was limited to outpatient only.

In AIC Kijabe hospital in Kenya there were some few challenges in providing healthcare services. The challenges included; servers were unable to cope with the load put on them and MsAccess database that was used in registering patient was slowing down. Also, there were in need of open source HIS to combine the MsAccess databases to support billing in laboratory, pharmacy, store and supplies. Due to these challenges, the hospital found an open source that assisted in solving all of the issues. They decided to use care2x since it is an open source and it is manageable. Thereafter the healthcare services were improved and all the registration challenges were covered by the use of care2x. However, the study did not consider the integration of care2x with other health information systems [12].

The study conducted by Khan *et al*. [13] showed that Care2x was customized and deployed successfully in two premiere client hospitals in India. Care2x was customized according to the requirements of information workflow in the Indian hospitals. It reduces data redundancy, which was a major problem in several health facilities in India. In addition, it was customized purposely for managing patient information and information sharing. The study described the architecture of care2x which is based on the Model View Controller (MVC) that makes it easier for customization to accommodate low cost HMIS solution. However, the study did not consider the exchange of information between care2x and other HMIS.

Betuel *et al*. [14] conducted an experiment to analyse the performance of a virtual private network on information exchange between health information systems. It fits well in exchange of information among health facilities. In Tanzania, the exchange of patient information between facilities which are using care2x was done manually because care2x does not have such functionality. The study focused on analysing the performance of a virtual private network instead of developing the module to assist the exchange of patient information among care2x users. On the other hand, the study was based on data exchange between homogeneous systems only (Care2x to Care2x) rather than Care2x and other systems.

The study done by Wambura *et al.* [15] described the development of a discharge letter module to assist in communicating information of patients hospital visit, treatment and care plans to the next caregiver and hospital. A discharge letter module for Care2x was developed specifically for exchanging information with the patient and other healthcare providers. The discharge letter module in care2x helps to reduce handwriting human errors and enhance good communication between inpatient and outpatient caregivers in following the progress of the patient. However, the information exchange is done by printing information from the system

and submitted in paper-based to the intended user. This module does not support electronic data exchange between hospitals and other health-care providers. Therefore, the study proposes the development of data exchange module between Care2x and NHIF claim management system which will automate claims submission, reduce cost and time in processing claims thus increases the level of customer satisfaction and improve hospital workflow. On the other hand, NHIF will be able to receive and verify claims in time which will easy payment processes.

III. Material and Methods

The study was conducted at Arusha and Kilimanjaro regions in Tanzania. These two regions are located in the northern zone of Tanzania with 1260 health facilities in total [16]. In this zone, there were more than 9 health facilities which were using Care2x. The target groups were healthcare institutions which are using the Care2x system, the Care2x technical service providers and the NHIF office. The motive for selecting northern zone for this study is because it has a large number of health facilities compared to other zones. Moreover, Arusha and Kilimanjaro regions were selected due to the fact that they have a large number of hospitals which are using HIS such as Care2x. Hospitals involved in this study were Arusha Lutheran Medical Centre (ALMC) from Arusha region and Kibong'oto National Tuberculosis Hospital (KNTH) located in the Siha district of Kilimanjaro region.

A. Sample Size and Sampling Technique

The study involved a total of 15 respondents from different areas, 12 of the respondents were physicians from the two health facilities, two were technical persons from Lutheran Investment Company (LUICO) and one IT specialist from NHIF headquarters. Random purposeful sampling technique was used in selecting representative hospitals based on the experience in using Care2x. Furthermore, this technique was also employed to get eight (8) representative doctors and two nurses from each hospital.

B. Data Collection Methods

Data were collected from the study area in the period of January to April 2018. The study employed document review, interview and questionnaire as tools for data collection.

Questionnaire: Questionnaires were distributed to doctors and nurses to gather information about their experience in filling claim forms and using Care2x. Open-ended questions, close-ended questions, multiple choices questions and scale questions were used.

Interview: Structured interview with interview guide questions were conducted to technical team from LUICO to gather information about their experience in customizing and managing Care2x. Furthermore, we interviewed IT specialist from NHIF who is managing claim management system in order to understand claims submission flow and the challenges.

Document review: During the study we reviewed different documents including Care2x documentation, Care2x database structure, “standards and guidelines for electronic data exchange between NHIF and service providers” and “Integration API for Electronic Data Exchange with Health Service Providers”.

IV. Results

A. Overview of the Existing System

The interviews conducted at ALMC and KNTH hospitals were meant to understand the existing claim processing system and how it works. The study revealed that there are some difficulties in filling claim forms such as searching drug and services codes in the printed book, which consume a lot of time. Also, respondents claimed that claim forms were filled twice, in the hard copy and also filled into the NHIF claim system.

Moreover, the study found that NHIF spent a lot of money in printing claim forms. Also, the healthcare provider loses a lot of money due to claims which were rejected. Since claim forms are filled in hard copy, some forms were incomplete/wrongly filled which led to the rejection of the claim by NHIF. For example, at Kibong’oto National Tuberculosis Hospital in 2016 out of 3499 claims submitted, 207 of them were incomplete and hence rejected.

Due to the challenges revealed by respondents, most (87%) of them agreed into the development of data exchange module between Care2x and NHIF claim management system to increase accuracy in filling forms, reduce patient waiting time and time spent in filing claim forms.

Table 1. Responses for the integrated Care2x system and NHIF claims management system will reduce paper

	Frequency	Percent	Cumulative percent
Strongly Agree	10	67	67
Agree	3	20	87
Neutral	2	13	100
Disagree	0	0	100
Strongly Disagree	0	0	100

B. Technology Description

This paper presents both functional and non-function requirements for the development of a data exchange module. Functional requirements express what the data exchange module will provide to Care2x users while non-function requirements describe the properties of the system.

C. Functional Requirements

(a) The module must be able to extract mandatory information from car2x required for claim.
(b) Generated list of claims must contain only discharge patients folio(s)
(c) Mandatory claim information must be validated before submission

(d) User must be able to view pending claims
(e) User must be able to view claim detail for each folio
(f) Claims must be confirmed before submission
(g) Only confirmed claims must be submitted
(h) User must be able to generate report of submitted claims
(i) User must be able to export report of submitted claim

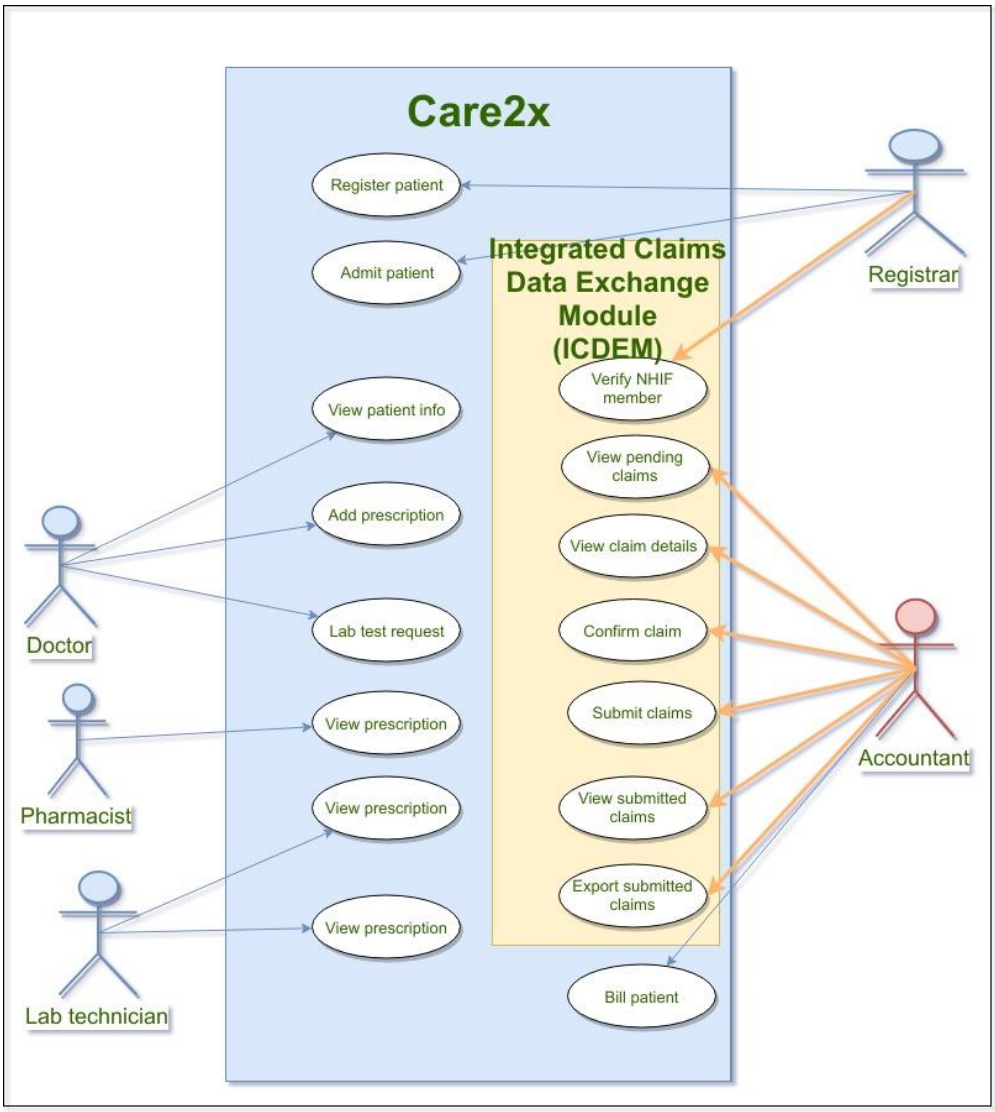

Fig.1. Use case diagram for data exchange module

D. Non-function Requirements

System Interoperability. After review of Care2x documentation, database structure and the system codes, Standards and Guidelines for Electronic Data Exchange between NHIF and Service Providers and Integration API for Electronic Data Exchange with Health Service Providers documents we have discovered that the two systems share information in very low level which has the impact in patient care. Furthermore, we noted the following information is missing in Care2x but are required by NHIF during claim submission.

1) Practitioner number (License number given by Medical Council of Tanganyika), which will be used to identify health practitioner who treated the patient.
2) NHIF codes for Drugs, Investigation, Surgery and Services. Which are used as reference of service during processing claim.
3) Folio Id, which is unique number which identifies batch of claims submitted to NHIF
4) Folio Item ID – a is unique value which identifies specific item claimed
5) Folio-No - is similar to serial numbers of folios.
6) Visit type - type of visit of a patient like normal visit or emergency visit
7) Referral number – a reference number given to patient transferred from one hospital to another.
8) Different version of International Classification of Diseases (ICD) where NHIF system use ICD-9 while Care2x uses ICD-10. Mapping will be done between ICD-9 and ICD-10.

Table 2. Description of functional requirements for data exchange module

REQUIREMENTS	DESCRIPTION
Verify NHIF Member	The Module will verify the validity of NHIF member by using membership number
View Pending Claims	The Module will generate the list of pending claims of a given range of date. The system will compute the amount which is claimed for each folio.
View Claim details	The claim processing personnel will be able to view the details of the claim. This view will be similar to the paper-based claim form.
Confirm Claim	The claim processing personnel will confirm the claim ready for submission. The system will validate if all required information is available for claim submission.
Submit Claim	The only confirmed claim will be submitted to NHIF.
Generate submitted claims report	The module will generate a report of submitted claims.
Export submitted claims	The system will export a report of claims submitted in form of Portable Document File (PDF), Excel and Comma Separated Values (CSV)

Data Exchange Structure. Integration API for Electronic Data Exchange with Health Service Providers document show data exchange structure is JavaScript Object Notation Syntax (JSON). A claim can be submitted online to NHIF by creating a Jason payload. This payload can contain one or more folios (At least one folio) and associated details.

Security for data exchange. The security will be taken into account when developing API in NHIF system in which each health facility provider will have username and password which are used to login. After successful login in NHIF system, the system generates a token which will be valid for a specific time. Token will be generated to make a connection between care2x and NHIF system during data exchange. Care2x was implemented using role-based access control (RBAC) in which user can perform a specific task based on the assigned role.

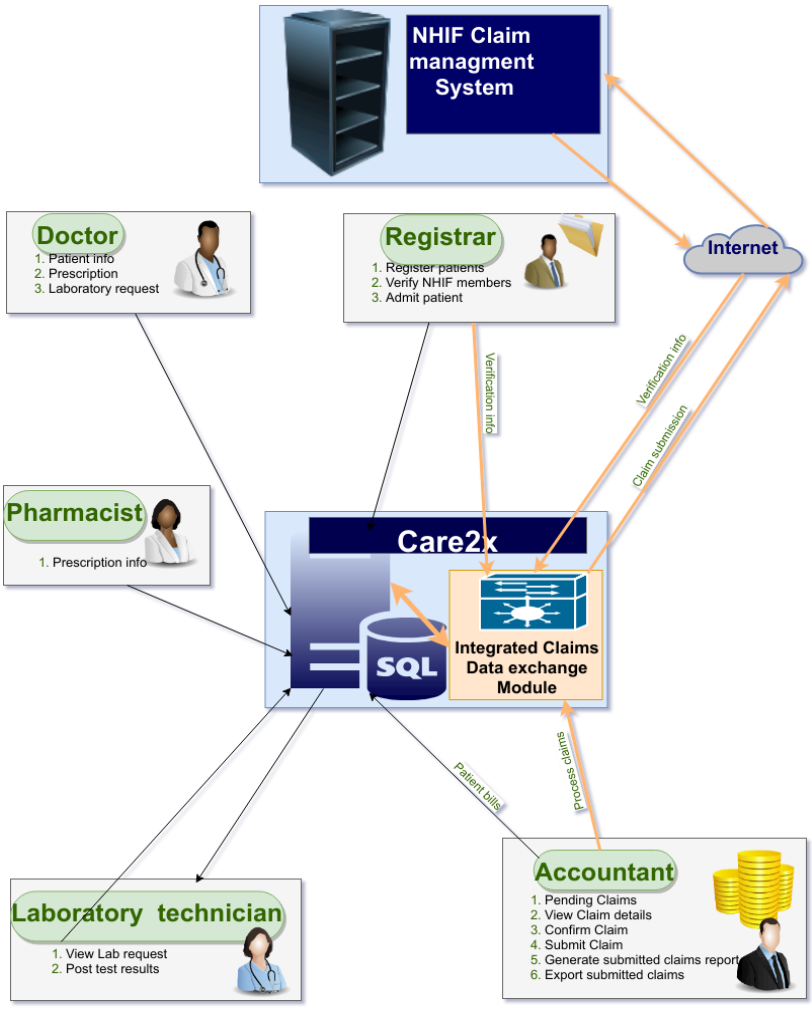

Fig.2. Conceptual framework of data exchange module.

V. Discussion

Based on the study findings, several challenges on claims processing were identified, such as; incomplete or wrongly filled claim forms, time spent in filling claims forms, cost incurred in printing claim forms and difficulties in search drugs and service codes. Incomplete or wrongly filled claim forms were rejected by NHIF and led to the loss of revenue to health-care providers. NHIF is responsible for printing claim forms, which are very cost-full and lead to loss of revenue.

Therefore, in solving the mentioned problems the study proposes the development of a data exchange module. The results indicate the importance of integration module which will reduce errors in filling claims forms, reduce time spent by doctors in filling claim forms which will be accessed and filled automatically from the Care2x system. The proposed solution provides integration between the two systems (Care2x and NHIF claim system) which reduce the workload of physicians from a specific hospital who were required to submit a claim form in hard-copy to NHIF office.

The proposed solution will help to generate reports of claims submitted and claims which are pending. Future work will involve the design and development of a data exchange module between Care2x and NHIF claim management system. The development will involve the use of several tools, software, and programming language which includes JavaScript, HTML, PHP, JAVA, MySQL, and Net-beans.

VI. Conclusion

In this paper, we have analysed the requirements for data exchange module between Care2x and NHIF claim management system. The study showed that the proposed solution is very significant to NHIF health services providers and NHIF insured patient. If accepted and deployed in the Care2x HIS, the proposed system will minimize cost which used to prepare patient claim forms. Moreover, the module helps to reduce the work done in manual verifying claims forms.

Furthermore, there will be a huge reduction in a number of rejected claims due to incomplete filled forms as the module will help verify the information before submission to NHIF. By implementing the proposed module there will be an increase in revenue collection to the healthcare providers. Lastly by eliminating repeated work of filling information in claim forms and Care2x system the proposed solution will reduce patient waiting time.

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Output 2: Manuscript

Development of Integrated Data Exchange Module between Health Information System and Insurance Claims Management System.

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Abstract

The usage of Health Management Information System in Hospitals has improved the health service delivery and increased satisfaction to the patients. The use of paper based in health facilities bring several challenges to both patients and the hospitals in general, such challenges include; patients waiting time, inaccurate of patients data, human errors during filling claims forms, time consumption in filling NHIF claim forms in hard-copy. This paper presents the developed integrated data exchange to solve the challenges and improve health delivery services to the health facilities. A case study of Kilimanjaro region with highest number of hospitals with the use if the Care2x. The viability of the developed data exchange module is to enhance health service in health facilities.

Key words: Hospital Information System, Data Exchange, System Integration, Care2x, Claim Management System

1 . Introduction

1.1 Background

Health Management Information System (HMIS) refers to a system that captures, stores, manages and transfers data among health facilities (Almunawar and Anshari, 2011). It also plays a great role in monitoring and evaluation, supporting patients and health facilities. The use of HMIS increases timeliness and accuracy of patient care, reduces of patient waiting time, increases patient satisfaction, and enables practitioners to serve a great number of patients in a short time. The HMIS contributes to the improvement of report submission, better decision-making, monitoring and evaluation of health sector activities and the management of patient information (Mutale *et al*., 2013) .

Globally, the use of ICT has contributed to the improvement of health services conducted in several health facilities. The adoption of ICT in health issues increased the involvement of patients in their own health progress (Talebian *et al*., 2014) . The usage of HMIS includes; data storage, sharing of information among health institution as well as communication between patients and practitioners.

There is a complex HMIS that combines several functionalities including self-care, forms for communication and data processing. This kind of system helps patients to fill the form by describing their problem/sickness in their geographical location then send to the respective practitioners before going to the hospital (Talebian, 2014). Examples of HMIS which are mostly used in Tanzania include; PatientOS, OpenMRS, OpenEMR, HospitalOS, HOSxP and Care2x.

Care2x is a free open source software which has been used in several countries to support health activities in health facilities. It was started as “care2002” project in 2002, which was then changed to care2x in 2013 and the first version (version1.1) was released in 2014. The latest version that is used in a health institutions recently is version 2.7. It also has the ability to be customized according to the requirements of the specific healthcare facilities. Furthermore, its security is 80% thus making it capable of handling healthcare matters in the respective institution (Gödert and Latorilla, 2017) .

Despite the fact that most of the hospitals are using HMIS and have dedicated desk for NHIF insured patients but there are few challenges in the health sector still faces some few challenges. The presence of NHIF form in hard copy, which is used for recording patient details results into patients’ long waiting time on queues. Consequently, long waiting time lowers patients’ satisfaction with the hospital services (Huang, 1994). Through the use of paper-based forms in recording patient information, the hospital manages to serve a few numbers of people in a given time. In such a condition, serving a large number of patients requires a large number of human resource and consumption of papers, which is costly. Moreover, human errors are unavoidable which sometimes reduce the accuracy of the patient data(Mark *et al*., 2018). Furthermore, submission and reporting of the patient records which were done on paper then submitted to NHIF offices physically. Therefore, this study developed a module for integration of the Care2x hospital system and the NHIF system that will computerize NHIF treatment form to reduce waiting time of NHIF insured patient at admission, to reduce time spent by doctors to attend NHIF insured patients and automate the process of submitting NHIF treatment form to NHIF for verification.

1.2 System Integration in Tanzania

System integration in Tanzania is considered as an important approach in conducting several activities both in public and private sectors. System integration involves joining/combining different subsystems or components to work as one large system. However, integration of HMIS plays a crucial role in managing health services and workflow in the health facilities. Systems integration facilitates local decision-making through, a supply of information among health sector departments in a timely and accurate manner. On the other hand, HMIS improves the allocation of resources, assist management of activities among health institutions and improve efficiency within the public sector. For better improvement of health care services, several systems have been integrated to minimize cost, human errors, resources while increasing patient satisfaction and timely reporting. For instance, in Tanzania, there is a module for discharge letter which was integrated with care2x to assist on recording discharge information (Wambura *et al*., 2017) .

Scott *et al.* (2016) on their study of measuring the operational impact of digitized hospital records showed that there is benefit gained through the use of digitized records such as access of information from multiple locations, better preparation of ward rounds, improvement of patients handover and improvement of timeline for patients events. The study concluded that digitized medical records can be implemented without negative impacts on health facilities operation (Scott *et al*., 2016).

2 . Materials and Methods

2.1 Requirements Analysis

Requirement analysis considered both functional and non-functional requirements for the development of the proposed data exchange module. The requirements of the proposed solution were obtained from the users of the HIS in the case study area. Both functional and non-functional requirements were extracted from use case diagrams. Some of the functional requirements include; automatic generation of the claims forms, automatic filling claims forms, automatic generation of submitted claims report, claimed forms must be confirmed before submission. On the other hand, non-functional requirements include; maintainability, security, less time response, usability and customizable.

2.2 Designed Solution

The designed solution is presented in different diagrams including data flow diagrams and database schema. Data flow diagrams shows the manipulation of input through the system process and its output. There are different levels of data flow diagram including level 0 (context diagram), level 1 and level 2. In this paper data flow and level 1 present flow of information of the proposed solution, as shown in Fig. 1. Database schema presents graphical view and structure of the database architecture. It also presents the logical diagram that comprises with table, fields and the relationship among the tables, as presented in Fig 2. New table(care_nhif_claims) where created in care2x database to store claim details. Furthermore care_person and care_tz_drugandservices where modified by adding practitioner_number and nhif_code fileds respectively.

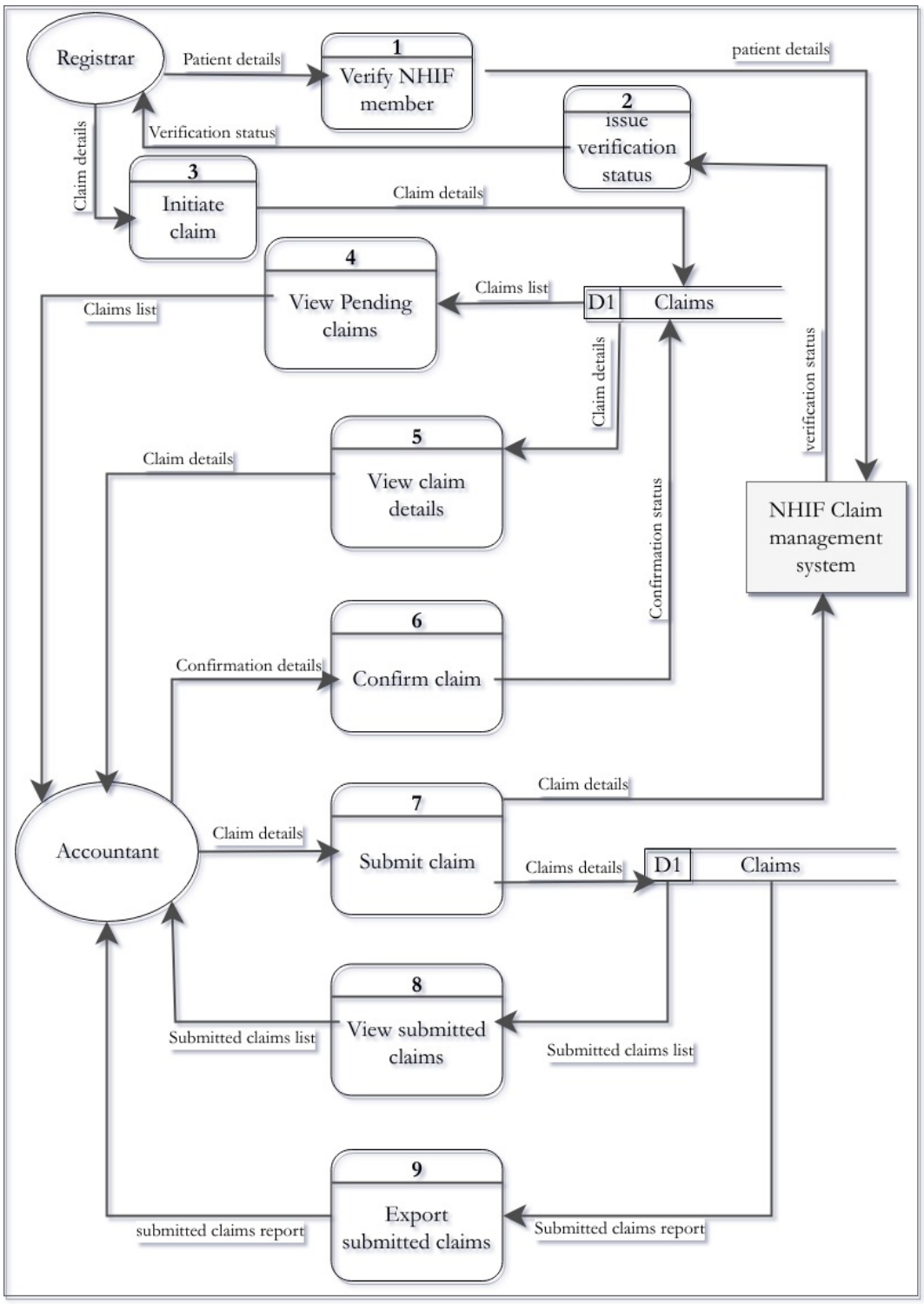

Figure 1: Data flow diagram level 1

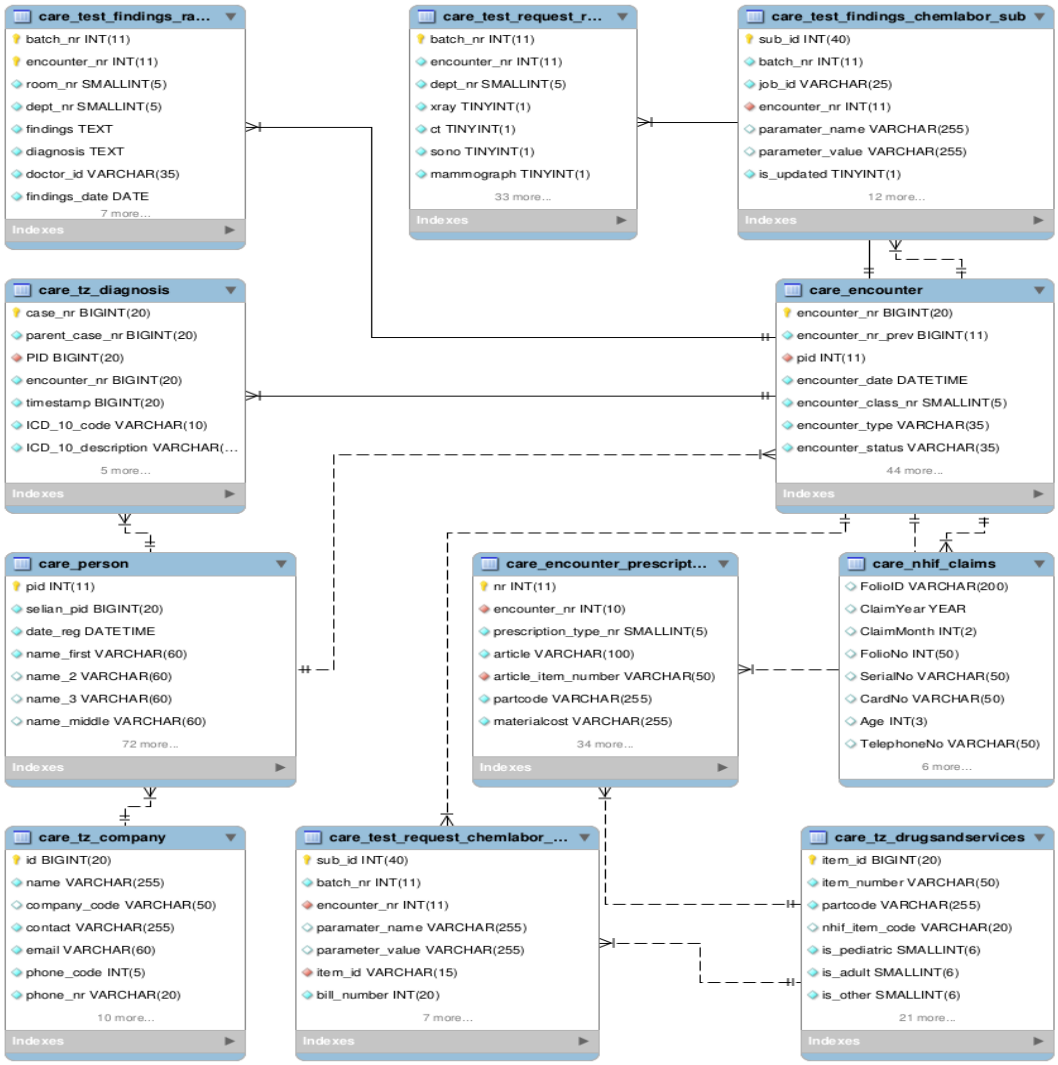

Figure 2: Database schema for integrated claims data exchange module

2.3 Data Exchange Structure

Integration API for Electronic Data Exchange with Health Service Providers document showed that the data exchange structure is JavaScript Object Notation Syntax (JSON). Claim can be submitted online to NHIF by creating a Jason payload. This payload can contain one or more folios (At least one folio) and associated details (Zunke and D'Souza, 2014) .

2.4 Development Approach

The development of exchange module based on the user requirements. However, system development life cycle (SDLC) was considered as the guideline for the development of the proposed solution. Prototyping is the one of the SDLC approaches, was adopted in the development of the exchange module. It is the development approach which has the ability to accommodate user

requirements after development. This approach was chosen because it reduces the time for development as well as its ability to involve user to assess the end product before its implementation. The major advantage of the prototyping is the accommodation of user feedback, which contributes to a better solution.

3 . Developed Data Exchange Module in the Care2x

The development of the data exchange module involved the use of following tools and technology; HTML5, CSS, PHP, MySQL, JavaScript, NetBeans and Apache as a web server. The developed system improve integration of Care2x Hospital System with the National Health Insurance Fund system. The system integrates Care2x with NHIF verification claim system. The developed integrated data exchange module had several functionalities that reduce workload in filing claim forms, improve patient verification which reduces patient waiting time, and reduce cost in processing claim form and increase accuracy in processing claims. The functionalities of the developed integrated data exchange module include; view pending claims, view claim details, confirm the claim, submit claims, view submitted claims, and export report of submitted claims. The system allowed a user to log in Care2x by providing their authenticity details. Figure 3 presents the login page.

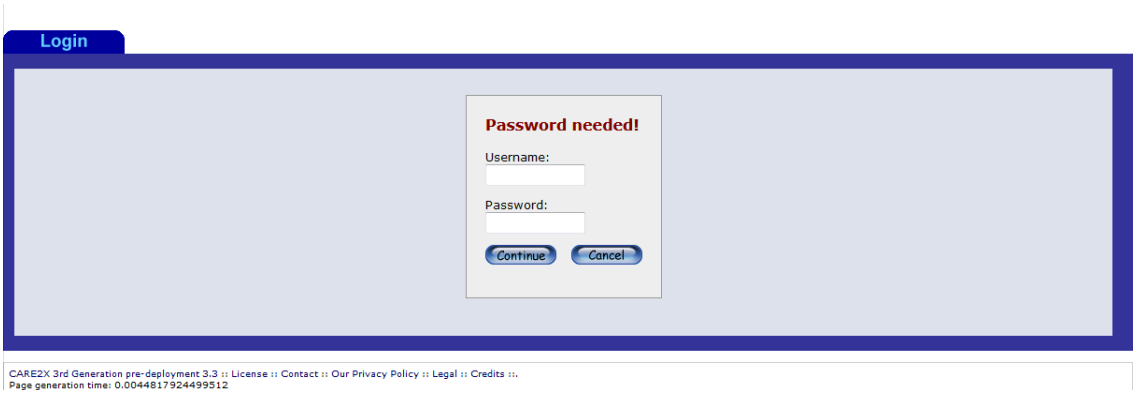

Figure 3: login page

3.1 Care2x Dashboard

The following interface displayed a Care2x home page that consists of several modules that improve health services in the hospitals. Once a user logged in the Care2x home page displayed as shown in Fig. 4 that allowed user to access the NHIF claim module.

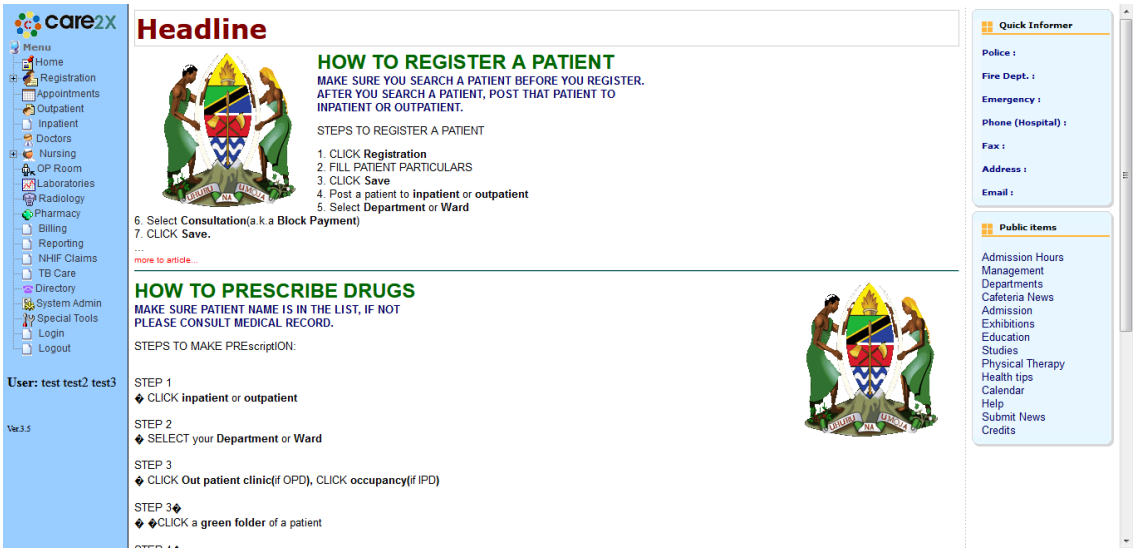

Figure 4: Care2x dashboard

3.2 Integrated Claims Data Exchange Module Dashboard

The NHIF claims page consists of the pending claim outpatient, pending claim inpatient and claim report forms as presented in the Fig. 5. These forms reduce workload done by a physician in filling hard copy forms

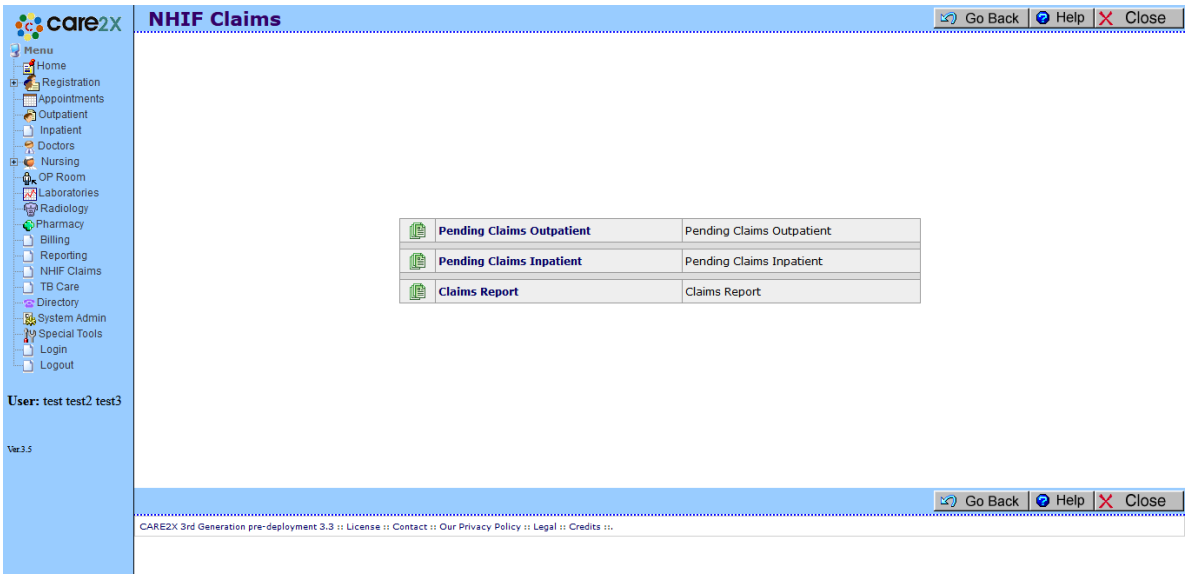

Figure 5: Integrated claims data exchange module dashboard (NHIF claims)

3.3 NHIF pending claims

The following figures show pages for pending claims of outpatients and pending claims for inpatients. The below pages allowed a user to filter the list of pending claim forms. The pending claims forms can

be filtered in daily, weekly, monthly and year bases. Figure 6 presents NHIF pending claims for outpatients while Fig. 7 present NHIF pending claims for inpatients.

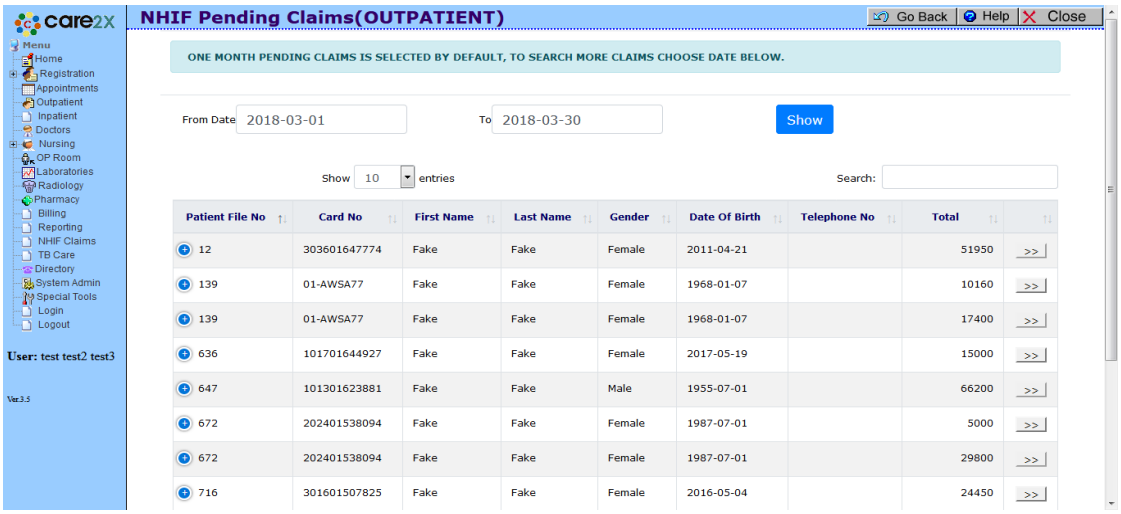

Figure 6: List of NHIF pending (claims outpatient)

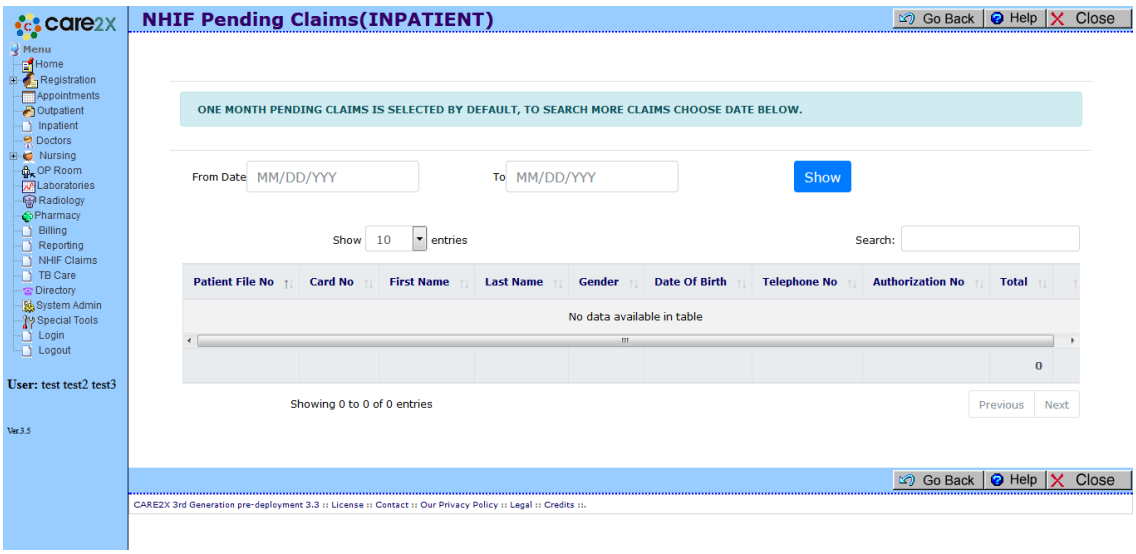

Figure 7: NHIF pending claims(Inpatient)

3.4 View Claim Details

The developed integrated data exchange module digitized patient claim form which reduced paperwork. NHIF pending claims display details that should be filled throughout patient treatment. Figure 8 shows claim form details.

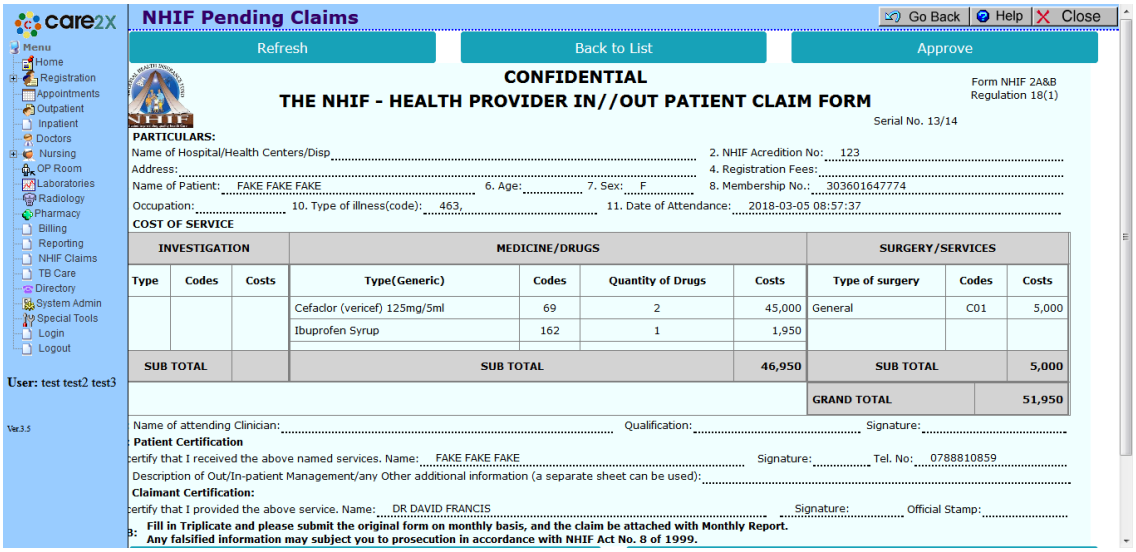

Figure 8: View claim details

3.5 Approve and Submit Claims Forms

The developed integrated data exchange module allow user to approve claims which are well filled by a physician. Figure 9 presents the results of the successful approved form. However, after claim form approved, user submit claims to NHIF system for verification and payment.

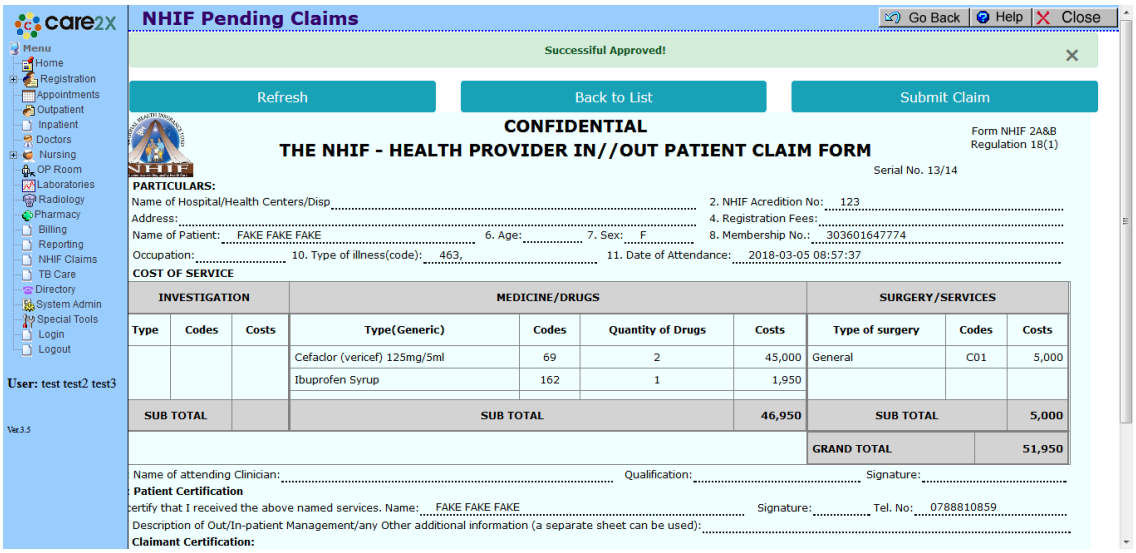

Figure 9: Approve and submit claim form

3.6 NHIF Claims Forms

Claims reports on admitted patients, inpatients and outpatients can be retrieved through the developed data exchange module. By default, the module generates current month claims report automatic, for more reports the user can choose date /month/year of his preference to retrieve the report. Reports were exported in CSV format.

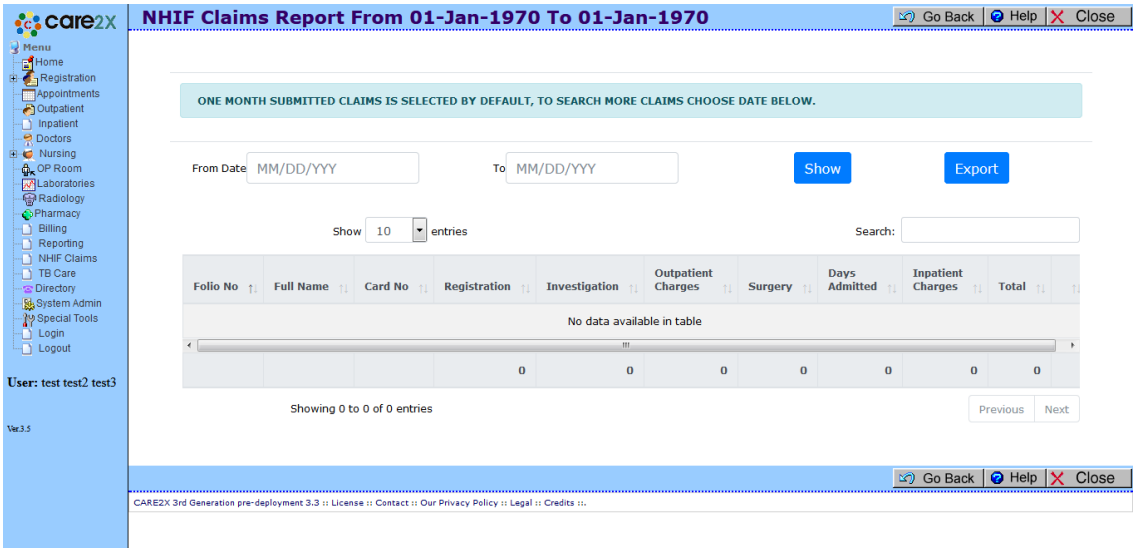

Figure10: Export submitted claims report

4 . Conclusion

This paper has presented the design and development of the developed integrated data exchange module in Care2x. The developed integrated data exchange is significant to patients, hospitals and the NHIF office. Through the use of data exchange the patients will be satisfied with the service as the patient waiting time to get service will be reduced to fasten the treatment of the patient. To the hospitals the workload of physicians will be reduced and minimize human resource. The accuracy of the data will be improved that will benefit both hospitals and NHIF offices, thus increases the performance to both hospitals and NHIF offices.

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Output 3: Poster Presentation

IMPROVED INTEGRATED CARE2X HOSPITAL MANAGEMENT INFORMATION SYSTEM WITH NATIONAL HEALTH INSURANCE FUND SYSTEM

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Introduction

The usage of Health Management Information System in Hospitals has improved the health service delivery and increased satisfaction to the patients. The use of paper based in health facilities bring several challenges to both patients and the hospitals in general, such challenges include; patients waiting time, inaccurate of patients data, human errors during filling claims forms, time consumption in filling NHIF claim forms in hard-copy. This paper presents the developed integrated data exchange to solve the challenges and improve health delivery services to the health facilities. A case study of Kilimanjaro region with highest number of hospitals with the use if the Care2x. The viability of the developed data exchange module is to enhance health service in health facilities

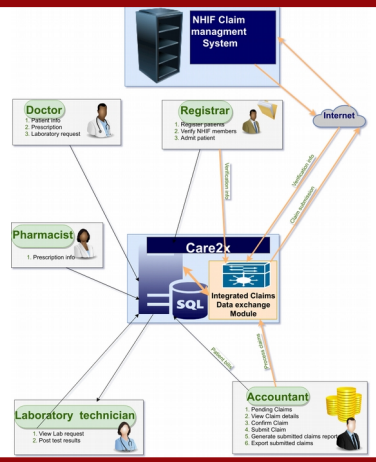
Methodology

The study was conducted at Arusha and Kilimanjaro regions in Tanzania.Hospitals were involved in this study were Arusha Lutheran Medical Centre (ALMC) and Kibong'oto National Tuberculosis Hospital (KNTH) located in the Siha district of Kilimanjaro region.The study involved a total of 15 respondent from different areas whereas 12 respondents were physicians from two health facilities, two technical persons from Lutheran Investment Company(LUICO) and one IT specialist from NHIF headquarter office. Random purposeful sampling technique where used in selecting representative hospitals based on the experience in using Care2x. Furthermore, this technique was also employed to get eight (8) representative doctors and two nurses from each hospital.

The development of the data exchange module involved the use of following tools and technology;

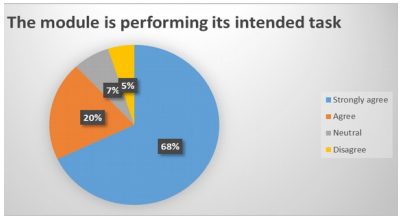
(i) HTML5 and CSS were used to format the module interface
(ii) PHP were used to connect client and server
(iii) Scripting language: JavaScript
(iv) NetBeans as integrated development environment
(v) MySQL were used for database manipulation
(vi) Apache as a web server

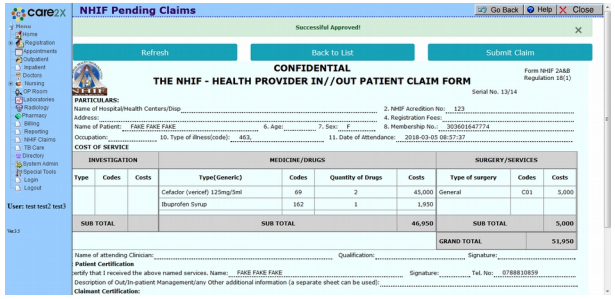
Conceptual Framework



Results

During the implementation of the developed integrated data exchange module, the whole system was tested to check if all functionalities are working properly and meet specified user requirements. The results and the analysis from the testing and evaluation showed that majority 68% strongly agree on the good performance of the developed module, 20% agree, 7% were neutral and 5% disagree. This results shows that developed integrated data exchange module was able to minimize resource when providing health services. For instance, the human resource was minimized since only one person was able to process and submit monthly claims in a single day compared to the previous manual process which was done in two weeks by two people.





Conclusion

The study aimed at improving health services by developing an integrated data exchange module between Care2x and NHIF claim management purposely to reduce the use of paper, reduce the workload of physicians from a specific hospital who were required to submit a claim form in hard-copy to NHIF office. Additionally, the exchange module enabled NHIF personnel to verify claims before processing payment.

The developed integrated data exchange module was able to minimize resource when providing health services. For instance, the human resource was minimized since only one person was able to process and submit monthly claims in a single day compared to the previous manual process which was done in two weeks by two people.