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Designing of elements for Digitized Referral Appointment System (DRAS) towards enhancing booking appointments in Tanzania

John J. Ndindwa[1], Agnes R. Semwanga [2], Ramadhan R. Sinde[3]
[1]Information, Communication Science and Engineering, The Nelson Mandela Institution of Science and Technology – Arusha, Tanzania. P.O. Box 447 Arusha, Tanzania. ndindwaj@nm-aist.ac.tz
[2] Information Syst. Dept, Faculty of Computing and IT, Makerere University, P.O. Box 7062 Kampala, Uganda asemwanga@cit.mak.ac.ug
[3]Information, Communication Science and Engineering, The Nelson Mandela Institution of Science and Technology – Arusha, Tanzania. P.O. Box 447 Arusha, Tanzania. ramadhani.sinde@nm-aist.ac.tz

Abstract
The issue of making an appointment with accessing referral services, you need to have individual relationships to the medical staffs like friendship or relatively. In Tanzania, many years ago, the tradition referral systems did not offer assurance to access specialty hospital services. Numbers of ICT projects have been adopted and put into application but referral area remains forgotten. The challenges to referral services include shortage of human resources, facilities and equipment. Tanzania has several regional hospitals with a few medical doctors who are not specialized in referral services. No way, patient has to travel from one hospital to another seeking for quality healthcare delivery by faith without assurance of being served. Thus, create long waiting time for patients, doctors' idle time, unnecessary cost to patients and disturbances.
The major purpose of this paper is to design detailed elements of Digitized Referral Appointment System (DRAS) through application of ICT to solve referral challenges by allowing patients to book an appointment to access referral services before travelling. This solution will provide efficient use of few available health resources like medical specialty doctors, time and equipments.
Keywords: Referral services, Patient appointment system/Technology (PAS/T), Information and Communication Technology (ICT), Digitized Referral Appointment System (DRAS) and E-healthcare.

1. Introduction

Health industry is rapidly overgrown industry that touched the lives of people directly[1]. Health sector deals with healthcare to provide accessing of health services offered by hospital or health clinic [2]. The purpose of healthcare is to improve health and life of the people for economic development of their own and their country [3]. In several ways, health service providers need to improve a standard of health services and waiting times for their patients and Medical doctors.
The challenges faced referral services in Tanzania are as follows; insufficient medical staff, lack of proper communication technology and improper appointment system. Lack of qualified human resources is a major limiting factors of implementing effective health policies and reforms as reported by USAID (2007) that, Tanzania has several regions with few specialty medical staff where majority are not specialized as per required minimum standard to offer advanced referral services. In fact, the patient has to travel at one hospital to another seeking for quality healthcare delivery. For that case; create long waiting time for patient and causing idle time to medical staff [4]. These challenges must be considered in finding a tool which will provide efficient use of few available resources through application of ICT. The proposed Digitized Referral Appointment System (DRAS) is a proposed solution that allows patients to book appointment in order to have assurance of accessing referral services. This will result reduction of waiting time both for patient and doctor's redundant time [5]

The general structure of this paper is arranged as follows: - Section1 for introduction of health industry in Tanzania; Section 2 provide details of ICT application for E-health care; Section 3 provide exposure to appointment booking methods; Section 4 provide proposed appointment methods of DRAS; Section 5 provide Designing and setting of 7 elements for DRAS; Section 6 are the conclusion and Section 7 is recommendations.

2. ICT in Healthcare

Information and Communication Technology (ICT) is defined as electronic technologies that enable collection, storing, retrieving, processing and transmission of information [6]. According to Herselman and Hay (2003), explained ICT as Technological supporter of communication and collaboration of people and their organizations [7]; hence it creates the platform of sharing knowledge to the medical staffs. The implementation of ICT in health industry should provide such solutions to solve booking and scheduling challenges. This will solve Doctors to waste their valuable time, reducing waiting time and satisfying health customer. The developers of e-health systems they have designed several Appointment Information

Management systems (AIMS) to improve referral services and hospital operations for other countries but not yet implemented fully in Tanzania.

In healthcare industry, tradition referral systems in Tanzania connects patients from regional hospital level to consultancy hospital level by using the special written documents or filled form to be submitted when he or she arrived at the hospital. This results doctor's un-awareness, increasing burdens on them, reduces working morale, long waiting for patients and sometime unnecessary deaths. The information to be in paper systems sometime lost during travelling; hence results disturbance to patients and incurring unnecessary expenses looking the way of getting it again which ends with doctors to decide serving life of patient than asking referral documents.

2.1 E-healthcare

This is the ICT application for health sectors where electronic machines are used to collect information and make it available anytime, anywhere and for specific purposes of improving health care delivery [8]. The advantages that are provided with e-healthcare initiatives in Tanzania include Hospital or Health Information Systems (HIS), Telemedicine Network (TN), Electronic health records (EHR) and Internet services [9] which came into use in the year 2000 [10]. In actual facts, E-healthcare is a promising field of medical informatics, referring to the organization and delivery of health care services and information using ICT [10]

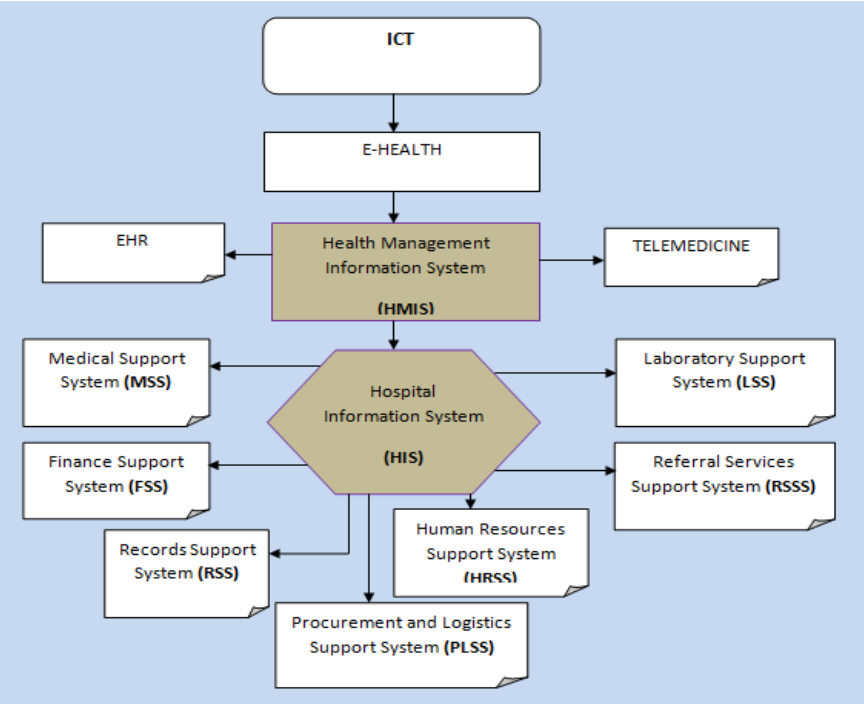

Figure 1: ICT architecture flow in Tanzania

The proposed DRAS have capabilities in managing the setting of booking appointments of providing patients to choose a calendar of available health resources electronically.

3. Exposure of Patient appointments system Technology (PAST) and their challenges from literature review

Patients Appointment System (PAS) in the literature review was done by using paper system long time ago. Most of the system was using telephone by which central operators they were using simple queuing models just to calculate patient time in consultations and in waiting time to know the medical staff capacity per day [11].

The telephone appointment system (TAS) had the following benefits; is cheaper and quicker than seeing patients face to face but it is risks because how can you understand the case by voice? In the right circumstances, they can increase efficiency, improves access and boost patient satisfaction. The drawbacks of telephone are that; Languages can be a barrier between doctors and patients to communicate which may affect booking processing. Sometimes doctor's phone during accepting appointment bookings becomes busy and patient delayed to get line and Doctors burden becomes great to talk more online.

Early appointment system including in Tanzania was done by considering the time of doctors is more important than patient time which was bad concepts because the life of the patient is very important to be given highest priorities than doctor's time. The researchers Wijewickrama and Takakuwa (2005) came with solution of developing appointment system by valuing time for patients and doctors to minimize waiting time for patients and doctors idle time [12]

Based on this concepts developers designed a system only to minimize doctor idle time but to solve this negative ideas current systems are developed by considering time both for patients and for doctors [12]

Internet appointment system allowing patients to create amend and cancel their appointments online which is convenient for patients than telephone; It quick and easy to use, Patients receive automated booking confirmations via system or email account [13]. It has the following drawbacks; not everyone has access to a computer, some patients may need training to use the system and patients may be concerned about the security and confidentiality of the information on the internet.
On the other hand, researchers focused on the following cases; Management of patient information, medication history, appointment system, Doctor schedule and calendar, health care document and payment systems.

Exposure of PAST approaches from literature review

Researchers have realized the root of referral services problems is waiting time and dissatisfaction of health care as a result of the improper referral appointment system [1]. A long time ago; patients went to a hospital expecting services without assurance and doctor's serves more people as a normal situation. The objective of booking appointment is as follows:-

- Reduction of unnecessary waits times [14].
- Encourage progress of patient care.
- Improve patient- medical staff relationship [15].
- Assure timely follow-up of patients with chronic diseases.

Good techniques are that is able to optimize doctors idle time and patient waiting time [1] and hence improving hospital operations and healthcare facilities [2].

3.1 Double booking (DB)

With the DB method more patients are given particular appointment time slots [1]. Basically DB requires many rooms and adequate staffs for serving different services and different departments. Hence; patients who came early thought negative perception of medical staffs and affect to doctors – patients' relationship [16]. DB utilizes resources better and always there are ready patients to get services but it has the following weakness; needs more resources, enough examination rooms, small number of patients per day for short waiting time and it creates long waiting time for late patients.

3.2 A Pure block systems (PBS)

This technique manages appointments of the start of a clinic session hour for all patients to be seen during the session [17] by allocating date rather than specific appointment times [18]. Challenges happen if many patients arrived on time for the beginning of clinic sessions; some of the patients will have to wait without knowing at what times they are going to get services within a day, although there is assurance of being treated for the day [19]

3.3 Singe block system (SBS)

Assign all patients to arrive in a block of the beginning of the clinic session; allocate date than a time [18]. PBS results long waiting times for late patients and increases unnecessary cost and complains [20], [1] but it shortens idle time for the medical staff [21]. Researchers had identified that the root of referral services problems is improper appointment systems at hospitals [1].

3.4 Wave scheduling (WS)

It is the methods used in hospitals having several and enough examination rooms and medical staff. It takes three – four patients to be seen at every half of the hour and two or three to be seen at the second half by the algorithm of FCFS and if happens all to come on timing the seriously patient will be seen first and the rest will wait less to 20 minutes which is standards [1]. This method needs people who are coordinating to prioritize patients' condition on waiting room.

3.5 Modified wave scheduling (MWS)

Modified Wave Scheduling (MWS) is the methods by which patient appointments overlap so that when one patient is late, the next patient will get advantage to be served [22]. Patient appointments are clustered to create heavier volume of the beginning of the hour and beginning of each clinical session. Clusters are the number of patients grouped together if having the same problems for easiest way of serving them fasters than patients with mixed problems. This algorithm is like double booking but it works such that if the first patient is served few minutes than allocated time then the remaining time will be the starting time of second patients [12]. For this case doctor idle times are removed more numbers of patients are served for appointed days. MWS results medical staff to bore by attending the same similar cases and huge load of patients grouped into clusters.

3.6 Intelligent Agency Rule (IAR)

It is based on centralized intelligent agents for making appointment of negotiating and collaborating with the agents of

doctors who process appointment time for the patient under all necessary considerations like patient condition. All the requests are received to central staff desks that prioritize to request; it causes long waiting chains in approving appointments, delay in notifications to patients on scheduled calendar and also creates great burden to appointment scheduling coordinators [2]

3.7 Modified Open Booking (MOB)

This is adopted from open booking as used at Muhimbili National Hospital (MNH). At MNH electronic HIS is used to manage hospital operation by connecting all departments' activities. It has small modules of recording and to managing appointments for the second visit patients by which 10 new cases are scheduled to come at 8:00am to be served up to 11:00am and 20 cases for return patients to come from 11:30am up to 16:00pm regardless the condition. The patient who will come first will be seen first (FCFS), but if happen seriously patients to arrive will be given highest priority. This approaches' creates complaining about patients assigned to come at one time and creates long waiting time for late patients.

4. Proposed appointment system Technology and scheduling approach for DRAS

Web-based PAS is proposed Technology to allow patients to order bookings through health caregiver at the hospital. This is because not all patients familiar with this technology expertise and patient can-not fill fact information about the cases. Patients will be able to register to this system and submitting contact information as email or phone number for receiving notifications about the requests from booking central system and sending requests. By using ICT Technological innovation; Phone, Email and PAS will be integrated for dual communications. The system will link all regions and consultancy hospitals in facilitating referral services and appointment bookings. Patient will be registered only once and the information will be distributed to all linked hospitals electronically. The following benefits will be created:- paper less environment, Gives quick and easy access to patients 24/7, Patients receive automated booking confirmations through email or phone, Appointments can be cancelled easily, allow patients to access profile, view and updating contact information to his or her profile.

From Web-based booking Technology, the proposed approach for managing scheduling of appointments is that minimizing the following challenges:-

- Shortage of referral hospitals,
- Shortage of health resources,
- Improper communication technology to connect hospitals and referral appointment system.

In this paper we are proposing booking method for DRAS as a combination of wave scheduling (WS) and intelligent rule (IR) to get HCH algorithm (H = Hot cases, C= Cold cases and H= Half of an hour) by which Hot cases are seen at the first half of every hour and the rest Cold cases to be seen at the second half of an hour. This is modified from Wave scheduling; the problems of this are not considering the cases of the patients while in IR we are considering patients cases by involving human central system to manage patient's conditions cases and decision making. This central system coordinator receives booking requests and channeling them to respected system element by considering the cases triggered. By using HCH algorithm will balance stress to doctors and other medical staff in attending two or three tough cases first and easily two or three cases at the second half of an hour. If happen each one to arrive separately FCFS queuing algorithm will take place; and if two or three Patients to arrive one time seriously patient will be taken first and even if all arrived on appointed time; waiting time will be less to 20 minutes which is not boring at all.

5. Designing and settings of DRAS

DRAS are the computerized application designed to manage appointments booking and scheduling for different health resources, different locations and calendar. The resources can be clinics, Medical specialty staff, Laboratory tests, Theater services, Ophthalmology services, CT-Scan, radiology, Magnetic Resonance Imagining (MRI), X-Ray Apparatus and advanced diagnostic services. Each resource has a defined daily schedule that indicates the available calendar and time slots for booking appointment. The term booking appointment it can be defined as arranging appointments with secured on-line access using the hospital web site or any web-based system available.

5.1 Objectives of the System

The appointments system is a means for E-health care that allows quick booking and managing patient's appointments while eliminating the possibility of one time collision of the same time slot for different patients. Only eligible people with access will reserve appointments, Thereby to provide the best service for patients. Specific objectives include:-

1. Establishments of a paperless environment,
2. Scheduling of the medical activities and services within the healthcare center,
3. Optimizes utilization of medical resources at the hospital and Increase efficiency of services outcome.

5.2 Functionality

1. On-line booking and reservation of Appointments,
2. direct explanations when the mouse are on a certain function button,

3. Access is permitted to authorized staffs of the respective functions,
4. Statistical data generation pertaining to invariable parameters,
5. Report generating, updating and Notifications to customer.

5.3 Cases to consider

In order to build sustainable referral appointment systems that will provide better solutions to prove efficient accessibility of the medical staffs and reduce patient waiting time. Lack of health resources to serve large numbers of patients is influential factors of this system to be considered in designing. Those factors include:-

1. Cold cases
2. Un-normal cases
3. Emergency cases

Cold cases: This is types of patients who are seeking only medical specialty consultation services as advising and counseling. This case can't be set to be at first priority scheduling.

Un-normal cases: This is when a patient experiencing problem need specialty services which are not offered by early hospital. In Tanzania specialty services are delivered to regional level, consultant level and National level (MoH 1990, 1994, 1998). Although the challenges are; not all specialty services are offered by regional level and consultancy level due to lack of resources (USAID 2007).

Emergency cases: these are hot cases to be given highest priority to be scheduled first than other cases; central coordinators will confirm seriousness after communication. Sometimes patients deciding to travel without passing to regional level due to transport infrastructure, economic status and geographical locations between those hospitals.

The observation during study; "Just imagine, aim a citizen of Tinde village in Tabora region, to go Tabora town seeking referral letter then to go Bugando Consultancy hospital is a wrong way geographically, From here via Shinyanga town to Mwanza is simple way" (Mr Jumakasomo, Health stakeholder -Tinde village, Tabora).

Hence; there is only one case takes highest priority and another one are taken as emergency which has no limit to referral hospital capacity. Remember at every referral hospital in Tanzania there are emergency department specials for those cases regardless there is facilities or not.

Therefore, in order to improve patients' to access referral services at public hospital, the **PSDN** principle Formulae for DRAS have capability to: (1) **P**atient's demand requests (2) **S**ervice provider's supply, (3) **D**emand Balancing and supply (4) **N**otifications to respected hospital and medical staff. **P**atient demand requests, it control requests of patient booking, **S**ervice provider are processing requests due to strategies criteria , **D**emand requests it Balance patients, health resources, calendar and **N**otification it inform the status of patients requests to interface user display.

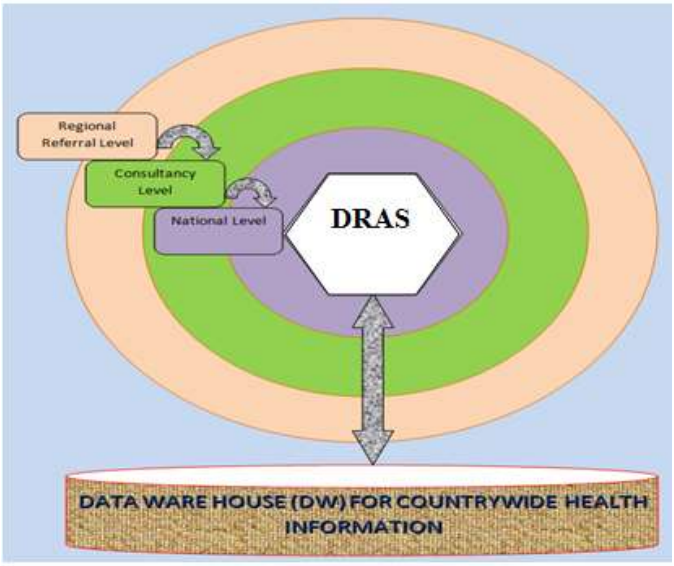

Figure 2: System integration countrywide

5.4 System design based on seven elements

Our proposed DRAS are composed of seven elements as adopted and modified from Hu, Yu and Yan, (2010) [23] (Figure 4):

1. System Interface (SI)
2. Data ware House (DW)
3. Request module (RM)
4. Performance module (PM)
5. Strategy module (SM)
6. Scheduling module (SMO)
7. Chatting or Reminding (CRR)

System Interface (SI)

It provides functionality of exchanging information on end users. SI it has important functions menus and system functionality properties.

The Data warehouse (DW)

All information about appointment scheduling is stored here as well as Requests, process and notification from systems administrators.

The Request module (RM)

It calculates patient's requests controlled by medical staffs, it traces all daily requests (pending or processed) and notification to be stored to data ware house. All requests are arranged accordingly and sorted. This module is entered by users who are given privilege to do so from the System Interface. RM classifies all requests and stores them in the data ware house. SI is responsible to retrieve and to display needed information stored to the database.

Performance module (PM)

It checks process performance of system functions to satisfy customers (Patient) like time to reply scheduling processes, updates and notifications. If the information processed is not in standard quality, PM will trigger to adjust the scheduling process till to be in satisfaction way.

Strategy module (SM)

At every process there are protocol (set of rules), to control user who making appointment to get expected results. (If you command un-coded function, you can't get what you want)

Scheduling module (SMO)

It is used to manage health providers' workload, arrange to request, arranging facilities with available calendars and after all conditions to be met; results will be displayed to SI. Expected results are as follows; processed requests, pending requests, cancelled requests and unprocessed requests. If appointment is scheduled, User to SI will get notification of when and where are going to access referral services.

Chatting or Reminding (CRR)

This is very important sections in any real time system which will enable SMS chatting to ask or to remind requests updates. Because of system integration technology, it is possible to integrate with mobile applications.

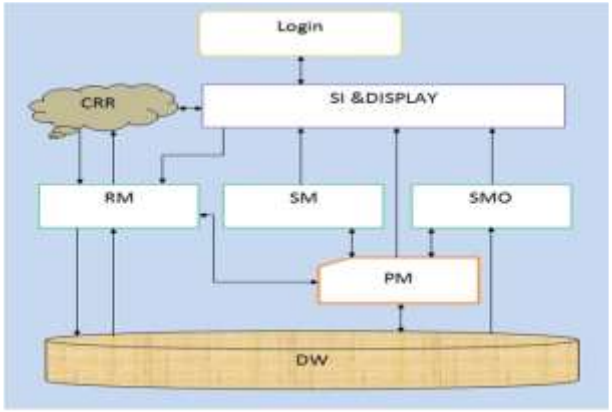

Figure 3: Seven elements of DRAS

5.5 Main descriptions about seven elements

5.5.1 Request module (RM)

This module calculates numbers of patients and their bookings for the purpose of matching with service provider capacity per day. It traces requests process by process at every stage as; succeeded bookings, pending bookings and cancelled bookings. It deals with controlling SMS communication (Chatting) for reminding and updating the customer. RM is initial sections which channeling requests for respected departments and specialty. The best work of RM is to control and managing requests, supply and calendar.

If the request is pending, means there is some condition not met e.g. required facilities and machine while if the request is cancelled means, the customer has decided to postpone or to stop the process.

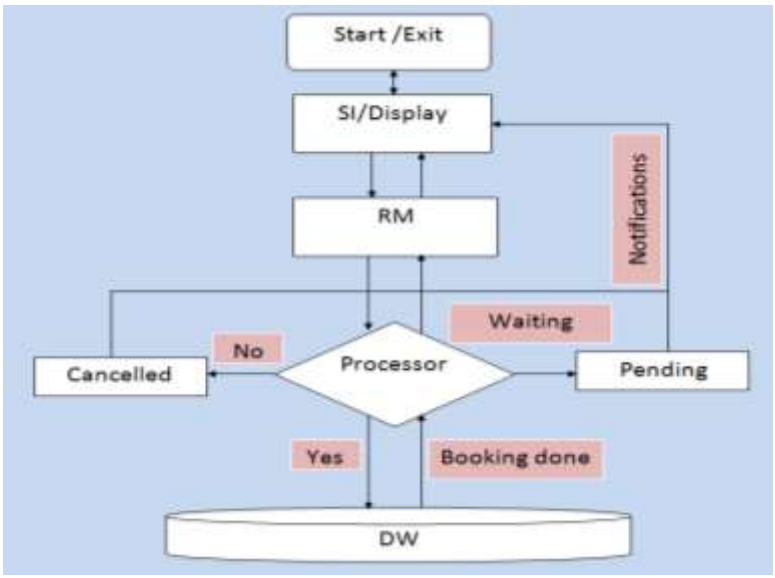

Figure 4: Request module (RM)

In order to process the requests, let me use the following principle formulae:

Condition one:

Service Provider Capacity (SPC) = Succeeded Booking (SB)…… . (1)

SPC = Second Day Requests – Pending Requests (PR)…….. (2)

From equation (1) because of lack of facilities faced health sector in Tanzania, Requests must be large than (SPC),

Hence all requests cannot be processed within a day; those unprocessed requests will be given first chance to be processed early on the following day……..…. *Refer equation (2)*

At every process, customer will be notified (Bookings done, Cancelled or Pending (Waiting)). The entire requests will be received to the central system and at the end of every working day hours; all notifications will be sent to customers to confirm booking. No requests will be processed out of working time, although the system will be working 24 hours a day to receive requests. For any emergency cases, the patients will have to travel directly to hospital to be treated as the emergency patients.

5.5.2 Schedule module (SMO)

It deals with recording of every day patient demands for future focusing. This is because there is difference between SPC and PR as illustrated in Equation (2); if happen the demand is great, it will be the challenges for the Medical staff to make sure that all demand are fulfilled [24]. Remember all appointments are made for patient to be attended within working hours unless Medical staff should be paid for working extra time (overtime) [25]. The challenges of this factor are; if the employer refused to pay medical staff for extra time, the patient should be able to pay.

During interviews in one of the regional referral hospital in Arusha called Mount- Meru, I interviewed two Medical doctors about this case, One from the department of Orthopaedic, He said the problems of referral service is load compared to the number of patients even within working hours. So by doing extra hours, he reported to need motivation of payments while the other one from the department of Maternal, she reported that; appointment information system is good but the challenges is education for medical staff and patients to adopt this technology. using existing referral system, It happen to schedule an

appointment to a certain patients, But most of them they don't care, others they delay while others they decide to come before the arranged day that results great burden to medical staff; hence motivation is needed for increasing working competency..
The allocation of this schedule must specify reporting time from 16:00pm Such that algorithm to be used will FCFS and FCRS without complaining. The patient have rights to complain for normal working hours agreement and not else.

Condition two:

Service Provider Capacity (SPC) = Succeeded Bookings (SB)…….... (1)
(SB) = Normal (SPC) + Emergence Patients (ESP)…….. (3)
SPC = (SB) - (PR) ……..…… (4)

Note: *SPC = Number of patients to be served within working hours*
ESP = Number of patients to be served after working hours
For Comfort ability of Doctors; SPC >ESP

The magnitude of a SPC is managed by SMO; this follows the rules and algorithm triggered by the PM to satisfy end users [23].

5.5.3 Performance module (PM)

The PM is a module to control system performance example speed of processing requests, notifications, keeping tracking PR to balance with new requests. By doing so, it will be solving waiting time problems, load for the medical staff and satisfying patients (customer). PM managing RM, SMO, SM, SI and DW accessibility in efficiency and security manner [26].

5.5.4 Strategy module (SM)

At every rule there are coded principle, here is conditions that should be satisfied to make an appointments scheduling. The rules are as follows:-

- The patients should be registered for the HIS and the referral appointment system (RAS) to be a sub module of it such that patient to be able accessing this RAS via existing hospital website.
- All HIS for all hospitals to facilitate referral services should be networked to central system zones as referral consultancy administrators (refer figure 7).
- The first thing to check for request to start being processed is Specialty availability, second is to check specialist calendar, third is to check possible facilities and last is Notifications. Remember the system cannot be fully automated; it depends on Doctors decision to trigger system functions based on human central system coordination.
- If number of requests > SPC = Reminder (that should be allocated to the following day).
- At second day PR should take first chance to be processed early then followed by new requests.
- No appointment should be processed if the customer did mistakes in using the system.
- The system should specify date and approximated time for the patient to arrive at hospital such that waiting time to be reduced. HCH approach will create environment of waiting time to be less to 20 minutes for 2 or 3 appointed patients to come one time.

5.5.5 Chatting or Reminding request module (CRR)

For real time system designing, chatting possibilities is very important section such that a customer is able to ask the progress of his or her requests by simply sending text massage to central system. Some of the requests may delay while medical staff is trying to arrange the required resources for cases. Customer by asking help desk platform, they will trace the requests and notify the customer. It is possible to integrate this module with mobile phone applications.

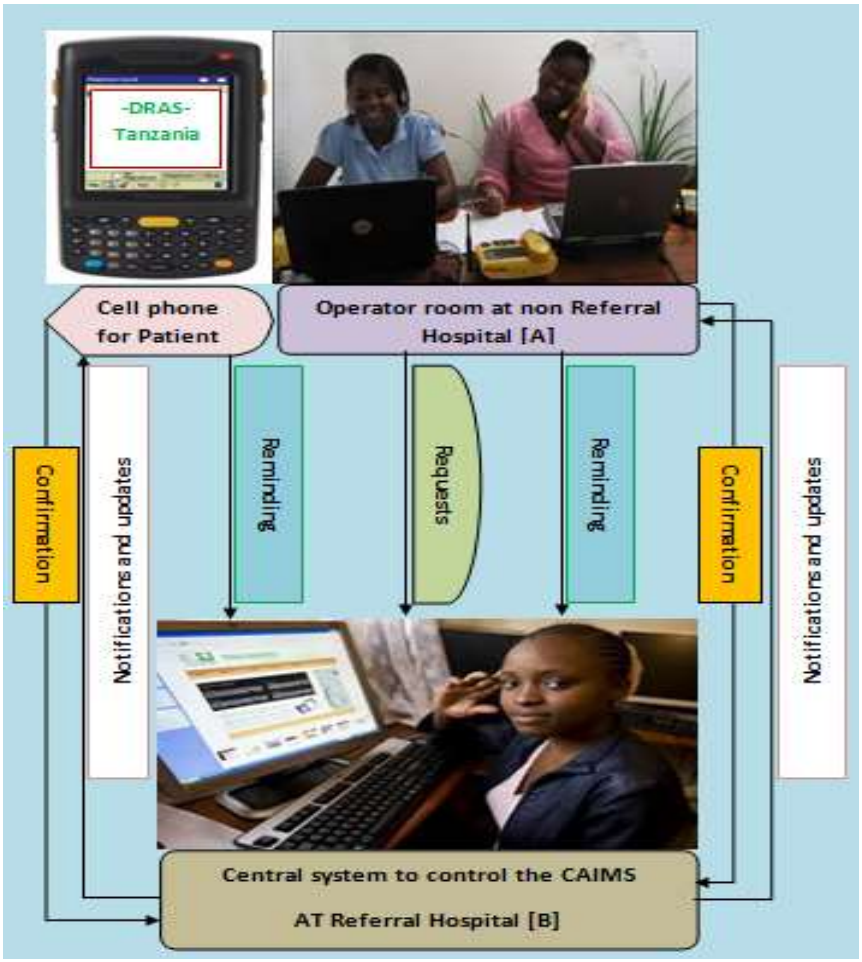

Figure 5: DRAS integration with Cell phone

5.5.6 System Interface (SI)

Is a module managing applications programs and operating system to enable users interfacing menu buttons, sliders, text-boxes and navigation pages hyperlinks in accessing an application; SI is enable users to link web-based application and mobile phone application for requests updating and notifications.

5.5.7 Data Warehouse (DW)

The DW is responsible to manage all health information from different levels of health levels such that data is easy to store, share and retrieve in distributed hospitals environment for supporting referral services communications (figure 2, 3 and 4).

5.6 System business Processes (SBP)

It explains general system flows technically step by step.

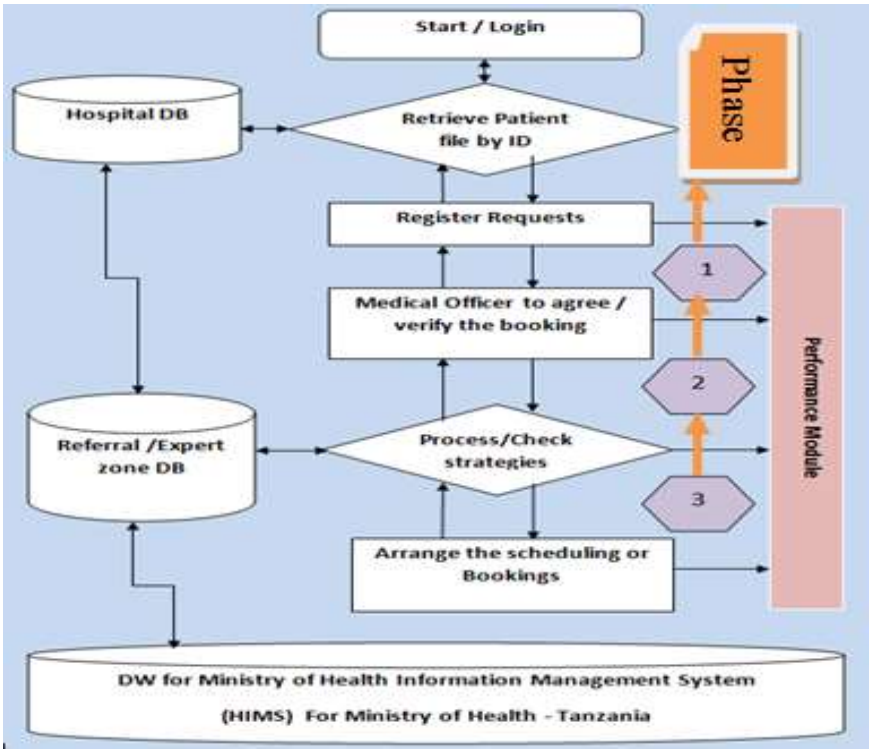

Figure 6: DRAS business processes

5.6.1 Refer no 1 phase from figure 6

1. To register the patient and to fill health profile
2. To check if it is new requests or not
3. If it is new request, will be forwarded for processing
4. If it is not new (Pending) Will be picked from waiting queue and start to be processed

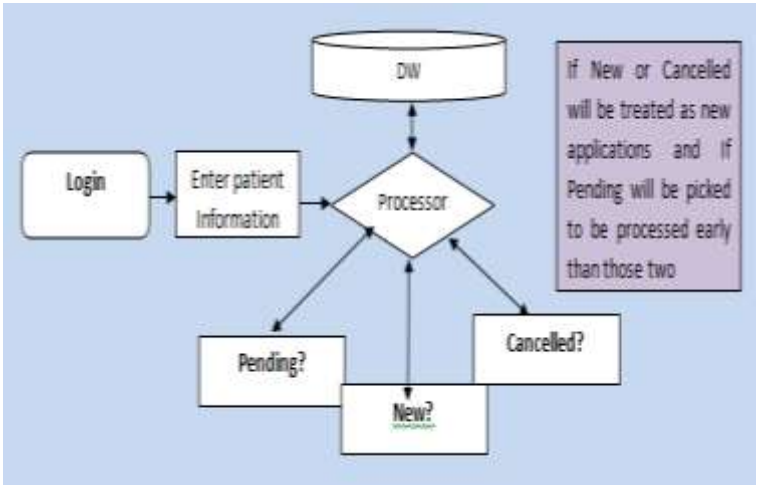

Figure 7**:** Phase 1:

5.6.2 Refer no 2 phase from figure 6

1. Check condition 1 If met (Specialty services is available?)
2. Check condition 2 if met (Specialty important facilities available?)
3. Check condition 3 if met (Available calendar)
4. If all condition 1 – 3 met, Then process the booking and notify

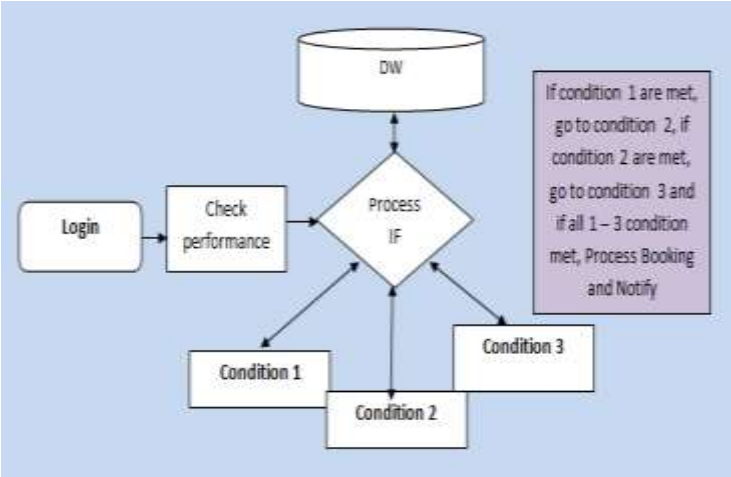

Figure 8: Phase 2:

5.6.3 Refer no 3 phase from figure 6

1. Start schedule the booking
2. If met the conditions (Refer 2 phase) Process the booking and display the notification to the customer
3. If not met some of the condition; leave pending for later processing.
4. If cancelled by the customer before mature, it will be stopped and cancelled.

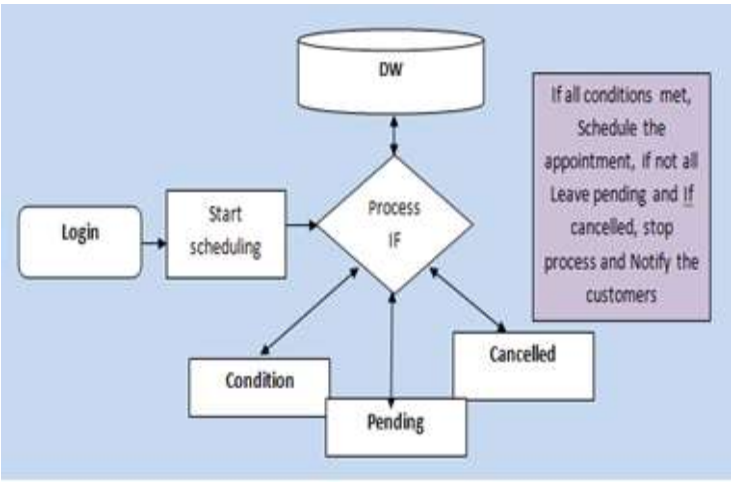

Figure 9: Phase 3:

6. Conclusion

The health services in Tanzania are very important sectors which are seen as a development mirror for everything. All classes of people in development or status of life depends on health. The quality of services to public referral hospitals is measured by waiting time for registration, consultation, diagnosis services and inconveniences caused by bad time management and improper communication Technology between hospital and hospital to link health information for quality health delivery. The designed seven elements for DRAS in this paper present an innovative solution to resolve challenges faced patients to access referral services in Tanzania.

7. Recommendation future work

Future work for researchers is to deal with the issue of safety of IS and security of health information in the context of convergence of different integrated and distributed environment.

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AUTHOR PROFILE

***John J. Ndindwa**:* Has BSc Degree in Information Technology (IT) at St. Joseph College of Engineering and Technology (2009). Currently is pursuing a Master degree in Information, Communication Science and Engineering (ICSE) Specialized in Information Technology System Development and Management (ITsDM) at The Nelson Mandela Institution of Science and Technology (NM-AIST), Arusha, 2012 – 2014, Tanzania.

Agnes R. Semwanga: Is a Lecturer in the Information Systems Department at the Faculty of Computing and Information Technology, Makerere University in Uganda. She has PhD in Computer Science (majoring in Information Systems and Systems Modeling). She holds a M.Sc. in Computer Science and a BSc Education (Hons).

Sinde Ramadhani: Is an Assistant Lecturer in School of Communication science and Engineering (CoCSE) at Nelson Mandela Institution of Science and Technology, Arusha, Tanzania. He has BSC (Hons) degree in Engineering and Telecommunication from Moscow Technical University of Communication and Informatics (MTUCI), in 2009 and Master degree in Engineering and Technologies in Telecommunications from in Telecommunications from Moscow Technical University of Communication and Informatics (MTUCI) in 2011.