

Web-Based Specialty Care Interface Referral Service System for Outpatient-The Development and Implementation

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Abstract— Communication gap and poor coordination of care among primary care, secondary care, tertiary care, and specialty care providers lead to major inefficiencies in healthcare delivery. In resource constrained settings, these inefficiencies exacerbate mismatches between the demand and supply for specialist services. The overall sufferers are the patients. This paper, therefore, intended to address these challenges developed and implemented a workable web-based referral service system that filled this communication gap, and solved the poor coordination existing in the healthcare delivery. This is achieved by designing a workable model of the web-based referral service system and a referral workflow chart. Quantitative data were collected from the department of Health Information Management (HIM) of Federal Teaching Hospital, Ido-Ekiti, Nigeria, and structured interview was also carried out with the staffs of HIM and some of the hospital's specialists. For the implementation, the web applications are deployed on 2.0 GHz Core 2 SQL server with 2GB on 64 bit running Windows 8 OS and Microsoft Visual Studio 2010 Ultimate VB.NET programming language. The major result achieved in this research work is the system's acceptance. This acceptance was due to the perception that the system substantially improved access to specialty care, quality of care, and administrative efficiency in submitting and managing referral requests. However, poor and unavailability of information and communication technology (ICT) equipment and the security issues attached to cyber applications pose significant problems for some clinics.

Keywords— Healthcare delivery: Patients: Quantitative data: Specialists: Web-based referral: Structured interview.

I. INTRODUCTION

Healthcare is the maintenance or improvement of health via the prevention, diagnosis, and treatment of disease, illness, injury, and other physical and mental impairments in human beings. Healthcare is delivered by health professionals (providers or practitioners) in allied health professions, physicians, physician associates, dentistry, midwifery, nursing, medicine, optometry, audiology, pharmacy, psychology, and other health professions. It includes the work done in providing primary care, secondary care, and tertiary care, as well as in public health. Access to healthcare may vary across countries, groups, and individuals, largely influenced by social and economic conditions as well as the health policies and plans in relation to the personal and population-based healthcare goals within their societies. Healthcare systems are organizations established to meet the health needs of target populations. Their exact configuration varies between national and sub national entities. In all cases, according to the World Health Organization (WHO), a well-functioning healthcare system requires a robust financing mechanism; a well-trained and adequately paid workforce; reliable information on which to base decisions and policies; and well maintained health facilities and logistics to deliver quality medicines and technologies [1]. As shown in Fig. 1, e-referral otherwise known as electronic referral or electronic consultation is an electronic platform that enables the seamless transfer of patient information from a primary to a secondary treating practitioner's client management system [2], [3]. E-referral is a web-enabled system and process, where primary

care providers (PCPs) and specialists are able to communicate; share clinical information and consult electronically to manage patient care [4].

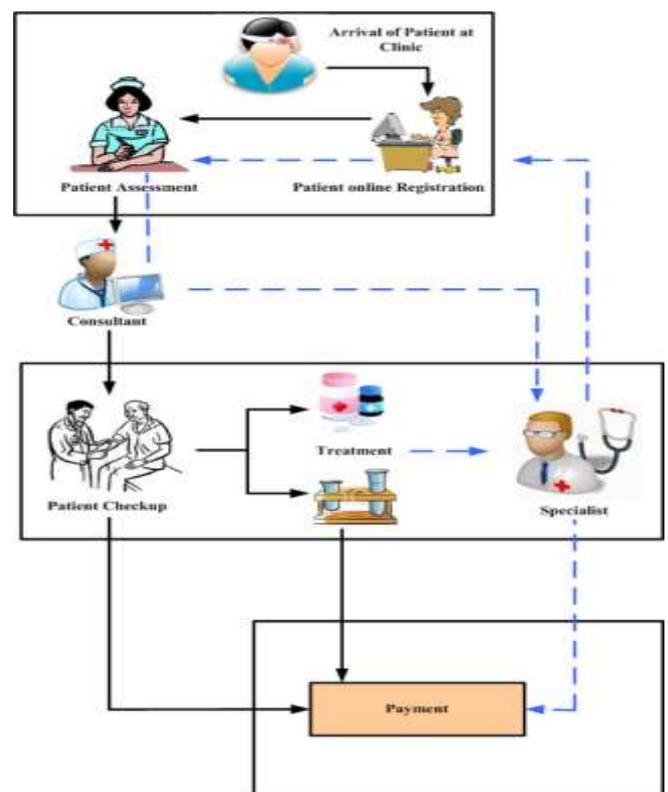


Fig. 1. E-referral healthcare service system

It reduces the specialty referral and appointment process to just a few days, which increases the speed delivery for patient care services [5]. E-referral has fast become the best replacement of paper-based referral, and hold great potential toward the ultimate goal of seamless communication and information sharing between practitioners [6]. The dysfunctional interface among primary care, secondary care, tertiary care, and specialty care providers in Nigeria often leads to woeful patient outcomes and notable inefficiencies in the delivery of health care. These inefficiencies lead to unnecessary demand on specialist services. This, in turn, makes access to specialty services more challenging, particularly in resource constrained settings, where specialists are in especially short supply. Information systems could potentially improve communication between primary care and specialist physicians by enforcing critical communications and by automating referral work processes. However, there is little literature reporting on such systems [7]. This statistically implies that little efforts have been put into developing a functional web-based referral system for healthcare delivery. The efforts put together by the authors of this work in no small measure have resolved the challenges being encountered

among primary healthcare providers and specialists in delivering healthcare through referral service system. Other benefits of this system to both patients and healthcare providers are (1) it enables the healthcare providers to exchange medical skills (2) it ensures less interrupted workflow (3) it ensures pre-screen potential in-person visit (4) it improves track of referrals (5) it increases patient satisfaction (6) it improves continuity of care (7) it improves access to specialty care and (8) it ensures timeliness of results.

II. RESEARCH DATA

Data for this work were primarily mined from the Health Information Management (HIM) department of Federal Teaching Hospital, Ido-Ekiti, Nigeria as presented in Table I and Table II. The data are for both male and female outpatients on referral. Table I and II are paper-based referral of outpatients showing the number of outpatients referred to individual specialist's clinics from January to December of 2017 in the hospital; the hospital comprises of eighteen referral clinics within it with none of them electronically linked together.

TABLE I. Paper-Based referral of outpatients for year 2017

Months	Specialist Clinics								
	NEUROLOGY	ENDOLOGY	POPD	XYZ	DERMATOLOGY	RENAL	PHYSIOTHERAPY	HAEMATOLOGY	PAEDIATRICS
	Number of Patients								
Jan	8	3	57	8	3	1	68	-	2
Feb	6	17	13	3	6	16	36	-	0
Mar	4	1	1	11	2	2	0	0	4
Apr	4	4	4	5	1	1	42	-	1
May	10	1	10	8	3	1	41	3	0
Jun	-	3	6	5	1	-	18	0	0
Jul	5	1	5	5	3	1	18	-	1
Aug	7	2	17	10	4	0	4	2	0
Sep	4	2	6	4	3	0	8	-	-
Oct	8	0	6	15	1	0	32	0	1
Nov	2	1	8	7	4	0	8	0	0
Dec	6	0	7	3	0	0	19	0	0

POPD-PSYCHIATRIC, XYZ-HIV/AIDS

TABLE II. Paper-Based referral of outpatients for year 2017

Months	Specialist Clinics								
	GIT	CHEST	SURGICAL	EYE	UROLOGY	ORTHOPAEDIC	EAR, NOSE AND THROAT (ENT)	DENTAL	CARDIOLOGY
	Number of Patients								
Jan	4	2	12	108	8	8	30	-	13
Feb	13	5	43	80	24	11	43	-	27
Mar	5	1	37	99	4	10	26	-	6
Apr	2	2	18	94	10	11	48	-	7
May	5	5	16	81	10	8	55	-	15
Jun	0	1	11	34	9	3	10	-	36
Jul	3	3	31	74	4	4	17	-	9
Aug	3	7	18	85	8	14	36	-	9
Sep	2	1	9	52	0	2	28	-	1
Oct	2	0	17	74	4	7	44	-	2
Nov	10	0	15	106	4	8	32	-	7
Dec	4	0	7	64	2	6	48	-	1

GIT-Gastro Intestinal Track

III. METHODOLOGY

The approach used in this work is based on the concepts shown in Fig. 2 and Fig. 3. Quantitative data mined from the

department of Health Information Management (HIM) of Federal Teaching Hospital, Ido-Ekiti, Nigeria and the structured interview with the staffs of HIM and some of the hospital's specialists helped at the developmental stage of the

system. For the implementation, the web applications are deployed on 2.0 GHz Core 2 SQL server with 2GB on 64 bit

running Windows 8 OS and Microsoft Visual Studio 2010 Ultimate VB.NET programming-language.

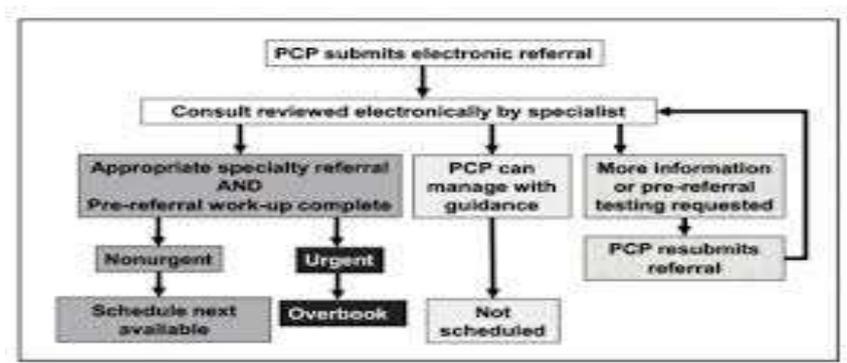


Fig. 2. Workflow chart of e-referral

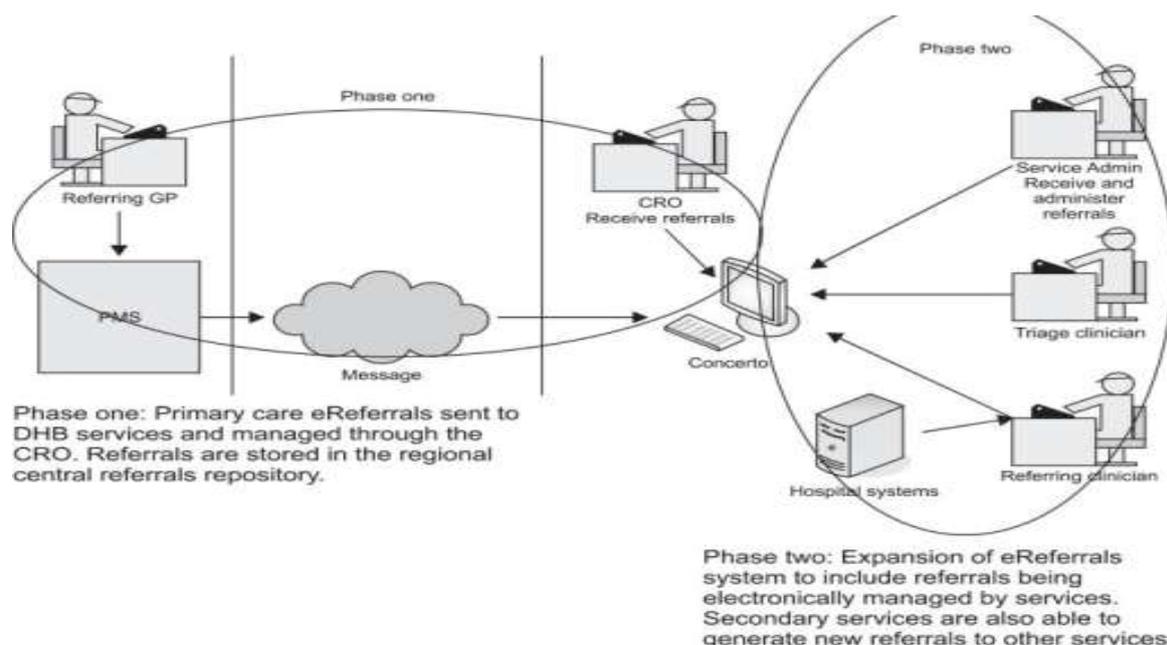


Fig. 3. Model of web-based referral

IV. RESULTS AND DISCUSSIONS

The techniques for implementing the web-based referral system require the availability of both the computer hardware and application software packages. The following are the minimum hardware requirements to run the application:

- i. Computer: ACPI x86-based PC
- ii. Processor: Pentium (R) Dual-core CPU T4500 or above
- iii. Processor speed: 2.30 GHz (2 CPUs)
- iv. Memory: 3072 MB or higher
- v. Hard-disk space: 80GB or higher
- vi. Monitor: Generic PnP 15" monitor
- vii. Uninterrupted power supply unit
- viii. Display adapter: Latel (R) 4 series express chipset
- ix. DVD/CD-ROM drives: HP DVDRAM GT 30L
- x. Keyboards: Standard 101/102-Key or Microsoft Natural PS/2 Keyboard with HP QLB
- xi. Mice and other pointing devices: Synaptic PS/2 Port Touchpad

- xii. Network adapter: Real-tekPCIe FE Family Controller
- xiii. Ports: COM and LPT
- xiv. Ethernet (Through which client is connected to the web server). While the following are the software requirements:
 - i. Microsoft Windows Vista/Windows 7/Windows 8 operating System
 - ii. Microsoft.NET framework 4.0 and higher version
 - iii. Browser

Visual Basic.NET programming language was used as application software for the implementation. This is due to the fact that the programming language possesses some characteristics and capability that underline the decision to use it. The rich and extensive API enables developers to easily incorporate packages into their codes which enhance reusability and utility of codes. The following are some of the possessed characteristics:

- a. Code can be created faster and better because there is no need to create functionality from scratch. Best of all, many

developers can create their own packages and make them open-source, allowing other developers to use their codes and hopefully make improvement. The packages are well documented, so learning about a particular method is as easy as incorporating them in one's code, a phenomenon that dramatically improves the productivity of programmer.

- b. The major problems in programs like memory management and bounds checking are not seen in VB.NET, all these issues are handled automatically.
- c. Serial I/O, networking, graphics sound, and even video are all supported packages.

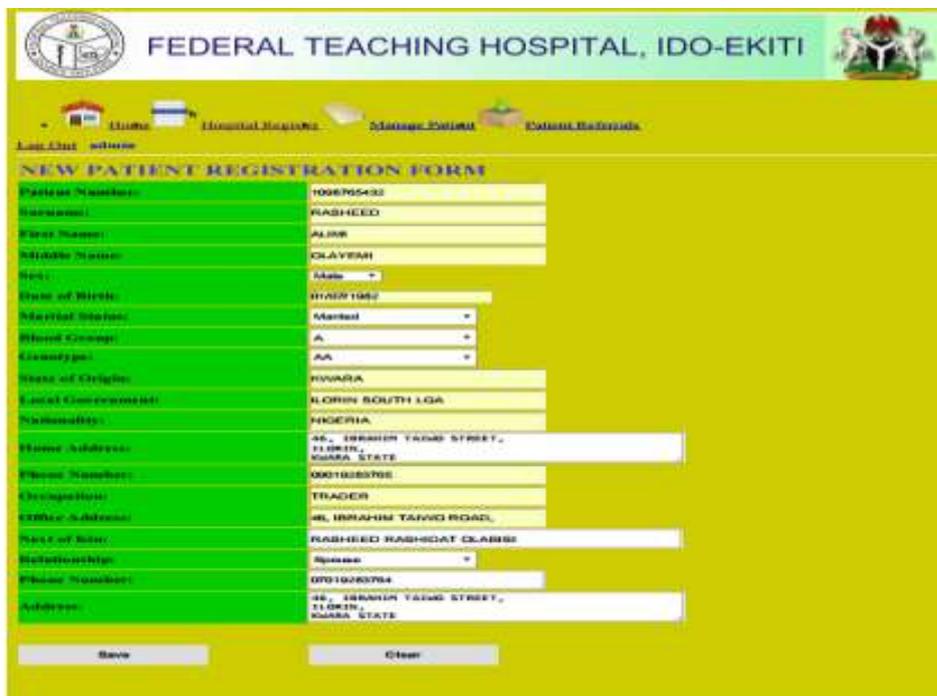


Fig. 4. Patient registration form snapshot of web-based referral service system

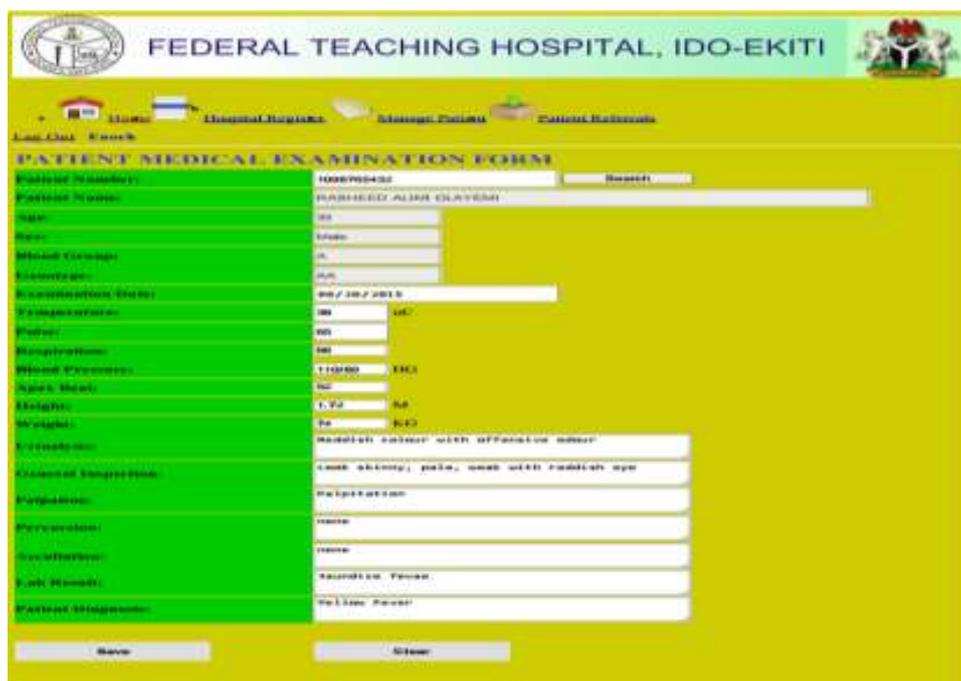


Fig. 5. Patient medical examination form snapshot of web-based referral service system



The screenshot shows the 'PARTNERING HOSPITAL REGISTRATION FORM' interface. It features a header with the hospital's logo and name, 'FEDERAL TEACHING HOSPITAL, IDO-EKITI', and a Nigerian coat of arms. Below the header is a navigation menu with icons for Home, Hospital Register, Manage Patient, and Patient Referrals. The form itself has a light blue background and contains the following fields:

Hospital Code:	EK004
Hospital Name:	GENERAL HOSPITAL, IKERE
Address (street):	125, ADD - IKERE ROAD
City:	IKERE EKITI
State:	EKITI
E-Mail:	info@generalthospitalikere.gov.ng
Contact Officer:	OLAMIDE FAGBUAGUN
Password:	****
Confirm Password:	****

At the bottom of the form are two buttons: 'Save' and 'Clear'.

Fig. 6. Partnering hospital/clinic registration form snapshot of web-based referral service system



The screenshot shows the 'User Administration Manager' interface. It features the same header and navigation menu as Fig. 6. The form has a light blue background and contains the following fields:

User Name:	Enoch
Password:	****
Re-confirm Password:	****
Surname:	Fadpe
Other Names:	Enoch Tomidayo
Post Held:	Medical Doctor
User Roles:	<input checked="" type="radio"/> Administrator <input type="radio"/> Doctor <input type="radio"/> Nurse

At the bottom of the form are two buttons: 'Submit' and 'Clear'.

Fig. 7. User administration manager snapshot of web-based referral service system

The implementation of this web-based referral service system is such that all the primary healthcare providers' hospitals/clinics and specialists' hospitals/clinics are web-based and linked together. This is to ensure reduced medical costs and quality healthcare delivery. Primary healthcare provider's hospitals/clinics handle the information about patients and patients' related matters and this information must be made available online and up to date for the specialists to make use of at a distance. This web-based referral system consists of interface for specialists to manage patient records such as patient's medical history, diagnoses reports, treatment reports, and laboratory test results among others as shown in Fig. 4 and Fig 5. While Fig. 4 is a web-based platform for the registration of new patient to the

database of hospital's records, Fig. 5 is the medical examination of patient on referral.

Patients are managed through two links. These links consist of register patient and medical examination as shown in Fig. 4 and Fig. 5. The register patient serves as a link for registering new patient to the records database and can only be done by the user administration manager in Fig. 7. The patient number is a unique id to individual patient, this serves as one of the measures to reduce vulnerability of patient's information. While the medical examination serves as a link for detailing the medical examination results of patient on referral and other purposes. Fig. 6 is a link that consists of partnering hospital registration form; it is the registration link for any hospital that wants to be in partnership with the

primary healthcare provider's hospital. Three partnering hospitals' security details were put in place here, they are:

- i. Hospital code
- ii. E-mail (by RSA algorithm)
- iii. Password

The security details will be included in the partnering hospital registration form submitted; this will prevent any hospital not in partnership from playing intruder and attacker to the partnering hospitals during the course of transacting patient information on the internet.

Patient referral link consists of multiple sub-links; refer patient (Fig 8), patient referral record (Fig. 9), and patient referral record access (Fig. 10). The refer patient form under

this link gives room for filing on the web the patient's name, patient's number, name of hospital the patient is referred and the date such referral is made as shown in Fig. 8. The patient referral record summarizes the health status of the patient in a downloadable form as shown in Fig. 9. This is only accessible by the partnering hospital whose hospital identity has already been stored in the primary healthcare provider's record database through the partnering hospital registration form as shown in Fig. 6. Through this, the parameter manipulation is defeated where wrong identity results in denial of access. Hospital access link will demand for the hospital code and password as security measure through the hospital access login page as shown in Fig. 11.

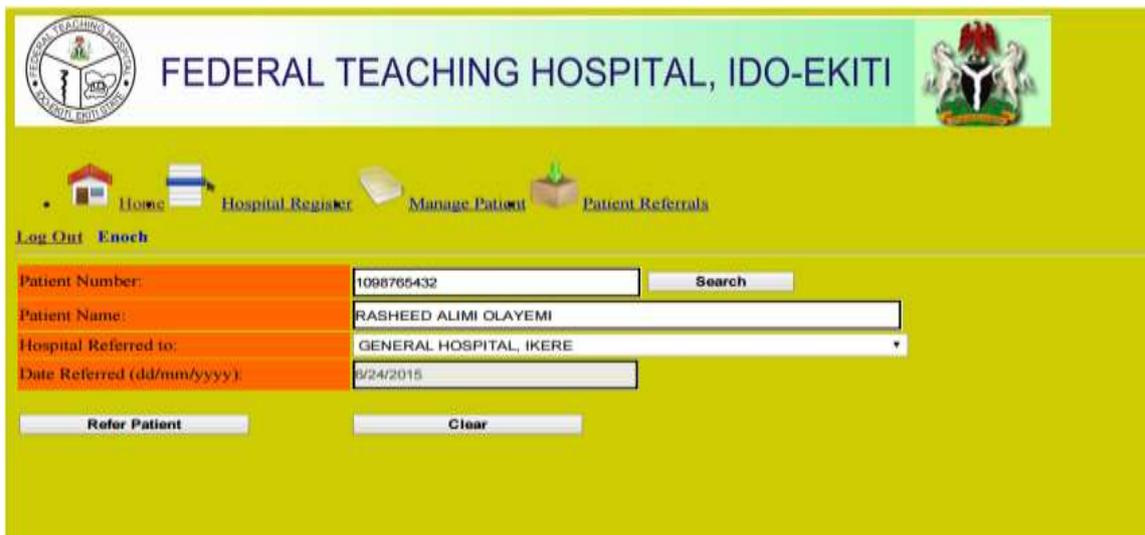


Fig. 8. Referred patient form snapshot of web-based referral service system



Fig. 9. Patient referral record snapshot of web-based referral service system



Fig. 10. Patient referral record access snapshot of web-based referral service system

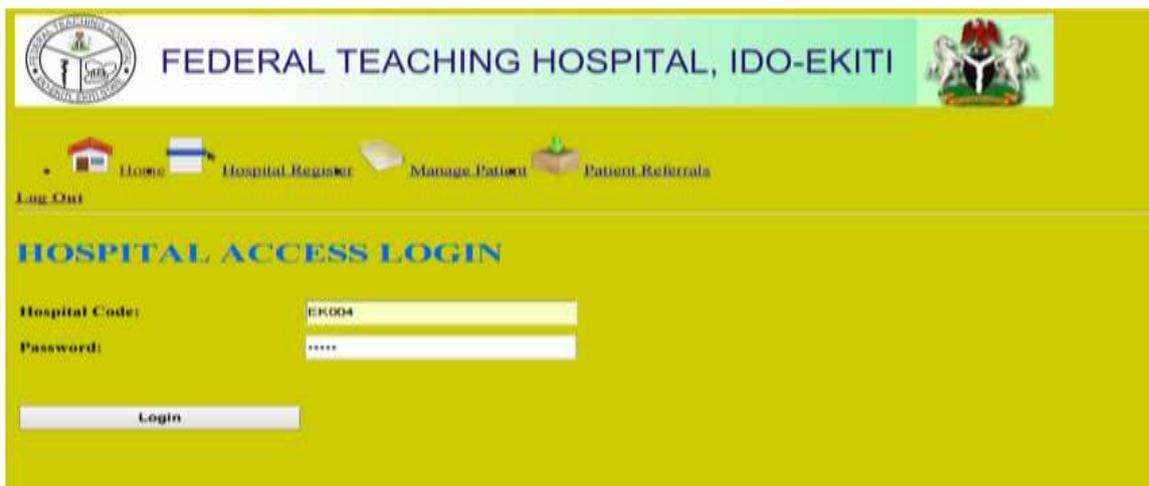


Fig. 11. Partnering hospital access login snapshot of web-based referral service system

V. CONCLUSION

Web-based referral service system is widely accepted as a success, among referring primary healthcare providers and specialists. The system has substantially improved access to specialty care and communication between specialists and primary healthcare providers. However, based on the data collected as seen in Table I and II, our model of the web-based referral service system work process and the implementation discovered, on average that, the time wasted on avoidable appointments and other efficiencies in paper-based referral service system was greater than the time expended to review and master the use of web-based referral service system on the long run. The limitations are poor and unavailability of information and communication technology (ICT) equipment and the security issues attached to cyber applications for some clinics.

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