

## The Impact of Using SMS Alert-Based E-Health in Increasing Outpatients Access to Health Care Resources in Nigeria

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**Abstract:** Electronic-health with Short Message Servicebased alert system designed and developed in the course of the Research workis to increase the access to Health Care Providers by the Outpatients. The system has 3modules namely: the web application subsystem which serves as theinteractive GUI(front end) for inputs were developed using Visual Basic.NETIDEin line with Waterfall Methodology. The database(back end) was designed using MSSQL which handles the system data services. The Web Service of SMSLive247.NET connectivity API used for SMS gateway sends alerting messages to patients or doctors for service availability. The hosting of the web-based app in [www.appsgility.com.ng](http://www.appsgility.com.ng) is to make it accessiblethereby providing health servicesany time around theclock through internet connection. Theexperimental results of using the system in accessing health services indicated thatmore number of outpatients accessede-health services from more doctorsfrom different geographical locations in Nigeria.

**Keywords:** Accessing Health Care, e-Health, Primary Health Services, Outpatients, SMS, Outpatients

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### I. Introduction

“Health is wealth” is a simple statement that everyone is working daily to achieve. Health care services are everyone’s need, but the ways they can be accessed by the patients are more expedient to them[1].

E-health is a recent term used to describe healthcare practice supported by electronic processes, communication and internet, dating back to at least 1999. With the continuous growth of mobile network coverage, internet strength and usage and unprecedented penetration of mobile devices in the developing world, several eHealth and mHealth initiatives have been implemented in the developing countries. This work describing how a developed SMS Alert-Based e-health Service for Outpatients that need only Primary Health Care Service will increase access to Health Care services through internet connection with Mobile Phones and PCs anytime, anywhere thereby breaking the bearer of Geographical locations to medical services accessibility.

There is a burgeoning body of evidence suggesting that e-Health interventions can improve the efficiency and quality of healthcare delivery [2].The huge crowd that is often seen at any of the out-patient clinic of public hospitals in Nigeria can be so scary to any doctor who means well and have planned to meet up with the demands of all his patients as much as possible on any normal day. This congestion can be traced to inadequate alternative means of accessing health services without been physical with the medical practitioner in a particular building at a specific duration. Outpatients queue together with inpatients before accessing Health Care services in most hospitals and clinics in Nigeria. The existing means of accessing health care service delivery system does not meet the ever health service accessibility needs of the Nigeria population.I thinks the time has come to step up healthcare services from the local ways of health service delivery [3]. E-health is not a replacement of existing medical and health care services, but it is an additional tool to improve access to existing medical facilities and resources [4].

### II. Related Works

Looking at the existing and related works of the other researchers, it was reviewed that health care systems adopted is as old as human existence, starting from orthodox health care which is still practiced even today in form of herbalist, spiritualist, etc.[5] The clinical hospital established by the European explorer and trader [6] was denied to the Nigeria until catholic missionaries established hospital[7] and today clinical hospital has improved to health insurance scheme[8].

Many communication tools or methods have been deployedin the past in health care delivery for accessing health services such as telephone line, ISDN, satellite, RF, Wi-Fi, Bluetooth, videoconferencing, email services, as it was implemented in these related works of other researchers:

- a) Mobile Phone Short Message Service on Antiretroviral Treatment adherence in Kenya was a SMS intervention care for randomized clinical trial of HIV-infected adults initiating antiretroviral therapy (ART) in three clinics in Kenya [9].

- b) Voice-based Mobile Prescription Application is e-prescription system on a mobile phone by dialing an appropriate number to connect users to an e-prescription application on a web server [10].
- c) Text Reminders for Immunization Compliance in Kids was deployed in African-American to motivate old people participation in immunization through Text [11] and [12].
- d) The Cameroon mobile phone SMStrial system was used to test the efficacy of weekly reminder and motivational text messages for patients attending a clinic in Yaoundé, Cameroon [13]
- e) Mobile-Based Alert System for Outpatients [14] aids user for reminding drug time and dosage and [15].
- f) Ghana e-Health. This e-health initiative serves as a platform for doctors to share ideas and experiences relating to patients, as well as a network for care providers who are the core of the scheme [14]
- g) Wedjat another mobile medication reminder and monitoring system design in a smart phone application to help remind patients correct medicines on time and record the in-take schedules for later review by healthcare professionals [15].
- h) Text 4 Baby [16] and Heartsaver[17] are other application used to investigate the potential of SMS in reducing attendance of outpatients.

However, the internet incorporated one or all these communication tools for accessing resources globally. It remains the widest means of accessing resources without geographical location bearer, time constraints, etc. The implementation of online e-health system makes primary health care available to outpatients round the clock. The SMS sent or received by the system users builds the consciousness of the service availability

### **III. Methods**

#### **3.1 Software Development**

The waterfall model employed in the design and development of this work passed through four phases namely; analysis, design, implementation, and testing in line with system development life cycle (SDLC). The users and system requirements for reliable, affordable and reliable e-health system include the operational, functional, data, regulatory, security, availability, hardware and software requirements as implemented in the system Design.

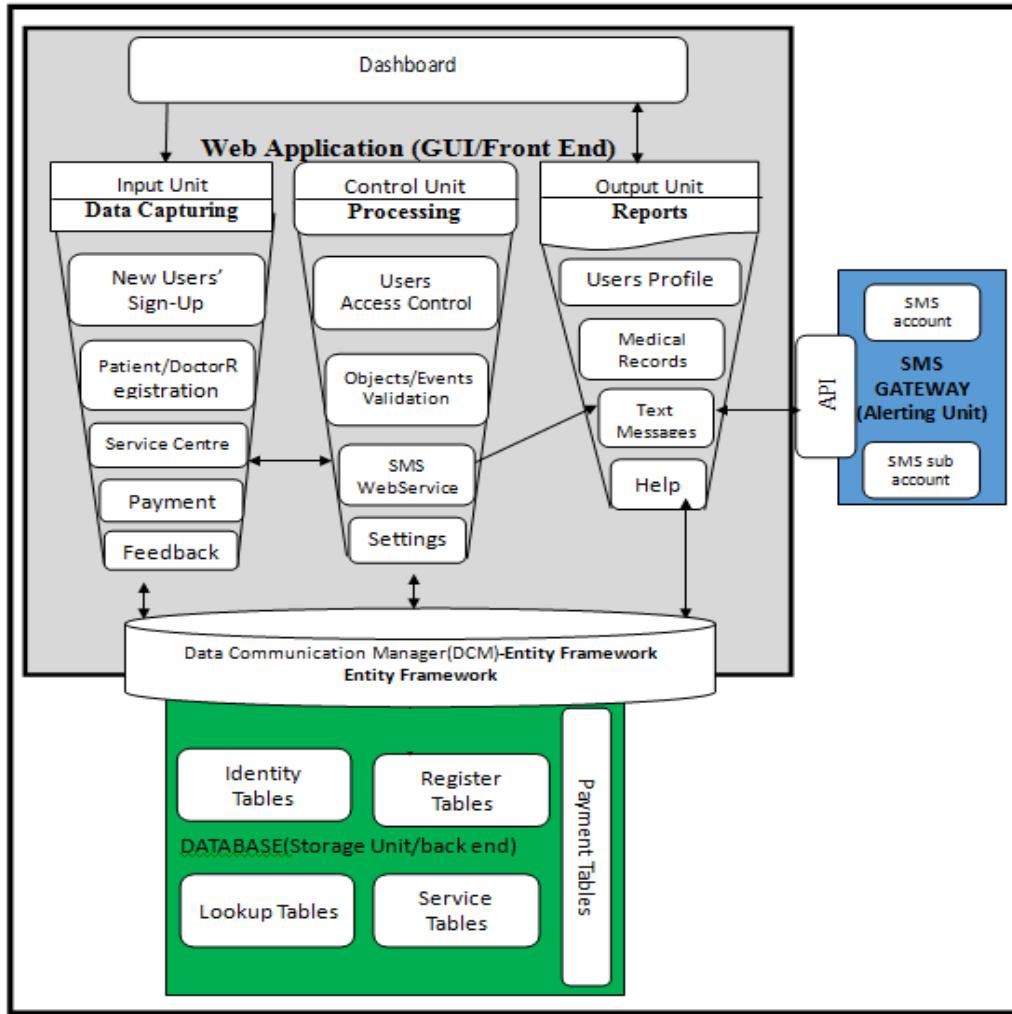
The software design architecture involved the structural, patterns & style and communication architectures. The structural architecture of the web application module bears the data capturing input of GUI for signup of new users (patients and doctors), login for existing users, and registration of patients/doctors bio-data, contacts and specialization. The service centre, for patient diagnosis validates after payment. The system security controls the login access and medical reports printing. The SMS Gateway has the web service components such as HTTP Connectivity API using SOAP Protocol. The Database Management System (MSSQL Server) objects include tables (users identity, patients, doctors, service and lookup tables), views and stored procedures for dataservices.

The Object Oriented Developing Platform (V.NET/C#) make use of components based patterns, event-driven development, rule-based system, server-clients, and comment programming in designing the interface and coding.

#### **3.2 Sub Systems Functionalities**

The system is made up three subsystems namely: the web interfaces (front end), the database (back end) and the Text messaging (SMS Gateway) as shown in Figure 1 and the functionalities of the modules and their units are classified under

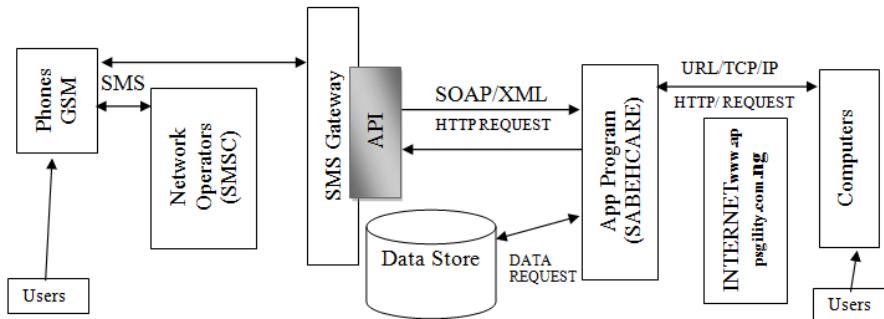
- a) **Data capturing/Input units** are interfaces for data capturing for login detail, registration of bio data, contacts, and payment detail, etc.
- b) **Control/Validation units** for authenticating access to the system operations such as logins access, keyed data validation, record retrieval access.
- c) **SMS Alerting Unit** is responsible for sending and receiving text messages for notification of service available from the SMS gateway through API of SMS24/7 Alive connected with SOAP of “sendsms” model.
- d) **Data unit** for data storage, security, integrity, recovery and recovery management with MSSQL. Such records include registered patients and doctors’ profile, medical and payment records, etc.
- e) **Output/Reporting Unit** is responsible for displaying information retrieved from the database through connection string of entity framework model.



**Figure 1.** System Components

### 3.3 Communication Architecture

The interaction between the components of the three modules of the system can be described using the communication architecture diagram in Fig. 2 below.



**Figure 2** System Communication Architecture

### IV. Web Application Interfaces and SMS Alerting System

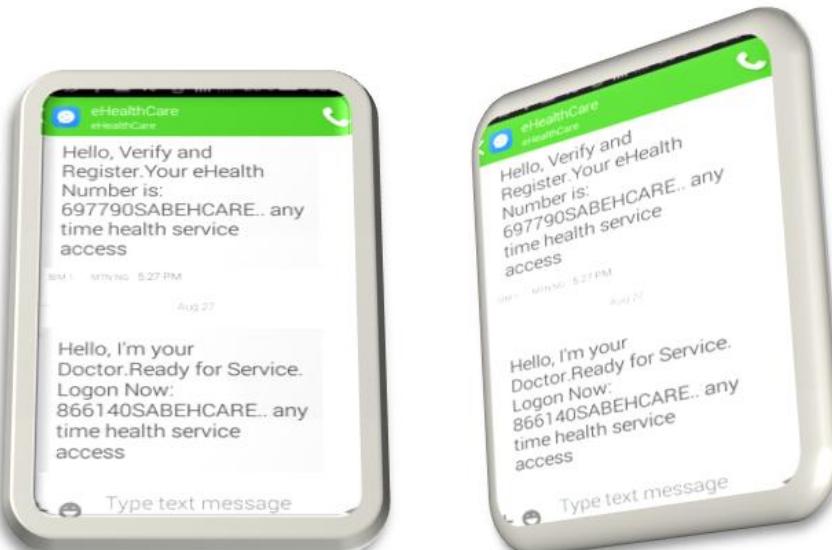
Therefore, to access the application through [www.apgility.com.ng](http://www.apgility.com.ng), the dashboard of the system appears first which services as entrance or home page for the various operations of the system. The operations includes users registration by clicking “**signup icon**”, signing in as an existing user is done by clicking on “**login icon**”, booking appointment for health services can be done using “**meet doctor**” unit, notifying a patient of doctors availability is done with “**alert patient**”, and diagnosis through “**service center icon**”, service payment through “**vpay**” viewing medical records through “**view reports**” by only authorized users.



**Figure3.** Web Application Dashboard

When outpatient logs into the application, he/she select doctor based on the specialization and SMS alert message will be automatically send to a selected registered doctor to notify him/her that the patient is ready to receive health service. In the other side, doctors also alert patients when they provided solution based on the diagnosis request. The alerting messages encourage the patient to access health services from the doctors through e-health application.

The SMS alert notification can be received during verification of the registration, notification to doctors and patients for service availability as shown in the Fig. 4



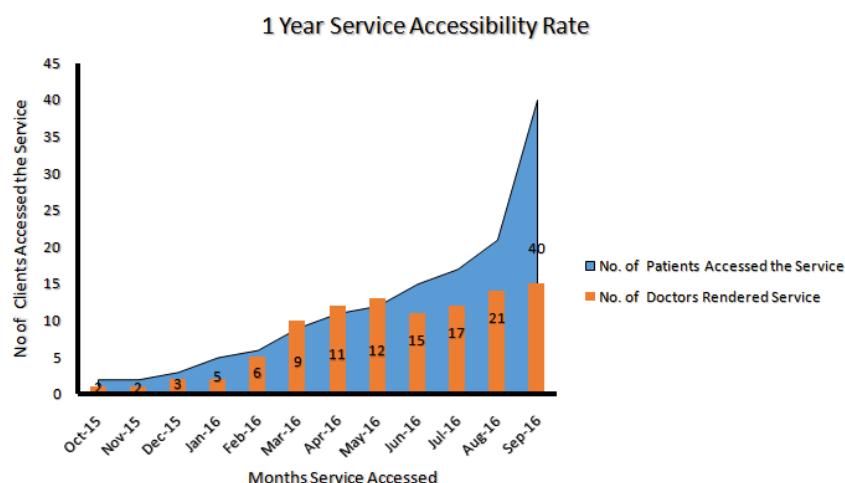
**Figure 4.** Screenshot of Text Message

## V. Experimental Results

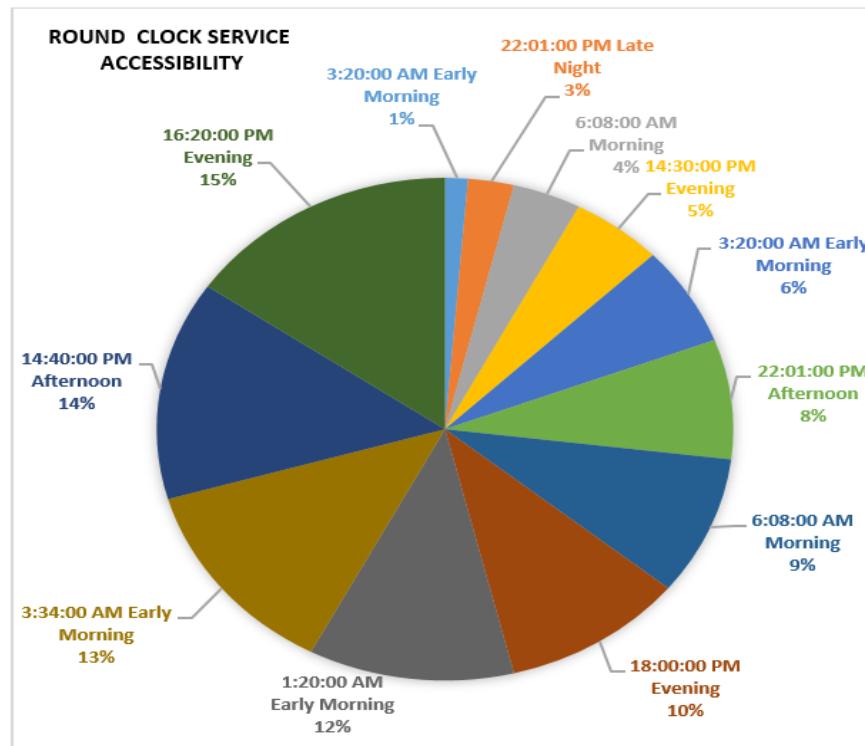
The experimental results from the system which includes usage result, coverage result, and access round the clock result in respect to the systems requirements are shown in the table 2 below. The records imported from the database was analyzed and the values tabled. The graph and histogram of the table deduced the increase in the area of the service coverage caused by the increase in the access to health care resources as the patients can connect to their doctor anytime, anywhere after receiving a real-time text message. Similarly, the Pie chart indicates that using the application, health care resource or the care providers can be access anytime of the day.

**Table 2:** Health Resource Access

Month Service Accessed	No. of Patients Accessed the Service	No. of Doctors Rendered Service
October 2015	2	1
November 2015	2	1
December 2015	3	2
January 2016	5	2
February 2016	6	5
March 2016	9	10
April 2016	11	12
May 2016	12	13
June 2016	15	11
July 2016	17	12
August 2016	21	14
September 2016	40	15



**Figure 5.** Graph of Patient to Doctors Access in a Year



**Figure 6.** Pie Chart of Services Accessed at any time

## **VI. Conclusion**

The integration of the three modules work out successfully following the system specifications and requirements engineering. The end result of the integration is the developing and hosting a web application for outpatients and doctors interaction for health services using Short Message Service API. Database for storing and retrieving outpatients' health service records and doctors' profile was implemented and can be accessed through an interface from the web application as reports.

The success of the implementation realized an alternative solution for accessing health care service delivery thereby reducing out-patients number in the queue before obtaining health services in the immobile hospital building. The use of the system by the doctors to attend tooutpatients'health needs and health service satisfaction obtained by the out-patients opens a room to various ideas on why developing and deployment of the e-health care is necessary in medical field in Nigeria thereby improving access to existing medical personnel resources.

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