IMPROVEMENT OF HEALTHCARE APPOINTMENT SCHEDULING PROCESS THROUGH MOBILE APPLICATION

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ABSTRACT

There is an accentuation on the need to change in the way hospital services are offered by adopting e-Health technologies in order to achieve the national vision of applying information and communication technologies (ICT) in the health sector. Perfect patient scheduling is one of the key aspects of the healthcare industry. Being able to tackle patients proficiently and on time is crucial to patients' wellbeing and to the reputation of doctors, physicians or clinical establishments. Timely availability of doctors is critical whenever a patient needs to see a specialist doctor for treatment and a serious bottleneck lies in the application of appropriate technology techniques to improve appointment scheduling. In order to eradicate the existing problem of waiting time in the system before service been served, or without been attended to, several techniques have been suggested to reduce and enhance the flow by which appointment is scheduled in the healthcare centers, such as online patient registration and scheduling appointment. The Case study for this research, The Federal Polytechnic Ilaro health center, operates on the manual way of patients booking an appointment to see a doctor. This old system requires a patient to be in the clinic to fill the registration form, and wait to be called in for an appointment or wait for an agreed date for an appointment, which is time-consuming. The main aim of this paper is to develop a mobile-based application scheduling system for overseeing patient appointments. We also sampled the students' opinion, by administering the questionnaire, on the existing way of appointment booking and the new system to be developed. Furthermore, we utilized SPSS to analyze the questionnaire.

Keywords: e-Health, ICT, Appointment Scheduling, Mobile-based Application, SPSS

I. INTRODUCTION

Scheduling appointments can be difficult for service provider industries that must meet the needs of both the customer and the service provider (Rinder et al, 2012). Customers want to avoid long waits whereas service providers need to minimize the idle time of their resources and the use of overtime (Rau et al, 2012). Airline, legal, banking, and healthcare industries offer examples of the need to balance these conflicting interests. An effective patient appointment scheduling system is very critical in hospitals to ensure effective and efficient service delivery in the health sector in Nigeria. Yet in order to target efficient appointment scheduling, there is a need for appropriate management and quality evaluation of the scheduling system. Most patients complain about the time spent between walking into the hospital and being attended by hospital staff, especially doctors. And this calls for proper handling. The designed mobile application for patient appointment scheduling is poised to effectively facilitate delivery of health services in Federal Polytechnic, Ilaro Clinic (FPI Clinic).

Making appointments over the mobile phone provides more benefits. These include time-saving as staff spends less time attending patients compared to paper-based appointments where patients need to fill in lots of forms. There is no waste of time in queues when a mobile application based patient appointment scheduling system is used. Furthermore, the automated appointment reminder in the mobile appointment scheduling system also saves time as hospital operators won't be required to call and send SMS to patients reminding them of their appointments. Mobile phone-based appointment system allows for 24 hours convenient scheduling and patients can make appointments at any time compared to making appointments physically by showing up at hospitals, which can be done only during working hours.

There is an emphasis on the need to change in the way hospital services are offered by adapting e-Health technologies in order to achieve the national vision of applying information and communication technologies (ICT) in the health sector. In one study, it was reported that waiting time for patients who attended their disability hospital appointments before receiving treatment was reduced due to the enhancement of the system they implemented for triage patient appointment (Aeenparast et al, 2013). The hospitals' use of mobile technologies in scheduling appointments can facilitate rapid response; physicians can prescribe medication more safely, and there is a high possibility of improving the patient's hospital records during daily clinic visits (Prgomet et al, 2009).

This study's objective is to enhance the appointment scheduling system via a mobile application, which facilitates assigning time slots to patients whenever they make appointments and prioritize patients with high precedence. Patients who forget their appointments can receive a reminder alert on the upcoming appointment, and the clinic can track appointments and health performance of their patients

II. OVERVIEW OF THE APPOINTMENT SCHEDULING SYSTEM

Traditionally, medical appointments have been made with schedules over the telephone call or in person. Appointment scheduling via paper-based system requires patients to be at the hospital, fill in registration forms and return them to the registration desk, and patients are then assigned to the desired doctor. Sometimes, patients place hospital identification cards or appointment cards in the dedicated box near the doctor's room and then wait in the queue to be called by the nurse. Cards are placed in the order of first come, first serve (FCFS), whereby the patient who came early is the first to be served and the last to show up waits on the queue. Patient information in the paper-based appointment system cannot be easily corrected when changes need to be made: another form will need to be filled in, and the data entry registration desk staff experience problems in reading information written in the paper appointment forms, and it is difficult to retrieve patient details when required as you need the entire appointment application form (Pavlović et al, 2009).

This type of appointment scheduling system has a range of constraints, such as patients being required to fill in appointment forms upon arrival at the hospital, and there is no possibility to register while at home or any place, as a result, patients spend a lot of time waiting in queues, are required to follow dates of appointment assigned by the registration desk, and there is no mechanism for patients notification when appointments are postponed. Additional, managing paper-based hospital appointment system is difficult to manage, hence the need for a new method. The use of mobile appointment scheduling can enhance hospital appointments as it will allow patients to make appointments before going to the hospital. Patients can be reminded of the appointment as well. The clinic can monitor patient's performance while on the provided treatment, and the patient can select desired date of appointment based on his/her wishes. In addition, thousands of patients' appointments are changed to the later date for more than once. Outpatient satisfaction with healthcare procedures was not only associated with waiting times but over one-third chose to not fulfill the appointment schedule as they expected to have to wait for long periods. These issues still remain a challenge to the healthcare industry worldwide.

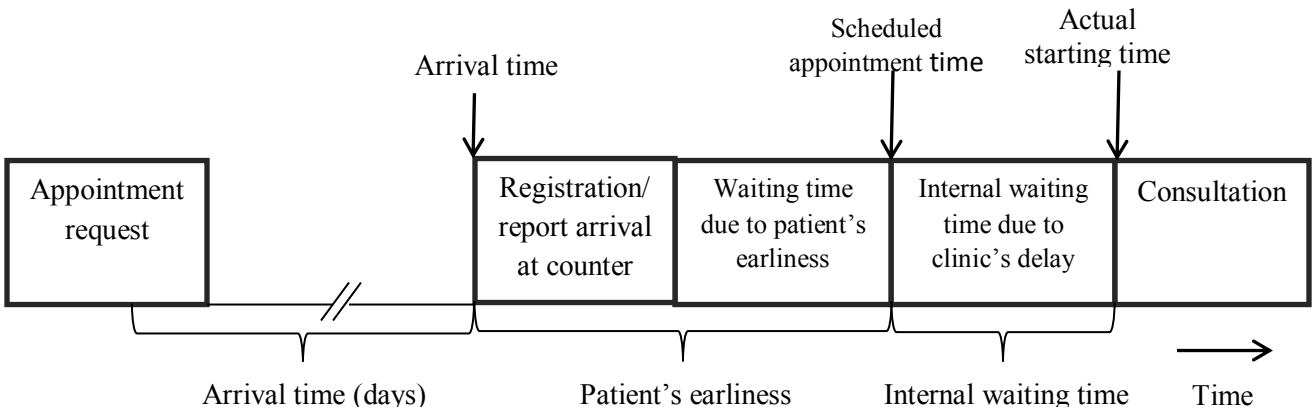

Figure 1: Patient flow diagram

Figure 1 above describes the general patient flow through the outpatient services up to the moment of consultation. Typically, the patient will contact the healthcare administrator to schedule an appointment and waits for any replies towards confirmation which usually takes days or even months (i.e. Access time). Once the appointment is confirmed, patients must first fill in registration forms upon arrival. Then between registration process and consultation, the total patient waiting time is divided into

- Patient's earliness – Time recorded between early arrival and scheduled appointment time.
- Internal waiting time – Period between scheduled time and the actual starting time of consultation.

The current procedure in the outpatient department is depending on first-come, first served basis, whereby there are two ways of having a professional consultation:

- Walk-in appointment where patients are required to fill in registration forms or presenting an identification card to the registration staff which will then be given a less complex registration form. However, most of the time, this procedure is repeated for every outpatient visits. Hence, it will result in more paper-based forms and less organized management.
- Scheduling an appointment beforehand in which patient has to call in, ask for any available dates and waits for the response from the administrative staffs. In other cases, appointments are made by the doctors, only for a patient with the frequent monitor.

III. RELATED WORK ON HEALTHCARE APPOINTMENT SCHEDULING

Near field communication technology is a wireless communication that is used to transmit data at a short range of distance, approximately 10cm. The intelligent agent system was developed for appointment scheduling where patients can register and make appointments through mobile devices and eliminate the registration desk staff (Masud et al 2014). Smart technologies for mobile appointment have been developed where patients use mobile and Near Field Communication Technology (NFC). Patients need to tap their NFC cards into NFC readers at the main entrance gate of the hospital, and once there is an information match, the other scheduling procedures follow (Mey and Sankaranarayanan, 2014).

Ingagepatient.com is an online appointment scheduling system where patients need to register or sign up online in order to make appointments. New patients are required to have email accounts at the initial stage of registration. Once registered, patients are required to fill appointment forms at their own pace without queuing. To facilitate effective service delivery in hospitals in Tanzania, a mobile system for patient appointment is proposed where patients need to download and install the application in their mobile phones, and then they can register on the application and receive username and password which can be used for login in the application. After login, patients need to select filtration type, and a list of doctors is displayed based on the selected filter. Then, the patient is required to select the desired doctor and his/her schedule is displayed, and finally, the patient can make an appointment based on the doctor's free time slot.

IV. ANALYSIS DESIGNED APPLICATION (SYSTEM)

The designed Mobile Healthcare Appointment Scheduling Application (MHASA) aims at enhancing appointment scheduling in the school clinic by allowing patients (students and staffs) to register for appointments through mobile phones at their own time wherever they are, and make an appointment on their desired slot of time. A modified wave appointment scheduling algorithm was used to designed approach for patient appointment scheduling in which patients are scheduled in 10 minutes and more than one patient is booked toward the beginning of every hour and the hour end is left open, permitting the specialist to make up for lost time, if needed. When the patient is attended to in less than the allocated time, the remaining time will be assigned to the next patient and idle time for waiting and doctor work overload will be reduced. Patient waiting time is expected to be reduced from 3 hours to half an hour. The modified wave scheduling will facilitate patient flow and raise patient satisfaction.

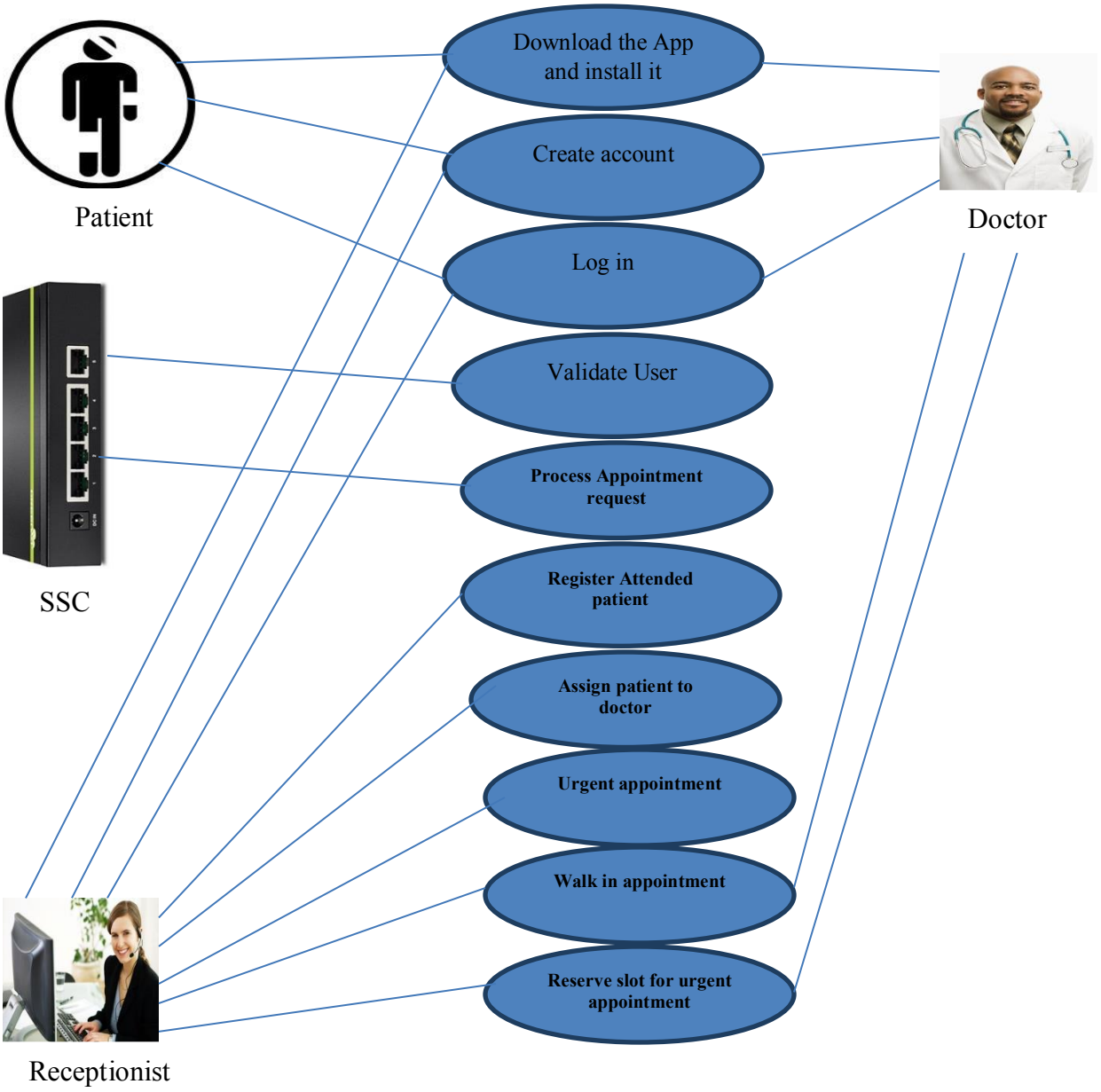

Figure 2: Involvement of users and their collaboration among themselves and the system

Figure 3: shows the welcome page for both thedoctors and the patient

Figure 4: shows the matriculation of a registered patient

Figure 5: shows the welcome page for login patient

Figure 6: shows the list of appointed doctor (Appointment History)

V. PRESENTATION, ANALYSIS, AND INTERPRETATION OF DATA

This part deals with the analysis and findings of the data collected during the field survey. The objective of this study has been to improve healthcare appointment scheduling through the use of the mobile application in the school clinic (FPI Clinic). Questionnaires were given out to students and some lecturers. Findings are been analyzed with the use of the Statistical Package for Social Science (SPSS) based on the fact gotten from the respondents, noting its interaction with the objectives of the study. Analysis of the data is as important as any other component of the research process.

A total of two hundred and eighty questionnaires were administered to the respondents (students and some of the staff) and two hundred and fifty were filled and returned.

Table 1. Gender distribution of the respondents

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	150	60.0	60.0	60.0
	Female	100	40.0	40.0	100.0
	Total	250	100.0	100.0	

Source: Field Survey (SPSS), November 2018.

Table 1 above shows the distribution by gender of the respondents. It is seen that out of the 250 respondents used for the survey work, 150 of them are male representing 60% of the respondents and the remaining 100 respondents representing 40% of the respondents are female.

Table 2. Age distribution of the respondents

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	15-20	54	21.6	21.6	21.6
	21-25	108	43.2	43.2	64.8
	26-30	53	21.2	21.2	86.0
	31-35	11	4.4	4.4	90.4
	36-40	17	6.8	6.8	97.2
	40-above	7	2.8	2.8	100.0
	Total	250	100.0	100.0	

Source: Field Survey (SPSS), November 2018.

Table 2 shows the distribution of the respondents according to their various ages. 54 of the respondents representing 21.6% of the respondents are between15 - 20 years of age, 108 representing 43.2% are between 21 to 25 years of age, 53 are between 26 to 30 years of age representing 21.2% of the respondents, 11 are within 31 to 35 years of age representing 4.4% of the respondents, 17 are within 36 to 40 years of age representing 6.8% and the remaining 7 representing 2.8% are above 40 years of age.

Table 3. Do you normally visit the school clinic for a checkup?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	33	13.2	13.2	13.2
	Yes	217	86.8	86.8	100.0
	Total	250	100.0	100.0	

Source: Field Survey (SPSS), November 2018.

Table 3 shows that 33 representing 13.2% of the respondents do does not like going to school clinic for a check-up while the remaining 217 respondents representing 86.8% do visit the school clinic for a check-up.

Table 4. Are you pleased with the conventional method of attending to you when you visit the school clinic?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	165	66.0	66.0	66.0
	Yes	85	34.0	34.0	100.0
	Total	250	100.0	100.0	

Source: Field Survey (SPSS), November 2018.

Table 4 shows that 165 representing 66.0% of the respondents do not like the manual method of scheduling while the remaining 85 respondents representing 34.0% are pleased the conventional way of service at the school clinic.

Table 5. Do you have any awareness about the mobile application?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	33	13.2	13.2	13.2
	Yes	217	86.8	86.8	100.0
	Total	250	100.0	100.0	

Source: Field Survey (SPSS), November 2018.

Table 5 shows that 33 representing 13.2% of the respondents do not have awareness about the mobile application while the remaining 217 respondents representing 86.8% have previous awareness about a mobile application.

Table 6. Would you like to schedule your next appointment on the mobile application?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	67	26.8	26.8	26.8
	Yes	183	73.2	73.2	100.0
	Total	250	100.0	100.0	

Source: Field Survey (SPSS), November 2018.

Table 6 shows that 67 representing 26.8% of the respondents are not ready to use mobile application for schedule their appointment while the remaining 183 respondents representing 73.2% are ready to make use of the mobile application to schedule their next appointment.

Table 7. Do you think the mobile application will reduce the waiting time of the patient?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	74	29.6	29.6	29.6
	Yes	176	70.4	70.4	100.0
	Total	250	100.0	100.0	

Source: Field Survey (SPSS), November 2018.

Table 7 shows that 74 representing 29.6% of the respondents do not think the mobile application would reduce the waiting time of the patient, while the remaining 176 respondents representing 70.4% believed that with the mobile application, waiting time would reduce.

Table 8. Do you think the mobile application will reduce the idle time of the doctor?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	74	29.6	29.6	29.6
	Yes	176	70.4	70.4	100.0
	Total	250	100.0	100.0	

Source: Field Survey (SPSS), November 2018.

Table 8 shows that 74 representing 29.6% of the respondents do not think the mobile application would reduce the idle time of doctor, while the remaining 176 respondents representing 70.4% believed that with the mobile application, the idle time of the doctor will be reduced.

Table 9. Do you think the mobile application will help in terms of emergency?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	101	40.4	40.4	40.4
	Yes	149	59.6	59.6	100.0
	Total	250	100.0	100.0	

Source: Field Survey (SPSS), November 2018.

Table 9 shows that 101 representing 40.4% of the respondents do not think the mobile application would help in terms of emergency, while the remaining 149 respondents representing 59.6% believed that the mobile application would be a great deal in case of emergency.

VI. STATISTICAL HYPOTHESIS TEST (CHI-SQUARE TEST)

We also carried out a test for hypothesis either to accept the use of the mobile application for scheduling an appointment in the school clinic or to continue with the conventional method of attending to the patient. The hypothesis test was based on either the students and staffs will embrace the mobile application or not. The tables below show the chi-square hypothesis test.

Table 10. Do you think the mobile application will reduce the waiting time of the patient?

	Observed N	Expected N	Residual
No	74	125.0	-51.0
Yes	176	125.0	51.0
Total	250		

Source: Field Survey (SPSS), November 2018.

Table 11. Test Statistics

	Do you think the mobile application will reduce the waiting time of the patient?
Chi-Square	41.616[a]
Df	1
Asymp. Sig.	.000

a. 0 cells (0.0%) have expected frequencies less than 5. The minimum expected cell frequency is 125.0.

Source: Field Survey (SPSS), November 2018

Ho: it means that mobile application would not be significantly embraced as an alternative to manual scheduling.

H1: Ho is not true

We rejected Ho of no significance since X^2cal of 32.40 with p-value < 0.05 level. Therefore, mobile application would be embraced significantly as an alternative to the manual method of scheduling appointment at the school clinic.

VII. CONCLUSION AND FUTURE WORK

Scheduling appointments appropriately and resourcefully are vital to the smooth process of the hospitals' service delivery. Working in the new era of science and technology, people have the slight patience for waiting in the queue at the hospitals. Patients, who make appointments weeks in advance, want to be attended within 20 minutes after showing up at the hospital. They prefer to be given a specific time for seeing the doctor rather than arriving at the hospital and wait for an open moment. Doctors need a smooth tide of patients when attending the scheduled patients. Conferring the challenges facing existing patient appointment systems, we designed an integrated mobile appointment scheduling system that enhances appointment scheduling in

hospitals with the aim of simplifying patients and doctors' task. In our system, the SSC gathers information from the users and schedule patients based on the availability of doctor time slots. In employing the proposed system, patients will be more relaxed whenever they make appointments without standing in the long queue as the system would replicate tasks which would otherwise be carried out by hospital personnel and patients. Doctors will be more comfortable in attending patients in a systematic flow as the system manages the appointment requests and scheduling. In future, the system can be developed to direct appointment.

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