Potential of SMS Based Automated Reminders towards Enhancing Adherence to Clinical Instructions for Dementia Patients: A Case of Healthcare Givers

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ABSTRACT

Background: The dementia condition is a growing global challenge in both developed and developing countries. The profound negative effect of dementia; progressive deterioration in memory, thinking and behavior, affects a person's ability to perform everyday activities including the ability to adhere to treatment or clinical appointment regime. In developed countries, elaborate programs that include care-homes and the use of technologies tailored to the needs of demented persons have been successfully implemented. The rising cases of dementia in developing countries, makes caring for persons with dementia an energy and time-consuming exercise for the care givers, who in most cases are family. Previous studies have largely focused on evaluating the potential of technology to enhance adherence to clinical instructions for demented persons.
Methods: This study focused on designing, implementing and evaluating the outcome of use of SMS based automated reminders for dementia care givers, towards enhancing adherence to clinical instruction for demented persons under their care. Statistical Analysis: Comparison of degree of adherence to clinical appointments before and after introduction of mHealth solution.
Results: The outcome the study showed that the use of mobile technology has a positive outcome towards enhancing adherence to clinical instruction for persons with dementia. Conclusion: mHealth technology should be explored through design and implementation of custom-tailored solutions to aid care givers and improve quality of life of persons with dementia.

INTRODUCTION

The global healthcare community continues to struggle with growing healthcare challenges with no matching strategies to counter the challenges. Studies [1][2] indicateglobal morbidity and mortality presents a burden to economies and has a negative effect on quality of the human life and World Health Organization [1] furtherpoints out that developing countries and particularly the Sub-Sahara Africa as one of the most severely affected regions and suggest that the most effective strategy for tackling this challenge should be based on three foundational pillars; prevention, surveillance and strengthening existing healthcare systems.

Dementia, a clinical syndrome of progressive deterioration in memory, thinking, behavior and the ability to perform everyday activity, has been identified as a growing global challenge. [3] In the report, WHO estimates that there are 50 million cases of dementia globally and nearly 10 million new cases are identified every year. It is further indicated that Africa has an increasing longevity and has been identified as one with the fastest growth rate of aging population in the world. It is therefore projected that care for persons with dementia will present one of the greatest economic burdens in the coming years.

The loss of memory normally has profound effect on the person and renders them incapable of managing simple and

critical life activities. Among the critical activities that are negatively affected when a person develops dementia is the failure to adherence to treatment regime; medication adherence and clinical appointments. The failure to adhere to treatment regime endangers the demented person's life and hence the need for care givers. Caring for persons with dementia is thus resource intensive and energy and time-consuming exercise.

In developed countries, the strategy for managing and caring for demented persons has been positively impacted by three factors; strong economies, experience in research on the subject and advanced technology. Elaborate and effective dementia care and management strategies have been designed, developed, implemented, evaluated and improved over time. [4][5] The adoption of *technology* and acceptance of *Care-Homes* strategies for the elderly, supported by effective legislation have worked well towards ensuing improving health care for dementia cases. The situation is different in developing countries, which face three major challenges in the effort to deal with dementia challenge; weak economy that limit resources that can be channelled to healthcare, challenges in technology innovativeness towards dealing with dementia and lack of legislative strategies for dealing with the emerging dementia challenge. [6][7] In most cases, the care for demented person is left to the care givers who in most cases are close relatives or neighbors. The care givers take on the care duties as one among their routine activities.

There is a gradual and progressive interest globally in providing support for people with dementia and their family. [4] In England, [8] a National Dementia Strategy by the Department of Health set out specific recommendations from the government for the National Health Service (NHS) and local government to improve dementia care. It has been pointed out that a critical challenge exists in supporting adults with dementia, to live healthy lives in the place of their choice and recommends technology as one of the potential tools that can be used to effectively support adults living with dementia and as well as their care givers. [9]

Studies [4][10] have shown that there is a growing attempt to explore the use of technology, with the aim of providing much needed support for persons with dementia as well as their caregivers. It has been pointed out that technology tools have the potential to lower the limitations of people with dementia and enhance patient's confidence and enhance the capabilities of the care givers, leading to an overall positive impact on their lives. This is evidently shown in a case where a hand-held computer registers when an affected person needs to take medication and emits a signal at the designated time. The idea of using technology has been explored [11] and the outcomes have established that people with dementia are positive about using electronic devices to facilitate their independence and reduce family stress. In the United Kingdom, there have been attempts to use mobile phone text message reminders to those prescribed oral antipsychotic medication, regardless of their demographic and diagnostic characteristics, attitudes towards medication and levels of past adherence. [12] In Kenya, [13] there is high willingness of caregivers to receive text message reminders in intervention of children with malaria in Western Kenya. Text messaging tools [14] used at weekly intervals, in managing adherence to HIV/AIDS antiretroviral have been found to enhance levels of efficacious in enhancing adherence to antiretroviral compared to standard care. However, a significant number of studies have focused on technologies used by persons with dementia and therefore little has been done on assistive technologies for the care givers in dementia cases.

The growth in the adoption and use of Information and Communication Technologies (ICT), especially the mobile technologies have revolutionized and positively impacted daily life activities in

many spheres of life; financial, Agricultural and healthcare. [1,15-17] The growth of these technologies has led to digitization of financial services, which in turn has led to increased efficiency, accessibility and effectiveness of service delivery. [15] In healthcare, the challenge of very low Doctor to patient ration means that many individuals do not get opportunity access healthcare practitioners. Sema Doc application is a mobile based solution, available on 24 hours/7 days a week basis and enables individuals seeking healthcare to have a direct interaction with doctors; for quick consultation, diagnosis and treatment, no matter the time and location of the individual. [18] The success of these innovations has led to the view that if creatively explored, mobile technology could lead to significant improvement in access to and provision of healthcare services. Global surveys, reports and studies [16][17][19] point to growing interests, efforts and attempts to explore the potential of this technology towards enhancing healthcare. The innovative solutions reported cover the three-key pillar; prevention, surveillance and strengthening of existing systems.

MATERIALS AND METHODS
Methods
The approach involved a number of seven key steps, outline below;

Step 1: Reviewed literature to understand some of the solutions that have been used in dealing with dementia challenge in developed and in developing countries and the weakness of these solutions.

Step 2: Carried out an exploratory qualitative study to gain a clinical understanding of the dementia condition and its effects on the ability of the affected person to lead a normal life. The key activities in this step involved interaction with medical personnel in charge of demented persons as well as healthcare givers with a minimum of 5-year experience of managing dementia condition. The step also focused on understanding the general attitude of demented person as well as care givers towards assistive technology. The outcome of this was critical in defining the type of technology solution for aiding care givers in cases of dementia cases.

Step 3: Purposively sampling was used to identify 30 care givers that participate in the study together with the persons under their care. The snowballing technique came in hand; where the first identified care giver, led us to other care givers. Each participant was briefed on the study and the purpose and their role as participants in the study. An informed consent note was presented to caregivers and they were given 14 days to make a decision on their willingness to voluntarily participate in the study.

Step 4: The personal attributes of the participants, both the affected individuals and the care givers; age, ability to read and understand instruction – level of education, their access to and ability to operate mobile phones and any other challenge the were likely to face for example ensuring that their phone was charged and operational at all times.

Step 5: The architecture of the proposed SMS-based reminder was designed (Figure 1), and using the Rapid Application Development (RAD) approach, the prototype was developed. The suitability of the message; simplicity and understand 1 ability were evaluated. The message was designed to communicate a reward component and a consequence component in order to motivate both the care giver and the patient to put in some significant efforts towards compliance. The general functionality and resilience of the system was evaluated.

Step 6: Operation of the system was started; on a visit to the hospital, the care giver was assigned an identification code and their mobile phone numbers together with the patient were registered into the system and a schedule for the SMS defined based on their next appointment.

Step 7: Clinical adherence for the 4 months was analyzed and compared to their previous levels of adherence, before the

assistive reminder technology was introduced.

Materials

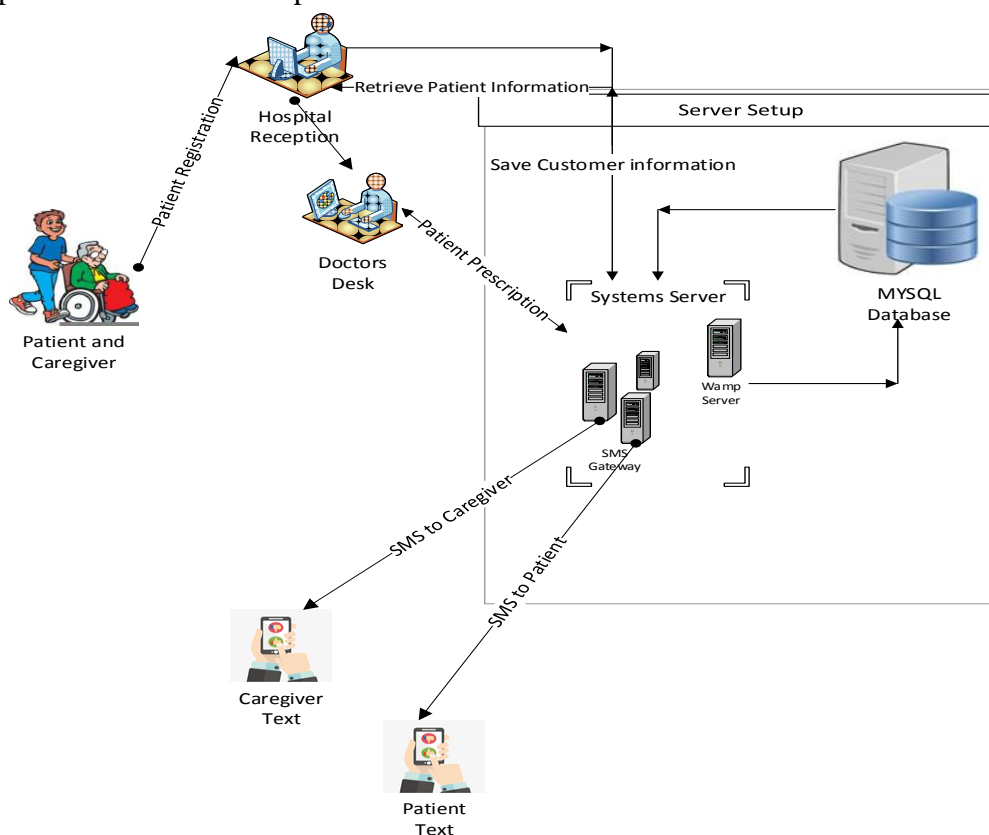Prototype Architecture and Implementation

Figure 1.1 – Prototype Architecture

Four SMS reminders were sent to both the Patient and the care giver simultaneously. The interval of the SMS reminder was as shown in Table 1.1.

Table 1.1 Interval of SMS-reminder

SMS-Reminder	Duration to Appointment
First Reminder	2 Week to Appointment
Second Reminder	1 Week to Appointment
Third Reminder	1 day to Appointment
Fourth (Final) Reminder	1 Hour to Appointment

The Figure 1.2(a) and Figure 1.2(b) show sample text message send to the patient and care givers respectively.
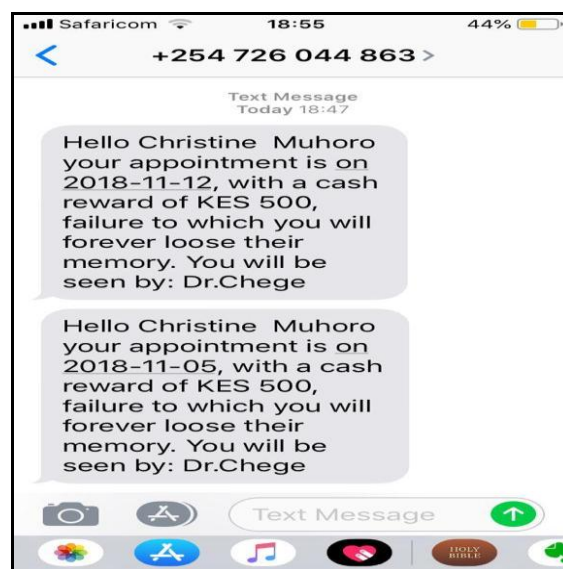

Figure 1.2(a) Sample Message to the Patient

These messages were designed to communicate a reward component and a consequence component in order to motivate both the care giver and the patient

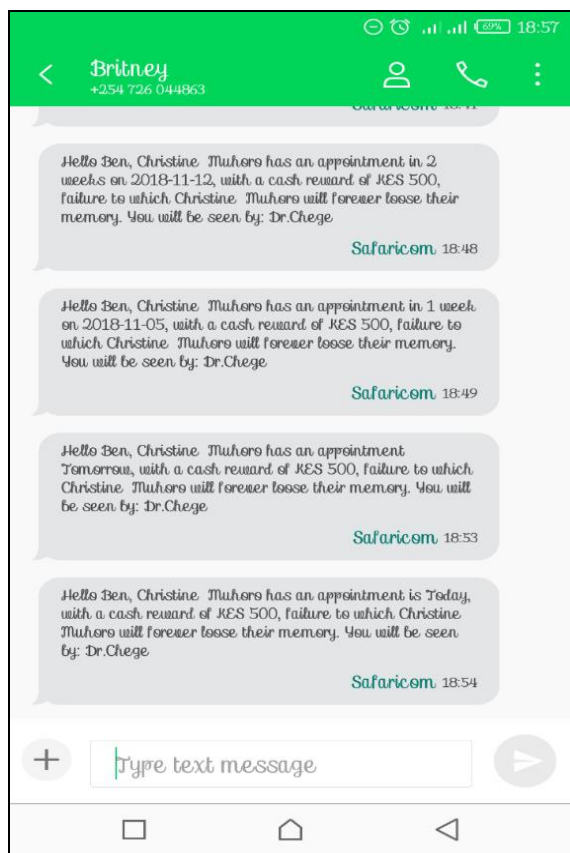to put in some significant efforts towards compliance.

Figure 1.2(b)Sample Message to the care givers

RESULTS

Adherence Analysis: Gender

The outcome of the analysis of appointment adherence, with regards to the age brackets is shown in Table 1.2.

Table 1.2: Gender Adherence Analysis Outcome

Gender	Clinical Appointment (4 Months) (15 Clinical Appointments: Number/Percentage Honoured)				
	Before Technology		After Technology		Change (%)
	Number	%	Number	(%)	
Female	4.2/15	28.17%	5.5/15	36.37%	8.2%
Male	4.24/15	28.21%	5.82/15	37.62%	10.98%

Adherence Analysis: Age Bracket

The outcome of the analysis of adherence to clinical instruction with regards to age bracket is shown in Table 1.3.

Table 1.3: Age Bracket Adherence Outcome

Age Bracket	Clinical Appointment (3 Months) (10 Clinical Appointments: Number/Percentage Honoured)				
	Before Technology		After Technology		% change
	Number	%	Number	%	%
< 50	4.7	41.1%	6.7	61.1	20.0%
50 – 60	3.6	31.38%	5.8	50.82%	19.44%
> 60	3.3	28.88%	5.47	48.43%	19.55%
Average	3.87	33.79%	5.99%	53.41%	19.7%

Adherence Analysis: Overall

The overall outcome of technology intervention is shown in Table 1.4.

Table 1.4: Appointment Adherence Overall outcome

Clinical Appointment (4 Months) (15 Clinical Appointments: Number/Percentage Honoured)				
Before Technology (Appointment Honoured)		After Technology (Appointments Honoured)		Percentage Change
Number	%	Number	%	%
3.9/15	28.19%	5.7/15	37.97%	9.79%

DISCUSSION

Gender analysis of adherence (Table 1.2) show that for the group of female participants, the average appointment adherence was 28.17% before introduction of the SMS based reminder but improved to 36.37% on introduction of the technology component. This therefore means that on average, there was an improvement of 8.2%%. On the other hand, the average percentage adherence for the males was at 28.21% before the introduction of the technology but improved to 37.62% on the introduction of the technology, indicating an improvement of 10.98%. A comparison of the female and male adherence improvement factor, it shows that on average, the improvement increased by almost the same factor; female 8.2% while the male was at 10.98%. The results tend to suggest that on average, technology has the same effect on both males and females.

Before introduction of the technology, the age bracket below 50 years had an adherence of 41.1% but this improved by 20.0% to 61.1% after the introduction of the technology. The 50-60

age bracket had an adherence of 31.38% before the introduction of technology, which later improved to 50.82%, an increment of 19.44%. Finally, for those above 60 years, adherence before introduction of technology was 28.88% but this rose to 48.43% after the introduction of assistive technology, indicating an improvement of 19.55%. The outcome shows that on average, the improvement was by 19.7%.

The outcome of technology intervention (Table 1.4) showed that there was a slight improvement of from 28.19% adherence before technology to 37.95% after the introduction of the assistive technology. The results tend to suggest that the SMS based reminders had a positive effect, leading to improved level of adherence to clinical instructions by 9.79%.

CONCLUSION

The outcome of the study suggests that introduction of SMS-Base reminders to the caregivers and dementia patients result into a significant improvement in adherence to clinical instruction for caregivers in cases of dementia patients. Age and gender attributes do not have an influence and therefore may not have an impact adherence to clinical appointment, where SMS based appointment reminders are used. This outcome points to the potential of mobile technology to enhance adherence to clinical appointment for care giver who support persons with dementia. This can therefore go a long way in improving the support and care give who support persons with dementia.

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