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USE OF MOBILE PHONES TO IMPROVE POST-HOSPITALISATION FOLLOW-UP OF CHILDREN IN RURAL KENYA
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ABSTRACT

***Background*: Re-admission is considered a high priority quality measure in the health care setting. Most of the studies using text messaging, however, have slanted towards adults, in the form of reminders or instructions of some sort. Paediatric patients are often re-hospitalised after discharge. Recurrent hospitalisations are responsible for considerable health care spending, and some studies suggest that a substantial proportion of re-admissions are preventable through effective discharge planning and close patient follow up.**

***Objective*: To examine the effect of use of mobile phone to improve post-hospitalisation follow-up of children in rural Kenyan health facilities.**

***Design:* A cross sectional study.**

***Setting:* Siaya County Health facilities, in Nyanza province, Kenya.**

***Subjects*: Children under five years of age, discharged following hospitalisation.**

***Main outcome measures:* These included, total number of discharges, readmissions, gender, socio-economics, prospective results, educational level and distance from hospital, home location, nearest health facility, acceptability, suitability, and utilisation of the message, and immunisation status of the child.**

***Results*: The respondents' minimum age was 18 years, with a maximum and mean age of 49 and 29.3 respectively. Most of the respondents were in monogamous marriages (69%), Protestants (57%), highest maternal education level was between primary five to eight (42%) and 40% were self employed. Re-admission rate in the Intervention group was 5% compared to Control group 1 and 2 of 28% and 21% respectively. In testing H_0:1,significant relationships of p-Value 0.00, at 95% confidence interval, when the alpha is 0.05, proves that SMS messaging led to reduced re-admission rates. In testing H_1:2, according to the responses relating to SMS satisfaction, majority (98.7%) expressed satisfaction with text messaging, compared to the 1.3% who expressed otherwise. There was no relationship between rate of re-admission and age, socio-economic status, distance from health facility or home location in relation to the admitting facility.**

***Conclusion*: The study found that there was a relationship between post-discharge SMS communication and rate of re-admission. It was also established that there was a relationship between post-discharge SMS communication and improved knowledge, efficacy in childcare as well as relationship with staff. Text messaging therefore was found to improve post discharge follow-up care and eventual reduction in re-admission rate. The researcher recommended that a similar study be done on adults to see if it could have the same effect.**

INTRODUCTION

Re-admissions are a high priority quality measure of efficiency in both the adult and paediatric settings. However, a broadening body of literature is evaluating the impact of SMS interventions on re-admissions in adult populations, the literature does not contain a similar breath of assessment of interventions in the paediatric setting. Hahnemann Hospital's Pilot study using mobile messaging to reduce hospital re-admission rates showed that sending patients mobile reminders resulted into 10% decrease in hospital re-admissions (1). Paediatric hospital stays are often of short duration, usually less than one week, unless the child has a chronic illness. A study on post discharge phone call after paediatric hospitalisation showed that the researchers reached 78% of all patients' families by phone after discharge. Of the families reached, 19.9% needed an issue addressed, half of which were medication related. There were improvements in 14-

day and 30 day re-admissions and 14 day Emergency Dept visit rates, as well as improvement in patient satisfaction scores, but none of these results reached statistical significance (2). After discharge, continued healing depends on the patient and the family caregivers' following instructions they may or may not have completely understood. However, many patients lack the support that they need for optimal recovery at home. Caregivers are often confused about medications and follow-up procedures, making preventing unnecessary readmission a challenge (3). Hospital re-admissions contribute to high cost of care and inefficiency of health care. A study conducted on post discharge telephon follow up on hospital re-admissions showed that among all members who were readmitted during the 30-day window, the median time to re-admission was 11 days. The re-admission rate were highest on days 2 and 3 after discharge and declined gradually from day 4 onwards (4). Technological intervention is the way to go for cost effective health care, that SMS communication and identification distance from nearest health facility through use of GIS, may be the best and cheapest options in the follow up of paediatric patients post-discharge. SMS may not only be useful as a reminder, but would probably come with side benefits such as improved relationship with health care providers.

MATERIALS AND METHODS

This was a cross sectional study, which was conducted in three randomly sampled facilities in Siaya County in Nyanza Province - Kenya. Siaya County is one of the counties in the former Nyanza Province which lies in the Southwest part of Kenya. It is bordered by Busia to the North, Kakamega County and Vihiga County to the Northeast and Kisumu County to the Southeast. The total area of the county is approximately 2,496.1 km^2. The County lies between latitude 0^0 26' to18 north and longitude 33^0 58 east and 34^0 33 west. It has been split into six new districts. The sampled facilities were Siaya County Referral Hospital, Sagam Community Hospital and Bondo Sub-County Hospital. These facilities, offer a range of services, which include outpatient, in-patient and diagnostic services. Siaya is a County referral hospital for the health facilities within the county. Siaya County was chosen because it is located in an area with high morbidity and mortality pattern among children, that is, Nyanza Province. The area also serves a big population with high prevalence of both Malaria and Hyper endemic HIV/AIDS (23.7%), TB, Diarrhoeal and Respiratory diseases. It has infant mortality rate of 113/1000 and under fives mortality of 102/1000. Siaya County has Poverty rate based on KIHBS 2005/6: 35.3. KEMRI/CDC has implemented Malaria Vaccine Initiative in the area and it would be interesting to compare some findings on Malaria status among under-fives.

The study population was caregivers and their children under thirteen years of age. There were three groups of participants in this study. The first group (Intervention),received SMS communication following their children's discharge. The second group (Control group 1), was not sent text messaging, but was given instructions to journalise/record whatever action they took, whenever the child fell sick or had a problem after discharge. The third group (control group 2) did not receive text messaging, and only released on the standard discharge protocol. The timeframe for the intervention was 14 days. This applied to all the groups.

Accrual of The Participants: Recruitment of participants was done systematically as the patients got discharged until the desired sample size was attained. They were randomised to receiving SMS or no SMS and journalising. The participants were randomly divided into three groups for intervention and controls.

The caregivers of paediatric patient under the age of thirteen years who were discharged from hospital to home, from the start of the study were put aside before going home. Patients with more than one caregiver had the person who would be responsible for care after discharge included. Unique identifiers prepared and distributed by the researcher. Each discharged patient's diagnosis was coded for ease of tagging response. The study was un-blinded to participants and the researchers.

At enrolment, baseline information was collected from both the intervention group and the control arms. The caregivers were assessed using a standardised questionnaire designed on SurveyMonkey,and administered using Tablets. The intervention participants were informed about the timingsfor SMS messages. They were informed that they would need to come back to hospital, at a specified date.

The research desk person delivered the discharge messages, which had predetermined timing, schedule and messaging content. The messages were semi-automated and customised to the recipient since the discharges took place on different dates. The responses to the text messages or any concerns raised by the caregiver through text messaging were also automatically recorded through a phone linked to a computer database (Dashboard), in a network system. The desk person received alerts whenever a message came in and responded appropriately. The desk person's responses were also recorded.

The post discharge SMS messaging was focused on reducing preventable hospital re-admission. Participants (caregivers) received pre-determined SMS messages from the research desk person to ensure that the participant received discharge instructions and understood the proper steps to take. The messages also allowed the caregiver to express any health concerns. Communication dissemination was one

sided.Therefore the researcher ensured uniformity of understanding by pre-testing the understanding. A guideline was written to direct the approach of communication for standardisation purposes. At the end of 14 days, the groups were interviewed again using a post discharge interview schedule.

Message content: SMS messages were developed for Medication adherence, Relevant/specific care at home, nutrition – child feeding, Appointment reminder and General Child health enquiry, such as, asking the caregiver to repeat the instructions given at hospital and the desk staff responds with relevant/ specific advice if needed. As much as possible, uniformity was maintained, save for specific questions relevant to a specific diagnosis. The messages were simple, practical and culturally acceptable.

The SMS Intervention: The first SMS message was sent two days after discharge. This was done to enable the caregiver to settle at home and also to avoid the risk of medications not being given, as they should through asking them to explain to how they are administiring it, to confirm their understanding of instructions. The next messaging was after four days and thereafter every four days until 14 days.

This first SMS message was to enquire how the child was, and if there was any problem that could warrant clinic attendance, such as bringing the child to hospital to be reviewed. The caretaker would also be asked whether the child was taking the medicine well, or had any problem like vomiting out the drugs. The second one was a follow up on treatment and any special care the baby might require, like if the child was discharged on Oral Rehydration Salts (ORS) to find out whether diarrhoea had stopped. All caregiverswere asked about child feeding pattern after discharge.

The third one was to check on the general condition and any problem the child might have. This was a follow up to find out if the caregiver still had any difficulty caring for the baby after the previous week's explanation. At this point, it was possible to get some cues on change of condition. Advice was given as needed.

The fourth SMS messaging was to confirm any appointment due (need for re-admission may come from the caregiver). If things were okay and the child never got re-admitted, then at this point she would be invited to come to the hospital as planned for a brief interview to provide feedback as per stated objectives. A structured interview schedule was used for all caregivers and Control group 2 presented their records.

During these communication processes, appropriate health advice on child carewould be given. The data for all the communications were captured at the facility level using a specialised database system. A database of all caregivers' personal details was made creating for each of them a unique identifier. A separate table was used for messages. A simple user-friendly gateway was used to link mobile phone messages with a computer for automatic interaction documentation. There was a chart facility which would interact with the network to generate reports as required. There was also a database for re-admissions, no-response, non-compliant and misunderstanding of instructions. Summarised coding was captured using Excel. Normalisation was done before use to ensure that everything was captured the right way to avoid conflict

On the 15th day after discharge, the research participants were interviewed using a questionnaire, which was administered face-to-face in hospital. The controls were asked what they would have liked, that is, some recall questions such as any incidences on the child concerning the problem the child had, what type, and what they could have done if they had been followed up. Some of the follow-up group might have asked unnecessary/irrelevant questions, so a record was kept in case of such. In all this, the image of the facility was maintained. In case there would be a question the researcher could not answer, the caregiver would be referred to the right person. Because it would be important to be clear on how communication between the caregiver and the researcher would capture both the experience and care in order to elicit the added value of the follow-up, it was necessary to do accurate documentation. There was no interference with the non-followed up groups. The journal/record kept by the Control group 2 wasentered into the computer in preparation for coding and data analysis. The group was interviewed at the end of 14 days, besides the records that they had presented.

Pre-testing of the SMS message content: A sample of ten caregivers of discharged patients, who were not participating in the study, was individually subjected to cognitive interview, to elicit their views, perception and response to the pre-determined questions. The researchers probed for what they might not have understood. The cognitive interview was done outside the research participants to avoid implicitly or explicitly pre-empting their response to the SMS messages. The researcher used caregivers who were from the same hospital but not in the study to ascertain the peculiarity of that place.

Data collection method and Analysis: A questionnaire designed on SurveyMonkey, using Tablets,was used on discharge and on return after 14-day period.

Information was gathered through SMS using mobile phone. GIS was used to gather spatial data. Journalised information from the second control group was also used.The first randomisation was done at the start of the study, then, percentage of re-admissions was compared among the randomisation arms. Both quantitative and qualitative analysis was done using SPSS. QGIS was used for mapping and spatial distribution analysis.

RESULTS

This chapter reports the study findings based on quantitative, qualitative and spatial data obtained from 223 child caregivers in Siaya County. Out of the 240 population sampled, 223 (92.9%) completed all stages required of participants in this study. The results are given as per study objectives.

Table 1
Age (in years) of respondents (N=223)

	N	Minimum	Maximum	Mean	Std. Deviation
Age	223	18.00	49.00	29.3540	5.3939
Valid N (listwise)	223				

Table 1 above shows the minimum, maximum and mean age of respondents in all the three groups of participants in the study.

Table 2
Marital Status of respondents (N=223)

	Frequency	Percent
Married Monogamous	155	69
Married Polygamous.	19	8
Single(Never Married).	34	15
Divorced/Separated.	13	6
Widowed.	5	2
	223	100

Table 2 above shows the distribution of marital status of respondents. The highest number of participants were mogamously married (69%), while widows were the fewest (2%). the age range of those were never married was between 19 and 36 years.

Figure 2 below shows maternal education levels. Most of respondents had primary education five to eight (42%), with the fewest who had primary education level of one to four (13%). All the respondents were females, even when a child's father was present. Although some married women and other caretakers would give the child's father's level of education, which was recorded, it was noted that some respondents indicated there that the fathers were not in the household due to various reasons like widowhood, separation or never married. Table 3 shows paternal education level indicating completed secondary level education of 31% compared to 22% in the maternal education level. There was no maternal post-secondary education, while 7% was recorded in paternal education.

Figure 1
Maternal Education level

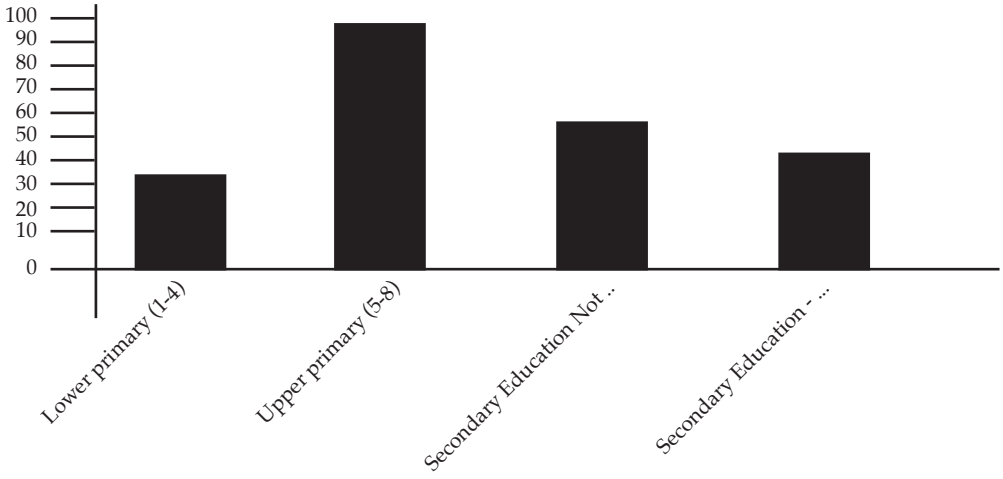


Figure 2
Readmission rate among respondents (N=223)

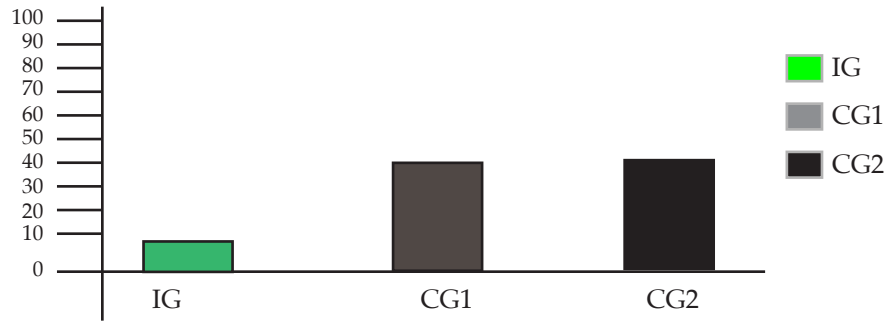


Figure 2 above shows the comparison of rates of re-admissions in the intervention group and the two control arms. The two control arms had a higher readmission rate than the intervention group.

The table below show that there is a significant difference between the admissions in the Intervention group (4) and those in the Control group 1-journalising (28). This is indicated by the resulting P (sig) value of 0.00, which is less than alpha (0.05) at 95% Confidence Interval.

Table 3a
Independent Samples Test - IG vs. JG1

	Levene's Test for Equality of Variances		t-test for Equality of Means						
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
Equal variances assumed	.599	.445	-18.892	30	.000	-23.53571	1.24581	-26.08000	-20.99143
Equal variances not assumed			-50.692	27.000	.000	-23.53571	.46429	-24.48835	-22.58308

The statistical results Table 3b below indicates that there is a significant difference between the re-admissions in the Control group 1(Journalising), and the control group 2. This is illustrated by the P-Value of 0.00, which is below alpha (0.05). Therefore the re-admissions in Control group 1(Journalising) and the control group 2 are significantly different.

Table 3b
Independent Samples Test – CG1vs CG2

	Levene's Test for Equality of Variances		t-test for Equality of Means						
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
Equal variances assumed	2.285	.138	19.651	41	.000	12.53571	.63792	11.24742	13.82401
Equal variances not assumed			27.000	27.000	.000	12.53571	.46429	11.58308	13.48835

The independent table above shows that the means of re-admissions between the Interventions group and the control group 2 are not the same. The P-Value of 0.00 indicates a strong significant difference between the two group means, hence a significant difference observed.

Table 3c
Independent Samples Test – CG1 vs CG2

	Levene's Test for Equality of Variances		t-test for Equality of Means						
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
Equal variances assumed	40.263	.000	-95.180	17	.000	-11.25000	.11820	-11.49937	-11.00063
Equal variances not assumed			-45.000	3.000	.000	-11.25000	.25000	-12.04561	-10.45439

The table above has a Levens' test sig. value of 0.00, which has a corresponding Equal variances not assumed, Significance value of 0.00 this value is less than alpha (0.05), which means that the means of the two groups, Control Group1 Journalising, and the control group 2 are statistically different.

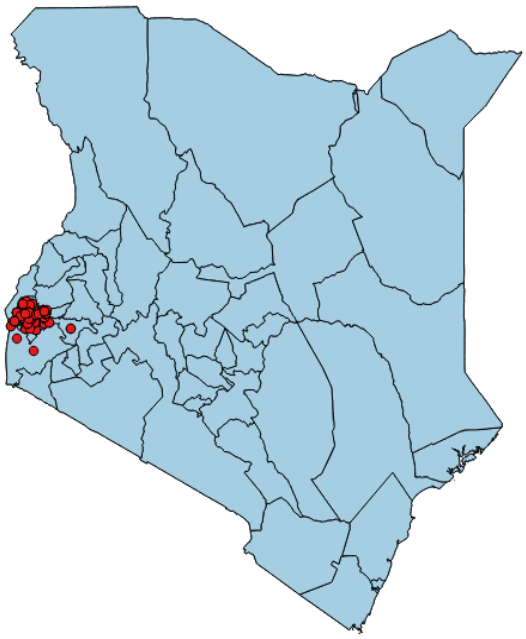
$H_0$1: that stated that the use of SMS messaging will not result in reduced re-admission rates when compared to standard post discharge care was rejected.

The table above indicates the association between text message satisfaction and the readmission rates in the intervention group in this study. It is shown that text messaging was effective and led to satisfaction by those in question. With significant relationships of p-Value 0.00, at 95% confidence interval, when the alpha is 0.05, proves that SMS messaging has led to reduced re-admission rates. From the intervention group, there were only four re-admissions, the least of the three study groups, with the other two, Control group one (Journalising) and Control group two were having 15 and 28 re-admissions respectively.

Spatial analysis on the physical distance between caregivers' home and health facilities with respect to post hospitalisation

Kenya Map showing the region from where the Participants were drawn

Figure 3
Siaya County Sample Distribution



The map above shows Nyanza Province in Western Kenya, where samples were drawn from. The region is charectirised with high infant mortarlity with amorbidity pattern mainly influenced by prevalence of Malaria, with a tropical humid climate.

Figure 4
Location vs. Sub-County hospitals

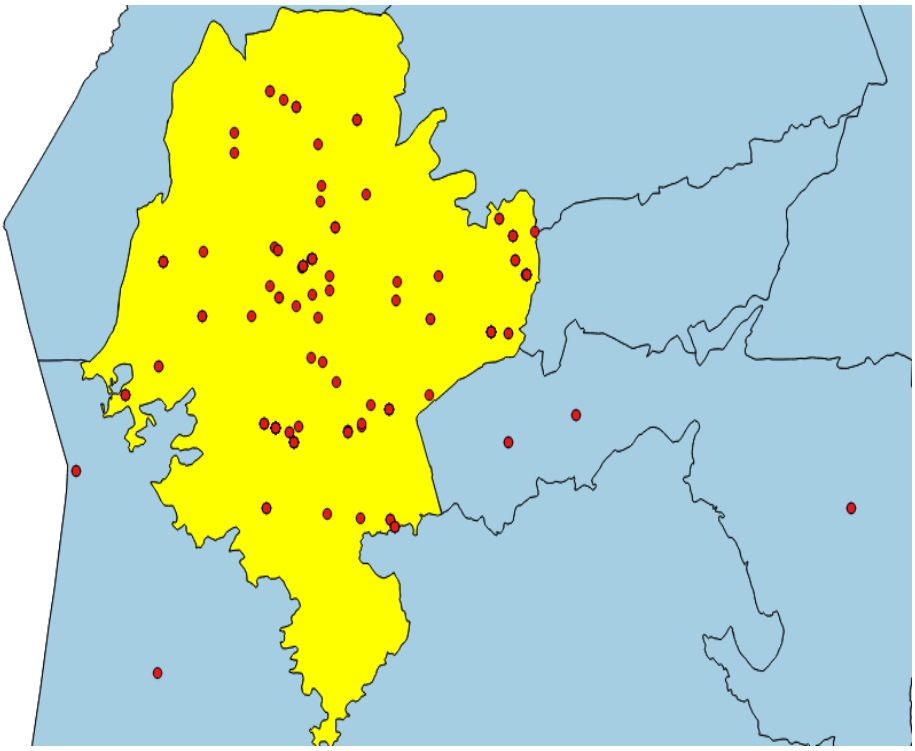
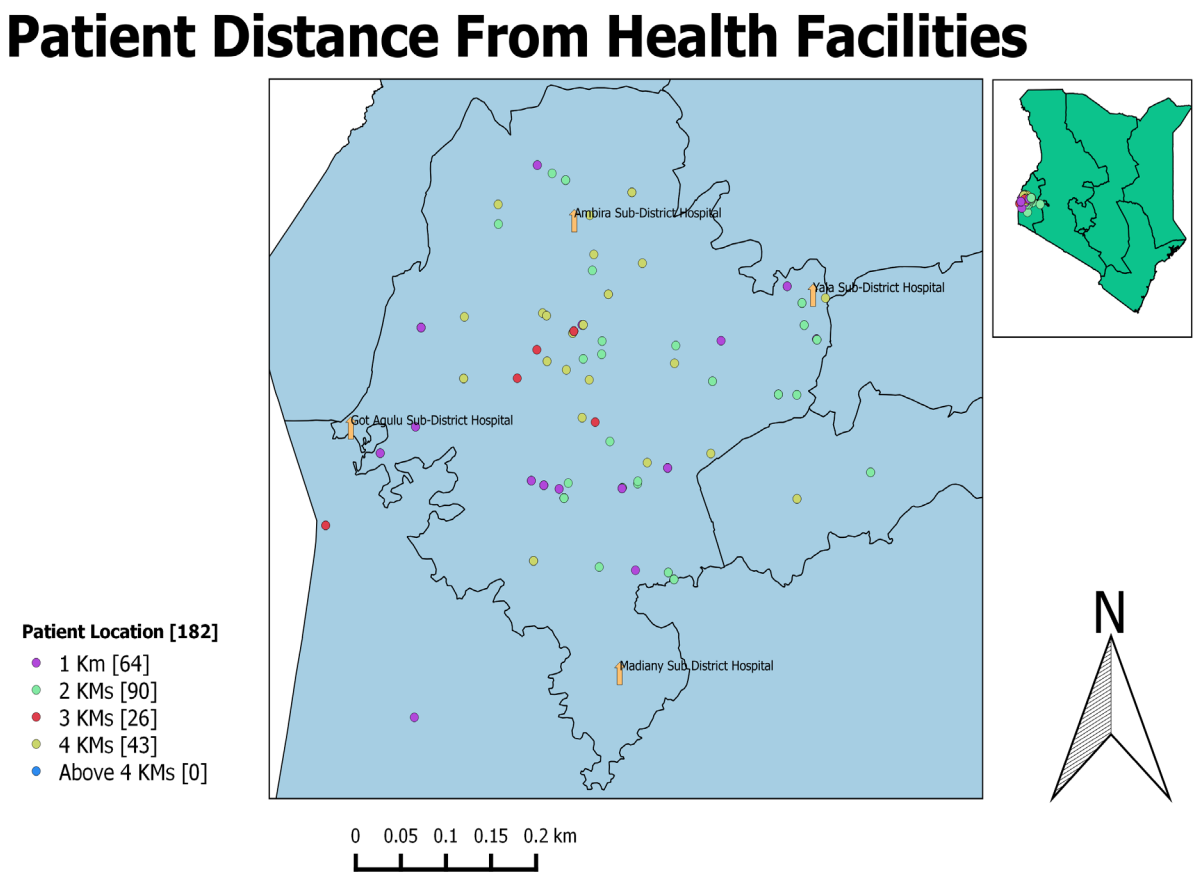


Figure 4 shows a map of Siaya County indicating some participants' home locations within the various Sub-Counties. The GIS analysis software, QGIS picked only the above homes based on the nearest landmark.

Figure 5
Home distance from health facilities



The map above shows the distance between the participants' home location and the health facilities. The Legend shows the distances and the map outlives the Sub-County facilities, which are the primary referral hospitals.

DISCUSSION

The study showed that involving parents in the transition process increases their ability and confidence. This was also confirmed in a study on Seamless Transitions and (Re)admissions (5)

The results from this study have given a clear pointer on the way forward in the reduction of re-admission rate among paediatric patients in Kenya. The respondents' minimum age was 18 years, with a maximum and mean age of 49 and 29.3 respectively. An observation was made in a study on Improving Patients' Post-discharge Communication indicated that the adoption of streamlined approach for communication, in which shared language is used by patients and all types of providers will trigger actions in post-discharge care (6).These tallies with the observation in this study, where it has been established that post-discharge SMS communication has a positive effect on post-discharge care.

The effect of post-discharge SMS messaging was measured through various statistical tests and the results show that there is a significant difference between the admissions in the Intervention group (4) and those in the Control group 1-journalising (28). This is indicated by the resulting P (sig) value of 0.00, which is less than alpha (0.05) at 95% Confidence Interval.

The results also indicate that there is a significant difference between the re-admissions in the Control group 1 (Journalising), and the control group 2. This is illustrated by the P-Value of 0.00, which is below alpha (0.05). Therefore the re-admissions in Control group 1(Journalizing) and the control group 2 are significantly different. H_0: 1, which stated that the use of SMS messaging would not result in reduced

re-admission rates when compared to standard post discharge care, was rejected.

In conclusion, the study found that there was a relationship between post-discharge SMS communication and rate of re-admission. It was also established that there was a relationship between post-discharge SMS communication and improved knowledge, efficacy in childcare as well as relationship with staff. Text messaging therefore was found to improve post-discharge follow-up care and eventual reduction in readmission rate. The researcher recommended that a similar study be done on adults to see if it could have the same effect.

Re-admission for adults has been subject for substantial research. However, readmission for children has received less attention. In order to understand potential opportunities to improve paediatric practice and reduce readmissions, information is needed on which diseases have the highest number of re-admissions and whether there differences in re-admission rates across hospitals, both government and private. It was recommended that a similar study be done on adult patients to see whether it works the same way.

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