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Full Length Research Paper

Influence of Communication Systems for Community-Based Referrals on Maternal Outcome in the Selected Districts of East-Central Uganda

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ABSTRACT: Many communication interventions in East – Central Uganda that have been aimed at increasing deliveries at health centres have proved to be futile. The innovation, communication and technology referred to as Closed Caller User Group (CUG) was introduced with the intention of reducing the communication gap between mothers and boda-boda riders for better community referrals to health centres. The study investigated the influence of communication systems for community-based referrals on maternal outcome (health centre deliveries) based on the observed increase in home-based deliveries with the aid of relatives and Traditional Birth Attendants (TBAs). A non randomized control trial intervention study design was conducted in Iganga and Bugiri districts of East – Central Uganda. The study population consisted of 375 respondents including mothers, boda-boda riders and health workers in the intervention arm and 358 in the control arm randomly and some purposively selected. Self-administered structured questionnaires, in-depth and key informant interviews and focus group discussions were used to collect both quantitative and qualitative data. Quantitative data were analyzed using STATA version 14. Thematic analysis was done using atlas Ti 7 software. Results revealed that communication systems had a statistically significant influence on deliveries at health centres (p=0.000). This implies that the more pregnant mothers were exposed to communication systems, the more they delivered from health centers (OR=4.173). For communication systems, possession of phones by mothers (OR=4.200, p=0.000) and time interval boda-boda rider took to respond when contacted (21 – 30 min, OR=0.124, p=0.002 and 31 – 60 min, OR= 0.003, p=0.000) had an influence on maternal outcome (deliveries at health centres). In conclusion, mothers and boda-boda riders, and the innovation of closed caller user group to bridge the gap of communication, has potentially addressed the challenges associated with community referral needs in rural settings.

Keywords: Communication systems; closed caller user group, maternal outcome, community-based referrals, east-central Uganda

INTRODUCTION

Great concern is attached to maternal outcomes; and according to the World Health Organization WHO (2013), antenatal care (ANC), deliveries under skilled personnel amongst others give a yard stick for daily estimation of deaths of mothers from preventable pregnancy and childbirth related causes at 1000. Patel *et al.* (2016) study about benefits and limitations of a community-engaged emergency referral system indicated that 99% of the deaths do occur in developing countries and only 1% is shared among all developed countries. Another report from WHO (2015) shows that about 3.6 million children die in the first four weeks after birth (neonatal period) annually, and 30.1 per 1,000 live births come from Africa. This is a sign to show unfair state of maternal outcomes which exists in the different parts of the world. In Uganda alone, UBOS (2017) report shows that the maternal

mortality ratio is at 336 per 100,000 live births. The report states further, that for each maternal death in Uganda, six survive with chronic and dilapidating health. According to Khalifa and Elaine (2015), the neonatal mortality rate in Uganda is at 21.4 per 1,000 live births. Basing on this picture on the ground, Ssebunya and Matovu (2016) commend the availability of referrals from community for expectant mothers to get into the health centres to deliver. This is in consideration that the first place for maternal referral is home to the health centre, then from one health centre to another.

A study by Prachi (2020) found out that communication promotes successful transmission of ideas or any other important information to people in communities and enhances acquisition of services as urgently as possible. Owing to this, the endeavor to investigate into exchange of information/messages through a closed caller user group (CUG) in the study was a step in the right direction.

Patel *et al.* (2016) established that 77% of the people facing communication challenges are mothers and 48.2% of these are in rural communities. Mandu and Matheson, (2019) established that in certain parts of the world, communication is a problem due to cost of mobile phones while in some societies, mothers are not aware of the efficacy of communication for maternal purposes. Telhealth, (2019) report indicates that around 20% of the United States lives in rural areas, which makes it difficult to administer healthcare to these patients on a timely basis, and thus enhancing the role of effective communication.

Malande (2019) found out that in Uganda, about 37% of the pregnant mothers in rural areas do not possess mobile phones to ease communication with boda-boda riders and drivers of ambulances to health centres. Malande (2019) added that in some instances, pregnant women do not have telephone numbers of people who can help them accordingly. In other words, there is very limited information about the need for a mother to communicate to drivers of ambulances directly for transportation services. Consequently, the mothers who lack transport to antenatal or delivery centres end up not getting the required services. STANAG (2020) report states that the RESCUER project was introduced in Uganda with a solar-powered VHF radio communications system with a fixed base station at health centres and walkie-talkies for TBAs. However, its impact was not literally felt leaving most of the Maternal and Child Health (MCH) indicators bothering the country. This affects the number of mothers who opt to deliver in health centres under skilled health personnel.

Allen and Keohanne (2016) noticed challenges in maternal referrals despite the availability of road signs/flags, telephones, radios, televisions (TVs), internet access, and telemedicine. This study aimed at introducing the exchange of information between mothers and the boda-boda riders for transport at no cost through a closed caller user group (CUG). Motorcycle (boda-boda) riders are commercial riders with the core value of transporting people (pregnant mothers inclusive) for a financial gain. Therefore, appropriate communication systems for mothers to be transported in time to health centres during obstetric emergencies were established. In addition to phones and transport means, this study considers humans as a sub component of a communication system termed as “Physical Information Delivery System” and these included; the health workers, village health teams (VHTs), mothers and their partners, drivers and riders, and other people, and how they can pose an effect on maternal referrals from the community.

METHODS AND MATERIALS

Research design

The study used a 2 arm cluster non randomized control trial study design; with an intervention and control group from the selected districts and sub counties where some health centres and communities as the units of non-randomization were selected. Non-randomized trials are interventional study designs which compare a group where an intervention was performed with a group where there was no intervention.

Selection criteria of study districts

The selection of the districts was based on the already existing services of the motorcycle ambulances. These ambulances were a donation from non government organisations. In the East – Central region, the motorcycle ambulance services were only in the districts of Iganga and Bugiri but its operation was not good.

Selection criteria of study sub-counties

Like the districts, sub counties were selected based on the already existing services of the donated motorcycle ambulances. Motorcycle ambulances were operating in only four sub counties; that is, three in Iganga and one in Bugiri districts.

The 4 sub-counties in the intervention arm were purposively chosen because of the motorcycle ambulance services which were offered in the purposively selected districts of Iganga and Bugiri. These included; Nawandala, Nabitende and Nambale sub counties in Iganga district and Budaya Sub County in Bugiri district. However, in the control arm, four (4) sub counties were selected out of the twenty four (24) sub counties in the two districts of Iganga and Bugiri. These sub counties included; Nawaningi, Ibulanku and Makuutu in Iganga and Nabukalu sub county in Bugiri district whose geographical characteristics are similar to those in the intervention arm.

Selection criteria of study health centres

A total of 10 health centres; 8 of which were from Iganga and 2 from Bugiri, were selected for both the intervention and control arms. These were specifically health centre IIIs and IVs respectively. These health centres were purposively selected because they are the only health centres according to the ministry of health structure which are permitted to conduct deliveries in the selected sub-counties. Also some of these health centres were experienced in community trials and it was an added advantage to this study. An average of 25 deliveries was expected in each health centre selected for this study per month; a six months period was deemed enough for completion.

The closed caller user group – CUG

Realizing the need for a clear channel of communication between the riders and mothers as well as VHTs and health workers, the researcher appreciated the need to cover the communication gap through training and the initiation of a closed caller user group (CUG). Training was conducted at sub counties for the boda-boda riders and health centres for mothers. A total of 375 users were registered in the CUG. Having one's telephone number registered onto this caller group enabled him/her to make telephone calls free of charge to all other registered users strictly on the MTN network. Additionally, the users were also given bonus airtime of Uganda shillings 10,000 (Ten thousand shillings) to enable their communication to other network users whenever the need arose. Prior to the operationalization of the CUG, all the selected users underwent intensive training through which they were equipped with knowledge on the mode of operation and benefits of the CUG in addition to other MCH related topics that emphasized the participants' respective roles in MCH and maternal referral.

The main aim of the CUG was to streamline communication amongst key players in the referral chain to quicken the maternal referral process which would in turn positively impact on maternal and neonatal outcomes. The CUG lasted for a period of 6 months during the study. Particulars of pregnant mothers were captured in the tracking log by the midwives during ANC at the health centres. Telephone numbers of potential CUG members were registered and shared amongst participants during their training and health education sessions. These were later confirmed by the research team and shared amongst the CUG members at the beginning of the intervention. Telephone contacts of riders were availed to mothers during ANC visits and trainings. The CUG was exhaustively utilized in times of emergency and delivery to the benefit of mothers and the community. The display of boda-boda riders' contacts in health centres also benefitted the community since people outside this study also made use of this opportunity to acquire and utilize telephone contacts of the riders for transport services. Training of the riders together with other players on the referral chain coupled with the introduction of the CUG were an effective combination in quickening the referral process; thereby increasing number of deliveries in the study health centres of east – central, Uganda (Table 1).

Study population

The study population consisted of mainly pregnant mothers in their third trimester and boda-boda riders from East – Central Uganda and specifically in the districts of Iganga and Bugiri. 503 mothers (255 in the intervention arm and 248 in the control arm) were selected from 14,430 projected populations of expectant mothers in the region (MOH, 2017). The investigator aimed at improvement in the utilization of health centre and skilled deliveries. Similarly, 192 boda-boda riders (100 in the intervention arm and 92 in the control arm) were selected from 2,231 estimated populations of boda-boda riders according to the boda-boda associations' data (2017) in Iganga and Bugiri districts (un-published data). However, other stakeholders included midwives and VHTs. 12 of the 138 midwives in the intervention arm and 8 of the 112 midwives in the control arm at the different health centres were selected (HRIS, 2017 data at DHO's office un-published). Also, 18 VHTs (8 in the intervention arm and 10 in the control arm) were selected from the 965 VHTs from 193 villages of the selected intervention and control sub counties.

Inclusion criteria for participants

(a) Pregnant mothers in their 3rd trimester.
(b) The participant must be a female member of one of the villages in the study districts.
(c) Pregnant mothers who must be willing to participate in the community trial.
(d) Motorcycle (boda-boda) riders belonging to one of the selected stages and willing to participate in the community trial. These riders must have worked at that stage for at least three months.
(e) Health workers willing to participate in the study and working in ANC, postnatal care (PNC) and maternity ward/department at the selected health centre for at least 6 months prior to the commencement of the study.
(f) Mothers with a personal telephone contact (or that of their husbands / next of kin) for the registration into the closed caller user group and easy follow up.

Exclusion criteria for participants

(a) Pregnant women with visible signs and symptoms of mental instability and those terminally ill could not be trained and were excluded from participating in the study.

Table 1: Categories of participants in the CUG (intervention) and control arms.

Categories of respondents	Total number of respondents		Sub counties of intervention	Sub counties of control
	Intervention	Control		
Boda-boda riders	100	92	Budaya, Nawandala, Nabitende and Nambale sub counties	Nabukalu, Ibulanku, Makuutu and Nawaningi sub counties
Health workers	12	8		
Mothers	255	248		
VHTs	8	10		
Total	375	358		

(b) Motorcycle (boda-boda) riders who did not have telephone contacts through which mothers could contact them in the intervention arm were also excluded from participation in the study. This was not considered for the control arm.
(c) In addition, boda-boda riders with known history of indulgence in crime whom community members voluntarily reported to police and informed the investigation team were as well excluded from the study.
(d) All male health workers and nurses were left out at all health centres in both the control and intervention arm.

Research instruments

Questionnaire

Self-administered structured questionnaires were administered to the consenting respondents (mothers) at the health centres and boda-boda riders at the sub counties during training to capture mainly the quantitative data. Questionnaires were filled by the research assistants for respondents who did not know how to read and write.

Interview guide

This was done to guide Key Informant Interview (KII), In-Depth Interviews (IDI) and Focus Group Discussions (FGDs) or community dialogues. An interview schedule was made for some respondents who were considered to have vital information. Ideally, there was a verbal interaction with one or more persons at a time and responses were recorded. Open-ended questions were prepared in the interview guide and used to obtain qualitative data.

Data analysis

Data analysis of descriptive statistics was computed using STATA *version* 14 for the quantitative data. Paired t tests of independence were used to determine the statistical significance of the different variables with the *p*-value set at 0.05 and confidence interval (CI) at 95 percent. Atlas Ti *version* 7 was used for qualitative analysis. It involved re-reading the interview transcripts to identify themes and sub themes that emerged from the respondents' answers during the FGDs, KIIs and IDIs. The arrangement for analysis was based on the topics and questions formulated for the interviews in order to synthesize the answers to the proposed questions. Topics and questions were designed according to the study objectives from which themes and sub themes were extracted. Relevant quotations were used to validate the quantitative findings. Purposely, it enabled the description of the effect of training mothers and boda-boda riders on maternal outcome.

RESULTS

The communication system that is most appropriate for referrals to boost maternal outcome (deliveries at HCs)

Communication systems were based on seven variables used to establish influence on deliveries at health centres as an outcome of community-based referrals in the selected districts in the East – Central Uganda (Table 2). Communication systems for mothers to contact boda-boda riders were subjected to logistic regression analysis and results were as seen in Table 2. Results show that there was a statistical significant influence of communication systems on deliveries at health centres. Pregnant mothers who accessed the communication systems were 1.173 times more likely to deliver from health centres compared to those who did not access the communication systems (p=0.001; CI=0.760 – 4.501). This implied that when mothers got exposed to the communication systems, the deliveries in health centres increased.

Considering specific variables, mothers possessed phones to determine the effect on maternal outcome (deliveries from health centres). From the results in Table 2, there was significant influence of phone possession on deliveries in health centres (p=0.003). Mothers who possessed phones were 3.813 times more likely to deliver from a health centre compared to those without phones (p=0.003; CI=1.559 – 9.324).

Table 2: Communication systems and its association with maternal outcome (health centre deliveries).

Predictive variables		Odds ratio (95%)	P-value
Category	Control	*1*	
	Intervention	1.173 (0.760, 4.501)	0.001
Communication 1		3.813 (1.559, 9.324)	0.003
Communication 2		1.110 (0.544, 2.566)	0.466
Communication 3		1.372 (0.500, 3.764)	0.539
Communication 4	Husband	1.604 (0.661, 3.896)	0.297
	Friend/VHT	4.166 (0.743, 23.343)	0.105
	Relative	0.211 (0.051, 0.868)	0.031
	Neighbor	*1*	
Communication 5	Phone call	*1*	
	Send a message	7.963 (1.242, 51.055)	0.029
	Send a person	10.561 (1.377, 80.965)	0.023
	I walk to them	39.117 (4.380, 349.383)	0.001
Communication 6.	5 –20 min	*1*	
	21-30 min	0.344 (0.189, 0.626)	0.000
	31-60 min	0.027 (0.007, 0.103)	0.000
Communication 7.	Phone switched off	*1*	
	No network	0.828 (0.379, 1.812)	0.637
	Does not pick phone call	15.616 (5.109, 47.729)	0.102

Communication1: Possession of phones by mothers.
Communication2: Loading of airtime on phones of mothers.
Communication3: Use of another person's phone to communicate to the boda-boda rider.
Communication4: Relationship between the owner of the phone and the mother.
Communication5: Ways mothers use to communicate to the boda-boda riders.
Communication6: Time interval taken for the boda-boda rider to arrive when contacted by the mother.
Communication7: Challenges faced by mothers in communication.

Therefore, the more the mothers got exposed to phone possession, the more deliveries were experienced in health centres.

"…Fortunately, with this study, majority of mothers recruited had their own phones despite the fact that only one telecommunication network was needed."

A midwife who worked as a maternity in-charge (respondent 24, 2019) narrated. She further explained that very few mothers registered other people's numbers for easy communication especially for the follow up.

"…Most of the mothers who had no phones were able to register numbers of other people. These mothers included those who had no MTN numbers. But they were not very many."

This was stated during an in-depth interview in the intervention arm. There was no difference in the control arm according to the in-depth interview with one of the midwives (respondent 28, 2019) who was also recruiting mothers for the study.

"…Mothers possessed phones. They had different numbers of telecommunication networks. However, most of them had Airtel and MTN lines."

Having explained phone possession and its effect on the maternal outcome, mothers were then asked if they loaded airtime on their phones; thereby enabling the study to establish the relationship between having airtime on phone and the maternal outcome. Mothers who loaded airtime on their phones were 1.110 times more likely to deliver from health centres than those who did not load airtime but had no statistical significant influence (p=0.466; CI=0.544 – 2.566). The improvement in the number of mothers loading airtime on phones and the deliveries at health centres was supported by the different stakeholders in the in-depth interviews.

"…Sensitization of mothers was continuously done during antenatal care by health workers at health centres and VHTs in the community.

Some of us know the importance of having airtime on phone." This was during an in-depth interview with a mother in the intervention arm (respondent 22, 2019) who gave birth from a health centre.

The mother loaded her phone with airtime to call the boda-boda riders for transport to the health centres even after receiving the bonus airtime. From an in-depth interview of the same mother in the intervention arm; several reasons for loading phones with airtime were given.

"…The ten thousand airtime is little and not limited to calling any telecommunication network. I used it to call even people outside the study. However, with the knowledge attained, my phone was to have airtime all the time, so I had to load it." A mother said.

However, some of the participants registered in the CUG continued to enjoy the privilege of the free calls to everyone who was in the caller group. Notable among these was a midwife in one of the health centres in the intervention arm who was stranded with a mother at 2am who had obstructed labour and was referred to Iganga General Hospital for further management but with no readily available transport means to effect the referral. Upon calling a member on the research team, the efforts made to help this mother were fruitful. This was eased by the existence of the CUG through which its users made telephone calls free of charge.

It was a little different in the control arm where the boda-boda riders were not trained and registered in the CUG. Regardless of having the health workers in the CUG for easy communication with the research team, it was not easy for mothers to get boda-boda transport especially at night because they were all not registered in the CUG. Midwives in the control arm faced difficulties in communicating with boda-boda riders and VHTs whenever the need for transport for maternal referrals arose.

"…I made a phone call to one of the research assistants for coordination of transport to save the mother and indeed I was successful. You know, it is difficult to get transport here. Even boda-boda riders are difficult."

A midwife at Makuutu health centre III in the control arm narrated in an in-depth interview following the scenario of saving the mother with transport to the main hospital.

"…I don't know how we can tame these boda-boda riders to help mothers with transport to health centres." She continued.

The use of another person's phone to contact the boda-boda riders to have effect on maternal outcome was not different from loading airtime. Statistically, using another person's phone did not have influence on deliveries at health centres as seen in Table 2 (p=0.539); though a mother who used another person's phone to contact the boda-boda rider for transport to the health centre was 1.372 times more likely to deliver from a health centre (p=0.539; CI=0.500 – 3.764).

Generally in the entire study area, it was clearly noted that other people had phones which mothers could use to contact boda-boda riders. These included; the spouses (husbands), relatives (who included siblings, parents and in laws), friends and even the VHTs. For mothers who did not possess phones, very few used friends' and relatives' phones to contact boda-boda riders. Majority of mothers used their husbands' phones to contact the boda-boda riders for transport. During an in-depth interview with a midwife in the intervention arm (respondent 23, 2019), she stated that with the exception of few mothers, most mothers possessed phones.

"…Few of the mothers do not have phones. Some mothers say phones were spoilt. They opted to register the husbands' telephone numbers. Much as some of them were not comfortable using their husbands' contacts for communication," she narrated.

This study further established the influence of the relationship of the pregnant mother with the person who assisted her to use the phone to communicate to the boda-boda rider for transport to the health centres on deliveries at health centres. Considering deliveries conducted in health centres, there was a strong influence of the relations the mothers had with the owners of the phones used to contact the boda-boda riders for transport to the health centres on the deliveries at health centres. More people with phones close to pregnant mothers were still needed to help mothers to deliver in health centres. Pregnant mothers who had registered to use husbands' phones to communicate to the boda-boda riders for transport to the health centres were 1.604 times more likely to deliver from health centres compared to those who registered phones not belonging to their husbands (p=0.297; CI=0.661 – 3.896). However, it had no statistical significant influence on deliveries at health centres. Supportive information was captured during the focus group discussion in the intervention arm.

"…We are all people of the same village. We need to help one another. Today is me and the other day will be you. Therefore, let us help each other in all ways to enable mothers go to health centres."

This was one member during a FGD in the intervention arm.

"…Really, I cannot see my wife interested in calling a boda-boda rider for transport to a health centre and I refuse to give her a phone. Whose baby is she going to give birth to? Men get serious."
A male VHT in that same FGD in the intervention arm added.

Similarly, pregnant mothers who had friendship with persons whose phones were registered to communicate to the boda-boda riders for transport to the health centres were 4.166 times more likely to deliver from health centres compared to those who were not friends (p=0.105; CI=0.743 – 23.343) and had no statistical significant influence. Pregnant mothers who had relatives whose phones were used to communicate to the boda-boda riders for transport to the health centres were 0.211

times more likely to deliver from health centres compared to those with no relatives (p=0.031; CI=0.051 – 0.868) and had a statistical significant influence.

This study tested the approaches which mothers used to communicate to the boda-boda riders for transport to the health centres. These included; making a phone call, sending a message, sending a person to the boda-boda stage or walking to the stage. From the findings in

Table 2, approaches of communication to the riders by the pregnant mothers statistically significantly had influence on deliveries at health centres.

Phone calling as an approach used to contact boda-boda riders had no influence on health centre based deliveries.

Pregnant mothers who sent telephone messages as an approach to use to contact boda-boda riders for transport to health centres, were 7.963 times more likely to deliver from health centre compared to those who could not afford to send a telephone message (p=0.029 CI=1.242 – 51.055). Sending messages statistically had significant influence on deliveries at health centres. When pregnant mothers got exposed to message sending, deliveries at health centres improved.

Similarly, a mother sending a person as an approach to contact a boda-boda rider for transport were 10.561 times more likely to deliver from a health centre compared to those who did not send people (p=0.023; 1.377 – 80.965). Sending an individual to contact a boda-boda rider statistically had significant influence on deliveries at health centres as shown in Table 2. Finally, for the approaches used by mothers to communicate, walking to the boda-boda stage was 39.117 times more likely to enable mothers deliver at health centres compared to other approaches (p=0.001; CI= 4.380 – 349.383). Walking to the stage had a statistically significant influence on deliveries at health centres. Mothers later on knew the importance of calling boda-boda riders for transport, sending messages, sending someone to the stage and walking to the boda-boda stage for transport to health centres.

"…Initially, I used to walk to the boda-boda stage when I was to go to the health centre. For sure I was a little lazy. But when the study included me in the caller group, I called and directed the boda-boda rider to my home when I had a complication with my pregnancy. It was the same when I went to deliver."

This was narrated by a mother during an in-depth interview (respondent 28, 2019) in the intervention arm. However, in the control arm, it was slightly different. Most of the mothers did not call boda-boda riders for transport to the health centres; they instead walked or sent someone to the stage.

*"…I'm used to walking to the boda-boda stage or sending one of my children to call the boda-boda riders"...*A grown up mother (respondent 29, 2019) stated. She further explained that she had no phone since it got spoilt, and therefore had no other options to get boda-boda riders apart from sending some body or walking to the stage.

"…The advantage is that the stage of boda-boda riders is near; I can force myself to walk to them and they take me to the health centre. After all, my husband who has the phone is not always at home. Therefore, calling boda-boda riders for transport is very difficult. Also, they are difficult people to be called"... This was during an in-depth interview with a mother in the control arm (respondent 43, 2019).

When boda-boda riders were contacted by mothers for transport to the health centres, they took different time intervals to arrive. Some took less than 20 minutes, others between 20 – 30 minutes, 31 – 60 minutes and above 60 min. According to the results of the study, time taken for the boda-boda riders to arrive when contacted by the mothers had influence on the maternal outcome as seen in Table 2. Generally, time taken for the boda-boda rider to arrive when contacted by the mother had a statistically significant influence on the deliveries at health centres. The 5 – 20 minutes interval which boda-boda riders took to arrive when contacted by mothers had no influence on deliveries at health centres. It was quite different for the other time intervals boda-boda riders took to respond to mothers' calls when contacted.

Pregnant mothers who contacted boda-boda riders for transport to health centres and took 21 – 30 minutes to arrive were 0.344 times more likely to deliver from health centres compared to those who arrived in different time intervals (p=0.000; CI=0.189 – 0.626). Statistically, 21 – 30 minutes interval significantly had influence on deliveries at health centres as seen in Table 2. The time interval of 31 – 60 minutes had no difference with time interval of 21 – 30 minutes. Pregnant mothers who contacted boda-boda riders for transport and it took them 31 – 60 minutes to arrive, were 0.027 times more likely to deliver from health centres compared to those who arrived in the different time intervals with statistical significant influence (p=0.000; CI=0.007 – 0.103). During a FGD in the intervention arm specifically in the pre intervention phase, boda-boda riders were encouraged to be quick and respond whenever a mother contacts them.

"…Do not take much time to go to mothers whenever they call you. Just know, that is a hard moment especially when in labour. Mothers cannot walk at that time. These are our relatives, wives, daughters and sisters. Learn to rush to them." One of the members of the group urged colleagues.

During the period when mothers contacted boda-boda riders, mothers experienced very many challenges in their communication. These included; boda-boda riders switching off their phones, poor network and boda-boda

riders not picking calls of mothers, amongst others. These challenges directly had effect on the maternal outcome. Challenges faced in communication to boda-boda riders by mothers in relation to deliveries at health centres were not very different from time intervals. Boda-boda riders switching off their phones had no influence on health centre based deliveries. However, lack of network affected mothers not to access boda-boda riders for transport to health centres. Similarly, when boda-boda riders refused to pick phone calls when contacted, it affected deliveries in health centres. However, mothers found others means of reaching the health centres. Pregnant mothers whose calls were not picked by boda-boda riders were 15.616 times more likely to deliver from health centres compared to mothers who experienced other challenges but had no statistically significant influence (p=0.102; CI=5.109 – 47.729). During the focus group discussions, most of the challenges discussed above were highlighted.

"…The problem we face in calling for transport is the network and also boda-boda riders switching off their phones and not picking calls at night." A mother said during a FGD in the post intervention phase.

Communication systems as predictors of maternal outcome (deliveries at health centres)

The study further aimed at establishing the predictors of deliveries at health centres in the East – Central Uganda. The study subjected communication system variables that showed significant influence on the maternal outcome to a multiple logistic regression analysis and results were presented in Table 3. The regression model was automatically generated at 95% confidence interval leaving the acceptable error at less than 0.05. Results also helped to test the null hypothesis of the study. There was a statistical significant influence of communication systems on deliveries at health centres (p=0.000). The null hypothesis that communication systems for community based referrals do not have a significant influence on maternal outcome in the selected districts of East – Central Uganda, at this point was rejected. Pregnant mothers exposed to the communication systems were 4.173 times more likely to deliver from health centres compared to those without access to the communication systems. The implication is that exposure of mothers to the communication systems improved deliveries at health centres. Possession of phones by mothers and the time interval taken by boda-boda riders to arrive when contacted statistically and significantly had influence on maternal outcome ($p < 0.05$). Mothers who possessed phones to contact boda-boda riders for transport to health centres were 4.200 times more likely to deliver from health centres compared to mothers who had no phones and had a statistically significant influence (p=0.000; CI=2.063 – 8.552). As pregnant mothers possessed phones, deliveries at health centres improved. The time interval of 5 – 20 and 60 and above minutes had no influence on deliveries at health centres. Basically, 21 – 30 minutes interval which boda-boda riders took to arrive when contacted had a statistical significant effect on deliveries at health centres. Pregnant mothers whose boda-boda riders arrived in 21 – 30 minutes were 0.124 times more likely to deliver from health centres and had a statistical significant influence (p=0.002; CI=0.034 – 0.452). Similarly, pregnant mothers whose boda-boda riders arrived in 31 – 60 minutes when contacted were 0.003 times more likely to deliver from health centres and with a statistically significant influence (p=0.000; CI=0.001 – 0.022).

DISCUSSION

The number of mothers who possessed phones to contact the boda-boda riders for transport to health centres had a significant relationship with deliveries at health centres ($p<0.05$). According to several studies conducted (Patel *et al.,* 2016; PATH, 2013; MOH, 2014), mothers have not been given phones for communication. This is how rural mothers have been missing to contact the ambulance drivers and riders. In the East – Central region, majority of mothers were mobilised and sensitised about the CUG and those with phones were recruited for the study and results showed increased use of boda-boda riders for transport to health centres especially during the time for delivery.

However, for the mothers to call the boda-boda riders, they were supposed to use the free calls when registered in the CUG or load their phones with airtime. Mothers also received bonus airtime of ten thousand shillings (Uganda shillings) in addition to the free calls made to other members who were registered in the CUG. Sensitisation of mothers was continuously done during antenatal care by health workers at health centres and VHTs in the community. Some mothers loaded their phones with airtime to call the boda-boda riders for transport to the health centres. Despite the fact that mobile phones play different roles when it comes to healthcare (PATH, 2013), no single study pointed at loading airtime on these phones; yet free airtime can be an incentive. Process theories of motivation, motivates individuals or organisations with financial incentives to influence results (El-Jardall *et al.,* 2011). There was need to constantly load airtime for mothers on their phones which the East – Central study missed. The bonus airtime was loaded once and it affected the utilisation of boda-boda transport by mothers to health centres. Much as majority of the mothers possessed their own phones, some of them used other people's phones to communicate. In 1997, China designed a communication system to respond to emergencies in hospitals specifically

Table 3: Communication systems as predictors for maternal outcomes.

Predictive variable		Odds ratio (95%)	P-value
Category			
	Control	*1*	
	Intervention	4.173 (0.960, 32.661)	0.000
Communication 1		4.200 (2.063, 8.552)	0.000
Communication 4			
	Relative	0.431 (0.151, 0.784)	0.051
	Neighbor	*1*	
Communication 5			
	Phone call	*1*	
	Messaging	0.678 (0.046, 10.030)	0.778
	Send a person	0.097 (0 .004, 2.239)	0.145
	Walking to them	0.030 (0.001, 1.165)	0.060
Communication 6			
	5-20 minutes	*1*	
	21-30 minutes	0.124 (0.034, 0.452)	0.002
	31-60 minutes	0 .003 (0.001, 0.022)	0.000
	60+ minutes	*1*	

Communication1: Possession of phones by mothers.
Communication4: Relationship between the owner of the phone and the mother.
Communication5: Approaches mothers use to communicate to the boda-boda riders.
Communication6: Time interval taken for the boda-boda rider to arrive when contacted by the mother.

in Shenzhen, but mothers did not directly call the vehicle ambulance driver, they instead called the control centre as it was a hotline (Shuk *et al*., 2012). Similarly, it was very difficult for the vehicle to move beyond the radius of 3 – 5 km, yet the area of coverage was very big (Shuk *et al*., 2012). Therefore, mothers who had no phones could use another person's phone to call for transport. This seemed easier because of the hotlines which did not require airtime. This was quite different in East – Central Uganda, whereby the person assisting the pregnant mother had to load airtime in order to call the boda-boda rider for transport. Another person's phone was not registered in the closed caller user group which would have acted as an incentive for better utilization of boda-boda transport to health centres as further explained by the theories of human motivation (Goodman, 2011).

For mothers who did not possess phones, very few used friends' and relatives' phones to contact boda-boda riders. Like in China, majority of mothers in East – Central Uganda used their husbands' phones to contact the boda-boda riders for transport. As responsible people, husbands were obliged to prioritize assisting mothers to reach health centres for maternal services in accordance with the agenda setting theory (Shaw, 1979).

The study was to find out the approaches used by mothers to contact the boda-boda riders. Many options were in place which included; phone calls, sending a telephone message, sending a person to the boda-boda stage or the mother walking to the stage. The most used approach was phone call. Majority of the mothers made phone calls to the boda-boda riders for transport to health centres. The rest of the mothers walked to the stage or sent someone to pick the rider. In most studies, phones were a common means of communication used (Shuk *et al*., 2012) as reflected by the East – Central region study in Uganda.

Most of the mothers estimated 21 – 30 minutes for a boda-boda rider to arrive at the homes of mothers when they called for transport to the health centre. The time taken by the boda-boda riders to arrive when mothers called them had a statistically significant influence on the deliveries conducted at the health centres ($p<0.05$). In Malawi, radio-telephones were used in health centres. The use of radio-telephones in the mother care project in Malawi helped to handle the "second delay" as it helped to reduce average transport delays from six hours to three hours (Khalifa and Elaine, 2015). This was not equally very good to mothers who were experiencing labour or pregnancy related complications. When the boda-boda riders got trained in maternal and child health services, they improved on the time of responding to the mothers' calls for transport to the health centres. Therefore, it was rightly decided to train mothers and boda-boda riders to improve community-based referrals for increased deliveries from health centres. This was in line with the individual differences theory where individuals retain information and change the perceptions as supported by Chris-Otubor (2015).

The possible challenges mothers faced when communicating to boda-boda riders for transport included

the following; the phones of the boda-boda riders being switched off, no network or signals for particular locations, the boda-boda riders not picking the phone call and others. The integrated communication system during times of emergencies for referral in rural communities in developing countries especially in the Sub Saharan Africa and Asia is inappropriate if not lacking (Patel *et al.,* 2016). It hinders service delivery, especially to the rural population. This is because of the unfavorable environments (networks) for the known types of communication systems to be effected. Unfavorable conditions in the East – Central study were detected, especially poor networks for the phones.

Conclusion

The innovation, communication and technology of the closed caller user group (CUG) has demonstrated its potential in addressing the challenges associated to community referral needs. Phone possession by mothers and timely arrival of boda-boda riders when contacted for transport services can ably reduce on the maternal and neonatal deaths that are often times caused by inadequate referral and transport delays to reach the health centres in rural settings. The caller group has the potential to address the communication and transport linkage gaps in the maternal health structure of the health system for low resource countries.

Recommendations

(i) Instead of the closed caller user group, a communication App can be designed and installed on users/mothers' phones. The communication App will be continuously utilized by mothers compared to the CUG which is managed centrally by the telecommunication company after payment is made.
(ii) This study should be expanded to more sub counties and districts regardless of the inclusion criteria at all levels. The study impact was exhibited in the shortest time of community involvement especially in the area of intervention. This study was in only two districts out of 16 districts in the region.

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Authors' declaration

We declare that this study is an original research by our research team and we agree to publish it in the journal.

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