Original Research Article

ASSESSING THE INFLUENCE OF COMMUNITY HEALTH WORKERS ON UPTAKE OF MATERNAL HEALTH SERVICES IN MUSANZE DISTRICT, NORTHERN PROVINCE, RWANDA

ABSTRACT

Background: Community-based initiatives are a worldwide policy that guarantees that key health services are available and accessible closer to the community. CHWs are an important element of healthcare services in Rwanda. Community health workers integrate individuals of their communities to provide preventive, habitual, and emergency maternity healthcare requirements. Maternal health is still a challenging to the achievement of SDGs by 2030 in the health-care sector compared with the effort provided by CHWs. The aim of this research was to assess the influence of community health workers ' on the uptake of maternal health services in Musanze District. **Methods:** The study design used was an analytical cross-sectional study design utilizing both quantitative and qualitative methods. This research was cross-sectional because it examined the exposure and outcome at a time. In this study, a simple random sample approach was employed to choose 208 CHWs and 16 CHWs' supervisors were interviewed for qualitative data (KII). The statistical tool for social sciences (SPSS) Version 26, was used to examine the data. Categorical variables were summarized with descriptive statistics for frequencies and percentages. Bivariate analysis with the Chi-square test of independence was used to check the association between both dependent and independent variables. Ordinal logistic regression was used as the most suitable inferential statistic because the predictor variables and the dependent were ordinal variables. Qualitative data were analyzed by NVIVO version 10. CHWs 208 participated in the study and all were female.**Results**:This study found that the uptake of maternal health services was regarded as very high.CHWs 85.1% were knowledgeable on the warning signs of an emergency among pregnant mothers, and 89.4% reported that they would act based on these warning signs. CHWs had necessary training to provide care to pregnant mothers with p*=. 001.Skills that CHWs have on administration of misoprostol to prevent post-partum hemorrhage was significant with p*<.001. Factors that influenced uptake of maternal health services were CHW's regular supervision with p*=.001, provision of transportation p*=.001, regular refresher training p* =.002, and motivation/incentives p*=.001, as they were associated with the performance of CHWs towards uptake of Maternal Health care services. The research recommends improvement of maternal health services through access to contraception, antenatal care, and postnatal care, with particularly scale-up key motherly health services, regular training and supervision for CHWs, governmental support in terms of motivations of CHWs.

Key words: AssessingInfluence of Community health workerson uptake of maternal health services.

1. INTRODUCTION

One of the most urgent global health problems is maternal health, particularly in low- and middle-income countries, where 99% of all maternal deaths occur,the majority of maternal deaths can be avoided and the maternal mortality ratio in Rwanda significantly fell from 1020 in 2000 to 290 in 2015 as a result of initiatives to improve women's access to professional birth attendants (Binagwaho, et al., 2019).Every year, 140 million women give birth throughout the world. While much is known about the clinical treatment of labor and delivery, less attention is paid to what has to be done to make women feel secure, content, and positive about the skill or practice outside of medical interventions(WHO, 2018).Community Health workers play an essential role particular in low- and middle-income countrythat guarantees key health services are available and accessible to the community members. World Health Organization established a community-based initiative programs and uses community volunteers to provide health care to their people (Lauren Crigler,2014;Abraham,A.et al.,2019).The goal of the Rwanda Community Health Program, which was established in 1995, was to increase the uptake of essential maternal health treatments by educating expectant mothers, encouraging healthy behavior, and maintaining links to services. More than 15,000 CHW in charge of maternal health working at the village level provide the line of service. Since 1995, Rwanda's Ministry of Health reported over 120,000 CHWs have been trained among them, 60,000 have been decentralized to the cell and village level in 30 Districts of Rwanda (Beatrice, U. (2016).The training provided to the CHWs help them to have overview on maternal health packages such as: pregnancy danger signs, vaginal bleeding, fever, swelling, convulsions, rigorous headache, lower abdominal pain, loss of consciousness and weight loss.The CHWs are community members who have been voted through their peers rather than qualified health professionals, they are mentored by the health system. As previously stated, the four CHWs work in each village with clearly defined tasks and responsibilities(Rwanda Ministry of Health,2018).Communityhealth workers enhances their performance in their daily activities like health education and household visiting (David Musoke, et al., (2019). Research conducted in Rwanda byGatwaza 2016,reported that about 60.8% of CHWs confirmed transportation is the barrier to their daily activities and the study done on effect of payment and incentives on motivation and focus of CHWs, where giving more incentives and motivation to CHWs increases their focus from other part-time works to their work as CHWs in delivering health services to the community members at the community level(Debra,2015).The qualitative study conducted on Rwanda's evolving community health worker system revealed that irregular training and insufficient supervision are still the main challenges to the performance of CHWs (Condo et al., 2014).Another study done, found that training covering the scope of CHWs found to increase the performance of CHWs in delivering health services(David Musoke, et al., 2019).Community health workers play an important role in providing primary health care in community, they are health-care professionals who have been trained and monitored by health center, where each health center has one supervisor in charge of ~~Community~~ community health workers, he is the one who has the tasks of coordinating all activities done by CHWs with health facility staff, the involvement of community health workers differs and is completely reliant on the field in which they work (welfare care, health care), the services they provide to patients (support, community engagement, teaching and or heath education, medical services), and the skills and competencies required for the position (message, cultural ability, training, practiced experiences, education)(Gatwaza,2016). CHWs in charge of maternal service should know all ~~woman~~ women with age of reproduction and total pregnant wom~~e~~n in the village even those who are

Comment [MSA1]: Should divide into separate paragraphs

Comment [MSA2]: Font size should be consisitent

completed ANC and deliveries attendance and follow them outreach vaccination(Mwizerwa , 2018).This study focused on the ~~Influence~~influence of CHWs on the uptake of maternal health services in Musanze District.

2. MATERIALS AND METHODS

2.1. Study setting and Data collection

This was a cross-sectional study utilized quantitative and qualitative methods because it examined the exposure and outcome at a time.Research was carried out in Musanze District. The district has 15 Sectors, 68 cells and 432 villages. It has 16 health centers and 432 community in charge of maternal health~~, .~~Musanze District has a population of 424,572 people and is densely populated of 5,30~~,~~ 4 per km^2. The participants in this study were community health workers and their supervisors appointed at health facilities levels in Musanze District.

2.2. Specific Objectives

i. To determine the necessary CHW's knowledge associated with uptake of maternal health services in Musanze District

ii. To examine factors associated with performance of CHWs towards maternal health services in Musanze District.

2.3. Inclusion and Exclusion criteria

1. The research included only the CHWs-MH, who had resided in research area for at minimum 6months andthe research excludes CHWs called "Binome" and counselors or health care professionals are not considered.

2.4. Determining the sample size

The researcher utilized Slovin's formula to calculate the sample size, that proposes the random sample is obtained by multiplying the average population by the number of people in the sample, a square of the confidence level.This means that

$$n = \frac{N}{1 + (N \cdot e^2)}$$

Where;

n is the sample size

N represents the total population, in this case, total number of CHWs in Musanze District= 432

e indicates the level of confidence (0.05).

$$n=\frac{432}{1+(432)(0.05^2)}=207.69230\approx 208$$

So, the estimated sample size was 208 CHWs then for qualitative data, community health supervisor's all were interviewed in16 Health facilities of Musanze district.

Comment [MSA3]: Phrasing error

2.5. Sampling procedures and techniques

A simple random sampling procedure was utilized to choose 208 CHWs from 432 CHWs in charge of maternal health of Musanze District. The number of CHWs was proportionally distributed to 16 health facilities. The table below shows how CHWs were proportionally distributed to 16 Health facilities.

table 1. shows the distribution of CHWs to the Health facilities.

Health Center's Name	**Number of CHWs per Health facility.**	**Representative sample proportional to sample size**	**Rounded Sample size**
Kimonyi	13	6.2	6
Musanze	18	8.6	7
Busogo	25	12.03	12
Gataraga	16	7.7	8
Kinigi	23	11.07	11
Kabere	25	12.03	12
Nyange	32	15.4	14
Bisate	29	13.9	14
Karwasa	30	14.4	14
Gasiza	27	13	13
Muhoza	49	23.5	24
Nyakinama	51	24.5	25
Rwaza	32	15.4	15
Gashaki	22	10.5	11
Murandi	18	8.6	9
Shingiro	22	10.5	11
TOTAL=16	**432**	**207.33**	**208**

2.6. Quantitativeand qualitative data collection

In this research a semi-structured questionnaire with open and closed-ended questions was used to collect quantitative data. The questionnaire had two sections:1.The necessary CHW's knowledge and association with uptake of maternal health services;. 2. factors associated with performance of CHWs towards maternal health services and qualitative data were collected using key informants iInterview (KII) with community health supervisors. The data were collected using a conversation guide with pre-prepared questions, the guide extracted information from the participants. The information was recorded using an audio recorder.

2.7. Quantitative and qualitative Data analysis

The statistical tool for social sciences (SPSS) Version 26 was utilized to analyze quantitative data and dependent variables.Categorical variables were summarized with descriptive statistics for frequencies and percentages. Bivariate analysis with Chi-square test of independence was used to check the relationship between the dependent and independent variables where the significance level was set at a *P*-value of $\leq .05$. Ordinal logistic regression was the most suitable inferential statistic as the dependent variable was ordinal. This statistic established further associations for the variables which were significant in bivariate analysis. Data and results were presented using text, tables, and figures and qualitative data were analysed by NVIVO version 10. Data was recorded using audio recorder, the audios were transcribed to text format for analysis. Transcripts were then uploaded to NVIVO. Similar patterns were identified, and themes were generated.

3. RESULTS

3.1. The necessaryCHW's knowledge associated with uptake of maternal health services in Musanze District.

This study involved 208 CHWs responded to various metrics of the research questionnaire. All the participants were female, 100%. The knowledge of CHWs also were assessed to establish whether there was any association with the uptake of maternal health care, these variables were measured using a five-point Likert scale. When CHWswere asked how they know that a

pregnant woman is in an emergency situation, the majority (85.1%) cited vaginal bleeding and high fever with vaginal bleeding (12.5%) as the most common danger sign.

When ~~C~~community health workers were asked what they do in order to help the mothers in the case of home deliveries, 89.4% of participants responded that they would implement administration of Misoprostol, t~~T~~ransfer to the health facility, and send a red alert (Rapid SMS) comprehensively as it can be seen table 1.

When ~~asked about their~~ knowledge of pregnancy complications triggering CHWs' attention to give mothers direct transfer to the health facility was asked, they mentioned for vaginal bleeding (10.6%), for high fever (3.8%), and a large percent proportion of them (84.6%) would transfer the mother if they see any of the above complications.

Though the findings showed that a large number of CHWs recognized that they have the necessary knowledge leading them to help pregnant mothers when providing maternal health care in the village, a small number of CHWs still do not consider all dangers signs for pregnant mothers when making their decisions and this could negatively affect maternal health services and involved maternal mortality in the community.

The result shows that CHWs needs a common understanding of primary health care offered to home delivery in the community so that maternal health should be improved in their respective village even if the majority of CHWs indicated that were on primary care provided on that level.

Comment [MSA4]: Sentence construction is not clear

The result showed that a small number of community health workers have insufficient knowledge about pregnancy complications that can attract them to give transfer at HF, so improving their knowledge must be considered to improve maternal health care provision.

Comment [MSA5]: What does this mean?

In contrast to this study, other studies have shown that CHWs are trained for more advanced practice despite recognizing the danger sign (Olanian et al., 2019) and Gatwaza (2016). The qualitative findings also supported that there was a clear link between the knowledge of CHWs.

Comment [MSA6]: Should be mentioned in discussion.

When community health workers received an emergency case, immediately they give transfer to the health facility and therefore they make follow up until the mother gets intervention from the health facility, and send Rapid SMS in addition to basic services provided by CHWs, these has influenced positively the uptake of maternal health services (KII 16).

The findings shows that CHWs had necessary training to provide care to the mother in their community 105(50.4%) and among those who were Strongly agreed 101 (48.5%) ranked the uptake of maternal health services as very high with 90.1%.

Considering the level of knowledge of CHWs on maternal emergencies, those who had a moderate level of knowledge 5(2.5%) rated the uptake of maternal health services as low. 122(58.6%) of those who had a very high level of Knowledge on maternal emergencies, rated the uptake of maternal health services as very high with 85.2%) and then 78(37.5%) were answered high ,and ranked the uptake as high with 34.6%.

Among participants, those were answered high 120(57.6%) confirmed that they have skills on administration of misoprostol for PPPH towards maternal health services, ranked the uptake as high with 31.6%).

Majority were responded very high 83(39.9%) and ranked the uptake of maternal health as very high with 91.6%), and only 3(1.4%), were moderate as is seen in table 1

The findings are consistent with existing literature as similar results were reported by Mwizerwa (2018) that confirmed the knowledge and contribution of CHWs on maternal health uptake. These results were also supported by qualitative data from CHWs supervisors.

CHWs have the necessary knowledge of maternal emergencies through the training provided to them and this has increased their skills related to the pregnant mother who has an emergency case and how they decide to transfer directly, CHWs need regular refresher training in order to perform well their work (KII 16).

Note that because CHWs are not regarded to be certified health professionals, they are not recognized to be able to treat patients at home (e.g., nurses, doctors). Moreover, taking into consideration the instruction they have received, they are able to identify and assist patients in some situations. However, when a patient requires full medical attention, they refer them to health facilities, or hospitals for additional examinations, diagnostics, and care.

Table .2. Distribution of CHW's Knowledge

Variable	Category	Frequency	Percentage
Danger signs that make CHWs think that a pregnant woman has an emergency case	Apply all	177	85.1
	High fever	1	.5
	Loss of consciousness	4	1.9
	Vaginal bleeding	26	12.5
Primary care CHWs give to the home deliveries when they meet them in the community	Administration of misoprostol	17	8.2
	Transfer to the health centre	1	.5
	Red Alert	4	1.9
	Apply all	186	89.4

The pregnancy complications which attract CHW's attention to give mothers direct transfer to the health centre	Vaginal bleeding	22	10.6
	Lower abdominal pain	2	1.0
	High fever	8	3.8
	Apply all	176	84.6

3.1. 1. Association between CHW's Knowledge and Uptake of Maternal Health Services

This research sought to find out whether there is an association between knowledge and uptake of maternal health services.

The analysis's results revealed a statistically significant correlation between CHWs' had necessary training to provide services to the mothers and uptake of maternal health services (X^2 =25.401 df =8 p* =.001), this was run to assess whether there was a relationship between CHW's knowledge of maternal emergencies and uptake of maternal health care, and the results revealed that there was a statistically significant association between the two examined variables (X^2 =21.525 df =6 p* =.001). About skills of CHWs on administration of misoprostol to prevent PPPH and uptake of maternal was significant with X^2 =28.152 df =6 p*=.001).

Table 3. Association of CHW's knowledge and uptake of maternal health services

Bivariate Analysis – Chi-square Test of Independence

CHWs Knowledge	Category	Uptake of Maternal Health Services			Chi-square p-value
		Moderate	High	Very High	
CHWs had necessary training to provide care to mothers	Strongly disagree	0(0.0%)	1(100.0%)	0(0.0%)	X^2 =25.401
	Disagree	0(0.0%)	2(28.6%)	5(71.4%)	df =8
	Neutral	0(0.0%)	1(25.0%)	3(75.0%)	p* =.001
	Agree	2(1.9%)	34(32.4%)	69(65.7%)	
	Strongly disagree	1(1.1%)	8(8.8%)	82(90.1%)	

Comment [MSA7]: It is suggested to check whether Chi-square test is acceptable for these data because there are many zero cells in the table. You should check number of cells with expected frequency <5. If it is not acceptable, Fisher's exact test is recommended.

Knowledge of CHWs on maternal emergencies	Very Low	0(0.0%)	0(0.0%)	3(100.0%)	X^2 =21.525
	Moderate	1(20.0%)	1(20.0%)	3(60.0%)	df =6
	High	2(2.6%)	27(34.6%)	49(62.8%)	*p** =.001
	Very High	0(0.0%)	18(14.8%)	104(85.2%)	
Ranking the skills of CHWs on administration of misoprostol for PPPH.	Low	0(0.0%)	0(0.0%)	2(100.0%)	X^2 =28.152
	Moderate	1(33.3%)	1(33.3%)	1(33.3%)	df =6
	High	2(1.7%)	38(31.7%)	80(66.7%)	*p**=.001
	Very high	0(0.0%)	7(8.4%)	76(91.6%)	

These variables proceeded to the following analysis step with ordinal logistic regression. The model fitting statistic was less than the alpha value (X^2 =62.518, df =14, p <.001), confirming that the final regression model fits all the independent variables. Additionally, the Goodness-of-fit statistic is greater than the alpha value (X^2 =89.666, df =90, p =.490). Thus, the model has a goodness-of-fit for the fitted data.

Table 4. Showing Multivariate Analysis – Ordinal Logistic Regression on Knowledge of CHWs towards uptake of maternal health services.

Model Fitting Information

Model	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	160.891			
Final	98.373	62.518	14	.000

Link function: Logit.

Goodness-of-Fit

	Chi-Square	df	Sig.
Pearson	89.666	90	.490
Deviance	62.282	90	.989

Link function: Logit.

Pseudo R-Square

Cox and Snell	.260
Nagelkerke	.371

McFadden	.250

Link function: Logit.

The odds ratio shows that CHW's had strongly agreed necessary training to provide care to mother resulted in 2.9 times in increase uptake compared mere agreed. A very High Knowledge of CHWs in maternal emergencies leads to 2.3 times increase in the uptake of maternal health services. Similarly, very high skills of CHWs on administration of misoprostol to 5.1 times increase.

Table 5. Logical Regression of CHW's knowledge on uptake of maternal health

Comment [MSA8]: Logistic regression analysis should be modified and it is suggested to explain clearly about the outcome variable and covariates. The output table from SPSS should not be copied directly for manuscript.

Parameter Estimates

							95% Confidence Inter	
		Estimate	Std. Error	Wald	df	Sig.	Lower Bound	Upper Bound
Threshold	[Uptake_of_Maternal_Health_Services_Grouped = 3]	-7.845	.940	69.632	1	.000	-9.688	-6.003
	[Uptake_of_Maternal_Health_Services_Grouped = 4]	-4.125	.619	44.445	1	.000	-5.338	-2.912
	[Q17_Knowledge_on_maternal_emergencies=1]	16.631	8940.5	.000	1	.999	-17506.410	17539.672
	[Q17_Knowledge_on_maternal_emergencies=3]	-.237	.994	.057	1	.812	-2.185	1.712
	[Q17_Knowledge_on_maternal_emergencies=4]	-.843 **Exp(B)= .431**	.412	4.174	1	.041	-1.651	-.034
	[Q17_Knowledge_on_maternal_emergencies=5]	0[a]	.	.	0	.	.	.
	[Q19_CHW's_had_training to provide care=1]	-2.671	2.477	1.163	1	.281	-7.525	2.183
	[Q19_CHW's_had_training to provide care=2]	-.638	1.055	.365	1	.545	-2.705	1.430
	[Q19_CHW's_had_training to provide care=3]	.975	1.508	.418	1	.518	-1.980	3.931
	[Q19_CHW's_had_training to provide care=4]	-1.081 **Exp(B)= .339**	.474	5.193	1	.023	-2.010	-.151
	[Q19_CHW's_had_training to provide care=5]	0[a]	.	.	0	.	.	.

	[Q21_ CHW's_ skills_ on_ administration_ of misoprostol=2]	17.030	.000	.	1	.	17.030	17.030
	[Q21_ CHW's_ skills_ on_ administration_ of misoprostol =3]	-2.890	1.469	3.869	1	.049	-5.770	-.010
	[Q21_ CHW's_ skills_ on_ administration_ of misoprostol =4]	-1.622 **Exp(B)= .198**	.481	11.355	1	.001	-2.565	-.678
	[Q21_ CHW's_ skills_ on_ administration_ of misoprostol _=5]	0[a]	.	.	0	.	.	.

Link function: Logit.

3.1.2. Factors Associated with the Performance of CHWs towards Uptake Maternal Health

The researcher also examined factors (i.e. Benefits from cooperatives, supervision, regular refresher training, provision of transport and incentives) could be associated with the performance of CHWs towards uptake of maternal health services. About 25 (12.0%) of CHWs who were very satisfied by benefits they receive from cooperatives as members ranked the uptake of maternal Health services as very high 80.0%.

2(2.1%) of those who were satisfied ranked the uptake of maternal health services as moderate. While12(27.3%) of those who were said were neutral regarding the level of satisfaction of the benefits from cooperative ranked the uptake of maternal health care as high.

Those who were satisfied on benefits they are receiving from their cooperative as member ranked the uptake of maternal health services as high with 75.0%. Fisher's exact test determined that there was no association between the level of satisfaction of CHWs and the uptake of Maternal Health care (X^2 = 5.972, df =8, p* =.635).

This is different from the findings in a study done by Mugeni (2014), Where CHWs level of satisfaction was associated with the uptake of maternal health care as the satisfaction of profits from their cooperative was linked with the increased uptake of the health care in the village.

Most of CHWs 118 (56.7%) who said regular supervision of CHWs affects the uptake of maternal health services rated the uptake as very high with 87.3% and only 3(3%) of them rated the uptake as moderate with 3.3%. There was an association between regular supervision of CHWs and the uptake of maternal health services (X^2 = 18.462, df 1, p*<.001).

More than half 113(54. 3%) of CHWs who said regular refresher training influence the uptake of maternal health services rated the uptake as very high with 85.0% while only 3(3.2%) of them rated the uptake as moderate. While 95(45.6%) of those who said refresher, training is not affecting the uptake of maternal health services rated the uptake as high.

Fisher's exact test of independence found a significant association between the regular refresher training of CHWs and the uptake of maternal health services (X^2 = 11.036, df =1, p =.002). Findings were similar to the findings from David Musoke et al (2019) who found that training covering the scope of CHWs found to increase the performance of CHWs in providing health care services.

Findings from a qualitative research on Rwanda's developing CHWs system found that inconsistent training and inadequate supervision continue to be the biggest obstacles to CHWs performing to their full potential (Condo et al., 2014).

Comment [MSA9]: Not necessary for results section.

Among the CHWs who said transport is one of the factors affecting their performance, those who said that transport was not a factor affecting their performance, 89(57.2%) rated the uptake as high with 39.3% while those who perceived transport as a factor, 119(57.2) ranked the uptake of maternal health services as very high with 90.8%.

Those who said transport is affecting their performance, ranked the uptake of maternal hath services as very high was (57.3%) and none of them ranked the uptake as moderate. There was a

significant association between the transport as a factor affecting CHWs performance and the uptake of maternal health services (X^2 = 31.950, df =2, p<.001).

This is the same with a research conducted in Rwanda by Gatwaza 2016 which reported that about 60.8% of CHWs reported transportation is the barrier to their daily activities and there was a statistical relationship between transportation as the barrier to their activities in the community with p = 0.048.

On incentives, about 114 (54.8%) CHW who perceived incentives as a major factor to their performance, rated the uptake as very high with 89.5% and 3(3.2%) of them rated the uptake to be moderate. However,96 (46.1%) of CHWs reported incentives was not affecting their performance rated the uptake of maternal health care in the village as high, none of them rated the uptake as moderate.

In bivariate analysis with fisher's exact test of independence, there was a significant relationship between the incentives given to CHWs and the uptake of maternal health services (X^2 = 24.260, df 2, p*<.001). Findings from an interview also revealed the importance of incentives to CHWs as it shows in table 6.

Table 6. Association showing the factors associated with the Performance of CHWs towards Uptake Maternal Health Services.

Bivariate Analysis – Chi-square Test of Independence

Factors Associated with the Performance of CHWs towards Maternal Health Services	**Category**	**Uptake of Maternal Health Services**			**Chi-square p-value**
		Moderate	**High**	**Very High**	
Level of CHWs satisfaction on benefits they are receiving from their cooperative as member	Very Dissatisfying	0(0.0%)	0(0.0%)	8(100.0%)	X^2 = 5.972 df =8 p* =.635
	Dissatisfying	0(0.0%)	8(22.9%)	27(77.1%)	
	Neutral	0(0.0%)	12(27.3%)	32(72.7%)	
	Satisfied	2(2.1%)	22(22.9%)	72(75.0%)	

Comment [MSA10]: It is suggested to check whether Chi-square test is acceptable for these data because there are many zero cells in the table. You should check number of cells with expected frequency <5. If it is not acceptable, Fisher's exact test is recommended.

	Very Satisfied	1(4.0%)	4(16.0%)	20(80.0%)	
CHW's appreciation on their work	Neutral	0(0.0%)	2(33.3%)	4(66.7%)	X^2 = 17.182
	Satisfied	1(1.2%)	30(35.3%)	54(63.5%)	df =4
	Very satisfied	2(1.7%)	14(12.0%)	101(86.3%)	*p** =.001
Regular supervision is associated with performance	No	3(3.3%)	31(34.4%)	56(62.2%)	X^2 = 18.462
	Yes	0(0.0%)	15(12.7%)	103(87.3%)	df =2
					*p**<.001
Transportation is associated with the performance	No	3(3.4%)	35(39.3%)	51(57.3%)	X^2 = 31.950
	Yes	0(0.0%)	11(9.2%)	108(90.8%	df =2
					*p**<.001
Refresher Training is associated with performance	No	3(3.2%)	29(30.5%)	63(66.3%)	X^2 = 11.036
	Yes	0(0.0%)	17(15.0%)	96(85.0%)	df =2
					*p** =.002
Consideration from Local Leaders is associated with performance	No	1(1.0%)	18(17.1%)	86(81.9%)	X^2 = 3.605
	Yes	2(1.9%)	28(27.2%)	73(70.9%)	df =2
					*p** =.138
Motivation or Incentives (PBF) is associated with performance	No	3(3.2%)	34(36.2%)	57(60.6%)	X^2 = 24.260
	Yes	0(0.0%)	12(10.5%)	102(89.5%)	df =2
					*p**<.001

*Shows Fisher's Exact Test

The five variables associated with the dependent variable were modeled with ordinal logistic regression. This developed a prediction model on factors associated with the performance of CHWs towards maternal health services. Results from the model fitting statistic were significant (X^2 =79.434, *df* =6, *p*<.001), and thus the model fits the two independent variables.

The Goodness-of-fit results are statistically insignificant (X^2 =44.294, *df* =62, *p* =.957), which means that the model bears an acceptable goodness-of-fit for the fitted data. The Nagelkerke R-square shows that the prediction model explains a 45.4% variance in the uptake of maternal health services.

Table 7. Showing Model Fitting Information, Goodness-of-Fit and Pseudo R-Square and factors associated with uptake of maternal health services.

Model Fitting Information				
Model	-2 Log Likelihood	Chi-Square	df	Sig.

Intercept Only	156.663			
Final	77.229	79.434	6	.000

Link function: Logit.

Goodness-of-Fit			
	Chi-Square	Df	Sig.
Pearson	44.294	62	.957
Deviance	36.648	62	.996

Link function: Logit.

Pseudo R-Square	
Cox and Snell	.317
Nagelkerke	.454
McFadden	.318

Link function: Logit.

The odds ratio from the Exp(B) value shows that CHWs' regular supervision increased the odds of maternal services uptake by 3.7. CHWs' regular motivation/incentives (PBF) result in 3 times increase in the uptake of maternal health services, while CHWs' regular refresher training leads to 3 times increase.

CHWs transportation brings up to 7.8 times increase in the uptake of maternal health services. Additionally, CHW's appreciation of their work led to 4.3 times increase in the uptake of maternal health services compared to mere appreciation.

Table 8. Ordinal logistic regression tables showing factors associated with the performance of CHWs towards Uptake Maternal Health Services

Comment [MSA11]: Should be modified for representing sound statistical analysis.

Parameter Estimates								
							95% Confidence Interval	
		Estimate	Std. Error	Wald	Df	Sig.	Lower Bound	Upper Bound
Threshold	[Uptake_of_Maternal_Health_Services_Grouped = 3]	-3.368	.690	23.833	1	.000	-4.721	-2.016

	[Uptake_of_Maternal_Health_Services_Grouped = 4]	.597	.424	1.983	1	.159	-.234	1.429
Location	[Appreciation_of_work=3]	-1.496	1.064	1.976	1	.160	-3.582	.590
	[Appreciation_of_work=4]	-1.462 Exp(B) = .232	.431	11.504	1	.001	-2.308	-.617
	[Appreciation_of_work=5]	0[a]	.	.	0	.	.	.
	[Regular supervision is associated with performance? =0]	1.303 Exp(B) = 3.682	.435	8.978	1	.003	.451	2.156
	[Regular supervision is associated with performance? =1]	0[a]	.	.	0	.	.	.
	[Transportation is associated with performance? =0]	2.047 Exp(B) = 7.748	.471	18.931	1	.000	1.125	2.970
	[Transportation is associated with performance? =1]	0[a]	.	.	0	.	.	.
	[Regular refresher Training is associated with performance? =0]	1.087 Exp(B) = 2.966	.432	6.343	1	.012	.241	1.933
	[Regular refresher Training is associated with performance?=1]	0[a]	.	.	0	.	.	.
	[Regular motivation Incentives is associated with performance? =0]	1.107 Exp(B) = 3.026	.442	6.268	1	.012	.240	1.974
	[Regular motivation Incentives is associated with performance =1]	0[a]	.	.	0	.	.	.

Link function: Logit.

a. This parameter is set to zero because it is redundant.

3.3. Qualitative findings

Qualitative approaches used key informants' interview for16 CHW's supervisors in 16 health centers of Musanze District, two themes such as necessary CHW's knowledge and factors associated with performance of CHWs towards maternal health were analyzed and generated.

3.1. 1. Association between CHW's Knowledge and Uptake of Maternal Health Services

The result showed that a small number of community health workers have insufficient knowledge about pregnancy complications that can attract them to give transfer at HF, so improving their knowledge should be considered to enhance maternal health services provision.

In contrast to this study, other studies have shown that CHWs are trained for more advanced practice despite recognizing the danger sign (Olanian et al., 2019) and Gatwaza (2016). The qualitative findings also supported that there was a clear link between the knowledge of CHWs.

When community health workers received an emergency case, immediately they give transfer to the health facility and therefore they make follow up until the mother gets intervention from the health facility, and send Rapid SMS in addition to basic services provided by CHWs, these has influenced positively the uptake of maternal health services (KII 16).

CHWs have the necessary knowledge of maternal emergencies through the training provided to them and this has increased their skills related to the pregnant mother who has an emergency case and how they decide to transfer directly, CHWs need regular refresher training in order to perform well their work (KII 16).

Note that CHWs are not supposed to treat patients at their homes as they are not considered to be trained health workers (e.g., nurses, doctors), however, considering the training they have undergone, they can detect and help patients in some cases but when the problem requires full medical attention, they make referrals for patients to visit dispensaries, health facility or hospital for further diagnosis, testing, and treatment.

3.1.2. Factors Associated with the Performance of CHWs towards Uptake Maternal Health

In an interview with CHWs supervisor 16, the supervisor pointed out that; "*Regular supervision and regular training are also limited while it is a very important factor that helps CHWs to enhance the uptake of maternal health services at the community level through the exchange of ideas with their supervisors"* (KII 16).

Maybe because working under supervision increase pressure and no one would want to make a mistake by negligence.

David Musoke et al (2019), also reported the same findings on supervision of CHWs in a study in Uganda where the study found that, improved supervision of CHWs enhance their performance in their daily activities like health education and household visiting.

Findings were also similar to the findings from qualitative study conducted on Rwanda's evolving community health worker system revealed that irregular training and insufficient supervision are still the main challenges to the performance of CHWs (Condo et al., 2014).

Findings from an interview also revealed the importance of incentives to CHWs that is associated with their performance as stated below:

"The incentives of CHWs called PBF is a very important factor that is associated with their performance but is not sufficient and not given on time"(KII 16).

The same findings were also reported by Debra2015 in the study done on effect of payment and incentives on motivation and focus of CHWs, where giving more incentives and motivation to CHWs increases their focus from other part-time works to their work as CHWs in delivering health services to the community members at the community level.

4.Discussions

This study found that the uptake of maternal health services was increased significantly. CHWs 85.1% were knowledgeable on the warning signs of an emergency among pregnant mothers, and 89.4% reported that they would act based on these warning signs. CHWs had necessary training to provide care to pregnant mothers with p^* =.001. Skills that CHWs have on administration of misoprostol to prevent post-partum hemorrhage was significant with p^*<.001. Factors that influenced uptake of maternal health services were CHW's regular supervision with p^*=.001, provision of transportation p^*=.001, regular refresher training p^* =.002, and motivation/incentives p^*=.001, as they were associated with the performance of CHWs towards uptake of Maternal Health Services.

Conclusion

The study found that the uptake of maternal health services has increased in Musanze District. CHW's knowledge towards maternal health services, these were significantly associatedwith uptake of maternal health services

Comment [MSA12]: Discussion points should be included comparisons with other studies and providing reasons based on the findings, weakness and limitation of study. Should discuss about the main findings that reflects the objectives of the study.

Comment [MSA13]: It should be modified for more completeness and to be understandable by readers.

Factors associated with performance of CHWs towards maternal health services, regular refresher trainings, regularsupervision,Transportation, Incentives were significant associated with the uptake of maternal health services.

The implication of the study is that continued research on community health workers will bring the public health community one step closer to understanding the optimal approach to understanding and fulfilling the goals of community-based development.

Recommendations

The study recommends the following:

1.The Ministry of health to improve maternal health services through regular training and regular supervision for CHWs.

2.The governmental through Ministry of health to provide transport to CHWs and regularly motivate them through provision of incentives.

3.The CHWs should petition local leaders to support their activities of creating awareness of the importance of maternal healthcare services in the reduction of mortality rates in Musanze District.

Suggestions for Further Studies

The future research should be conducted on a wide scale especially in the whole Rwandan District to determine the specific achievements and challenges that CHWs face during the delivery of MHC services

Consent and Ethical Consideration

The MKU Institutional Research Ethics and Review Committee (IREC) provided ethical approval for this study. The permission to perform the research was sought from Musanze district after presenting an official authorization letter from MKU. Following receiving written permission, the investigator went to the health facilities to consent the participants to participate. The participation was voluntary, and confidentiality was assured to the participants by excluding any information that can directly identify the participants.

Availability of Data and Materials

The datasets used and analysed during the current study are available from the principal or corresponding author on reasonable

Comment [MSA14]: Need grammar check

request through Mount Kenya University. This article is a part of the whole thesis.

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Comment [MSA15]: Style should be consistent for all references.

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