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The Impact of Health Communication Interventions on Measles Immunization Awareness in the Bamenda and Santa Health Districts, North West Region of Cameroon: A Cluster Randomized Control Trial

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Abstract

Background: Measles is an extremely contagious viral infection causing high morbidity and mortality especially in childhood globally. It is characterized by fever and rash in addition to any of cough, catarrh (coryza) or red eye. It is prevented with the measles vaccine. Due to the highly infectious nature of measles, it tends to occur in epidemics when the proportion of unprotected persons is over 40% in a community. Measles has been on the rise in recent years globally and even in Cameroon. This has been marked by recurrent epidemics even in the North West Region, blamed on low measles vaccination coverage. Several factors could contribute to this situation including poor communication to raise awareness of and to influence positive attitudes towards immunization adherence to improve vaccination coverage. **Objective:** The objectives of this work was firstly to assess the level of awareness of measles and measles immunization; and secondly to determine the impact of health communication interventions on the awareness of measles immunization in Bamenda and Santa Health District of the North West Region of Cameroon. **Methods:** The study design was a mixed method (made up of a cross-sectional study and an intervention). The target populations were parents and health

personnel, in Bamenda and Santa Health Districts. Sample sizes used were 420 for the Cross-sectional study; and 324 each for the Experimental and Control health districts. The sampling design was a multi-stage sampling, involving Systematic random sampling for health districts, Purposive sampling for the field study, Simple random sampling to select health areas and communities; and finally, Cluster sampling for study participants. A semi-structured questionnaire was used for data collection. Data from the Cross-sectional study was analyzed by descriptive statistics. Quantitative data from the intervention was analyzed using ANOVA test to compare the mean score of the experimental and the control arms. Chi square test was used to compare the proportion of participants with good knowledge. Analysis was also performed to determine the level of significance of communication channels in improvement of participants' knowledge. **Results:** The study established a low level of awareness of measles among parents, but also among health personnel. It also registered a significant improvement in awareness following the six months health communication interventions ($p < 0.05$). Text message was the most significant communication channel for disseminating health information ($p < 0.05$). **Conclusion:** Low level of knowledge of measles among parents in the community is improved by health communication, with Mobile phone text messaging being the most significant communication channel.

Keywords

Impact, Health, Communication, Measles, Immunization, Bamenda and Health District

1. Introduction

Among the targeted diseases of the Expanded Program on Immunization (EPI), measles or Rubeola, is designated as "premiere disease", which need immunization during the first year of age to avoid encephalitis. Indeed, measles is highly contagious and associated with high morbidity and mortality [1]. It is caused by a virus of the myxoviruses group, characterized by fever and catarrh symptoms of the upper respiratory tract (coryza, cough), which is followed by a typical rash. Measles is an endemic disease in Cameroon like other developing countries as a whole, and the North West Region of Cameroon in particular. According to Cummings and colleagues, distinct patterns of measles incidence were found in two different areas of Cameroon [1]. These were the three Northern-most regions (Extreme North, North and Adamawa) experiencing major epidemics every year; whereas the seven Southern regions (North West, South West, West, Center, East, Littoral and South) showed evidence of experiencing major epidemics every third year [2]. They went further to indicate that the length of this period has been found to be dependent upon vaccination coverage, population density and birth rates [1]. As such, differences in these factors across Cameroon could create different patterns of incidence [2].

Measles remains a global public health problem with over 20 million cases occurring annually [3]. Due to its highly infectious nature, when measles is introduced into a virgin community (with no immunity), more than 90% of the total population will be infected [1]. By 1980 before the use of the measles vaccine became widespread, about 2.6 million measles deaths occurred worldwide [1]. This situation called for a need to accelerate the reduction of measles mortality, and led to the decision by the WHO and UNICEF for delivering 2 doses of measles containing vaccine to every child through routine vaccination services and supplementary immunization activities (SIAs), coupled with improved disease surveillance [1]. The implementation of this decision (strategy) started in 2001 and had reduced measles deaths from 733,000 in the year 2000 to 122,000 in 2012 [1]. In the same line, further evidence points out that measles deaths reduced from 550,000 in 2000 to 89,780 in 2016, being the first time that there have been less than 100,000 measles deaths recorded globally in a particular year, even though this achievement was not sustained as 2017 met with resurgence in measles deaths [4] [5]. By 2018, the death toll for measles rose to 140,000 people globally and has been on a steady increase according to the WHO and the US CDC [5] [6]. As an immunization achievement, the UNICEF [6] [7], indicated that since the year 2000, over 21 million lives have been saved through measles immunizations. Despite these achievements and the availability of a safe, effective and affordable measles vaccine, 367 children still die from measles every day [7] [8]. In 2016, measles cases reportedly increased by more than 30% worldwide [6] [7]. This current wave of measles outbreaks was blamed by the WHO on the gaps in the implementation of the control strategy for 2 doses of measles vaccines for routine immunization [8] [9]. The Global Alliance for Vaccines and Immunization (GAVI) on their part, pointed out that failing to increase routine immunization coverage and strengthening health systems, will lead to chasing one outbreak of measles after the other [6] [7]. Of recent, the occurrence of measles has been on the rise globally, even in areas that were previously declared measles free and preparing towards its elimination, as in the developed world [1]. This could also be seen in the light that globally measles vaccination coverage by 2018 was still at 86% for the first dose and 70% for the second dose, below the 95% coverage required for population immunity according to the WHO [5] [6].

In the developing countries measles has remained endemic with high childhood morbidity and mortality due to the failure of vaccination programs to deliver at least one dose of the vaccine to all infants [1]. As such, measles tends to occur in epidemics when the proportion of unimmunized (susceptible) children is about 40% [1] thus, qualifying the disease as an ultrasensitive and merciless marker of insufficient vaccination coverage [3]. A study to this effect in Nigeria, indicated that as measles vaccination coverage in children 9 - 59 months old drops, the number of confirmed measles cases in the population increases, resulting in an increase in the number of measles outbreak [9] [10].

This increase in measles occurrence has also been recorded in Cameroon like

elsewhere in the world [2]. A study conducted in the North West Region of Cameroon blamed a measles epidemic on low vaccination coverage (about 80%) and reported marked unawareness of the EPI program, with a low level of measles surveillance [10] [11]. Equally, the absence of a communication plan for the EPI in Cameroon, to ensure regular education and reminder to parents, and to influence positive attitude towards immunization [11] [12], is blamed for low levels of awareness and low vaccination coverage. Furthermore, the time lapse between 12 weeks when the first set of routine vaccines ends and 9 months when measles vaccine is to be administered could play a rule in the noncompliance to the vaccination calendar due to inability to recall appointments in the absence of regular reminders to parents. In Cameroon, vaccination communication focuses more on mass vaccination campaign than on routine vaccination, and mostly done over mass media [11] [12]. This, mainly to inform and educate; or to recall and remind parents of vaccination and to complete their children's vaccination calendar on time, as opposed to giving parents and community members an understanding of what each vaccination is for and why they should bring their children for vaccination [11] [12]. Also, immunization communication pays less attention to health workers who form a credible source of health information [4]-[12]. Rather, health personnel are only considered when a new vaccine is to be introduced into the EPI program, wherein they are briefed on administering and telling parents the need for the vaccine [11] [12]. Furthermore, communication interventions for vaccination in Cameroon are developed at the national level by the EPI program and partners like the WHO and UNICEF, and mostly used during vaccination campaigns. The print materials here come in standard forms from the national level without any local information [11] [12]. At times, communication material will come in the language most of the concerned population do not understand and even in the middle of the campaign with no time for translation [11] [12]. Low routine immunization coverage has also been blamed on a low level of integration of community health workers and failure to build and maintain public trust in vaccines [13]. Equally, the immunization system lacks a solid network among health workers, community groups and leaders, to improve trust and promote behavior change [14]. Therefore, this study with particular focus on measles immunization, was to come out with some information to fill the knowledge gap in communication in favor of immunization. This could be used to promote behavior change in favor of immunization to increase vaccination coverage and measles surveillance, to contribute in curbing the recurrent measles epidemics in Cameroon.

2. Methods

The study was conducted in Bamenda and Santa health districts of the North West Region (NWR) of Cameroon. The seat of these health districts is found in the capital city of the NWR but has health areas that extends to cover populations in both urban and rural communities. They also have adequate coverage of modern

mobile communication technology, good road networks. This study involved both a survey to establish baseline information on knowledge of measles and measles immunization; and an intervention to determine impact of health communication intervention on knowledge of measles and measles immunization. Knowledge of participants assessed at baseline was equally evaluated after the intervention. This knowledge (KAP) would focus on the value of vaccine, safety of vaccines, measles and measles immunization. This was to be used to inform the development of a communication plan to address lapses identified on the awareness of the value of vaccine, safety of vaccine, measles and measles immunization. The intervention involved the delivery of Health Education messages to the target population in Health facilities and in the community, on a weekly basis for six months in the intervention arm. It was geared towards creating awareness in the target population. These messages were focused on the value of vaccines and the safety of vaccines in immunization; how to identify and report measles in the community; the effects of contracting measles and when to get children vaccinated against measles. The intervention study was conducted in the communities of some selected health areas of the Bamenda Health District on the intervention arm, while Santa Health District which served as the control arm, saw no activity carried out, other than the routine health talks. This intervention was hoped in the short run would improve awareness and in the long run improve measles vaccination coverage and measles surveillance in the region.

These health districts (HD) were purposefully selected out of the 16 HDs (which experienced at least one Measles epidemic between 2006 and 2015 according to Measles Surveillance reports of the Regional Delegation of Public Health), due to its low level of insecurity compared to the other 14 HDs, as a result of the prevailing armed conflict in the North West Region.

The study covers a period of six (6) months, from April to September 2020, during which the exercises of the intervention were conducted in health facilities, church groups and community groups.

The target population involved parents and health personnel of both sexes, aged 15 years and above. They are considered as important stakeholders in the decision to have children vaccinated. To be eligible, a respondent was at least 15 years old or above, and resident in the area for a minimum of one year. He/she was either a parent or a health personnel in the health districts under study; and has consented to for the study at baseline and intervention. Any person less than 18 years old where parents failed to provide assent, and those who were resident in the area for less than a year were excluded from the study. This also included persons who did not consent to the study.

As inclusion criteria, participants should be a parent or health personnel resident in the area for at least one year before the start of the study. He/she must have participated in the base-line study.

Any person less than 15 years old where assent was not secured, and those who were resident in the area for less than a year were excluded from the study. This

also included persons who did not consent to the study.

The sample size was gotten from participants of both sexes aged 15 years and above in the Intervention and Control Health Districts. The sample size (n) for the survey was calculated using the following Cochran's formula:

$$n = \frac{z^2 pq}{d^2}$$

$$n = \frac{z^2 p(1-p)}{d^2}$$

where:

n = Sample size;

d = Margin of error (Precision level = 5% = 0.05);

p = 50% or 0.50 Population proportion (No previous study to determine population proportion so, we use 50%);

$q = 1 - p$;

z = 1.96 (Based on a 5% margin of error (Use Z table)).

$$n = \frac{1.96 \times 1.96 \times 0.5(1-0.5)}{0.05 \times 0.05} \quad [15]$$

Therefore, $n = 1.96 \times 1.96 \times 0.5 \times (1-0.5) / (0.05 \times 0.05)$

$$n = 3.8146 \times 0.25 / 0.0025$$

$$n = 381.4 = 382 \text{ persons}$$

A ten percent (10%) of the sample size was added to make up for anticipated refusals to participate and for incomplete (or poorly) filled questionnaire.

This gives 10/100 × 384 = 38.4 = 38.

Therefore, 382 + 38 = 420 persons.

The sample size for the cross-sectional study was 420 participants.

For the intervention study, the following sample size formula (for comparison between two groups) below was used:

$$n = \frac{2\left(Z_{\alpha/2} + Z_{\beta}\right)^2 p(1-p)}{\left(P_1 - P_2\right)^2} \quad [15]$$

where,

$Z_{\alpha/2} = Z_{0.05/2} = Z_{0.005}$ = 1.96 (from Z table) at type 1 error of 5%;

$Z_{\beta} = Z_{0.20}$ = 0.842 (from Z table) at 80% power;

$P_1 - P_2$ = Difference in proportion of events in the two groups;

P = Pooled prevalence = [prevalence in intervention group (P_1) + prevalence in control group (P_2)].

Therefore,

$$n = \frac{2(1.96 + 0.84)^2 \times 0.43(1-0.43)}{(0.48 - 0.38)^2}$$

Sample size n = 294.

Adding a 10% of the sample size to take care of dropouts and other inconsistencies, gave: $10/100 \times 294 = 29.4 = 30$.

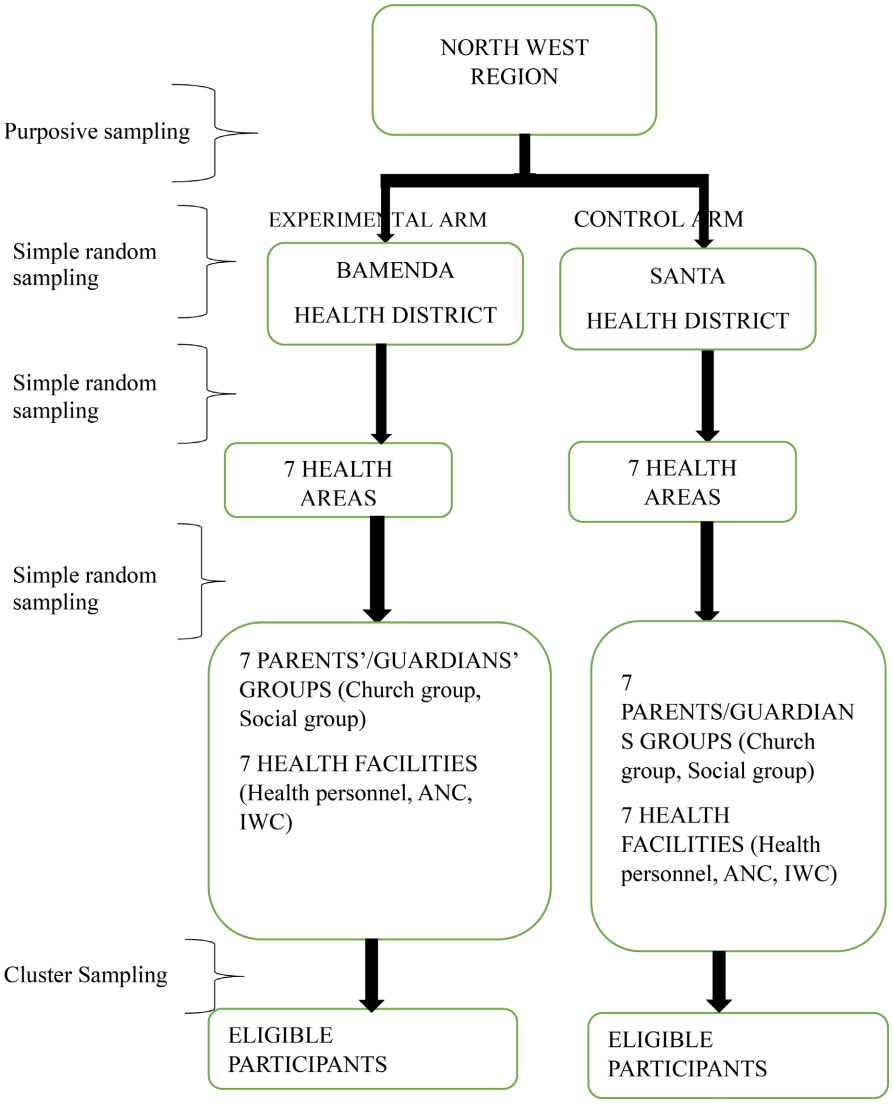
Therefore, $294 + 30 = 324$ persons.

This gave a sample size for the intervention of 324 for the experimental arm and 324 for the control arm, a 1:1 ratio in both the experimental and control arms.

The sampling design was a multi-stage sampling. After having selected 16 out of 19 health districts for having registered at least one Measles epidemic during the study period, 2 health districts were then selected by purposive sampling due to their low levels of insecurity in the current crisis. One was randomly assigned to the experimental and the other to the control arm. These 2 health districts purposefully selected, had a total population of 42,982 and 99,657 inhabitants respectively for Bamenda and Santa Health Districts (2018 population estimate, MOH). In each of the health districts which are already divided into health areas, 6 and 4 health areas were selected respectively from the Bamenda and Santa Health Districts by simple random sampling, proportionate to the number of health areas in the health districts to make a total of 10 health areas. In each health area which is already subdivided into communities, 12 and 8 communities were selected still by simple random sampling respectively from Bamenda and Santa Health Districts, proportionate to the size (or total number) of communities in the health area to a total of 20 communities. Finally, in each community the entire number of eligible persons was studied until the target for the health district was reached. Bamenda Health District has over 60% of the total population of these two health districts, and a total of 18 Health areas while, Santa Health District make up 40 % of the total population with a total of 11 Health areas. This gave a ratio of 6:4 (3:2) health areas for Bamenda and Santa respectively to make up the 10 health areas needed for the study. Considering that the population of the Bamenda Health district is over 60% of this Study population, therefore, it was considered that 60% of the 20 communities to be studied came from Bamenda Health District. As such 12 communities came from Bamenda while 8 came from Santa Health District. In this same light, 60% of the sample size came from Bamenda Health District. Therefore, 470 participants came from Bamenda Health District while 340 came from Santa Health District.

For the intervention study in both the experimental and the control health districts, 7 health areas each were selected by simple random sampling. In each of the health areas, 1 church group and/or 1 social group; and 1 health facility was selected by simple random sampling from an established list. In each group, the entire members were involved in the intervention. During data collection after the intervention, in each group all the eligible participants were considered (cluster sampling) for data collection until the target for each health area/health district was reached. This is further elaborated in the flow chart below (**Figure 1**). **Table 1** below equally summarizes the sampling techniques for the cross-sectional and the intervention study.

The education messages for the intervention were developed and presented in



Source: [Field work of this author].

Figure 1. Flow chart for multi-stages sampling method.

Table 1. Summary of sampling techniques used.

Study design	Sample population	Actual sample size	Sampling techniques	Sampling method	Data collection tool
Cross-sectional study	Parents and health personnel	420	Multistage	Probability	Semi-structured questionnaire
Intervention	Parents and health personnel	200 per arm	Multistage	Probability	Semi-structured questionnaire

a communication plan for delivery to the target population. While data collection involved the use of a Semi-structured questionnaire, developed to capture knowledge of participants on the value of vaccines in disease prevention, the safety of vaccines, measles and measles immunization. This questionnaire was adapted from a pre-existing KAP survey on Cholera vaccination; and Knowledge, attitude and opinion study in New South Wales. The data was collected with the questionnaire

using two approaches by research assistants and data collectors. It was self-administered to those who can read and write; and through individual interview for participants who could not read and write. This was the same questionnaire administered to collect base-line data.

A communication plan (an outlined package of interventions) was developed to address the lapses observed from the analysis of baseline data from the Cross-sectional study. This document was used to educate the population on the value of vaccine; vaccine safety; measles and measles immunization. The template is presented in Table 2 below.

Table 2. Refocused EPI communication plan framework.

Problem Identified	Possible causes (gaps)	Needs according to the communication to vaccination	Communication								
			Goals	Objective (s)	Situation analysis	Resources available	Target audience (s)	Three-point message(s)	Strategy	Channels	Evaluation measurements
1.											
2.											

The Semi-structured questionnaire and the Communication intervention package were pre-tested in the Mbengwi and Njikwa Health Districts of the North West Region of Cameroon. This helped for the identification and correction of inadequacies of questions in meeting the specific objectives, before these instruments were used in the real study to collect accurate data.

The intervention—Communication to improve knowledge of measles

This aspect of the study was carried out in the Experimental health district—Bamenda Health District. It comprised of Health Education messages delivered through: Health Talks, Tract Messages and Mobile phone Text messages, by the principal investigator, trained research assistants and Community health workers. The messages targeted community leaders, parents and health personnel at different forums such as weekly gatherings of Church groups and Social groups ("Njangui" groups, farm groups); and Health facilities of the selected health areas in the community. For the community leaders' forum, education messages were delivered mainly through Health talks. This held same for parents at church groups and social groups (through health talks). While for parents at ANC and IWC. Participants were placed into four groups – 1 = Health Talks only; 2 = Tract messages only; 3 = Mobile phone Text Messages only and 4 = Health Talks, Track Messages and Mobile phone Text Messages combined. These were Ntambag IHC and Atuakum IHC; Mulang IHC; Azire IHC and Medankwe IHC; Nkwen Rural IHC and Nkwen Urban MHC, for methods 1, 2, 3 and 4 respectively. Parents were considered here to be the main decision makers on children's vaccination and so were the main target for communication here. This is why they were involved with different communication mix (methods) to test the effectiveness of each of the mix

(methods) in conveying immunization messages. For the health personnel who are considered as a credible source of health information, 6 health facilities were selected, 2 randomly assigned for education through text messages, 2 for tract messages and 2 for text and tract messages. These were Atuakum and Mulang IHC; Medankwe and Nkwen Rural IHC; and Azire IHC and Nkwen Urban MHC respectively. These messages were focused on addressing lapses identified from baseline findings, with regards to the value of vaccines and the safety of vaccines in immunization; how to identify and report measles in the community; the effects of contracting measles and when to get children vaccinated against measles. All of these were done following the specifications in the communication plan framework (Table 2). The intervention lasted for six months to ensure the impact could be felt, to create awareness in the target population. The following flow chart (Figure 2), illustrates the education intervention:

In all health facilities, a health talk set the ground, during which the communication medium for education was unveiled to the concerned. Where text messages were involved, only participants with registered contact (phone) numbers were enrolled for participation after an informed consent was signed. The participants, method of communication, frequency and person (s) in-charge for health communication is elaborated in Table 3 below.

With regards to the control arm of the study, they received the traditional or routine health education messages, delivered through health talks at their various social groups, ANC and IWC services in the health facilities for the intervention period of 6 months. After Post-intervention data collection, the populations on the control arm were given the messages contained in the intervention to address the gaps identified with their knowledge, attitude practice, and beliefs with regards to measles, value of vaccine and safety of vaccine.

The data collected and submitted on daily basis was cross checked for completeness and then filed according to health area/health district per day. Then, the data was coded according to the measles immunization variables (value of vaccines, safety of vaccines, knowledge on measles, age of receiving Measles vaccine,

Table 3. Participants, method, frequency and person (s) in-charge for health communication.

Study group		Contact forum	Medium of communication	Frequency of communication	Person(s) in charge
Parents	At Church groups and community social groups	Weekly meetings	Health talks	2 times a month	CHWs, research assistants
	At Antenatal consultations (ANC) and Infants welfare clinics (IWC)	Health facility	Health talks	weekly	Research assistants
			Text messages	weekly	PI
			Tract messages	weekly	Research assistants
Health personnel		Health facility	Text messages	weekly	PI
			Tract messages	weekly	Research assistants

Source: [Filed work of this author].

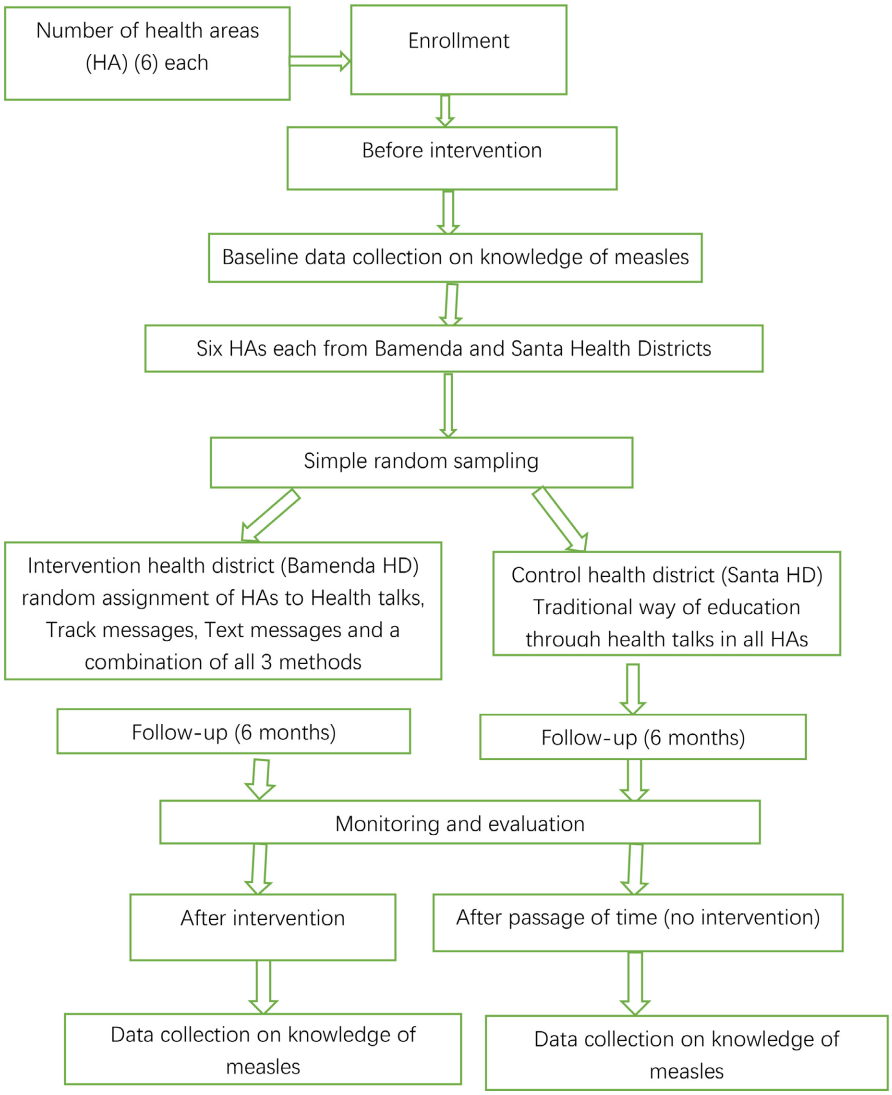


Figure 2. Flow chart for clustered randomized controlled trial in Bamenda and Santa Health Districts in 2020.

number of doses required, and side effects). These codes were given numerical values which were later entered into the computer software for analysis (excel spread sheet) and stored using password into the researcher's laptop.

For the cross-sectional study, data was analyzed using descriptive statistics such as means (± standard deviation) to summarize numerical variables. Proportions and percentages were used to summarize categorical variables. This provided information to set as baseline in the first phase of the study, and then after the implementation of the communication intervention, data was analyzed and the two were compared to note the impact of the health communication intervention.

The knowledge of participants on measles were scored using nine variables on the disease. These variables include cause of measles, signs and symptoms, means of exposure, method of prevention, reason for missing a child's measles vaccine, effectiveness of the vaccine, side effects following measles vaccination, actions

taken when side effects occur and whether measles vaccine is linked to/cause any disease condition. The participants' knowledge was graded based on the provision of correct responses for questions on the above variables. The overall score on 9 was classified as either 'correct knowledge' for a score of 5 and above on 9 or as 'incorrect knowledge' for a score less than 5 on 9.

A comparison was done for the proportion of participants with good knowledge, in the experimental group and the control group, and before and after the implementation of the communication interventions using Chi square test. These results were used to indicate if there is any significant difference in the proportions between the experimental and the control group; and before and after the intervention in the experimental group; as well as with the passage of time in the control group.

The One-way analysis of variance (ANOVA) test was also performed (using the Statistical Package for Social Sciences (SPSS) software, version 21), to determine the level of significance of each channel of communication in passing messages about measles to the population, in favor of the EPI programme. Descriptive statistics were used as well to describe the performance recorded by the different communication channels.

A conclusion was made on the awareness of measles and the impact of health communication intervention on knowledge of measles and measles immunization coverage.

3. Results

This sub-study was conducted in two health districts of the North West Region—Bamenda and Santa Health Districts. This study was to capture participants' awareness of measles (measles and measles immunization). The participants were Health personnel; Parents and Community leaders, aged 15 years and above. The data was collected to answer the following research question:

1) What is the level of knowledge of measles in the community of Bamenda and Santa Health Districts?

This research question represented objective two for the study. The findings of this sub-study at baseline, was to be used to provide information for the development of communication intervention messages, to target identified lapses for the intervention phase of the research project. The results from this sub-study are presented below.

From Table 4, a majority of parents who participated in this study were of the age group 21 to 30 years old and accounted for 64.1% of parents in Bamenda Health District and 62.6% in Santa Health District. For the health personnel on their part, it is equally noticed from the table that a majority of participants were of the same age group 21 to 30 years and accounted for 60.1% of participants in Bamenda and 73.3 % in Santa Health District. It is equally seen that a majority of parents from both health districts were females (64.8%) as against 35.2% for males. For the health personnel, 84.7% were females while 15.3% were males. With regards to the occupation of parents, business and farming dominated in

Table 4. Socio-demographic characteristics of participants in Bamenda and Santa health districts.

Characteristic	Parents Bamenda H/D	Parents Santa H/D	Health personnel Bamenda H/D	Health personnel Santa H/D
Age group (Years)	No (%)	No (%)	No (%)	No (%)
<20	38 (14.8)	24 (11.2)	11 (6.0)	3 (1.9)
21 - 30	164 (64.1)	134 (62.6)	110 (60.1)	115 (73.3)
31 - 40	53 (20.7)	46 (21.5)	45 (24.6)	22 (14.1)
41+	1 (0.4)	10 (4.7)	17 (9.3)	17 (10.7)
Total	**256 (100)**	**214 (100)**	**183 (100)**	**157 (100)**
Sex				
Female	166 (64.8)	139 (65.0)	148 (80.9)	139 (88.5)
Male	90 (35.2)	75 (35.0)	35 (19.1)	18 (11.5)
Total	**256 (100)**	**214 (100)**	**183 (100)**	**157 (100)**
Marital status				
Divorced	3 (1.2)	0 (0.0)	2 (1.1)	3 (1.9)
Married	204 (79.7)	182 (85.0)	105 (57.4)	101 (64.3)
Single	49 (19.1)	32 (15.0)	76 (41.5)	53 (33.8)
Total	**256 (100)**	**214 (100)**	**183 (100)**	**157 (100)**
Occupation				
Accountant	8 (3.2)	1 (0.5)		
Business	70 (27.3)	27 (12.6)		
Farming	49 (19.1)	83 (38.8)		
House wife	20 (7.8)	34 (15.9)		
Laboratory Technician			5 (2.7)	16 (10.2)
Medical Doctor			0 (0.0)	4 (2.5)
Nurse			178 (97.3)	137 (87.3)
Secretary	1 (0.4)	0 (0.0)		
Student	34 (13.3)	18 (8.4)		
Teacher	21 (8.2)	17 (7.9)		
Vocation	53 (20.7)	34 (15.9)		
Total	**256 (100)**	**214 (100)**	**183 (100)**	**157 (100)**
Level of Education				
Primary	44 (17.2)	63 (29.4)	4 (2.1)	6 (3.8)
Some Secondary	100 (39.1)	97 (45.3)	27 (14.8)	26 (16.6)
Completed Secondary or higher	112 (43.7)	54 (25.3)	152 (83.1)	125 (79.6)
Total	**256 (100)**	**214 (100)**	**183 (100)**	**157 (100)**

Continued

Conduct vaccination				
Yes			89 (48.6)	98 (62.4)
No			94 (51.4)	59 (37.6)
Total	**0 (0.000)**	**0 (0.00)**	**183 (100)**	**157 (100)**

these two health districts. In these health districts, 47% of parents were involved in business while 51% were into farming. While more parents in Bamenda Health District were into business, more parents in Santa Health District took up farming. For the health personnel, 97 % were Nurses in Bamenda Health District compared to 87% for their counterparts in Santa Health District.

In both health districts, most parents had attended secondary school and higher at the rate of 82% and 71% respectively for Bamenda and Santa. For the health personnel in Bamenda and Santa Health Districts, 83% and 77% completed secondary school and higher respectively. This indicated a good level of education in the community.

3.1. The Level of Awareness of Measles in the Community

3.1.1. Awareness of Measles among Parents in Bamenda and Santa Health Districts at Baseline

The data from participants' responses with regards to the level of awareness of measles in the communities of Bamenda and Santa Health Districts, were captured and presented below. These were analyzed to answer the research question "What is the level of knowledge of measles in the community of Bamenda and Santa Health Districts?" The variables used in answering this research question included knowledge with regards to: the cause of measles; the signs and symptoms of measles; means of exposure to measles; method of measles prevention; reason for missing child's vaccine; effectiveness of measles vaccine; side effects of measles vaccine; action to be taken if side effect occur and measles vaccine's link to any disease.

According to Table 5 for the Bamenda Health, 104 parents (40.6% CI 38.2 - 43.0) had correct knowledge of the cause of measles compared to 84 parents (39.3% CI 36.8 - 41.8), of their counterparts in the Santa Health District. This indicates that a majority of parents from both health districts, were not aware of the cause of measles. An assessment of awareness of the signs and symptoms of measles, assesses knowledge of the case definition by the WHO for measles surveillance purposes. This entails anybody presenting with fever and rash in addition to any of cough, catarrh and red eye (for the health personnel); or anybody presenting with fever and rash (for the community members). Here, a total of 144 parents (55.1% CI 52.7 - 57.5) in Bamenda HD and 114 parents (53.3% CI 52.4 - 58.2) in Santa H/D, had a correct knowledge of the presentation of a measles case. This indicates that only an average proportion of parents from both health districts were aware of the signs and symptoms of a measles case. As concerned the

Table 5. Baseline knowledge of measles among parents in Bamenda and Santa health districts in 2020.

Variable	Response category	Health district		Mean Diff.
		Bamenda No. (%)	Santa No. (%)	
Cause of measles	Correct knowledge	104 (40.6)	84 (39.3)	1.3
	Incorrect knowledge	152 (59.4)	130 (60.7)	
Total		**256 (100)**	**214 (100)**	
Signs and symptoms of measles	Correct knowledge	144 (56.2)	114 (53.3)	1.8
	Incorrect knowledge	112 (43.8)	100 (46.7)	
Total		**256 (100)**	**214 (100)**	
Means of exposure to measles	Correct knowledge	197 (77.0)	163 (76.2)	0.8
	Incorrect knowledge	59 (23.0)	51 (23.8)	
Total		**256 (100)**	**214 (100)**	
Method of measles prevention	Correct knowledge	202 (78.9)	167 (78.0)	0.9
	Incorrect knowledge	54 (21.1)	47 (22.0)	
Total		**256 (100)**	**214 (100)**	
Reason for missing child's measles vaccine	Lack of Vaccine	164 (64.1)	134 (62.6)	1.5
	Fear of side effects	42 (16.4)	34 (15.9)	
	Difficult access + Others	50 (19.5)	46 (21.5)	
Total		**256 (100)**	**214 (100)**	
Effectiveness of measles vaccine	Agree	225 (87.9)	187 (87.4)	0.5
	Disagree	31 (12.1)	27 (12.6)	
Total		**256 (100)**	**214 (100)**	
Side effects of measles vaccine	Correct knowledge	176 (68.8)	144 (67.3)	1.5
	Incorrect knowledge	80 (31.2)	70 (32.7)	
Total		**256 (100)**	**214 (100)**	
Actions to be taken when side effects occur	Correct knowledge	143 (55.9)	116 (54.2)	1.7
	Incorrect knowledge	113 (44.1)	98 (45.8)	
Total		**256 (100)**	**214 (100)**	
Measles vaccine's link to any disease	Agree	91 (35.5)	81 (37.9)	
	Disagree	165 (64.5)	133 (62.1)	2.4
Total		**256 (100)**	**214 (100)**	

means of exposure to measles, the table indicates that a total of 197 parents (77.0% CI 74.1 - 79.9) had correct knowledge in Bamenda HD as oppose to 163 (76.2% CI 74.4 - 78.0) in Santa HD. With regards to knowledge of the method of preventing measles infection, 202 parents (78.9% CI 76.2 - 81.6) had correct knowledge in the Bamenda HD compared to 167 (78.0% CI 74.5 - 81.5) of their counterparts

in the Santa HD. Participants' responses were also captured on their reason for missing a child's measles vaccine. Here, 164 parents (64.1% CI 61.4 - 66.8) responded that they would miss a child vaccine due to lack of measles vaccine at the health unit, 42 (16.4% CI 15.2 - 17.6) gave reason as fear of side effects while 50 (19.5% CI 18.3 - 20.7) gave difficult access + others (lack of transportation means, lack of time; and staff attitude) as their reason, for Bamenda HD. For the Santa HD, 134 parents (62.9% CI 59.5 - 65.7) gave lack of vaccine at the health unit as reason for failing to vaccinate; 34 (15.9% CI 14.9 - 16.9) gave fear of side effects while 46 (21.5% CI 20.1 - 22.9) gave difficult access + others (lack of transportation means, lack of time and staff attitude) as their reason for failing to vaccinate in the Santa HD. Overall, the lack of measles vaccine at a health unit was a major reason among parents for missing their child's vaccine, followed by fear of side effects and then difficult access to vaccination unit. As concerned the effectiveness of measles vaccine in the prevention of measles, a majority of parents 225 (87.9% CI 84.4 - 91.4) agreed that the vaccine is effective, for the Bamenda HD. For the Santa HD, 187 (87.4% CI 84.0 - 91.1) agreed that measles vaccine is effective in measles prevention. This presents a majority of parents from both health districts with the opinion that measles vaccine is effective in measles prevention. Data was also collected on the knowledge of participants with regards to the side effects from measles vaccination. Analysis indicated that 176 parents (68.8% CI 65.7 - 71.9) had correct knowledge of the side effects of measles vaccination for the Bamenda HD compared to 144 (67.3% CI 64.0 - 70.6) for the Santa HD. This indicates that only a relative majority of parents from both health districts, had correct knowledge of the side effects from measles vaccination. As concerned the actions to be taken when these side effects occur, 143 parents (55.9% CI 53.2 - 58.6) had correct knowledge for the Bamenda HD. For the Santa HD, 116 (54.2% CI 51.3 - 57.1) reportedly expressed a good knowledge. This points to an average proportion of parents with correct knowledge of what to do if a side effect following measles vaccination do occur. The responses of participants were also captured on whether measles vaccine is linked to any disease condition (that is, if the vaccine can cause a disease condition). The analysis indicated that 165 parents (64.5% CI 61.6 - 67.4) disagreed that measles vaccine is linked to other diseases for the Bamenda HD. For the Santa HD, 133 (62.1% CI 59.0 - 65.2) equally disagreed of any link between measles vaccine and other diseases. Overall, a majority of parents from both health districts were not aware of any link between the measles vaccine and other diseases. This data is presented in Table 5 below.

1) Cause of measles: Correct knowledge = A virus; Incorrect knowledge = bacteria.

2) Signs and symptoms: Correct knowledge = Presence of rash and fever in any individual (for parents/community members). Incorrect knowledge: Presence of rash only, fever only, rash and cough, Presence of catarrh and watery eyes; catarrh and cough.

3) Means of exposure: Correct knowledge = Contact with an infected person

and if one is not vaccinated; Incorrect knowledge = Body contact, breathing contaminated air and contact with body fluid.

4) Method of prevention: Correct knowledge = vaccination and avoiding crowded places; Incorrect knowledge = avoiding crowded places only or Traditional medicine.

5) Reason for missing child's vaccine: Lack of vaccine; Fear of side effects; Difficult access.

6) Effectiveness of measles vaccine: Agree (correct knowledge), Disagree (incorrect knowledge).

7) Side effects of measles vaccine: Correct knowledge (four of): Fever, swelling at injection side, abscess, rash, Headache, shock, convulsion. Incorrect knowledge: Open wound.

8) Actions to be taken when side effects occur: Correct knowledge: Give antipyretic, take child to health facility if temperature persist and inform CHW. Incorrect knowledge: Allow to get finished on its own.

9) Measles vaccine's link to any disease: Agree (incorrect knowledge), Disagree (correct knowledge).

3.1.2. Awareness of Measles among Health Personnel in Bamenda and Santa Health Districts at Baseline

From Table 6, for the health personnel in Bamenda HD, 149 (81.4% CI 80.0 - 82.8) had correct knowledge of the cause of measles. For their counterparts in the Santa HD on the other hand, 127 health personnel (80.9% CI 79.5 - 82.3) were knowledgeable about the cause of measles. It is equally seen that 150 health personnel (82.0% CI 78.1 - 85.9), had correct knowledge of the signs and symptoms of measles for the Bamenda HD, compared to 127 (80.9% CI 75.7 - 84.3) in Santa HD. This indicates that a majority of health personnel from both health districts, had correct knowledge of the signs and symptoms of measles. With regards to the means of exposure to measles, 146 health personnel (79.8% CI 75.9 - 83.7) reportedly expressed a good knowledge, for the Bamenda HD while in Santa HD, 123 (78.4% CI 74.1 - 82.4) responded with a good knowledge. Overall, a majority of health personnel from both health districts had correct knowledge of the means of exposure to measles infection. Again, from Table 6, it is seen that 110 health personnel (60.1% CI 56.6 - 63.5) had correct knowledge of the method of prevention of measles infection for the Bamenda HD as opposed to 94 (59.9% CI 56.2 - 63.6) of their counterparts from the Santa HD. With regards to reason a child would miss a measles vaccine, 126 health personnel (68.9% CI 65.2 - 72.6) reported the lack of measles vaccine at the health unit; 35 (19.1% CI 17.5 - 20.7) gave fear of side effects while 22 (12.0% CI 11.0 - 13.0) gave difficult access + others (lack of transportation means, lack of time and staff attitude) in the Bamenda HD. As for their counterparts of Santa HD, 106 (67.5% CI 63.6 - 71.4) gave lack of measles vaccine at health unit; 31 (19.8% CI 17.8 - 21.8) gave fear of side effects while 20 (12.7% CI 11.5 - 13.9) gave difficult access + others (lack of transportation means, lack of time and staff attitude). This result indicates that a majority of

health personnel from both health districts would fail administering a child's measles vaccine due to a lack of the vaccine in the health facility. As concerned the effectiveness of measles vaccine, 168 health personnel (91.8% CI 87.5 - 96.1) agreed it is effective in measles prevention for the Bamenda HD. For their counterparts of the Santa HD, 145 health personnel (92.4% CI 87.9 - 96.9) agreed to the effectiveness of the measles vaccine. Considering knowledge of the side effects from measles vaccine, it is observed that 130 health personnel (71.0% CI 67.3 - 74.7) had correct knowledge in the Bamenda HD. For health personnel in Santa HD, 112 (71.3% CI 67.6 - 74.7) responded with a good knowledge of these side effects following measles vaccination. This indicates that a good proportion of health personnel from both health districts, had correct knowledge of the side effects following measles vaccination. With regards to what to do when side effects following measles vaccination occur, 139 health personnel (76.0% CI 72.1 - 79.9) expressed a good knowledge, for the Bamenda HD. For the Santa HD on the other hand, 118 health personnel (72.2% CI 71.1 - 79.3) also reported a good knowledge of the actions to be taken if side effects following measles vaccination occur. This equally indicates that a majority of health personnel from both health districts had correct knowledge of what to do if a side effect following measles vaccination do occur. Responding to whether measles vaccine is linked to any disease, 131 health personnel (71.6% CI 68.2 - 75.3) disagreed; for the Bamenda HD. For the Santa HD on the other hand, 115 health personnel (73.3% CI 69.2 - 77.4) as well-expressed disagreement with regards to measles vaccine's linked to any disease conditions. It is also observed here that a majority of health personnel from both health districts disagreed measles vaccine is linked to any disease condition. This is presented in Table 6 below.

Table 6. Baseline knowledge of measles among health personnel in Bamenda and Santa Health Districts in 2020.

Variable	Response category	Health district		Mean Diff.
		Bamenda No. (%)	Santa No. (%)	
Cause of measles	Correct knowledge	149 (81.4)	127 (80.9)	0.5
	Incorrect knowledge	34 (18.6)	30 (19.1)	
Total		**183**	**157**	
Signs and symptoms of measles	Correct knowledge	150 (82.0)	127 (80.9)	1.1
	Incorrect knowledge	33 (18.0)	30 (19.1)	
Total		**183**	**157**	
Means of exposure to measles	Correct knowledge	146 (79.8)	123 (78.3)	1.4
	Incorrect knowledge	37 (20.2)	34 (21.7)	
Total		**183**	**157**	
Method of measles prevention	Correct knowledge	110 (60.1)	94 (59.9)	0.2
	Incorrect knowledge	73 (39.9)	63 (40.1)	

Continued

Total		**183**	**157**	
Reason for missing child's measles vaccine	Lack of Vaccine	126 (68.9)	106 (67.5)	1.4
	Fear of side effects	35 (19.1)	31 (19.8)	
	Difficult access + Others	22 (12.0)	20 (12.7)	
Total		**183**	**157**	
Effectiveness of measles vaccine	Agree	168 (91.8)	145 (92.4)	−0.6
	Disagree	15 (8.2)	12 (7.6)	
Total		**183**	**157**	
Side effects of measles vaccine	Correct knowledge	130 (71.0)	112 (71.3)	−0.3
	Incorrect knowledge	53 (29.0)	45 (28.7)	
Total		**183**	**157**	
Actions to be taken when side effects occur	Correct knowledge	139 (76.0)	118 (75.2)	0.8
	Incorrect knowledge	44 (24.0)	39 (24.8)	
Total		**183**	**157**	
Measles vaccine's link to any disease	Agree	52 (28.4)	42 (26.7)	
	Disagree	131 (71.6)	115 (73.3)	−1.7
Total		**183**	**157**	

1) Cause of measles: Correct knowledge = A virus; Incorrect knowledge = bacteria; don't know.

2) Signs and symptoms: Correct knowledge = Presence of maculo-papular rash and fever plus one of cough, or coryza (running nose) or conjunctivitis (red eye). Or a suspected person by a physician—WHO. Incorrect knowledge: Presence of rash, fever, rash and cough, cough and conjunctivitis.

3) Means of exposure: Correct knowledge = Contact with an infected person and if one is not vaccinated. Incorrect knowledge = Body contact and breathing contaminated air, contact with body fluid.

4) Method of prevention: Correct knowledge = vaccination and avoiding crowded places if cases; Incorrect knowledge = avoiding crowded places only or Traditional medicine.

5) Reason for missing child's vaccine: Lack of vaccine; Fear of side effects; Difficult access.

6) Effectiveness of measles vaccine: Agree (correct knowledge), Disagree (incorrect knowledge).

7) Side effects of measles vaccine: Correct knowledge (four of): Fever, swelling at injection side, abscess, rash, headache, shock, convulsion; Incorrect knowledge: Open wound.

8) Actions to be taken when side effects occur: Correct knowledge: Give antipyretic, take child to health facility if temperature persist, and inform CHW. In-

correct knowledge: Allow to get finished on its own.

9) Measles vaccine's link to any disease: Agree (incorrect knowledge), Disagree (correct knowledge).

3.1.3. Awareness of Measles per Socio-Demographic Variables

A good knowledge of measles would help in the early recognition of a case of the disease in the community thereby, favouring initiation of quick measures for it control. This will therefore, improve on the performance of the measles case-based surveillance system in particular and the control of the disease at large. In this light, awareness was assessed by on the knowledge of the presentation of a measles case (signs and symptoms). The results obtained, based on this criterion are presented below.

With regards to the age group of participants, a majority of those who expressed a good knowledge of the signs and symptoms of measles came from the 21 to 30 years age group, 92 (36.0% CI 33.3 - 38.2) and 75 (35.0% CI 32.5 - 37.2) in Bamenda and Santa HDs respectively. As concerned the sex of participants, those with a good knowledge of measles, 94 (36.7% CI 34.5 - 38.9) and 75 (35.0% CI 32.8 - 37.2) were females from Bamenda and Santa HDs respectively. Amongst parents with a correct knowledge of the signs and symptoms of measles, a majority were married persons 108 (42.2% CI 39.8 - 44.6) and 88 (41.1% CI 38.2 - 44.0) respectively for Bamenda and Santa H/Ds. For the level of education, a majority of parents who had correct knowledge of the presentation of measles were those who attended some secondary school, 58 (22.6% CI 19.7 - 25.5) for Bamenda HD and 47 (22.0 CI 18.7 - 25.3) for the Santa HD. These results are presented in Table 7.

As for the health personnel, the age group of 21 to 30 years equally constituted a majority among those who reportedly with correct knowledge of the signs and symptoms of measles, 89 (48.6% CI 46.4 - 50.8) and 75 (47.8% CI 46.0 - 49.6) respectively for Bamenda and Santa HDs. On the other hand, female health personnel made up a majority among those with correct knowledge of the presentation of a measles case, 117 (63.9% CI 61.9 - 65.9) and 98 (62.4% CI 60.2 - 64.6) respectively for the Bamenda and Santa HDs respectively. With regards to the marital status, married health personnel equally made up as relative majority amongst those who expressed correct knowledge of the signs and symptoms of measles, 86 (47.0% CI 45.4 - 48.6) and 75 (47.8% CI 46.0 - 49.6) respectively for Bamenda and Santa HDs. As concerned the level of education, a majority of health personnel who had a correct knowledge of the signs and symptoms of measles, were health personnel who completed secondary school and higher, 135 (73.8% CI 71.8 - 75.8) and 118 (75.2% CI 73.0 - 77.4) for both HDs. It was observed on the contrary that health personnel who do not conduct vaccination made up a relative majority among those who had a correct knowledge of the signs and symptoms of measles 76 (41.5% CI 39.1 - 43.9) and 66 (42.0% CI 39.5 - 44.5) for Bamenda and Santa HD respectively. These results are presented in Table 8.

Table 7. Knowledge of measles (signs and symptoms) among parents in Bamenda and Santa Health districts in 2020.

Variable	Bamenda HD		Total No (%)	Santa HD		Total No (%)
	Correct knowledge No (%)	Incorrect knowledge No (%)		Correct knowledge No (%)	Incorrect knowledge No (%)	
Age group (years)						
<20	22 (8.60)	15 (5.8)	37 (14.5)	17 (8.0)	15 (7.0)	32 (15.0)
21 - 30	92 (36.0)	77 (30.1)	169 (60.0)	75 (35.0)	61 (25.3)	136 (63.5)
31 - 40	27 (10.5)	22 (8.6)	49 (19.1)	21 (9.8)	22 (10.2)	43 (20.1)
41+	0 (0.0)	1 (0.4)	1 (0.4)	1 (0.5)	2 (0.9)	3 (1.4)
Total	**141 (55.1)**	**115 (44.9)**	**256 (100)**	**114 (53.3)**	**100 (46.7)**	**214 (100)**
Sex						
Male	47 (18.4)	43 (16.8)	90 (35.2)	39 (18.2)	34 (15.9)	73 (34.1)
Female	94 (36.7)	72 (28.1)	166 (64.8)	75 (35.1)	66 (30.8)	141 (65.9)
Total	**141 (55.1)**	**115 (44.9)**	**256 (100)**	**114 (53.3)**	**100 (46.7)**	**214 (100)**
Marital status						
Single	32 (12.5)	16 (6.3)	48 (18.8)	26 (12.2)	33 (15.5)	59 (27.6)
Married	108 (42.2)	97 (37.8)	205 (80.1)	88 (41.1)	67 (31.2)	155 (72.4)
Divorced	1 (0.4)	2 (0.8)	3 (1.2)	0 (0.0)	0 (0.0)	0 (0.0)
Total	**141 (55.1)**	**115 (44.9)**	**256 (100)**	**114 (53.3)**	**100 (46.7)**	**214 (100)**
Level of education						
Primary	35 (13.7)	9 (3.6)	44 (17.2)	28 (13.1)	7 (2.8)	35 (16.4)
Some secondary	58 (22.6)	46 (17.9)	104 (40.6)	47 (22.0)	37 (17.3)	84 (39.2)
Completed secondary and higher	48 (18.8)	60 (23.4)	108 (42.2)	39 (18.2)	56 (26.1)	95 (44.4)
Total	**141 (55.1)**	**115 (44.9)**	**256 (100.0)**	**114 (53.3)**	**100 (46.7)**	**214 (100.0)**

Table 8. Knowledge of measles (signs and symptoms) among health personnel in Bamenda and Santa health districts in 2020.

Variable	Bamenda HD		Total No (%)	Santa HD		Total No (%)
	Correct knowledge No (%)	Incorrect knowledge No (%)		Correct knowledge No (%)	Incorrect knowledge No (%)	
Age group (years)						
<20	8 (4.3)	3 (1.6)	11 (6.0)	6 (3.8)	3 (1.9)	9 (5.7)
21 - 30	89 (48.6)	20 (10.9)	109 (59.6)	75 (47.8)	20 (12.7)	95 (60.5)
31 - 40	36 (19.7)	10 (5.5)	46 (25.1)	31 (19.8)	7 (4.5)	38 (24.2)
41+	17 (9.3)	0 (0.0)	17 (9.3)	15 (9.6)	0 (0.0)	15 (9.6)
Total	**150 (82.0)**	**33 (18.0)**	**183 (100)**	**127 (80.9)**	**30 (19.1)**	**157 (100)**

Continued

Sex						
Male	33 (18.1)	2 (1.2)	35 (19.1)	29 (18.5)	5 (3.2)	34 (21.7)
Female	117 (63.9)	31 (16.8)	148 (80.9)	98 (62.4)	25 (15.9)	123 (78.3)
Total	**150 (82.0)**	**33 (18.0)**	**183 (100)**	**127 (80.9)**	**30 (19.1)**	**157 (100)**
Marital status						
Single	62 (33.9)	13 (4.4)	75 (41.0)	51 (32.5)	9 (5.7)	60 (38.2)
Married	86 (47.0)	18 (9.8)	104 (56.8)	75 (47.8)	20 (12.7)	95 (60.5)
Divorced	2 (1.1)	2 (0.0)	4 (2.2)	1 (0.6)	1 (0.6)	2 (1.3)
Total	**150 (82.0)**	**33 (18.0)**	**183 (100)**	**127 (80.9)**	**30 (19.1)**	**157 (100)**
Level of education						
Primary	4 (2.2)	3 (1.6)	7 (3.8)	3 (1.9)	4 (2.5)	7 (4.5)
Some secondary	11 (6.0)	15 (8.2)	26 (14.2)	6 (3.8)	7 (4.4)	13 (8.3)
Completed secondary and higher	135 (73.8)	15 (8.2)	150 (82.0)	118 (75.2)	19 (12.1)	137 (87.2)
Total	**150 (82.0)**	**33 (18.0)**	**183 (100)**	**127 (80.9)**	**30 (19.1)**	**157 (100)**
Conduct vaccination						
Yes	74 (40.3)	16 (8.7)	90 (49.1)	61 (38.9)	12 (7.6)	73 (46.5)
No	76 (41.5)	17 (9.3)	93 (50.8)	66 (42.0)	18 (11.5)	84 (53.5)
Total	**150 (82.0)**	**33 (18.0)**	**183 (100.0)**	**127 (80.9)**	**30 (19.1)**	**157 (100.0)**

To determine the Predictors of parents' correct knowledge of measles, socio-demographic variables and other variables were subjected to univariate logistic regression model and the crude odd ratios and p-values were determined. Variables that showed a statistically significant relation with the knowledge of measles were then subjected to a multivariate logistic regression model in order to get rid of confounders such that variables with significant p-values (< 0.05) were considered as predictors of correct knowledge of measles. Here, age group above 20 years and level of education from secondary school and higher were statistically associated with correct knowledge of measles. Parents who were of age above 20 years old were 0.494 times more likely to have correct knowledge of measles than those below age 20 years. On the other hand, parents who attended secondary school and higher were 0.546 time more likely to have a correct knowledge of measles than those who ended at the primary level of education. These results are presented in Table 9 below.

For the health personnel, socio-demographic variables with other variables under consideration were equally used to determine their association with participant's knowledge of measles. This was done by first subjecting them to univariate logistic regression model and the crude odd ratios and p-values were determined. Variables that showed a statistically significant relation with the knowledge of

Table 9. Predictors of correct knowledge of measles among parents in Bamenda health district in 2020.

Variable	Correct knowledge	Incorrect knowledge	Total No (%)	COR	95% CI	p-value	AOR	95% CI	p-value
Age group (years)									
<20	30 (11.8)	20 (7.8)	50 (19.5)	1			1		
>20	132 (51.6)	74 (28.9)	206 (80.5)	0.506	0.290 - 0.880	0.016	0.494	0.276 - 0.851	0.012
Total	**162 (63.3)**	**94 (36.7)**	**256 (100)**						
Sex									
Male	53 (20.7)	37 (14.4)	90 (35.2)	1					
Female	109 (42.6)	57 (22.3)	166 (64.8)	0.605	0.233 - 1.570	0.302			
Total	**162 (33.3)**	**94 (36.7)**	**256 (100)**						
Marital status									
Single	28 (10.9)	21 (8.2)	49 (19.1)	1					
Married	134 (52.4)	73 (28.5)	207 (80.9)	0.615	0.307 - 1.229	0.169			
Total	**162 (63.3)**	**94 (36.7)**	**256 (100)**						
Level of education									
Primary	33 (12.9)	11 (4.3)	44 (17.2)	1			1		
Secondary and higher	129 (50.4)	83 (32.5)	212 (82.9)	0.583	0.349 - 0.907	0.018	0.546	0.338 - 0.882	0.013
Total	**162 (63.3)**	**94 (36.7)**	**256 (100.0)**						

measles were then subjected to a multivariate logistic regression model in order to get rid of confounders such that variables with significant p-values (< 0.05) were considered as predictors of correct knowledge of measles. Here as well, age group above 20 years and level of education from secondary school and higher were statistically associated with correct knowledge of measles. Health personnel who were of age above 20 years old were 0.546 times more likely to have correct knowledge of measles than those below age 20 years. In the same light, health personnel who attended secondary school and higher were 0.272 time more likely to have a correct knowledge of measles than those who ended at the primary level of education. These results are presented in Table 10 below.

3.2. Communication Intervention

3.2.1. Intervention Study (Cluster Randomized Controlled Trial—RCT)

The intervention was in two parts that each ran for a period of six months in Bamenda Health District. The first part comprised of sending messages to participants using different mediums such as Health talks, Tract messages and Mobile

Table 10. Predictors of correct knowledge of knowledge of measles among health personnel in Bamenda health district in 2022.

Variable	Correct knowledge	Incorrect knowledge	Total No (%)	COR	95% CI	p-value	AOR	95% CI	p-value
Age group (years)									
<20	10 (5.5)	1 (0.5)	11 (6.0)	1			1		
>20	134 (73.3)	38 (20.8)	172 (94.9)	0.609	0.381 - 0.973	0.038	0.546	0.335 - 0.892	0.015
Total	**144 (78.7)**	**39 (21.3)**	**183 (100)**						
Sex									
Male	28 (15.3)	7 (3.8)	35 (19.1)	1					
Female	116 (63.4)	32 (17.5)	148 (80.9)	1.037	0.391 - 2.749	0.942			
Total	**144 (78.7)**	**39 (21.3)**	**183 (100)**						
Marital status									
Single	59 (32.2)	17 (9.3)	76 (41.5)	1					
Married	85 (46.5)	22 (12.0)	107 (58.5)	1.573	0.751 - 3.137	0.238			
Total	**144 (78.7)**	**39 (21.3)**	**183 (100)**						
Level of education									
Primary	4 (2.2)	0 (0.0)	4 (2.2)	1			1		
Secondary and higher	140 (76.5)	39 (21.3)	179 (97.8)	0.325	0.119 - 0.885	0.028	0.272	0.097 - 0.766	0.015
Total	**144 (78.7)**	**39 (21.3)**	**183 (100.0)**						

phone Text messages to improve knowledge of measles and measles immunization. The second part which ran concomitantly with the first was made up of Mobile phone Text message reminders to parents of children who were due measles vaccine, to improve adherence to measles vaccination appointment thereby improving measles vaccination coverage. The results of these interventions are presented below.

3.2.2. Communication Intervention to Improve Knowledge of Measles and Measles Immunization

In the Bamenda Health District purposefully chosen for this study, participants in health areas recruited at baseline were randomly assigned to each of the communication mediums—Health talks, Tract messages and Text messages. This was first to document improvement in knowledge and secondly to document which of the communication channels is most significant in improving knowledge of measles. Change in knowledge of measles for the Bamenda Health District, following the communication intervention was documented by comparing baseline and post-intervention results. To further confirm the impact of the communication inter-

vention on the change in knowledge therefore, baseline knowledge of measles was also compared with that of the Santa Health District. The comparison indicated no significant difference at baseline. This comparison was equally done post-intervention.

From Table 11, there is no significant difference between the proportions of

Table 11. Comparison of Baseline results on knowledge of measles among parents in Bamenda and Santa health districts in 2020.

Variable	Response category	Health district		Mean Diff	p-value
		Bamenda No. (%)	Santa No. (%)		
Cause of measles	Correct knowledge	104 (40.6)	84 (39.3)	1.3	0.419
	Incorrect knowledge	152 (59.4)	130 (60.7)		
Total		**256 (100)**	**214 (100)**		
Signs and symptoms of measles	Correct knowledge	141 (55.1)	114 (53.3)	1.8	0.383
	Incorrect knowledge	115 (44.9)	100 (46.7)		
Total		**256 (100)**	**214 (100)**		
Means of exposure to measles	Correct knowledge	197 (77.0)	163 (76.2)	0.8	0.463
	Incorrect knowledge	59 (23.0)	51 (23.8)		
Total		**256 (100)**	**214 (100)**		
Method of measles prevention	Correct knowledge	202 (78.9)	167 (78.0)	0.9	0.453
	Incorrect knowledge	54 (21.1)	47 921.9)		
Total		**256 (100)**	**214 (100)**		
Reason for missing child's measles vaccine	Lack of Vaccine	164 (64.4)	134 (62.6)	1.5	0.410
	Fear of side effects	42 (16.4)	34 (15.9)	0.5	
	Difficult access + Others	50 (19.5)	46 (21.5)	−2.0	
Total		**256 (100)**	**214 (100)**		
Effectiveness of measles vaccine	Agree	225 (87.9)	187 (87.4)	−1.9	0.448
	Disagree	31 (12.1)	27 (12.6)		
Total		**256 (100)**	**214 (100)**		
Side effects of measles vaccine	Correct knowledge	176 (68.8)	144 (67.3)	1.5	0.405
	Incorrect knowledge	80 (31.2)	70 (32.7)		
Total		**256 (100)**	**214 (100)**		
Actions to be taken when side effects occur	Correct knowledge	143 (55.9)	116 (54.2)	1.7	0.092
	Incorrect knowledge	113 (44.1)	98 (45.8)		
Total		**256 (100)**	**214 (100)**		
Measles vaccine's link to any disease	Agree	165 (64.5)	133 (62.1)	2.4	0.337
	Disagree	91 (35.5)	81 (37.9)		
Total		**256 (100)**	**214 (100)**		

parents in Bamenda and Santa HDs with regards to their performance (correct knowledge) on the variables for knowledge of measles and measles immunization. This therefore, allows us to compare their results as well post-intervention for this study, since the two populations are similar.

The results of the performance of health personnel for the variables under consideration were also compared at baseline and presented in the table below.

Table 12, shows no significant difference between the proportions of health personnel in Bamenda and Santa HDs with regards to their performance (correct knowledge) on the variable for knowledge of measles and measles immunization. This therefore, permits us to compare their results at post-intervention on these variables since the two populations are as well similar.

Table 12. Comparison of Baseline results on Knowledge of measles among health personnel in Bamenda and Santa health district in 2020.

Variable	Response category	Health district		Mean diff.	p-value
		Bamenda No. (%)	Santa No. (%)		
Cause of measles	Correct knowledge	149 (81.4)	127 (80.9)	0.5	0.091
	Incorrect knowledge	34 (18.6)	30 (19.1)		
Total		**183 (100)**	**157 (100)**		
Signs and symptoms of measles	Correct knowledge	150 (82.0)	127 (80.9)	1.1	0.064
	Incorrect knowledge	33 (18.0)	30 (19.1)		
Total		**183 (100)**	**157 (100)**		
Means of exposure to measles	Correct knowledge	146 (79.8)	123 (78.3)	1.4	0.081
	Incorrect knowledge	37 (20.2)	34 (21.7)		
Total		**183 (100)**	**157 (100)**		
Method of measles prevention	Correct knowledge	110 (60.1)	94 (59.9)	0.2	0.132
	Incorrect knowledge	73 (39.9)	63 (40.1)		
Total		**183 (100)**	**157 (100)**		
Reason for missing child's measles vaccine	Lack of Vaccine	126 (68.9)	106 (67.5)	1.4	0.074
	Fear of side effects	35 (19.1)	31 (19.8)	−0.7	
	Difficult access + Others	22 (12.0)	20 (12.7)	−0.7	
Total		**183 (100)**	**157 (100)**		
Effectiveness of measles vaccine	Agree	168 (91.8)	145 (92.4)	−0.6	0.141
	Disagree	15 (8.2)	12 (7.6)		
Total		**183 (100)**	**157 (100)**		
Side effects of measles vaccine	Correct knowledge	130 (71.0)	112 (71.3)	−0.3	0.082
	Incorrect knowledge	53 (29.0)	45 (28.7)		
Total		**183 (100)**	**157 (100)**		

Continued

Actions to be taken when side effects occur	Correct knowledge	139 (76.0)	118 (75.2)	−0.3	0.093
	Incorrect knowledge	44 (24.0)	39 (24.8)		
Total		**183 (100)**	**157 (100)**		
Measles vaccine's link to any disease	Agree	131 (71.6)	115 (73.2)	−1.7	0.074
	Disagree	52 (28.4)	42 (26.8)		
Total		**183 (100)**	**157 (100)**		

The socio-demographic characteristics of participants recruited for the communication intervention in Bamenda Health District and their corresponding counterpart of Santa Health District are presented in Table 13. The demographic data were similar for parents of both health districts. A majority of participants were of the age group 21 to 30 years (64.0 %) mostly made of females and married persons. Equally a majority from both health districts attended secondary school and higher (76.7%). The only difference was that most parents from Bamenda Health District (BHD) were into business (27.3%) while most of them in Santa Health District (SHD) were into farming (38.8 %).

The demographic data for health personnel of both Bamenda and Santa HDs were equally similar. A majority of them were of the age group 21 to 30 years (66.7%), mostly made of females and married persons. Equally a majority of health personnel from both health districts attended secondary school and higher (97.1%). Participants were mostly nurses from both health districts (92.3%). There was no significant difference between the health personnel from both health districts with regards to their demographics.

Table 13. Socio-demographic characteristics of participants for post-intervention.

Characteristics	Parents Bamenda H/D No. (%)	Parents Santa H/D No. (%)	Health personnel Bamenda H/D No. (%)	Health personnel Santa H/D No. (%)
AGE GROUP (YEARS)				
<20	16 (8.0)	27 (13.5)	4 (2.7)	5 (3.3)
21 - 30	142 (71.0)	114 (57)	72 (48.0)	98 (65.3)
31 - 40	39 (19.5)	42 (21.0)	57 (38.0)	35 (23.4)
41+	3 (1.5)	17 (8.5)	17 (11.3)	12 (8.0)
Total	**200 (100.0)**	**200 (100.0)**	**150 (100.0)**	**150 (100.0)**
SEX				
Male	21 (10.5)	20 (10.0)	19 (12.7)	25 (16.7)
Female	179 (89.5)	180 (90.0)	131 (87.3)	125 (83.3)
Total	**200 (100)**	**200 (100)**	**150 (100)**	**150 (100)**

Continued

MARITAL STATUS				
Single	42 (21.0)	47 (23.5)	43 (28.7)	54 (36.0)
Married	157 (78.5)	152 (76.0)	107 (71.3)	96 (64)
Divorced	1 (0.5)	1 (0.5)	0 (0.0)	0 (0.0)
Total	**200 (100)**	**200 (100)**	**150 (100)**	**150 (100)**
OCCUPATION				
House wife	13 (6.5)	24 (12.0)		
Farming	20 (10.0)	82 (41.0)		
Business	50 (25.0)	20 (10.0)		
Vocation	46 (23.0)	25 (12.5)		
Student	42 (21.0)	32 (16.0)		
Paid job	29 (14.5)	17 (8.5)		
Nurse			130 (86.7)	86 (57.3)
Laboratory technician			20 (13.3)	64 (42.7)
Medical doctor			0 (0.0)	0 (0.0)
Total	**200 (100)**	**200 (100)**	**150 (100)**	**150 (100)**
CONDUCT VACCINATION				
Yes	0 (0.0)	0 (0.0)	89 (59.3)	79 (52.7)
No	0 (0.0)	0 (0.0)	61 (40.7)	71 (47.3)
Total	**0 (0.00)**	**0 (0.00)**	**150 (100)**	**150 (100)**
LEVEL OF EDUCATION				
Primary	13 (6.5)	42 (21.0)	2 (1.3)	9 (6.0)
Some secondary	86 (43.0)	101 (50.5)	22 (14.7)	16 (10.7)
Completed secondary or higher	101 (50.5)	57 (28.5)	126 (84.0)	125 (83.3)
Total	**200**	**200**	**150**	**150**

The analysis to note the impact of the communication intervention was done per communication intervention (Health talk, Text message, Tract message and a combination of these). This was equally done for both health personnel and parents. These results are presented below.

3.3. Knowledge of Measles among Parents in Bamenda Health District Following 6 Months Communication Intervention

3.3.1. Parents under Health Talks Channel

Table 14 indicates that the proportion of parents with good knowledge of measles under Health Talk (HT) communication channel, improved following the communication intervention. This improvement was statistically significant for three of seven variables - effectiveness of measles vaccine (χ^2 = 12.507, p-value = 0.00); side effects of measles vaccine (χ^2 = 4.220, p-value = 0.031) and actions to be taken when side effects occur (χ^2 = 3.130, p = 0.057).

Table 14. Knowledge of measles among parents from health talk in Bamenda Health Districts in 2020.

Variable	Correct knowledge Before No (%)	Correct knowledge After No (%)	Mean Diff	χ^2	p-value
Cause of measles	28 (51.9)	32 (64.0)	12.1	1.772	0.127
Signs and symptoms of measles	32 (59.3)	34 (68.0)	8.7	0.373	0.341
Means of exposure to measles	33 (61.1)	34 (68.0)	6.9	2.660	0.079
Method of measles prevention	42 (77.8)	42 (84.0)	6.2	0.083	0.488
Effectiveness of measles vaccine	31 (57.4)	41 (82.0)	24.6	12.507	0.001
Side effects of measles vaccine	27 (50.0)	36 (72.0)	22.0	4.220	0.031
Actions to be taken when side effects occur	28 (51.9)	34 (68.0)	16.1	3.130	0.057
Mean (±SD) correct knowledge	32.1 (1.7)	36.6 (1.3)			

3.3.2. Parents under Text Messages Channel

For parents under Text Message communication channel, it is observed that there was a significant improvement in knowledge between baseline and post-intervention. This improvement is highly significant at p-value 0.01, for all the variables under consideration for knowledge of measles. These results are presented in Table 15. The mean for correct knowledge of measles increased from 39 (±2.8) to 49 (±0.0). This is presented in Table 15 below.

Table 15. Knowledge of measles among parents from text messages in Bamenda Health Districts in 2020.

Variable	Correct knowledge Before No (%)	Correct knowledge After No (%)	Mean Diff	χ^2	p-value
Cause of measles	17 (31.5)	50 (100.0)	68.5	53.939	0.001
Signs and symptoms of measles	32 (59.3)	49 (98.0)	38.7	31.444	0.001
Means of exposure to measles	33 (61.1)	50 (100.0)	38.9	20.111	0.001
Method of measles prevention	34 (63.0)	50 (100.0)	37.0	18.949	0.001
Effectiveness of measles vaccine	35 (64.8)	50 (100)	35.2	7.634	0.004
Side effects of measles vaccine	32 (59.3)	50 (100.0)	40.7	21.298	0.001
Actions to be taken when side effects occur	34 (63.0)	49 (98.0)	35.0	17.112	0.001
Mean (±SD) correct knowledge	32.1 (2.1)	49.7 (0.5)			

3.3.3. Parents under Tract Messages Channel

With regards to Tract Message channel of communication as pr4sebted in Table 16, the proportion of parents with good knowledge of measles increased from baseline to post intervention. This result was also significant for three of the seven variables with p-values < 0.05. These variables were Cause of measles (χ^2 = 22.581, p-value = 0.000); signs and symptoms of measles (χ^2 = 13.073, p-value = 0.000) and side effects following measles vaccination (χ^2 = 4.471, p-value 0.031).

Table 16. Knowledge of measles among parents from tract messages in Bamenda Health Districts in 2020.

Variable	Correct knowledge Before No (%)	Correct knowledge After No (%)	Mean Diff	χ^2	p-value
Cause of measles	17 (31.5)	36 (72.0)	40.5	22.581	0.001
Signs and symptoms of measles	24 (44.4)	38 (76.0)	31.6	13.073	0.001
Means of exposure to measles	36 (66.7)	38 (76.0)	9.3	0.349	0.340
Method of measles prevention	42 (77.8)	44 (88.0)	10.2	2.087	0.112
Effectiveness of measles vaccine	43 (79.6)	44 (88.0)	8.4	0.038	0.511
Side effects of measles vaccine	34 (63.0)	40 (80.0)	17.0	4.471	0.031
Actions to be taken when side effects occur	33 (61.1)	37 (74.0)	12.9	1.322	0.165
Mean (±SD) correct knowledge	35.0 (4.6)	39.8 (1.1)			

3.3.4. Parents under Health Talk, Text and Tract Messages Channels

As concerned communication channel combining Health Talk; Text Message and Tract Message, the proportion of parents with good knowledge equally increased from baseline to post-intervention. This improvement is also significant for three of seven variables under consideration with p-values 0.05. These variables that registered significant knowledge improvement include cause of measles $\chi^2 = 9.098$, p-value 0.002), signs and symptoms of measles ($\chi^2 = 5.207$, p-value = 0.018) and side effects following measles vaccination ($\chi^2 = 8.901$, p-value = 0.002). These results are presented in Table 17.

Table 17. Knowledge of measles among parents from health talk, text and tract messages in Bamenda Health Districts in 2020.

Variable	Correct knowledge Before No (%)	Correct knowledge After No (%)	Mean Diff	χ^2	p-value
Cause of measles	23 (42.6)	36 (72.0)	29.4	9.098	0.002
Signs and symptoms of measles	28 (51.9)	37 (74.0)	22.1	5.207	0.018
Means of exposure to measles	36 (66.7)	38 (76.0)	9.3	0.731	0.260
Method of measles prevention	36 (66.7)	40 (80.0)	13.3	2.327	0.094
Effectiveness of measles vaccine	41 (75.1)	42 (84.0)	8.9	0.347	0.367
Side effects of measles vaccine	28 (53.7)	40 (80.0)	26.3	8.901	0.002
Actions to be taken when side effects occur	31 (57.4)	36 (72.0)	14.6	1.964	0.114
Mean (±SD) correct knowledge	32.8 (2.1)	38.0 (0.8)			

Following this analysis, Text Message communication channel was the most significant for the improvement of parents' knowledge of measles following the six months communication intervention.

3.4. Knowledge of Measles among Health Personnel in Bamenda Health District Following 6 Months Communication Intervention

The comparison was also done on knowledge of measles at baseline and post-in-

tervention for the health personnel and the analysis results presented below.

3.4.1. Health Personnel under Text Messages Channel Post-Intervention

The analysis comparing knowledge of measles under text message communication channel indicates a highly significant improvement in knowledge among health personnel from baseline to post-intervention. This improvement was found to be highly significant at the 0.05 level of significance for all seven variables under study as can be seen in Table 18.

Table 18. Knowledge of measles among health personnel from text messages in Bamenda health districts in 2020.

Variable	Correct knowledge Before No (%)	Correct knowledge After No (%)	Mean Diff	χ^2	p-value
Cause of measles	35 (67.3)	50 (100.0)	32.7	17.610	0.001
Signs and symptoms of measles	41 (78.8)	50 (100.0)	21.2	10.008	0.001
Means of exposure to measles	39 (75.0)	49 (98.0)	23.0	10.320	0.001
Method of measles prevention	29 (55.8)	50 (100.0)	44.2	27.830	0.001
Effectiveness of measles vaccine	42 (80.8)	50 (100.0)	19.8	8.028	0.003
Side effects of measles vaccine	35 (67.3)	50 (100.0)	32.7	17.610	0.001
Actions to be taken when side effects occur	34 (65.4)	50 (100.0)	34.6	19/996	0.001
Mean (±SD) correct knowledge	36.9 (1.6)	49.9 (0.1)			

3.4.2. Health Personnel under Tract Messages Channel Post-Intervention

Analysis on performance under Tract message communication channel equally indicates an improvement in knowledge from baseline to post-intervention for the health personnel. This improvement was significant for three of seven variables under study, with p-values < 0.05. The variables are cause of measles ($\chi^2 = 5.199$, p-value = 0.025); method of measles prevention ($\chi^2 = 13.172$, p-value = 0.000) and side effects following measles vaccination ($\chi^2 = 21.365$, p-value = 0.004). The results are presented in Table 19.

Table 19. Knowledge of measles among health personnel from tract messages in Bamenda Health Districts in 2020.

Variable	Correct knowledge Before No (%)	Correct knowledge After No (%)	Mean Diff	χ^2	p-value
Cause of measles	45 (86.5)	50 (100.0)	13.5	5.199	0.025
Signs and symptoms of measles	43 (85.2)	43 (86.0)	0.8	0.313	0.531
Means of exposure to measles	40 (82.7)	42 (84.0)	1.3	0.251	0.403
Method of measles prevention	31 (59.6)	46 (92.0)	32.4	13.172	0.001
Effectiveness of measles vaccine	50 (96.2)	50 (100.0)	3.8	0.020	0.700
Side effects of measles vaccine	36 (69.2)	46 (92.0)	22.8	21.365	0.004
Actions to be taken when side effects occur	44 (84.6)	45 (90.0)	5.4	0.007	0.580
Mean (±SD) correct knowledge	**42.1 (2.2)**	**46.2 (1.1)**			

3.4.3. Health Personnel under Text and Tract Messages Channels Post-Intervention

With regards to the communication channel combining text and tract messages, analysis equally indicates an improvement in knowledge from baseline to post-intervention for knowledge of measles among health personnel. This improvement was significant for two of seven variables, with p-values < 0.05, as presented in Table 20.

Table 20. Knowledge of measles among health personnel from text and tract messages in Bamenda Health Districts in 2020.

Variable	Correct knowledge Before No (%)	Correct knowledge After No (%)	Mean Diff	χ^2	p-value
Cause of measles	41 (78.8)	49 (98.0)	19.3	9.297	0.002
Signs and symptoms of measles	41 (78.8)	40 (80.0)	1.3	0.029	0.528
Means of exposure to measles	42 (80.8)	41 (82.0)	1.7	0.002	0.576
Method of measles prevention	32 (62.0)	42 (84.0)	25.0	8.210	0.003
Effectiveness of measles vaccine	48 (92.3)	48 (96.0)	4.2	0.819	0.309
Side effects of measles vaccine	37 (71.2)	41 (82.0)	9.9	1.492	0.160
Actions to be taken when side effects occur	36 (69.2)	41 (82.0)	13.2	2.518	0.085
Mean (±SD) correct knowledge	42.0 (2.0)	43.4 (1.3)			

Text message channel of communication also registered the most significant improvement of knowledge of measles among the health personnel in the Bamenda Health District.

Overall, Text message communication channel was the most significant of all the other channels, registering a significantly higher proportion of participants with good knowledge of all the variables under consideration and for both parents and health personnel. This was followed by Tract Message and a combination of Health Talk, Text Message and Tract Message, with Health Talk being the least, all of which were not significant at the 5% level of significance as can be seen in Table 21 and Table 22.

3.5. Comparison of the Different Communication Channels in the Improvement of Knowledge of Measles

This was done using the One-way analysis of variance (One-way ANOVA) test,

Table 21. Comparison of mean score in knowledge of measles among parents per communication channels in Bamenda health district in 2020.

Communication Channel	Knowledge score at baseline Mean(±SD)	Knowledge score post-intervention Mean(±SD)	p-value
Health talk	32.1 (1.7)	36.0 (1.3)	0.160
Text message	32.1 (1.7)	49.7 (0.5)	0.001
Tract message	35.0 (4.6)	39.8 (1.1)	0.166
Health talk, text and tract messages	32.8 (2.1)	39.8 (1.1)	0.122

to compare means on knowledge of participants with regards to measles. This permitted a comparison of the different channels used for health communication, for any statistically significant difference between them. These communication channels were Health Talk (HT); Text Message (Text M.); Tract Message (Tract M.) and a combination of Health Talk, Text Message and Tract Message (HT/TeM/TrM). The analysis indicated that there was a statistically significant difference between the communication channels with p-values < 0.05. The results are presented below in Table 23.

Table 22. Comparison of mean score in knowledge of measles among health personnel per communication channels in Bamenda health district in 2020.

Communication Channel	Knowledge score at baseline Mean(±SD)	Knowledge score post-intervention Mean(±SD)	p-value
Text message	36.9 (1.6)	49.9 (0.1)	0.001
Tract message	42.1 (2.2)	46.2 (1.1)	0.320
Text and tract messages	42.0 (2.0)	43.4 (1.3)	0.238

Table 23. Comparing knowledge of measles among parents across communication methods in Bamenda Health Districts in 2020.

Variables		Sum of Squares	Mean Square	F	Sig.
Cause of measles	Between Groups	3.580	1.193	7.902	0.001
	Within Groups	29.600	0.151		
	Total	33.180			
Signs and symptoms of measles	Between Groups	2.580	0.860	5.977	0.001
	Within Groups	28.200	0.144		
	Total	30.780			
Means of exposure to measles	Between Groups	2.800	0.933	6.846	0.001
	Within Groups	26.720	0.136		
	Total	29.520			
Prevention of measles	Between Groups	1.180	0.393	4.190	0.007
	Within Groups	18.400	0.094		
	Total	19.580			
Measles vaccine effective in preventing measles	Between Groups	1.015	0.338	3.730	0.012
	Within Groups	17.780	0.091		
	Total	18.795			
Side effects of measles vaccine	Between Groups	2.140	0.713	5.985	0.001
	Within Groups	23.360	0.119		
	Total	25.500			
Action taken when side effect occurs	Between Groups	2.655	0.885	5.794	0.001
	Within Groups	29.940	0.153		
	Total	32.595			

The One way ANOVA was also performed to determine if there is a difference between the communication channels used, in improving knowledge of measles for the health personnel. Here, a significant variation between these communication channels was equally noted as indicated by the F-statistics and p-values < 0.05, as indicated in Table 24.

Table 24. Comparing knowledge of measles among health personnel across communication methods in Bamenda Health Districts in 2020.

Variables		Sum of Squares	Mean Square	F	Sig.
Cause of measles	Between Groups	0.013	0.007	1.000	0.370
	Within Groups	0.980	0.007		
	Total	0.993			
Signs and symptoms of measles	Between Groups	1.120	0.560	5.592	0.005
	Within Groups	14.720	0.100		
	Total	15.840			
Means of exposure to measles	Between Groups	0.893	0.447	4.182	0.017
	Within Groups	15.700	0.107		
	Total	16.593			
Prevention of measles	Between Groups	0.640	0.320	4.523	0.012
	Within Groups	10.400	0.071		
	Total	11.040			
Measles vaccine effective in preventing measles	Between Groups	0.040	0.020	1.014	0.365
	Within Groups	2.900	0.020		
	Total	2.940			
Side effects of measles vaccine	Between Groups	0.813	0.407	5.405	0.005
	Within Groups	11.060	0.075		
	Total	11.873			
Action taken when side effect occur	Between Groups	0.840	0.420	4.877	0.009
	Within Groups	12.660	0.086		
	Total	13.500			

A comparison of knowledge of measles among parents indicated that there was a statistically significant improvement $p < 0.05$ post-intervention as compared to the baseline results. These results are summarized in Table 25.

With regards to the health personnel, the comparison equally indicates a statistically significant improvement $p < 0.05$ in knowledge post-intervention as compared to the baseline results. These results are summarized in Table 26.

A comparison for the proportion of participants with correct knowledge of measles was equally done between Bamenda and Santa HDs to ascertain the

Table 25. Summary statistics for correct knowledge before and after Six months of text messaging intervention (Parents in Bamenda HD) in 2020.

Study area	Sample size	Total score	Mean score	Variance	Std deviation
Before Text message intervention					
Bamenda HD	256	1152	64.3	4.518	2.126
Santa HD	214	975	65.1	4.577	2.139
Analysis of variance for correct knowledge					
Variation	Sum of square	Degree of freedom	Mean square	F-statistics	p-value
Between groups	0.521	1	0.521	2.161	0.143
Within groups	61.229	254	0.241		
Total	61.750	255			
After 6 months of Text message intervention					
Study area	Sample size	Total score	Mean score	Variance	Std deviation
Bamenda HD	200	1170	83.6	5.879	2.425
Santa HD	200	1050	75.0	5.276	2.297
Analysis of variance for correct knowledge					
Variation	Sum of square	Degree of freedom	Mean square	F-statistics	p-value
Between groups	2.940	1	2.940	19.250	0.001
Within groups	30.240	198	0.153		
Total	33.180	199			

Table 26. Summary statistics of correct knowledge before and after Six months of text messaging intervention (Health personnel in Bamenda HD) IN 2020.

Study area	Sample size	Total score	Mean score	Variance	Standard deviation
Before Text message intervention					
Bamenda HD	183	985	76.9	5.412	2.326
Santa HD	157	846	77.0	5.423	2.329
Analysis of variance for correct knowledge					
Variation	Sum of square	Degree of freedom	Mean square	F-statistics	p-value
Between groups	0.790	1	0.790	4.975	0.027
Within groups	28.730	181	0.159		
Total	29.519	182			
After 6 months of Text message intervention					
baseline	Sample size	Total score	Mean score	Variance	Standard deviation
Bamenda HD	150	969	92.3	6.503	2.550
Santa HD	150	898	85.5	6.027	2.455

Continued

Analysis of variance for correct knowledge					
Variation	Sum of square	Degree of freedom	Mean square	F-statistics	p-value
Between groups	1.080	1	1.080	10.829	0.001
Within groups	14.760	148			
Total	15.840	149			

impact of the communication intervention. Here, Santa HD where no intervention took place, served as the control while Bamenda HD was the intervention arm.

From Table 27, a majority of parents 158 (79.0% CI 77.0 - 81.0) had a correct knowledge of the cause of measles, for Bamenda HD compared to 105 parents (52.9% CI 50.9 - 54.9) of their peers from Santa HD. Bamenda HD therefore, registered the greatest majority of parents with correct knowledge of the cause of measles 79% while Santa HD had 52.5%, with a p-value of 0.000 level of significance.

It is equally observed from the table that 162 parents (81.0% CI 79.0 - 83.0) had a correct knowledge of the signs and symptom of measles for the Bamenda HD, while the Santa HD registered 124 parents (62.0% CI 62.0 - 64.0).

With regards to the means of exposure to measles, it is equally observed that a majority of parents 164 (82.0% CI 80.0 - 84.0) had a correct knowledge from Bamenda HD as opposed to 157 parents (78.5% CI 76.5 - 80.5) for their peers in Santa HD.

In Bamenda HD, 178 parents (89.0% CI 87.0 - 91.0) expressed a correct knowledge of the method of prevent from measles infection, compared to 173 parents (86.5% CI 84.5 - 88.5) in Santa HD. This difference was not significant at the 5% level of significance (p-value 0.888).

As concerned the reason for missing a child's measles vaccine, 142 parents (71.0% CI 69.2 - 72.8) reported measles vaccine stock out at the health facility; 11 (5.5% CI 4.9 - 6.1) reported fear of side effects while 47 (23.5% CI 21.3 - 25.7) reported difficult access, for Bamenda HD. For the Santa HD, 118 parents (66.5% CI 64.0 - 68.0) gave vaccine stock out at health facility as reason for failing to vaccinate; 25 (12.5% CI 11.9 - 14.1) gave fear of side effects while 42 (21.0% CI 19.0 - 23.0) gave difficult access. Overall, the lack of vaccine was a major reason for failing to vaccinate, registering 71.0% and 66.5% respectively in the Bamenda and Santa Health Districts.

A majority of parents 179 (89.5% CI 87.5 - 91.5) had a correct knowledge of the effectiveness of measles vaccine for measles prevention for Bamenda HD as compared to 183 (91.5% CI 89.5 - 93.5) of their counterparts of the Santa HD. This difference was not significant, with a p-value of 0.972.

A majority of parents, 170 parents (85.0% CI 83.0 - 87.0) expressed a correct knowledge of the side effects following measles vaccination from Bamenda HD as opposed to 163 parents (81.5% CI 79.5 - 83.5) for those from the Santa HD. According the table, Bamenda HD registered a higher proportion of parents with a correct knowledge of the side effects from measles vaccination (85.0%), compared

Table 27. Post-intervention knowledge of measles among parents in Bamenda and Santa Health Districts in 2020.

Variable	Response category	Health district		p-value
		Bamenda No. (%)	Santa No. (%)	
Cause of measles	Correct knowledge	158 (79.0)	105 (52.5)	0.043
	Incorrect knowledge	42 (21.0)	95 (47.5)	
Total		**200 (100)**	**200 (200)**	
Signs and symptoms of measles	Correct knowledge	162 (81.0)	124 (62.0)	0.007
	Incorrect knowledge	38 (19.0)	76 (38.0)	
Total		**200 (100)**	**200 (100)**	
Means of exposure to measles	Correct knowledge	164 (82.0)	157 (78.5)	0.33
	Incorrect knowledge	36 (18.0)	43 (21.5)	
Total		**200 (100)**	**200 (100)**	
Method of measles prevention	Correct knowledge	178 (89.0)	173 (86.5)	0.888
	Incorrect knowledge	22 (11.0)	27 (13.5)	
Total		**200 (100)**	**200 (100)**	
Reason for missing child's measles vaccine	Lack of Vaccine	142 (71.0)	133 (66.5)	0.007
	Fear of side effects	11 (5.5)	25 (12.5)	
	Difficult access + Others	47 (23.5)	42 (21.0)	
Total		**200 (100)**	**200 (100)**	
Effectiveness of measles vaccine	Agree	179 (89.5)	183 (91.5)	0.972
	Disagree	21 (10.5)	17 (8.5)	
Total		**200 (100)**	**200 (100)**	
Side effects of measles vaccine	Correct knowledge	170 (85.0)	163 (81.5)	0.224
	Incorrect knowledge	30 (15.0)	37 (18.5)	
Total		**200 (1000)**	**200 (100)**	
Actions to be taken when side effects occur	Correct knowledge	159 (79.5)	145 (72.5)	0.003
	Incorrect knowledge	41 (20.5)	55 (27.5)	
Total		**200 (100)**	**200 (100)**	
Measles vaccine's link to any disease	Agree	60 (30.0)	71 (35.5)	
	Disagree	140 (70.0)	129 (64.5)	0.049
Total		**200**	**200**	

to their counterparts from Santa HD (81.5%).

From Table 27 below, 159 parents (79.5% CI 77.5 - 81.5) reported a correct knowledge of the action to be taken when side effects following measles vaccination occur for the Bamenda HD. For Santa HD, 145 parents (72.5% CI 70.7 - 74.3) reported with a correct knowledge of their actions when side effects do occur. This

difference was also found to be significant at the 5% level of significance (p-value 0.003).

With regards to whether measles vaccine is linked to other diseases, Table 27 indicates that 140 parents (70.0% CI 68.2 - 71.8) for Bamenda HD, had a correct knowledge of no such link, compared to 129 (64.5% CI 62.7 - 66.3) of their peers from the Santa HD. The difference registered here was significant, with p-value 0.049.

With regards to the health personnel, Table 28 indicates that 147 of them (99.3% CI 94.4 - 100.0) had a correct knowledge of the cause of measles, for the Bamenda HD. For the Santa HD, 136 health personnel (90.7% CI 86.2 - 95.2) expressed correct knowledge of the cause of measles. Overall, the Bamenda HD registered the highest majority of health personnel who knew the cause of measles, compared to their Santa HD counterparts, 99.3% and 90.7% respectively, but this difference was not significant (p-value 0.075). As concerned the signs and symptoms of measles, 132 (88.0% CI 85.8 - 90.2) had a correct knowledge for Bamenda HD as opposed to 99 health personnel (84.0% CI 81.5 - 86.5) in Santa HD. This difference was highly significant at the 5% level of significance (p-value 0.000). Considering how one can be exposed to measles, 131 health personnel (87.3% CI 85.1 - 89.5) expressed a correct knowledge of the means of exposure for the Bamenda HD compared to 121 (80.7% CI 78.5 - 82.9) for Santa HD. From the Bamenda HD, health personnel with a good knowledge of the method of prevention of measles were 138 (92.0% CI 89.6 - 94.4) while their counterparts with a correct knowledge from the Santa HD were 122 (81.3% CI 97.1 - 83.5).

As reasons why health personnel would fail administering a child's measles vaccine, 120 (80.0% CI 77.8 - 82.2) reported vaccine stock out at the health unit; 6 (6.0% CI 5.0 - 7.0) reported fear of side effects while 21 (14.0% CI 12.6 - 15.5) gave difficult access, for the Bamenda HD. For the health personnel in the Santa HD, 104 (69.3% CI 67.1 - 71.5) gave lack of vaccine at the health unit; 18 (12.0% CI 10.8 - 13.2) gave fear of side effects while 28 (18.7% CI 16.7 - 20.7) reported difficult access, as reason for failing to vaccinate against measles. The Bamenda HD registered a higher proportion of those who would miss vaccinating a child due to lack of vaccine at the health unit, (80.0%), compared to those from Santa HD (69.3%). Considering the effectiveness of the measles vaccine for the prevention of measles, 147 health personnel (98.0% CI 95.6 - 100.0) reported with a correct knowledge of the effectiveness of the vaccine for the Bamenda HD compared to 146 (97.3% CI 94.9 - 99.7) for the Santa HD. This difference was not significant at the 5% significant level (p-value 0.289). The table indicates that there was an overall good knowledge of measles vaccine's effectiveness in measles prevention from Bamenda and Santa HDs of 98.0% and 97.3% respectively for health personnel. On the other hand, health personnel with a good knowledge of the side effects following measles vaccination were 137 (91.3% CI 88.9 - 93.7) from the Bamenda HD while their counterparts for Santa HD, registered 119 (79.3% CI 77.1 - 81.5). The table equally indicates that health personnel in Bamenda HD, registered a higher proportion

Table 28. Knowledge of measles among Health personnel in Bamenda and Santa Health District in 2020.

Variable	Response category	Health district		p-value
		Bamenda No. (%)	Santa No. (%)	
Cause of measles	Correct knowledge	149 (99.3)	136 (90.7)	0.075
	Incorrect knowledge	1 (0.7)	14 (9.3)	
Total		**150 (100)**	**150 (100)**	
Signs and symptoms of measles	Correct knowledge	132 (88.0)	126 (84.0)	0.067
	Incorrect knowledge	18 (12.0)	24 (16.0)	
Total		**150 (100)**	**150 (1000)**	
Means of exposure to measles	Correct knowledge	131 (87.3)	121 (80.7)	0.077
	Incorrect knowledge	19 (12.6)	29 (19.3)	
Total		**150 (100)**	**150 (1000)**	
Method of measles prevention	Correct knowledge	138 (92.0)	122 (81.3)	0.001
	Incorrect knowledge	12 (8.0)	28 (18.7)	
Total		**150 (100)**	**150 (1000)**	
Reason for missing child's measles vaccine	Lack of Vaccine	120 (80.0)	104 (69.3)	0.001
	Fear of side effects	9 (6.0)	18 (12.0)	
	Difficult access + Others	21 (14.0)	28 (18.7)	
Total		**150 (1000)**	**150 (1000)**	
Effectiveness of measles vaccine	Agree	147 (98.0)	146 (97.3)	0.289
	Disagree	3 (2.0)	4 (6.7)	
Total		**150 (1000)**	**150 (100)**	
Side effects of measles vaccine	Correct knowledge	137 (91.3)	119 (79.3)	0.001
	Incorrect knowledge	13 (8.7)	31 (20.7)	
Total		**150 (100)**	**150 (100)**	
Actions to be taken when side effects occur	Correct knowledge	135 (90.0)	128 (85.3)	0.043
	Incorrect6 knowledge	15 (10.0)	22 (14.7)	
Total		**150 (100)**	**150 (100)**	
Measles vaccine's link to any disease	Agree	27 (18.0)	38 (25.3)	
	Disagree	123 (82.0)	112 (74.7)	0.001
Total		**150 (100)**	**150 (100)**	

(91.3%) of those with a good knowledge of the side effects from measles vaccination, compared to their Santa counterparts (79.3%), a difference which is highly significant (p-value 0.000).

Table 28 equally indicates that 135 health personnel (90.0% CI 87.6 - 92.4) had correct knowledge of what to do when side effects following measles vaccination

occur, for the Bamenda HD. For the Santa HD on the other hand, 128 health personnel (85.3% CI 83.1 - 87.5) reported with a good knowledge of these actions when side effects occur.

It is equally observed from Table 28 that 123 health personnel (82.0% CI 78.1 - 85.9) had a correct knowledge of no link between measles vaccine and any disease for the Bamenda HD. The Santa HD on the other hand registered 112 health personnel (74.7% CI 72.5 - 76.9) with correct knowledge of no link between measles vaccine and any disease. Health personnel from Bamenda HD registered a higher proportion (82.0%), for those with correct knowledge compared to their Santa counterparts (74.7%), a difference which was highly significant (p-value 0.001).

4. Discussions

The study set out to assess awareness of measles in Bamenda and Santa Health Districts of the North West Region. To determine the impact of health communication interventions on measles immunization in Bamenda Health District.

As findings, the study established a low level of awareness of measles among parents. Finally, the study identified a significant positive impact of the use of mobile phone text messages on the improvement of knowledge.

The EPI programme has contributed tremendously in the prevention of disease and death in the past decades especially in children under five years of age. This study was conducted to capture participants' awareness of measles, the value of vaccine and the safety of vaccine, in a bit to contribute in improving measles vaccination awareness and coverage in the North West Region of Cameroon. The participants were Health personnel, Parents and Community leaders, aged 15 years and above.

4.1. Awareness of Measles

Knowledge of the cause of measles, signs and symptoms and the means of exposure to measles were used to assess participants' awareness of measles. The study found that a low proportion of parents 40.6% and 39.3% for Bamenda and Santa HDs respectively had a good knowledge of the cause of measles. These findings are consistent with those of Abebe *et al.* in Ethiopia, who attributed poor vaccination coverage to low levels of awareness of measles immunization [16]. On the other hand, a good proportion of health personnel 81.4% and 80.9% respectively for Bamenda and Santa HDs knew the cause of measles. A good knowledge of measles would help in its early detection and consequently, eases it control in a community when it does occur. Findings following a measles outbreak investigation in a hospital in China pointed out that a low level of knowledge of measles (56%) among healthcare workers was responsible for the outbreak in the hospital institution and therefore, recommended education about measles to these professionals [17].

The WHO defines a suspected measles case as any person with generalized maculo-papular rash and fever plus one of cough, coryza (runny nose) or conjunctivitis (red eye), and at the community level, any person with fever and rash [8].

Following this case definition, only 56.2% and 53.3% of parents in Bamenda and Santa HDs respectively had a good knowledge of measles. This relatively proportion of parents with good knowledge of the presentation of a measles case could affect the ability to identify suspected measles cases and reporting to health facility at the level of the community. A majority of health personnel on their part 82.0% and 80.9% for Bamenda and Santa HDs respectively, had a good knowledge of the presentation of a suspected measles case.

A majority of parents 77.0% and 76.2% for Bamenda and Santa HDs respectively, were aware that measles can be contracted by living with a measles case and if one is not vaccinated, as a means of exposure. Health personnel registered a proportion of 79.8% and 78.4% respectively for Bamenda and Santa HDs.

Overall, only a relatively greater proportion of parents demonstrated good knowledge of measles and therefore necessitate a rigorous education on measles to better equip them for the fight against this highly contagious disease. Even though an overall high proportion of health personnel had a good knowledge of measles, there is still need to carry out more education on measles to improve on this knowledge as they serve as a reliable source of health information to the community. Evidence points to the fact that there is an expressed reliance on health personnel for information on disease and vaccines, as such, demonstrate a need for more education and communication in this respect [18]. There is equally a need to encourage health personnel to embark on knowledge transfer on measles to parents in order to beef up the latter's knowledge of measles.

4.2. Awareness of the Value of Vaccine

Vaccines are among the best public health discoveries that have contributed in the reduction and elimination of most deadly infectious diseases on the global scene. Knowledge of the value of vaccine was further demonstrated when a majority of parents 78.9% and 78.0% from Bamenda and Santa HDs respectively had a good knowledge of the method of measles prevention. Also, a relatively high proportion of health personnel 60.1% and 59.9% from Bamenda and Santa HDs respectively aligned with parents in respect to good knowledge of measles prevention.

Parents attach value to vaccine but are held back at times due to constraints in acquiring it. It was found that 64.1% and 62.6% in Bamenda and Santa HDs respectively asserted that their primary reason for not vaccinating or missing a child's vaccine is when the measles vaccine is not available at the health facility. Whereas, a considerable proportion of parents 16.4% and 15.9% respectively for Bamenda and Santa HDs pointed to fear of side effects from measles vaccination. Over 68.9% and 67.5% of health personnel respectively for Bamenda and Santa HDs reported they would miss vaccinating children with measles vaccine when it is not available at the health facility. Whereas a small proportion of health personnel 19.1% and 19.8% from Bamenda and Santa HDs respectively still, would be held back due to fear of side effects. Parents identified vaccination constraints that could cause missing of children's vaccine to also include the persistent civil crisis in the North

West Region, far distances and of recent the COVID 19 pandemic. The health personnel would blame failing to vaccinate for measles on lack of vaccine and the number of children present for a measles vaccine vial to be opened. This indicates that the unavailability of measles vaccine in a health facility, the number children present for measles vaccine, far distances, the civil crisis and COVID 19 pandemic were the main reasons for parents failing to vaccinate a child against measles. While others would fear side effects from measles vaccination. The proportion of parents who would miss a child's measles vaccine because of these stated constraints is important and could affect measles vaccination coverage. Vaccine side effects are an important aspect of vaccination and often are under reported by both parents and health personnel. Danova *et al.* found that the overall side effects following vaccination were 6 times higher than that reported to health institutions that follow side effects following vaccination [19] and therefore, necessitate education for parents on reporting side effects. These findings are also consistent with those of Kagone *et al.* [20] for reasons children would miss their vaccine, including the practice of not opening a vaccine vial unless a certain number of children are present at the health facility, and the fear of side effects associated with vaccination.

A majority of parents 87.9% and 87.4% respectively for Bamenda and Santa HDs had a good knowledge of measles vaccine effectiveness in the prevention of measles. This was equally acknowledged by a majority of health personnel 91.8% and 92.4% for Bamenda and Santa HDs respectively. Overall, there was a high rate of acknowledgement of the effectiveness of measles vaccine in measles prevention. Even so, there was still a small proportion of parents over 3.1 % who believe measles vaccine is not effective in measles prevention, as children will receive the one dose of the vaccine and still suffer from measles infection.

There was therefore, an overall good knowledge of the method of measles prevention especially among the health personnel than the parents. This coupled with the fact that children's measles vaccine doses most often could be missed if the vaccine is not available at the health facility, keeping aside the recent events. Masadeh *et al.* found out that mothers who received regular information about vaccination during visits from health staff had significantly high vaccination knowledge [21] and therefore pointed to the importance of education to parents by health care workers on vaccine and vaccination. Karlsson *et al.* on the other hand, demonstrated that health care workers with high confidence in the benefit of vaccines were more likely to accept vaccines for the children and themselves, and to recommend vaccines to others [22]. Furthermore, evidence points to the fact that knowledge of vaccine would increase with the level of education among health care workers [23].

4.3. Awareness of the Safety of Vaccine

Analysis demonstrated that a good proportion of parents 68.8% and 67.3% respectively from Bamenda and Santa HDs had a good knowledge of the side effects fol-

lowing measles vaccination. Health personnel equally showed a good knowledge with 71.0% and 71.3% respectively from Bamenda and Santa HDs. A good proportion of participants therefore demonstrated a good knowledge of the side effects following measles vaccination and pointed to the fact that measles vaccine is safe.

A relative majority of parents 55.9% and 54.2% from Bamenda and Santa HDs said they will take the child back to the health facility when a side effects occurring following measles vaccination do persist, while a small proportion would report to the community health worker. For the health personnel on their part, 76.0% and 75.2% respectively from Bamenda and Santa HDs would advise parents to take the child back to the health facility with the persistence of side effects following measles vaccination. Meanwhile, a small proportion would advise to report side effects to community health worker or allow it to get finish on its own. Equally noted was a practice by some parents administering an antipyretic and analgesic like Paracetamol to their children before going for vaccination to prevent the occurrence of side effects.

Most parents 64.5% and 62.1% respectively from Bamenda and Santa HDs did not agree measles vaccine is linked to other diseases. The situation was same among health personnel, with 71.6% and 73.3% respectively not agreeing to the existence of any link between measles vaccine and other diseases. Overall, a majority of participants considered measles vaccine to be safe in measles prevention.

4.4. Intervention (Cluster Randomized Controlled Trial)

To improve awareness of measles, the value of vaccine and the safety of vaccine

Education on the value of disease prevention is fundamental and represents a moment for the development of an aware culture in the entire population. This part of the intervention used Health talk, tract messages and Mobile phone Text messages as channels to deliver health education messages to participants in health areas randomly sampled to those communication channels all geared to improve knowledge.

4.4.1. Parents

A good knowledge of a disease condition remains paramount for its prevention and control, which are the goals of a vaccination programme. Therefore, knowing about measles and its devastating effects would be necessary to parents for them to get fully engaged in its control measures.

1) Awareness of measles

Following this communication intervention, there was a marked improvement in the proportion of parents with good knowledge of the cause of measles, increasing from 40.6% to 79.0% that is a 38.4% increase whereas this was not the case with the control arm of the study which registered only a 13.2% increase in proportion, moving from 39.3% to 52.5%. The proportion of parents with correct knowledge of the signs and symptoms of a measles case also increased by 42.4% that is moving from 55.1% to 81.0% whereas the control arm registered an 8.7% increase, moving from 53.3% to 62.0% for the parents with correct knowledge. A

5.0% increase in the proportion of parents with good knowledge of the means of exposure to measles, increasing from 77.0% to 82.0% was also registered in the intervention arm whereas the control arm registered a 2.3% increase, from 76.2% to 78.5%. This intervention recorded an overall improvement in the proportion of parents who had a good knowledge of measles in Bamenda HD on the intervention arm than it was the case with Santa HD on the control arm of the study.

2) Awareness of the value of vaccine

The value of vaccine and vaccination goes further than just the health benefits in term of disease prevention and control to improvement of the quality of life of the individual and the nation. Parents therefore should value vaccine and vaccination in order to remain adhere to the vaccination of their progeny. Following the communication intervention, the proportion of parents with a good knowledge of the method of prevention of measles, increased by 10.1% that is from 78.9% to 89.0% while the control arm only registered an 8.5% increase, from 78.0% to 86.5%. As for the primary reason why a parent would miss a child's vaccine, the proportion of parents who said it can only occur when measles vaccine is not at the health facility increased by 6.9% that is increasing from 64.1% to71.0% while the control arm registered an increase of 3.9%, moving from 62.6% to 66.5%. With regards to those who would miss a child's vaccine due to fear of side effects, the proportion rather dropped by 10.9% that is moving from 16.4% to 5.5% in the intervention arm and decreased by 3.4%, moving from 15.9% to 12.5% in the control arm. As concerned the effectiveness of the measles vaccine, the proportion of parents with good knowledge rose by 1.6% that is from 87.9% to 89.5% compared to the control arm which saw a 4.1% increase, moving from 87.4% to 91.5%. Overall, there was a remarkable increase in the proportion of parents with a good knowledge of the value of vaccine in the intervention arm compared to the control arm. This indicates that the intervention was effective in imparting knowledge of measles.

3) Awareness of the safety of vaccine

Vaccines before being brought to use for the prevention of diseases do undergo rigorous scientific testing to prove its worth and safety to humanity and during its use by the wider community, its safety is continuously being monitored. This safety is usually confirmed and certified over years before a vaccine is declared safe for use to ensure that its benefits surpass its secondary or side effects. Following this communication intervention, the proportion of parents with good knowledge of the side effects of the measles vaccine increased by 16.2% that is moving from 68.8% to 85.0% on the intervention arm while the control arm registered an increase of 14.2%, from 67.3% to 81.5%. With regards to the proportion of parents who had a good knowledge of the action to be taken when a side effect from measles vaccination occurs, there was an increase of 23.6% moving from 55.9% to 79.5% for the intervention arm while the control arm registered an increase of 18.3%, moving from 54.2% to 72.5%. Concerning knowledge of whether measles vaccine is linked to other diseases, the proportion of parents with correct knowledge of no such link, increased by 5.5% for the intervention arm, moving from 64.5%

to 70.0% while the control arm only witnessed a 2.4% increase, moving from 62.1% to 64.5%. There was therefore, a greater increase in the proportion of parents with good knowledge of the safety of the measles vaccine registered on the intervention arm than it was the case with the control arm. The findings of this study are consistent with those of Lu *et al.* in China, who reported an increase in caregiver's knowledge about measles, increased willingness to seek immunization services for their children, and increased measles vaccination coverage [24].

4.4.2. Health Personnel

Health personnel are considered as a credible source of health information with regards to disease prevention and control to the people entrusted to their care and as such, need to be well equipped with adequate knowledge so as to meet up with this responsibility. In this light, the WHO posits that Health professionals are the single most important influence on whether individuals decide to have themselves or their children vaccinated; therefore, information and education for health professionals are essential [25].

1) Awareness of measles

Following the communication intervention, the proportion of health personnel with good knowledge of the cause of measles increased by 17.9% that is moving from 81.4% to 99.3% on the intervention arm, whereas the control arm registered a 9.8% increase, moving from 80.9% to 90.7%. With regards to the signs and symptoms of measles, the proportion of health personnel with good knowledge increased by 6.0% that is moving from 82.0% to 88.0% while the control arm registered a 3.1% increase, moving from 80.9% to 84.0%. As concerned the means of exposure to measles, the proportion of health personnel with good knowledge increased by 7.5% that is from 79.8% to 87.3% for the intervention arm whereas the control arm registered a 2.3% increase, moving from 78.4% to 80.7%. These results are similar to those of Blanchard *et al.* 2020 who found that an interactive education intervention with adolescent students, would increase their awareness of measles significantly ($p < 0.05$) [26]. A similar study conducted by Goodarzi *et al.*, 2018 in Isfahan, Iran, also found similar results with a significant increase in the level of knowledge of Diabetic patients following education through the use of SMS cell phone text messages [27].

2) Awareness of the value of vaccine

The proportion of health personnel who had a good knowledge of the method of measles prevention, increased by 31.9% that is moving from 60.1% to 92.0% while the proportion on the control arm increased by 21.4%, moving from 59.9% to 81.3%. For the primary reason of missing a child vaccine, the proportion of health personnel who said it would be due to unavailability of the measles vaccine at the health facility increased by 11.1% that is, moving from 68.9% to 80.0% while the control arm registered an increase of 1.8%, moving from 67.5% to 69.3%. For those who gave fear of side effects as a cause of missing a child's vaccine, the proportion of health personnel reduced by 13.1% moving from 19.1% to 6.0% while the control arm registered a 7.8% reduction moving from 19.8% to 12.0%. As con-

cerned the effectiveness of measles vaccine in measles prevention, the proportion of health personnel with good knowledge increased by 6.2% that is moving from 91.8% to 98.0% on the intervention arm, while the control arm registered a 4.9% increase, moving from 92.4% to 97.3%. Overall, there was a marked increase in the proportion of health personnel with a good knowledge of the value of vaccination following the six months communication intervention.

3) Awareness of the safety of vaccine

The proportion of health personnel with a good knowledge of the side effects from measles vaccination increased by 20.3% that is, moving from 71.0% to 91.3% on the intervention arm while the control arm registered 8.0% increase, moving from 71.3% to 79.3%. For the actions to be taken when side effects from measles vaccination do occur, the proportion of health personnel with a good knowledge increased by 14.0%, moving from 76.0% to 90.0% while the control arm witnessed a 10.1% increase, moving from 75.2% to 85.3%. With regards to whether measles vaccine is linked to other diseases, the proportion of health with a correct knowledge of no such linkage increased by 10.4%, moving from 71.6% to 82.0% on the intervention arm while the control arm recorded a 1.4% increase in proportion, moving from 73.3% to 74.7%. There was an overall marked increase in the proportion of health personnel with good knowledge of the safety of vaccine on the intervention arm of the study compared to the control arm.

A confounder noted here which is manifested by some increases in proportions registered as well on the control arm of the study is the fact that a second dose of measles vaccine was introduced by the EPI programme in Cameroon and which saw some education going on for the need of this second measles dose. This vaccine was introduced one month before the collection of baseline data, which registered no significant difference on awareness between the two HDs, and the education went on in both the control and the intervention health districts right into the intervention phase. Even so, the intervention health district still registered significant increases in the proportion of participants' with good knowledge compared to that on the control arm, an indication that the intervention had an impact on the level of awareness of measles.

4.5. Impact on Knowledge per Communication Channel

A comparison of the proportion of participants with correct knowledge of measles at pre- and post-intervention per communication channel, indicated a major improvement. Although all the channels produced improvement in knowledge of measles, the Health talk communication channel produced a statistically significant change $p < 0.05$ only for three of seven variables used to measure parents' knowledge of measles. On the other hand, Text message channel of communication produced the most significant improvement in knowledge with all the seven variables at $p < 0.05$. With regards to the Tract message channel, there was equally an improvement in knowledge, which was also significant for three of the seven variables under consideration. The last communication channel combined Health

talk, Text message and Tract message. This on its part, also produced improvement in knowledge of measles from baseline to post-intervention. This improvement was as well, statistically significant for three of the seven variables under consideration. Overall, Text Message was the most significant communication channel for the improvement of parents' knowledge of measles following the six months communication intervention. A comparison was also done for the communication channels to note any significant difference between them, using the One-way ANOVA. This indicated a significant difference with P-value < 0.05.

The proportion of health personnel with correct knowledge of measles was also compared at baseline and post-intervention. This analysis also indicated that Text message channel of communication produced the most statistically significant improvement in knowledge of measles at p-value < 0.05 for all seven variables under consideration. Tract message communication channel also produced improvement in knowledge of measles, which was statistically significant for three of the seven variables. Finally, the communication channel combining both Text and Tract messages as well produced improvement in knowledge of measles from baseline to post-intervention, but these results were statistically significant only for two of the seven variables under consideration. Therefore, Text message channel of communication equally produced the most significant results in knowledge improvement for health personnel.

Overall, Text message communication channel was the most statistically significant communication channel in improving knowledge of both parents and health personnel on measles following the six months communication intervention in Bamenda Health District.

Improvement on knowledge of parents and health personnel followed the constructs of the Health belief model, which stipulates people will adopt behaviour change based on the level of perception of vulnerability, potential barrier and the cost to obtain the services.

5. Conclusion

5.1. Awareness

5.1.1. Level of Awareness of Measles

With an overall demonstration of average level of knowledge of measles by parents in the community, there is a need to develop and implement education interventions to target the areas of inadequacy in knowledge identified, to better equip them for the fight against this highly contagious disease. Even though a good proportion of health personnel demonstrated an acceptable level of knowledge of measles, there is still need to carry out more focused education on measles to improve on their knowledge since they serve as a more reliable source of health information to the community.

5.1.2. Level of Awareness of the Value of Vaccine

A significant proportion of parents and health personnel showed a good knowledge

of the value of vaccine as demonstrated by a high proportion of 95.0 % and 97.3 % respectively with a good knowledge of the method of measles prevention. This coupled with the fact as expressed during investigation, that a child's measles vaccine can only be missed if the vaccine is not available at the health facility 71.0%.

5.1.3. Level of Awareness of the Safety of Vaccine

A high proportion of parents as well as health personnel were aware of the side effects from measles vaccination and stated that even though they occur, their intensity of occurrence have greatly reduced and they are often short leave and would finish on their own. Both parents and health personnel did not see any link between measles vaccine and a health condition likewise knowing a disease measles vaccine could cause except for side effects which most often are self-limiting. Overall, a high proportion of parents and health personnel were aware measles vaccine is safe for measles prevention.

Therefore, to improve measles vaccination coverage towards achieving the 92 - 95% coverage, would require considering barriers such as low awareness of measles; measles vaccine non availability at health facilities (stock outs of measles vaccine) and the need to revise the practice of opening a measles vaccine vial only when a certain number of children is reached in trying to prevent vaccine wastage.

5.2. Intervention to Improve Awareness of Measles, the Value of Vaccine and the Safety of Vaccine (Cluster Randomized Controlled Trial)

The six months of communication intervention to improve participants' knowledge of measles registered a significant improvement in the proportion of both parents and health personnel with correct knowledge. The variables considered were the cause of measles, the presentation of a case, the means of exposure to measles, the method of measles prevention, the effectiveness of the measles vaccine, the side effects following measles vaccination and what to do if the side effects occur or persists.

With regards to the communication channels used in the dissemination of health messages about measles to participants, the study demonstrated that Text message communication channel, produced the most significant improvement in knowledge with p-value less than 0.05. This is therefore, the best channel for recommendation for immunization message transmission, followed by a combination of Text and Tract message communication channel according to this study.

Improvement on knowledge of parents and health personnel followed the constructs of the Health belief model, which stipulates people will adopt behaviour change based on the level of perception of vulnerability, potential barrier and the cost to obtain the services.

6. Recommendations

With regards to the awareness of measles, there is a need to design and implement a focused rigorous health communication programme to engage community lead-

ers, parents and health personnel to improve knowledge of measles in the community.

There is a need to incorporate Mobile phone text messaging (SMS) in measles vaccination of the EPI programme to improve vaccination coverage in the North West Region of Cameroon.

7. Limitations of the Study

- This study was the first study to be conducted on health communication and measles immunization in the North West Region of Cameroon. Therefore, it lacked a theoretical background that could have been laid down from the previous studies. The finding of this study therefore, would serve this purpose for future studies in the region on the same subject.
- Only participants with a registered mobile phone number in health facility registers were selected for education through text messages during the intervention phase of the study. This therefore, limited the participants without a mobile phone number from participating in the study and therefore could affect the representativeness of the population. Future studies should ensure integrating participants without a mobile phone number but whose family relation has one.
- The socio-political crisis in the North West Region limited access to some communities and the free implementation of some communication activities for the study. This reduced the coverage of the overall intended communities for the study. Future studies should consider excluding conflict zones in the design of the project.

Ethical Clearance

Ethical clearance was obtained prior to administrative authorization, from the University Ethical Committee (The Institutional Review Board of the Faculty of Health Sciences of the University of Buea). This Ethical clearance from the University was presented to the Regional Ethical Committee for the North West Region and an authorization issued before descend to the field was effected for data collection. This was to ensure that the protocol was read and the rights and security of the participants was ensured.

Administrative Authorizations

The administrative authorizations for this study were obtained at different levels of hierarchy. To begin, an administrative authorization was obtained at the level of the Regional Delegate of Public health for the North West Region, the Director of Health Board and lastly from the Chiefs of Centers. At the level of each Health District, these administrative documents were presented to the various District medical officers (Chiefs of Service for public health for the district) to ensure further permission and collaboration on the field. Finally, at the level of health facilities, these administrative documents were equally presented to the directors and

Chiefs of centers, to obtain further collaboration on the field.

Author Contributions

Conceptualization, Wasu Chrispus Nchandone, Njamnshi Alfred Kongnyu, Same Ekobo Albert and Assob Jules Clement Ngueda; methodology, Wasu Chrispus Nchandone, Njamnshi Alfred Kongnyu, Same Ekobo Albert and Assob Jules Clement Ngueda; software, Wasu Chrispus Nchandone; validation, Njamnshi Alfred Kongnyu, Same Ekobo Albert and Assob Jules Clement Ngueda; formal analysis, Wasu Chrispus Nchandone; investigation, Wasu Chrispus Nchandone; resources, Wasu Chrispus Nchandone; data curation, Wasu Chrispus Nchandone; writing—original draft preparation, Wasu Chrispus Nchandone; writing—review and editing, Wasu Chrispus Nchandone; validation, Njamnshi Alfred Kongnyu, Same Ekobo Albert and Assob Jules Clement Ngueda; visualization, Wasu Chrispus Nchandone; supervision, Njamnshi Alfred Kongnyu, Same Ekobo Albert and Assob Jules Clement Ngueda.; project administration, Wasu Chrispus Nchandone. All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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