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Original article

Reactions of community members regarding community health workers' activities as a measure of the impact of a training program in Amazonas, Brazil

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Abstract

Objectives: The aim of this study was to evaluate the impact of community health worker (CHW) training on recognition and satisfaction regarding the performance of CHWs among members of the community in Amazonas, Brazil, which is a resource-poor area underserved with regard to medical health-care accessibility.

Methods: Baseline and endline surveys concerning recognition and satisfaction with respect to CHW performance among members of the community were conducted by interview using a questionnaire before and after implementation of a program to strengthen community health projects in Manicoré, Amazonas, Brazil. One of the components of the project was CHW refresher training, which focused on facilitating adequate use of health-care services and providing primary health care, including health guidance. The baseline survey was performed in February 2004 at the beginning of the project, and the endline survey was performed in February 2006 at the end of the project. There were 82 and 120 CHWs working in Manicoré at the times of the baseline and endline surveys, respectively. Statistical analysis was performed to determine the significance of changes in experience with CHW activities, expected functions of CHWs, and satisfaction regarding the performance of CHWs between the baseline and endline surveys. In addition, qualitative analysis was conducted to evaluate the acceptability, feasibility, and sustainability of CHW refresher training.

Results: Overall recognition and level of satisfaction regarding CHW performance among members of the community were improved from the baseline to the endline survey, regardless of type of residential area, such as town and/or remote area. Members of the community came to not expect CHWs to "provide strong medicine" ($P < 0.001$) and "provide injections" ($P < 0.001$), and came to appreciate "go to hospital with a sick person" ($P = 0.031$) as a function and role of CHWs.

Conclusions: The results of the present study indicated that steady approaches to motivate and support CHWs in resource-limited settings could improve performance of CHWs and satisfaction of people in the community regarding the activities of CHWs to sustain their health.

Key words: community health worker, training, satisfaction, Amazon

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Introduction

Community health workers (CHWs) are involved in the achievement of millennium development goals (MDGs) to provide primary health care services and facilitate universal health-care accessibility, although their roles/functions and status/positions vary between countries and settings[1)]. The commitment of CHWs improves community-based health service provision, in not only developing countries[2, 3)], but also in developed countries[4, 5)], especially in socially disadvantaged settings.

While there is still debate regarding medical/clinical care provision by CHWs, as this role requires formal professional training[6)], CHWs still play an important role in community-based antiretroviral treatment in sub-Saharan Africa, which is an area with a high prevalence of HIV[7)]. In addition, several studies have highlighted the high quality of health-care service provision by CHWs. For example, a study performed in Uganda demonstrated significant re-

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ductions in rates of child morbidity and mortality through intensive training and monthly supervision of CHWs[3]. A previous study performed in South Africa indicated that new mothers showed high rates of compliance with the recommendations of CHWs regarding their newborn infants[8]. CHWs in Madagascar were reported to provide high-quality contraception services if they had a higher educational level and more weekly volunteer hours, and received refresher training[9]. However, it is necessary to consider not only the positive effects of both task shifting and skill mixing, but also to take into account the negative effects, such as overwork and inappropriateness of service provision by CHWs in the absence of adequate training opportunities and supervision[10].

The effectiveness and sustainability of CHW programs are dependent on the initial and refresher training and continuous supervision[9, 11, 12]. Several types of CHW training program, including those with community participation, have been implemented in different settings and with different objectives depending on the type of health challenges and sociocultural concerns. A study performed in Uganda indicated that the three main factors of involved in motivating CHW retention were "improved child health in village," "education and training," and "community members ask me for health advice or assistance," although the main reasons for discontinuation were "too busy," "moved," "business/employment," "death," and "separation/divorce"[13].

North Wales in the UK implemented the Brazilian CHW system to increase health-care coverage, and this relatively low-cost, simple, and effective program was shown to be successful in this industrialized setting[14]. Transdisciplinary collaboration and familiarity with the community are considered as factors in the successful implementation of Brazil's unified health system, including the CHW system[15].

Brazil is a unique and diverse country, with especially marked contrasts between the industrialized southern part of the country and the northern part that includes Amazonas and has dynamic natural conditions. The Brazilian CHW system, which is called *Programa dos Agentes Comunitários de Saúde* (PACS), was initiated in the early 1990s, and was universally introduced throughout the country in 1997 as part of the unified health system, which is called *Sistema Único de Saúde* (SUS). The roles and functions of CHWs are outlined in the CHW manual published by the Ministry of Health, and include: 1) visiting each family in the catchment community at least once a month, 2) identification of risks and referral to the responsible sectors, 3) monthly monitoring of the growth of children under 2 years old (weight and height) and recording on a child monitoring card, 4) promotion of breastfeeding, 5) ensuring compliance with vaccination, 6) provision of guidance to families regarding oral rehydration salts to prevent diarrhea and dehydration among children, 7) identification and registration of all pregnant women and accompaniment of them to antenatal care, 8) provision of guidance about family planning, 9) provision of guidance about HIV/AIDS prevention, 10) provision of guidance about prevention of infectious diseases, 11) monitoring of dermatitis and parasitic infection among children, 12) provision of health education about prevention of cervical cancer and breast cancer, 13) provision of health education about menopause, 14) provision of guidance on healthy food/nutrition, 15) provision of guidance on oral hygiene, 16) supervision of families with tuberculosis, leprosy, hypertension, diabetes, and other chronic disease patients, 17) provision of preventive care and promotion of health in the elderly, and 18) identification of people with psychophysical disabilities and provision of family support[16, 17]. In the present study area, CHWs fulfill these roles and functions mainly by making home visits and organizing community meetings.

The present study was performed to evaluate the impact of CHW training on recognition and satisfaction regarding the performance of CHWs among members of the community in Amazonas, Brazil, which is a resource-poor and underserved setting with regard to medical health-care accessibility.

Methods

Study area

Manicoré is a city in the state of Amazonas, Brazil, with a population of 51311 in 2013 according to the Instituto Brasileiro de Geografica e Estatistica (the Brazilian Institute of Geography and Statistics, IBGE). Manicoré City has an area of 48283 km², which is larger than Denmark (43094 km²). Approximately 15000 people live in the town, while the rest of the population live in 225 communities along the Madeira River, which is the largest tributary of the Amazon River. The people who live in town do not need to travel far and can reach the city office or hospital by land, while people in rural communities in remote areas must travel by boat to reach such facilities. The rural communities nearest and farthest from town are located at distances requiring about 30 min or more than 15 h of travel by motorboat, respectively.

In Manicoré City, one state hospital provides secondary medical care, and four health centers provide primary medical care, but there are no formal health facilities or health professionals in the outlying rural communities. People within the community have to travel to town by motorboat or ship, which takes 3–5 times longer than motorboat, for medical care, including institutional childbirth. For those

without access to their own motorboat or fuel, this also involves additional costs to pay for transportation.

A health needs assessment conducted by the nonprofit organization Health and Development Services (HANDS), indicated that the CHW system did not function appropriately in the early 2000s and that the quality of health-care services did not fulfill the health needs of the people in Manicoré. There were 26 CHWs in town and 54 CHWs in remote areas in 2001. Most CHWs in town had graduated from high school, but the majority of CHWs in remote communities had completed only 4 years of primary education.

Study procedure

The community health project in Manicoré received support from the nonprofit organization HANDS between 2004 and 2006. The objectives of the project were to improve the health conditions of people in the community through CHW capacity development with regard to primary health care, because Manicoré is among the areas in Brazil with the poorest health-care accessibility. One of the project's component of activities was CHW refresher training, which focused on facilitating adequate use of health-care services and providing primary health care, including health guidance, such as guidance concerning water sanitation and basic hygiene in daily life, based on the CHW manual published by the Ministry of Health, Brazil. The project provided training for CHWs when they came to Manicoré City to receive their monthly remuneration. CHWs were also provided ad hoc training, such as first-aid training and training about blood pressure measurement, child nutrition, sexually transmitted infections, and HIV/AIDS. Physicians, nurses, and other medical health professionals in the state hospital and/or other invited trainers performed participatory training for CHWs at least once a month during the period of the project from 2004 to 2006. The training program was coordinated by the project with collaboration of Manicoré City and the state hospital. The project also supported the activities of CHWs by supplying essential equipment, such as manometers and home visit bags.

1. Qualitative evaluation procedure

Qualitative evaluation was conducted to assess the acceptability, feasibility, and sustainability of CHW refresher training with regard to the following points: (i) political mobilization by Manicoré City; (ii) degree of community participation; (iii) degree of increased awareness of CHW performance; (iv) capacity to manage CHW refresher training; and (v) partnerships established among Manicoré City, the state hospital, and health centers through stakeholder analysis, process evaluation of CHW refresher training, and participatory observation (Table 1)[18]. The qualitative evaluation framework was established by modifying a project assessment tool in the project cycle management, which is used as a project management tool by the Japan International Cooperation Agency (JICA), which was the funding agency for the community health project in Manicoré conducted by HANDS. The project reports were used to assess qualitative data of the CHW refresher training procedure. The data were analyzed by members of the community health project in Manicoré (three of the authors) according to the qualitative evaluation framework as shown in Table 1.

2. Quantitative evaluation procedure

Baseline and endline surveys concerning the functions of CHWs and satisfaction of members of the community regarding the performance of CHWs were conducted to evaluate the impacts of the project. The baseline survey was performed in February 2004 at the beginning of the project, and the time of the endline survey was performed in February 2006 at the end of the project. There were 82 and 120 CHWs working in Manicoré at the time of the baseline survey and the endline survey, respectively. Some CHWs covered more than two communities because of the population size and distribution. Five wards from the town area and 10 communities from remote areas were randomly selected for the baseline survey, while 10 wards from the town area and 10 communities from remote areas were randomly selected for the endline survey. Ten households from each ward or community were randomly selected, and therefore, the baseline survey was conducted among a total of 50 households from the town area and 100 households from rural areas, and the endline survey was conducted among 100 households from both the town and rural areas. Interviewers visited each household to perform the interviews. In cases in which the head of the household or housewife/homemaker could not be interviewed, the next household was visited.

The interviews in the baseline and endline surveys were conducted using the same questionnaire, which was established by the project team for the baseline survey, and included items regarding experience with CHW activities based on the Ministry of Health CHW manual, expected functions of CHWs, and satisfaction regarding the performance of CHWs.

Prior to each survey, six interviewers were recruited from among university students from the local campus of the university in the study area. They received a 4-day participatory training course, including role-playing using expected interview scenes, including a case in which people would refuse to participate in the study, and practice with people in the community from wards that were not selected for the survey, using the interview guide and questionnaire, which was prepared with consideration of locally accept-

Table 1 Qualitative evaluation framework

	Acceptability	Feasibility	Sustainability
(i) Political mobilization by Manicoré City	How Manicoré City accepted CHW refresher training.	How Manicoré City made a commitment to CHW refresher training.	Potential of Manicoré City to sustain their commitment to CHW refresher training.
(ii) Degree of community participation	The level of acceptance was demonstrated regarding CHWs' performance.	The level of community participation demonstrated to contribute to CHW refresher training.	Potential of people within the community to sustain participation in CHW refresher training.
(iii) Degree of increased awareness of CHW performance	How CHWs and their performance were accepted by people within the community.	How people within the community understood and were aware of CHWs and their performance.	How people within the community can maintain their motivation to sustain their contribution to CHW refresher training.
(iv) Capacity to manage CHW refresher training	How Manicoré City and people within the community demonstrated a supportive attitude toward CHW refresher training.	How Manicoré City and people within the community performed in CHW refresher training.	Potential of Manicoré City and people within the community to sustain dealing with CHW refresher training.
(v) Partnerships established among Manicoré City, the state hospital and health centers, and CHWs	How they accepted establishment of partnerships among Manicore City, the state hospital, and health centers.	How they showed partnerships during CHW refresher training.	Potential for sustaining partnerships.

able expressions using simple and general terminology. Interviewer training also highlighted ethical considerations and informed consent regarding participation in the survey, especially oral communication skills necessary to explain study procedures and ethical considerations regarding people with low educational status. Interviewers were also trained to protect the privacy of data obtained through interviews, such as the names, addresses, and health conditions of interviewees.

Analysis of the quantitative evaluation

Changes in experience with CHW activities, expected functions of CHWs, and satisfaction regarding the performance of CHWs between the baseline and endline surveys were compared by chi-square test or Fisher's exact test. In addition, Mantel–Haenszel analysis was performed to compare changes regarding the recognition of functions and roles and high-priority functions and roles of CHWs between the baseline and endline surveys stratified by the town and remote areas. Changes regarding the satisfaction with CHW home visits between the baseline and endline survey were analyzed by chi-square test or Fisher's exact test and between the town areas by Mantel-Haenszel analysis among people who had experienced home visits by CHWs. Experiences of receiving health education/guidance by CHWs were compared between the baseline and endline surveys by Mantel–Haenszel analysis.

Ethical considerations

The present study was approved for publication by the Ethics Committee of the Nagasaki University Graduate School of Biomedical Sciences and the local health government of Manicoré city. Before commencement of the study, the present study was approved by the local health government of Manicoré City after being informed regarding the study procedure and ethical issues. A verbal explanation regarding study participation, including ethical considerations, was provided to the participants using a standardized format each time they participated in an interview. The study participants were informed about their rights to refuse and/or decline participation in the study at any time without any disadvantage. In addition, the study participants were also informed that they would receive no substantial benefits due to their participation in the study.

Results

Qualitative evaluation

Table 2 shows a summary of the qualitative evaluation, with the details presented below along with examples of the opinions of CHWs and people within the community.

(i) Political mobilization by Manicoré City

A change in Manicoré City's government administration occurred during the period of the project, and there was personnel reshuffling not only among local government officers but also among CHWs. The project remained politically neutral and made arrangements to adjust to local govern-

mental needs and the project objectives. The local government was supportive of the project.

The mayor and health director of Manicoré City gave greater consideration to disease prevention and not only treatment. They appreciate the work of CHWs and mentioned that the role of local government should be to improve the continuous support system for CHWs.

(ii) Degree of community participation

Many people within the community voluntarily participated in the CHW refresher training in remote areas in the latter part of the project, although people from the community were not invited to take part in the training. One of the community participants reported the following:

"We haven't had an opportunity to learn how to proceed in our work and draw the attention of people in the community. We also want to participate in the meetings with CHWs." (report by one of the people from the community)

(iii) Degree of increased awareness of CHW performance

At the beginning of the project, CHWs were considered to be people who provide medicine and clinical treatment in remote areas rather than in the town. However, people within the community came to recognize and appreciate the role and performance of CHWs both in the town and in remote areas at the end of the project.

"The incidence of diarrhea among children decreased after treatment of drinking water and use of toilets based on the CHWs' recommendations." (report by one of the people from a remote community)

"Nobody went to antenatal care before implementing the project. However, recently everybody goes to the hospital/health center for antenatal care when they become pregnant." (report by a remote CHW)

"Only two of 29 households in my community had a toilet before the project, but 22 households now have a toilet. There has been a decrease in parasite infections among people in the community." (report by a remote CHW)

(iv) Capacity to manage the CHW refresher training

Health personnel, including nurses who worked in the state hospital and health centers, did not have collaborative relationships with CHWs at the beginning of the project. The project invited health personnel to the CHW refresher training and arranged opportunities to work together. This allowed the establishment of supportive partnerships when CHWs required supervision by health professionals to assess the conditions of their patients.

The project improved the capacity of CHWs and awareness and participation of people within the community regardless of the political changes that occurred during the period of the project. Considering the level of community participation, the project supported collaborative efforts between CHWs and community churches and organizations such as "Pastoral da Criança" (Pastoral Care for Children).

"CHWs are working well, and community leaders and community organizations have changed their level of participation. I have seen an improvement in the health conditions in communities." (report by a CHW supervisor)

(v) Partnerships established among Manicoré City, the state hospital and health centers, and CHW

As mentioned above (iv), some health personnel began to collaborate with CHWs regarding patient care and referral coordination as part of the community-based family support program. Such experiences increased the motivation and quality of performance of CHWs, including that relating to the monthly reporting system.

The project took on the role of supervision of CHWs, but CHW refresher training and supervision will be taken over by the health division of Manicoré City and the community organization "Amazonas Sustainable Development Agency" after the project has ended.

In addition, partnerships among CHWs living in neighboring communities were also observed. For example, CHWs performed joint home visits as peer review of activities and joint health education in both the town and remote communities.

Quantitative evaluation

A total of 151 study participants in the baseline survey (because there were two families in one household) and 198 study participants in the endline survey were analyzed in the present study. Table 3 shows differences in recognition regarding community health workers between the baseline and endline surveys. The number of study participants with recognition of CHWs increased significantly from the baseline survey to the endline survey.

Among the participants with recognition of CHWs ($n = 321$), 118 (94.4%) at the baseline survey and 196 (100.0%) at the endline survey reported that they had received home visits by CHWs.

Table 4 shows the study participants' recognition of CHW functions and roles, and differences in the expected functions and roles between the baseline and endline surveys among those familiar with people in charge as CHWs. Functions and roles for which recognition decreased significantly between the baseline and endline surveys (chi-square test) were "provide strong medicine," such as antibiotics, "provide non-strong medicine", such as antipyretics and/or analgesics, "provide herbal medicine," and "perform injections". Functions and roles of CHWs with significantly increased recognition between the baseline and endline surveys were "measure blood pressure", "measure body temperature". "give health guidance/information", "visit

Table 2 Results of qualitative evaluation

	Acceptability	Feasibility	Sustainability
(i) Political mobilization by Manicoré City	Manicoré City (city mayor and health director) was supportive of CHW refresher training and their activities, although there was local political change during the period of the project.	Manicoré City established a supportive supervisory system for CHWs.	Manicoré City agreed to continue the CHW support system, including supervision, as part of the role of the health division.
(ii) Degree of community participation	Community organizations and people welcomed working together.	People within the community organized a community-based institution to supervise CHWs, especially for CHWs in remote communities, because the division of Manicoré City cannot constantly supervise all CHWs.	There is confidence among community organizations, people within the community, and CHWs regarding continuous collaboration.
(iii) Increased awareness of CHW performance	People within the community appreciated CHWs' activities.	People within the community came to understand that the roles of CHWs involved disease prevention and promotion of health, not only giving medicine and performing clinical treatment.	People within the community have learned that "health can be obtained by ourselves, not by someone else." People within the community and CHWs stimulate each other to maintain a good level of motivation for self-management.
(iv) Capacity to manage CHW refresher training	People within the community became more supportive of CHWs and their training, especially in the latter period of the project.	People within the community voluntarily participated in CHW training.	The project directly addressed CHWs and people within the community, and they were in charge of decision-making and management at the local level from the beginning of the project. Thus, they obtained a sufficient capacity to manage the CHW system.
(v) Partnerships established among Manicoré City, the state hospital and health centers, and CHW	CHWs and health personnel of the hospital/health center did not have collaborative relationships at the beginning of the project, but after beginning to work together, they established more supportive relationships.	Manicoré City integrated a CHW support system as part of the role of the health division with the hospital and health centers.	CHWs' activities are part of the national health strategies; stakeholders at all levels, including the local government (Manicoré City), local health sector (hospital/health centers), community organizations, and people within the community, recognize their responsibilities and harmonization of each role.

patients at home", "visit pregnant women", "confirm sick person", and "confirm immunization received".

Expected functions and roles of CHW that showed significant decreases between the baseline and endline surveys were "provide strong medicine", such as antibiotics, "provide herbal medicine", and "perform injections", while recognition of "go to hospital with a sick person" was significantly increased.

Table 4 also shows CHW functions and roles that were evaluated as being of high priority by the study participants familiar with people in charge as CHWs. The priority of "confirm immunization received" decreased significantly, while that of "prepare hospital referral forms" increased significantly between the two surveys.

Table 5 shows a comparison of current recognition and priority of CHW functions and roles between the baseline and endline surveys according to area of residence (i.e., town or remote area) using the odds ratio, with the results of the baseline survey as a reference among those familiar with people in charge as CHWs. There were no differences in expected CHW functions and roles between the two surveys, i.e., more than 90.0% of study participants responded with expected functions and role in 11 and 10 of 14 items at the baseline and endline surveys, respectively, and Mantel-

Table 3 Recognition of community health workers (CHWs) by local people (n = 349)

	Baseline (n = 151)		Endline (n = 198)		P-value
	n	%	n	%	
Person to consult when family members have health problems					
Community leader	2	1.3	2	1.0	1.000
Community health worker	76	50.3	120	60.6	0.055
Traditional birth attendant	11	7.3	3	1.5	0.011
Traditional healer	34	22.5	29	14.6	0.058
Head of family	9	6.0	13	6.6	0.818
Family member	45	29.8	38	19.2	0.021
Hospital	98	64.9	158	79.8	0.002
Knowing someone who performs home visits or who is in charge as a CHW	125	82.8	196	99.0	< 0.001

The chi-square test or Fisher's exact test was performed.

Haenszel analysis could not be performed. "Provide strong medicine" showed a decrease in recognition as a current CHW function and role (OR: 0.17) and high priority (OR: 0.19) at the endline survey among people in town. Although there was no significant difference in "provide strong medicine" between the baseline and endline surveys among people in remote areas, there was a significant difference as an expected function and role at the endline survey (OR: 0.31). "Provide herbal medicine" also showed a decrease in recognition as a current CHW function and role (OR: 0.16) and high priority (OR: 0.37), at the endline survey among people in town, although no such trend was observed among people living in remote areas. "Measure blood pressure" (OR: 6.90), "measure body temperature" (OR: 3.97), "visit patients at home" (OR: 5.85), "visit pregnant women" (OR: 3.17) and "confirm sick person" (OR: 5.12) showed significant increases in recognition as CHW functions and roles at the endline survey among people in town. "Go to hospital with a sick person" showed an increase in recognition as an expected function and role of CHWs at the endline survey among people in town (OR: 5.76). "Visit patients at home" (OR: 0.33) and "confirm immunization received" (OR: 0.15) showed decreased recognition as high-priority CHW functions and roles at the endline survey among people in town, although recognition as current functions and roles was increased. On the other hand, "give health guidance/information" (OR: 5.01), "visit patients at home" (OR: 5.28), "visit pregnant women" (OR: 2.10), "confirm sick person" (OR: 5.04), and "confirm immunization received" (OR: 3.90) showed significantly increased recognition as current functions and roles of CHWs at the endline survey among people living in remote areas.

Table 6 shows the satisfaction of study participants who had received home visits with regard to CHW performance at the baseline and endline surveys. Among people in the community who experienced home visits by CHWs (n = 314), 62 (52.5%) at the baseline survey and 159 (81.1%) at the endline survey reported that CHWs performed home visits every month. Among people in the community who reported that CHWs did not perform monthly home visits (n = 92), the number of people in the community who experienced CHW home visits within the last 3 months increased from 54.5% at the baseline survey to 89.2% at the endline survey, and only 4 (10.8%, 3 from town and 1 from a remote area) had not met a CHW in the last 3 months. The number of study participants who reported "the CHW well understood the health conditions of family members" ,"home visits by the CHW were helpful" and "overall performance of the CHW was satisfactory to maintain your and your family's health" was significantly increased between the baseline and endline surveys (chi-square test).

Table 7 shows the differences in satisfaction regarding CHW performance between the baseline and endline surveys among people who had received home visits according to area of residence. Both the study participants from the town and remote areas were likely to report significantly higher satisfaction with regard to CHW performance at the endline survey. In particular, the study participants from the town showed increased satisfaction in areas such as "CHWs performed home visits every month" (OR: 26.89), "the CHW well understood the health conditions of family members" (OR: 5.56), "home visits by the CHW were helpful" (OR: 8.84), and "overall performance of the CHW was satisfactory to maintain your and your family's health" (OR: 12.35).

Provision of health education/guidance is one of the functions and roles of CHWs. Table 8 shows the study participants' experiences of activities related to health education/guidance by CHWs at the baseline and endline surveys among those familiar with people in charge as CHWs. Expe-

Table 4 Current recognition and expected functions and roles of community health workers (CHWs), and priority of expected functions and roles among people who know a person in charge as CHW (n = 321)

	Current recognition of functions and roles of CHWs		*P*-value	Expected functions and roles of CHWs		*P*-value	High-priority functions and roles of CHWs		*P*-value
	Baseline	Endline		Baseline	Endline		Baseline	Endline	
	%	%		%	%		%	%	
Provide strong medicine	18.4	9.2	0.016	60.0	31.6	< 0.001	16.8	8.7	0.028
Town	10.7	2.0		25.0	19.4		14.3	3.1	
Remote area	20.6	16.3		70.1	43.9		17.5	14.3	
Provide non-strong medicine	59.2	46.9	0.032	88.8	87.2	0.678	40.0	38.3	0.756
Town	14.3	12.2		57.1	74.5		21.4	30.6	
Remote area	72.2	81.6		97.9	100.0		45.4	45.9	
Provide herbal medicine	61.6	39.3	< 0.001	95.2	88.8	0.047	32.8	29.1	0.481
Town	17.9	3.1		78.6	78.6		39.3	19.4	
Remote area	74.2	75.5		100.0	99.0		30.9	38.8	
Measure blood pressure	46.4	79.6	< 0.001	97.6	100.0	0.058	40.0	46.4	0.258
Town	21.4	65.3		92.9	100.0		71.4	54.1	
Remote area	53.6	93.9		99.0	100.0		30.9	38.8	
Measure body temperature	35.2	57.7	< 0.001	98.4	97.4	0.710	10.4	15.3	0.208
Town	14.3	39.8		96.4	95.9		25.0	16.3	
Remote area	41.2	75.5		99.0	99.0		6.2	14.3	
Perform injections	31.2	15.8	0.001	79.2	55.6	< 0.001	17.6	8.7	0.017
Town	10.7	11.2		46.4	45.9		14.3	4.1	
Remote area	37.1	20.4		88.7	65.3		18.6	13.3	
Treat injuries	52.8	42.3	0.067	96.8	95.9	0.771	16.8	17.9	0.808
Town	10.7	18.4		85.7	91.8		14.3	13.3	
Remote area	64.9	66.3		100.0	100.0		17.5	22.4	
Prepare hospital referral forms	54.4	54.6	0.973	96.8	99.0	0.213	25.6	34.2	0.104
Town	25.0	33.7		89.3	98.0		35.7	39.8	
Remote area	62.9	75.5		99.0	100.0		22.7	28.6	
Go to hospital with a sick person	43.2	39.8	0.546	94.4	99.0	0.031	48.8	37.2	0.041
Town	14.3	29.6		89.3	98.0		57.1	43.9	
Remote area	51.5	50.0		95.9	100.0		46.4	30.6	
Give health guidance/information	64.8	76.0	0.030	98.4	100.0	0.151	22.4	18.4	0.378
Town	39.3	59.2		92.9	100.0		39.3	23.5	
Remote area	72.2	92.9		100.0	100.0		17.5	13.3	
Visit patients at home	62.4	83.2	< 0.001	99.2	100.0	0.389	21.6	20.4	0.798
Town	32.1	73.5		96.4	100.0		46.4	22.4	
Remote area	71.1	92.9		100.0	100.0		14.4	18.4	
Visit pregnant women	41.6	53.6	0.036	97.6	99.0	0.381	6.4	9.2	0.373
Town	17.9	40.8		96.4	99.0		14.3	8.2	
Remote area	48.5	66.3		97.9	99.0		4.1	10.2	
Confirm sick person	67.2	90.3	< 0.001	98.4	100.0	0.151	10.4	9.7	0.837
Town	60.7	88.8		96.4	100.0		25.0	13.3	
Remote area	69.1	91.8		99.0	100.0		6.2	6.1	
Confirm immunization received	48.0	71.4	< 0.001	98.4	98.0	1.000	11.2	3.1	0.003
Town	46.4	64.3		100.0	99.0		17.9	3.1	
Remote area	48.5	78.6		97.9	96.9		9.3	3.1	

The chi-square test or Fisher's exact test was performed.

Table 5 Comparison of current recognition of CHW functions and roles among people who know someone in charge as CHW, and appropriateness of expected functions according to area of residence: comparison between baseline and endline evaluations (n = 321)

	Current recognition of functions and roles of CHWs		High-priority functions and roles of CHWs	
	OR	95% CI	OR	95% CI
Provide strong medicine				
Town	0.17	0.03, 1.10	0.19	0.04, 0.90
Remote area	0.75	0.36, 1.56	0.78	0.36, 1.70
Provide non-strong medicine				
Town	0.84	0.25, 2.83	1.62	0.60, 4.40
Remote area	1.71	0.87, 3.37	1.02	0.58, 1.80
Provide herbal medicine				
Town	0.16	0.03, 0.65	0.37	0.15, 0.92
Remote area	1.07	0.56, 2.05	1.41	0.78, 2.56
Measure blood pressure				
Town	6.90	2.56, 18.65	0.47	0.19, 1.17
Remote area	13.27	5.30, 33.20	1.41	0.78, 2.56
Measure body temperature				
Town	3.97	1.28, 12.32	0.59	0.21, 1.61
Remote area	4.39	2.38, 8.11	2.53	0.93, 6.88
Perform injections				
Town	1.05	0.27, 4.07	0.26	0.06, 1.10
Remote area	0.43	0.23, 0.83	0.67	0.31, 1.46
Treat injuries				
Town	1.88	0.51, 6.90	0.92	0.27, 3.07
Remote area	1.06	0.59, 1.92	1.36	0.67, 2.76
Prepare hospital referral forms				
Town	1.52	0.59, 3.95	1.19	0.50, 2.85
Remote area	1.82	0.98, 3.38	1.36	0.71, 2.60
Go to hospital with a sick person				
Town	2.52	0.80, 7.92	0.59	0.25, 1.37
Remote area	0.94	0.54, 1.65	0.51	0.28, 0.92
Give health guidance/information				
Town	2.24	0.95, 5.29	0.47	0.19, 1.16
Remote area	5.01	2.06, 12.18	0.72	0.33, 1.58
Visit patients at home				
Town	5.85	2.35, 14.54	0.33	0.14, 0.81
Remote area	5.28	2.18, 12.79	1.33	0.62, 2.86
Visit pregnant women				
Town	3.17	1.11, 9.04	0.53	0.15, 1.92
Remote area	2.10	1.18, 3.74	2.64	0.80, 8.73
Confirm sick person				
Town	5.12	1.91, 13.69	0.46	0.16, 1.30
Remote area	5.04	2.17, 11.69	0.99	0.31, 3.18
Confirm immunization received				
Town	2.08	0.89, 4.86	0.15	0.03, 0.65
Remote area	3.90	2.09, 7.29	0.31	0.08, 1.18

Mantel-Haenszel analysis was performed. Reference: baseline evaluation compared with endline evaluation. OR. odds ratio; 95% CI, 95% confidence interval.

Table 6 Satisfaction regarding performance of CHWs among people who had received home visits: comparison between baseline and endline evaluations (n = 314)

	Baseline (n = 118)		Endline (n = 196)		P
	n	%	n	%	
CHW visits home every month	62	52.5	159	81.1	< 0.001
Town	3	12.0	77	78.6	
Remote area	59	63.4	82	83.7	
CHW well understood the health conditions of family members	61	51.7	130	66.3	0.010
Town	5	20.0	57	58.2	
Remote area	56	60.2	73	74.5	
Home visits by CHW were helpful	97	82.2	186	94.9	< 0.001
Town	14	56.0	90	91.8	
Remote area	83	89.2	96	98.0	
Overall performance of the CHW was satisfactory to maintain your and your family's health	80	67.6	171	87.2	< 0.001
Town	6	24.0	78	79.6	
Remote area	74	79.6	93	94.9	

The chi-square test or Fisher's exact test was performed.

Table 7 Satisfaction regarding performance of CHWs among people who had received home visits at the endline evaluation: comparison between town and remote areas (n = 314)

	Town (n = 123)		Remote areas (n = 191)	
	OR	95% CI	OR	95% CI
CHW visits home every month	26.89	7.33, 98.58	2.87	1.45, 5.68
CHW well understood the health conditions of family members	5.56	1.93, 16.04	1.93	1.04, 3.57
Home visits by CHW were helpful	8.84	3.03, 25.79	5.21	1.09, 24.77
Overall performance of the CHW was satisfactory to maintain your and your family's health	12.35	4.36, 34.98	4.78	1.70, 13.40

Mantel-Haenszel analysis was performed. Reference: baseline evaluation. OR, odds ratio; 95% CI, 95% confidence interval.

Table 8 Experience of meeting activities related to health education/guidance by community health workers (n = 321)

	Baseline (n = 125)		Endline (n = 196)		P-value
	n	%	n	%	
Immunization	69	55.2	139	70.9	0.004
Dengue fever	49	39.2	134	68.4	< 0.001
Sexually transmitted infections and HIV/AIDS	42	33.6	99	50.5	0.003
Diabetes	65	52.0	107	54.6	0.650
Hypertension	46	36.8	144	73.5	< 0.001
Tuberculosis	71	56.8	92	46.9	0.085
How to treat water to ensure it is safe for drinking	15	12.0	139	70.9	< 0.001

The chi-square test or Fisher's exact test was conducted.

riences of activities of health education/guidance regarding "immunization", "dengue fever", "sexually transmitted infections and HIV/AIDS", "hypertension", and "how to treat water to ensure it is safe for drinking" were more likely to be reported at the endline survey, although no such trends were observed for "diabetes" or "tuberculosis" (chi-square test).

Discussion

The qualitative evaluation indicated positive reactions toward CHWs and their performance at the Manicoré municipal level, such as the mayor and health director, health personnel of the hospital and health centers, and community organizations and people within the community. Such stakeholders have been motivated to continue sustainable support for and collaboration with CHWs, who were also observed to have become more confident with their role and performance.

According to the quantitative evaluation, overall recognition and satisfaction regarding the performance of CHWs among members of the community were improved from the baseline to the endline survey, regardless of area of residence (i.e., town and/or remote areas). The results of the present study indicated that members of the community came not to expect CHWs to "provide strong medicine" and "provide injections" but came to appreciate "go to hospital with a sick person" as included in the functions and roles of the CHWs. However, people in remote areas still place high priority on providing medicine and performing injections compared with to those in town, because there is a lack of formal medical health care in remote areas. On the other hand, at the end of the project, routine home visits by CHWs had increased in both the town and remote areas, and the capacity of CHWs to provide care for people in the community, such as blood pressure and body temperature measurement, was also improved. People in the community observed improvements in the reliability of CHWs through enabling and supporting CHW training. The expected functions and roles of CHW may be different in the town and remote areas because of the differences in availability of medical health-care services, but having good communication between CHWs and people in the community through routine home visits is essential to obtain satisfaction regarding maintenance of health condition in resource-limited settings.

Regular monthly meetings and training of CHWs may have provided motivation to continue good performance of their functions and roles as well as improving their knowledge and skills to help maintain a high quality of care. Some of the CHWs from remote areas had only completed the 4th grade of elementary school. Face-to-face training, including demonstrations and role-playing, were effective and affordable means of improving their capacity. On the other hand, global and Brazilian technology using cell phones and SMS can be utilized for efficient communication, especially for timely supervision of CHWs and for first-aid care in emergencies. Although the literacy level of CHWs should be taken into consideration in the provision of training, e-learning and distance learning technology has been shown to facilitate improvement of the knowledge and capacity for care provision of CHWs as well as maintenance of their motivation to maintain a high quality of care[19]. A study in Rwanda also indicated the effectiveness of SMS-based alert systems in increasing the rates of childbirth at medical facilities[20]. In the present study, face-to-face training was appropriate considering the literacy level of the CHWs, but training and supervision style can be changed according to the current conditions.

CHWs in Manicoré at the time of the present study could not be expected to perform medical/clinical treatment, as they were not trained as medical/clinical professionals. However, in resource-limited settings, especially remote areas of Manicoré, CHWs represented the sole health care-related resources. Therefore, some CHWs performed medical/clinical activities, such as "provide strong medicine" and "perform injections", by empirically acquiring skills, and members of the community also expected CHWs to perform such medical/clinical activities. Through training and other support from the project conducted by HANDS, CHWs renewed the recognition of their functions and roles. Performance of the principle duties of CHWs, i.e., monthly home visits in their catchment area and identification of people who require health-care, such as sick people and pregnant women, reemphasized their raison d'être. The changes in CHWs with this training resulted in a greater awareness among members of the community of the value of CHW functions and roles focusing on health promotion and prevention, including monitoring of health conditions.

People in remote areas appreciated a certain measure of CHW functions at the baseline evaluation, because they had no alternative source of help in the event of health problems. Therefore, satisfaction regarding the performance of CHWs among people in remote areas was moderately increased in the endline evaluation, although that of people in town showed a marked increase, because people in town had direct access to the state hospital in the event of health problems regardless of the functions of CHWs at the baseline evaluation. After implementation of the training program for CHWs, their performance may have improved, especially in town, and people in the town were more likely to recognize the value of CHW functions, such as promotion, prevention, periodic monitoring of health conditions, and accompanying patients on visiting the hospital.

The present study did not specifically assess the performance of CHWs regarding noncommunicable diseases (NCDs), such as hypertension, or infectious chronic illnesses, such as tuberculosis, although the control of such diseases was also included in their role as defined in the manual of the Ministry of Health. The functions of CHWs regarding health

promotion and prevention of diseases, such as NCDs, were recognized as important aspects of community-based healthcare provision, and not only functions related to maternal and child health, and their importance was not considered to be limited to Amazonas, Brazil. A previous study performed in South Africa[21] indicated that CHWs should function in roles related to NCDs in developing countries and in resource-limited settings, including Amazonas, Brazil.

The present study had several limitations. First, it was not a randomized controlled trial, and so it was not possible to conclude that the observed changes were brought about solely through training and other project-related activities. Second, the actual performance of CHW activities was not evaluated; for example, there was no shadowing observation or simulated patient assessment in this study. Although self-reporting by CHWs showed appropriate performance of roles and functions as CHWs in resource-limited settings, the accuracy of their performance was not evaluated objectively. Third, differences in disease/injury incidence and prevalence rates between the baseline and endline surveys were not taken into consideration in this study. If disease/injury incidence and prevalence rates were low at the time of the endline survey, members of the community may have given excessively positive evaluations, even if the performance of CHWs was inadequate, because they may not have required the services of the CHWs.

Conclusion

Despite the limitations noted above, the present study indicated that steady approaches to motivate and support CHWs in resource-limited settings could improve their performance and the satisfaction of people within the community regarding the activities of CHWs to sustain their health. In addition, the establishment of close relationships between CHWs and people in the community may result in appropriate CHW functions and higher levels of satisfaction within the community.

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