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The Costs of Volunteering: Quantifying the Economic Value of Community Resources Contributed to an Integrated Neglected Tropical Disease Control Program in Nigeria

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By

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An abstract of
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Abstract

The Costs of Volunteering: Quantifying the Economic Value of Community Resources Contributed to an Integrated Neglected Tropical Disease Control Program in Nigeria

By Edward Jaszi

Background/Objective
Neglected tropical disease (NTD) control programs in Africa typically rely on community volunteers to carry out drug distribution and other essential tasks. Although the benefits of using volunteer labor have been demonstrated from a programmatic perspective, little is known about the costs that are imposed on volunteers themselves. This research aimed to quantify the financial and opportunity costs incurred by community volunteers contributing to the Carter Center-supported NTD program in north central Nigeria between 2009 and 2010.

Methodology/Principal Findings
Retrospective data on inputs were collected from a sample of community-directed distributors (CDDs) and village heads (VHs) using a survey instrument. Programmatic data were used to make inferences about the study population. While performing NTD activities each year, the average CDD worked 15.5 days and incurred financial costs of $5.36 (USD, 2010), while the average VH worked 5 days and had costs of $4.09. When volunteer time was valued in monetary units and combined with financial costs, the total value of resources contributed was estimated at $.06 per treatment distributed and $72.60 per community. For opportunity costs related to NTD activities, a downward trend was observed between study years. However, when inputs to insecticide-treated bed net (ITN) distribution in 2010 were included, this trend was reversed due to significantly higher costs among those distributing ITNs. The sum total of economic costs incurred by communities in the study area was estimated at $259,630 per year for NTD activities, and $337,527 for NTD and ITN activities combined in 2010.

Conclusion
This study finds that significant and wide-ranging economic costs were imposed on community members contributing to an NTD program. CDDs in particular bore the brunt of these economic costs, although community support played a role in redistributing them more broadly. The data suggest that while integration of preexisting interventions may have contributed to modest reductions in communities' economic costs, the addition of a new intervention led to substantial cost increases. Overall, the findings raise concerns about whether integrated NTD programs can sustainably expand the scale and scope of their services without providing commensurate incentives to CDDs.

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Chapter 1: Introduction

Introduction/Rationale

The disease burden in Africa is the highest in the world, at least twice that of any other region (Mathers, Fat, & Boerma, 2008). Whereas noncommunicable diseases have become increasingly prevalent globally, in Africa it is communicable, maternal, perinatal, and nutritional conditions that continue to cause by far the greatest share of disability and premature death (Mathers et al., 2008). Although efficacious health interventions for many of these conditions already exist, resources available for implementing them are scarce. Of particular concern is the extreme paucity of health personnel in the region; for every 10,000 people there are only 2.2 physicians and 9 nurses, about a tenth of that in high income countries (WHO, 2012a). Over the last decade, the growth of international programs and financing to combat infectious diseases and achieve the Millennium Development Goals (MDGs) in low-income countries has brought renewed attention to the problem of human resources for health (HRH) (Christopher, Le May, Lewin, & Ross, 2011).

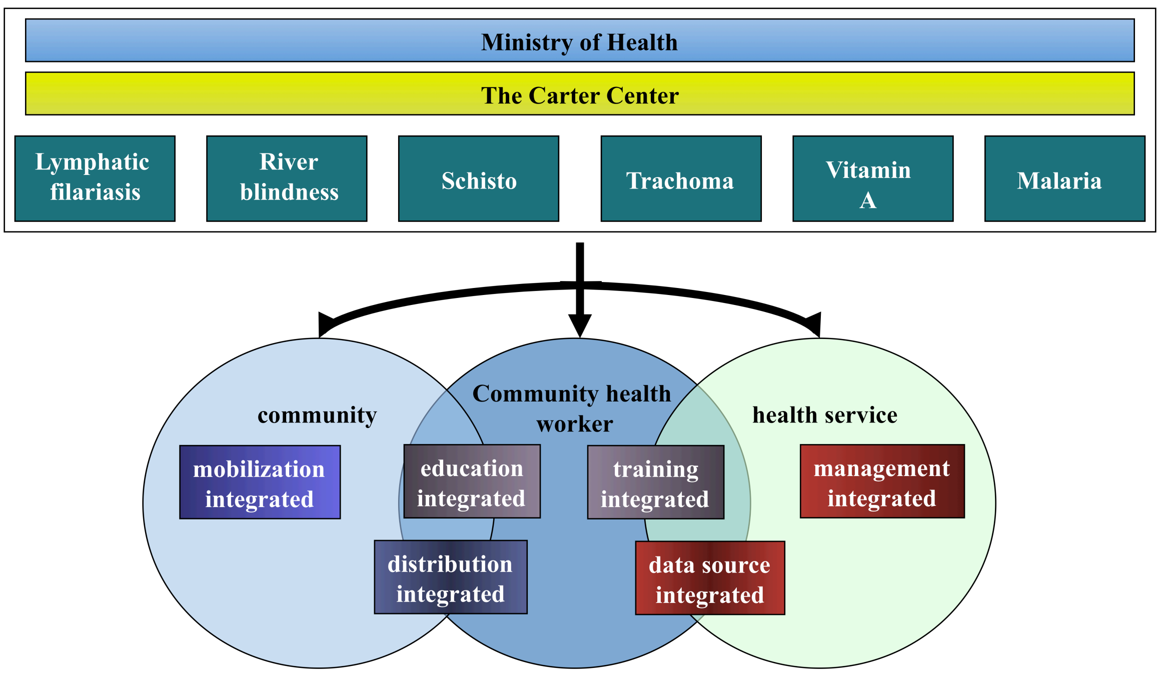
Addressing the shortage of health personnel requires strategies aimed at increasing recruitment and training, reducing the migration and attrition of workers, and improving the performance and management of the existing workforce (WHO, 2006). To achieve efficiencies in workforce performance, the WHO recommends a strategy of task delegation, whereby tasks are "shifted from specialized (and therefore scarce) workers to less specialized ones" (WHO, 2006). This strategy includes shifting tasks from salaried professionals to nonprofessionals including volunteers, informal workers, and patients. In low-income settings, the use of community health workers (CHWs), laypeople trained to provide basic health services in their communities, has been of particular interest as a means of scaling-up interventions without further burdening public sector human resources. In Africa, CHWs have been used to deliver services or treatments for a wide range of interventions including those targeting malaria, pneumonia, childhood diarrhea, HIV, TB, and a number of neglected tropical diseases (NTDs) (Christopher et al., 2011; WHO & APOC, 2010a).

One model for task-shifting using CHWs in Africa is that developed by the African Programme for Onchocerciasis Control (APOC), a multinational public-private partnership to combat onchocerciasis in 19 southern African countries, initiated in 1995. Onchocerciasis, or river blindness, is a debilitating NTD and the second leading infectious cause of blindness worldwide. Transmission of the disease can be controlled or stopped through annual region-wide mass-drug administration (MDA) with the antiparasitic ivermectin (Mectizan) over the course of 14-35 years (Boatin & Richards, 2006). To achieve and sustain high levels of MDA coverage in endemic areas, APOC utilizes a strategy referred to as community-directed treatment with ivermectin (CDTI). With CDTI, rural communities are called upon to organize drug distribution on their own behalf and are responsible for: collecting the drug from the nearest health facility; determining the schedule and mode of distribution; delivering the drug to community members; and conducting basic record-keeping and monitoring (Homeida et al., 2002). To supply the necessary labor for these activities, communities appoint members to serve as community-directed distributors (CDDs). CDDs are generally considered volunteers and receive no official remuneration, but communities may opt to provide them with their own financial or in-kind incentives. Using this strategy, APOC has scaled up geographic coverage over time, with over half a million CDDs distributing ivermectin to nearly 67 million people in 2009 (WHO & APOC, 2010b).

The success of APOC's community-directed strategy has led to its adoption by other MDA programs for the control of NTDs endemic in Africa, including lymphatic filariasis (LF), schistosomiasis, and three soil-transmitted helminth (STH) infections. LF is a chronic parasitic infection transmitted by mosquitoes, which causes painful acute episodes of local inflammation and chronic enlargement of body parts, leading to disfigurement and incapacitation (WHO, 2013). To interrupt transmission of LF in areas where it is co-endemic with onchocerciasis, the WHO recommends annual MDA with a single dose of ivermectin and albendazole (WHO, 2013). Albendazole has been donated by the company GlaxoSmithKline for eradication efforts through 2020. STH infections, common intestinal worm infections that cause anemia and stunting, can be treated through MDA with either albendazole or ivermectin. Schistosomiasis, a chronic disease caused by infection with parasitic worms, can be treated through annual MDA of school-aged children with the drug praziquantel. The common features of treatment for these NTDs, along with the availability of donated or low-cost generic drugs, have contributed to growing international focus on the integration and scale-up of NTD control efforts (P. Hotez, Raff, Fenwick, Richards, & Molyneux, 2007). Programs that have carried out integration have generally continued to utilize the community-directed model.

The Carter Center, a non-governmental nonprofit organization founded in 1982, has been a leader in supporting African governments to develop integrated community-directed programs for NTD control. The Carter Center has been active in Nigeria since 1988, when it began efforts to eradicate guinea worm there. In 1996, it assumed the onchocerciasis control activities of the River Blindness Foundation (RBF) in the central Nigerian states of Plateau and Nasarawa, and began supporting the distribution of ivermectin treatments using CDDs. Subsequently, efforts to establish and integrate LF and schistosomiasis programs with the existing onchocerciasis control program were initiated (The Carter Center, 2009a). In 2008, triple drug administration (TDA) for the simultaneous treatment of the three diseases was begun, after its safety and feasibility had been demonstrated (The Carter Center, 2009a). Efforts to further integrate the program with trachoma control, as well as the distribution of Vitamin A and insecticide treated bed nets (ITNs) for malaria, have also been carried out. Figure 1 illustrates how the Carter Center's strategy seeks to integrate various programmatic activities including training, education, mobilization, distribution, data collection, and management. As the integrated program has expanded to include additional interventions, it has continued to rely on the participation of communities and the labor provided by unpaid CDDs.

Figure 1. The Carter Center Integration Model



Source: The Carter Center

Problem Statement

In the context of persistent shortages in human resources for health in Africa, governments and programs are increasingly looking to CHWs and their communities to take on greater responsibilities in the delivery of interventions. Although task shifting to CHWs may reduce financial costs and free up human resources in the public sector, CHWs themselves may become overburdened. Where entire communities participate in programs and support volunteer CHWs—as in the case of CDTI—economic costs may be imposed at the community level. These costs may include material and financial contributions, in addition to opportunity costs, i.e., the time taken away from other productive activities. Integration of health programs has been recommended as a strategy for improving workforce efficiency by capitalizing on shared human resources. However, integration may also entail the expansion of programs and the assigning of new tasks to already overstretched CHWs. Costs imposed on poor communities may have unforeseen negative consequences on their economic security (Maes, 2010).

The value of the contributions to health programs made by CHWs and communities has not been widely investigated. Research into CHW programs has tended to focus on the health benefits generated for the population and the financial implications for the health sector. Where research has focused specifically on CHWs, a management perspective has generally been adopted, and issues around performance and motivation explored. Of the economic evaluations that have been conducted, many have excluded the economic costs of unpaid labor and other community inputs. By ascribing no economic value to these contributions, the misperception that communities can take on progressively greater responsibilities without incurring additional costs may be perpetuated. Where economic analyses have included some valuation of community contributions, a lack of consensus on the correct methodological approaches has contributed to poor interpretability and comparability of findings. Improved understanding of the costs of CHW programs to communities is necessary for the efficient management of community resources. Better quantification of community inputs may also allow programs to forecast the costs of using alternative strategies, and inform comparisons between programmatic alternatives at a national and international scale.

Currently, NTD control programs rely on considerable international support. As funding is withdrawn, the efficient use of domestic resources—including those of communities—will become increasingly paramount. A lack of understanding of these resources may contribute to poor program management and sustainability. Furthermore, little is known about how the integration of NTD interventions impacts the burdens placed on communities. Where integration leads to the overuse of limited community resources without adequate compensation, the sustainability of disease control efforts may be threatened. Although one study on the costs of the Carter Center's integrated NTD program has been conducted (Evans et al, 2011), it did not include analysis of the economic costs incurred by communities. Given the importance of community contributions to the success of MDA programs, consideration of community costs—and how they are impacted by integration—is important.

Purpose

The purpose of this research is to describe, quantify, and explore the economic costs of communities' inputs to the Carter Center-supported integrated MDA program in Plateau and Nasarawa States of north central Nigeria, and to identify methodologies that could be used in future evaluations of programs that rely on community support.

Research Goals

This research seeks to achieve the following goals:

1. Identify and apply appropriate methodologies for the economic valuation of community contributions to the program
2. Summarize, quantify, and compare the value of community contributions to the program

at the district and state levels

3. Explore the relative value of different types of contributions, including time, out of pocket costs, and other inputs
4. Explore factors that are associated with differences in community costs between districts and states
5. Compare community costs incurred by CDDs relative to other community members
6. Explore the costs of replacing CDDs with paid CHWs or other health personnel

Significance

The results of this research will inform programmatic development of NTD control projects in Nigeria and elsewhere in sub-Saharan Africa (SSA). A better understanding of the nature of community support will allow for improved management of limited resources, thereby contributing to long-term sustainability. By exploring methods for the valuation of community inputs, this research will also contribute to future efforts to understand the value and role of these contributions in national and international disease control programs. Data from this study will add to the evidence base on the costs of health interventions, which can in turn inform policy makers and program managers in decision-making around resource allocation for health services.

Definition of Terms

Cost refers to *economic cost* where not otherwise indicated.

Economic cost refers to the value of a resource forgone by not using it in the best alternative activity; the economic cost of a decision is likewise the value of the best alternative decision forgone.

Economic valuation is the expression of economic costs in monetary terms.

Financial cost refers to monetary expenses.

Mass-drug administration (MDA) refers to the administration of drugs to entire populations irrespective of disease status.

Chapter 2: Comprehensive Review of the Literature

Background

Description of CHWs

The umbrella term *community health worker* (CHW) refers to a diverse category of nonprofessionals who "perform one or more functions associated with health-care delivery and are trained in some way but usually have no formal professional or paraprofessional certification" (Haines et al., 2007). CHWs are often conceived of as providing a link between communities and the formal health system (Perry & Zulliger, 2012). The specific roles and responsibilities that CHWs take on are extremely varied. CHWs participate in both curative and preventative interventions, providing health services and education related to nutrition, infectious disease, non-communicable disease, family planning, and maternal, infant and child health (Bhutta, Lassi, Pariyo, & Huicho, 2010). They may be 'generalists' who perform a wide range of functions, or 'specialists' who only perform tasks related to specific health issues (Lehmann & Sanders, 2007). Likewise, they may be full-time salaried workers or part-time informal workers or volunteers. The names used for CHWs are equally diverse, and are often specific to the country or programmatic context. A 2007 WHO report identified 36 alternative titles used for CHWs, including *village health agent*, *lady health worker*, and *health promoter*; and the list was by no means exhaustive (Lehmann & Sanders, 2007). In APOC literature, the term *community-directed distributor* (CDD) refers specifically to volunteers selected by their own communities to participate in ivermectin distribution and other activities. The term has subsequently been adopted by other programs employing a similar community-directed intervention (CDI) strategy.

Global distribution and characteristics of CHWs

According to the WHO, CHWs can account for as much as a third of the health workforce in some countries (WHO, 2006). Although likely incomplete, the latest WHO global health workforce data suggest that there are over 1,370,000 CHWs worldwide[1] (WHO, 2012b). China (1,113,331), India (50,715), Bangladesh (48,692), and Iran (25,242) have the highest estimated numbers. In Africa, the total from 20 countries with data available is 81,171. The countries with the greatest estimated numbers on the continent are Ethiopia (24,571), Nigeria (19,268), Rwanda (12,000) and Malawi (10,055). According to this data, the density of community and traditional health workers in Africa ranges from 1 to 400 per 100,000 people, with a median of 9 per 100,000.

Other data suggest that these figures significantly underestimate the total numbers of CHWs in Africa. In Ethiopia, there were a reported 30,190 *health extension workers* (HEWs) employed by the government at the district level in 2008 (WHO & Global Workforce Alliance, 2010). In Nigeria, an assessment estimated that there were 86,600 community-level health staff, including *community health officers* and *community health extension workers*, with a density of 64 per 100,000 (Chankova et al., 2006). No WHO data on CHWs were reported for Zambia, but a government report documents the presence of 4,480 active CHWs there in 2006 (Sunkutu & Nampanya-Serpell, 2009). If CDDs are considered, then the actual numbers are likely even higher. In 2009-2010, APOC reported a total of 585,673 active CDDs in 15 countries (WHO & APOC, 2010a).

The demographic characteristics of CHWs vary greatly from setting to setting. Lehmann & Sanders (2007) found that in the majority of articles on CHWs that specified gender, female CHWs were dominant. In Ethiopia, Pakistan, and Bangladesh, CHWs tend to be exclusively

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[1] This number rises to 2,373,294 if aggregate totals combining community and traditional health workers are used. Traditional health workers include traditional birth attendants and midwives.

female, at least in part due to their involvement in maternal and child health interventions (Bhutta et al., 2010; WHO & Global Workforce Alliance, 2010).

Conversely, according to APOC reports, a large majority of CDDs are male (82% in 2009-2010) (WHO & APOC, 2010a). CDDs also tend to be farmers, with teachers and civil servants also represented to a lesser degree. In one study of 757 CDDs in Cameroon, Nigeria, Tanzania, and Uganda, 59% were farmers; 9.1% civil servants; 7.6% teachers; 2.1% health workers; and 22.2% had other occupations (Amazigo, Obono, et al., 2002). Another study of 279 CDDs in three of the above countries reported that 64.2% were farmers, 19% civil servants, and that 58.1% had received some secondary level education (WHO, 2003a). In that study, significant variations in these characteristics were observed between and within countries; for example, in one site in Nigeria, the proportion of civil servants (38%) and corresponding education levels were significantly higher (WHO, 2003a).

Use of CHWs by multiple programs

In African settings, evidence suggests that the use of CHWs by multiple health programs is widespread. A study conducted in Cameroon, Uganda, Ethiopia, and Nigeria found that, on average, 10 health programs used CHWs at each study site, and it was common for individual CHWs to be participating in 2 or more programs (WHO & APOC, 2008). Similarly, a multi-country WHO (2003a) study found that 82% of CDDs were involved in up to six other health and development activities, the most common of which were related to the Expanded Program of Immunization (EPI) including polio immunization, community development, and water and sanitation. In a study of Carter Center-assisted CDTI areas in Cameroon and Uganda, at least 72% of CDDs reported additional healthcare activities besides CDTI each year; these were principally related to Vitamin A, HIV/AIDS, Malaria control, EPI, family planning, and water and sanitation programs (Katabarwa, Habomugisha, Eyamba, Agunyo, & Mentou, 2010). A study of the LF program in Tanzania found that the vast majority of LF CDDs were involved in other activities, including Vitamin A (93%) and ITN distribution (56%) (Wallace, 2005). Some programs have explicit policies on the sharing of CHWs, although coordination and harmonization between programs is generally limited (WHO & APOC, 2008). Thus, although multiple programs may utilize the same CHWs, this does not suggest that formal integration of those programs has taken place.

Integration of NTD programs

Since early in the program's history, the APOC community-directed strategy has been promoted as a platform for integration with various other vertical disease control efforts, including treatment for lymphatic filariasis and schistosomiasis, distribution of ITNs and home management of malaria, and vitamin A supplementation (CDI Study Group, 2010; Homeida et al., 2002). In 2009-2010, nearly half of all CDDs participated in co-implementation of ivermectin distribution with other activities (WHO & APOC, 2010a).

A parallel development has been the growing international focus on NTDs, initiated in part by a series of policy papers published between 2004 and 2006 that first drew widespread attention to the global burden of these diseases (P. Hotez et al., 2007). These papers emphasized the common features of seven of the most prevalent NTDs, providing the rationale for their integrated control through preventive chemotherapy (P. Hotez et al., 2007).

International funding for integrated NTD control has subsequently increased substantially. In 2006, the USAID NTD Control Program began supporting 8 African countries (via a variety of implementing partners) in the integration and scale-up of NTD control efforts for LF, onchocerciasis, trachoma, schistosomiasis, and STH. An evaluation of the program after three years found that in seven countries conducting annual MDA, the number of persons receiving treatment had grown by 55 million, and the number of treatments provided had risen by over 120 million (Linehan et al., 2011). In 2008, former President Bush announced the Presidential Initiative for Control of Neglected Tropical Diseases, which led to substantial increases in funding for integrated NTD control efforts (P. J. Hotez & Goraleski, 2011). President Obama's administration has since incorporated NTD control into its Global Health Initiative (GHI). The Bill and Melinda Gates Foundation (BMGF) has also been a major funder of NTD control programs. In 2012, 13 pharmaceutical companies, the U.S., U.K., and U.A.E governments; the BMGF; the World Bank; and a number of NGOs endorsed the London Declaration on Neglected Tropical Diseases, which set the goal of accelerating the coordination and funding of control and elimination efforts to meet WHO 2020 NTD targets (Uniting to Combat NTDs, 2012). At the announcement of the declaration, private and public donors pledged $785 million to be disbursed over several years. According to the first annual report on the declaration published in January of 2013, these financial commitments had begun to be met; over 40 countries had developed multi-year integrated NTD control plans; and Nigeria, Cameroon, and Burundi had launched their plans (Uniting to Combat NTDs, 2013).

Results of Integration

Research into the impact of CDD involvement in multiple activities on their performance has resulted in conflicting findings. Katabarwa et al. (2010) found that attainment of 90% coverage tended to decrease with each additional CDD activity, although it does not appear that this trend was statistically significant. Conversely, a WHO (2003) study of CDD involvement in other healthcare activities found that coverage was positively associated with the number of additional activities in a linear regression, possibly due to more motivated and capable individuals taking on greater responsibilities. A study of integrated community-directed interventions found that ivermectin coverage improved with the addition of other interventions (CDI Study Group, 2010).

A qualitative study of CDDs involved in Carter Center-supported integrated treatment of onchocerciasis, LF, schistosomiasis, trachoma, malaria, and Vitamin A deficiency in Nigeria found that most reported spending more time on program activities than in previous years, with the amount of the increase ranging widely from one to 39 days (Welter, 2009). The lack of consistency between time increases and the number of interventions was attributed to the multitude of influential factors interplaying with integration, including "the size of the coverage area, community cooperation, level of sensitization needed by the community towards the new drugs, the number of [CDDs] in the community and drug availability," as well as the season of distribution. CDDs reported a number of sacrifices made in the course of distribution, including experiencing hunger while working, "spending less time on their own farms, physically exhausting themselves to ensure all eligible people receive the drugs and ITNs, and spending their own money to successfully carry out the distribution." A lack of monetary incentives was a frequent theme and a clear source of frustration. However, despite these burdens, and the increased responsibilities associated with integration, the majority of respondents said they would continue to work as CDDs.

Financing

No consensus exists on how CHWs should be compensated and whether the use of volunteer CHWs is appropriate or sustainable (Perry & Zulliger, 2012). A WHO Study Group recommended that CHWs be paid in cash or in kind when they have no other source of income and their responsibilities take up a "significant proportion of the day," and that whatever authority the CHW is accountable to—be it a government agency, NGO, or the community itself—should provide the payment (WHO, 1989). Indeed, some CHWs are formal full-time salaried workers, such as Ethiopian HEWs (WHO & Global Workforce Alliance, 2010). These HEWs are female high-school graduates who receive a year-long training in the provision of various preventative and curative services, and are employed by the government to serve at health posts (WHO & Global Workforce Alliance, 2010).

More frequently, CHWs are informal workers who receive no official salary. Literature on informal CHWs often refer to this class of workers as 'volunteers.' However, it has been argued that in the sub-Saharan African context, the term is a misnomer, as such workers generally come from the lowest income brackets and either expect or "hope that they may receive some form of remuneration for the services they provide" (Sunkutu & Nampanya-Serpell, 2009). Furthermore, it is common practice for CHWs to be provided some type of compensation for their services (Bhutta et al., 2010). In the case of CDDs, they are often selected by their communities to participate, rather than volunteering for the position.

A study of monetary incentives for 'community volunteers' in four sub-Saharan African countries found that the majority of specific health programs had a policy or practice of providing incentives, generally in the form of cash (including transport allowances, stipends, and per diems) (WHO & APOC, 2008). In-kind incentives such as bicycles were provided to volunteers only in a minority of programs. On an annual basis, TB/leprosy, reproductive health, STI/HIV/AIDS and malaria programs were found to provide the most valuable incentive packages per volunteer, whereas NTD and epidemiological surveillance programs provided the least valuable incentives. The average value of cash incentives ranged widely between study sites, from US$ 20 to US$ 310 per volunteer per year. The average annual value of incentives was $2340 per community; using this figure it was projected that the annual country-level costs of CHW incentives could constitute a substantial portion of the total health budget in a country such as Nigeria. Only in the minority of programs were communities involved in setting policies on incentives, with international donors generally playing a more dominant role. It was also noted that coordination of CHW incentives among programs was minimal and that few policies existed at the national level.

Nevertheless, some informal CHWs receive no external incentives from the government or program, relying only on support from their communities or alternative financing mechanisms. One example is the Bangladesh Rural Advancement Committee (BRAC), an NGO that uses unpaid community members to deliver a broad range of health services. These CHWs, who number about 80,000 in Bangladesh, have opportunities to earn a small income (approximately $4 per month) through the sale of essential medicines and health commodities to households (Khan & Ahmed, 2011). However, improved income earning opportunities in various sectors for rural women—in part due to improved literacy and mobility—have increased the opportunity costs of serving as a BRAC 'volunteer' (Khan & Ahmed, 2011). In addition, the demographic transition and emergence of non-communicable diseases, and the consumer preference for trained medical personnel, have reduced the demand for the CHWs' services (Khan & Ahmed, 2011). These factors have contributed to high attrition (15-20% per year) (Khan & Ahmed, 2011). As a result, BRAC has begun experimenting with new models to increase retention, and a recent report recommended providing the CHWs with better and more secure incentives (Khan & Ahmed, 2011). APOC's CDTI program is another example of a one that does not provide external incentives.

Incentives and Community Financing in NTD MDA Programs

Although CDDs participating in APOC programs generally do not receive official remuneration for their services,[2] they may benefit from compensation, or 'incentives,' provided by their own communities. This compensation takes many forms, including monetary contributions, payment of the costs of transport or materials, in-kind support in the form of produce or substitute farm labor, and intangible incentives such as "prayers and greetings" (CDI Study Group, 2010; WHO, 2003a). The literature is inconclusive on the relative frequency of different types of incentives. In general, community social structures, including kinship and clan systems, are thought to allow resources and responsibilities to be spread across a community in an equitable fashion, such that the costs of onchocerciasis control do not burden individuals alone (Katabarwa, Richards Jr., & Ndyomugyenyi, 2000). In some cases, non-APOC MDA programs, such as the LF program in Tanzania, provide per diems (Wallace, 2005).

Some qualitative evidence has indicated that the practice of communities giving monetary or material incentives to unpaid CDDs is uncommon. In a WHO (2003a) study of CDTI in Nigeria, Togo, and Cameroon, community leaders expressed the belief that such incentives would be inappropriate given the cultural norms around participation in communal labor; CDDs were described as their "sons," who were obliged to carry out tasks for them as part of their normal responsibilities. Other studies have similarly pointed out that where CDDs serve their own family members and kinship group, they are unlikely to be able to demand financial incentives (Amazigo, Brieger, et al., 2002; Katabarwa et al., 2000). However, tensions between the CDTI program and other programs that provide monetary incentives have been noted; in one study, some CDDs reported feeling "cheated" for being left out of other opportunities to earn income (Amazigo, Obono, et al., 2002). To reduce conflict, and to compensate CDDs for their efforts, communities and health workers often select CDDs for other CHW activities that do provide financial incentives. (WHO, 2003a). In Nigeria, a focus group participant commented:

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[2] Per diems are generally provided only during training.

"the reason we involved them (in immunization) is that they distribute the Mectizan free of charge from house to house. They are not given anything, not even common food. So we involved them because it is from that immunization that they are able to get small-small thing" (WHO, 2003a).

Some quantitative studies have found the practice of giving CDDs monetary or material incentives to be more widespread. Amazigo et al (2002) found that of 757 CDDs interviewed in 10 countries, 26.6% received monetary or in-kind incentives, 21% received transport support, while 53% received no incentives (Amazigo, Obono, et al., 2002). A subsequent evaluation of 41 APOC projects in 10 countries conducted between 2002 and 2003 found a much higher prevalence of community-organized incentives; 220 of 238 (93%) of communities with information available were giving incentives to CDDs, with the majority providing cash (Amazigo et al., 2007). In one study, the practice of using a levy on all adults in a community to fund incentives was documented (Onwujekwe, Chima, Shu, & Okonkwo, 2002). However, it is unclear how widespread this practice is, or if other community financing strategies are being utilized.

The provision of non-financial incentives provided to CDDs is more widely documented. CDDs involved in the Carter Center-supported integrated NTD program in Nigeria reported occasionally receiving money from community members, but more commonly some material incentive such as water, prepared food or produce (Welter, 2009). Another form of non-financial incentive offered to CDDs in some communities (and an example of resource sharing) is the exemption from communal labor. In rural Uganda, as elsewhere in Africa, individuals are typically obligated to serve their kinship group through the provision of communal labor without financial compensation (Katabarwa et al., 2000). Those who avoid their kinship duties are likely to face steep fines and other punishments (Katabarwa et al., 2000). Qualitative studies have reported that some communities will exempt CDDs (and other local CHWs) from this type of communal labor as compensation for their service (Amazigo et al., 2007; Katabarwa et al., 2000). In these cases, exempted communal labor may represent a substantial opportunity cost for communities as a whole; in a qualitative study of CDD sustainability, Amazigo et al. (2007) reported that in three countries, village leaders in several communities with low numbers of CDDs stated that they could not afford to increase the numbers because "having more CDDs would imply exempting more people from communal labor" (Amazigo et al., 2007).

Motivation and Performance

A multitude of monetary and non-monetary factors have been described as contributing to CHW motivation, performance, and attrition. Monetary factors include consistent financial or material incentives, as well as the perception of opportunities to gain future employment and increased income (Bhattacharyya, Winch, LeBan, & Tien, 2001). Non-monetary factors include training, supervision, clarity of roles and responsibilities, personal development, as well as community involvement, support and recognition (Bhattacharyya et al., 2001).

Literature on APOC programs has generally emphasized the importance of non-monetary incentives as motivators of CDDs. A WHO (2003) study reported that the most common reasons cited by CDDs for wanting to continue volunteering were to "help my community" (76%) for "self-fulfillment" (28%) and for "recognition" (12%); meanwhile, less than 4% said that cash or in-kind incentives contributed to their wanting to continue (WHO, 2003a). In another study of ivermectin distributors in Uganda, community support and appreciation were cited as important factors in volunteers' willingness to participate the following year (Katabarwa & Richards, 2001). A multi-country study of integrated community-directed interventions found that CDDs were more motivated by intangible incentives than external financial incentives (CDI Study

Group, 2010). In another study, no significant relationship was found between the provision of material or in-kind incentives and treatment coverage or CDD willingness to continue serving (Amazigo, Obono, et al., 2002). It has also been argued that kinship structures improve ivermectin treatment coverage, in part through increased community support and a sense of obligation on the part of CDDs (Katabarwa, Habomugisha, Agunyo, et al., 2010). The desire for future benefits can also be influential. In Uganda, several CDDs with political ambitions mentioned the possibility of gaining votes in future elections as a motivating factor (Amazigo et al., 2007). Some CDDs perceive that they benefit from training and experience, through which they gain knowledge that may make them more qualified for other jobs and lead to future employment (Welter, 2009).

However, financial and in-kind incentives have also been reported as important motivators for CDDs. A lack of monetary incentives has been found to be associated with CDD attrition in Nigeria (Emukah et al., 2008; Welter, 2009). A study of CDDs' involvement in multiple health and development activities found that CDDs tended to report being more motivated by those activities that provided financial incentives compared with ivermectin distribution (WHO, 2003a). A majority of CDDs being paid a per diem for LF MDA in Tanzania similarly reported being more motivated for other activities that paid higher per diems (Wallace, 2005). However, all the Tanzanian CDDs also reported a willingness to continue serving .

Likewise, literature on other volunteer CHWs emphasizes the importance of tangible incentives. A qualitative study of CHWs in rural Kenya found that, although CHWs were motivated by non-financial drivers including personal recognition, a lack of financial incentives was a significant source of discontent (Takasugi & Lee, 2012). Most CHW participants in that study agreed that monetary incentives would increase their motivation and performance.

Methods for the economic evaluation of CHW programs

Economic evaluations in health care

Economic evaluation has been defined as "the comparative analysis of alternative courses of action in terms of their costs and consequences" (Drummond, Sculpher, Torrance, O'Brien, & Stoddart, 2005). In health care, the purpose of economic evaluation is to assess the relative merits of different options for spending limited resources (Drummond et al., 2005). As CHW programs utilize limited resources, economic evaluations of such programs are needed to determine how to deploy those resources efficiently (Walker & Jan, 2005).

The perspective taken in economic analysis determines whose limited resources are taken into consideration, and thus which costs and consequences are included. The broadest possible perspective is that of society, with "all costs and consequences to whomsoever they accrue" being considered (Drummond et al., 2005). A societal perspective is most relevant to questions of overall resource allocation. More restrictive viewpoints could include "that of a specific provider or providing institution, the patient or groups of patients, [or]a third-party payer (public or private)" (Drummond et al., 2005). A health services perspective would exclude all costs that do not impact the health sector, including those of unpaid service providers and patients. Analyses can also include multiple perspectives in order to identify the distribution of costs among different parties in addition to total societal costs (Drummond et al., 2005).

Cost-effectiveness analysis (CEA) is a type of economic analysis that has often been used to evaluate the costs and health effects of "prospective new interventions compared with current practice" (WHO, 2003b). The perspective of many CEA analyses has been criticized as insufficiently broad, in that they have not allowed for the comparison of all possible interventions to identify "the mix that maximizes health for a given set of resource constraints" (WHO, 2003b). The WHO has thus proposed the use of a broader form of CEA, referred to as generalized cost-effectiveness analysis (GCEA), to facilitate comparison of a wide range of interventions and the efficient allocation of overall resources in health systems internationally.

Although economic evaluations of healthcare programs take different forms, all include the measurement of the costs incurred by the program. There is general agreement that *economic costs* should be used rather than *financial costs* (WHO, 2003b). The financial cost of a resource is equivalent to its price, which may be determined by the market (WHO, 2003b). On the other hand, the economic cost of a resource is its "opportunity cost" to society, i.e., "the value forgone by not using the same resource in the best alternative activity" (WHO, 2003b). Observed prices do not always coincide with the estimated economic value (or 'shadow price') of a resource, particularly in imperfect markets (WHO, 2003b). This is especially true for non-market goods and services, for which there are no prices, and for non-traded goods, which cannot be readily bought and sold on the market, and for which price data may therefore be unrepresentative of economic costs (CDC, 2012; WHO, 2003b). Major non-market resource inputs to health care programs include volunteer time, patient/family time, and donated goods (CDC, 2012; Drummond et al., 2005). Non-traded goods include personnel, utilities, buildings, and domestic transport (WHO, 2003b). However, there is no consensus on which non-market resources should be included in economic evaluations and how both non-market and non-traded goods should be valued.

Transfers

In economic evaluations, it is important to distinguish between economic costs and transfers. Financial flows from one party to another are considered transfer payments, and are generally excluded from the analysis of economic costs because the gains to one party cancel out the losses to another (Weinstein, Siegel, Gold, Kamlet, & Russell, 1996). Incentives in cash or in-kind provided to CDDs by their communities might therefore be considered transfers as opposed to costs. These transfers could potentially be used as a proxy for the economic value of CDD labor, although this method has not been discussed in the literature.

Cost distribution

Multiple sources have pointed out the importance of identifying the distribution of costs, that is, the amount of resources contributed to a given intervention by different actors (Posnett & Jan, 1996; WHO, 2003b). In the context of community-directed strategies, particularly where resource sharing is prevalent, it may thus be appropriate to separately identify costs accruing to communities as a whole.

Community economic costs

Community economic costs related to CDTI identified in the literature principally include labor (both that of CDDs and of other community members) and transportation costs. Transportation costs result mainly from the requirement that communities pick up ivermectin at their own cost from health facilities, which may be located at some distance (Amazigo, Obono, et al., 2002). In other types of programs, CHWs that play a caregiver role may also spend their own money on the transportation and medical costs of destitute patients (Takasugi & Lee, 2012).

Valuation of donated goods

The shadow price of a donated good can generally be estimated from the price of a similar good in the marketplace (CDC, 2012). However, the WHO Guide on Cost-Effectiveness Analysis recommends that donated goods specific to an intervention, such as pharmaceuticals, should be valued at 0 if the intervention can "always be provided using donated goods" (WHO, 2003b). A similar treatment is suggested for donated labor, discussed in more detail below.

Valuation of paid labor

When dealing with labor costs, most literature on economic evaluation methods in health care focus on those related to services provided in medical facilities by professionals. Costing of labor in a community setting by non-professionals requires different methodologies. The WHO Guide to Cost-Effectiveness Analysis distinguishes between scarce, typically skilled, labor and non-scarce labor, generally unskilled (WHO, 2003b). For scarce labor, the guide recommends valuing the opportunity cost of time at prevailing market wages plus the value of all fringe benefits. For unskilled labor (more relevant to CHWs) a further distinction is made between labor drawn from those engaged in agricultural production and those in the informal sector. For the former, the recommendation is to use the rural wage rate, adjusting for seasonal fluctuations in demand, as a proxy for the value of lost production. For the latter, the estimated annual incomes in the informal sector are deemed a good estimate. The use of the minimum wage, or any formal sector wage rate, is explicitly not recommended for non-scarce labor.

Valuation of volunteer labor

The valuation of volunteer labor appears to be particularly contentious. The principle methods for the valuation of volunteer time discussed in the literature are outlined below.

A) The replacement cost approach

The replacement cost approach, or 'substitute method', estimates the economic value of a volunteer's contribution as the cost of replacing the labor they provide (CDC, 2012; Salamon, Sokolowski, & Haddock, 2011). The cost of hiring someone to do the work of the volunteer can be estimated using a 'specialized' or 'generalist' method (Salamon et al., 2011). With the former, the average wage of a specialist with the skills necessary to perform the job done by the volunteer is used, which may require detailed information on the specific tasks performed by volunteers and on the market wages of workers in corresponding professions. Where such data is unavailable, an appropriate 'generalist wage' can be used as a proxy applied to all volunteer time, such as the average wage in a relevant field or in the economy as a whole, or the average unskilled wage rate (Drummond et al., 2005; Salamon et al., 2011). The WHO Guide to Cost-Effectiveness Analysis recommends distinguishing between volunteer labor that can be assumed to always be available for the intervention and that which cannot (WHO, 2003b). In the case of volunteer labor that can be "taken for granted," its opportunity cost would be valued at 0. For labor that may not always be provided, the replacement cost should be used; according to the guide, this would typically be "the wage rate of health personnel who would normally be employed to do the same tasks" (WHO, 2003b).

B) Opportunity cost approach

The opportunity cost approach measures the value of volunteer labor in terms of the value of forgone alternative productive activities (Salamon et al., 2011). However, economists diverge in opinion on how to correctly identify alternative activities (Salamon et al., 2011).

One method is to treat leisure as the universal alternative to volunteer labor (Salamon et al., 2011). However, no consensus exists on the value of leisure time, and a wide range of values have been used (Drummond et al., 2005). In evaluations of health programs, it is common practice to value leisure time at 0 in the primary analysis (Drummond et al., 2005); however, this method risks portraying volunteer labor as having no economic value.

Another method attempts to identify more specifically the type of activity being displaced by volunteer activity, distinguishing between paid work, unpaid work, and leisure (Drummond et al., 2005). In practice, this means using the employment status, wage, and/or demographic characteristics of volunteers, as ascertained by surveys. Posnett & Jan (1996) recommend valuing displaced work time at employed volunteers' net wage rate or full wage. For the unemployed, displaced activity may be considered either leisure or unpaid work (Posnett & Jan, 1996). One specific option to value leisure time for the unemployed is to use the generalist replacement wage of the volunteer (as discussed above) as a proxy for their potential wage (Posnett & Jan, 1996). For displaced unpaid work, or "household production," Posnett & Jan (1996) recommend using the full market wage of a housekeeper as a proxy. A critique of this general method is that it values the volunteer labor of two people differently depending on their employment status and wages, even if the contribution they make as volunteers is identical (Salamon et al., 2011). However, we can theorize that this method might also capture true differences in the value of individual volunteers' outputs, given that wages may be a reflection of education and skill levels, and thus the productive capacity of a volunteer.

An alternative to using specific employment data from volunteers is to use values from a wider population, which can lead results that are more generalizable (Posnett & Jan, 1996). For example, the Panel on Cost-Effectiveness and Medicine recommended using average national wages of employed individuals with similar characteristics (including age and gender) to those in the target population (Weinstein et al., 1996).

C) Other approaches

As an alternative to the valuation of volunteer contributions in monetary units, another approach is to simply measure inputs of volunteer time in natural units and report them alongside other costs, allowing decision makers to assess the reliance of a program on volunteer support (Drummond et al., 2005). The costs of other nonmarket resources that are difficult to quantify may also be discussed qualitatively in studies (CDC, 2012).

Economic evaluations of CHW programs in the literature

Overview

Although it is often presumed that programs using CHWs are more cost-effective than facility-based programs, few economic evaluations have been conducted to provide supporting evidence (Bhutta et al., 2010; Lehmann & Sanders, 2007). In this review, 26 economic evaluations of programs using CHWs were identified. Of the studies, most either involved paid CHWs (7), whose time was valued based on their salaries or wages, or employed a health services perspective (6) and excluded costs associated with volunteers. Two studies found the costs of volunteer CHWs to be negligible and excluded them, and another did not specify the method employed to value volunteer time. The remainder used a variety of valuation methodologies. Although it was not always possible to clearly distinguish the type of approach used, the studies appeared to be divided among those employing an opportunity cost approach and a replacement cost approach, with one study explicitly using both. However, in no case was the WHO Guide's recommendation of using "the wage rate of health personnel who would normally be employed to do the same tasks" employed. Four studies used the minimum wage to value all of, or some segment of, volunteer labor. Justification for why a particular method was chosen was often omitted or poorly explained. A majority of studies were of experimental or pilot interventions, rather than of mature large-scale programs. More detailed descriptions of these studies and the methods they employed in the valuation of non-market costs are provided below.

Economic evaluations of CHW programs in higher income countries

A systematic review of studies on CHW interventions in the US published between 1980 and 2008 included 79 studies, but only 6 had data on cost or cost-effectiveness (Viswanathan et al., 2010). Of the 6, 4 were of interventions using paid CHWs, whose contributions were valued using their wages. Of the two studies involving unpaid CHWs, one calculated the value of volunteer time using the minimum wage (Wolff et al., 1997). The other study employed two different methodologies: with the first, volunteer time was valued at the minimum wage plus a fringe benefit rate and an estimate of the indirect costs of volunteers' workspace; with the second, the base salary for what individuals in similar jobs would earn was used (Stockdale, Keeler, Duan, Pitkin, & Fox, 1997).

A review of studies of vaccination programs delivered by lay health workers identified only three studies that met the criteria of "full economic evaluations," all of which were conducted in high or upper-middle income countries (Corluka, Walker, Lewin, Glenton, & Scheel, 2009). Among these studies, one used salaried community-based personnel, whose time was valued based on their salaries and benefits (Deuson, Brodovicz, Barker, Zhou, & Euler, 2001). The second study valued the costs of volunteer time at unskilled wage rates, while the third used mean hourly earnings of people aged 65 and over (Corluka et al., 2009).

Economic evaluations of TB programs using CHWs

Several economic evaluations of tuberculosis programs involving unpaid CHWs or caregivers have been conducted. Two studies of standard vs. community-based TB treatment, in Malawi and Kenya respectively, assessed costs incurred by health services, patients, and the community (Floyd, Skeva, Nyirenda, Gausi, & Salaniponi, 2003; Nganda, Wang’ombe, Floyd, &

Kangangi, 2003). In both studies, the opportunity costs of caregivers and unpaid community members were found to be negligible and were excluded. Patient time costs were valued based on the average reported income among interviewed patients, although the instrument used to collect income data was not described. Both studies found that community-based treatment was associated with decreased costs and increased cost-effectiveness per case cured.

Another study compared the cost-effectiveness of community-based TB care with conventional hospital-based care in Uganda (Okello, Floyd, Adatu, Odeke, & Gargioni, 2003). This study employed a societal perspective and included the time and travel costs of community-nominated volunteers. On average, volunteers were found to spend 40 hours on supervision, 6 hours motivating patients, and 2 hours in training per patient over the 8 month course of treatment. Time costs were valued based on the average reported income of volunteers, although again the instrument used was unclear. The average costs of time were found to be $11 per patient, which were considered minimal compared to overall patient and health system costs. One limitation of this methodology cited in the study was the possibility that it overestimated volunteer opportunity costs by not capturing the benefits of being involved in TB care. These benefits were inferred from the "positive reaction" to being involved with care expressed by community members in acceptability studies. Overall, community-based care was found to be more effective and less costly than conventional care.

Datiko & Lindtjørn (2010) calculated the cost-effectiveness of TB treatment by Ethiopian HEWs compared to general health workers. The time costs of HEWs were valued based on their salaries. The time costs of patients were valued based on unskilled wage rates, reported to be US$1.39 per day in the study area, although it is unclear what source was used for this wage figure. The study concluded that the use of HEWs in TB treatment was highly cost-effective, costing only 37% of treatment by general health workers while achieving similar health outcomes.

Economic evaluations of child survival interventions using CHWs

According to a report by Perry & Zulliger (2012), the most extensive research on the cost effectiveness of CHWs focuses on child survival interventions. The majority of published studies identified in the report that dealt with specific interventions or programs employed a health services perspective (including: Bachmann, 2009; Borghi et al., 2005; Loevinsohn, Sutter, & Costales, 1997; Ryan et al., 2008; Wilford, Golden, & Walker, 2012). Only two studies identified in the report took a broader perspective and included costs of some non-market goods.

In one study (Fiedler & Chuko, 2008), an economic evaluation of Child Health Days (CHDs) in Ethiopia was conducted. To measure program costs, the authors used a combination of activity-based costing and the 'ingredients approach,' which involved identifying major program activities and creating unit cost algorithms for each. These algorithms identified the "types, quantities, and costs of the inputs required to produce" each activity. Among these inputs were donated goods and time provided by volunteers and members of target communities. The authors stated that volunteer time was quantified in order to better understand "whether or not volunteers should be paid, and if so, how much, and what would be the cost of doing so." However, it is unclear precisely how volunteer and community member time was valued, and the lack of separate reported findings on the quantity and value of donated time make interpretation difficult. Cost-effectiveness of the program was reported as the average cost per life saved (US$228) and per DALY averted (US$9).

The other study identified in the report (Mbonye, Hansen, Bygbjerg, & Magnussen, 2008) involved a cost-effectiveness analysis of community-based vs. facility-based preventative treatment of malaria among pregnant women in Uganda. Community-based care was delivered by "community resource persons"; remuneration was provided to these individuals and their inputs valued at these wages. Costs borne by pregnant women, including out-of pocket and opportunity costs, were included. The value of lost patient time was calculated based on "the average loss in earnings due to absence from work," which had been assessed in a previous study of the economic burden of malaria in the country. The incremental cost-effectiveness of the community-based strategy was reported as $1.10 per DALY averted.

Economic evaluations of MDA interventions utilizing CHWs

A study of the costs of national LF programs in several countries assessed both financial and economic costs from a "national program perspective" (Goldman et al., 2007). Although the authors discussed the importance of volunteer opportunity costs, the value of volunteer time was not quantified and thus was "very definitely underestimated." On the other hand, the value of donated drugs was included, and was found to contribute substantially to total economic costs. Given the specified perspective, it is unclear why donated drug costs were included. The study found that programs utilizing volunteers had significantly lower costs than those that did not.

Onwujekwe, Chima, Shu, & Okonkwo (2002) conducted a cost-analysis of a pilot CDTI program in two Nigerian communities using a societal perspective. All community financial and non-financial costs "that would not have occurred otherwise" were assessed. These included in-kind contributions of materials and food (except for cola-nuts, which were considered customary for welcoming visitors), and the opportunity costs of community facility and time use. Community time, including that of CDDs, was valued at the minimum wage. The method used for facility use costing was not reported. Total community non-financial costs in the two communities ($3338.00 and $2559.30) far exceeded financial costs ($168.16 and $202.28). The majority of community non-financial costs were incurred during distribution of ivermectin by

CDDs and committee members. In one community, total community costs were greater than provider costs, while the opposite was true in the other. The authors stated that it would have been preferable to use more detailed data on community members' income sources and volunteer hours to more accurately value opportunity costs.

A report from an ongoing study of the cost of the CDTI strategy (McFarland, 2005) assessed both the financial and non-financial costs of 11 APOC projects in Cameroon, Nigeria and Uganda. Community costs included in the study were the time and resources used by CDDs and other community members during drug collection, drug distribution, training, and other activities. Community member time was valued in monetary terms using an equivalent daily wage, based on the per capita GNI in each country. Using this method, the costs of volunteer time and financial contributions were found to represent 27% of total costs. When volunteer time was excluded, community financial costs represented only 6.3% of all costs. A sensitivity analysis on the value of volunteer time was also conducted using two other valuation methods: minimum wage standards and an estimate of subsistence-level income in West Africa from prior studies. These disparate methods led to significantly different estimates of cost. Ultimately, this variation in values and the lack of clarity on the relative validity of each methods led volunteer time to be excluded from secondary analyses. Volunteer time was also presented in natural units. It was found that in 2003, the average CDD spent 33 days performing CDTI activities while treating 391 community members. The majority of time was spent distributing the drug (17.8 days), with other important tasks including mobilization and sensitization (5.5 days), and conducting the census (4.6 days). Other community members were found to contribute substantially to mobilization and sensitization activities.

Other relevant economic evaluations

In the only study identified during this literature review that focused exclusively on the costs of unpaid labor, Ama & Seloilwe (2010) utilized an opportunity cost approach to measure the caregiver costs of providing home-based care for people living with HIV/AIDS in Botswana. Caregivers included both family members and volunteers from the community, with the latter in the majority. The time of employed caregivers was valued at their current salaries. For the unemployed, who represented the majority, the legal minimum wage was used. The study also assessed the explicit out-of-pocket expenditures incurred by caregivers, including money spent to support their clients, to feed themselves during visits, and on transport. It is unclear whether the costs of food should have been included, since presumably similar costs would have been incurred in the absence of care-giving. The mean monthly opportunity cost for caregivers was found to be $25.23, compared to $65.22 in explicit costs. Caregiver costs were also reported on a per client basis, amounting to $184.17 per month and $15.26 per visit. One surprising finding was that the mean explicit monthly cost for caregivers was equivalent to their mean monthly earnings ($66), suggesting that the majority of their income was spent on care giving. Although a minority of caregivers reported receiving donations or a small monthly government allowance, most were self-supporting. Better quantification of this income would have improved the interpretability of the findings. The authors concluded that, although community home based care might appear affordable from a health services perspective, substantial costs had been shifted from the government to caregivers. In the absence of adequate and equitably distributed compensation, this burden of costs was predicted to lead to poor sustainability and performance of home-based care.

Conclusion

As a result of task-shifting within health-systems, CHWs have become essential components of a large number of health programs in Africa and elsewhere. However, reliable data on the size and performance of this workforce remains scant. Qualitative evidence provides a general picture of community members who are eager to participate in programs to help improve health in their communities on the one hand, but constrained in their ability and motivation to do so without adequate compensation on the other. Community-directed strategies benefit from the ability to harness community resources and networks to support and motivate CDDs in the absence of external incentives. The integration of NTD programs (in addition to other interventions) using a community-directed strategy has been promoted as a method for increasing efficiency and saving costs. However, evidence on the impacts of integration on communities and CDD performance is conflicting. Better quantitative and qualitative data are needed to understand whether a reliance on community volunteers is sustainable in the context of increasing program integration and scale-up.

Economic evaluation can be used to quantify the resources that communities contribute to programs, which may be useful for better monitoring and managing of these resources. However, research on the costs and cost-effectiveness of NTD programs has generally employed a programmatic perspective and excluded the costs of volunteer labor (Brady, Hooper, & Ottesen, 2006; Evans et al., 2011; Goldman et al., 2007). Although this methodology may provide results that appear most relevant to program managers, it greatly undervalues the contributions of communities and thus provides only a partial representation of the sum of resources used by a program. This research seeks to fill in this evidence gap by explicitly employing a community perspective in the economic analysis of an integrated NTD program

Chapter 3: Methodology

Introduction

This research was conducted in tandem with a larger study of the costs associated with Carter Center-supported integrated NTD control programs in Haiti, Uganda, Nigeria, and Burkina Faso. Whereas the larger study assessed costs from a programmatic perspective, this study took a community perspective to quantify the inputs provided by participating community volunteers. Thus, this study was designed to produce results that complement those from the larger study by providing insight into the role played by community resources.

Research Design

The methods and materials used to collect data for the larger integrated NTD study were developed in 2008 by the PI at Emory University and collaborators at the Bill and Melinda Gates Foundation (BMGF) (McFarland & Hooper, 2009). The community level questionnaire used in this study (Appendix A) was based on an instrument originally developed for a study of costs associated with the APOC CDTI program (McFarland, Menzies, Njoumemi, & Onwujekwe, 2005), and was further refined by the PI in July of 2010.

Study Setting

The study was carried out in the contiguous states of Plateau and Nasarawa in north central Nigeria, which is the site of the largest and most mature of the Carter Center-supported NTD control programs. The two states are approximately the same size (about 2,7200 km^2), but Plateau is more densely populated; in 2006, its population was 3,206,531, compared to 1,869,377 in Nasarawa (National Population Commission (Nigeria), 2010). The states are subdivided into 30 local government areas (LGAs): 17 in Plateau and 13 in Nasarawa.

Population and Sample

The study population was comprised of all CDDs, village heads, and other community members in the two states who provided resources to the NTD control program implemented by the Nigerian Ministry of Health (MOH) with support from the Carter Center between 2009 and 2010.

Two rounds of data collection were conducted, one for each distribution year. For each round, a study sample was selected through multiple sampling stages. First, a majority of local government areas (LGAs) in each state (10-11) were selected purposively to exhibit variation representative of all LGAs in the state, in terms of population size and treatment integration type. Subsequently, within each sampled LGA, all health districts were selected, and within each health district, two communities were randomly selected. This led to between 4 and 12 communities being selected per LGA per year, with the majority of LGAs having 10 communities selected. Within each sample community, interviewers selected the village head (or other local leader) and 1-2 CDDs to be interviewed. In 2009 and 2010, a total of 399 and 383 respondents were interviewed, respectively.

Instruments

The survey instrument used in this study was designed to collect self-reported retrospective data on resources provided to the program by the community, including labor (measured in time) as well as financial and material inputs. Respondents were prompted to detail the total inputs they provided for each of six interventions, broken down by seven programmatic activities. Time inputs were recorded in full working days. Respondents were asked to provide information on any relevant financial expenditures they made (referred to as "personal costs"), as well as to detail any cash or goods they received from the community (referred to as "community costs"). For in-kind community costs, respondents were asked to describe the quantity and type of goods received, and to provide an approximate market value. All costs were recorded in Nigerian naira (NGN).

Prior to data collection, all portions of the study were reviewed by Emory University's Institutional Review Board (IRB00002551) and determined to meet the criteria for exemption. The survey was fielded in August through September of 2010 and 2011 by trained field staff employed by the Carter Center and by LGA MOH staff.

Data entry and analysis

Data entry forms were created in Microsoft Access by project staff prior to data collection. Trained data entry staff in Nigeria entered all data into these forms. Data cleaning was carried out by a research assistant at Emory University.

All data analysis was conducted by the author. Data was converted from Access files to Excel files for cleaning. Analysis was conducted in Excel and SAS Version 9.3 (Cary, NC). For the primary analysis, data were restricted to that relevant to the control of onchocerciasis, LF, schistosomiasis, and STH. Reported financial costs and time inputs related to trachoma were excluded, and those associated with the distribution of ITNs were analyzed in a subsequent analysis. Five respondents classified as "masons" were assumed to be involved only in trachoma control and were also excluded from analysis. Respondents classified as "head teachers" or "head masters" were re-categorized as CDDs, and "district heads" and "ward heads" were re-categorized as village heads (VHs), with the assumption that these were functionally equivalent. For each year, communities with no time inputs reported for both CDDs and VHs in one year were considered to have missing data and were excluded from analysis. Any CDDs reporting no time worked were also considered to have missing data and excluded. One respondent reporting more than 100 days worked was considered an extreme outlier and also excluded. In total, 4 CDD records and 3 VH records were excluded. After data cleaning, a total of 400 CDD records and 375 VH records were analyzed. Responses to open-ended questions about community inputs were categorized by the author as cash, labor, food/drink, stationery, transportation, or unknown. Open-ended responses on the frequency of community cost inputs were not included in the analysis because they were difficult to interpret. Thus, all community inputs were assumed to have occurred only once.

Costs reported in 2009 were converted to 2010 Nigerian Naira (NGN) using the 2009 national rate of inflation in consumer prices (11.5%) (The World Bank, 2013). Thus, all costs are presented in constant 2010 NGN.

Routinely collected Carter Center programmatic data from Plateau and Nasarawa were also merged with study data during analysis to facilitate standardization and interpretation. Programmatic data utilized included the numbers of CDDs, treatment communities, and treatments distributed.

Data was weighted using estimates for the size of the study population in each LGA. However, weighting was not found to a have a significant impact on calculations, and thus only unweighted results are presented.

Valuation of Time Inputs

A variety of methods for the valuation of respondents' opportunity costs in monetary units were assessed (Table 1). The replacement cost approach equates the value of volunteer time with the wage rate of personnel who would otherwise be employed to do the same tasks (WHO, 2003b). For this method, we identified the lowest pay grade in the public healthcare sector in Plateau State and converted it to a daily wage (191 NGN). We considered this rate an upper-bound for the value of respondents' time. As an alternative, we also considered using the nationally mandated state government minimum wage of 5500 NGN per month, equivalent to 181 NGN per day. However, as this value was nearly equivalent to the above, it was not used in the analysis. The opportunity cost approach measures the value of volunteer labor in terms of the value of forgone productive activities (Salamon et al., 2011). As we did not collect data on respondents' normal productive activities, and detailed local expenditure and income data were not available, we used the World Bank international poverty line of $1.25 per day (PPP, 2005) as a proxy for displaced production. This value was considered a lower-bound for the value of opportunity costs. GNI per capita was considered but ultimately rejected as a method for valuing volunteer time, as it would have led to values considerably larger than any other method.

Table 1. Valuation Methods for Opportunity Costs of Volunteer Time

	World Bank International Poverty Line*	State Government Minimum Wage (2000-2009)**	Lowest Public Healthcare Salary in Plateau State (2007)***	GNI per capita (2010)****
Published Value	$1.25/day (PPP, 2005)	5500 NGN/month	69,793 NGN/year	$2160 (Atlas Method, current US$)
Value per Day (2010 NGN)	142 NGN	181 NGN	191 NGN	883 NGN

*Haughton & Khandker, 2009; **Department of Primary Healthcare/Diseases Control, 2007
***Aminu, 2011; ****World Bank, 2013

Limitations and Delimitations

This study was designed to provide insight into the Nigerian NTD control program implemented in the states of Nasarawa and Plateau during the study period. Thus, study findings may not be generalizable to other programs, settings or time periods. The lack of true randomization in the sample selection may limit the external validity of the findings. Measurement error may have also resulted from factors related to the survey instrument and respondents. For example, the complicated nature of the data collection instrument may have led to some double counting of inputs. Because responses on the frequency of community inputs were excluded, these costs may be undervalued. Poor respondent recall and response bias may have also contributed to error. Some respondents may have been motivated to alter responses if they believed that doing so would lead to future rewards. A lack of a control or comparison group may also limit the interpretability of findings.

Chapter 4: Results

Summary of Programmatic Data

In 2009 and 2010, the Carter Center-supported NTD program in Plateau and Nasarawa completed a transition to integrated treatment of onchocerciasis, LF, and schistosomiasis treatment in all LGAs where the diseases were co-endemic. According to programmatic data, schistosomiasis treatment was provided to school-aged children in all 30 LGAs in both study years. In 2009, 5 of these LGAs[3] (all of which are included in this study) conducted separate rounds of treatment for schistosomiasis and LF. In 2010, these 5 LGAs then transitioned to exclusive treatment of schistosomiasis, because LF transmission had been halted (and they were non-onchocerciasis endemic). In all but four of the remaining LGAs, TDA for the three diseases was carried out in both years. In the four LGAs that were onchocerciasis but not LF endemic (two of which were included in this study), ivermectin and praziquantel were jointly administered both years. Thus, in 2010, no separate treatment rounds for the three diseases were conducted in any LGA. Because the transition to integrated treatment was still underway in 2009, data from 2010 were considered more representative of the fully integrated NTD program.

According to Carter Center annual reports, 10,011 CDDs participated in MDA in the two states in 2009, with the number increasing modestly to 10,357 in 2010. The CDDs participated in the provision of 4,443,094 MDA treatments in 2009 and 4,270,581 treatments in 2010, with each CDD distributing an average of 428 treatments per year (Table 2). Overall, the large majority of treatments distributed across the two years were for LF and onchocerciasis (77%), while the remainder were for schistosomiasis. High coverage rates for the treatments was recorded in both years. LF and onchocerciasis treatment reached 92.2% of the at-risk population

[3] The five LGAs with dual treatment rounds in 2009 were Barkin Ladi, Jos North, Langtang South, Keana and Keffi.

in 2009 and 95.9% in 2010. Schistosomiasis treatment coverage was 94.1% in 2009 and 89.7% in 2010.

The precise number of individuals treated was not recorded, but can be estimated as the number of LF and/or onchocerciasis treatments distributed in LGAs where either or both of these diseases were endemic, and the number of schistosomiasis treatments in LGAs where only that disease was endemic. Using this method, the estimated number of people treated was 3,477,526 in 2009 and 3,382,894 in 2010, with each CDD treating 337 community members on average. Although the total number of treatments distributed in each state was similar, there were roughly 2.5 times as many communities receiving treatments in Plateau. As a result, the ratio of CDDs to communities was significantly higher in Nasarawa. While the number of treatments distributed in each state remained relatively stable from 2009 to 2010, the number of CDDs fell in Nasarawa by 14% and rose in Plateau by 20%. This resulted in changes in the average number treatments distributed per CDD (Figure 2).

Programmatic reports also indicate that limited distribution of ITNs was carried out in 2009, with much larger scale distribution occurring in 2010. In 2009, 244,661 ITNs were distributed in 200 communities, reaching only 7.2% of the target population.[4] In 2010, 2,266,578 ITNs were distributed in 3,638 villages in all 30 LGAs, reaching 97.4% of the targeted population. Distribution of ITNs was conducted at a separate date from MDA.

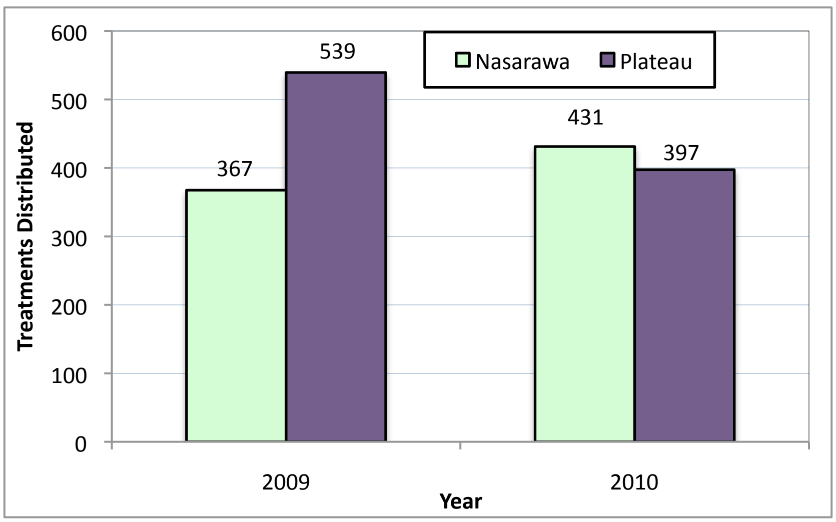
[4] Low coverage in 2009 was attributed to a failure on the part of the Nigerian government to deliver promised ITNs.

Table 2. Summary of NTD Programmatic Data during Study Period

Year	State	Treatments	Individuals Treated*	CDDs	Communities	Treatments per CDD	Treated per CDD	CDDs per Community
2009	Nasarawa	2,045,054	1,642,965	5,565	1,050	367.5	295.2	5.3
	Plateau	2,398,040	1,834,561	4,446	2,549	539.4	412.6	1.7
	Total	4,443,094	3,477,526	10,011	3,599	443.8	347.4	2.8
2010	Nasarawa	2,066,543	1,613,650	4,792	1,054	431.2	336.7	4.5
	Plateau	2,204,038	1,769,244	5,546	2,499	397.4	319.0	2.2
	Total	4,270,581	3,382,894	10,338	3,553	413.1	327.2	2.9
2009-2010	Total	8,713,675	6,860,420	20,349	7,152	428.2	337.1	2.8

* Estimate based on assumption that all of those treated for schistosomiasis were also treated for LF and/or Onchocerciasis where the diseases were co-endemic.

Figure 2. Average Number of NTD Treatments Distributed per CDD by Year and State



Programmatic reports also documented the practice of monetary incentives being provided to CDDs in the majority of communities in 2009 and 2010. In 2009, the reports document a total of 1,267,334 NGN ($8494) provided as support to 7,722 CDDs (77%) from 1,930 communities (54%). Thus, among those who received support, the average CDD received 164.12 NGN ($1.1). In 2010, reports indicate that a total of 2,137,821 NGN ($14,329) was provided as support to 4,648 CDDs (45%) from 3,067 communities (86%), amounting to an average of 459.94 NGN ($3.08) per CDD.

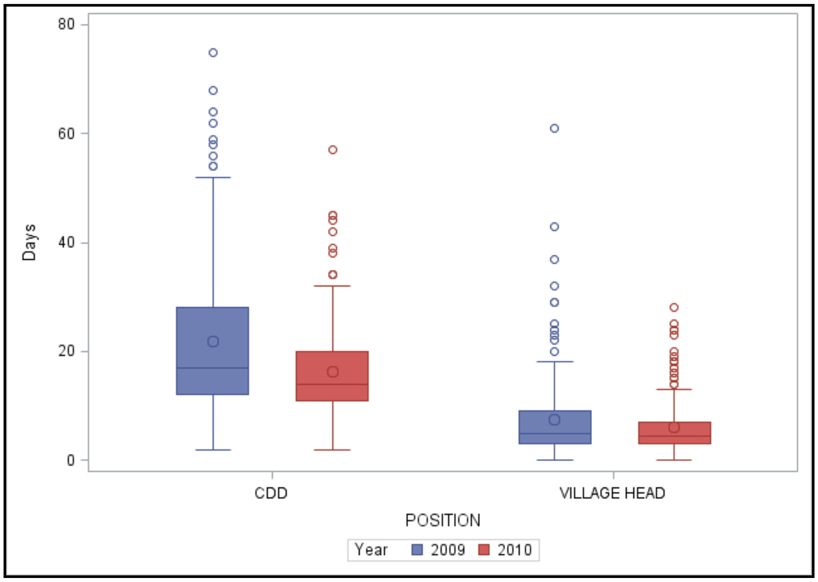
Respondent Characteristics

The numbers of CDD and VH respondents were roughly equivalent across the two years. In 2009 and 2010, the number of CDD records was 198 and 202, respectively. For VHs, the number of records decreased from 195 in 2009 to 180 in 2010. A majority of records corresponded to individuals who were interviewed in both years. Although the variable spelling of respondents' names made it difficult to assess the precise number, a hand count yielded 122 CDDs and 136 VHs who were respondents in both years. Eight respondents were also identified who were listed as CDDs in one year, and as VHs in another. It is unclear whether these reflected an actual change in roles or whether they were miscategorized. For the purposes of analysis and reporting, individuals were considered to be independent respondents in year 1 and 2.

Time Inputs for NTD Activities

The total days reported for all NTD treatment activities in the study period ranged from 2 to 75 days for CDDs, and 0 to 61 days for VHs. The distribution of time input data was heavily right-skewed for both types of respondents. The range of values for total days reported by CDDs and VHs decreased from 2009 to 2010, contributing to reduced inner quartile ranges (Figure 3). The mean number of days spent on all NTD activities each year was 19.0 for CDDs and 6.8 for VHs, while median days were lower: 15.5 for CDDs and 5.0 for VHs. Because of the data's skewed distribution, the median was considered a better measure of central tendency.

Figure 3. Distribution of Total Days Reported by Position and Year



Median values were calculated by state, LGA and year (Table 3). Among CDDs, the median days reported decreased 3 days between study years, from 17 to 14 days. Among VHs, there was a negligible decrease of .5 days.[5] The decrease in Nasarawa (19 to 13 days) was more pronounced than in Plateau (16 to 14 days). When analysis was restricted to LGAs that carried out integrated or single rounds of treatment, median days in Nasarawa in 2009 were lower (17 days), but other results were unaffected. The difference in the distributions of total days reported by CDDs between 2009 and 2010 was found to be significant using the Mann–Whitney U test ($z=3.83$, $p<.001$). This held true in the restricted analysis as well ($z=3.80$, $p<.001$). For VHs, no significant difference was found between the two years ($z=-1.36$, $p<.18$). Between the two states, no significant differences in the distribution of days reported by CDDs or VHs were found in either year.

At the level of LGAs, the median number of total days reported by CDDs ranged from 7 to 39 during the study period. In 2009, the highest median days reported by CDDs were in Keffi

[5] Mean time inputs reported by CDDs decreased from 21.8 days in 2009 to 16.2 days in 2010. Mean days reported by VHs decreased from 7.4 to 6.1 days.

(36.5), Jos North (33.0), and Jos South (39). Keffi and Jos North were among the 5 LGAs in which dual rounds of treatment were administered in 2009. Although TDA was employed in Jos South according to programmatic data, 11 of 12 CDDs there reported days for separate treatments rather than for TDA.[6] The three LGAs are also the most densely populated in the two states, all with over 500 inhabitants per square kilometer (National Population Commission (Nigeria), 2010). Two of these LGAs also experienced the greatest declines in CDD reported days between 2009 and 2010: Keffi (-24.5 days) and Jos South (-21 days). Overall, in 15 of 21 LGAs the median number of total days reported by CDDs decreased between study years. The greatest increase in median days occurred in Kanam (+9 days).

Median days reported by VHs ranged from 0 to 15 days within LGAs. From 2009 to 2010, medians decreased in 9 LGAs, increased in 7, and did not change in 4. Changes ranged from a decrease of 13.5 days in Wamba to an increase of 7 days in Kokona.[7] The large decrease in Wamba was due to 8 of 10 VHs reporting no days in 2010.

[6] On the other hand, all VHs in Jos South reported days for TDA only.
[7] In one LGA, no VH data were available for 2010.

Figure 4. Median Days Reported by CDDs for All Activities by LGA and Year

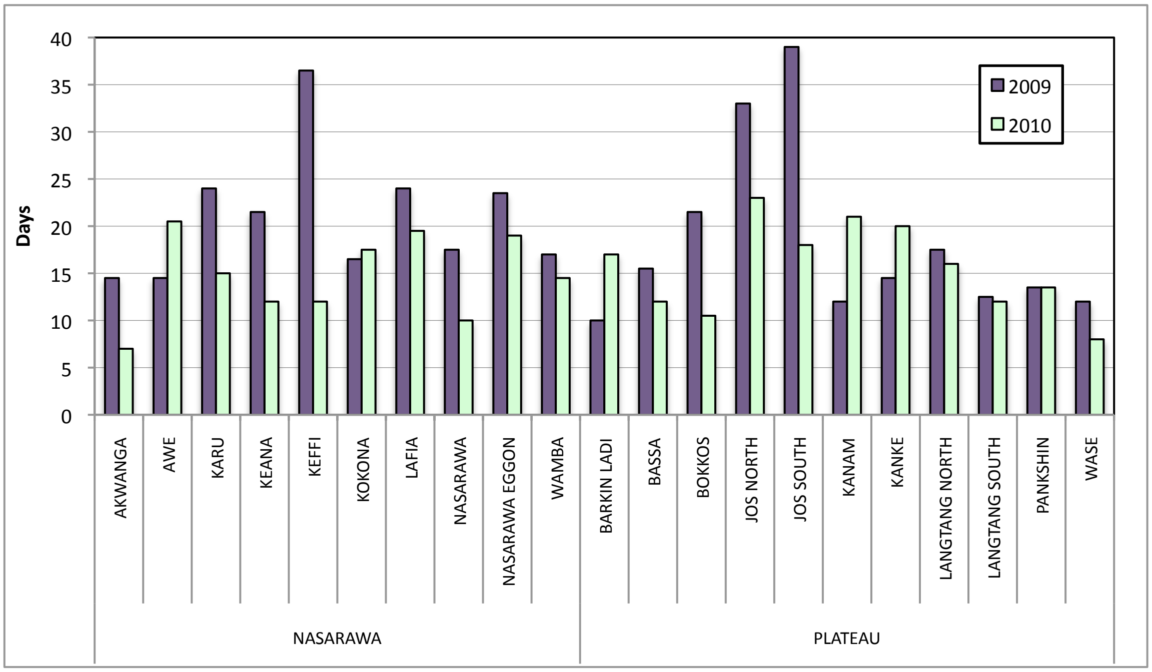


Table 3. Median Days Reported by LGA, State, and Year

		CDDs (n=400)			**Village Heads** (n=375)		
State	LGA	2009	2010	Change	2009	2010	Change
Nasarawa	Akwanga	14.5	7	-7.5	3.5	7	3.5
	Awe	14.5	20.5	6	9	7	-2
	Karu	24	15	-9	2.5	4	1.5
	Keana	21.5	12	-9.5	6	--	--
	Keffi	36.5	12	-24.5	5.5	3.5	-2
	Kokona	16.5	17.5	1	4.5	11.5	7
	Lafia	24	19.5	-4.5	6	3	-3
	Nasarawa	17.5	10	-7.5	3.5	2.5	-1
	Nasarawa Eggon	23.5	19	-4.5	6.5	6.5	0
	Wamba	17	14.5	-2.5	13.5	0	-13.5
	Nasarawa State	19	13	-6	6	4	-2
Plateau	Barkin Ladi	10	17	7	3	3	0
	Bassa	15.5	12	-3.5	4.5	4.5	0
	Bokkos	21.5	10.5	-11	7	8	1
	Jos North	33	23	-10	15	3	-12
	Jos South	39	18	-21	14	4	-10
	Kanam	12	21	9	2	7	5
	Kanke	14.5	20	5.5	3	6.5	3.5
	Langtang North	17.5	16	-1.5	9	9	0
	Langtang South	12.5	12	-0.5	5	4	-1
	Pankshin	13.5	13.5	0	3	5.5	2.5
	Wase	12	8	-4	5	2	-3
	Plateau State	16	14	-2	5	5	0
Both States	Minimum	10	7	-24.5	2	0	-13.5
	Maximum	39	23	9	15	11.5	7
	All LGAs	17	14	-3	5	4.5	-0.5

Time Inputs by NTD Programmatic Activity

Time inputs were reported for 9 programmatic activities: training, mobilization, drug collection, drug distribution, census collection, monitoring and evaluation, reporting, and two "other" categories. Across both years, CDDs reported working a median of 7 days for drug distribution, 2 days for mobilization, and 1 day for all other primary activities (Table 4). Among VHs, the median days reported were 0 for all activities except mobilization (2), M&E (1), and other administrative activities (1). The activities with the highest median days reported also had the greatest variance. CDDs reported between 0 and 70 days spent on drug distribution, and VHs between 0 and 30 for mobilization. The large majority of VHs reported spending no days on training (82.6%), drug collection (91.5%), drug distribution (88.5%), census collection (93.3%), and reporting (93.0%). A smaller proportion of CDDs reported spending no days on drug collection (31.5%), census collection (38.5%), and monitoring and evaluation (39.8%). Although drug distribution is a primary responsibility of CDDs, 20 (5.0%) reported spending 0 days on this activity. For all primary activities, except in one instance, the number of CDDs and VHs reporting 0 days decreased from 2009 to 2010.

Table 4. Median Days Reported by Activity and Year

			Activity							
Position	Year	All Activities	Training	Mobilization	Drug Collection	Drug Distribution	Census	Monitoring & Evaluation	Reporting	Other
CDD	2009	17	1	2	1	7	1	1	2	0
	2010	14	1	1	1	5	1	1	1	0
	2009-2010	15.5	1	2	1	7	1	1	1	0
VH	2009	5	0	2	0	0	0	2	0	1
	2010	4.5	0	2	0	0	0	1	0	1
	2009-2010	5	0	2	0	0	0	1	0	1

Comparison of Time Inputs for Integrated and Non-Integrated NTD Treatment

Analyses were conducted to compare time inputs in the 5 LGAs that transitioned from dual to single treatment rounds (Group A) with all other LGAs (Group B). In 2009, median days in Group A were 2 days higher for CDDs and 1 day higher among VHs (Table 5). However, no significant difference in distributions of CDD days was found between the two groups using the Mann–Whitney *U* test (z=-0.36, p=.72). The lack of a more pronounced difference between the two groups in 2009 may be due to the small sample size in Group A and the fact that a majority of respondents in that group did not report contributing time to separate rounds of treatment. Out of 60 respondents, 31 reported time inputs for praziquantel only, 13 for LF treatment only, and 16 for TDA. Of the 28 Group A respondents reporting separate rounds of treatment, 20 were in Jos North. Among these 28 respondents, the average time reported was 34.3 days for CDDs and 12.9 for VHs, considerably higher than the means for Group B (21.9 and 7.3, respectively). When the data was restricted to respondents who reported hours in concordance with programmatic data, a significant difference was found in the distributions of the two groups (Mann Whitney *U,* z=3.34, p<.001).

In both groups, the median days reported by CDDs and VHs decreased between 2009 to 2010, with this trend particularly pronounced in Group A. Among CDDs, the median days reported decreased 5.5 days in Group A and 3 days in Group B. Among VHs, median days decreased 3 days in Group A but did not change in Group B.

Table 5. Mean and Median Days by LGA Grouping and Year

Position	LGA Group*	Year	Median	Mean	N
CDD	A	2009	19.0	21.7	47
		2010	12.5	15.2	44
	B	2009	17.0	21.9	151
		2010	14.0	16.4	158
VH	A	2009	6.0	7.7	40
		2010	3.0	3.9	31
	B	2009	5.0	7.3	155
		2010	5.0	6.6	149

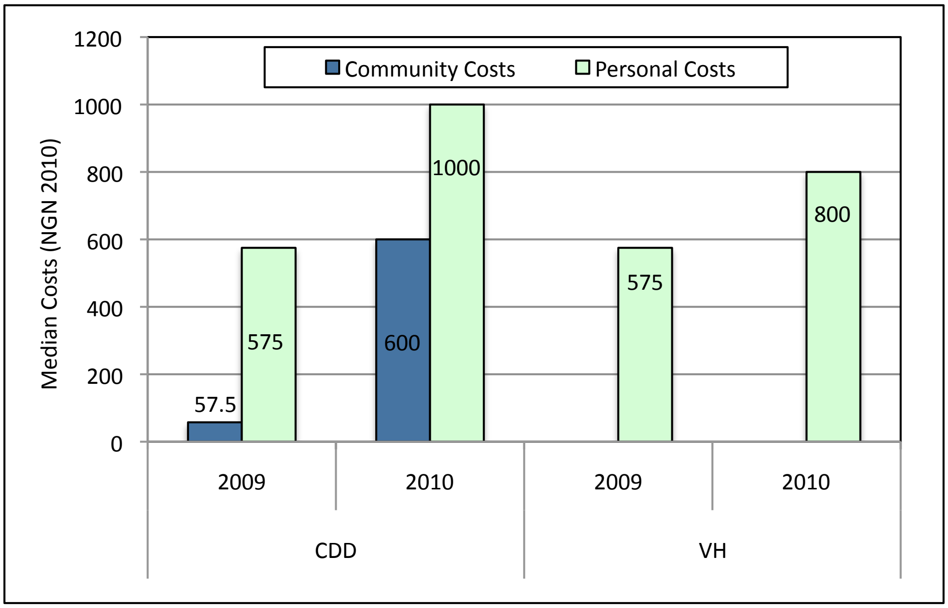
* Group A is comprised of the 5 LGAs that transitioned form dual to single treatment rounds
Group B corresponds to LGAs with single or integrated treatment rounds in both years

Costs and Transfers: Financial and In-Kind

Costs were reported either as "personal costs" incurred by the respondent, or as "community costs," cash or goods provided to the respondent by the community. Personal costs were reported by intervention type, while community costs were only reported for all interventions together. Personal costs related to ITN distribution were excluded in the primary analysis. A majority of CDDs reported personal (82.7%) and community costs (69.8%). A majority of VHs also reported personal costs (64.8%), but only a minority reported community costs (41.1%). 6.8% of CDDs and 26.9% of VHs reported no costs of either type. Personal costs associated with NTD activities ranged from 0 to 16,708 NGN ($112) among CDDs, and between 0 and 23,000 ($154) among VHs. The distribution of all cost data was heavily right-skewed and thus median values are reported.

Across both years, median personal costs were 800 NGN ($5.36) among CDDs and 609.5 NGN ($4.09) among VHs. Median community costs were lower: 342.5 NGN ($2.30) among CDDs and 0 among VHs. Figure 5 shows that median personal costs increased between the two years among both types of respondents, and community costs rose among CDDs. Among CDDs, the change in distributions of both types of costs from 2009 to 2010 was significant using the Mann-Whitney *U* test ($p<.01$). Among VHs, significant differences were not found.

Figure 5. Median Reported Costs by Year and Type



CDDs and VHs also provided information on the types of inputs provided to them by the community (Table 6). Among respondents reporting any community costs, a large majority received cash: 83.9% of CDDs and 73.4% of VHs. 22.6% of CDDs and 24.0% of VHs reported receiving stationery supplies or services, including pens, pencils, notebooks, and letter printing. Smaller proportions reported receiving farm products, including yams, corn, rice, and chickens; prepared food and/or beverages; transportation, including the use of a motorcycle; and labor, including assistance with CDD tasks and farm labor. Among respondents who reported receiving cash from the community,[8] the median value of those transfers was 600 NGN ($4.02) for CDDs (range: 5-7,900 NGN) and 59 NGN ($.40) for VHs (range: 5-11,000 NGN).

[8] Records indicating 0 value were excluded.

The cash provided to CDDs by community members were considered transfers to compensate them for their financial and opportunity costs. Likewise, reciprocal labor, food and drink, as well as produce and other farm products provided to CDDs, were considered in-kind transfers. On the other hand, notebooks, pens, and other stationery goods, in addition to assistance with transportation and programmatic activities, could be interpreted as inputs to the program. However, because the majority of community costs were in the form of transfers, all community costs are reported separately from personal costs.

Table 6. Community costs by category, among respondents reporting any community inputs (2009-2010)

CDDs	Cash	Stationery	Farm Products	Food/Drink	Transport	Labor	Unknown	Any
Count	234	63	15	3	4	5	11	279
Percent	83.9%	22.6%	5.4%	1.1%	1.4%	1.8%	3.9%	100.0%
Village Heads	**Cash**	**Stationery**	**Farm Products**	**Food/Drink**	**Transport**	**Labor**	**Unknown**	**Any**
Count	113	37	9	15	2	3	3	154
Percent	73.4%	24.0%	5.8%	9.7%	1.3%	1.9%	1.9%	100.0%

Inputs per NTD Treatments Distributed in the Study Population

Sample medians were multiplied by the numbers of CDDs and VHs in the study population and divided by the number of treatments distributed to calculate median community inputs per treatment in the population. During the study period, CDDs and VHs contributed a combined median of 40.3 days per 1,000 treatments distributed,[9] 90% of which was contributed by CDDs (36.2 days). Between 2009 and 2010, median days per 1,000 treatments dropped from 42.4 to 36.4. At the state level, there was a substantial 22.7 day decrease in Nasarawa while there was a modest 5.9 day increase in Plateau (Figure 6). This trend is due in part to the influence of the estimated number of treatments distributed per CDD, which differed between

[9] Mean days per 1,000 treatments were 44.3 days.

states and years. On a per treatment basis, the bulk of CDDs' and VHs' time was spent on drug distribution and mobilization (Figure 7). As an average of 1218 treatments were distributed per community, we can estimate that in the average community, CDDs and VHs worked a combined 49.1 days on NTD activities.

Median financial costs (among CDDs and VHs combined) amounted to 3,364 NGN ($22.55) per 1,000 treatments in 2009 and 5,578 NGN ($37.39) per 1,000 treatments in 2010. Per community, average costs were 4559 NGN ($30.56).

Figure 6. Median Days per 1000 treatments distributed by State and Year

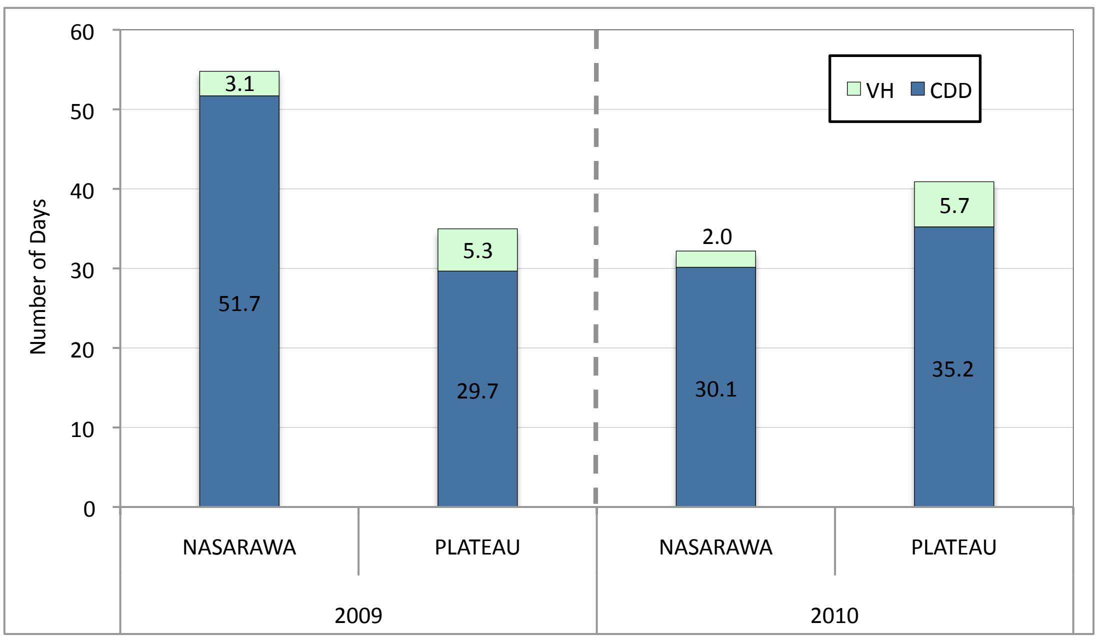
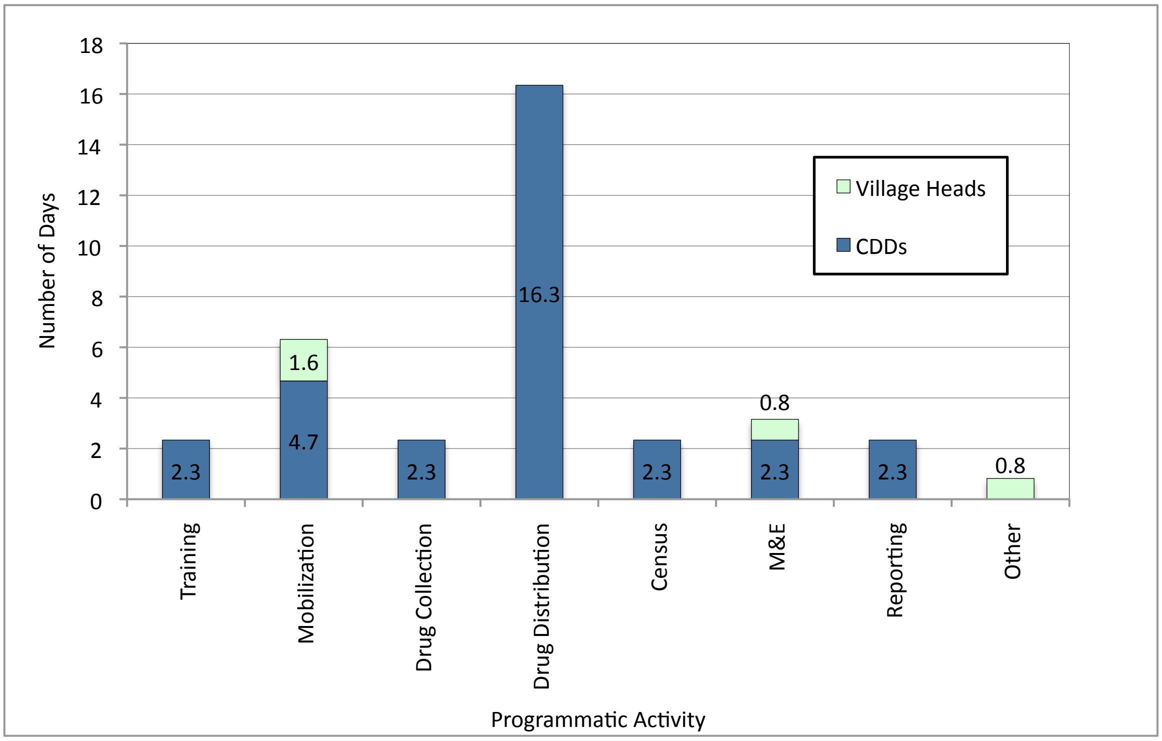


Figure 7. Median Days Reported per 1000 Treatments Distributed by Programmatic Activity (2009-2010)



Inputs for ITN Distribution

In 2009, only 2 CDDs and 2 VH respondents reported time inputs for ITN distribution activities. However, in 2010, 57.4% of CDDs and 48.3% of VHs reported working at least one day on ITN activities. In 2010, days worked on ITN distribution ranged from 2 to 34 days among CDDs and from 1 to 41 days among VHs. Among respondents who reported any days spent on ITN activities, CDDs and VHs spent a median of 13 and 5 days on these activities, respectively. CDDs spent the bulk of this time on distribution (4 days), training (2 days), and mobilization (2 days), while VHs spent the most time on mobilization (2 days) and monitoring and evaluation (2 days).

When time inputs for ITN activities were combined with those for MDA activities, the total median days reported by all respondents in 2010 rose to 22 days among CDDs and 7 days among VHs. With these inputs included, median days were higher in 2010 than in 2009 for both CDDs (+5 days) and VHs (+2 days) (Figure 8). The differences in distributions of total days between 2009 and 2010 were significant for CDDs (z=-2.2, p=.026) and VHs (z=2.8, p=.005).

In 2010, CDDs involved in ITN distribution spent a median of 27 days on all interventions, while those who were only involved in NTD activities worked a median of 14 days. Among VHs, those involved in ITN distribution worked a median of 9 days total, 4 more than those who did not. The differences in the distribution of days between these respondents were significant for CDDs and VHs (Table 8).

Among respondents reporting time spent on ITN activities, median personal costs associated those activities were 950 NGN for CDDs and 900 NGN for VHs.

Figure 8. Median Days by Year and Intervention

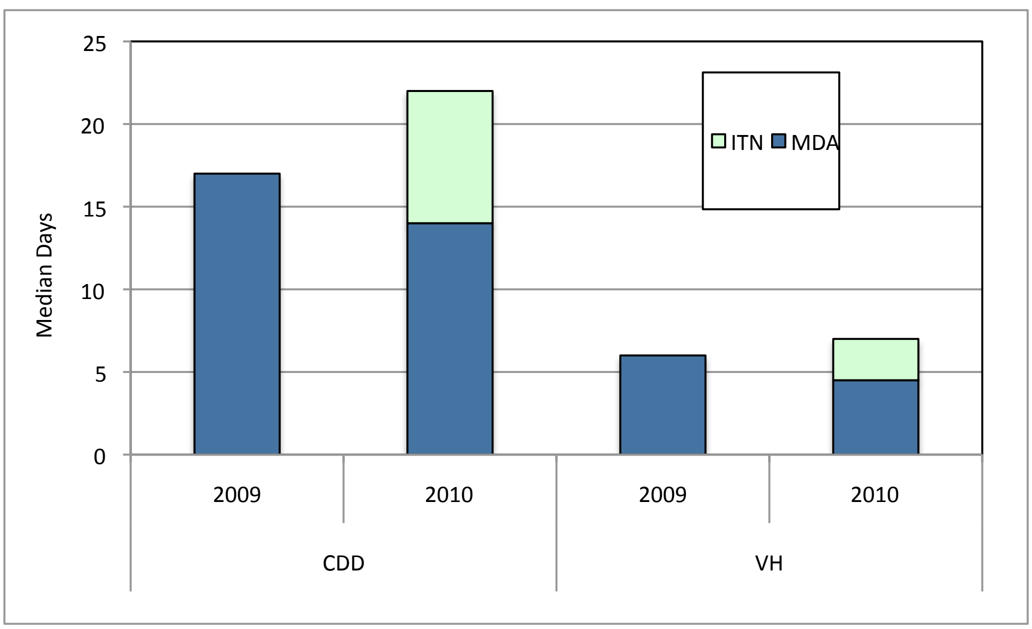


Table 7. Comparison of Median Days by Distribution Type (2010)

Position	Distribution Type	Median Days	Mann–Whitney U	Median Personal Costs	Mann–Whitney U
CDDs	MDA only	14	z=-7.7, p=<.001	800 NGN	z=-5.0, <.001
	MDA+ITN	27		2200 NGN	
VHs	MDA only	5	z=5.1, p=0.01	600 NGN	z=2.8, p=.005
	MDA+ITN	9		1930 NGN	

Total Value of Economic Costs

Using our lower and upper bound estimates of the value of a volunteer work day, we calculated the value of each respondents' time inputs (Figure 9). Lower bound values were then summed with personal financial costs to produce a conservative estimate of the total economic value of all inputs provided by each respondent. For inputs associated with NTD control, the median estimated economic value over both years was 3247 NGN ($21.76) among CDDs and 1594 NGN ($10.68) among VHs. A modest downward trend was observed from 2009 to 2010 (Figure 10). Among those respondents who reported doing ITN distribution in 2010, median values were 7678 NGN for CDDs ($51.46) and 3928 NGN ($19.60) for VHs.

Estimations of the combined economic costs incurred in the study population were made by multiplying median economic costs by the number of CDDs and VHs in the population. The economic value of all inputs to NTD activities was estimated at 8.89 NGN ($.06) per treatment distributed (Figure 11). Per community, these costs were estimated at 10,832 NGN ($72.60) (Figure 12). When inputs for ITN activities were included in 2010, economic costs per community were estimated at 18,815 NGN ($126.10). The sum total of economic costs incurred by communities in the study area was estimated at 38,736,745 NGN ($259,630) per year for NTD activities, and 50,358,996 ($337,527) for NTD and ITN activities combined in 2010. If the upper bound value for opportunity costs is used, our estimate of total economic costs would be

48,776,122 NGN ($326,918) per year for NTD activities, and 61,821,283 NGN ($414,351) for NTD and ITN activities in 2010.

Figure 9. Median Value of Opportunity Costs for NTD Activities by Valuation Method and Year, Per Treatment Distributed

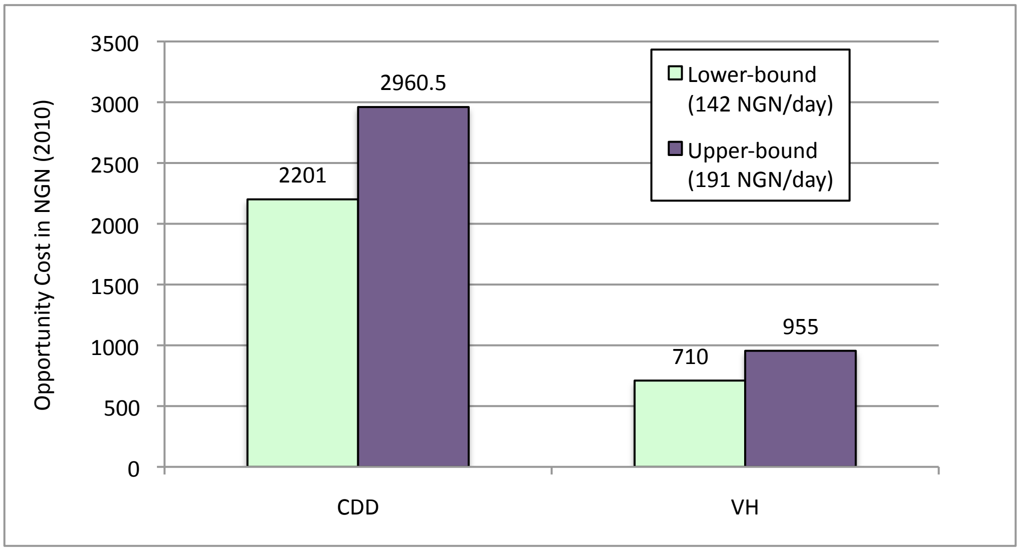


Figure 10. Median Economic Value of All Inputs to NTD Activities by Year (Time Valued at International Poverty Line)

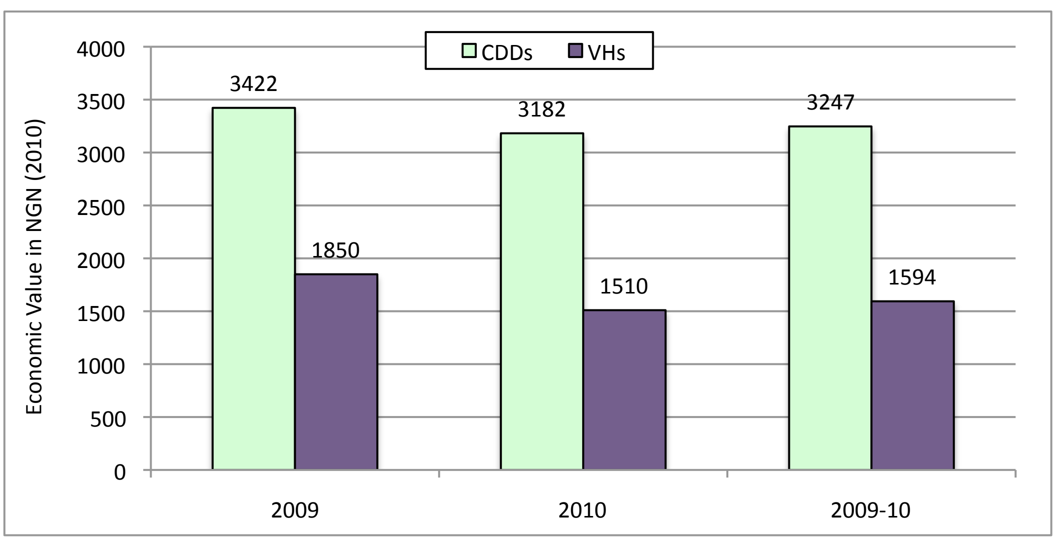


Figure 11. Median Economic Costs per Treatment Distributed by Year (Time Valued at International Poverty Line)

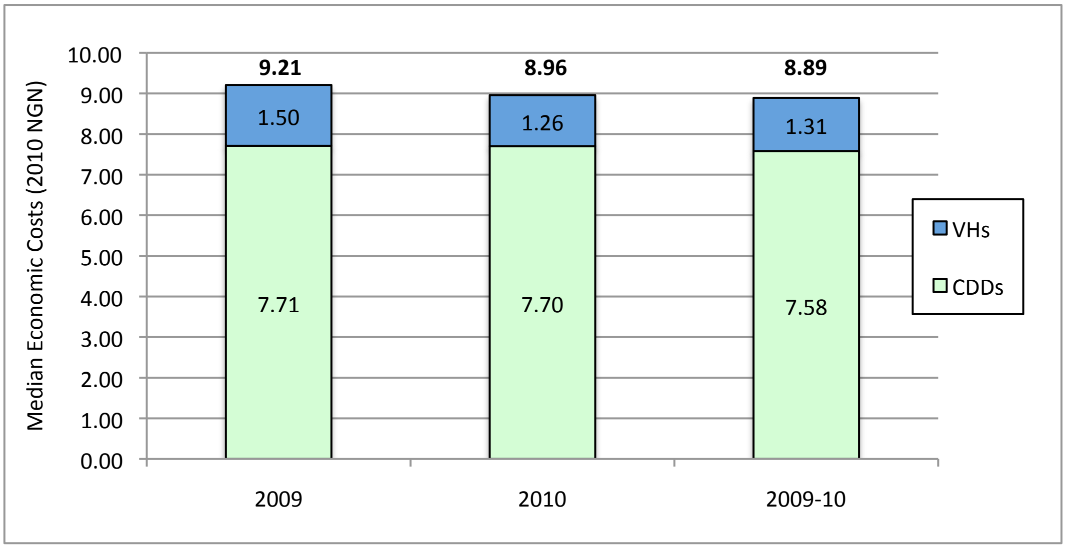
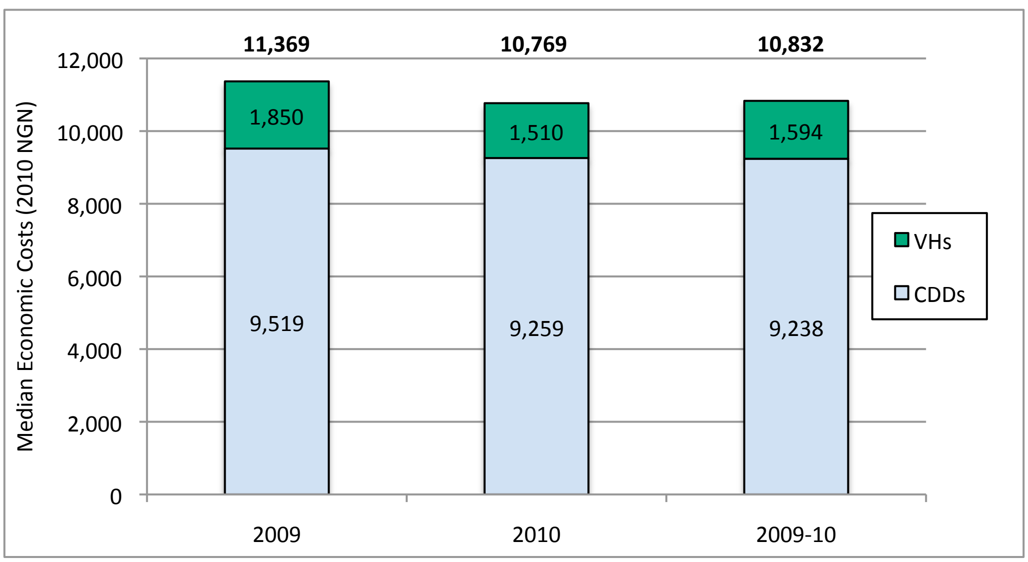


Figure 12. Median Economic Costs for NTD Activities per Community by Year (Time Valued at International Poverty Line)



Chapter 5

Discussion

The goal of this study was to quantify the economic costs of community resources provided to an integrated NTD program by explicitly employing a community perspective. CDDs and VHs in our sample reported wide-ranging financial and opportunity costs associated with NTD treatment and ITN distribution activities. Relative to VHs, CDDs supplied the great majority of inputs to the program.

Our study found that opportunity costs incurred during NTD activities were similar although somewhat lower than those reported in previous studies. McFarland *et al.* (2005) found that CDDs worked an average of 33 days on onchocerciasis MDA, and Welter (2009) found that CDDs worked an average of 30 days on integrated MDA. As these studies reported means rather than medians, we can compare their results to the mean of 19 days spent on NTD activities found among CDDs in our study.[10] Our findings on the allocation of time to different programmatic activities were generally consistent with those of McFarland *et al.* (2005), with CDDs spending most time on drug distribution, followed by mobilization activities, and VHs contributing most to mobilization followed by monitoring and evaluation. However, respondents in our study spent a smaller proportion of time on census taking, and VHs' contributions to mobilization activities were less significant. It is important to note that methodological differences between the studies make comparisons difficult to interpret. Welter's (2009) study relied on purposive sampling and a small sample size, and was thus not designed to be representative of the population, and McFarland et al. (2005) focused on a different, and more geographically diverse,

[10] Although the median is a better measure of central tendency in our data, we present the mean here for the purposes of comparison with previous studies.

study population.

Between the two study years, we found a statistically significant downward trend in time inputs reported by CDDs for NTD activities, which was particularly pronounced in (but not exclusive to) those LGAs that transitioned from dual rounds to a single round of MDA. These findings are consistent with the hypothesis that integration of standalone interventions can lead to modest decreases in workloads for community volunteers. The overall downward trend in opportunity costs associated with NTD activities also suggests that efficiencies in the use of community resources may be achieved as the program matures, although the precise drivers remain unclear.

However, when we also considered inputs related to large-scale ITN distribution in 2010, we found that participating CDDs worked nearly twice as many days (27) as their counterparts who did not (14), with a similar trend observed among VHs. The inclusion of this data also led to increases in the average number of days worked by all respondents between 2009 and 2010, rather than to decreases (Figure 8). Unlike schistosomiasis treatment, ITN distribution was not previously part of the intervention package and was not meaningfully integrated with the other interventions in 2010. Although it is unsurprising that the scale-up of ITN distribution led to increased responsibilities for CDDs and VHs, our findings highlight the importance of the distinction between the introduction of new tasks and the substantive integration of preexisting ones. Further integration of ITN distribution with MDA activities may attenuate the observed increase in CDD and VH opportunity costs.[11]

The majority of respondents reported personal financial costs associated with NTD activities, which on average amounted to 800 NGN ($5.36) among CDDs, and 609.5 NGN

[11] It should also be noted that ITN distribution at the scale conducted in 2010 will not be conducted annually.

($4.09) among VHs. In contrast to opportunity costs, personal financial costs increased significantly from 2009 to 2010. This trend underscores the importance of assessing both types of costs, as gains in one can be cancelled out by reductions in the other. Respondents who conducted ITN distribution in 2010 reported additional financial costs of about 900 NGN on average, and had total median financial costs about three times those of respondents who only participated in MDA. Thus, ITN distribution was associated with increases in both opportunity and financial costs.

When we assigned a monetary value to respondents' time, we found the value of opportunity costs to be nearly three times that of financial costs among CDDs. By combining financial and opportunity costs, we were able to estimate the total value of all inputs donated by communities. Although the value of these resources appears modest on a per treatment basis (9 NGN, or $.06, per treatment distributed), it is likely to be significant to community volunteers, and in particular to CDDs. The average CDD in our study contributed resources valued at 3247 NGN ($21.76) to NTD interventions, and those also involved in ITN distribution contributed an average of 7678 NGN ($51.46). In the average community, CDDs and VHs provided combined resources worth 10,832 NGN ($72.6) for NTD activities, or 18,815 NGN ($126.10) for NTD and ITN activities together. When projected to the study population, we estimated that communities contributed inputs worth a total of 38,736,745 NGN ($259,630) per year for NTD activities, and 50,358,996 ($337,527) for NTD and ITN activities combined in 2010.

The relative burden that these costs represented for respondents' is unknown, as our study did not collect data on income or expenditure. However, according to a recent Nigerian Bureau of Statistics Report (National Bureau of Statistics (Nigeria), 2012), the majority of individuals in

Plateau and Nasarawa live below the absolute poverty line of 149 NGN per day (or about $1).[12] For a CDD living at this poverty line, our lower-bound estimate of the average value of resources provided to NTD activities would be equivalent to 6% of his or her annual expenditures, or 14% if ITN activities are included.

We found that many CDDs were able to offset some of these high costs through the support of community members. The majority of CDDs (69.8%) in our study received some type of community support, with cash being the most frequent type of support (Table 6). This finding is consistent with previous evidence of high rates of community material and financial support of CDDs involved in MDA (Amazigo et al., 2007; Welter, 2009), as well Carter Center programmatic reports indicating that the majority of communities provided financial incentives to CDDs in 2009 and 2010 (The Carter Center, 2009b, 2010). We observed that community support increased between the two study years, possibly in response to the increased burdens imposed on CDDs by ITN distribution responsibilities. However, we estimated that the level of support that the majority of CDDs received from communities was equivalent to 25% or less of their total economic costs.

Areas of further study

This study was not designed to investigate non-material forms of compensation, such as exemption from communal labor, and thus it is unknown if these played an important role in compensating CDDs in the study population. Nor did we investigate the program's benefits to community members. For a community as a whole, these may include improvements in health and productivity. Additionally, communities' participation may strengthen their relationship

[12] Poverty was measured in terms of household consumption expenditure per capita.

with the health system and enhance trust in health services. For CDDs, qualitative research suggests that there may be a number of intangible benefits to volunteering, including the status of the position; the potential to acquire knowledge, credentials and contacts that could lead to paid work; and the positive feelings gained from providing a beneficial service to the community (Amazigo et al., 2007; Wallace, 2005; Welter, 2009). Such intangible benefits may help explain many volunteers' willingness to continue serving.

Although qualitative evidence from the study area in 2009 suggested that attrition was relatively infrequent (Welter, 2009), better data on attrition are needed to monitor the impacts of programmatic changes. If demands on CDDs increase without commensurate increases in incentives, we would expect CDD attrition to rise and performance to suffer, thereby negatively impacting program sustainability. Community cost data, such as that collected in this study, should be compared with data on attrition and performance to explore the relationships between these factors. Further qualitative and quantitative studies are also needed to better understand the causes of the wide variability in opportunity and financial costs faced by community volunteers. Potential causes could be identified by comparing volunteers with high and low levels of costs on a number of community level factors, including the geographic dispersion of community members; programmatic factors, such as the date of distribution; and individual factors, including age, level of education, and involvement in other healthcare activities. The collection of GPS data could also allow for the identification of spatial trends.

Future studies of the economic costs of community volunteers would benefit from collecting data from all volunteers within randomly selected communities. This would enable better estimates of communities' total costs and would provide a more accurate picture of how costs are distributed within communities. Although our data suggest that integration contributed to modest gains in efficiency, studies are needed to identify whether there are diminishing returns to integration from the perspective of communities.

Recommendations

The community-directed model developed by APOC has been promoted as a cost-effective platform for the integration of multiple interventions (CDI Study Group, 2010; Homeida et al., 2002). However, our findings suggest that further efforts to add interventions to community-directed NTD programs should proceed with caution so as not to burden marginalized communities with undue financial and opportunity costs. Additionally, strategies should be identified to increase efficiency and reduce the amount of time expended by CDDs. Methods of compensating CDDs for their valuable labor without compromising programs' financial viability should also be explored, particularly in programs seeking to expand the roles of CDDs. Such compensation may offer the dual benefits of improving worker motivation and enhancing communities' economic security. It would thus be consistent both with WHO recommendations for task-shifting (WHO, 2007) and the vision of integrated NTD programs as a strategy for breaking the cycle of poverty and disease in low-income settings (P. J. Hotez, Fenwick, Savioli, & Molyneux, 2009). Ultimately, ministries of health should play a stronger role in harmonizing the use of incentive strategies for CHWs, thereby avoiding redundancies and competition between NTD programs and other vertical programs that use CHWs. Improved coordination and compensation of CHWs would also be in line with increasing calls for their integration into the formal health system "as a trained and paid corps" with expanded responsibilities (Singh & Sachs, 2013). Of course, making the vision of scaled-up salaried CHWs a reality will likely require substantial and sustained commitments from international donors.

Conclusion

In conclusion, we have shown that significant economic costs were imposed on communities participating in an integrated NTD program. CDDs in particular bore the brunt of these economic costs, although community support played a role in redistributing them more broadly. We have also shown that, while integration of preexisting interventions may have contributed to reductions in communities' economic costs, the addition of a new intervention had the opposite effect. This finding raises the question of whether NTD programs can expand the range of services they provide while relying on a community-directed volunteer model. Overall, our analysis highlights the importance of considering the value of limited community resources in the planning, monitoring and evaluation of CHW programs.

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Appendices

Appendix A. Community Inputs Survey Instrument

Community Inputs

Investigator Name	Date (Month / Year)
LGA / Village	# of HH covered by CDD
CDD or Village Head name	
Position (eg village head, Community Directed Distributor)	Highest level of education

Does the village provide anything else needed by the project? Who exactly provides it, and how often? What was the item(s) used for (referring to the same activity categories mentioned on the first page)?

Item/Source	Cost	How often?	Activity Used for:

(Continued on next page)

Enter each intervention which occurred last year in each column. If integrated, enter time/cost in one column and INT in neighboring column.

Please indicate how you spent your time, by listing the number of days or part-days and personal spent on each of the activities listed below:

Intervention code	TDA	IVR/ALB	PZQ	ITN	VAS	TRA
Attending training						
Were there any personal costs? If yes, how much?						
Mobilisation and Sensitisation						
Were there any personal costs? If yes, how much?						
Collecting the drugs						
Were there any personal costs? If yes, how much?						
Giving out the drugs to the community						
Were there any personal costs? If yes, how much?						
Collecting the census						
Were there any personal costs? If yes, how much?						
Monitoring and Evaluation						
Were there any personal costs? If yes, how much?						
Reporting to NTD Project						
Were there any personal costs? If yes, how much?						
All other administration						
Were there any personal costs? If yes, how much?						
Other project activities (describe)						
Were there any personal costs? If yes, how much?						