Assessing the Impact of Leveraging Traditional Leadership on Access to Sanitation in Rural Zambia

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Abstract. Open defecation is practiced by more than one billion people throughout the world and leads to significant public health issues including infectious disease transmission and stunted growth in children. Zambia implemented community-led total sanitation (CLTS) as an intervention to eliminate open defecation in rural areas. To support CLTS and the attainment of open defecation free communities, chiefs were considered key agents of change and were empowered to drive CLTS and improve sanitation for their chiefdom. Chiefs were provided with data on access to sanitation in the chiefdom during chiefdom orientations prior to the initiation of CLTS within each community and encouraged to make goals of universal sanitation access within the community. Using a survival regression, we found that where chiefs were orientated and mobilized in CLTS, the probability that a village would achieve 100% coverage of adequate sanitation increased by 23% (hazard ratio = 1.263, 95% confidence interval = 1.080–1.478, $P = 0.003$). Using an interrupted time series, we found a 30% increase in the number of individuals with access to adequate sanitation following chiefdom orientations (95% confidence interval = 28.8–32.0%). The mobilization and support of chiefs greatly improved the uptake of CLTS, and empowering them with increased CLTS knowledge and authority of the program in their chiefdom allowed chiefs to closely monitor village sanitation progress and follow-up with their headmen/headwomen. These key agents of change are important facilitators of public health goals such as the elimination of open defecation in Zambia by 2020.

INTRODUCTION

Open defecation is practiced by approximately one billion people (14% of the world's population) globally and an estimated 35% of people in developing countries.¹ The United Nations Sustainable Development Goals have targeted the elimination of open defecation by 2030. Open defecation enables the transmission of fecal pathogens through contaminated water, soil, food, or vectors such as *Musca sorbens*.² These transmission pathways account for a large proportion of diarrheal disease (bacterial, viral, and parasites), soil-transmitted helminths, and trachoma, as well as other illnesses,³ which not only contribute to an estimated 11% of all-cause child mortality globally⁴ but also stunt child growth and retard cognitive development.^{5,6} In addition to improved health benefits, the elimination of open defecation worldwide would lead to an estimated cost savings of more than \$150 billion per year.²

In Zambia, 14.7% of all households and 24.0% of rural households have no access to toilet facilities and report using the bush, for example, open land or agricultural fields, for defecation.⁷ The Zambia Ministry of Local Government and Housing (MLGH) has adopted community-led total sanitation (CLTS) as an intervention to improve access to and consistent usage of improved sanitation facilities in rural areas. CLTS is a subsidy-free behavior change intervention introduced by Kamal Kar in rural Indian communities in late 1999–2000. According to the CLTS handbook, “CLTS entails the facilitation of the community's analysis of their sanitation profile, their practices of defecation and the consequences leading to collective action to become Open Defecation Free (ODF).”⁸

The intervention leverages shame, disgust, and fear within the community to encourage ending open defecation. The term “Community-Led” refers to the idea that change within the community should be intrinsically motivated and produced without any inputs or subsidies provided externally. “Total Sanitation” refers to the idea that sanitation not only focuses on latrines, but is inclusive of other hygiene practices such as keeping the environments around the dwelling clean, penning animals, and having an area for bathing and washing clothing, though in Zambia the focus has been on sanitation. To accomplish its principles, CLTS uses a three-pronged approach that engages technical experts (government and non-governmental organization staff), civic or political leaders (elected counselors), and traditional leaders (chiefs and headmen/headwomen).

Herein, we examine how the engagement of chiefs specifically impacted community-level access to sanitation in rural Zambia during the implementation of a CLTS intervention. In rural areas of Zambia, chiefs play a pivotal role in reinforcing community behavior and setting norms. There are a total of 288 chiefdoms in Zambia, or nearly five chiefdoms per each rural district. With a 2015-projected rural population of approximately 9,000,000, each chiefdom has an average population of roughly 30,000 and 6,000 households. Zambian Chiefs generally serve for life and come to power in a variety of ways, including through inheritance, general election, or appointment by a council of elders. The majority of chiefs are men; however, women chieftainesses are also present in the country. Primary chief duties in Zambia include the distribution of communal land, the administration of justice, and the organization of communal projects, all of which make chiefs powerful figures in rural Zambian communities. Although unable to run for office directly, chiefs in Zambia are politically powerful, often seen as gatekeepers for parliamentary elections.⁹ Each village in a chiefdom is led by a headman or headwoman, and each headman or headwoman reports directly to the chief.

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METHODS

CLTS intervention. In Zambia, community members are identified to serve as volunteer community champions (CCs) to “trigger” villages and change their open defecation practices through teaching the negative health, financial, and social effects of poor household and community sanitation. CCs work closely with village-level volunteer sanitation action groups and health-facility-based environmental health technicians to monitor sanitation. In 2013, the Zambia MLGH implemented a real-time mobile-to-web information management system to monitor rural water supply and sanitation conditions across the country.¹⁰ Between 2013 and 2015, 1,500 volunteer CCs were trained to report household population and sanitation data from more than 15,000 villages through the District Health Information Systems 2 (DHIS2, Oslo, Norway) software. These data are limited to village population, number of households, latrines, and four parameters related to latrine adequacy: smooth cleanable floor; lids on top of the hole; superstructures providing privacy; and hand washers with soap or ash and water. In the monitoring system village-level sanitation action groups collect household-level information monthly on paper-based forms. Specifically they determine the number of household members, whether that household has a latrine, and whether that latrine has the four parameters. CCs then report monthly aggregated village-level numbers into DHIS2. (CCs are responsible for reporting on 10–20 villages each month). District and provincial health teams then have access to these data and can either drill down to specific village level or aggregate to any level in the geopolitical hierarchy. Once a village reports 100% coverage of latrines with all adequate parameters for three consecutive months, a verification visit may occur. Because of the scale of the program and limited funds only a convenience sample of verification visits occur; however, > 90% of villages visited during a verification visit are certified as having 100% coverage of adequate sanitation.

Chiefdom orientations. Chiefdom orientations were held to sensitize chiefs to CLTS and the importance of attaining 100% coverage of adequate sanitation as well as to educate them on the sanitation access within their chiefdoms. During chiefdom orientations, sanitation access within the chiefdom and within specific villages was compared with neighboring chiefdoms and presented during chiefdom orientations. Several stakeholders were invited to chiefdom orientations: village headmen/headwomen, sanitation action group chairpersons, CCs, environmental health technicians, district representatives, and the chief or chieftainess. The orientations also served to clarify individual and group roles and responsibilities, specifically the role of the volunteer CCs in collecting and submitting data through the mobile to web database. During chiefdom orientations, chiefs or chieftanesses publicly recognized the CCs to underscore the significance of the role to all stakeholders. At the end of an orientation, with more knowledge about CLTS and how to achieve open-defecation free status, each village headperson works with their designated CC to set sanitation targets.

Chiefdoms were selected for an orientation based on the following criteria: 1) chief has demonstrated engagement and commitment in other program areas through activities such as ongoing follow-ups with village headmen/headwomen or village spot checks and 2) chiefdom is not currently in

dispute over leadership. Since the chief’s buy-in and support are integral to maintain reporting rates and increase latrine propagation, it was essential to select chiefdoms where the chief was respected and had demonstrated support of other social programs for the benefit of the chiefdom.

Data. Sanitation data used in this analysis were retrieved from the MLGH sanitation monitoring system (DHIS2) described previously. Program records were also used to determine when a chiefdom orientation occurred and classified the months after a chiefdom orientation as having chief involvement and the months before a chiefdom orientation as having no chief involvement. Figure 1 shows the geographic distribution of districts that participated in the water, sanitation, and hygiene mobile-to-web reporting system and were included in this analysis.

Analysis. We examined the impact of involving chiefs using two separate outcomes and analyses. First, we defined a village achieving universal household adequate latrine access as that village having an improved latrine for every household that is not shared, that is, each household had a latrine with a superstructure for privacy, a smooth and cleanable floor, a lid to cover the hole, and a handwashing station with water and either soap or ash. We then conducted a time-to-event analysis of villages reaching 100% coverage of adequate latrines. We compared universal latrine access achievement with and without chiefdom orientations first with a log-rank test and then with a Cox proportional hazards model after accounting for chiefdom as a shared frailty and both village size (quintiles) and province as covariates. Villages not achieving 100% coverage of adequate latrines were included in the analysis and censored following the last month they reported into the data system. Using chiefdom as a shared frailty in these models accounts for variation between chiefdoms that are not measured in the available data. In the data used in the analysis, there were a total of 72 chiefdoms, 56 of which received a formal chiefdom orientation.

Second, we defined individuals as those with newly acquired household-level latrine access if they lived in a household that constructed a latrine after the household entered the monitoring system. (Households with latrines prior to the beginning of the monitoring system yielded no new users.) We removed outliers (further than three standard deviations from the mean) and log-transformed individuals with latrine access to account for right skewed data. We compared the log-transformed individuals with latrine access at the village level with and without chiefdom orientation using a mixed effects segmented linear regression with village as a random intercept. We adjusted the correlation coefficient to be autoregressive with a lag of one to account for temporal trends. As part of the interrupted time series we included the following covariates: time (sequential), postintervention time (zero for all time points before the intervention and sequential for time points following), and a postintervention group (zero for all time points before the intervention and one for all time points after the intervention). Villages in chiefdoms that never received an orientation were included in the model to account for unknown time-varying confounders. We also included a covariate of village size classified into quintiles. The bootstrap method conservatively estimated standard errors. All analyses were conducted in Stata, version 13.1 (College Station, TX); all models were conceptualized a priori.

RESULTS

Between August 2013 and July 2015, 1.15 million people had access to sanitation facilities following CLTS activities (Figure 2). During the period May 2014–July 2015, we conducted 56 chiefdom orientations across 20 districts where the total number of chiefdoms is 72. Among these chiefdoms the number of villages per chiefdom ranges from 6 to 509, with a median of 102. Of these chiefdoms, during the stated analysis period, three reached universal coverage of adequate latrine access and four more had a mean village universal coverage attainment of 95%. Since running the analysis and writing this paper, an additional seven chiefdoms reached universal coverage in the 20 districts.

Time-to-event analysis. Between August 2013 and July 2015, a total of 3,137 villages of the 10,932 that were first entered into DHIS2 achieved universal coverage of adequate latrine access. Among villages reaching universal coverage, time to reaching ranged from 3 to 23 months, with a median of 12 months. The Cox proportional hazard model of 10,932 villages and 72 chiefdoms found that after chiefdom orientation the probability of villages reaching universal coverage increased by approximately 23% (Table 1). Smaller villages were more likely to reach universal coverage than larger villages. Variation in the probability of a village achieving universal coverage was also demonstrated at the provincial level,

with villages in Central Province most likely to reach universal coverage during the period and villages in Lusaka Province least likely to achieve universal coverage during the period.

Interrupted time series. The interrupted time series results indicate that the chiefdom orientations were associated with a 30.4% increase in the number of individuals with household-level latrine access after accounting for temporal trends (95% confidence interval [CI] = 28.8–32.0%) (Table 2) suggesting that orientating chiefs in the CLTS surveillance program had a large impact on individual access to sanitation. Before chiefdom orientations, the number of individuals with household-level latrine access increased 3.0% per month (95% CI = 2.8–3.1%). Immediately following the 30% increase from chiefdom orientations, the rate of increase in the number of individuals with household-level latrine access decreased to 2.2% per month (95% CI = 1.8–2.5%).

DISCUSSION

Following the empowerment of chiefs through increased CLTS knowledge and elevated CC status in the chiefdom via chiefdom orientations, access to sanitation greatly improved in rural Zambia. Chiefdom orientations have proven to be a powerful tool in not only directly engaging chiefs, but also leveraging their traditional influence to improve behavior change practices at village level. In this case, chiefdom

FIGURE 1. Map shows the districts operating community-led total sanitation (CLTS) in August 2015 and included in the analysis. Since drafting of this article, CLTS has expanded to approximately two-thirds of the country of Zambia. This figure appears in color at www.ajtmh.org.

FIGURE 2. Monthly village median number of number of individuals with household-level access to adequate sanitation following CLTS before and after chiefdom orientations for villages receiving the chiefdom orientation (intervention) and those not receiving the chiefdom orientation (control). This figure appears in color at www.ajtmh.org.

orientations increased CLTS knowledge, elevated the perception of CCs within chiefdoms, and contributed to the improvement in access to sanitation. Although chiefs in Zambia are aware of the CLTS program,¹¹ the chiefdom orientations provide a powerful event to bring all the key stakeholders together to discuss and plan for increasing access to sanitation. Most importantly, the orientations create accountability: village headmen/women set sanitation targets and present their targets to the chief, thus providing the chief

a benchmark with which to measure progress. With continued follow-up throughout the chiefdom after the orientations, the probability of a village achieving universal coverage of sanitation increased by 23% and the number of individuals with to household-level latrine access increased by 30.4%.

Chiefdom orientations were enhanced by accurate data demonstrating access to latrines within the chiefdoms and also within specific villages. The mobile-to-web monitoring system for CLTS provided the backdrop for chiefs and village

TABLE 1

Results from a survival regression assessing the association between chiefdom orientation and the probability of a village achieving universal sanitation coverage

Factor		Hazard ratio (95% CI)	P value
Chiefdom orientation	Before orientation	Reference	Reference
	Postorientation	1.263 (1.080–1.478)	0.003
Village size	< 15 houses	Reference	Reference
	15–23 houses	0.750 (0.673–0.836)	< 0.0001
	24–34 houses	0.660 (0.589–0.739)	< 0.0001
	35–53 houses	0.530 (0.471–0.596)	< 0.0001
	> 53 houses	0.372 (0.327–0.424)	< 0.0001

CI = confidence interval. The model accounted for different chiefdoms through a shared frailty and province through a covariate. *N* (villages) = 10,932; *N* (chiefdoms) = 73.

TABLE 2

Results from interrupted time series regression assessing the association between log-transformed individuals with household-level latrine access before and after involving chiefs and traditional leaders via chiefdom orientations

	Factor	Coefficient (95% CI)	P value
Monthly trend	Before or without orientation	0.0295 (0.0283 to 0.3068)	< 0.0001
	Postorientation	-0.0081 (-0.0103 to -0.0059)	< 0.0001
Period	Before or without orientation	Reference	Reference
	Postorientation	0.3038 (0.2876 to 0.3200)	< 0.0001

CI = confidence interval. The model accounted for different chiefdoms through a covariate and for correlated data at the village level using a random intercept. *N* (villages) = 10,304.

headmen to understand that they would be held accountable to achieving universal sanitation coverage. During numerous chiefdom orientations, village headmen declared that their village would be the first to achieve universal coverage within the chiefdom, and chiefs declared that their chiefdom would have universal coverage before their rival neighbors. The mobile-to-web monitoring system also provided data that empowered chiefs and village headmen to accompany the progress of their respective chiefdoms and villages to achieving universal coverage. Unfortunately, these analyses were conducted with data from the mobile-to-web system so we cannot separate the impact of accurate monitoring from the chiefdom orientation. As a result chiefdom orientations may not have been as effective without accurate monitoring through the mobile-to-web surveillance system.

Access to latrines has been associated with decrease in the transmission of soil-transmitted helminths.^{12,13} Thus, the 23% improvement in villages achieving universal sanitation coverage was particularly encouraging for the control of soil-transmitted helminths, which requires high coverage of sanitation to ensure that eggs are no longer present in the environment.^{14,15} Furthermore appropriate disposal of excreta and handwashing practices have also been shown to decrease diarrheal diseases.^{16,17} In Mali, CLTS led to a 26% reduction in the prevalence of stunting in children under 5 after just 2 years,¹⁸ and we are planning research to examine the specific impact of increased access to sanitation through CLTS on health outcomes in Zambia.

Health interventions aimed at changing health behavior without addressing the underlying culture that reinforces and facilitates the targeted behavior are likely to face serious challenges in actually changing the targeted health behavior.¹⁹ By giving chiefs knowledge, a voice in CLTS and control over CLTS progress in their chiefdom, we leveraged the positive aspects of traditional society in rural Zambia and have seen the first district in Zambia achieve universal coverage of access to adequate sanitation.²⁰

The influence that chiefs have on culture and village-level behavior change may in part be tied to the communal model of land ownership,²¹ which in some parts of sub-Saharan Africa is actually seen as an obstacle to economic development.^{22,23} Traditional leadership throughout sub-Saharan Africa has come under scrutiny since colonial rule when colonial powers manipulated the traditional leadership structure to maintain control over colonies.²⁴ Some scholars have suggested that traditional leadership is incompatible with democracy,^{25,26} whereas others argue that traditional leadership enhances a new hybridization of African-style democracy.²⁷ Our experience has illustrated that the inclusion of chiefs in public health programs is a powerful approach to elicit change within communities. Public health interventions that seek to change behavior and even culture need to be aware of the agents of

change in the community, and throughout sub-Saharan Africa traditional leaders hold great influence.

The improvements in access to sanitation we observed in Zambia following the empowerment of chiefs are similar to successes observed by other health programs that have worked with chiefs. For example, a separate study in Zambia found that including chiefs in the design of an umbilical cord care randomized trial led to 96% of births receiving a visit within 48 hours.²⁸ Public health programs working together with chiefs, however, must recognize that these chiefs are not value neutral and often have strong opinions.²⁹ For example, an human immunodeficiency virus/acquired immunodeficiency syndrome program in South Africa found chief's views on attitudes toward women and youth as well as celebration of polygamy to undermine the project's aim of "empowerment via participation."³⁰ Still, not including chiefs in the implementation of health interventions may lead to barriers and delays as witnessed in the efforts to regularize male circumcision in Uganda.³¹

These analyses were limited by the data collected during CLTS monitoring,¹⁰ which unfortunately do not include any measures of socioeconomic status that might affect latrine uptake. The data came from a government information system, systems which are known to have pitfalls including reporting rates and operational definitions.³² This system does not likely suffer from issues with operational definitions, as only seven separate data elements are reported and definitions are quite simple. Also reporting rates in this system are quite high; > 85% of the villages in the system report monthly suggesting that the data are quite robust. Social desirability bias may influence the falsification of latrine data, and pressure from traditional chiefs could potentially enhance that falsification. Therefore these results should be taken cautiously.

Actual use of latrines is not measured in the information system and so could not be included in the analysis. Access to sanitation does not necessarily mean utilization as various studies have shown.^{33–35} With our measures of latrine access, the latrine is improved with the four parameters of a smooth and cleanable floor, a lid to cover the hole, a superstructure for privacy, and a handwashing station with either soap or ash. These types of components have been identified as key parameters to increase measured latrine use and other CLTS programs have been found to increase measured latrine use.³⁶ Further evaluation is needed to measure the extent of latrine use in the context of the Zambian CLTS intervention.

Chiefdoms were not selected for orientation at random, and those that did receive orientation were more engaged in their villages and were not involved in leadership disputes. In the interrupted time series analysis, we included chiefdoms that were never oriented to serve as a counterfactual; however, this inclusion may have biased results because of inherent

differences between chiefs receiving and not receiving orientations. We conducted a sensitivity analysis by excluding the chiefdoms never receiving orientations and found little difference in the magnitude or direction of effect.

Although the chiefdom orientations facilitated CLTS knowledge and clarified stakeholder roles, routine access to data on sanitation access within the chiefdom may also be powerful for chiefs. To address this gap and further engage chiefs, we have developed a Chiefdom Visualizer Application that allows chiefs to view sanitation progress by village and compare their progress against other chiefdoms throughout the country. The application is loaded onto a tablet, which allows chiefs to easily view charts, maps, and graphs, and syncs with the DHIS2 weekly to display updated data. This is a new initiative that builds on the power of knowledge by increasing data accessibility and creating competition in moving toward universal sanitation coverage, and its impact on universal sanitation coverage will be measured over time as the CLTS mobile-to-web reporting will be scaled up to the remaining 68 rural districts across Zambia by 2017.

The Ministry of Chiefs and Traditional Affairs have been taking CLTS one-step further by linking it to traditional ceremonies, encouraging clean village competitions, and identifying chief's spouses as handwashing ambassadors. In addition to empowering chiefs through chiefdom orientations and increasing their access to data, these social mechanisms can create greater community awareness of CLTS.

The great improvements in access to sanitation seen in the Zambian CLTS program following the empowerment of chiefs bring great optimism in improving sanitation across rural Zambia. Empowering effective agents of change like traditional leaders with knowledge will enhance community-led initiatives such as CLTS to propel the world toward an open defecation free 2030.

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