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Beyond Distance: An Approach to Measure Effective Access to Case Management for Sick Children in Africa

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Abstract. Health planners commonly use geographic proximity to define access to health services. However, effective access to case management requires reliable access to a trained, supplied provider. We defined effective access as the proportion of the study population with geographic access, corrected for other barriers, staffing patterns, and medicine availability. We measured effective access through a cross-sectional survey of 32 health facilities in Malawi, Mali, and Zambia and modeled the potential contribution of community case management (CCM). The population living within Ministry of Health (MOH)–defined geographic access was 43% overall (range = 18–52%), but effective access was only 14% overall (range = 9–17%). Implementing CCM as per MOH plans increased geographic access to 63–90% and effective access to 30–57%. Access to case management is much worse than typically estimated by distance. The CCM increases access dramatically, again if providers are available and supplied, and should be considered even for those within MOH-defined access areas.

INTRODUCTION

Malaria, pneumonia, and diarrhea remain the leading causes of death in children less than five years of age globally, despite the availability of effective and affordable treatments.[1–5] Children need reliable access to case management for these illnesses because they can become ill at any time and die quickly. Access is often defined and measured by Ministries of Health (MOHs) and program planners in geographic terms, namely distance to a health facility.[6,7] However, even families with geographic access can face other barriers such as those that are physical (mountains, rivers), temporary (flooding, rains), security, cultural, social and economic.[8,9] The normative definition of access better suits preventive than curative interventions because under-staffed and under-supplied facilities can serve as staging points for outreach teams that bring their own personnel to deliver interventions. However, to provide case management, a health facility must be open daily and for sufficient duration; staffed with persons trained to treat sick children; and supplied with essential frontline treatments.

There is no single agreed framework or even definition for access to health care.[8–11] Terms such as access, accessibility, and availability are used commonly but inconsistently.[11] Many theories and frameworks have been developed to better define and standardize what is meant by access to care, but none have been fully adopted.[9,11] A point of consistency across these various theories and framework is the notion that access to health care is multi-dimensional and requires interplay of demand and supply side factors.[8–11] In this study, we focused on the supply side, exploring factors that influence travel to a health facility and receiving treatment services once there.

We coined the term effective access to case management of child illness to mean access to a trained provider and to appropriate medicines. The primary purpose of our study was to measure levels of effective access to case management of child illness at health facilities in Malawi, Zambia, and Mali and to describe the influence of selected factors on effective access. A secondary purpose was to explore the potential contribution of community case management (CCM), in which community-based health workers (CBHWs) are trained and equipped to provide case management for common child illnesses closer to the home.

MATERIALS AND METHODS

Study site and context. The study was conducted in three districts, one each in Malawi, Mali, and Zambia, where Save the Children (SC) supports the MOH to improve integrated case management services at the community level (Table 1). All study areas are rural and under-served and have limited roads, public transportation, and electricity. Our study focused on public health facilities that provided case management services for children less than five years of age. The MOH definition of access to health care varied: ≤ 5 km (Zambia) versus ≤ 8 km (Malawi) versus ≤ 10 km (Mali). In Zambia and Malawi, facility-based health services were managed at the district level and provided free. In Mali, health facilities were managed by local health committees who charged user fees to deliver and maintain services. All three districts lacked private sources of standard case management. Data collection for the study was completed as part of routine programmatic activities and did not involve the collection of any individual identifiable data.

The design and implementation stage of CCM programs varied by country. In Malawi, the MOH was scaling up CCM through a cadre of paid, centrally recruited health surveillance assistants (HSAs) and targeting hard-to-reach areas (> 8 km from a health facility). In Zambia, CCM was delivered through unpaid community health workers selected by their communities, although the policy was under review. In Mali, the MOH recently created a new cadre of paid, CBHWs, Agents de Santé Communautaire, to deliver CCM supported through local health committees.

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TABLE 1
Characteristics of the study districts*

Parameter	Malawi	Mali	Zambia
District	Mulanje, Southern Region	Bougouni, Sikasso Region	Lufwanyama, Copperbelt Province
Population (source year)	525,429 (2008 census)	459,509 (2009 census)	87,592 (2010 census)
Size (population density/km^2)	2,056 km^2 (256)	20,028 km^2 (23)	8,774 km^2 (10)
Ministry of Health definition of access	≤ 8 km	≤ 10 km	≤ 5 km
Health facility infrastructure	23 facilities (1 district hospital, 1 mission hospital, 18 health centers, 2 dispensaries, and 1 maternity center)	140 facilities (1 district hospital, 34 health centers, and 105 maternity centers)	15 facilities (11 health centers and 4 health posts)
CBHW cadre for CCM	Health surveillance assistants (HSAs) centrally recruited and assigned to hard-to- reach areas (> 8 km from HF); Each HSA serves approximately 1,000–1,500 population	Newly introduced cadre Agent de Santé Communautaire recruited by local government/health committees to serve areas > 5 km from health facility and with a population of at least 1,500	CHWs and/or TBAs, both which are identified by communities, trained centrally for 6 weeks to serve hard to reach communities in clinic catchment areas. A CHW is expected to cater for a population of 1,000, and a TBA serves 500
Age group and conditions covered by CCM	Treat children 2–59 months of age for malaria (ACTs), pneumonia (cotrimoxazole) and diarrhea (ORS and zinc)	Treat children 2–59 months of age for malaria (ACTs), pneumonia (amoxicillin) and diarrhea (ORS and zinc)	Treat children 2–59 months of age for malaria (ACTs), pneumonia (amoxicillin) and diarrhea (ORS and zinc)
No. CBHWs trained in CCM at time of study	81	35	59

*CBHW = community-based health worker; CCM = community case management; HF = health facility; CHW = community health worker; TBAs, traditional birth attendants; ACT = artemisinin-based combination therapy; ORS = oral rehydration salts.

Study design and sampling. We conducted a cross-sectional assessment of health services in study areas, including all 15 health facilities in Lufwanyama, Zambia; all 10 health centers in the SC intervention areas of Mulanje, Malawi (representing approximately half the district population and health facilities); and all seven health centers in the health zones of Bougouni, Mali, where SC was implementing CCM (representing nearly one-third of the district's population).

Study tools and data collection. Save the Children staff collected data through structured interviews with the health facility in-charge and other staff during July–October of 2010 as part of baseline assessments and program planning. Relevant district authorities granted permission, and all respondents provided consent upon being informed of the study purpose.

We designed survey tools to collect the following information at each facility: number of staff trained in case management of childhood illness; number of hours during the previous week the trained staff was available (either on-site or on-call) to provide case management; and availability of first-line antimalarial drugs (artemesinin-based combination therapy), antibiotics (amoxicillin or cotrimoxazole) and oral rehydration salts. In Malawi and Mali, we determined the number of stockout days for each medicine in the last month. In Zambia, we observed availability on the day of the survey. Respondents also listed all villages in their catchment area, specifying for each total population, distance to health facility in kilometers, and presence of CBHWs providing CCM either then or in the near future. For villages with MOH-defined geographic access, we assessed other barriers that would affect reaching a health facility: permanent physical (mountains, rivers), temporary physical (flooding), and security (check-points, insecure areas). Permanent physical barriers referred to features such as mountains or rivers that increased travel time by foot (carrying a sick child) beyond the times implied by the MOH distance definitions (e.g. > 1 hour for 5 km, > 1.5 hours for 8 km, or > 2 hours for 10 km). For temporary physical or security barriers, respondents estimated the number of months per year that travel to the facility was affected.

Data analysis. Data were entered in Microsoft (Redmond, WA) Excel (Malawi/Zambia) and Microsoft Access (Mali) and analyzed by using Microsoft Excel. We defined geographic access as the proportion of the total study population living within the MOH-defined distance to a health facility. We then calculated an annualized adjustment factor to account for other barriers to reaching a health facility for this population. This factor was the proportion of annual person-months the population with official access actually had access to the facility after accounting for permanent and temporary physical barriers or security barriers. The denominator of annual person-months was the study population living within MOH-defined access areas multiplied by 12 months.

The numerator was the denominator minus the number of person-months over a 12 month period during which access was affected by any of the barriers. We then multiplied geographic access by the annualized adjustment factor to obtain adjusted geographic access.

We defined effective access as adjusted geographic access to a facility plus available trained staff, with available essential frontline medicines. Thus, effective access was the product of (adjusted geographic access) × (staff availability) × (medicine availability). Staff availability was the proportion of time one or more staff trained in case management was available. The numerator was the total number of hours a trained provider was available, within the denominator of the 84 hours defined by 8:00 AM to 8:00 PM seven days per week. The definition of medicine availability varied by setting. In Malawi and Mali, medicine availability was calculated as100% less the sum of reported stockout days in the past month for three essential case management medicines (artemisinin-based combination therapy, antibiotic, and oral rehydration salts) divided by a total of 90 potential stock-out days (three medicines × 30 potential stock-out days/medicine) expressed in percentage. In Zambia,

TABLE 2
Geographic and adjusted geographic access by study area

Parameter	Mulanje, Malawi	Bougouni, Mali	Lufwanyama, Zambia
Health facilities sampled	10	7	15
Study population*	269,305	147,095	119,799†
Population within Ministry of Health–defined access limits (access limit)	133,657 (≤ 8 km)	76,573 (≤ 10 km)	22,148 (≤ 5 km)
Geographic access	50%	52%	18%
Population affected by permanent physical barriers (no. months affected)	2,735 (12 months)	0	2,756 (12 months)
Additional population affected by temporary physical barriers (no. months affected)	802 (5 months)	1,498 (3 months) 1,363 (2 months)	0
Population affected by security barriers	0	0	0
Total no. person-months affected over one year	36,830	7,220	33,072
Annualized adjustment factor‡	98%	99%	88%
Adjusted geographic access	48%	52%	16%

*Based on facility estimates of their catchment population.
†Lufwanyama facilities use headcount figures for population estimates that tend to be higher than official census figures.
‡Calculated among the proportion of the population with geographic access. Denominator = population within Ministry of Health–defined access limits × 12 months; numerator = denominator – number of person-months affected by physical, cultural, or security barriers.

medicine availability was 100% less the sum of the number of health facilities with stockouts for each type of medicine divided by the total number of health facilities times the number of medicines (15 health facilities × same three medicines) expressed as a percentage. All access variables were calculated for each health facility and then for each study area by weighting each health facility's value according to its population size.

To explore the potential contribution of CCM, we calculated the proportion of the study population with potential geographic access and with potential effective access to case management once CBHWs trained in case management were deployed. In each study area, we used MOH data on the number and location of CBHWs already trained or scheduled for training in CCM. We ran two scenarios. The first assumed that deployed CBHWs would be available continuously and fully stocked with necessary medicines (ideal), and the second applied levels of likely availability of CBHWs (75%) and medicines (60%) based on data from separate monitoring studies conducted around the same time (U.S. Agency for International Development/Malawi Community Case Management Evaluation).

RESULTS

The catchment areas of the 32 surveyed health facilities included 541 villages with a population of 536,199. Our sample represents approximately half of the combined population of the three study districts. The impact of geographic and other factors that influence reaching a health facility is shown in Table 2. More than half (57%) of the total study population lived beyond MOH-defined access limits, which varied from ≤ 5 km in Zambia to ≤ 10 km in Mali. Among those with geographic access, other barriers such as mountains or rivers and temporary factors like flooding had little additional effect on access. Only 4% (range = 3–12% by district) of those living within MOH-defined access areas across study districts were affected by year-round or temporary physical barriers. Security barriers were not reported for any village in the study.

Although nearly all health facilities were mandated to provide case management, availability of trained staff was uneven (Table 3). In Mulanje, trained staff was available an average of 30 hours per week across facilities, and only 36% were available the desired 84 hours/week. In Bougouni, staff availability varied highly across facilities (range = 6–99%). In Lufwanyama, four facilities had no staff trained in case management, and one facility reported a single trained staff member who was absent the entire week before data collection; staff availability in the remaining 10 facilities ranged from 36% to 88%.

Frontline medicines for case management of malaria, pneumonia, and diarrhea were available in most facilities in Mulanje and Lufwanyama. In Mulanje, five health centers had stockouts in the previous 30 days, mostly for oral rehydration

TABLE 3
Staff availability and medicine availability at health facilities by study area*

Parameter	Mulanje, Malawi	Bougouni, Mali	Lufwanyama, Zambia
Health facilities sampled	10	7	15
No. HFs with ≥ 1 staff trained in case management	9	7	12
Total no. staff trained in case management available across HFs	18	8	16
Average hours per week CM services available	30	36	45
Staff availability†	36%	42%	47%
No. HFs with stockouts (total no. stockout days)			
ACTs	1 (3)	7 (185)	0 (NA)
Antibiotics	1 (5)	0	2 (NA)
ORS	4 (62)	1 (30)	0 (NA)
Medicine availability‡	91%	66%	93%

*HF = health facility; CM = case management; ACT = artemisinin-based combination therapy; ORS = oral rehydration salts.
†Denominator = 7 days × 12 hours = 84 hours/week.
‡Malawi and Mali calculation: (Total no. stockout days for all medicines/total no. potential stockout days, where total no. stockout days = 30 days × 3 medicines); Zambia calculation: (Total no. health facilities with stockout × no. medicines with stockouts/no. health facilities × no. medicines).

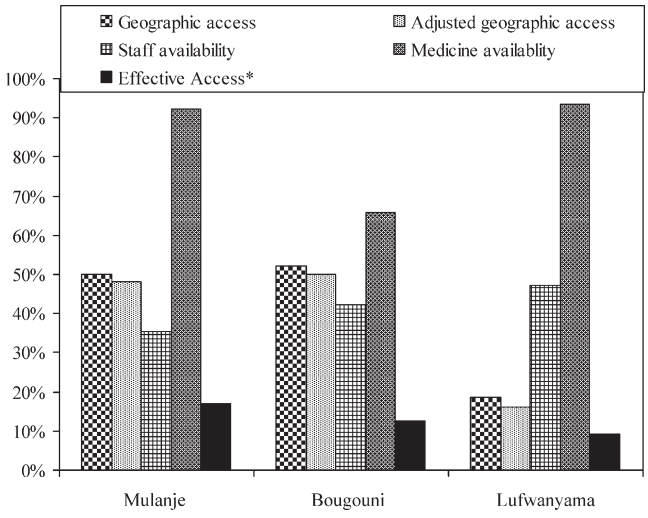

FIGURE 1. Effective access to case management for childhood illness at facility level by study area.

salts and ranging from 14 to 21 days. In Lufwanyama, two facilities lacked amoxicillin on the day of the survey. Stockouts for antimalarial drugs were pervasive in health facilities in Bougouni, where all seven facilities reported stockouts of antimalarial drugs in the past 30 days (average = 26 days).

Effective access. Effective access was low (< 20%) in all settings (Figure 1). Full details by facility are shown in Table 4. In Mulanje, half of the study population had geographic access, but case management was only available at the facilities 34% of the time, mainly because of shortages of trained staff; medicines for case management were generally available. As a result, effective access was only 17%, just one-third of geographic access.

Similar patterns were observed in Bougouni. Effective access was only 13%, just 25% of geographic access. Among the population within 10 km of a health facility with no additional barriers, access to a trained provider equipped with all necessary medicines to treat malaria, pneumonia, and diarrhea was available only 24% of the desired time. In Lufwanyama, the overall pattern of access was also similar, but a greater proportion of the population did not have geographic access, partly because of the stricter MOH definition of access. Among those living within 5 km of a health facility, access to trained staff averaged approximately 47%, which was higher

TABLE 4
Access indicators and effective access by study district and health facility

District and health facility	Total population	Geographic access	Annualized adjustment factor	Adjusted geographic access	Staff availability	Medicine availability	Effective access
Mulanje, Malawi							
Mulomba	51,067	23%	100%	23%	33%	100%	8%
Thuchira	34,072	65%	93%	60%	36%	97%	21%
Bondo	21,670	28%	82%	23%	42%	79%	8%
Mimosa	22,655	71%	100%	71%	37%	78%	21%
Mpala	25,494	82%	98%	80%	50%	100%	40%
Chambe	45,968	40%	100%	40%	42%	77%	13%
Dzenje	8,583	86%	100%	86%	0%	0%	0%
Kambenje	21,854	46%	100%	46%	42%	92%	18%
Milonde	14,833	28%	100%	28%	33%	100%	9%
Chinyama	23,109	72%	100%	72%	41%	100%	30%
Total	269,305	50%	98%	48%	36%	92%	17%
Bougouni, Mali							
Keleya	25,515	56%	98%	55%	99%	67%	36%
Domba	11,773	34%	100%	34%	19%	67%	4%
Koumantou	28,542	44%	100%	44%	6%	67%	2%
Faragouaran	15,086	54%	97%	52%	40%	83%	18%
Bougouni-ouest	28,367	61%	100%	61%	32%	67%	13%
Garalo	18,457	42%	100%	42%	93%	33%	13%
Kologo	19,355	66%	99%	65%	7%	78%	4%
Total	147,095	52%	99%	52%	42%	66%	13%
Lufwanyama, Zambia							
Bulaya	4,503	14%	100%	14%	88%	100%	13%
Chikabuke	3,416	30%	100%	28%	36%	100%	11%
Chinemu	11,585	21%	100%	18%	76%	100%	16%
Fungulwe	5,345	23%	81%	23%	88%	100%	17%
Kapilamikwa	5,800	14%	0%	14%	0%	100%	0%
Lumpuma	6,107	26%	100%	26%	88%	100%	23%
Mibenge	4,142	34%	100%	34%	0%	100%	0%
Mibila	10,500	7%	100%	7%	0%	100%	0%
Mukumbo	10,859	20%	89%	20%	88%	100%	16%
Mukutuma	5,752	7%	100%	7%	0%	67%	0%
Mushingashi	13,382	11%	34%	11%	52%	100%	2%
Nkana	4,917	65%	100%	0%	48%	100%	31%
Shimukunami	9,272	33%	84%	32%	67%	100%	18%
St. Joseph's	10,353	11%	100%	11%	76%	100%	8%
St. Mary's	13,866	5%	100%	5%	0%	67%	0%
Total	119,799	18%	88%	16%	47%	93%	9%

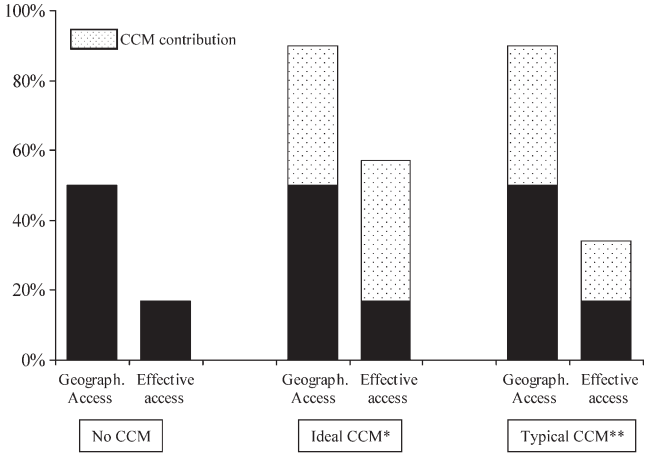

FIGURE 2. Model of geographic (geograph.) and effective access to integrated case management for childhood illness with community case management (CCM) implemented according to Ministry of Health (MOH) plans in Mulanje study area. CBWWs = community-based health workers.

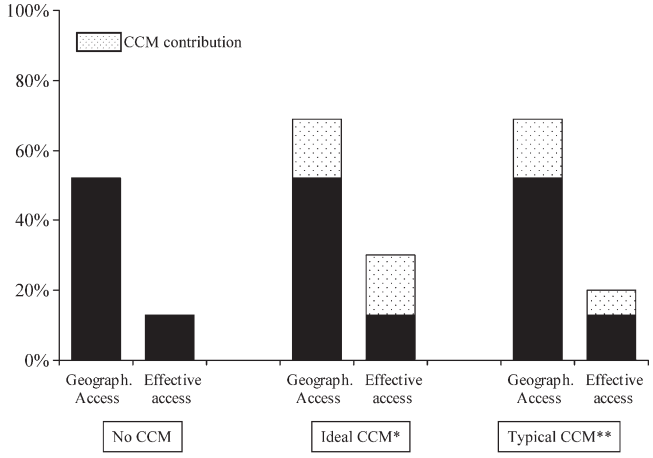

FIGURE 3. Model of geographic (geograph.) and effective access to integrated case management for childhood illness with community case management (CCM) implemented according to Ministry of Health (MOH) plans in Bougouni study area. CBWWs = community-based health workers.

than the other study areas. In total, effective access was only 50% of MOH-defined access.

Potential contribution of CCM. Results for Mulanje are shown in Figure 2. The addition of the 81 CBHWs trained in CCM increased the proportion of the population with potential geographic access to case management in Mulanje from 50% to 90%. The ideal CCM scenario where CBHWs are always available and fully stocked showed that potential effective access overall tripled from 17% to 57%. However, the addition of CCM in the hard-to-reach areas alone did not address the limited availability of trained staff and supplies at the health facility. As a consequence, there was a facility service gap for the 50% of the population who had MOH-defined access, constraining potential effective access for the total population. Potential effective access under typical CCM conditions in Mulanje (75% availability of CBHWs and 60% availability of medicines) reached 35%, barely half of the ideal CCM scenario, but twice the level without CCM. The addition of CCM as per MOH plans in Bougouni and Lufwanyama increased potential geographic access to 69% and 63% and potential effective access under ideal CCM conditions to 30% and 58%, respectively; full details are shown in Figures 3 and 4 and Table 5.

DISCUSSION

This study showed that official measures of access based on distance overestimate the proportion of the population with access to integrated case management by between two- and three-fold. The distinction between access to a service site and access to life-saving case management cannot be overstated. Access to a trained provider supplied to treat malaria, pneumonia, and diarrhea was less than one-third among those who lived within MOH-defined access areas.

Effective access is the product of several factors, low levels of most will yield a low overall value. In our study, limited availability of trained staff at health facilities in particular translated into low effective access. Even if all necessary medicines were available at the health facilities studied, effective access would remain less than 20% for the total population and range between 28% and 48% for those living within the MOH-defined access across the study areas. A simultaneous household survey in Lufwanyama District showed that the proportion of children receiving antibiotics for likely pneumonia (13%) and fever/malaria (12%) was nearly equal the level of effective access (9%) and was much lower than the proportion who reported seeking care for these illnesses, highlighting the gaps at facility level (Yeboah-Antwi K and others, unpublished data). Families may consider what care may or may not be available at a health facility before committing their time and resources to care-seeking. The poor human resource availability at health facilities in developing countries is well documented.[7,12–14] A recent study in Malawi reported that only 49% of the expected clinical staff was available in

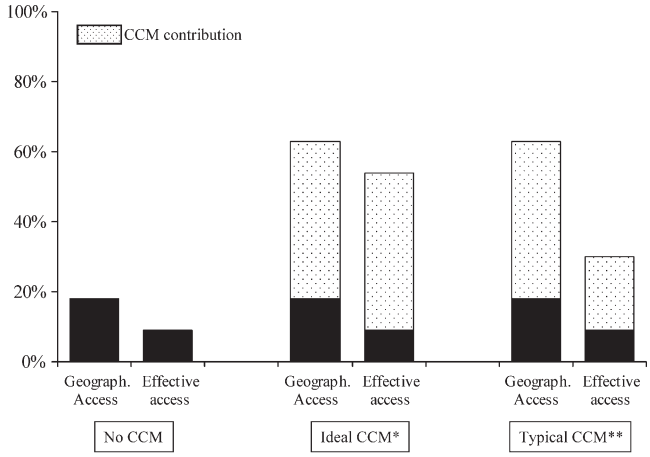

FIGURE 4. Model of geographic (geograph.) and effective access to case management for childhood illness with community case management (CCM) implemented according to Ministry of Health (MOH) plans in Lufwanyama study area. CBWWs = community-based health workers.

TABLE 5
Geographic access and effective access with addition of CBHWs trained in CCM by study district and health facility*

District and health facility	Total population	Geographic access, no CCM	Effective access, no CCM	CBHWs trained in CCM	Potential geographic access	Potential effective access, ideal†	Potential effective access, typical‡
Mulanje, Malawi							
Mulomba	51,067	23%	8%	16	80%	65%	33%
Thuchira	34,072	65%	21%	11	99%	54%	36%
Bondo	21,670	28%	8%	9	100%	79%	40%
Mimosa	22,655	71%	21%	2	80%	29%	24%
Mpala	25,494	82%	40%	4	100%	58%	48%
Chambe	45,968	40%	13%	18	88%	61%	34%
Dzenje	8,583	86%	0%	1	100%	14%	6%
Kambenje	21,854	46%	18%	10	99%	70%	41%
Milonde	14,833	28%	9%	5	81%	62%	33%
Chinyama	23,109	72%	30%	5	87%	45%	36%
Total	269,305	50%	17%	81	90%	57%	35%
Bougouni, Mali							
Keleya	25,515	56%	36%	6	73%	53%	44%
Domba	11,773	34%	4%	4	47%	17%	10%
Koumantou	28,542	44%	2%	5	61%	19%	9%
Faragouaran	15,086	54%	18%	3	60%	24%	20%
Bougouni-ouest	28,367	61%	13%	5	75%	27%	20%
Garalo	18,457	42%	13%	6	63%	34%	22%
Kologo	19,355	66%	4%	6	94%	31%	16%
Total	147,095	52%	13%	35	69%	30%	21%
Lufwanyama, Zambia							
Bulaya	4,503	14%	13%	4	59%	58%	33%
Chikabuke	3,416	30%	11%	1	48%	29%	19%
Chinemu	11,585	21%	16%	2	79%	74%	42%
Fungulwe	5,345	23%	17%	2	70%	63%	38%
Kapilamikwa	5,800	14%	0%	2	74%	60%	27%
Lumpuma	6,107	26%	23%	6	70%	67%	43%
Mibenge	4,142	34%	0%	4	100%	66%	30%
Mibila	10,500	7%	0%	4	100%	93%	42%
Mukumbo	10,859	20%	16%	2	39%	35%	25%
Mukutuma	5,752	7%	0%	1	11%	4%	2%
Mushingashi	13,382	11%	2%	6	19%	10%	6%
Nkana	4,917	65%	31%	0	65%	31%	31%
Shimukunami	9,272	33%	18%	5	52%	38%	27%
St. Joseph's	10,353	11%	8%	10	70%	67%	35%
St. Mary's	13,866	5%	0%	10	91%	86%	39%
Total	119,799	18%	9%	59	63%	54%	30%

*CBHW = community-based health worker; CCM = community case management.
†CBHWs are always available and have all three drugs in stock 100% of the time.
‡CBHWs are available 75% of the time and have all three drugs in stock 60% of the time.

health centers because of unfilled positions and to staff absences related to trainings and leave time.[14]

At the time of the study, medicine availability on the whole was quite good at the health facilities we assessed. However, medicine stocks fluctuated and lengthy stockouts were common, as shown by antimalarial drug stockouts in Bougouni and other studies in Malawi and Zambia.[14,15] In Lufwanyama, we measured availability of medicines on the day of the survey and did not capture reports of stockouts; and in Mulanje and Bougouni, a stockout of one of the three medicines only contributed one-third of a stockout day. Thus, we may have overestimated the availability of medicines.

We did not commonly identify permanent or temporary physical barriers or security barriers to reaching the facilities in these study districts. In other settings, such as South Sudan where rainy seasons are lengthy and disruptive or Somalia where insecurity is rife, these barriers would be more important. In the few study areas that did report additional year-round or temporary physical barriers, they often affected most of a given facility's catchment area, highlighting the importance of identifying such areas so that solutions can be tailored.

This study showed that even those living near health facilities often lacked access to trained staff and medicines. These observations can help explain the often contradictory findings regarding influence of distance on access to health care and shed light on why those living nearby facilities still face poor health outcomes.[8,16–18] These findings reinforce the need to consider options to mitigate access barriers for those living within MOH-defined access areas. In instances where staffing problems are caused by lack of training in case management (as opposed to staffing shortages and operational hours), training of existing staff in IMCI is sensible. However, addressing staff shortages at health facilities will take more time and resources. The CBHWs can be trained to treat common childhood illness in as little as six days, but CCM involves similar if not greater inputs for supply chain management and supervision. Typically, CCM programs target communities beyond the MOH-defined access areas, but MOHs could consider redefining the catchment areas so that more CBHWs could be deployed, even in areas traditionally considered to have access as a complementary strategy to help ensure reliable access to case management. Families living at the margins of these MOH-defined access areas often have

limited alternatives for care and venturing on foot even 4 or 5 km to seek care is a significant time and resource gamble.

Our exploration of the potential contribution of CCM showed that training CBHWs to provide case management nearer to the home can reduce the geographic barriers for those living beyond the traditional access areas. However, the modeled results depended on the MOH implementation plan, underscoring the need to ensure that CCM policy makers, planners, and managers consider how to optimize distribution and availability of CBHWs within defined target areas. Furthermore, our study showed that under typical conditions of CCM programming at scale CBHWs are not always available because of other responsibilities or turnover and stockouts can be common. Thus, the potential increase in effective access from CCM is not fully realized. In Malawi for example, CBHWs (HSAs) are encouraged by the MOH to operate their village health clinics for at least two days per week, in recognition of the other tasks HSAs are expected to perform. In addition, although HSA basic training guidelines request HSAs to reside in their catchment areas, this requirement is not consistently enforced, and hard-to-reach areas targeted for integrated CCM (iCCM) tend to be the most difficult to staff. The competing demands on HSAs' time, combined with the reality that many do not reside in their catchment areas, limit the availability of case management at the community level in Malawi. Policies that support availability of CBHWs to deliver CCM on a routine basis, including for emergencies after hours and on weekends, are needed to help protect against erosion of services.

Another challenge concerns medicine availability. At present, iCCM programs in most settings are supported by partners who provide additional inputs, such as medicines and support to the government supply chain to improve medicine availability at the community level. As a result, availability of medicines for iCCM in areas wholly dependent on government supply chain would in some settings likely be even lower than the 60% we modeled. Strategies for supply chain management and effective human resources management for CCM programs operating at scale are essential to optimize the returns on investments in CCM.

We designed a simple, rapid method to measure effective access to iCCM that can be conducted by program planners with limited time and financial resources. Although more sophisticated methods exist to precisely measure distance to a health facility and to quantify other access barriers, they require additional human and financial resources and may be more difficult to communicate to decision-makers.[19,20] Our experience in Malawi demonstrated that the process of systematically considering access barriers for each village within a facility catchment area was valued by district health officials and led to areas not previously considered hard-to-reach being so identified and targeted for CCM (Chimuna T, unpublished data).

The study has limitations. The study settings were underserviced, rural districts of three countries in Africa where availability of facilities, trained staff, and supplies were probably lower than typical. Governments often ask implementing partners to program in under-served areas. The study was cross-sectional and captured effective access at a single point in time and from a supply perspective only. Collection of data at multiple time points would strengthen the reliability of an annualized estimate. Estimates of distance and whether villages faced physical or security barriers were based on reports by facility staff, which may have underestimated the communities' perspective. Furthermore, the quality of case management and availability of essential supplies, such as timers, to provide case management were not assessed. Other documented barriers to effective access from the demand side, such as cultural, economic, and social constraints, were not captured. Likewise, we did not measure clients' expectations. Experiencing an understaffed facility or a stockout of even one essential medicine could discourage future care seeking for sick children, not only by the family in question, but also by neighbors. In light of the off-setting biases (relatively under-served districts versus overestimations of access), the findings probably do represent much of rural Africa.

This study demonstrates that access to case management is much worse than officially estimated once the contribution of physical barriers, staff availability and stockouts are accounted. We also proposed a method to account for intermittent barriers. In study areas, less than 50% of the population had geographic access (i.e., lived within 5, 8, or 10 km of a facility), and less than 20% had effective access. Our findings highlight the important distinction between access to a health facility and access to case management. Poorly staffed and supplied facilities cannot save the lives of sick children, and planning for curative services should look at how to improve effective access for the total population, including those who live within MOH-defined access areas. Although CCM typically targets areas that do not have geographic access, CCM can also be considered even in those areas near to facilities to overcome other access barriers such as physical barriers and limited staff availability. However, CCM will only improve effective access if CBHWs are adequately distributed and supported.

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