

Expanding community case management of malaria to all ages can improve universal access to malaria diagnosis and treatment: results from a cluster randomized trial in Madagascar

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Abstract

Background: Global progress on malaria control has stalled recently, partly due to challenges in universal access to malaria diagnosis and treatment. Community health workers (CHWs) can play a key role in improving access to malaria care for children under 5 years (CU5), but national policies rarely permit them to treat older individuals. We conducted a two-arm cluster randomized trial in rural Madagascar to assess the impact of expanding malaria community case management (mCCM) to all ages on health care access and use.

Methods: Thirty health centers and their associated CHWs in Farafangana District were randomized 1:1 to mCCM for all ages (intervention) or mCCM for CU5 only (control). Both arms were supported with CHW trainings on malaria case management, community sensitization on free malaria care, monthly supervision of CHWs, and reinforcement of the malaria supply chain. Cross-sectional household surveys in approximately 1600 households were conducted at baseline (Nov–Dec 2019) and endline (Nov–Dec 2021). Monthly data were collected from health center and CHW registers for 36 months (2019–2021). Intervention impact was assessed via difference-in-differences analyses for survey data and interrupted time-series analyses for health system data.

Results: Rates of care seeking for fever and malaria diagnosis nearly tripled in both arms (from less than 25% to over 60%), driven mostly by increases in CHW care. Age-expanded mCCM yielded additional improvements for individuals over 5 years in the intervention arm (Rate ratio for RDTs done in 6–13-year-olds, $RR_{RDT6-13yrs}=1.65$; 95% CIs 1.45–1.87), but increases were significant only in health system data analyses. Age-expanded mCCM was associated with larger increases for populations living further from health centers ($RR_{RDT6-13yrs}=1.21$ per km; 95% CIs 1.19–1.23).

Conclusions: Expanding mCCM to all ages can improve universal access to malaria diagnosis and treatment. In addition, strengthening supply chain systems can achieve significant improvements even in the absence of age-expanded mCCM.

Keywords: community health; geographic access to care; last mile interventions; health systems strengthening; supply chain

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Table 1. Population and health system characteristics in the study area, 2019–2021.

	Study area	Study arm		Distance to health center	
		Control	Intervention	Less than 5 km	5 km or more
Population (2019)¹					
All Ages	363 962	177 858	186 104	228 340	135 622
0-5 years	82 617	40 372	42 245	51 831	30 786
6-13 years	94 998	46 421	48 577	59 601	35 397
14+ years	186 347	91 065	95 282	116 908	69 439
Health center level (01/2019 – 12/2021)²					
Number of facilities	30	15	15	-	-
Consultations	462 215	239 679	222 536	363 729	98 486
Fever cases	307 752	160 367	147 385	240 069	67 683
RDTs done	382 187	193 294	188 893	301 226	80 961
Malaria cases (RDT+)	221 845	111 791	110 054	175 534	46 311
ACTs administered	217 202	108 708	108 494	171 913	45 289
Community health level (01/2019 – 12/2021)³					
Number of CHWs	502	262	240	296	206
Consultations	464 440	201 555	262 885	275 196	189 244
Fever cases	422 271	177 709	244 562	251 874	170 397
RDTs done	370 267	154 785	215 482	222 902	147 365
Malaria cases (RDT+)	242 682	94 436	148 246	144 095	98 587
ACTs administered	228 304	87 282	141 022	134 722	93 582

¹ Source: MoPH sectorization, based on 2018 national census

² Source: health center registers

³ Source: CHW registers and monthly reports

Table 2. Characteristics of households and individuals participating in the baseline and endline surveys in Farafangana, Madagascar

Variable	Category	Baseline Average (95% CI)	Endline Average (95% CI)
Households characteristics — socio-demographics		N = 1458	N = 1631
Age of head of household in years, mean		41.5 (40.0-43.0)	43.9 (42.3-45.4)
Male head of household, %		58.2 (52.0- 64.2)	68.5 (64.7-72.0)
No primary education of head of household, %		84.6 (80.1 -88.2)	81.3 (76.1-85.6)
Occupation of head of household occupation, %	Farming or agriculture	76.4 (66.9-83.9)	85.9 (78.7-90.9)
	Day laborer	11.5 (7.7-16.9)	4.9 (2.7-8.9)
	Other	12.1 (7.5-18.9)	9.2 (6.3-13.4)
No toilet in the home, %		68.6 (58.8-77.0)	58.4 (48.8-67.5)
No electricity in the home, %		94.5 (92.0-96.3)	94.9 (90.0-97.4)
Number of bed nets used per sleeping space in household, %		0.95 (0.92-0.98)	0.97 (0.96-0.98)
Household characteristics — healthcare access and use			
Time to CHW, one-way, mean hours		0.5 (0.42-0.58)	0.45 (0.39-0.52)
Last visit to CHW, % — any household member —	≤ 1 year	75.9 (69.4-81.4)	81.3 (77.7-84.5)
	> 1 year	8.1 (6.2-10.6)	11.5 (9.3-14.1)
	Never	16.0 (10.8-23.0)	7.2 (5.2-9.9)
Reason for last visit to CHW, % — any household member —	Fever	83.3 (79.0-86.8)	91.8 (89.3-93.8)
	Cough	8.2 (6.3-10.6)	4.2 (2.9-6.2)
	Diarrhea	2.2 (1.3-3.7)	1.2 (0.6-2.4)
	Other	6.4 (4.3-9.4)	2.7 (1.8-4.1)
Time to health center, one way, mean hours		1.48 (1.13-1.82)	1.54 (1.24-1.9)
Last visit to health center, % — any household member —	≤ 1 year	81.5 (77.2-85.2)	70.1 (65.3-74.5)
	> 1 year	11.6 (9.2-14.5)	19.9 (16.7-23.6)
	Never	6.9 (4.7-10)	10 (6.8-14.4)
Reason for last visit to health center, % — any household member —	Fever	52.2 (46.7-57.6)	58.7 (54.4-62.8)
	Cough	10.7 (8.3-13.8)	10.1 (7.5-13.3)

	Diarrhea	5.9 (4.5-7.6)	3.6 (2.3-5.7)
	Other	31.2 (26.8-36)	27.7 (23.9-31.8)
Individual characteristics		N = 8050	N = 9046
Sex, %	Male	47.7 (46.6-48.9)	48.5 (47.1-49.9)
Age, %	< 5 years	19.4 (18.5-20.3)	19.1 (18-20.2)
	5-14 years	30 (28.4-31.7)	28.5 (27.4-29.7)
	15 + years	50.6 (49.1-52)	52.4 (50.8-54)
Individual ill in previous 2 weeks, %		6.7 (5.3-8.4)	5.1 (4-6.6)
Febrile illness, %		82.2 (76.6-86.8)	74.7 (67.6-80.7)
Care seeking for fever at HF or CHW, %		22.8 (16.5-30.6)	60.7 (49.3-71)
mRDT done for fever at HF or CHW, %		20.0 (14.2-27.4)	59.3 (48.7-69.1)
ACT treatment provided for mRDT+, %		87.7 (72.2-95.1)	95.5 (91.4-97.7)
Diarrhea (children under 5 years), %		0.6 (0.3-1.4)	1.6 (0.9-2.8)
Pneumonia (children under 5 years), %		3.9 (2.8-5.4)	5.1 (3.1-8.3)
Care seeking for pneumonia at HF or CHW, %		22.2 (11-39.7)	50.4 (38-62.7)
Treatment for pneumonia at HF or CHW, %		16.1 (7.3-31.7)	22 (9.9-42)
Malaria prevalence - children under 15 years		N = 3316	N = 3905
Malaria prevalence (mRDT+, %)		25 (19.4-31.2)	30.4 (24.9-36.2)
mRDT+ with recent fever (last 2 weeks, %)		21.5 (15.6-28.5)	10.1 (7.7-13)
Prevalence by sex (mRDT+, %)	Female	23.3 (17.5-29.9)	26.8 (21.3-32.9)
	Male	26.8 (20.8-33.5)	33.7 (28.0-39.7)
Prevalence by age group (mRDT+, %)	Under 5 years	15.7 (10.1-22.9)	19.5 (15.4-24.1)
	With recent fever	26.6 (15.2-41.0)	17.5 (12.3-23.8)
	5-14 years	31.5 (25.4-38.2)	37.6 (30.9-44.7)
	With recent fever	19.7 (13.9-26.7)	7.5 (5.2-10.5)

Table 3. Impact of age-expanded mCCM on the proportion of RDTs done among febrile individuals¹ (logistic regression, difference-in-differences analyses using survey data)

Age group	Level of care	Intercept	Change over time (ref. baseline)	Arm differences (ref. control arm)	Difference-in- differences (Period X Arm)	Observations
			OR (95% CI)	OR (95% CI)	OR (95% CI)	
All ages	Both levels of care	0.22 (0.14–0.33)***	8.46 (3.72–19.23)***	0.88 (0.37–2.1)	0.76 (0.24–2.38)	717
	Health center	0.15 (0.09–0.25)***	3.25 (1.09–9.71)*	0.88 (0.25–3.06)	0.55 (0.12–2.57)	717
	CHW	0.09 (0.04–0.18)***	6.21 (2.25–17.17)***	0.83 (0.28–2.43)	1.46 (0.43–4.97)	717
Children 0–5 years	Both levels of care	0.24 (0.13–0.4)**	20.53 (6.74–62.51)***	0.79 (0.31–2.03)	0.4 (0.09–1.86)	261
	Health center	0.18 (0.08–0.33)***	2.77 (0.59–12.95)	0.49 (0.17–1.43)	1.1 (0.18–6.71)	261
	CHW	0.08 (0.03–0.19)***	11.73 (3.44–40.03)***	1.43 (0.37–5.48)	0.63 (0.12–3.18)	261
Children 6–13 years	Both levels of care	0.24 (0.13–0.4)**	10.03 (2.5–40.16)**	0.73 (0.22–2.44)	0.75 (0.12–4.65)	229
	Health center	0.13 (0.07–0.24)***	6.63 (1.76–24.94)**	0.97 (0.2–4.62)	0.21 (0.03–1.69)	229
	CHW	0.13 (0.05–0.31)**	2.61 (0.75–9.16)	0.5 (0.12–2.04)	4.38 (0.81–23.64)	229
Individuals 14+ years	Both levels of care	0.17 (0.09–0.31)***	2.74 (0.84–8.98)	1.27 (0.4–4.04)	1.51 (0.29–7.92)	226
	Health center	0.13 (0.07–0.24)***	1.39 (0.51–3.8)	1.38 (0.38–5.04)	0.99 (0.2–4.96)	226
	CHW	0.05 (0.01–0.18)***	6.61 (1–43.85)	0.8 (0.12–5.18)	1.53 (0.15–16.11)	226

¹ Equivalent results for fever care seeking and malaria ACT treatments are available in Additional file 1.

*p<0.05; **p<0.01; ***p<0.001

Table 4. Impact of age-expanded mCCM on the number of RDTs done per month¹ (negative binomial regression, interrupted time-series analyses² using health system data)

Age group	Level of care	Change over time (ref. before)	Arm differences (ref. control)	Impact of mCCM (level of change)	Impact of mCCM (slope of change)	Impact of mCCM over distance to HF (km)
		RR (95% CI)	RR (95% CI)	RR (95% CI)	RR (95% CI)	RR (95% CI)
All ages	Both levels of care	2.3 (2.17–2.44)***	0.93 (0.8–1.07)	0.96 (0.88–1.06)	0.99 (0.91–1.07)	1.08 (1.06–1.09)***
	Health center	1.11 (1.05–1.18)***	0.97 (0.77–1.23)	1.08 (0.98–1.2)	0.79 (0.72–0.87)***	1.01 (1–1.03)
	CHW	5.6 (5.04–6.21)***	0.95 (0.84–1.09)	1.28 (1.08–1.5)**	1.30 (1.12–1.51)***	1.02 (1–1.04)
Children 0-5 years	Both levels of care	2.7 (2.53–2.88)***	0.92 (0.8–1.06)	0.76 (0.68–0.84)***	1.01 (0.92–1.11)	1.04 (1.03–1.05)***
Children 6-13 years	Both levels of care	1.2 (1.11–1.29)***	1.15 (0.92–1.44)	1.65 (1.45–1.87)***	0.88 (0.79–0.98)*	1.21 (1.19–1.23)***
Individuals 14+ years	Both levels of care	1.32 (1.23–1.41)***	1.12 (0.91–1.38)	1.46 (1.3–1.63)***	0.87 (0.79–0.95)**	1.18 (1.16–1.19)***

¹ Equivalent results for the number of fever cases and malaria ACT treatments given are available in the Additional file 1.

² Analyses were controlled for linear time trends, seasonality, lagged utilization (t-1 month) and a non-linear smooth for distance from fokontany to nearest health center.

*p<0.05; **p<0.01; ***p<0.001