Impact Evaluation of Public Health Interventions

Experimental Evidence from Nigeria

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Overview

1. Can informal health providers help reach the last mile? Experimental evidence on malaria control from Nigeria (together with Pedro Carneiro, Sanghmitra Gautam, Marcus Holmlund, Costas Meghir, Edit Velenyi)
2. Task reallocation of community health workers: Experimental evidence from Nigeria

Can informal health providers help reach the last mile?

Motivation

1. **Main challenge: poor people do not seek adequate health care**
   - households with malaria tend to self-diagnose and buy over-the-counter medication (Dupas 2011; Cohen et al. 2011)
   - reluctant to seek formal care due to long waiting times, high user fees, and transportation costs (Gertler et al. 1987; Ogunfowokan and Mora 2012)

Motivation

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2. **Potential Solutions**
   - Increase access to formal health care?
     - Importance of formal care (Adhvaryu and Nyshadham 2015)
     - Low quality of services at public health facilities (Das et al. 2008; Bedoya et al. 2020)
   - Increase quality and supply of existing (informal) sources of healthcare
     - Informal providers are preferred since they have flexible working hours and offer more rapid services (World Bank 2015).
     - In Nigeria, drug vendors are the first source of treatment where people seek care from when they are sick (DHS 2013).
     - What we do!

Overview

1. **Research question:**
   - Can improving access to informal health care providers improve health of households in developing countries?
2. **What we do:**
   - Use cluster-randomized controlled trial to evaluate the effectiveness of involving informal health providers in malaria prevention and treatment in Southern Nigeria
     - Identify two important informal health providers in the region - community-directed distributors (CDDs) and patent medicine vendors (PMVs)
     - Randomly assign 280 wards in Anambra into four study arms - (i) CDD; (ii) PMV; (iii) CDD+PMV; (iv) control arm
   - Understand the heterogeneous treatment effect by quality of formal health services

Preview of Findings

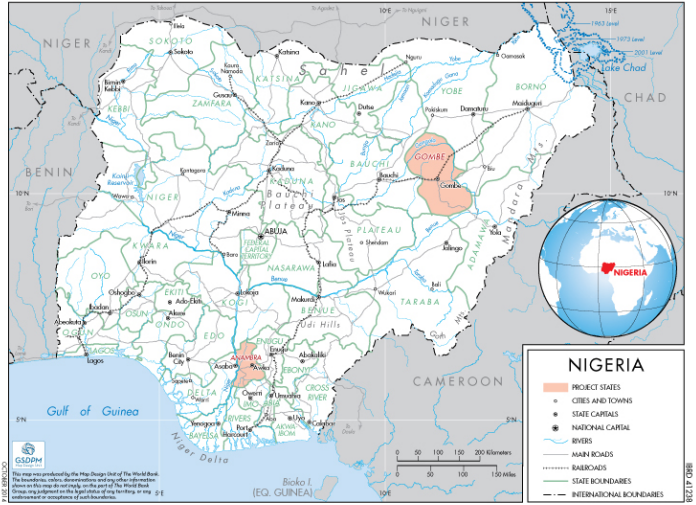
1. **Main Findings:**
   - $\Downarrow$ malaria prevalence across treatment villages
2. **Potential Mechanism:**
   - Households residing in treatment wards have increased knowledge related to malaria, but do not engage in more preventive activities nor better care-seeking behavior.
   - Higher impact in wards with better quality primary health facility
     - Complementary effect between informal health workers and the existing public health system

1. Context, Intervention Design and Experimental Design

Context and Design

- **Malaria is the leading health burden in Nigeria.**
  - In 2015, 27 percent of children under five were tested malaria positive (Malaria Indicator Survey).
  - Economic cost of malaria in Nigeria has been estimated to be 13 percent of the country's GDP (Jimoh et al. 2007).
- **Child health is very poor in Nigeria.**
  - Infant mortality rate of 82 per 1,000 births (World Bank 2013).
  - 37% of Nigerian children under five are stunted (NDHS 2013).
- **Our study takes place in Anambra State.**
  - In Anambra, 10 percent of children under five were tested malaria positive (2015 Malaria Indicator Survey).
  - The state has 327 wards, of which 280 were included in the study area for the impact evaluation.
  - There are 382 public primary health facilities, each covering approximately 10,936 individuals.

Project Map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CITIES AND TOWNS
STATE CAPITALS
NATIONAL CAPITAL
RIVERS
MAIN ROADS
RAILROADS
STATE BOUNDARIES
INTERNATIONAL BOUNDARIES
NIGER
BENIN
CHAD
CAMEROON
Gulf of Guinea
Bioko I. (EQ. GUINEA)
Lake Chad
1963 Level
1973 Level
2001 Level
Sahel
Bauchi Plateau
Jos Plateau
Udi Hills
Mandara Mts.
Niger Delta
SOKOTO
KEBBI
ZAMFARA
KATSINA
KANO
JIGAWA
YOBE
BORNO
GOMBE
BAUCHI
KADUNA
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FEDERAL CAPITAL TERRITORY
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Bauchi
Kaduna
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GSDPM Map Design Unit
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Intervention Design

Community-Directed Distributors (CDDs)

- CDDs are similar to community health workers, conducting home visits and providing medical advice and drugs to community members.
- 4,176 CDDs from Anambra were trained on malaria prevention, diagnosis and treatment.
- Malaria drugs were provided for free for CDDs.

Patent Medicine Vendors (PMVs)

- PMVs are private entrepreneurs running service outlets and selling medicines, although they lack formal pharmaceutical training.
- 979 PMVs from Anambra were trained on malaria prevention, diagnosis and treatment.
- Malaria drugs were subsidized for PMVs.

Causal Chain

Intervention

- Selection and training of CDDs and PMVs
- Provision of free or subsidized ACT

Change in service delivery

- Improvement in CDDs and PMVs knowledge
- Better diagnosis and treatment of patients with fever

Household level outcomes

- Improved malaria-related knowledge
- Improved prevention and care-seeking behavior
- Reduction in malaria prevalence

Experimental Design

PMV Intervention	CDD Intervention: No	CDD Intervention: Yes
No	Control	CDD Only
Yes	PMV Only	Joint Arm (CDD + PMV)

280 wards were randomly assigned into four study arms - (1) CDD, (2) PMV, (3) CDD+PMV, and (4) control arm.

Main Outcome of Interest

1. **Knowledge**
   - Main cause of malaria
   - Danger signs of malaria
   - Most vulnerable group to malaria
   - Best protection against malaria
   - Best treatment for malaria as ACT
   - Knowledge on RDT
2. **Preventive activities**
   - Have at least one mosquito net
   - Sprayed dwelling in the past 12 months
   - Percentage of household members sleeping under a net is higher than 50
   - Used mosquito net against malaria
3. **Malaria prevalence**
   - Malaria prevalence for children under five and children 5-12

2. Data and Empirical Strategy

Data

- Baseline data collected in 2013 and endline data collected in 2015
- Collected data from both supply and demand-side actors
  - household, community, PMVs, CDDs, and PHF workers samplesize
- Total sample consists of approximately 4,200 households per wave
  - Collected anthropometric measurements for children under five and conducted biomedical test for children under 12

Baseline Balance

$$Var_{ijs} = \beta_0 + \beta_1 CDD_j + \beta_2 PMV_j + \beta_3 (CDD + PMV)_j + \delta_s + \varepsilon_{ijs} \quad (1)$$

	Control	CDD	PMV	CDD+PMV	Joint-Test	N
Female-head	0.225	-0.025	-0.034	-0.015	0.767	3782
	(0.418)	(0.026)	(0.023)	(0.023)		
Christian	0.953	-0.03	-0.027	-0.01	0.664	3717
	(0.212)	(0.019)	(0.021)	(0.020)		
Educated	0.393	-0.048	-0.019	-0.015	0.679	3741
	(0.489)	(0.038)	(0.038)	(0.039)		
Employed	0.121	0.004	0.001	-0.001	0.968	3583
	(0.327)	(0.020)	(0.021)	(0.020)		
Stunting	0.328	0.086	0.026	-0.015	0.517	667
	(0.471)	(0.062)	(0.063)	(-0.055)		

Empirical Strategy

$$Var_{ijs} = \beta_0 + \beta_1 CDD_j + \beta_2 PMV_j + \beta_3 (CDD + PMV)_j + X_{js}\gamma + \delta_s + \varepsilon_{ijs} \tag{2}$$

- Var_{ijs}: Outcome for individual i, ward j, and senatorial district s
- X_{js}: Vector of ward-level control variables measured at baseline
- δ_s: Senatorial district fixed effects
- Standard errors are clustered at ward level

3. Estimation Results

Main Result

Table 1: Malaria Incidence among Children under 12

		Treatment Arm			
	Control mean	CDD	PMV	CDD+PMV	Joint Test
	(1)	(2)	(3)	(4)	(2)=(3)=(4)=0
Panel A. Children under-5					
RDT positive	0.085	-0.009	-0.036**	-0.013	[0.251]
		(0.020)	(0.018)	(0.021)	
		⟨0.650⟩	⟨0.052⟩	⟨0.650⟩	
Panel B. Children aged 5 to 11					
RDT positive	0.186	-0.062*	-0.028	-0.070**	[0.101]
		(0.033)	(0.035)	(0.030)	
		⟨0.057⟩	⟨0.641⟩	⟨0.022⟩	

4. Potential Mechanisms

Mechanisms

1. $\Uparrow$ in household knowledge $\Rightarrow$ $\Uparrow$ preventive and care-seeking behaviors $\Rightarrow$ $\Downarrow$ in malaria prevalence?
   - What is the program impact on intermediate outcomes, including household knowledge, preventive activities, and care-seeking behaviors?
   - Break in the causal pathway between knowledge and behavior suggests that the intervention was not sufficient to change household's care-seeking behaviors.

Intermediate Outcomes

Table 2: Household Knowledge Components

		Treatment Arm		
	Control (mean)	CDD	PMV	CDD+PMV
	(1)	(2)	(3)	(4)
Knowledge Index	0.000	0.160**	0.245***	0.248***
	{1.00}	(0.069)	(0.064)	(0.063)
Behavior Index	0.000	0.006	0.024	0.048
	{1.00}	(0.085)	(0.084)	(0.076)

Mechanisms

1. $\Uparrow$ in household knowledge $\Rightarrow$ $\Uparrow$ preventive and care-seeking behaviors $\Rightarrow$ $\Downarrow$ in malaria prevalence?
   - What is the program impact on intermediate outcomes, including household knowledge, preventive activities, and care-seeking behaviors?
   - Break in the causal pathway between knowledge and behavior suggests that the intervention was not sufficient to change household's care-seeking behaviors.
2. What are the contextual supply-side factors that may have affected the program impact?
   - Do impacts vary by the quality of the primary health facilities (PHFs)?

PHF Quality

1. **Why PHF quality?**
   - PHF acts as implementing agency through which trainings are provided and medicines are distributed to informal health providers.
   - There is a large variation in the quality of health facilities, which is one of the main barriers to better health outcomes in low-income countries (Das and Hammer 2014).
2. **PHF quality index**
   - Select PHF characteristics that best predict baseline malaria prevalence using LASSO method
   - Create PHF quality index based on the selected PHF quality variables
   - Community characteristics do not differ by PHF quality

By PHF Quality

Table 3: Malaria Incidence: Heterogeneous Treatment Effects by Primary Health Facility (PHF) Quality

			Treatment Arm			
		Control mean	CDD	PMV	CDD+PMV	Joint Test
		(1)	(2)	(3)	(4)	(2)=(3)=(4)=0
Panel A. Children under-5						
RDT positivity in	I^{st} quartile	0.100	-0.022	0.007	-0.034	[0.777]
			(0.041)	(0.041)	(0.041)	
	IVth quartile	0.095	-0.044	-0.079**	-0.053*	[0.351]
			(0.029)	(0.031)	(0.031)	
p-value: $I^{st} = IV^{th}$ quartile			[0.664]	[0.095]	[0.710]	
Panel B. Children aged 5 to 11						
RDT positivity in	I^{st} quartile	0.103	-0.029	0.097	-0.034	[0.368]
			(0.064)	(0.081)	(0.066)	
	IVth quartile	0.236	-0.063	-0.152**	-0.119**	[0.094]
			(0.052)	(0.065)	(0.059)	
p-value: $I^{st} = IV^{th}$ quartile			[0.682]	[0.017]	[0.332]	

Why is PHF quality important?

1. **Stock-out issue**
   - Drug stock-out is a well-documented problem in Nigeria
     - 57% of CDDs and 24% of PMVs experienced at least one stock-out of ACT at endline
   - Above-median PHFs (and informal health providers in these areas) are less likely to suffer from drug stock-outs
2. **Referral activities**
   - CDDs and PMVs refer their patients to nearby health facilities for complicated malaria
     - Complementary effect between informal health providers and the existing public health system

Conclusion

1. There is a break in the causal pathway between knowledge and behavior, but lower malaria prevalence in general
2. Significantly higher treatment effects in areas with better quality of primary health facilities
   - Informal health providers should be regarded as complementary with rather than substituting the existing public health system
3. Stock-out issues faced by CDDs and PMVs prevented households from accessing ACT
   - Need more reliable supply chains for any intervention aiming to extend primary healthcare services
4. Contribute to the debate on importance of evaluating large-scale programs (Muralidharan and Niehaus, 2017)
   - Inform large-scale spending decisions and improve external validity
   - Highlight the importance of the quality of existing health system

Task reallocation of community health workers in Nigeria

Motivation

1. Development programs can result in spillover effects which can weaken or strengthen the effectiveness of these programs (Angelucci and Di Maro 2016).
   - Increase in food prices following cash transfer program in the Philippines (Filmer et al. 2018)
   - Exit of private schools following school construction program in the Dominican Republic (Dinerstein et al. 2020)

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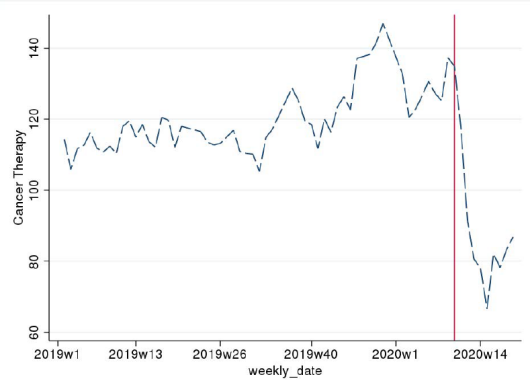
2. In the public health field, health interventions may generate unexpected spillover effects on health outcomes not targeted by the program (Ziedan et al. 2020).

Motivational Example

Figure 16: Trends in Weekly Cancer Therapy Between Jan 1st 2019 and May 15th 2020



- Large drops in cancer therapy and cancer screenings following the Covid-19 related policy (Ziedan et al. 2020)

Motivation

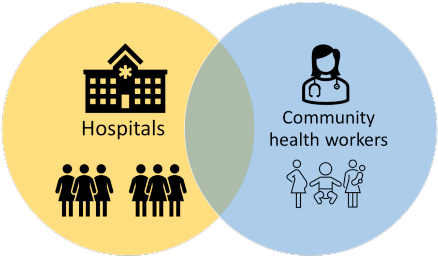
1. Development aid programs can result in spillover (or general equilibrium) effects which can weaken or strengthen the effectiveness of these programs.
   - Increase in food prices following cash transfer program in the Philippines (Filmer et al. 2018)
   - Exit of private schools following school construction program in the Dominican Republic (Dinerstein et al. 2020)
2. In the public health field, health interventions may generate unexpected spillover effects on health outcomes not targeted by the program (Ziedan et al. 2020).
   - Difficulties in empirically testing these spillover effects since most programs only monitor health outcomes directly related to the project
   - Overcome this challenge by exploiting a randomized controlled trial in Nigeria

Overview

1. **Research question:**
   - What are the implications of a disease-specific intervention that involves community health workers on other health outcomes?
     - What are the mechanisms?
2. **Community health workers:**
   - Approximately 5 million community health workers functioning in developing countries (Perry et al. 2014).
   - Members of the community that offer health services including counseling and home visits especially for underserved households
   - No formal medical education $\Rightarrow$ controversial quality of health services (Das and Hammer 2014).
   - Under the malaria control program, community health workers were involved in diagnosing and treating malaria.

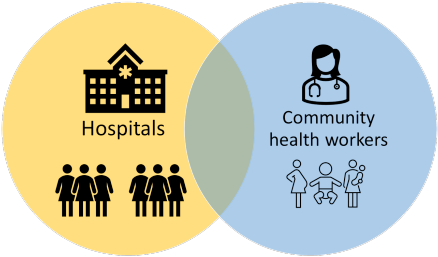
Hypotheses

Before intervention

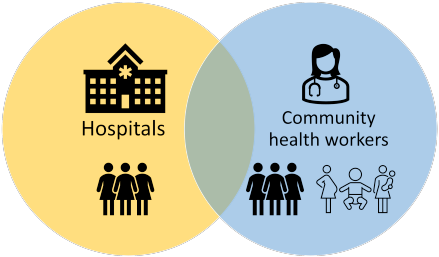


Hypotheses

Before intervention



After intervention



Two Levels of Health Behavior Change:

1. Households seek care from informal instead of formal health providers.
2. Community health workers alter their behaviors.

Preview of Findings

1. **Change in care-seeking behavior**
   - Non-poor households $\Uparrow$ seek care from informal health providers
     - More educated households are more likely to process and adopt the new information (Dupas 2011).
   - No change at the extensive margin (making individuals that would have otherwise not sought care for their illness to seek care)

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2. **Change in health**
   - $\Downarrow$ in malaria prevalence for treated children
   - Children from poor households $\Downarrow$ physical growth

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2. **Change in health**
   - $\Downarrow$ in malaria prevalence for treated children
   - Children from poor households $\Downarrow$ physical growth
3. **Mechanism**
   - Increase in service utilization by non-poor households $\Rightarrow$ community health workers reallocate their tasks $\Rightarrow$ poor households are crowded out
   - Rule out other potential channels

Literature Review and Contribution

1. **Spillover effects of development programs**
   ⇒ Reallocation of tasks by existing health providers
   - Externalities: Miguel and Kremer 2004; Lipscomb and Mobarak 2017
   - Social interactions: Angelucci and De Giorgi 2009
   - General equilibrium effects through labor market or food market responses: Beegle et al. 2017; Filmer et al. 2018; Muralidharan et al. 2020
2. **Inequality concern of public programs**
   ⇒ Poor households can be worse off from a universal public health program
   - More advantaged households are better able to access and utilize universally available programs (Heckman and Landerso, 2021).
   - Elite capture in community-driven development programs (Saguin 2018)
3. **Vertical vs. horizontal health programs**
   ⇒ Vertical health programs can generate unintended spillover effects
   - De Maeseneer et al. 2008; Msuya 2004; Strasser et al. 2016 lit2

2. Data and Empirical Strategy

Baseline Characteristics of CDDs

- 69% of CDDs are female and 44 years old on average
- Have been resident in their community for 26 years on average
- 59% of CDDs have provided health services in the past 3 months

Empirical Strategy

$$Var_{ijs} = \beta_0 + \beta_1 CDD_j + \beta_2 PMV_j + \beta_3 (CDD + PMV)_j + X_{js}\gamma + \delta_s + \varepsilon_{ijs} \quad (3)$$

- Var_{ijs}: Outcome for individual i, ward j, and senatorial district s
- X_{js}: Vector of ward-level control variables measured at baseline
  - Baseline value of the dependent variable
  - Age of child, age of child squared, and gender of child for child health outcomes
  - Household-level control variables measured at endline for robustness check
- δ_s: Senatorial district fixed effects
- Standard errors are clustered at ward level

Main Outcome of Interest

1. Stunting: children whose height-for-age z-score is below minus two standard deviations from the median of the reference population
   - signals that a child failed to receive adequate nutrition or suffered from recurrent infections over a long period of time, especially during their first year of life
2. Underweight: children whose weight-for-age z-score is below minus two standard deviations from the median of the reference population
   - signals that a child failed to receive adequate nutrition in the period immediately before the survey

3. Estimation Results

Results: Careseeking Behaviors

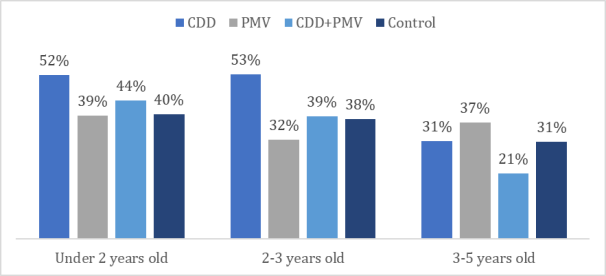
	(1) Seek care for illness	(2) Seek care from informal health providers
CDD	-0.006	0.109**
	(0.043)	(0.052)
PMV	-0.040	0.081
	(0.041)	(0.050)
CDD+PMV	-0.037	0.001
	(0.037)	(0.045)
Observations	2,257	1,747
Controls	YES	YES
Strata FE	YES	YES
Mean of dependent variable	0.662	0.331

Results: Children's Physical Growth

	(1) Height-for-age	(2) Stunting	(3) Weight-for-age	(4) Underweight
CDD	-0.326*	0.091**	0.041	0.027
	(0.176)	(0.039)	(0.172)	(0.027)
PMV	0.176	0.004	0.201	0.001
	(0.206)	(0.042)	(0.169)	(0.027)
CDD+PMV	0.055	-0.004	0.147	0.052**
	(0.193)	(0.039)	(0.174)	(0.025)
Observations	1,618	1,618	1,834	1,834
Controls	YES	YES	YES	YES
Strata FE	YES	YES	YES	YES
Mean of dependent variable	-1.301	0.379	-0.136	0.153

estimates

Stunting prevalence by age of child



- Why is stunting rate substantially higher only among children under 3 years old?
  - child growth particularly sensitive to health conditions during the first year of life + intervention implemented for two years

4. Heterogeneity

Heterogeneity by Asset Index

- Adoption of new health information or technology differs substantially by socioeconomic status in developing countries (Dupas 2011).
  - More educated individuals are more likely to access information, by reading the newspaper or listening to the radio, and be more responsive to new information (De Walque 2007, Thomas 1990).

Results: By Asset Index

	(1)	(2)	(3)	(4)
	Care from informal health providers		Stunting	
	Poor	Non-Poor	Poor	Non-Poor
CDD	0.068	0.154***	0.154***	0.012
	(0.066)	(0.058)	(0.047)	(0.062)
PMV	0.057	0.119*	0.049	-0.059
	(0.062)	(0.062)	(0.053)	(0.061)
CDD+PMV	-0.073	0.097*	0.052	-0.090
	(0.056)	(0.058)	(0.045)	(0.060)
Observations	949	779	952	657
Controls	YES	YES	YES	YES
Strata FE	YES	YES	YES	YES
Mean of dependent variable	0.399	0.230	0.377	0.380

5. Potential Mechanisms

Potential Mechanisms

	Community	Household	Health Facility
Supply	Direct resources toward malaria-related services	Change in quality of health services	Change in quality of health services
Demand	Increased number of households covered by each health worker	1. Change in health-seeking behavior 2. Increased awareness related to malaria	Reduced demand for formal health services

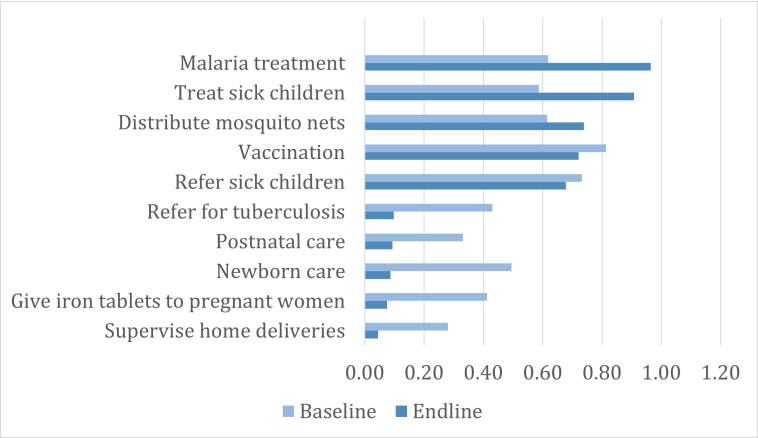
Potential Mechanisms

1. **Community level**
   - Community health workers may direct resources toward malaria-related services.
   - Community health workers may experience an increase in service demand.
2. **Household level**
   - Change in care-seeking behavior may lead to change in quality of health services.
   - Increased awareness related to malaria may lead to intra-household resource transfer.
3. **Change in quality of public health facility**
   - There could have been a decrease in service quality provided at formal health facilities following the intervention if public health facilities are occupied with training CDDs and distributing malaria-related drugs to the informal health providers.

First Channel: Changes at community level?

1. Supply-side: CDDs may direct resources away from child-health related services toward malaria-related services.
    - Compare activities performed by CDDs before and after the intervention

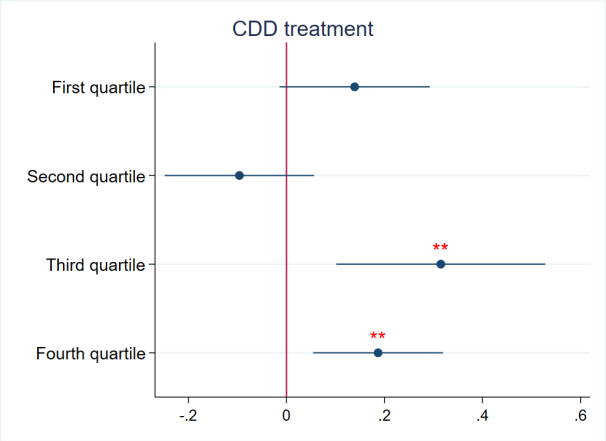
Health Services Provided by CDDs Before and After the Intervention



Second Channel: Changes at community level?

1. CDDs may direct resources away from child-health related services toward malaria-related services.
   - Compare activities performed by CDDs before and after the intervention
2. Demand-side: CDDs are responsible for an increased number of households $\Rightarrow$ lower access to CDDs, especially for poor households
   - Fixed number of CDDs (30) per ward: Larger ward size $\Rightarrow$ higher number of households covered by each CDD wardsize $\Rightarrow$ larger crowding-out effects

Increase in Stunting by Population Quartile



crowdout

Second Channel: Changes at household level?

1. Demand-side: Households are more likely to seek care from informal instead of formal health providers.
2. Supply-side: This change in care-seeking behavior may lead to change in quality of health services received (Adhvaryu and Nyshadham, 2015).

Second Channel: Switching from formal to informal health care?

Are children more likely to suffer from malnutrition as they were more likely to receive care from informal health providers instead of formal hospitals?

$$Var_{ijs} = \beta_0 + \beta_1 InformalCare_{ijs} + X_{js}\gamma + \delta_s + \varepsilon_{ijs} \tag{4}$$

- Endogeneity: Individuals select into health care options (Adhvaryu and Nyshadham, 2015).
  - Treatment households living further away from public health facilities are more likely to switch from formal to informal health services.
  - Differential impact by the distance to a health facility?

More likely to switch from formal to informal health care?

$$InformalCare_{ijs} = \beta_0 + \beta_1(Treat_{js} * Distance_{ijs}) + \beta_2 Treat_{js} + \beta_3 Distance_{ijs} + X_{js}\gamma + \delta_s + \varepsilon_{ijs} \quad (5)$$

	Seek care from informal health providers
Treatment * Distance to PHF	0.310***
	(0.093)
Distance to PHF	-0.096**
	(0.048)
Treatment	-0.033
	(0.037)
Observations	1,747
Controls	YES
Strata FE	YES

Differential Impacts by Distance to PHF

	(1) Height-for-age	(2) Stunting
CDD * (Distance to PHF)	0.453	-0.027
	(0.601)	(0.123)
PMV * (Distance to PHF)	-0.585	0.100
	(0.568)	(0.122)
(CDD+PMV) * (Distance to PHF)	0.205	0.147
	(0.658)	(0.124)
Observations	1,618	1,618
Controls	YES	YES
Strata FE	YES	YES

Switching from formal to informal health providers may not necessarily lead to worse child health outcomes.

Other Channels

- Resource transfer within household? siblings
  - Children aged 5-12 are more likely to have been infected with malaria (18.6%) compared to children under five (8.5%).
  - Parents are more aware of the symptoms and danger signs of malaria $\Rightarrow$ resource transfer from younger siblings under five to older siblings aged 5-12 who are particularly susceptible to malaria?
    - Run regressions including (siblings * treatment) interaction
    - No intra-household resource transfer
- Change in quality of health services at PHF? phfquality
  - PHFs are occupied with training CDDs $\Rightarrow$ decrease in service quality provided at PHF?
    - Examine changes in PHF quality index
    - No change in quality of PHFs

Addressing Concerns

1. Unforeseen events $\Rightarrow$ poor feeding practices and increased child malnutrition
   - No difference in total value of crops across treatment arms crop
   - Median regression median kernel
2. Survival bias
   - Lower child mortality from malaria in treatment arms $\Rightarrow$ surviving children are weaker
   - No difference in child mortality rate across treatment arms
3. Additional controls addcontrols

6. Conclusion

Conclusion

1. Negative spillover effects of a community-based health intervention on outcomes not directly targeted by the intervention
   - Important to understand how households and community health workers may respond to a supply-side health intervention
2. Suggestive evidence that crowding-out as one of the underlying mechanisms for the negative spillovers
   - CDDs direct resources away from general health-related services
   - Increase in service utilization by non-poor households are more likely to crowd out poor people

Policy Implications

1. When involving community health workers in a disease-specific intervention?
   - Crucial to understand the existing activities provided by community health workers
   - Allocating portion of resources to fill the needs of households that used to rely on community health workers
2. Vertical vs. horizontal approaches to health program?
   - Vertical programs are easier to manage while they might incur unexpected spillover effects on other health outcomes.
   - Integrate disease-specific interventions within the broader health system
3. Inequality concerns of public programs?
   - Programs should be carefully designed so that poor households are not left behind.
   - More consumer awareness campaign are needed to engage poor households to benefit from public programs
   - Involving disadvantaged households in decision-making

Appendix

Literature Review: Community Health Workers

1. Empirical studies:
   - Community health workers have contributed to improving childhood nutrition and reducing child and maternal mortality (Fitzsimons et al. 2016, Björkman Nyqvist et al. 2019).
   - Effectiveness of community health worker programs depends on their design features (Wagner et al. 2020).
2. Qualitative study:
   - Structural factors of a weak health system can produce unintended consequences for community health worker programs, including community health workers moonlighting for multiple organizations (van de Ruit 2016).
3. This study is the first to exploit a randomized-controlled trial to demonstrate the unintended consequences of involving community health workers.

back

Comparable Estimates

1. By providing nutrition-related knowledge to mothers, child height-for-age improved by 0.29 standard deviation in Malawi (Fitzsimons et al. 2016).
2. An increase in food prices in the Philippines, following a cash transfer program, resulted in a 0.4 standard deviation decrease in the height-for-age z-score, and a 34 percent increase in stunting (Filmer et al. 2018).

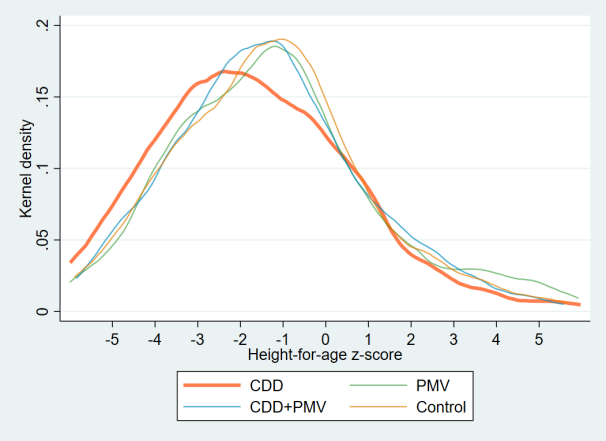
back

Sample Size

Wave	Instrument	CDD	PMV	CDD+PMV	Control	Total
Baseline	PHFs interviewed	70	70	70	70	280
	CDDs interviewed	266		297		563
	PMVs interviewed	143	142	147	130	562
	Households interviewed	1,032	1,037	1,048	1,036	4,153
Endline	PHFs interviewed	70	69	70	70	279
	CDDs interviewed	336		350		686
	PMVs interviewed	139	106	108	150	503
	Households interviewed	1,016	1,094	1,092	1,063	4,265

back

Kernel density of height-for-age z-score



back

Effects on children's physical growth, by ward size

	(1) Height-for-age	(2) Stunting	(3) Weight-for-age	(4) Underweight
Pop * CDD	-1.044***	0.234***	-0.624**	0.032
	(0.359)	(0.073)	(0.309)	(0.058)
Pop * PMV	0.002	0.146*	0.035	-0.012
	(0.459)	(0.082)	(0.315)	(0.064)
Pop * (CDD+PMV)	0.184	0.049	0.360	-0.046
	(0.414)	(0.083)	(0.305)	(0.053)
Population (> 10,000)	Y	Y	Y	Y
Treatment Dummies	Y	Y	Y	Y
Observations	1,618	1,618	1,834	1,834
Controls	YES	YES	YES	YES
Strata FE	YES	YES	YES	YES
Mean of dependent variable	-1.301	0.379	-0.136	0.153

back

Channel: Intra-household resource transfer?

	(1) Height-for-age	(2) Stunting	(3) Weight-for-age	(4) Underweight
Siblings * CDD	-0.089	0.010	0.580*	-0.046
	(0.296)	(0.070)	(0.305)	(0.054)
Siblings * PMV	-0.409	0.024	0.171	-0.045
	(0.343)	(0.071)	(0.291)	(0.048)
Siblings * (CDD+PMV)	-0.249	0.035	0.271	-0.008
	(0.345)	(0.073)	(0.268)	(0.049)
Observations	1,618	1,618	1,834	1,834
Siblings Dummy	Y	Y	Y	Y
Treatment Dummies	Y	Y	Y	Y
Controls	Y	Y	Y	Y
Strata FE	Y	Y	Y	Y

back

Channel: Change in quality of public health facility?

	PHF Quality
CDD	0.063
	(0.240)
PMV	-0.181
	(0.240)
CDD+PMV	0.173
	(0.237)
Constant	-0.015
	(0.169)
Observations	264

PHF Quality Index: (i) availability of reception room; (ii) indoor waiting area; (iii) separate waiting area for women; (iv) air conditioning; (v) observation beds; (vi) water for all working hours; (vii) referral service to other facilities; (viii) transportation service for patients.

back

Concerns: Unforeseen events?

	(1) Total value of crops
CDD	7,317
	(8,136)
PMV	3,563
	(7,609)
CDD+PMV	4,091
	(7,463)
Observations	1,005
Controls	YES
Strata FE	YES
Mean of dependent variable	25,081

back

Robustness: Median Regression

	(1) Height-for-age
CDD	-0.562***
	(0.182)
PMV	-0.030
	(0.179)
CDD+PMV	-0.058
	(0.172)
Observations	1,618
Controls	YES
Strata FE	YES
Mean of dependent variable	-1.301

back

Robustness: Additional Controls

	(1) Height-for-age	(2) Stunting	(3) Weight-for-age	(4) Underweight
CDD	-0.330*	0.092**	0.051	0.029
	(0.178)	(0.039)	(0.173)	(0.027)
PMV	0.170	0.004	0.200	0.004
	(0.207)	(0.042)	(0.170)	(0.027)
CDD+PMV	0.053	-0.004	0.151	0.055**
	(0.194)	(0.039)	(0.173)	(0.025)
Observations	1,618	1,618	1,349	1,834
Control	YES	YES	YES	YES
Strata FE	YES	YES	YES	YES
Mean of dependent variable	-1.301	0.379	-0.136	0.153

back

Ward Size and Number of Households Covered by Each CDD

	(1) Log of number of households covered by each CDD
Log of total population in ward	0.079**
	(0.036)
Constant	2.996***
	(0.333)
Observations	509

back