Reducing Child Mortality in the Last Mile: A Randomized Social Entrepreneurship Intervention in Uganda

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Introduction

MDG 4: "Reduce by two-thirds, between 1990 and 2015, the under-five mortality rate"

1990: 91 deaths per 1000 births $\rightarrow$ 2015: 43 deaths per 1000 births

- $\rightarrow$ target was missed [New SDG 3: 25 deaths per 1000 births by 2030]
- $\rightarrow$ 5.6 million children under-5 died in 2016
  - $\hookrightarrow$ leading causes: birth complications, pneumonia, diarrhoea, malaria
- $\rightarrow$ children in SSA more than 15 times more likely to die

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More than half of the deaths could be prevented with access to simple, affordable interventions (WHO, 2017)

Introduction

"*Community Health Workers should be members of the communities where they work, should be selected by the communities, should be answerable to the communities for their activities, should be supported by the health system but not necessarily a part of its organization, and have shorter training than professional workers.*" (WHO, 1989)

Key advantages:

→ community-based apporach

→ compatible with scarcity of qualified health personnel

→ low cost

Key challenge:

→ weak incentives for CHWs

Introduction

- Systematic reviews suggest overall positive health impact...
  - ↪ Haines et al (2007), Bhutta et al (2010), Christopher et al (2011), Gilmore and McAuliffe (2013)...
- ...but still (surprisingly) scarce rigorous evidence
  - → especially from RCTs (PubMed search) Details
  - → *"...admittedly limited in quality and quantity"* (Haines et al, 2007), *"insufficient evidence is available to draw conclusions for most interventions"* (Gilmore and McAuliffe, 2013)
  - → especially for SSA (*"...there is still little evidence from Africa on the effectiveness of CHWs...large-scale rigorous studies, including RCTs, are now urgently needed."* (Christopher et al, 2011)
- WHO survey (2010) confirmed lack of incentives and sustainability as one of the main challenges

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In this study:

We evaluate (through a RCT) an innovative entrepreneurial model of community health delivery in Uganda

Roadmap

1. The program
2. Study Design
3. Results
4. Conclusion

The program

New CHW program implemented by two NGOs (Living Goods and BRAC):

- women, 18 to 45 years, community members
- 2 weeks initial training (key health and business)
- monthly refreshment trainings
- task: provide a mix of preventive, promotive, and basic curative services

- mixed product line: [***NEW COMPONENT***]
  - → prevention goods (mosquito nets, water purification tablets, vitamins...)
  - → treatments (ORS, zinc, antimalarial drugs...)
  - → consumer goods (pampers, soap, toothpaste...)
- goods bought at wholesale price from local branches and sold with a markup ($\sim$15% on average)
- additional incentives ($\sim$0.7\$) for visiting and assisting pregnant women

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The program

A local door-to-door sales-force, stocked with expertise and a basket of health and consumer goods to:

Diagnose and treat under-5 children

Make prompt referrals to clinics

Provide counselling to pregnant women

Sell affordable health and consumer products

Make a small but steady income

The program


ZINKID


NEW
RESTORS


HABARI
TRIPLE REFINED IODIZED SALT


30 x 24 Tablets
Lumartem
ACTm
Cipla


iiaama
Xtra

Roadmap

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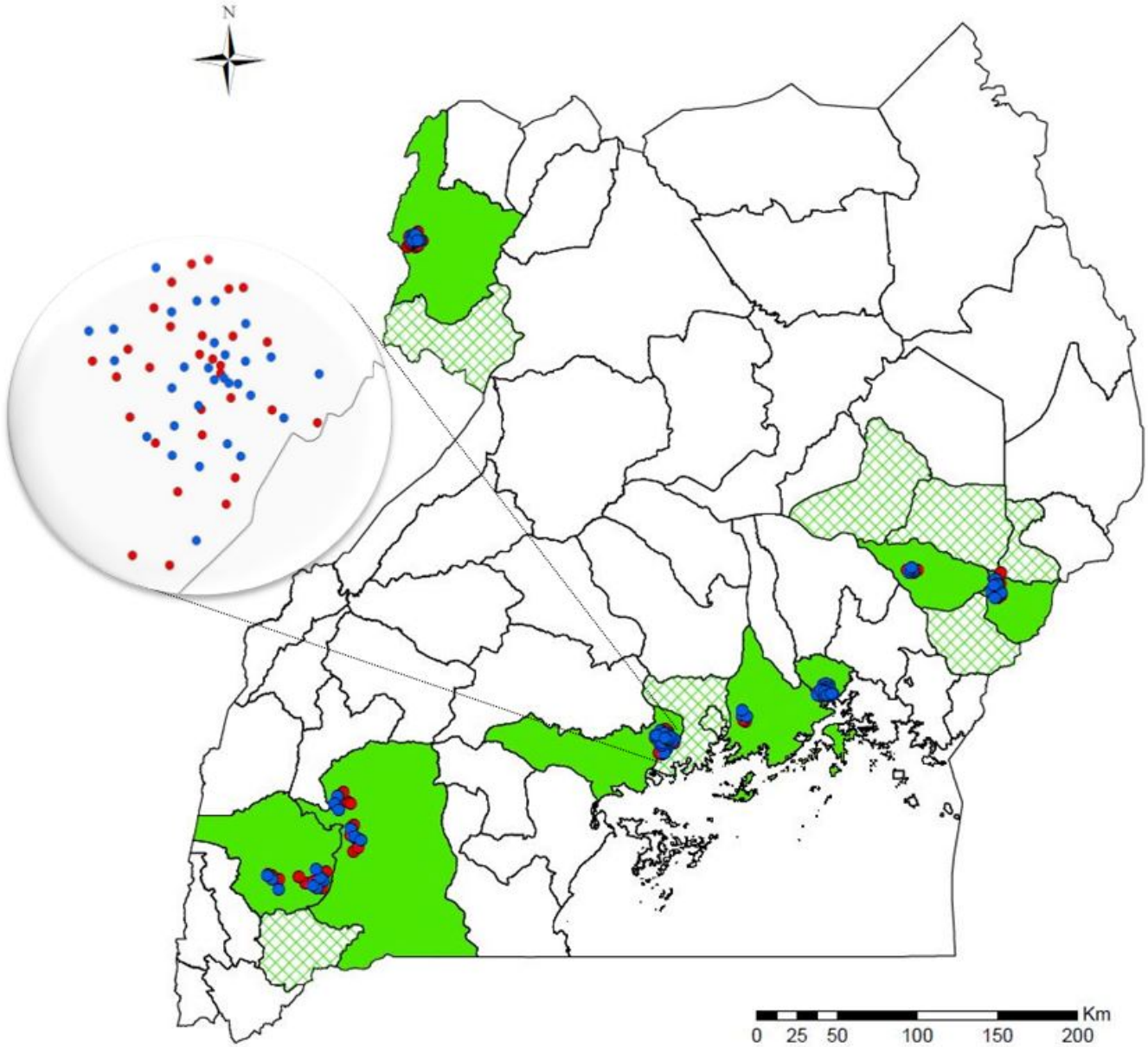
Study Design



Roadmap

Results

Empirical Model

$$Y_{(i,h,)c,b} = \beta ProgramImpact_c + \mu_b + \epsilon_{(i,h,)c,b}$$

→ Y: outcome of interest

→ *ProgramImpact*: indicator for villages that received the program

→ μ: branch fixed effect

→ ϵ: error term

Sample:

- 12 branches b
- 214 clusters (villages) c
- 7,018 households h
- 11,563 children under 5 i

Results

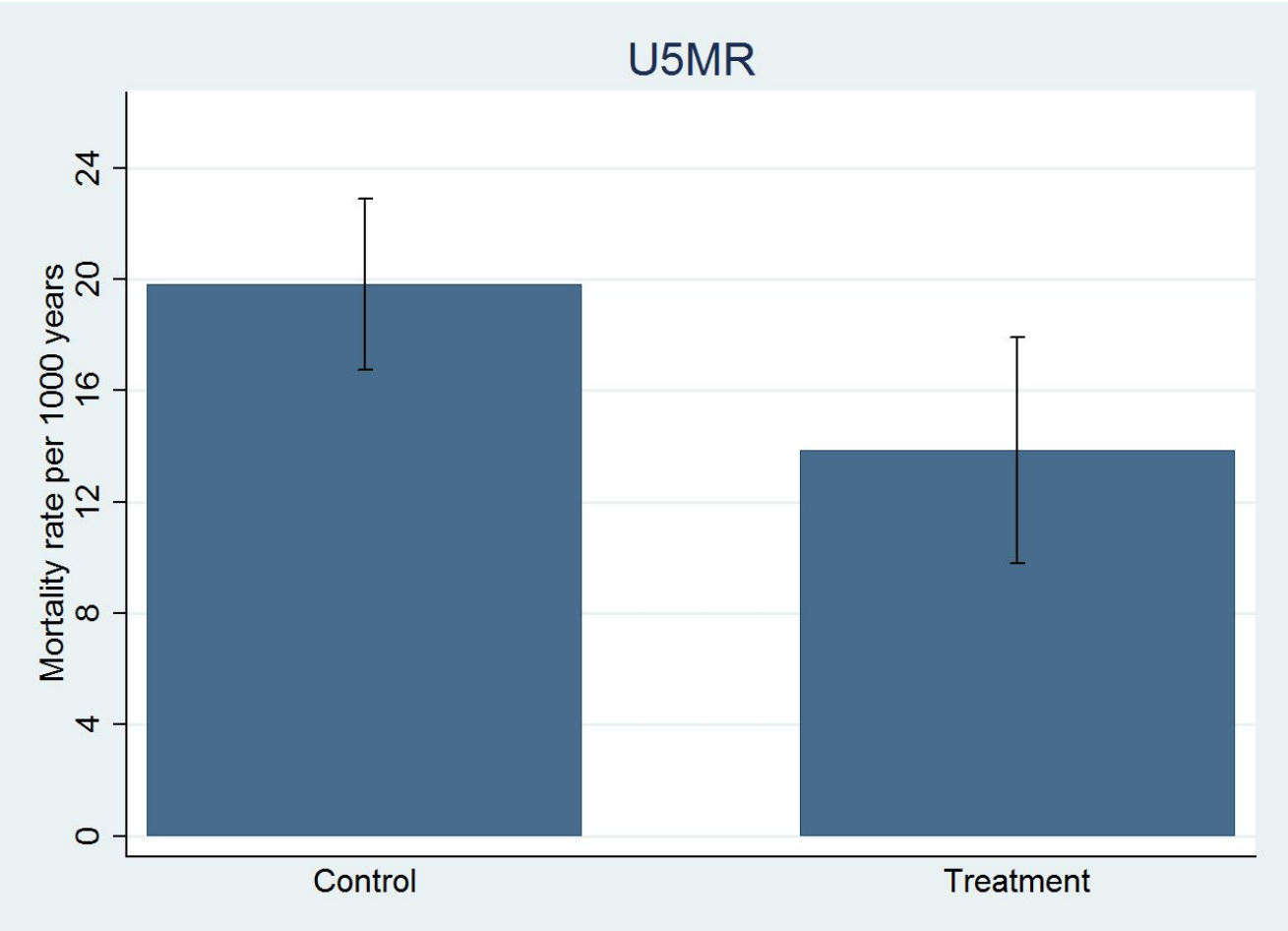
Table: Household interactions with CHWs

Dependent Variable:	HH visited last month (i)	Bought products (ii)	Received advice (iii)	Received follow-up (iv)	Received referral (v)
Program Impact	0.175^{***}	0.218^{***}	0.203^{***}	0.155^{***}	0.059^{***}
	(0.021)	(0.023)	(0.022)	(0.020)	(0.009)
Mean Control Group	0.054	0.129	0.125	0.064	0.032
Branch FE	Yes	Yes	Yes	Yes	Yes
Observations	7018	7018	7018	7018	7018
R^2	0.16	0.23	0.19	0.15	0.03

Notes: *Program Impact* measures the coefficient on the assignment to treatment indicator. Branch fixed effects are included in every regression. There are 12 branches in the sample. Robust standard errors in parentheses, clustered at the cluster level. There are 214 clusters in the sample. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

Results

Impact: Primary health outcome → 27% drop in mortality under 5



↪ Similar effects for Infant or Neonatal mortality ▸ Graphs ▸ Table

Roadmap

Results

Channels

Indication of different channels at work:

i. Improved knowledge and behavior
   ↪ especially concerning malaria and diarrhea Table

ii. Improved access to health services
   ↪ more than 50% increase in follow-up health visits Table

iii. Improved access to high quality health products
   ↪ more likely to buy (guaranteed) drugs from CHWs Table

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Roadmap

1. The program
2. Study Design
3. Results
   - 3.1 Main Outcomes
   - 3.2 Channels
   - 3.3 Cost-Effectiveness
4. Conclusion

Results

Cost-Effectiveness (PRELIMINARY)

- Estimated cost per averted death: $< \$4,500$
- Estimated cost per life-year gained: $< \$75$

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- 35% of estimated cost per life saved that could be achieved by expanding a range of health services known to be effective (Perry and Zulliger, 2012)

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Conclusion

First evidence of the effectiveness of an *entrepreneurial* CHW program

- $\rightarrow$ highly effective: large and significant health effects
- $\rightarrow$ different channels at work
- $\rightarrow$ (preliminary) cost effectiveness figures compares favorably to existing estimates from other programs

Conclusion

First evidence of the effectiveness of an *entrepreneurial* CHW program

- → highly effective: large and significant health effects
- → different channels at work
- → (preliminary) cost effectiveness figures compares favorably to existing estimates from other programs

Policy impact: program is currently being scaled up to reach 5,500 villages and 4.4 million people by 2018 ($\Rightarrow$ second evaluation is ongoing)

Thank you

For further questions / comments / feedback:
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Related Literature

- The health impact of CHW programs
  - → Systematic reviews: Haines et al. (2007), Bhutta et al (2010), Christopher et al (2011), Gilmore and McAuliffe (2013)
  - → PubMed library using *"mortality"*, *"community"*, *"cluster"* and *"trial"*: 9 studies (of which 2 proof-of-principle)
    - → 5 studies find no significant impact on child mortality
    - → large variations in the estimated effects
    - → the 2 proof-of-principle studies on home visits found very large reductions (36-54%)

- The role of financial incentives
  - ↪ Ashraf et al (2017), Deserranno (2017), Bandiera et al. (2011) for overview

- Competition and the market for fake drugs
  - ↪ Björkman-Nyqvist et al (2016)

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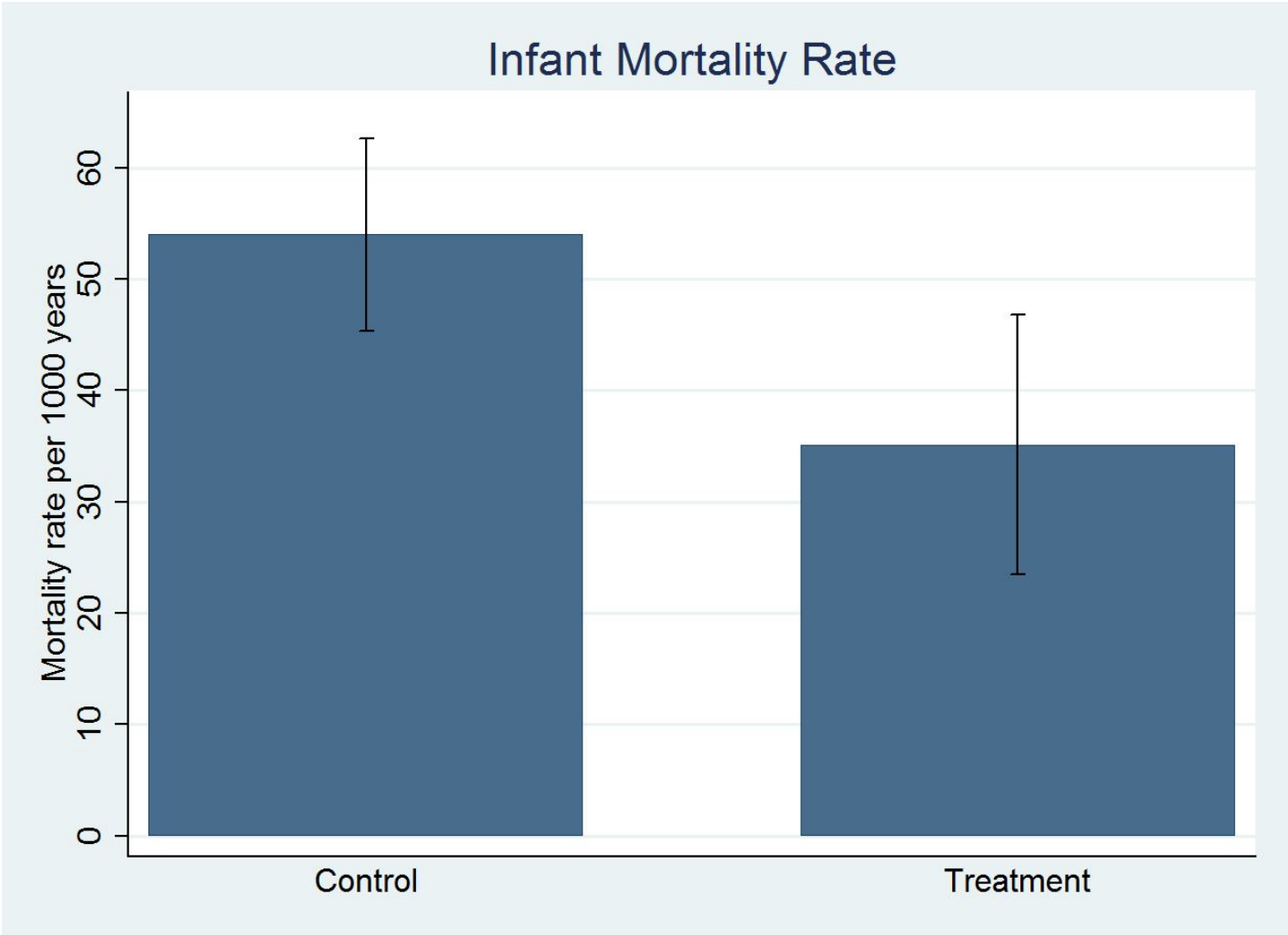
Results - Mortality Outcome



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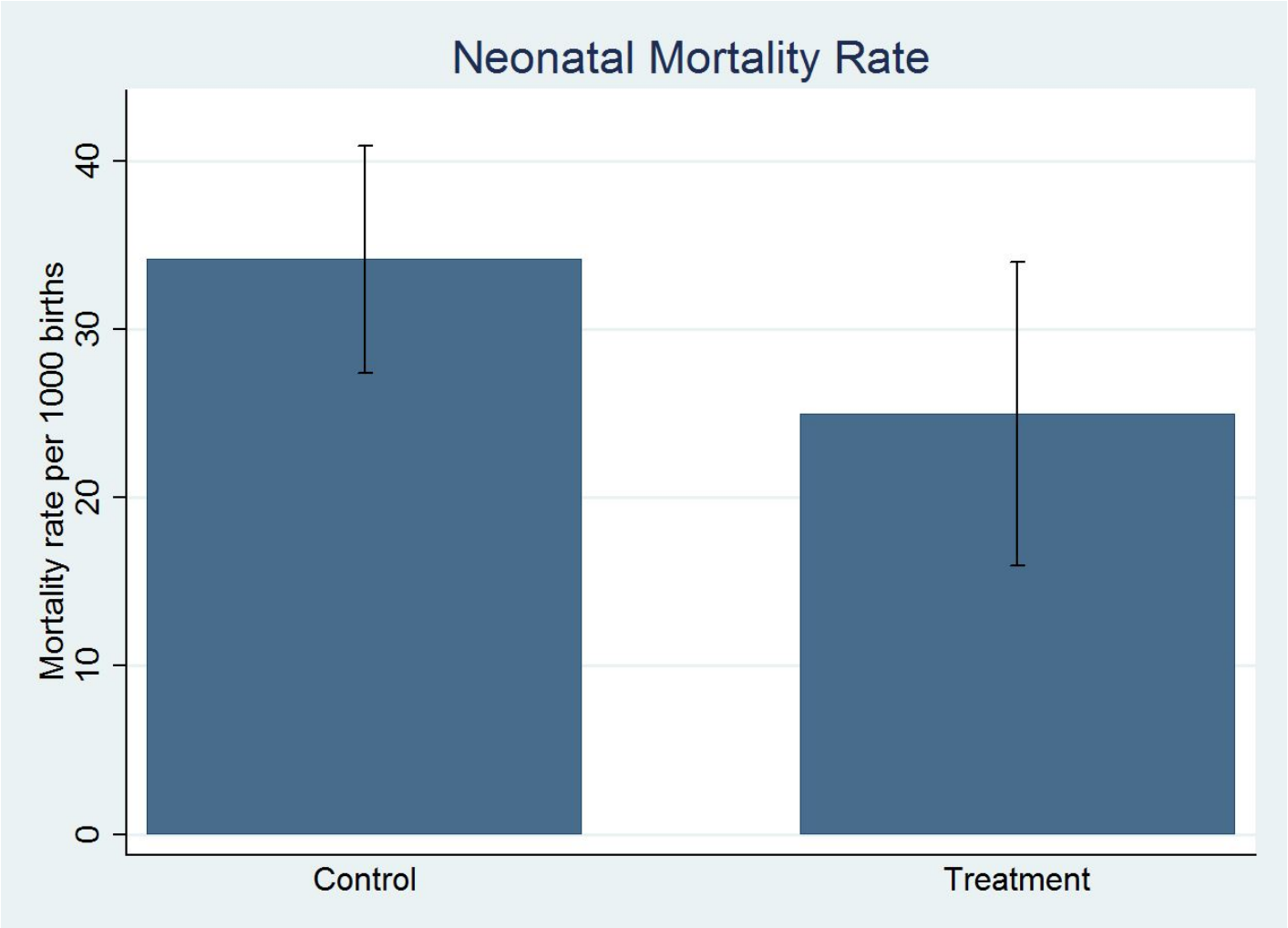

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Results

Table: Child mortality

	Mortality per 1000 years of exposure		
	Under-5 (i)	Infant (ii)	Neonatal (iii)
Program Impact	-5.95^{***}	-18.87^{***}	-9.27^{**}
	(2.06)	(5.94)	(4.62)
Rate Ratio	0.73^{**}	0.67^{***}	0.73^{**}
	(0.09)	(0.09)	(0.11)
Mean Control	19.4	52.7	33.36
Observations	214	214	214

Notes: *Program Impact* measures the coefficient on the assignment to treatment indicator, from a standard OLS regression. *Rate ratios* are derived from a Poisson model, with branch fixed effects and standard errors clustered by village; the number of observations for those specifications are 11,342 (i), 8,808 (ii), and 6,499 (iii). Branch fixed effects are included in every regression. There are 12 branches in the sample. Robust standard errors in parentheses. *Significant at 10% level; **Significant at 5% level; ***Significant at 1% level.

Results

Table: Child mortality

	Number of deaths			Mortality per 1000 live births		
	Under-5 (i)	Infant (ii)	Neonatal (iii)	Under-5 (iv)	Infant (v)	Neonatal (vi)
Program Impact	-0.58^{**}	-0.54^{***}	-0.29^{*}	-19.86^{***}	-17.26^{***}	-9.27^{**}
	(0.23)	(0.19)	(0.15)	(7.23)	(5.35)	(4.62)
Mean Control	2.08	1.62	1.07	68.4	49.7	33.36
Observations	214	214	214	214	214	214

Notes: *Program Impact* measures the coefficient on the assignment to treatment indicator. Branch fixed effects are included in every regression. There are 12 branches in the sample. Robust standard errors in parentheses. *Significant at 10% level; **Significant at 5% level; ***Significant at 1% level.

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Channels - Knowledge

Table: Program Impact on Health Knowledge

Dependent variable	Diarrhea from drinking untreated water (i)	Zinc is effective against diarrhea (ii)	Mosquito bites are the only cause of malaria (iii)	Aware of food with added nutrients (iv)	Bednets can help prevent malaria (v)	Women should deliver at hospital (vi)	Average standardized effect (i) - (vi) (vii)
Program Impact	0.041***	0.036***	0.027***	0.047***	0.001	0.000	0.064***
	(0.012)	(0.012)	(0.009)	(0.016)	(0.002)	(0.001)	(0.014)
Mean Control	0.373	0.227	0.071	0.591	0.991	0.997	
Branch FE	YES	YES	YES	YES	YES	YES	YES
Observations	7,018	7,018	7,018	7,018	6,977	7,018	
R-squared	0.035	0.084	0.056	0.065	0.005	0.005	

Notes: *Program Impact* measures the coefficient on the assignment to treatment indicator. Dependent variables are indicators taking value one if: (i) respondent knows that diarrhea is transmitted by drinking untreated water; (ii) respondent believes that Zinc is effective in treating diarrhea; (iii) respondent believes that mosquito bites are the only cause of malaria; (iv) respondent has ever heard of food with added vitamins or nutrients; (v) respondent believes that bednets can help prevent catching malaria; (vi) respondent believes a woman giving birth should deliver at an hospital or health facility. Results in columns (i) to (vi) are obtained from a standard OLS regression. Column (vii) reports average (standardized) effect size across outcomes, using the seemingly-unrelated regression framework to account for covariance across estimates. Branch fixed effects are included in every regression. There are 12 branches in the sample. Robust standard errors in parentheses, clustered at the cluster level. There are 214 clusters in the sample. *Significant at 10% level; **Significant at 5% level; ***Significant at 1% level.

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Channels - Behavior and Morbidity

Table: Program Impact on Health Behavior and Morbidity

Dependent variable	Treat water before drinking (i)	Child under treated bednet last night (ii)	Child ever received Vitamin A (iii)	Child had malaria over last 3 months (iv)	Child was treated with ACT for $>$ 3 days (v)	Child had diarrhea over last 3 months (vi)	Child was treated with ORS/Zinc (vii)	Average standardized effect (i)-(vii) (viii)
Program Impact	0.038**	0.051***	0.001	-0.013	0.004	0.005	0.053***	0.043***
	(0.015)	(0.014)	(0.012)	(0.014)	(0.015)	(0.009)	(0.020)	(0.013)
Mean Control	0.774	0.402	0.730	0.495	0.668	0.240	0.328	
Branch FE	YES	YES	YES	YES	YES	YES	YES	YES
Observations	7,013	10,953	10,953	10,931	5,422	10,934	2,686	
R-squared	0.190	0.227	0.006	0.057	0.016	0.018	0.019	

Notes: *Program Impact* measures the coefficient on the assignment to treatment indicator. Dependent variables are indicators taking value one if: (i) respondent treats the water before drinking it; (ii) the child slept under a treated bednet during the previous night; (iii) the child ever received a Vitamin A dose; (iv) the child ever fell sick with malaria during the previous 3 months; (v) the child that fell sick with malaria was treated with ACT drug for (at least) 3 days; (vi) the child ever fell sick with diarrhea during the previous 3 months; (vii) the child that fell sick with diarrhea was treated with ORS/Zinc. Results in columns (i) to (vii) are obtained from a standard OLS regression. Column (viii) reports average (standardized) effect size across outcomes (i) to (vii), using the seemingly-unrelated regression framework to account for covariance across estimates. Branch fixed effects are included in every regression. There are 12 branches in the sample. Robust standard errors in parentheses, clustered at the cluster level. There are 214 clusters in the sample. *Significant at 10% level; **Significant at 5% level; ***Significant at 1% level.

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Channels - Health Visits

Table: Program Impact on Health Visits

Dependent variable	Follow up visit...					Average standardized effect
	...in first week after delivery	...after child sick with malaria	...after infant sick with malaria	...after child sick with diarrhea	...after infant sick with diarrhea	
	(i)	(ii)	(iii)	(iv)	(v)	(vi)
Program impact	0.081***	0.061***	0.073***	0.043**	0.081**	0.248***
	(0.020)	(0.014)	(0.028)	(0.017)	(0.037)	(0.066)
Mean Control	0.114	0.084	0.067	0.069	0.077	
Branch FE	YES	YES	YES	YES	YES	YES
Observations	1,925	5,335	631	2,228	408	
R-squared	0.074	0.096	0.147	0.077	0.144	

Notes: *Program Impact* measures the coefficient on the assignment to treatment indicator. Dependent variables are indicators taking value one if the household received a follow up visit by an health care provider or community health worker: (i) in the first week after delivery; (ii) after a child under-5 fell sick with malaria; (iii) after a child under-1 fell sick with malaria; (iv) after a child under-5 fell sick with diarrhea; (v) after a child under-1 fell sick with diarrhea. Results in columns (i) to (v) are obtained from a standard OLS regression. Column (vi) reports average (standardized) effect size across outcomes (i) to (v), using the seemingly-unrelated regression framework to account for covariance across estimates. Branch fixed effects are included in every regression. There are 12 branches in the sample. Robust standard errors in parentheses, clustered at the cluster level. There are 214 clusters in the sample. *Significant at 10% level; **Significant at 5% level; ***Significant at 1% level.

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Channels - Health Products

Table: Access to high quality health products

Dependent Variable:	Child treated with ACT full dose (i)	...bought from CHW (ii)	Child treated with ORS/Zinc (iii)	...bought from CHW (iv)
Program Impact	0.004	0.089***	0.053***	0.102***
	(0.015)	(0.018)	(0.020)	(0.036)
Mean Control Group	0.668	0.019	0.328	0.039
Branch FE	Yes	Yes	Yes	Yes
Observations	5422	3508	2686	1125
R-squared	0.02	0.09	0.02	0.12

Notes: *Program Impact* measures the coefficient on the assignment to treatment indicator. Branch fixed effects are included in every regression. There are 12 branches in the sample. Robust standard errors in parentheses, clustered at the cluster level. There are 214 clusters in the sample. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

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Study Design - Balance checks

Table: Baseline Characteristics

Variables	Treatment Group	Control Group	p-value
Number of clusters	115	99	
Households per cluster	250 (113)	221 (107)	0.226
Households with under-5 children per cluster	86 (47)	78 (46)	0.665
Distance to main road	5.6 (11.6)	6.8 (12.7)	0.126
Distance to electricity transmission line	1.8 (1.5)	1.8 (1.5)	0.707
Distance to health center	1.4 (1.1)	1.7 (1.2)	0.256
Number of health centers within 5 km	8.3 (5.0)	7.3 (5.2)	0.459
Distance to hospital	10.4 (8.5)	11.1 (8.5)	0.916

Notes: Cells report mean (SD) across clusters included in the treatment or control group. A variety of sources were consulted to generate the original dataset, including documents and maps from national utilities, regional power pools, and the World Bank. Information on households and households with under-5 children per cluster was collected from the enumeration of trial villages at baseline. Data for medium and high voltage electricity transmission lines was obtained from the Africa electricity transmission network (AICD) study. Health Centers takes into account facilities from HCIII (i.e. parish-level health centers, roughly one per 5,000 people) and above. Hospitals refer only to district/national hospitals (roughly one per 500,000 people). Distance measures are all expressed in kilometers.

Study Design - Balance checks

Table: Baseline Characteristics of Households not Lost to Follow-up and Surveyed at Endline

Variables	Treatment Group	Control Group	p-value
A. Infant mortality			
Years of exposure to risk of death under 1 year	1927	1743	
Deaths under 1 year	101	87	
Mortality rate per 1000 years of exposure	52.4	50.0	0.830
B. Households			
Number of household	3787	3217	
Household size	5.2 (2.3)	5.3 (2.3)	0.518
Age household head	36.4 (12.1)	36.7 (12.4)	0.641
Years of education household head	8.0 (0.4)	8.0 (0.2)	0.320

Notes: Cells report mean (SD) from endline sample household survey data for household that have remained in the cluster throughout the trial, with values scaled back to baseline period.