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

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David Yanagizawa-Drott\textsuperscript{4}

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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 → 2015: 43 deaths per 1000 births

→ target was missed [New SDG 3: 25 deaths per 1000 births by 2030]
→ 5.6 million children under-5 died in 2016
    → leading causes: birth complications, pneumonia, diarrhoea, malaria
→ 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 approach
- compatible with scarcity of qualified health personnel
- low cost

Key challenge:
- weak incentives for CHWs
Introduction

- Systematic reviews suggest overall positive health impact...

- ...but still (surprisingly) scarce rigorous evidence
  - especially from RCTs (PubMed search)
  - “...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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    (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

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 (∼15% on average)
▶ additional incentives (∼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
Roadmap

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Study Design
Roadmap

1. The program

2. Study Design

3. Results
   3.1 Main Outcomes
   3.2 Channels
   3.3 Cost-Effectiveness

4. Conclusion
Results
Empirical Model

\[ Y_{(i,h),c,b} = \beta \text{ProgramImpact}_c + \mu_b + \epsilon_{(i,h),c,b} \]

→ \( Y \): outcome of interest
→ \( \text{ProgramImpact} \): indicator for villages that received the program
→ \( \mu \): branch fixed effect
→ \( \epsilon \): error term

Sample:
- 12 branches \( b \)
- 214 clusters (villages) \( c \)
- 7,018 households \( h \)
- 11,563 children under 5 \( i \)
Table: Household interactions with CHWs

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

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 $\rightarrow$ 27% drop in mortality under 5

$\rightarrow$ Similar effects for Infant or Neonatal mortality
Roadmap

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4. Conclusion
Results

Channels

Indication of different channels at work:

i. Improved knowledge and behavior
   \[\leftrightarrow\] especially concerning malaria and diarrhea

ii. Improved access to health services
    \[\leftrightarrow\] more than 50% increase in follow-up health visits

iii. Improved access to high quality health products
    \[\leftrightarrow\] more likely to buy (guaranteed) drugs from CHWs
Results

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Results
Cost-Effectiveness (PRELIMINARY)

- Estimated cost per averted death: < $4,500
- Estimated cost per life-year gained: < $75
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- The (few) existing estimates from other CHW programs range from $82 (Kenya) to $3,396 (Indonesia) per life-year gained (Borghi et al, 2005; McPake et al, 2015)
Results
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- The (few) existing estimates from other CHW programs range from $82 (Kenya) to $3,396 (Indonesia) per life-year gained (Borghi et al, 2005; McPake et al, 2015)

- A child under-5 in SSA is estimated to contribute ~$65k in economic activity over lifetime (Dahn et al, 2015)
  ⇒ returns > 15:1
Results
Cost-Effectiveness (PRELIMINARY)

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

- The (few) existing estimates from other CHW programs range from $82 (Kenya) to $3,396 (Indonesia) per life-year gained (Borghi et al, 2005; McPake et al, 2015)

- A child under-5 in SSA is estimated to contribute $\sim 65k in economic activity over lifetime (Dahn et al, 2015)
  \[ \Rightarrow \text{returns} > 15:1 \]

- 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

→ highly effective: large and significant health effects

→ different channels at work

→ (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 (⇒ second evaluation is ongoing)
Thank you

For further questions / comments / feedback:

guarisoa@tcd.ie
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)
Results - Mortality Outcome

![Infant Mortality Rate Graph]

The graph depicts the infant mortality rate per 1000 years in the control and treatment groups. The control group shows a higher mortality rate compared to the treatment group.
Results - Mortality Outcome

Neonatal Mortality Rate

Mortality rate per 1000 births

Control

Treatment
Results

Table: Child mortality

<table>
<thead>
<tr>
<th></th>
<th>Under-5 (i)</th>
<th>Infant (ii)</th>
<th>Neonatal (iii)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Program Impact</td>
<td>-5.95***</td>
<td>-18.87***</td>
<td>-9.27**</td>
</tr>
<tr>
<td></td>
<td>(2.06)</td>
<td>(5.94)</td>
<td>(4.62)</td>
</tr>
<tr>
<td>Rate Ratio</td>
<td>0.73**</td>
<td>0.67***</td>
<td>0.73**</td>
</tr>
<tr>
<td></td>
<td>(0.09)</td>
<td>(0.09)</td>
<td>(0.11)</td>
</tr>
<tr>
<td>Mean Control</td>
<td>19.4</td>
<td>52.7</td>
<td>33.36</td>
</tr>
<tr>
<td>Observations</td>
<td>214</td>
<td>214</td>
<td>214</td>
</tr>
</tbody>
</table>

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.
Table: Child mortality

<table>
<thead>
<tr>
<th></th>
<th>Number of deaths</th>
<th></th>
<th>Mortality per 1000 live births</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Program Impact</td>
<td>$-0.58^{**}$</td>
<td>$-0.54^{***}$</td>
<td>$-0.29^*$</td>
<td>$-19.86^{***}$</td>
</tr>
<tr>
<td></td>
<td>(0.23)</td>
<td>(0.19)</td>
<td>(0.15)</td>
<td>(7.23)</td>
</tr>
<tr>
<td>Mean Control</td>
<td>2.08</td>
<td>1.62</td>
<td>1.07</td>
<td>68.4</td>
</tr>
<tr>
<td>Observations</td>
<td>214</td>
<td>214</td>
<td>214</td>
<td>214</td>
</tr>
</tbody>
</table>

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# Channels - Knowledge

**Table:** Program Impact on Health Knowledge

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

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.
## Channels - Behavior and Morbidity

**Table: Program Impact on Health Behavior and Morbidity**

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

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.
## Channels - Health Visits

### Table: Program Impact on Health Visits

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

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.
Channels - Health Products

**Table:** Access to high quality health products

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

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. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.*
### Study Design – Balance checks

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

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**

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

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.
## Threats - Migration

### Table: Population Data and Flows

<table>
<thead>
<tr>
<th></th>
<th>Intervention group (115 clusters)</th>
<th>Control group (99 clusters)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rate of in-migration</td>
<td>0.16 (0.12)</td>
<td>0.15 (0.11)</td>
<td>0.478</td>
</tr>
<tr>
<td>Rate of out-migration</td>
<td>0.07 (0.13)</td>
<td>0.07 (0.13)</td>
<td>0.991</td>
</tr>
<tr>
<td>Share of migrants</td>
<td>0.14 (0.09)</td>
<td>0.13 (0.08)</td>
<td>0.614</td>
</tr>
</tbody>
</table>

Notes: Data are mean (SD) estimated by combining data from baseline census, endline census, and endline sample household survey. P-values are adjusted for the stratified randomized design. Rate of in-migration is $i_j / b_j$ and rate of out-migration is $o_j / b_j$, where $i_j = \hat{\theta}_j \times e_j$, $o_j = b_j - (i_j - \hat{\theta}_j \times e_j$, $b_j$ is number of households residing in cluster $j$ at baseline, $e_j$ is number of households residing in cluster $j$ at endline, and the share of migrants $\hat{\theta}_j$ is an estimate of the share of households in cluster $j$ that moved in to the cluster during the trial period, out of the total number of households living in the cluster at endline, based on the sample household survey.
## Results - Health Outcomes

### Table: Additional Health Outcomes

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Height-for-age</th>
<th>Weight-for-height</th>
<th>Hemoglobin</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>z-score (i)</td>
<td>z-score&lt;-2 (ii)</td>
<td></td>
</tr>
<tr>
<td>Program Impact</td>
<td>0.048</td>
<td>-0.019*</td>
<td>0.128***</td>
</tr>
<tr>
<td></td>
<td>(0.042)</td>
<td>(0.010)</td>
<td>(0.041)</td>
</tr>
<tr>
<td>Mean Control</td>
<td>-1.166</td>
<td>0.280</td>
<td>11,217</td>
</tr>
<tr>
<td>Branch FE</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Observations</td>
<td>10,570</td>
<td>10,570</td>
<td>10,568</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.009</td>
<td>0.009</td>
<td>0.053</td>
</tr>
</tbody>
</table>

Notes: *Program Impact* measures the coefficient on the assignment to treatment indicator, from a standard OLS regression. 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.
## Results - Mortality Outcome

**Table: Child mortality**

<table>
<thead>
<tr>
<th></th>
<th>Neonates (under 1m)</th>
<th>Infant (under 1y)</th>
<th>Children (under 5y)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Exposure to risk of death</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Treatment</em></td>
<td>3521</td>
<td>3553</td>
<td>12294</td>
</tr>
<tr>
<td><em>Control</em></td>
<td>2978</td>
<td>3015</td>
<td>10731</td>
</tr>
<tr>
<td><strong>Deaths</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Treatment</em></td>
<td>98</td>
<td>134</td>
<td>183</td>
</tr>
<tr>
<td><em>Control</em></td>
<td>106</td>
<td>160</td>
<td>206</td>
</tr>
<tr>
<td><strong>Mortality rate</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Treatment</em></td>
<td>27.8</td>
<td>37.7</td>
<td>14.9</td>
</tr>
<tr>
<td><em>Control</em></td>
<td>35.6</td>
<td>53.1</td>
<td>19.2</td>
</tr>
<tr>
<td><strong>Adjusted rate ratio for MR</strong></td>
<td>0.73**</td>
<td>0.67***</td>
<td>0.73**</td>
</tr>
<tr>
<td>95% CI</td>
<td>(0.55 - 0.98)</td>
<td>(0.51- 0.87)</td>
<td>(0.58 - 0.93)</td>
</tr>
</tbody>
</table>

Note: Exposure is measured in number of births for neonatal mortality and in years of exposure to the risk of death under 12 or 59 months for infant and under-five mortality, respectively. Adjusted rate ratios are computed using a Poisson model, adjusting for stratified randomization. Confidence intervals are constructed using robust standard errors clustered at the cluster (village) level. ***p < 0.01, **p < 0.05, *p < 0.1
**Threats - distorted incentives**

**Table: Under 5 mortality by wealth quartile**

<table>
<thead>
<tr>
<th></th>
<th>Quartile I</th>
<th>Quartile II</th>
<th>Quartile III</th>
<th>Quartile IV</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Years of exposure</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Treatment</em></td>
<td>3547</td>
<td>2918</td>
<td>3075</td>
<td>2724</td>
</tr>
<tr>
<td><em>Control</em></td>
<td>3121</td>
<td>2750</td>
<td>2500</td>
<td>2321</td>
</tr>
<tr>
<td><strong>Deaths under 5</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Treatment</em></td>
<td>57</td>
<td>42</td>
<td>42</td>
<td>41</td>
</tr>
<tr>
<td><em>Control</em></td>
<td>58</td>
<td>53</td>
<td>48</td>
<td>45</td>
</tr>
<tr>
<td><strong>Mortality rate</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Treatment</em></td>
<td>16.1</td>
<td>14.4</td>
<td>13.7</td>
<td>15.1</td>
</tr>
<tr>
<td><em>Control</em></td>
<td>18.6</td>
<td>19.3</td>
<td>19.2</td>
<td>19.4</td>
</tr>
<tr>
<td><strong>Adjusted rate ratio for MR</strong></td>
<td>0.83</td>
<td>0.73</td>
<td>0.64</td>
<td>0.72</td>
</tr>
</tbody>
</table>

Notes: Data are n and mortality rates from endline sample household survey. Wealth has been computed combining eight variables capturing ownership of durable assets (two sets of clothes for each household member, mobile phone, radio and television), infrastructure and housing characteristics (electricity, roof and floor material) and consumption habits (number of meals containing fish or meet served in a week), using Principal Component Analysis (PCA). The wealth index increases moving from quartile I to quartile IV. For 22 households asset information is missing.
Outcomes

Kernel density estimate

Kernel = epanechnikov, bandwidth = 2.1e+04
Outcomes
Conclusion

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