

Study title: Measles Vaccination Cash Incentives: Experimental Evidence from Nigeria

Names of Principal Investigators: Steven Brownstone, Maureen Stickel, Allison Connor, Dan Stein, Surili Sheth

Report prepared by: Surili Sheth, Dan Stein

Date: May 23, 2017

Date last revised: July 7, 2017

New Incentives measles vaccination program:

Pre-Analysis Plan

I. Introduction

IDinsight is conducting a randomized controlled trial to assess the impact of various sized cash incentives for caretakers of infants that require a measles vaccination on the completion rate for the vaccine in Nigeria. The purpose of the experiment is to help New Incentives (NI) determine the optimal size of the incentive as they scale to the North West region of Nigeria.

This pre-analysis plan documents the key research questions the evaluation will seek to answer, and specifies the analysis that will be performed for each question. It will be registered on 3ie's RIDIE evaluation registry.

This plan was written before commencing the analysis of the data collected through the clinics, from May-July 2017. Data collection has already started, as the data is collected in real-time when caretakers come to the clinic with their infants to get the vaccination.

Ia. Evaluation background

Intervention

In Nigeria, a child is considered fully vaccinated if he or she has received: a) a BCG vaccination against tuberculosis (at birth or as soon as possible after birth); b) three doses of DPT to prevent diphtheria, pertussis (whooping cough), and tetanus (at 6, 10, and 14 weeks of age); c) at least three doses of polio vaccine (at birth and at 6, 10, and 14 weeks of age); and d) one dose of the measles vaccine (at 9 months of age). "All of these vaccinations should be received during the first year of life, over the course of five visits, including the doses delivered at birth. According to this schedule, children aged 12-23 months would have completed their immunizations and be fully immunized" (Ophori et al. 2013).

The DHS survey in 2013 and the 2015 UNICEF-led SMART survey both reported 22% coverage for Measles in North West Nigeria – the region assumed to have the lowest vaccination coverage rates in Nigeria (IDinsight 2017). There are a number of potential drivers of this low immunization coverage in Northern Nigeria, particularly demand-side factors. There are a number of individual mother-specific explanations that seem to be drivers.

New Incentives hopes to overcome individual barriers to vaccination by offering mothers a conditional cash transfer for vaccinating their babies. This is based on evidence that small incentives can have a large impact on health behaviors like immunization rates ([Banerjee et al 2010](#)), and evidence that that this finding could apply to immunizations in Nigeria ([Sato 2014](#)) (New Incentives 2017). While the measles vaccination visit already has a higher incentive, based on cost-effectiveness calculations by GiveWell, an even higher cash amount could still be cost-effective given the low status quo completion rates and the relatively high benefit of the measles vaccine in particular on health outcomes. Additionally, these small cash transfers can provide some material benefit to new mothers from poor communities, at the minimum, covering them for time and transport costs.

Figure 1. New Incentives Status Quo CCT Model

Model 1	Stage:	Birth	6 weeks	10 weeks	14 weeks	9 months
	Amount:	N500	N500	N500	N500	N2,000
	Condition:	-BCG	-Penta1, PCV1*	-Penta2, PCV2*	-Penta3, PCV3*	-MV
Model 2	Stage:	Birth	6 weeks	10 weeks	14 weeks	9 months
	Amount:	N1,000	N1,000	N1,000	N1,000	N3,000
	Condition:	-BCG	-Penta1, PCV1*	-Penta2, PCV2*	-Penta3, PCV3*	-MV
* = if available at clinic. PCV rollout will be completed in most Nigerian states in 2016.						
Hep B0, OPV1-3, IPV and YV are also part of the above vaccination visits, however, will not be enforced as part of transfer conditionality.						
TT is not included for several reasons: vaccinations take place on a different day; some women only require one vaccination which is already given on the ANC registration day (=high baseline). New Incentives has found that incentives increase ANC registrations but does not believe this is a foremost priority to focus on and prove at this stage.						

Source: New Incentives, Pilot: CCTs for Immunizations - November 2016 to February 2017

Since NI is unsure of the optimal size of the measles incentive as they scale to the North West, IDinsight is conducting a study to test the effect of different cash incentive amounts for the measles visit. The study will be conducted in 9 NI pilot clinics across 3 states: Nassarawa (in the north), Anambara (in the south), and Aqwa Ibom (in the south). These clinics were selected for their basic supply-side readiness and for having median retention¹ rates. However, NI plans to focus scale-up in North West Nigeria given its particularly low vaccination coverage rates. Since the pilot states are more wealthy than the states in the North West, estimates from the pilot states will likely provide a lower bound on the impact of increasing incentive sizes in the North West.

The pilot study started in May 2017. The experiment will obtain estimates of the effect of different cash transfer amounts on completion of the last visit in the CCTs for routine immunizations (RI) program which is the visit for Measles 1 during the study period (May-July 2017).

Treatment arms

NI will call randomly selected mothers due for measles in the coming months and inform some that they will receive a larger incentive than they were originally told. In order to address the issue that

¹ Retention is defined in this context as the number of babies who start the vaccination schedule that complete the schedule 9 months later.

calling mothers in itself may have an effect on retention, some mothers will simply receive calls reminding them they will receive the amount they were previously told they would receive.

The study design is complicated by the fact that mothers are currently divided into two groups. In the first group, Model 1 clinics, the mothers are expecting a 2,000 Naira incentive for measles while in the second group, Model 2 clinics, the mothers are expecting a 3,000 Naira incentive for the same.

An illustration of the four arms of the experiment is provided below:

Figure 2. Treatment arms

Treatment	Model 1 Clinics	Model 2 Clinics
Status Quo	2,000 Naira Incentive without a reminder call	3,000 Naira Incentive without a reminder call
Reminder Call	2,000 Naira Incentive with a reminder call	3,000 Naira Incentive with a reminder call
1,000 Naira Bonus	3,000 Naira Incentive with a reminder call	4,000 Naira Incentive with a reminder call
3,000 Naira Bonus	5,000 Naira Incentive with a reminder call	6,000 Naira Incentive with a reminder call

Unit of treatment

The unit of treatment is the individual caretaker (mother).

Summary of evaluation method

A randomized controlled trial (RCT) will be employed to establish causal impact of the different incentive amounts on the probability of a mother completing the measles visit.

The final analysis will be done using a Linear Probability Model (LPM) specification.

Secondary analysis will include using a probit specification to test robustness, and a model using a continuous independent variable to denote the amount of the incentive, to provide some indications as to the elasticity of coverage to incentive amount.

Finally, we will use GiveWell's cost-effectiveness model to convert potential measles coverage rates into cost-effectiveness of the program.

Evaluation primary objective

To examine the impact of reminder calls and the level of cash incentives on the magnitude of increase rate of conducting the measles vaccine

Ib. Summary of data collection

Administrative setup

There are three New Incentives pilot clinics in each of three states in different parts of Nigeria. They each administer to a defined catchment area. The only form of advertising the vaccination program to caretakers (mothers) is a small poster immediately outside the clinic, and word of mouth.

Implementation and identification

When mothers arrive at the clinic, they are given numbers that determine the order that their babies will be vaccinated in.

Step 1: Paperwork

When a mother is called up, a nurse will complete paperwork:

1. Fill out the **clinic child health register**. This contains a child's complete vaccination history, phone number, and follow-up address.
2. Fill out the baby's **child health card**, which the mother is supposed to keep at home between visits. If this has been lost, the mother is issued a new one using the information in the child health register, or a duplicate card kept at the clinic.
3. Tally vaccine doses on a **tally sheet**, which is aggregated through the local government area and state administrative areas to determine coverage rates.

Step 2: Vaccination

Mothers are referred to nurses administering the vaccine. These nurses put a gold dot using a gold pen on the baby's child immunization card to prevent babies from going directly to the incentive table and skipping the vaccination station.

Step 3: Enrollment

To be eligible for enrollment in the incentives program, mothers must either have never vaccinated² or have record of receiving BCG, the first vaccine on the schedule, at the clinic where New Incentives is operating. As long as mothers have not received BCG at another clinic, they can enroll in the incentive program at any stage in the vaccination schedule. When enrolled, mothers receive a **card that illustrates the incentive structure** and has their **unique ID code**, which is also placed on the mother's child health card.

Measles vaccination incentive eligibility: All mothers in evaluation clinics, enrolled in the New Incentive program and are 9 months or older are eligible to receive the measles vaccine and are part of the study. Mothers who have eligible children at the beginning of the study were called immediately, and as additional children become eligible they are also called, approximately 2 weeks prior to the due date.

Step 4. Payment

² This can be easily verified by the absence of a BCG scar

Once a baby’s eligibility is confirmed, the staff member pays the mother the appropriate amount. This is recorded 4 times: electronically using a smartphone, on a paper tally sheet, by taking a photo of the mother with her cash, and a photo of the mother’s child health card so that other NI staff can verify that the field staff is correctly determining eligibility. A blue dot is applied to the child health card to guard against double payment. The card is also stamped to guard against card forgery.

Sampling

The sampling frame for the evaluation consists of 1,088 measles eligible mothers (see above for definition) who had received PENTA 3 and thus due for measles³ at the 9 pilot clinics. Study eligible mothers were randomly allocated equally into one of the four treatment arms, stratified by clinic. See Figure 3 for the number of mothers sampled in each treatment arm.

Figure 3. Sampling

Treatment	Model 1 Clinics	Model 2 Clinics	Total mothers sampled
Status Quo	2,000 Naira Incentive without a reminder call	3,000 Naira Incentive without a reminder call	273
Reminder Call	2,000 Naira Incentive with a reminder call	3,000 Naira Incentive with a reminder call	272
1,000 Naira Bonus	3,000 Naira Incentive with a reminder call n = 95	4,000 Naira Incentive with a reminder call n = 176	271
3,000 Naira Bonus	5,000 Naira Incentive with a reminder call n = 96	6,000 Naira Incentive with a reminder call n = 176	272

Types of data

- **Primary dataset to be used**
 - **New Incentives electronic administrative data.** At the time of payment for each vaccination, clinic staff inputs data electronically into a New Incentives database. This centralized administrative dataset contains information including: clinic, unique ID, DOB of the infant, vaccination date for each vaccination received at the clinic (inputted from the child health card), amount received for each vaccination, date provided to caretaker for the next vaccination, caretaker phone number and follow-up address, and transportation cost for the caretaker to come to the clinic.

³ The fraction of mothers who do not follow the routine immunization schedule is low. Out of the 1,088 infants randomized, only 72 skipped a vaccination prior to PENTA 3. 40 of those skipped vaccinations were BCG for which infants are often age ineligible.

- **Secondary dataset**

- **Phone data.** Each caretaker who is assigned to any group except for the Status Quo groups, will be called 10 times across 5 different days at varying times of day (to account for phones being out of network or battery at particular times or days). Hotline operators fill out a call log any time that they make a call. This dataset has information about whether and when the caretaker received the call, the experimental group she is in, and the infant's immunization status on the date of the call. This dataset will be used to verify whether each caretaker in the non-Status Quo experimental groups actually received a phone call. Note: everyone, both treatment and control group participants, receive an SMS reminder.

Unit of analysis

The unit of analysis is the individual caretaker (mother).

Data Collection

Data will be collected from the New Incentives electronic administrative data in May-July 2017.

II. Primary research questions

Research Questions

1. Does a phone call reminder result in higher measles vaccination rates?
2. Which incentive amount results in the highest likelihood of completing the measles vaccination visit?

Specification

We will estimate the following LPM regression specification:

$$Y_i = \beta_0 + \beta_1 * T_{2000i} + \beta_2 * T_{3000_1i} + \beta_3 * T_{3000_2i} + \beta_4 * T_{4000i} + \beta_5 * T_{5000i} + \beta_6 * T_{6000i} + \gamma_1 * X_i + \gamma_2 * D_i + \delta \rho_i + \theta \alpha_j + \varepsilon_i$$

where:

- $Y_i = 1$ if the eligible caretaker i came to the clinic for her infant's measles vaccination during the study period, and = 0 if not.
- $T_{amounti} = 1$ if the caretaker is called and offered the incentive amount indicated in the subscript, = 0 if not. T_{3000_1i} refers to caretakers that came to clinics where the baseline amount of transfer was 2000, and T_{3000_2i} refers to caretakers who came to clinics where the baseline amount of transfer was 3000.
- X_i is the cost of one-way transportation to the clinic for caretaker i
- D_i is the number of days between the date of the phone call reminder and the measles vaccination due date
- ρ_i is a vector of dummies corresponding all previous vaccinations that the infant of caretaker i could have received at the same clinic
- α_j is a vector of dummies, where j indexes pilot clinics
- ε_i is the error term for caretaker i

Estimation

We will estimate this model in Stata using the following syntax:

```
reg measles incent_2 incent_3a incent_3b incent_4 incent_5 incent_6 transport days bcg  
penta1 pcv1 penta2 pcv2 penta3 pcv3 i.clinic, r
```

Estimates of the average treatment effects will be calculated using a linear probability model (LPM). We will be estimating both the effect of a phone call reminder and the effect of cash incentive amounts from 2000 Naira to 6000 Naira (in 1000 Naira increments) on the mother's likelihood (probability) of bringing her infant to the clinic to complete the measles vaccination visit. The specification also controls for the cost of transportation to the clinic, and includes fixed effects for the clinic.

We will test whether each treatment coefficient is greater than zero, and will also test whether the estimated effects of larger transfers are greater than of smaller transfers.

We will also perform a cost-effectiveness analysis based on results.

Technical risks & study design constraints

- **Low power.** We are statistically powered to test how increases in incentive amounts affect probability of completion with statistical significance, but not well-powered to test what particular incentive amounts cause higher probability of completion.
 - **Mitigation:** We can still do some analysis on the potential magnitude of the effect (see next section).
- **Missing data.** There may be missing data on caretakers not reached.
 - **Mitigation:** There are other data sources to double-check some of the vaccination information – e.g. clinic health registers, child health cards, etc.
- **Balance in treatment arms.** There is not much data collected on the background of caretakers that may affect their probability of coming to the clinic for the Measles vaccination visit. We cannot check balance in the treatment arms.
 - **Mitigation:** We have added one covariate for transportation cost to get to the clinic into the specification. Transportation costs are a proxy for caretaker's distance from clinic.
- **Spillovers/heterogeneous effects.** The treatment arms, which give more cash incentive for the measles visit than any other vaccination visit, may disproportionately attract caretakers who live further away from the clinic more than those who live close to the clinic.
 - **Mitigation:** We can perform subgroup analysis by using cutoffs (established based on the variation in the data on transportation costs) for the sample that the specification is run using. This will allow us to examine heterogeneous effects of the treatment arms on caretakers that live closer and further away. However, we likely do not have enough power to get statistically significant results.
- **External validity for NI's context.** NI wants to scale the vaccination program to the North West region of Nigeria, which is assumed to have the lowest overall and Measles vaccination rates in the country. However, none of the three pilot states are in the North West region.

- **Mitigation:** Anambra and Aqwa Ibom are in the South, and not very representative of the North West in terms of demographics. However, Nassarawa may have a more representative population, as it is located in the North. Additionally, as noted above, estimates will give a lower bound due to the relative higher wealth of the states in which the pilot clinics are located compared to the North West states. Finally, we could perform subgroup analysis to see if the magnitude of the effects within this state are much larger or smaller than the overall results that we get. While we are likely not powered to get statistically significant comparisons, this can provide some inclination about how representative the pilot results are to North Western Nigeria.
- **External validity for coverage rates in Nigeria.** This study sample is not representative of Nigeria, though does provide some variation in regions as NI selected three different states, two in the south and one in the north, in which to run the pilot clinics and program.

III. Secondary analysis

Heterogeneous effects

We will perform subgroup analysis to examine heterogeneous treatment effects on those caretakers who live further away (proxied by transportation cost). We will decide cutoffs on transportation cost based on the transportation cost data in the sample, and run one regression using only those below the cutoff (those who live close to the clinic), and one regression using data from only those above the cutoff (those who live further away from the clinic).

Robustness checks

We will check for robustness of the estimates in the LPM model by running a probit model on the same specification.

Elasticity of Vaccination to incentive amount

We will test a model using a continuous independent variable to denote the amount of the incentive. The purpose is to provide some indications as to the elasticity of coverage to incentive amount.

References

IDinsight. *New Incentives Scoping Trip Report*. 9 March 2017.

Ophori, Endurance A., et al. "Current trends of immunization in Nigeria: prospect and challenges." *Tropical medicine and health* 42.2 (2014): 67-75.

New Incentives. *Pilot: CCTs for Immunizations - November 2016 to February 2017*