Pre-Analysis Plan:
Communal Sanitation Solutions for Urban India

Sharon Barnhardt, Vibha Mehta

September 3, 2019

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1 Introduction

1.1 Abstract

This project aims to create a scalable model of shared toilets to reduce open defecation and ultimately improve health among the urban poor. In doing so, the project aims to address the design, management and operational challenges of "community" toilets, which we define as shared toilet facilities serving a fixed residential population. Our study location and government partners are Bhubaneswar and Cuttack, the two largest cities in the eastern Indian state of Odisha (India). The research component comprises randomized field trials of four interventions: price discounts, a behavior trigger, a reward, and a demand generation campaign.

1.2 Motivation

The locus of global poverty is moving to cities, a process recognized as the "urbanization of poverty" (UN-Habitat 2003). Rapid urbanization and in-migration is stressing the limits of strained urban infrastructure. A large fraction of marginalized and transient families live in slums characterized by informal, overcrowded settlements of poorly constructed houses without tenure, security or adequate access to safe water, sanitation, and waste disposal (UN-Habitat 2003). Within the range of deficient services, sanitation coverage is especially low: just 50 percent of the urban population in the least developed countries (57 percent of urban South Asians) has access to improved sanitation facilities (World Bank 2011).

In densely populated, rapidly growing and urbanizing countries like India and Bangladesh, severe space constraints, poor utilities infrastructure, and dense but temporary (and often illegal) housing construction all but render private household sanitation solutions unfeasible. Descriptive survey data from Delhi (Banerjee et al. 2011) and Bhubaneswar (J-PAL 2011) indicate that many households in informal settlements that are using constructed sanitation facilities (as opposed to practicing open defecation) rely on shared toilets.

Communal shared toilets are a sensible response to the severe physical constraints in slums, but they pose a new set of challenges. While prior and ongoing work on rural sanitation infrastructure adoption are relevant, this project focuses on the challenges that are specific to shared toilet facilities. An in-depth ethnographic study of sanitation practices in slums across five Indian cities (Quicksand 2011) highlighted a number of these challenges. The genesis of most of these problems can be traced back to free riding and collective action failures. For example, the study documented under-investment in operations and maintenance, leading to community facilities falling into disrepair and user groups ultimately rejecting the derelict infrastructure. Each individual user, very rationally, chooses not to assume maintenance responsibility over a shared facility. The individual user will often find open defecation to be an attractive alternative to a poorly maintained community toilet facility. Furthermore, the primary health consequences of outdoor defecation spill over onto the community, while the choice to defecate in the open or not is primarily individual.

1.3 Project Description

Project Sammaan comprises three components: improved hardware, community management trained on professional practices, and experimental research on increasing adoption/ behavior change. The overall project is funded by the Bill & Melinda Gates Foundation. The experimental research is

being implemented by J-PAL South Asia, which is also overseeing the project's implementation partners. The primary investigators on the research are Sharon Barnhardt, Judith Chevalier and Mushfiq Mobarak. The IRB at Yale University approved the research.

1.3.1 Hardware

Toilet facilities are being built in individual slums in order to have proper functioning spaces to study adoption of community toilets. All facilities have gender-segregated toilets and washing facilities, universal access, aesthetic improvements outside and inside the facility, functional improvements (e.g. better lighting, ventilation, seating for waiting), improved cleaning equipment, etc. The choices made here were informed by an ethnographic study commissioned by the Gates Foundation and conducted by Quicksand referred to as "The Potty Project".

The hardware facilities provided are based on the number of potential users (sample households who don't have access to a private or shared toilet) and the size of the available plot of land. They may be broadly classified into three designs:

- Very Small Two Seater – Has basic urination and defecation facilities.
- Base layer – Has urination and defecation hardware, a child potty and urinal, spitting trough, a wash basin and a universal access stall (toilet open throughout the day).
- Enhanced layer – Has a broader set of complementary services (over and above the base layer) targeted to both women and men. These services include bathing stalls in each gender section and shop spaces that may be rented out for extra revenue.

Toilet construction started in January 2016 and the research components described in section 1.3.3 use facilities that were opened between May 2017 and April 2019.

1.3.2 Management of Toilet Facilities

All toilet facilities are managed by the user communities themselves. Each catchment area forms a community management committee with a president, secretary and treasurer, elected from and by the community. This committee is responsible for the overall management of the toilet facility. The committee appoints a caretaker, who will collect user fees, and manage toilet facilities on a daily basis. A sweeper is also appointed to clean the facility daily. Communities are provided a thorough operations and maintenance training before the opening of the facilities, for effective management.

1.3.3 Research

Our main interest is in the adoption of community toilets, while health is a secondary outcome of interest. We refer to our experimental research interventions as software, to complement the hardware improvements. The software interventions can be broadly classified into two types: habit formation and demand generation.

- At the household and gender side X neighborhood level: How are habits formed and sustained? To address the behavioural angle of open defecation, past research has focused on people's emotions (e.g., pride, shame) and their rational knowledge (e.g., awareness of germ/fecal matter transmission), social norms, and explicit action plans. These approaches have achieved some success in altering open defecation but still fail to sustain over time. Recent research

tries to incorporate new findings from behavioural science to try to affect change in open defecation. The behavioral science findings are that people think automatically, socially, and by using mental models that channel their decision making. These insights can be used to design behavioural change drivers that are automatic and cue-driven, namely:

  - Trigger: The project will test one driver – a wall calendar that will be provided to randomly assigned households known to practice open defecation, in slums where the project is building toilets in Bhubaneswar and Cuttack. A wall calendar is a ubiquitous household item. Repeatedly and automatically looking at the Project Sammaan calendar every day can serve as a cue to households, the first step in forming the habit of using a toilet instead of defecating in the open. This experiment is randomized at the household level.
  - Reward: Another step in the habit formation process is a psychological reward for performing the desired behavior. Our reward will be access to a hygiene sprayer in the toilet stall. This will serve as a reward for using the toilet, as it is expected to create a higher feeling of personal cleanliness (compared to cleaning with water and one's hand). This experiment is randomized at the gender side X neighborhood. Within each neighborhood toilet facility, the male side, female side, neither, or both will have hand sprayers installed.
  - Repetition: Repetition of a trigger-reward cycle is the final key to creating a habit. Pricing discount interventions will incentivize repetition of use of toilet facilities as a means to create a habit loop. Sample households will be randomly assigned different types of price discounts for 45 days. One voucher group will be able to use the facilities for free on all days at any time, a second group will be offered free use on Mondays, Wednesdays and Fridays, and a third (control) group will not get a voucher.

- At the neighborhood level – What is the impact of the community-led total sanitation (CLTS) approach on open defecation by slum residents? This intervention is targeted to groups of individuals who form identifiable sub-communities around each facility. We refer to this process of community sanitation mobilization as "Demand Generation". It will include information about the health risks associated with open defecation, and the negative externalities individuals impose on each other through their actions at shared community toilets. Demand Generation will be randomly assigned at the neighborhood level and will not have specific inclusion criteria.

2 Research Strategy

2.1 Sampling

2.1.1 Site Selection

The Bhubaneswar and Cuttack Municipal Corporations helped us identify slums where (new) toilets needed to be built. The first step was to identify locations which had at least 10 potential user households (via general observation). For our purposes, a potential user household is a household without a private or shared toilet, living within 160 meters of the facility site. There should be at least 300 square feet of land available to accommodate construction of the facility. The

community should be situated on government-owned land, and land clearance must be provided by the respective Municipal Corporation of either Bhubaneswar or Cuttack, based on the jurisdiction of land. We consider the 160 meters around a facility to be its catchment area or neighborhood. When two catchment areas overlap, we consider them to be the same neighborhood and randomize them together for experimental arms. Our projected construction will be 32 facilities across 29 slum neighborhoods, thus two overlapping pairs of neighborhoods.

2.1.2 Sample Household Selection

All dwellings residing within 160 metres of an approved facility site were marked on a map, and we conducted a census to ascertain the status of each household's access to a private or a shared toilet. Households who did not have access to a private or shared toilet were considered to be potential users of the proposed Sammaan facility and included in our baseline sample.

2.2 Statistical Power

We have conducted power calculations for three outcomes of interest: probability that an individual practices open defecation, proportion of household members that practice open defecation, and probability that a person will try the Sammaan facility. The interventions have different units of randomization: wall calendars and discount vouchers are at the household level, the demand generation campaign is assigned at the neighborhood level, and the hygiene sprayers have been assigned at the facility side level.[1] We adjust our power calculations for clustering among the individuals or households at the level of the unit of randomization (household, neighborhood, or facility side). Our assumptions in calculating the minimum detectable effect sizes for the available sample are as follows:

- There will be one baseline survey and one endline survey.
- The correlation between the baseline and the endline surveys, on all the outcome variables of interest is 0.8.
- Minimum acceptable power is 80% and minimum acceptable confidence is 95% (one-tailed).
- Attrition will be random.
- Only 32 facilities in 29 neighborhoods will be opened during our study period.

Here, we describe power calculations for the primary outcome variable i.e. the probability that a person practices open defecation. The other two outcomes are presented in Table 1. The means and standard deviation for our outcomes variables and the intra-cluster correlation of the same came from our baseline survey.

- Discount Vouchers: We will be able to detect a drop of 4 percentage points in the probability of an individual practicing open defecation (i.e. 75% to 71%). The intracluster correlation used in the calculations is 0.43. The average cluster size is 4, and the coefficient of variation of cluster size is 0.45.

[1] Each facility has two sides, one for males and one for females. Ranodmizing at the facility side doubles the sample size, making 64 sides across 29 neighborhoods. In neighborhoods that overlap, all sides assigned to the same gender are assigned the same treatment.

- Calendars: We will be able to detect a drop of 3 percentage points in the probability of an individual practicing open defecation (i.e. 75% to 72%). The intracluster correlation used in the calculations is 0.43. The average cluster size is 4, and the coefficient of variation of cluster size is 0.45.
- Demand Generation: We will be able to detect a drop of 19 percentage points in the probability of an individual practicing open defecation (i.e. 75% to 56%). The intracluster correlation used in the calculations is 0.26. The average cluster size is 230, and the coefficient of variation of cluster size is 0.78.
- Hygiene Sprayers: We will be able to detect a drop of 14 percentage points in the probability of practicing open defecation (i.e. 75% to 61%). This is about 19% of the control mean. The intracluster correlation used in the calculations is 0.26. The average cluster size is 115, and the coefficient of variation of cluster size is 0.78.

2.3 Assignment to Treatment

Households were stratified by neighborhood and then randomized into getting a **Calendar** or not. Then within each calendar treatment group, households were randomized into three different **Voucher** groups:

- No Discount
- Zero Price Discount Voucher valid on Mondays, Wednesdays and Fridays
- Zero Price Discount Voucher valid on every day of the week

Our other experiments were stratified by city, whether the neighborhood overlapped with another neighborhood or not, and for non-overlapping neighborhoods, by type of facility built (base layer or enhanced). This yields six strata within which randomizations were done.

Within each strata, slum neighborhoods were randomly assigned to receive the **Demand Generation Campaign** or not.[2]

Finally, each toilet facility has two sides, one reserved for females and one reserved for males. After stratifying the neighborhoods by the same criteria as above, sides were randomized to get **Hygiene Sprayers** independently as follows:

- A hygiene sprayer for the male side or not.
- A hygiene sprayer for the female side or not.

This leaves us with 64 facility *sides* and the treatment of "has a hygiene sprayer" or not.

2.4 Data Collection

2.4.1 Pre-intervention

- Census: We conducted a census of all households living within 160 meters of the facility site. The male or female head of the household, or any household member over 18 years old was

[2]There were four neighborhoods that overlapped with (only) one other neighborhood, and both neighborhoods were randomized into the same treatments to prevent contamination.

eligible to answer the survey. In it we capture the household's access to a private or shared toilet.

- Baseline: Following the census, if there were at least 10 households around the proposed site that did not have access to a private or shared toilet, then the slum neighborhood was considered part of our sample, and those households were administered a comprehensive baseline survey. This baseline survey comprises two modules, one which is posed to the male head of household and one to the female head of the household (if there is only one head of household, then a combined module is posed to the single head of household). The baseline survey provides information on water and hygiene practices, access to and usage of toilet facilities in greater detail, health information, social interactions, habit formation and openness to change.

- Verification Survey: This takes place in a neighborhood when the construction of the toilet facility is about to be completed. This survey is conducted to account for any changes in the household due to time lag between the baseline survey and the opening of constructed toilet facilities. It is administered to either the male or female heads of households in our baseline sample to verify basic demographic details of household members, new members added to the household, and the household's toilet access – whether or not they still lack access to a private or shared toilet.

2.4.2 During Intervention

A key aspect of the project is precise data on our outcome of interest, i.e., improved sanitation usage rates. To collect this data accurately, objectively, and with high frequency, we developed a tablet-based MIS application to be used by the caretaker of the toilet facility.

- Monitoring Survey: The first stage of the monitoring survey was registering research households in the MIS system and giving them a 4-digit codes to identify themselves at the toilet facility before using it. At the time of registration, we:
  - Took photographs of household members (for caretakers to later verify customers' eligibility for discounts).
  - Conducted in-field randomization for the household-level pricing interventions described above. During our community interactions, we faced some reluctance with even the idea of user fees, and anticipated that households might be unhappy if some of their neighbors received user fee discounts and they did not. To mitigate some of these negative perceptions, we conducted this randomization as an in-field lottery to demonstrate randomization as a fair process.
  - Distributed physical vouchers that contained the 4-digit code described above, stated the terms of the discount received. and gave a phone number to call in case of difficulties getting the discount.
  - Distributed calendars for the household-level trigger experiments.

The usage monitoring period for each facility is one year from the opening date of the facility. The primary data collection activity during this period is the collection of usage data. Once the toilets were opened, usage monitoring of the toilets was done by the caretaker using the tablet-based

application that recorded the usage of toilet, type of usage, and amount charged. This was carried out for a period of 1 year, whereas our household interventions i.e. zero price discount vouchers is for a period of 45 days upon toilet opening.

2.4.3 Post-intervention

After one year of operations in a given neighborhood, the endline survey is to be conducted. This survey has questions on health, water, hygiene, sanitation, disgust, frequency of Sammaan toilet usage, and toilet facility-related preferences. This survey is administered to all respondents appearing in the baseline and new additions to sample households, including children and adolescents. The survey also collects information on how much households can recollect the results of the randomizations, namely, did they get a calendar, how much was their discount, does their facility have a hygiene sprayer for them, and was there a campaign about using toilets.

2.4.4 Attrition from the sample

We will follow up with each household in our study sample multiple times to ensure that they are surveyed. The specific steps differ with the round of data collection:

- Census: We visited households that were locked a maximum of three times. If we were still unable to survey them on the third visit, they were dropped.
- Baseline: We visited households as many times as possible to be able to complete the survey. The maximum number of visits was eight before dropping a household.
- Verification: We limited our revisits to three visits to a household in smaller sites, but in larger sites where the verification survey took more days, we visited an individual household up to eight times before considering them dropped. This happened before the facilities opened.
- Monitoring: We conducted more than three visits in cases where individuals were temporarily absent. This was done to capture these individuals' photos which were necessary for the application collecting usage data. The randomization happened at this stage for households that were still present and still met our eligibility criteria for the household experiments.
- Endline: We visit households as many times as possible (maximum eight) to be able to complete the survey.

3 Empirical Analysis

The basic intent-to-treat analysis will be straightforward, given the empirical design. We describe our models below for each intervention.

3.1 Variables

Our primary *outcomes* of interest at the individual level are:

- Individual practices open defecation (Self-report from EL)
- Individual tried using a Sammaan facility (MIS usage data)

- Number of Sammaan uses during the 45-day voucher period (MIS usage data)
- Number of Sammaan uses during 45 days after the voucher period (MIS usage data)
- Number of Sammaan uses over 4.5 months following facility opening (MIS usage data)

Our secondary *outcomes* of interest at the individual level are:

- Incidence of diarrhoea (Self-report from EL. Parent-reported for kids)
- Perception of disgust (Self-report from EL)

Our secondary *outcomes* of interest at the facility level are:

- Index of infrastructure status (From facility audits)
- Maintenance quality index (From facility audits)

These variables from the baseline will be used as covariates:

- Gender
- Age
- Education completed
- Household income per person
- Household belongs to a scheduled caste
- Household follow a non-Hindu religion

These location characteristics will be used as covariates or to create dummies identifying each randomization strata:

- Ratio of potential user population at baseline to toilet seats constructed
- City
- Facility was built with the enhanced layer
- Site overlaps with another site[3]

3.2 Balance Checks

We will check for balance between treatment and control groups on all available baseline individual and household characteristics that may be correlated with toilet usage.

Our demand generation campaign and hygiene sprayer experiments were stratified by city, type of facility built (base layer or enhanced), and whether the facility's catchment area overlaps with another's, creating eight strata. The household experiments (vouchers and calendars) were stratified by slum neighborhood.

[3]Overlapping sites were randomized as a joint unit.

We will run the following two specifications to evaluate the equivalence of experimental arms, first using baseline data on individuals (such as age and gender) and then using data on households (such as household income):

$$X_{ih} = \alpha + \beta T_{ih} + \gamma D_h + \epsilon_{ih} \tag{1}$$

$$X_h = \alpha + \beta T_h + \gamma D_h + \epsilon_h \tag{2}$$

where x is any of our variables being evaluated, i indexes the individuals within households in turn indexed by h. D represents the set of dummies identifying the strata we created to stratify the sample before randomly assigning treatments. T is the treatment arm assigned to the household, neighborhood, or neighborhood facility side. For the calendar, demand generation campaign, and hygiene sprayer, the variable takes on the value 1 if the household, facility or facility side was treated and 0 otherwise. Therefore, we expect β, the difference between groups, to include 0 in its confidence interval.

For the voucher experiments, we distributed unconstrained-discount vouchers, day-constrained discount vouchers, and no-discount vouchers. We will run these regressions on two voucher treatment arms at a time and evaluate balance between no voucher and restricted vouchers, no vouchers and unrestricted vouchers, and restricted and unrestricted vouchers.

3.3 Treatment Effects

3.3.1 Repetition (Vouchers) and Trigger (Calendar) Experiments

We will estimate the following basic model with fixed effects for randomization strata and clustered standard errors to account for the clustered random assignment:

$$Y_{ih} = \alpha + \beta T_h + \gamma D_{ih} + \omega_h + \epsilon_{ih} \tag{3}$$

where Y is any of our outcomes for an individual i in household h. T is the treatment (voucher type and/or calendar) assigned to household h. D is a set of dummies identifying the randomization strata (neighborhoods). ω_h and ϵ_{ih} are household and individual error terms. We will also estimate the same model with the individual-level covariates listed in section 3.1:

$$Y_{ih} = \alpha + \beta T_h + \gamma D_{ih} + \tau_i + \lambda_{ih} + \omega_h + \epsilon_{ih} \tag{4}$$

where τ_i and λ_{ih} represent covariates at the individual and household level.

3.3.2 Demand Generation Campaign

We will estimate the following basic model with fixed effects for randomization strata and we cluster the standard errors to account for the clustered random assignment:

$$Y_{ihf} = \alpha + \beta T_f + \gamma D_f + \omega_f + \epsilon_{ihf} \tag{5}$$

where Y is any of our outcomes for an individual i in household h in facility f. T is the treatment (Demand Generation or not) assigned to facility f. D is a set of dummies identifying the randomization strata. ω_f and ϵ_{ihf} are facility and individual error terms.

We will also estimate the same model with the covariates listed above:

$$Y_{ihf} = \alpha + \beta T_f + \gamma D_{ihf} + \tau_i + \lambda_{ih} + \theta_{ihf} + \omega_f + \epsilon_{ihf} \tag{6}$$

where τ_i, λ_{ih}, and θ_{ihf} represent covariates at the individual, household, and facility level.

3.3.3 Reward (Hygiene Sprayer)

We again estimate the following basic model with fixed effects for randomization strata and clustered standard errors due to the clustered random assignment:

$$Y_i = \alpha + \beta T_s + \gamma D_s + \omega_s + \epsilon_{is} \tag{7}$$

where Y_I is any of our outcomes for for an individual. T is the treatment (hygiene shower or not) assigned to the individual's facility side s. D_s is a set of dummies identifying the randomization strata to which the side belongs. ω_f and ϵ_{is} are facility side and individual error terms. We will also estimate the same model with the covariates listed in :

$$Y_i = \alpha + \beta T_s + \gamma D_s + \tau_i + \lambda_{ih} + \theta_{ihs} + \omega_s + \epsilon_{is} \tag{8}$$

where τ_i, λ_{ih}, and θ_{ihf} represent covariates at the individual, household, and facility side level.

3.3.4 Habit Loop

The individual behavior change elements were designed as individual experiments knowing that their potential to form a habit lies in all of them happening simultaneously. Therefore, we also test a combination of experiments: when an individual's household has been randomized to receive a calendar (trigger), his or her side of the facility is randomly assigned a hygiene sprayer (reward), and the household has been randomly assigned the unconstrained free voucher (repetition promotion). This will be compared to individuals who have received none of these elements of the habit formation loop (no calendar, no discount voucher and no hygiene sprayer). The analysis will be similar to the models above, but with a much smaller sample as we exclude all individuals who received only one or two elements of the habit formation loop.

3.3.5 Heterogeneous Main Effects

We will test for heterogeneous effects of our interventions on several subgroups as the intervention may reasonably affect them differently. These subgroups include women (who have a greater demand for privacy), scheduled castes (who may face discrimination entering a community facility), lower income households (who may be more price sensitive), young children (whose faeces may not taken seriously as disease vectors), the elderly (who earn no income), and Hindus (who have been reported to have lower demand for improved toilets holding income constant).

3.4 IV estimates for Health Outcome

We will estimate a 2SLS model to measure the impact of all interventions on the incidence of diarrhoea, which should happen only after usage increases. For example to measure the impact of the unconstrained voucher on health, our two stages will be:

$$X_{ih} = \alpha + \beta Z_h + \gamma D_{ih} + \tau_i + \lambda_{ih} + \theta_{ihf} + \omega_h + \epsilon_{ih} \tag{9}$$

where X is the number of times the individual i in household h used the Sammaan facility in its first 60 days of being open. Assignment of the household to the unconstrained voucher is the instrument, Z assigned to household h. D is a set of dummies identifying the randomization strata. τ_i, λ_{ih}, and θ_{ihf} represent covariates at the individual, household, and facility level. ω_h and ϵ_{ih} are household and individual error terms.

Our second stage specification would be

$$Y_{ih} = \alpha + \beta \hat{X}_h + \gamma D_{ih} + \tau_i + \lambda_{ih} + \theta_{ihf} + \omega_h + \epsilon_{ih} \tag{10}$$

where Y represents the incidence of diarrhoea reported and $\hat{X}$ is the predicted times used from the first stage.

3.5 Attrition

Given that some households will inevitably leave the sample we will check our assumption that attrition is balanced by study arm. To do this, we will run the individual-level balance check (eqn 1) with the outcome "individual attrited from sample" to determine if the treatment group assigned can predict that the individual left the sample between baseline and endline. Similarly, we will check for differential attrition of households using the household-level balance check specification (eqn 2) and "household attrited" as the outcome variable. As in the balance checks, we expect 0 to be in the confidence interval of β.

If we do find that attrition is different between treatment arms, we will produce bounds around the estimated treatment effects by inferring both the most conservative outcomes for missing individuals and the most liberal to create a range of possible treatment effects.

Appendices

A Project History

The project's original aims as conceived in 2011 were to design, implement and rigorously test a range of hardware and software innovations within community toilets. Its initial goals were to:

- Randomly assign one of two hardware models to each neighborhood - a basic level of functionality or an experimental layer of more innovative designs added on to the basic layer.
- Randomly assign one of two software models to each neighborhood - a private or community management model
- Randomly assign demand generation activities to each neighborhood
- Household-level interventions such as discount vouchers, or distributing portable children's toilet seats to induce monthly pass purchase or other desired sanitation behaviours.

While the last two goals have been retained in the current design, we were forced to drop the hardware trial by 2013 because most sites were too small for the enhanced layer and not enough sites were available to have a pure control group where we built nothing. As a result, each neighborhood's hardware design is based on the available space and size of the facility.

The Municipal Corporations finally selected a set of 51 neighborhoods to build 58 community toilet facilities, but as of August 1, 2019 only 32 facilities have been opened (in 29 neighborhoods). The first research facility was opened on May 29, 2017 and the final facility in our anticipated dataset opened on March 17, 2019. We do not anticipate any more facilities being constructed and opened before the endline for the existing 32 facilities finishes at the end of September 2019, though another 6 are nearly completed.

The intervention in the management structure, i.e. testing community versus private management, had to be dropped in early 2017, due to long delays in the tendering process to select a third party agency for private management and also a dearth of third party agencies who were willing to manage a toilet facility. All toilets have operated using only the community management model.

We initially planned to measure the impact of these facility-level variations in hardware and software on facility-level outcomes, like maintenance and financial sustainability. Without the experimental variation in treatments, data collection to objectively measure specifically these facility-level outcomes at endline was cancelled.

B Detailed Power Calculations

Table 1: Household-level: Does anyone in the household practice open defecation?

Randomization Level	Treatment	Minimum Detectable Effect Sizes	Intracluster Correlation	Average Cluster Size	Cluster Size Variation
Neighborhood	Demand Generation	**0.19** 0.88 to 0.68 (about 22% of the control)	0.33	58	0.84
Household	Vouchers & Calendars	**0.05** 0.88 to 0.83 (about 5.7% of the control)	0	58	0.84

Table 2: Individual-level: Did person try Sammaan?

Randomization Level	Treatment	Minimum Detectable Effect Sizes	Intracluster Correlation	Average Cluster Size	Cluster Size Variation
Neighborhood	Demand Generation	**0.25** 0.21 to 0.46 (about 119% of the control)	0.45	230	0.78
Facility Side	Hygiene Sprayer	**0.17** 0.21 to 0.39 (about 81% of the control)	0.46	115	0.78
Household	Vouchers (3 groups)	**0.04** 0.21 to 0.25 (about 19% of the control)	0.65	4	0.45
Household	Calendars (2 groups)	**0.03** 0.21 to 0.25 (about 14% of the control)	0.65	4	0.45