Pre-Analysis Plan: Hold the Phone? Social and Economic Implications of Improving Women's Agency and Control over Smartphones

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1 Introduction

1.1 Motivation

In India, 24 percent of citizens had a smartphone in 2017, with ownership expected to double to 48 percent by 2025 (GSMA, 2018). Previous research shows that mobile phones improve individual well-being and promote productivity by enhancing market functioning and enabling value-added services such as mobile money, information provision, and reminders.[1] However, a second generation of research is needed to understand the impacts of smartphones, which are rapidly giving individuals in the developing world their first access to the Internet and social media platforms. As mobile technologies become increasingly necessary to participate in the modern economy, they may either close or reinforce gaps between socio-economically marginalized and advantaged groups.

In India, rural married women are 51 percentage points less likely to work than men (International Labour Organization , 2014) and face significant constraints on travel. Indian women lag men in adoption and use of mobile technology: 59 percent of women own a mobile phone – compared to 80 percent of men – and women are less than half as likely to use mobile Internet or own a smartphone (Pew Research Center, 2019; GSMA, 2019). Our qualitative research points to an important role for social norms: many families see phones as an unwelcome distraction that expose women to ideas and individuals that may threaten their purity (Barboni et al., 2018). In this study, we test whether a use case in line with pre-existing social norms can spur women's mobile adoption, close gender gaps in the adoption of mobile technology, and shift gender norms governing phone use. We also examine impacts on women's agency and work, but are agnostic on whether they should change.

Much of the existing work on gender norms focuses on women's labor force participation (see, e.g. Fernandez et al. 2004; Fernandez and Fogli 2009; Alesina et al. 2013; Bertrand et al. 2015), though gender norms influence myriad aspects of women's lives in India (Dhar et al., 2018). More recent work has sought to understand whether – and how – norms might change, either through interventions that explicitly seek to change the norm (Dhar et al., 2018; Bursztyn et al., 2018; Green et al., 2019) or policy that simply incentivizes individuals to buck the norm (Field et al., 2019). We aim to deepen the latter line of inquiry by studying peer effects in technology adoption and how new norms diffuse through communities.

[1] On market impacts, see Jensen (2007); Aker (2010); Aker and Fafchamps (2014); Tack and Aker (2014); Jensen and Miller (2018); Gupta et al. (2019). On mobile money, see Jack et al. (2013); Blumenstock et al. (2015, 2018); Suri and Jack (2016). On information/reminders, Aker et al. (2012); Cunha et al. (2017); Dammert et al. (2015); Cadena and Schoar (2011); Dammert et al. (2014); Kast et al. (2013); Karlan et al. (2012, 2016); Zurovac et al. (2011).

Our study will also provide evidence on how mobile Internet affects the social and economic well-being of women and their households in low-income rural areas. To our knowledge, there are few studies that explore the impact of Internet-enabled smartphones on the lives of the poor in developing settings. [2] Our focus on how deepening women's mobile engagement impacts their social connections and well-being will provide an important contribution to this area of research.

A final line of inquiry will contribute to the literature on citizen information and public service provision. While there is a large literature on the effect of information targeted to voters around the time of elections (see Kosec and Wantchekon (2020) for a review), less is known about the effect of information about specific government entitlements, and the evidence we do have is mixed.[3] In a supplementary paper, our research project will investigate how access to information on public health and workfare programs affects take up of services. This analysis is detailed in a separate pre-analysis plan.

This document summarizes the main tests that we intend to conduct. We do not rule out the possibility of running other tests. We will make clear in the paper which estimations are specified in this pre-analysis plan and which are not (Duflo et al., 2020).

1.2 Study Description

Our study leverages an at-scale policy initative led by the Government of Chhattisgarh (GoCG) to investigate these issues. In 2018, GoCG connected millions of rural women to Internet-enabled smartphones for the first time. Under the Sanchaar Kranti Yojana (SKY) program, GoCG distributed over 2 million smartphones to rural Chhattisgarhi households. The aim was to bring women and their families online: the government ensured all program villages had LTE (i.e., 4G) coverage, and all phones received 1 GB of free data each month for the first six months. The program was gender-targeted, with phones distributed to female heads of households.

Using a randomized control trial taking place in 212 SKY program villages in Raipur district in Chhattisgarh, we seek to understand whether providing women with a norms-compatible use for SKY phones can spur deeper use of phones, while quantifying how peer effects inform the adoption decision, and how adoption impacts social norms and women's social connections and well being. The trial leverages three interventions to address the barriers to smartphone use that women face. The first is a basic training, designed to build the skills women need to engage with SKY phones. The second, a service titled *Mor Awaaz*, offers a "use case" that is in line with the prevailing norm that women should care for the household. *Mor Awaaz* sends women weekly "push" calls with pre-recorded information on good health practices, government health services, and updates on India's workfare program. Overall, this content (with the possible exception of government workfare) was designed to be in line with women's accepted role as caretaker of the household. The service also includes monthly "pull calls", where trained enumerators call women to conduct a short survey to measure women's phone usage and their awareness of, and access to, public health and nutrition-linked services. The calling infrastructure allows us to measure whether the person who picks up pull calls is female and construct a measure of women's engagement with Mor Awaaz that is free of social desirability bias. The third intervention offers women an in-kind incentive to engage with

[2] Hjort and Poulsen (2019) find that connecting Sub-Saharan Africa to high-speed internet cables increased employment, both overall and for the less educated. Their paper does not speak to mobile Internet, however, which is far more common in low-income settings.

[3] For example, Banerjee et al. (2018) show that providing information on entitlements under Indonesia's rice subsidy program significantly increased benefits while reducing leakage. On the other hand, Dutta et al. (2014) find that while information about rights and entitlements under India's workfare program increased beneficiary knowledge, it had no impact on scheme participation or performance.

pull calls in order to amplify her individual returns to using her phone. Our research questions are as follows:

1. Can providing women with a use case for phones that is compatible with existing gender norms encourage deeper mobile engagement?

2. Do interventions designed to deepen mobile engagement reshape women's social connections, agency and well being?

3. Do interventions that shift behavior change social norms? And does norms change require a critical mass of adopters within the community?

4. Does women's mobile engagement increase when social norms liberalize?

2 Experimental Design

2.1 Sampling

To identify study villages, we began with a list of all SKY program villages in Raipur district. The following procedure was followed to select sample villages: First, we matched village data provided by the Chattisgarh Infotech Promotion Society (CHiPS) to Socio-economic Caste Census (SECC) village codes.[4] We dropped villages that we used to pilot our intervention as well as two CHIPS villages that could not be matched to SECC codes. Thereafter, the sample was restricted to villages with more than 50 and less than 375 SKY beneficiaries. We also dropped villages that did not meet our village-level sampling threshold of 36 literate and 12 illiterate women. Using this sampling procedure, 222 Gram Panchayats (GPs) were eligible for inclusion in the sample – we randomly selected 212 to enroll in the study, reserving the rest for piloting. All randomization was implemented using Stata software, with seeds set to ensure the randomization is reproducible. In cases where there was more than one village in a GP, we randomly selected one village per GP for inclusion in the study.

We classified women as "eligible" for our sample if they are:

- Under age 40 at the time of sampling, per age reported in the Census.
- Married
- In both the SKY and Census datasets, with at least two family member names listed in the Census (to allow our field team to identify them)
- Belonged to households with only one SKY beneficiary

We randomly selected a total of 48 eligible women per village and assigned them to the following sampling groups:

- "Core sample 1": 6 literate, 2 illiterate women. Core sample 1 women and their husbands were selected to be interviewed at our baseline and endline.
- "Core sample 2": 6 literate, 2 illiterate women. Core sample 2 women and their husbands will only be interviewed at the endline.

[4] As shorthand we refer to the SECC data as Census data in what follows.

- "Buffer": 24 literate, 8 illiterate. These women were back-up respondents and listed in random order within each village. Some were surveyed at baseline as replacements for unreachable core sample 1 women. The remaining women will be used (as needed) as replacements for core sample 2 women at endline.

Across the 212 villages this leaves us with a sample of 10,176 core and buffer women, 1,696 of whom will be targeted for both baseline and endline surveys; another 1,696 will be enrolled in the endline survey only.

2.2 Randomization

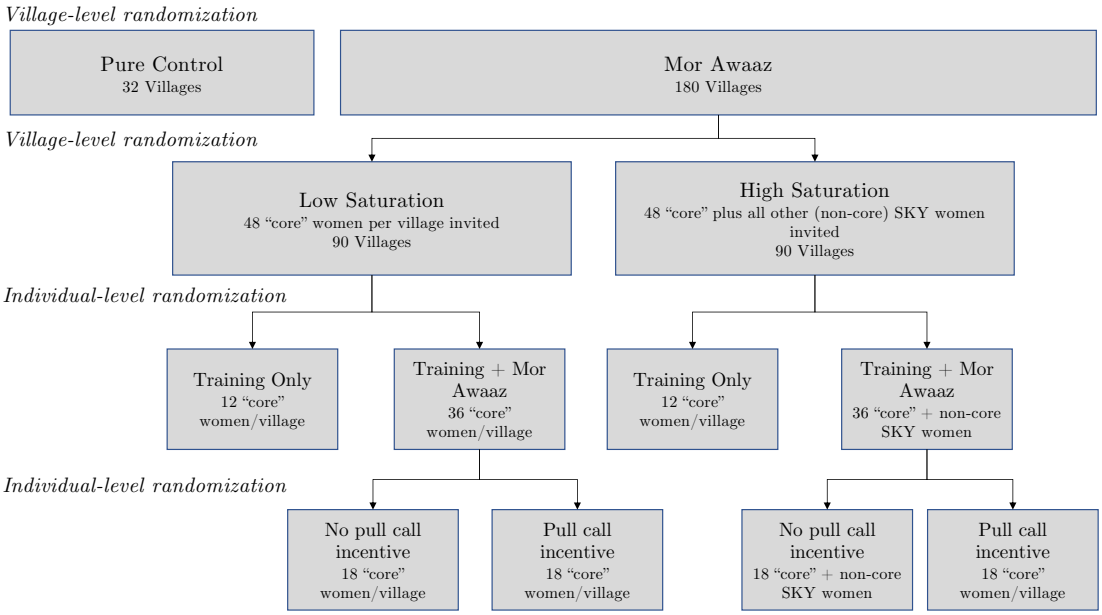
Before describing the experimental interventions, we outline the randomization. Figure 1 shows our RCT has four levels of randomization, some at the village and some at the individual level.
Village-level randomization: The 212 sample villages were randomized into one of three treatment conditions: (1) 32 villages to serve as a *pure control* in which respondents were only surveyed; (2) 90 villages in which respondents receive a *"low saturation"* version of *Mor Awaaz*; (3) 90 villages in which respondents receive a *"high saturation"* version of *Mor Awaaz*. So 180 villages were selected to receive the *Mor Awaaz* service in some form. In *"low saturation"* villages, only the 48 core and buffer sample women were invited to community enrollment camps, where we held a basic phone training and invited women to enroll in *Mor Awaaz*. In *"high saturation"* villages, all female SKY beneficiaries were invited to camps. Thus, in high saturation villages, a substantially larger share of women in the community will be encouraged to engage with smartphones.
Individual-level randomization: Within the 180 treatment villages, we randomized the 48 sampled respondents into one of three individual-level treatment conditions: (1) to receive only phone training (12 respondents); (2) to receive phone training, the *Mor Awaaz* service, and no in-kind incentive payments for answering the *Mor Awaaz* pull calls (18 respondents); or (3) to receive phone training, the *Mor Awaaz* service, and an in-kind incentive payments for answering the *Mor Awaaz* pull calls (18 respondents). The in-kind incentive was valued at Rs. 100 (approximately $1.40) for each pull call they answered. Both women and field staff were blinded to a woman's treatment status when distributing invitations to the camps. Women were informed of the incentive only after they decided whether or not to enroll in *Mor Awaaz*.

The village-level randomization was stratified based on whether the baseline survey was conducted before or after SKY phones were distributed, the block – the governmental administrative unit below the district – and whether the village was above or below median on an index of baseline community perceptions of women's acceptable phone use. We created the index of baseline community attitudes towards women's acceptable phone use using male and female responses to four questions: "in your opinion, is it appropriate for [married/unmarried] women to own/use a phone [with/without] supervision?". We generated dummy variables equal to one if the respondent agreed phone use was appropriate, standardized these dummy variables, and then took an average across all questions. Missing values were replaced with village $\times$ gender means before standardizing and averaging. The final index was the village-level average of both male and female responses.

2.3 Interventions

All interventions were delivered through community-based "enrollment camps". Enumerators and women were blinded to which individual-level intervention a woman would be offered at the camps; The camps were described as a "mobile phone event", where invited women could learn about useful things to do with their phones. Camps were held in central locations in the village over 1-2

Figure 1: Experimental Design



days. In order to keep camp attendance and waiting times constant for high and low saturation villages, we aimed to maintain a ratio of 1 venue-day per 50 invited women.

Mobile Phone Training

Every woman who attended a camp was offered a basic digital literacy training. The training covered dialing a number, receiving an incoming call, taking photos, and using Google's voice search feature. Women were trained in groups of 8-10.

Mor Awaaz

A randomly selected subset of the sample trained were offered a phone service named *Mor Awaaz* ("My Voice" in Chhattisgarhi). *Mor Awaaz* consists of two phone-based interventions:

1. Pushing information (push calls): *Mor Awaaz* provides information on health and government workfare benefits to women through interactive voice response (IVR) messages. In health, the initial focus was on reproductive life-cycle related messages like post-childbirth services, best practices during breastfeeding, hygiene during menstruation, and so on. The workfare component sends women updates on the status of any payments their households are owed as part of the Mahatma Gandhi National Rural Employment Guarantee Scheme. We have and will continue to work with the Government of Chhattisgarh to identify high-relevance topics for push calls, including, for example, a series of messages related to COVID-19 rolled out beginning in April 2020.

2. Pulling information (pull calls): The second component of *Mor Awaaz* is a phone-based feedback survey where trained enumerators call *Mor Awaaz* enrollees. The topic of these "pull calls" varies from month to month. Past topics have included MGNREGS, national deworming day, health knowledge, and COVID-19 knowledge. Findings from pull call rounds are periodically aggregated and shared with concerned state departments (Departments of

Health and Family Welfare and Panchayat and Rural Development respectively), with the aim of creating a dynamic citizen-state feedback loop.

Incentives

Incentives are linked to pull calls. Women earn INR 100 credit towards in-kind incentives for each pull call they complete. This credit can be redeemed for common consumables such as tea, lentils, and cooking oil. Incentives are distributed by trained field staff who visit women's homes. We made an effort to deliver a first round of incentives after the first pull call round. After that, we aimed to distribute incentives every few months; at the time of PAP writing, in-person incentive distribution was on pause due to COVID-19.

3 Hypotheses

In this section we recap our research questions and associated hypotheses.

Research Question 1: Can providing women with a use case for phones that is compatible with existing gender norms encourage deeper mobile engagement? In short, we expect all interventions to increase phone engagement by increasing women's return to using the phone. We hypothesize that *training* primarily increases mobile engagement by easing skills constraints: the curriculum covers all skills necessary to engage with Mor Awaaz, and provides women with a first introduction to Google voice search and the Internet. By establishing a new use case, *Mor Awaaz* should increase both the individual- and household-level returns to female phone use; the *incentives* treatment is designed to amplify these returns.

Research Question 2: Do interventions designed to deepen mobile engagement reshape women's social connections and well being? Our interventions could impact women's networks and well being in several ways. First by increasing phone use, the interventions could connect women to new sources of information, or change the frequency with which they communicate with friends and family. Here, impacts could be either positive or negative (e.g. greater phone use could decrease in-person interactions with friends). Second, we hypothesize that the *Mor Awaaz* service could impact a woman's networks and well being independent of her phone use. Receiving regular calls from the service could, for example, make a woman feel more important or valued. To the extent that women, their families, and their communities perceive *Mor Awaaz* information to be valuable, it could also increase a woman's social status and alter network connections. Here again the direction of impact is ambiguous: women may make fewer efforts to reach out to others if they feel they are better informed; on the other hand, they may be eager to share information with others, or uninformed individuals may make more efforts to reach out to them.

Research Question 3: Do interventions that shift behavior change social norms? And does norms change require a critical mass of adopters within the community? Here we separately consider actual norms (the community-wide average of first order beliefs) and perceived norms (average second order beliefs). In terms of norms, we hypothesize that the implementation of the intervention itself (which involves door-to-door mobilization, followed by a series of enrollment camps in central village locations) will telegraph a normative message that "it is appropriate for women to use phones", which could lead actual and perceived norms to liberalize. Direct receipt of both training and *Mor Awaaz* should further shift norms.

We hypothesize that norms will shift more in *high saturation* areas, because more women will be encouraged to engage with phones. Here a testable prediction is that norms - particularly perceived norms - respond to social learning: e.g. when an individual sees or hears about more women using phones, s/he updates her belief about what others think is appropriate.

At the same time, there is scope for male backlash. If men, for example, earn economic rents by preventing women from using phones, they may have an interest in reinforcing restrictive norms when faced with interventions like *Mor Awaaz*. In order to assess this possibility, we aim to interview both men and women at endline. We will also measure impacts on more general gender attitudes, that could indicate backlash (e.g. agreement with statements like "a woman's place is in the home" or "men have more use for phones than women do").

Research Question 4: Does women's mobile engagement increase when social norms liberalize? We hypothesize that some women may be held back from using phones by restrictive social norms. Insofar as our interventions liberalize norms, this could increase women's phone engagement conditional on "direct effects" from new use cases. This suggests a way to quantify how much norms constrain women's mobile engagement: if norms liberalize more in high saturation areas, then we should also observe greater rates of phone use among core sample women (in both the training only and training and Mor Awaaz arms). A key issue with this test is that phones have network externalities: even absent norms change, higher saturation approaches may increase the private returns to using a smartphone. This could happen, if, for example, women have more friends they can call and message with, or have more peers available to teach them new phone-related skills. Should we find that saturation increases phone use among core sample women, we expect to rely on non-experimental tests to shed light on the relative important of norms versus network externalities (e.g. heterogeneous treatment effects by baseline norms, or village-level proxies of norms).

One attenuation that both Research Question 3 and Research Question 4 are potentially subject to is that in high saturation villages we may observe equal or lower rates of Mor Awaaz engagement as in low saturation villages because of information sharing: in our pilot work, we found that women share information from the calls with one another. As a result, in villages where a woman is more likely to hear the information from a friend, she may be less likely to pick up the phone to listen to the message herself. We will therefore also use non-experimental tests to understand how much information sharing occurs between women.

4 Empirical Approach

4.1 Data

Baseline Data We conducted our baseline survey from August to November 2018 in Raipur district in Chhattisgarh. In each village, we surveyed 8 core sample SKY-eligible married women and their husbands for a total of 1,696 households across 212 villages. The baseline survey collected information from women and their husbands about individual mobile phone usage, actual norms (first order beliefs) governing women's phone use, perceived norms (second order beliefs), and a module that measures the size of women's social networks.

Administrative Data from Enrollment Camps We have administrative records of all women (core sample and saturation) who received camp invitations and attended camps. At the camps, we also collected data on respondents' first order beliefs around phone use and their phone numbers.

Administrative Data from *Mor Awaaz* Administrative data from push calls allows us to capture the weekly pick-up rate for the calls along with the amount of the call the respondent listened to. We also have data from pull call surveys and use pull call records to ascertain if initial phone calls are being picked up by the respondent or whether the phone is being passed to the respondent.

Supplementary Call Survey We plan on conducting at least one round of "supplementary calls", which will be made to all women who participated in the baseline, as well as all core and buffer women who attended the enrollment camps (prior to the submission of this PAP, we verified that core women's camp attendance rates are unrelated to treatment status). A first wave of calls will target baseline sample women and use phone numbers collected at baseline. A second wave of calls will target camp attendees using phone numbers collected during the camps. We will use these data to construct an objective measure of women's phone access that covers control and training only women. We also plan on collecting data on gender attitudes, mental health, government benefit receipt, and women's COVID-19 knowledge during these calls. We anticipate the possibility of differential attrition, especially if some of the interventions (e.g. saturation) shifted norms; the extent of differential attrition will inform our ability to use these data as outcomes.

Endline Data At endline we aim to survey all women (and their husbands) who participated in the baseline, as well as an additional 8 couples per village (the "core 2" sample described earlier). Thus the endline will cover a sample of 6,784 individuals: 3,392 women and their husbands.

The endline will cover the same topics as the baseline, along with additional questions to collect data on women's social connections. We will also collect additional data on gender attitudes, mental health, and well being. Finally, the endline will collect additional data related to the mechanisms through which we expect phones to reshape women's activities: contact with others, access to information, and economic activities.

4.2 Empirical Strategy

Regression Specifications

We will begin our inquiry by studying impacts in a fully saturated model using the full sample:

$$\begin{aligned} y_{iv} =& \alpha_0 + \alpha_{1v} train_v + \alpha_2 MA_{iv} + \alpha_3 Incentives_{iv} + \alpha_4 train_v \times HS_v + \\ & \alpha_5 MA_{iv} \times HS_v + \alpha_6 Incentives_{iv} \times HS_v + \mathbf{z_{iv}}' \nu + \epsilon_{iv} \end{aligned} \tag{1}$$

where y_{iv} is the outcome of interest, $train_v$ denotes a core sample woman was selected for training/lives in a non-control area, HS_v means the village is a high saturation village, MA_{iv} denotes random assignment to the Mor Awaaz use case at the individual level, and $Incentives_{iv}$ denotes random assignment, again at the individual level, to receive incentives for engaging with Mor Awaaz. Finally $\mathbf{z_{iv}}$ is a vector that includes our randomization strata, and ϵ_{iv} an error term. Standard errors are clustered at the village level. If we find that we are imbalanced along important predetermined covariates, we will also use PDS Lasso (Belloni et al., 2014) to select additional covariates to include in $\mathbf{z_{iv}}$.

We anticipate the possibility of using shorter regression specifications (e.g. a version of the above equation where the high saturation effect is constrained to be the same for women in training, Mor Awaaz only, and Mor Awaaz and incentive arms) in our core analysis in order to keep the discussion focused and maximize statistical power. Our choice of "short" regression model will be informed

by results of the fully saturated model. If we do this, we will make "long model" results available in an online appendix.

We may also conduct some analysis on subsamples: for example, to study the effects of saturation on non-Mor Awaaz women, we can limit the sample to training only women and run the following regression:

$$y_{iv} = \alpha_0 + {}_1 HS_v + \mathbf{z_{iv}}' \nu + \epsilon_{iv} \tag{2}$$

Similarly to study the effects of saturation and incentives using administrative *Mor Awaaz* data, we will use the following specification:

$$y_{iv} = \alpha_0 + \alpha_1 HS_v + \alpha_2 Incentives_{iv} + \mathbf{z_{iv}}' \nu + \epsilon_{iv} \tag{3}$$

Outcomes

Our analysis will focus on the following families of outcomes. When we collect multiple outcomes per family we will aggregate them into a standardized index following Kling et al. (2007) to address concerns regarding multiple hypothesis testing.

- *Women's Phone Ownership and Use:* Here we will rely on both self-reported measures (ownership, frequency and types of use) as well as objective measures (direct pick up on supplementary calls, participation in supplementary calls). We will also use administrative data from *Mor Awaaz* to study impacts of saturation and incentives among *Mor Awaaz* enrollees.

- *Gender Norms and Attitudes:* Here we will consider impacts on several sub-families of gender outcomes including actual and perceived norms governing women's phone use and broader norms about women's role in society. We will analyze impacts on norms and beliefs held by women and their husbands separately.

- *Mental Health and Well Being:* We will study impacts on measures of anxiety and depression (K6 index) and a woman's sense of self worth.

- *Empowerment:* The measure of empowerment most directly related to our intervention is a woman's ability to use a phone independently, without family interference. We will also study impacts on downstream measures of women's empowerment, including mobility, economic activity, and self-reported decision making power.

- *Social Connections and Networks:* We will measure the number of social contacts a woman has, how often she interacts with them, and whether these interactions are by phone or in person. We will also measure participation in women's self help groups.

- *Economic Activity:* We will measure women's labor force participation and engagement in income generating activities.

Heterogeneity

We may analyze heterogeneous treatment effects to explore mechanisms (e.g. a norms channel versus network externalities channel for saturation effects). We expect to study heterogeneity along the following dimensions:

- *Norms:* Here we will consider household-specific norms governing phone use (available for baseline couples only) and village-level aggregates based on average baseline responses (specifically, the above/below median split we stratified the saturation randomization on). We may also use SECC data to construct more general proxies of social norms (based on, e.g. caste composition or female labor force participation rates).
- *Returns to phone use:* Here we will consider literacy and baseline measures of phone use (the latter is only available for women who participated in the baseline survey).
- *Network connectedness:* Finally we may consider heterogeneity with respect to the depth of a woman's social networks and participation in self help groups.

5 Pre-PAP Statistical Analyses

This PAP was drafted after the intervention had been in the field for a number of months. To monitor the progress of the intervention, we carried out some statistical tests. We list these tests below:

Training and Enrollment in Mor Awaaz

We assessed differences in the following outcomes (among core and buffer sample women) by high- versus low-saturation status:

1. Mobile training camp recruitment rate
2. Mobile training camp registration rate
3. Mobile training rate
4. *Mor Awaaz* enrollment rate
5. Mean number of women in a training session[5]
6. Ratio of women invited to number of venue-days[6]
7. Waiting time between registration and training
8. Waiting time between training and enrollment

Push Calls

We have also evaluated differences in the following push call engagement measures by treatment status:

1. Pick up rate
2. Proportion of call listened to
3. Proportion of core message listened to[7]

[5] In most cases, the maximum number of women in a training sessions was restricted to 10.

[6] Based on the sample to be invited in each village, we would pick between 1-3 training venues in a village and conduct training over 1 or 2 days.

[7] Our push calls have a standard format. They begin with a jingle and welcome message, followed by the main script and end with the jingle and a conclusion. We drop the last part of the call consisting of the jingle and conclusion to compute the duration of the core message.

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