Amendment to Pre-Analysis Plan 20150514AA

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In May of 2015, we registered a cluster-randomized experiment titled "The Household Welfare and Political Impacts of Increasing Service Predictability: An Experimental Intervention in Bangalore's Water Sector."[1] Briefly, the experiment aims to assess the impact of SMS notifications about water supply arrival and cancellation on household behavior in Bangalore, a context in which water supply is intermittent. The baseline survey was conducted in the spring of 2015, after which treatment was administered by NextDrop, a Bangalore based social enterprise. The endline survey is currently on-going; not only have we not finished collecting data on outcomes, but we have not yet begun to clean or analyze this data. Nevertheless, the baseline data, interviews with NextDrop, and data from NextDrop have given us information we did not have when registering our original pre-analysis plan. This amendment discusses our plan to drop a block of treatment and control units from the study along with our planned analysis of partial non-compliance (also known as "treatment dilution"[2]) and heterogeneous treatment effects.

1. Units to drop from the study

We will need to drop one block of treatment and control clusters due to the fact that NextDrop decided (after we had designated clusters and randomized units to treatment and control) that it would be too difficult administratively for them to solicit notifications for a small set of the valve areas in E3. In particular, valve areas in utility subdivision E3 fall in two categories: a) CMC valve areas which draw on borewell water, and which pre-date BWSSB's administration of services in the area; and b) Cauvery valve areas, which draw on water from the Cauvery river. Subsequent to the design of our study, NextDrop found it more difficult to work with the CMC area valvemen, so decided not to solicit notifications from them. This problem affects one of our treatment clusters; as a result, we will be dropping all four clusters (two treated, two control) that form the block within which this particular treatment cluster lies.

2. Dilution of Treatment/Partial compliance

As described in the original design registration, NextDrop obtains information regarding the timing of water delivery in particular "valve areas" by collecting water flow information from valvemen—the individuals responsible for opening and closing the valves controlling water into particular districts—and disseminating notifications to NextDrop customers. NextDrop was able to solicit this information successfully in its pilot location, the city of Hubli-Dharwad. Our study, however, capitalizes upon NextDrop's rollout in a new location, Bangalore, where the enterprise set aside a section of the city for the purposes of our impact evaluation. When it began soliciting notifications in our study area, NextDrop found valvemen to be less willing to provide notifications consistently than in Hubli-Dharwad. During the course of administering treatment in our study area, we have found that valvemen may provide NextDrop with

[1] ID 20150514AA
[2] See Angrist, Joshua D. 2006. "Instrumental Variables Methods in Experimental Criminology Research: What, Why, and How." *Journal of Experimental Criminology*. 2:23-44.

information infrequently in some cases, directly affecting the frequency of information received by customers. Furthermore, certain households lie in areas serviced *both* by BWSSB and CMC valve areas, as described above (see Figure 1). Because we expect NextDrop to have received fewer notifications from valvemen operating CMC valves, it is very likely that households in these areas receive notifications a smaller fraction of the time than households located just in Cauvery valve areas.

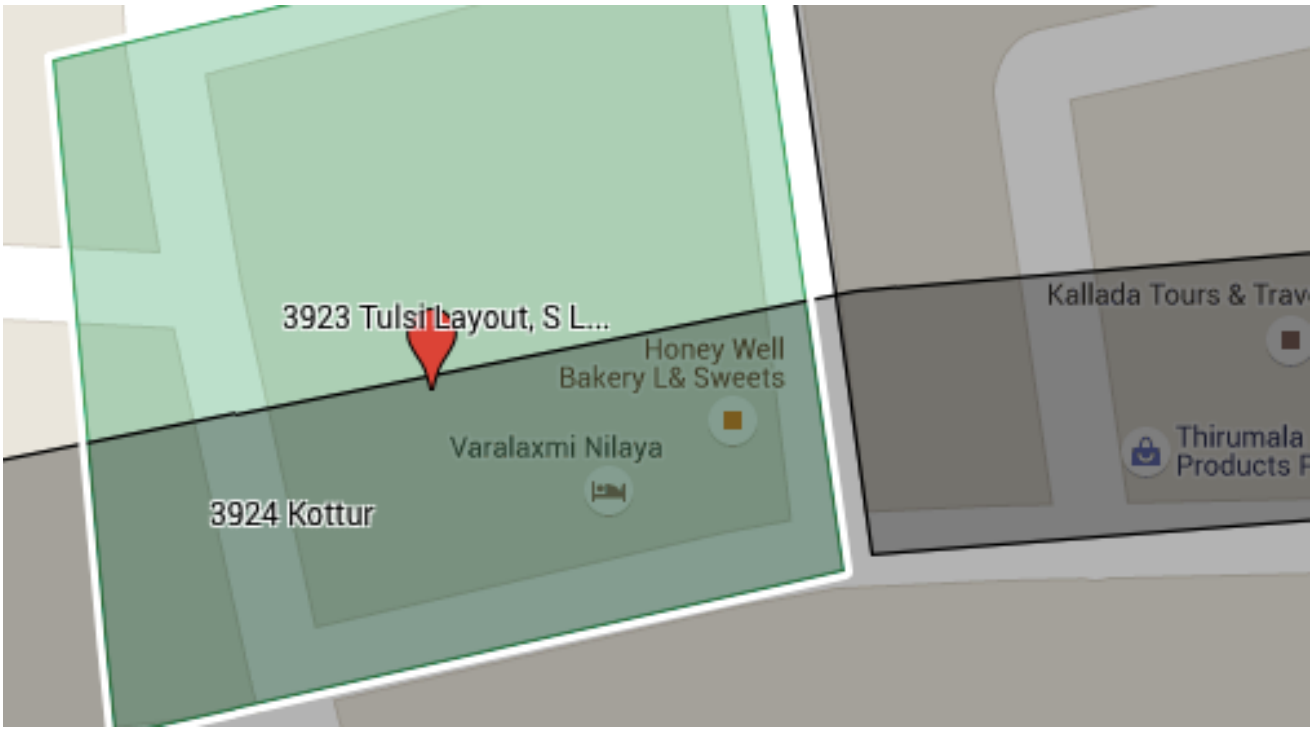

Fig 1. This household lies in an area covered by BWSSB and CMC valve areas

This problem appears to be a case of "dilution of treatment" (Angrist 2006), or what is referred to in more recent literature as partial compliance (Jin and Rubin 2008). The original design registration acknowledged one source of non-compliance, namely households' desire to enroll into NextDrop'services, and outlined a plan to calculate both intention-to-treat (ITT) and complier average causal effects (CACE). We will continue to follow this plan while including this new source of non-compliance. Importantly, we have information on treatment dilution for both treatment and control groups.

If feasible, we will also analyze the effects of different levels of compliance or dilution of treatment using the method of principal stratification as described by Frangakis and Rubin (2002) and Jin and Rubin (2008). If we do so, we will create strata based on levels on non-compliance, and analyze causal effects within these strata. In addition to household reported frequency of notifications, we will use NextDrop's data on valveman reports to confirm customer reports of notification frequency and place control households within strata.

3. Heterogeneous treatment effects

An analysis of our baseline survey data reveals variation in underlying water supply conditions for our sample. For example, the number of water supply days per week can range from 1 to 7, with some respondents claiming that there is no regularity to the supply. It is likely that treatment effects will be larger for households with poorer supply conditions. In addition to the variables for which we identified potential heterogeneous treatment effects in the original design registration, we will analyze treatment effects conditional on the following variables: frequency of water supply and frequency of supply cancellation. Data on these variables was collected before treatment in the baseline survey.

We also expect to see variation in respondent employment status and distance to the respondent's workplace. It is possible that treatment effects will be greater for the employed or for those who work far from home. As a result, we will calculate treatment effects conditional on these variables. Data on these variables was also collected before treatment in the baseline survey.

Additionally, while possessing a household mobile phone was a prerequisite for enrolling in our study, the individual within a household who keeps this phone may not be responsible for waiting for water. It is unlikely that NextDrop's messages will have an effect on household behavior unless the individual waiting for water also keeps the mobile phone. In both waves of our survey, we ensure that the individual being interviewed is also the household member responsible for collecting and storing water. In the second wave of the interview, we also ask if this individual keeps the mobile phone that was registered for the receipt of NextDrop notifications. We will analyze treatment effects conditional on whether or not the survey respondent keeps the mobile phone.

Finally, as described above, the behavior of valvemen is directly responsible for the information disseminated to customers. In addition to variation in the frequency of message delivery, we may also see variation in the accuracy or quality of information received by households. We expect to see greater effects for households to whom accurate information is delivered, and have asked households about the accuracy of NextDrop's notifications in the second wave of our survey. We will calculate treatment effects conditional on household responses to this question.

References

Angrist, Joshua D. 2006. "Instrumental Variables Methods in Experimental Criminology Research: What, Why, and How." *Journal of Experimental Criminology.* 2:23-44.

Frangakis, C.E. and Rubin, D.B. (2002). "Principal stratification in causal inference." *Biometrics* 58(1): 21-29

Jin, H. and Rubin, D.B. (2008). "Principal stratification for causal inference with extended partial compliance." *Journal of the American Statistical Association* 103 (481): 101-111.

VanderWeele T.J., and Hernan, M. A. (2013). "Causal inference under multiple versions of treatment." *Journal of Causal Inference* 1 (1): 1-20.