

# How can a large sample survey monitor open defecation in rural India for the Swatch Bharat Abhiyan?

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WORKING DRAFT

## Executive Summary

The Swatch Bharat Abhiyan has announced the important goal of eliminating open defecation in India. One key part of the Government's guidelines to achieve this goal is a latrine use and open defecation surveillance survey. In the 69th round of the NSS, the National Sample Survey Office took the laudable step of separately asking about latrine ownership and latrine use. This permitted measurement of open defecation among people living in households that do and do not own latrines. Motivated by these developments, we ask how a large-scale sampling survey should best ask about latrine use and open defecation, in order to usefully track progress towards the Prime Minister's goal of elimination of open defecation.

We compare results of eight studies of new data from rural India, all released in approximately the past year. Because these studies used slightly different survey questions, differences in results across survey designs can suggest principles for the design of new surveys.

In particular, surveys which asked a balanced question about open defecation or latrine use, individually, for *each person* in the household were able to document more open defecation than survey questions that grouped household members by demographic categories. This difference is statistically significant (meaning very unlikely to be due to chance alone) and is not because of differences in overall open defecation rates across study sites.

**Therefore, we recommend that any large-scale open defecation surveillance survey ask a balanced question about latrine use or open defecation, individually, for each household member.** This could be done effectively and inexpensively by incorporating these questions in to a high-quality existing sample survey with a household roster.

# 1 Introduction

The elimination of open defecation has emerged as a top policy priority for India. Prime Minister Narendra Modi’s Swachh Bharat Abhiyan has announced the elimination of open defecation as a chief goal for India over the coming few years. One critical part of this goal – recognized in the Government of India’s guidelines – is ongoing monitoring of latrine use and open defecation in a representative sample survey.

Earlier this year, the National Sample Survey Office released results from a special sanitation and water survey in the 69th round. For the first time that we are aware of, the NSS distinguished latrine use from latrine ownership, and asked about open defecation among people living in households that own latrines. This is an important advance, which we applaud: among the Census of India, the NFHS, the DLHS, and the IHDS, none of these well-respected large-scale data sources permit distinctions between latrine use and latrine ownership. The NSS has already taken an important step in understanding the problem of open defecation in India.

Motivated by the Prime Minister’s Swachh Bharat Abhiyan and by the results of the 69th round of the NSS, in this note we consider how to best measure open defecation in a large sample survey. In particular, we ask how a large-scale survey organization, operating throughout rural India, can best ask survey questions in order to monitor open defecation. We review data from eight recent surveys conducted or released over approximately the past year. We focus on rural India, rather than urban India, both because rural settings are the focus of these recent surveys and because approximately 90 percent of open defecation in India is rural, according to the 2011 Census.

Many issues are important for good survey design. Here we focus only on the structure and wording of survey questions. It is well-known that survey question and questionnaire design and methodology influence the quality and usefulness of the data obtained (Srinivasan, 1994; Deaton, 1997). We believe that survey questionnaire design is likely to be particularly critical for a quality survey of open defecation in rural India, and we can draw upon our own recent experience with such surveys. We ignore the technical issue of survey size calculation and sampling, which will be familiar to any large-scale survey organization. We also ignore the important issue of surveyor training and motivation.

A key finding of our analysis is that the disaggregation of the survey question matters: surveys which ask balanced questions about the open defecation behavior of each household member individually find more open defecation among latrine owners than surveys that ask questions which group people together into demographic categories. We believe that this is because a slower survey which asks about each person signals to surveyors and respondents

that these questions are important, and that it is common to sometimes find households where some members defecate in the open and some use latrines.

Each of the eight data sources that we review found a considerable amount of open defecation among latrine owners. This is an important measure of sanitation behavior for several reasons. First, it emphasizes the special challenges required to eliminate open defecation in populations where demand for latrine use is so low that even many people with a latrine choose not to use it. Second – and more relevant to our purpose here of providing information for a data-driven Swachh Bharat Mission – it will become increasingly important as the government builds more latrines, so a larger fraction of the rural Indian households become latrine owners.

## 2 Question types

In this section, we introduce the recent data collection efforts that we compare in this note. We categorize them into three groups: no disaggregation, full disaggregation, and partial disaggregation. Here, “disaggregation” means disaggregation among household members: did the survey ask about the individual behavior of each person, or only ask a household-level question, or do an intermediate disaggregation, such as by demographic groups? The level of disaggregation is important not merely because we might care about the details of each person’s sanitation behavior, but also because it creates an interview environment which slows the survey down, contributing to an expectation among both the surveyor and the respondent that it is normal and expected for some household members to use a latrine and some household members to defecate in the open, despite owning a latrine. Although from a health perspective, higher open defecation rates among latrine owners is not a desired outcome, it is important to measure this behavior as accurately as possible in order to be able to address it.

Two other dimensions of the survey questionnaire are also important. First is *balance*: does the survey question present balanced options of latrine use or open defecation, or does it bias the response in favor of one or the other? For example, a balanced question might ask “does Dean defecate in the open or does he use a latrine?”, while an unbalanced question might ask only “does Dean use a latrine?”. When asking unbalanced questions, it is easier for surveyors and respondents to speed through yes/no questions, or to tick off default responses, rather than noticing the verbal and non-verbal cues of respondents, which leads to the recording of more accurate information.

A particularly harmful combination would be for an unbalanced question to be the trigger

for disaggregation. For example, for households with a latrine, the survey might ask “does everyone in the household use the latrine?” and only follow up with individuals if the answer is no. This is a leading question which suggests a “yes” answer, and gives the surveyor an incentive to incorrectly tick “yes” in order to save surveying time.

The second important further dimension is whether the latrine is personally inspected by the surveyor. Both Clasen et al. (2014) and Jenkins et al. (2014) describe the usefulness of this technique. In particular, latrine inspections can reduce an expectation among respondents that the surveyor expects all owned latrines to be in use. It is an open question whether surveyors in a large statistical organization could be effectively motivated to personally inspect latrines, given that latrines are considered to be dirty and polluting places. Although latrine inspections could be very useful, we note that *requiring* latrine inspections could perhaps be counterproductive, if it reduces surveyor commitment to quality implementation of the latrine use questions.

Although in this analysis we compare studies that used different survey methodologies, we emphasize that each of these surveys was designed for its own purposes. As such, each research team made its own decision about the costs and benefits associated with strategies to achieve their goals; some studies, for example, are only interested in sanitation behavior, while others are part of randomized, controlled trials designed to estimate the effect of a binary treatment on measured health outcomes. Nothing in this paper is meant to suggest that any of these surveys was not well-designed to achieve its goals.

## 2.1 No disaggregation

Three important, large-scale, recent datasets fail to distinguish between latrine ownership and latrine use. Instead, these surveys only ask one household-level question. Clearly these surveys will, by design, overlook persons who defecate in the open in households which own latrines. The 2011 Census of India, the India Human Development Survey (IHDS), and the National Family Health Survey (NFHS), all report a single household-level measure that combines behavior and ownership. We will not further consider these surveys and they will not be included in our statistical analysis.

## 2.2 Full disaggregation

Three recent surveys ask about defecation behavior for every member of rural households that own latrines. Barnard et al. (2013) report a cross-sectional survey in rural Orissa. Their sample is important because it reflects an unrepresentatively *good* scenario for sanitation

policy: they study places where the Total Sanitation Campaign has been relatively well implemented. “Villages were eligible for inclusion in the study if the TSC was undertaken by an implementing partner NGO of WaterAid India at least three years prior to the study.”

They ask a disaggregated, balanced defecation behavior question of every member of the household, after a latrine inspection: “Household latrine coverage was assessed using the question ‘does your household have a latrine?’ Those that answered affirmatively were classified as having a latrine. In households with a latrine, enumerators visually examined the latrine and assessed its functionality. Latrines were considered ‘functional’ if they met the following criteria: walls over 1.5 meters, some type of closure over the entry for privacy, an unbroken and unblocked toilet pan and a functional pan-pipe-pit connection. Households that had a latrine were asked if the latrine was used by any member of the household. Those that responded affirmatively were further asked to report the age, gender and place of defecation of each member of the household.” We recommend that this important study be carefully read in full by anyone planning a study of sanitation behavior in rural India.<sup>1</sup>

Coffey et al. (2014a) report results from the SQUAT Survey (Sanitation Quality, Use, Access, and Trends) in rural parts of five states of north India: Bihar, Haryana, Madhya Pradesh, Rajasthan, and Uttar Pradesh. The SQUAT survey was a quantitative study of 22,787 persons in 3,235 households from 13 districts, chosen to be representative of their states. The survey first asked about latrine ownership unobtrusively in a standard asset index questionnaire; thus the immediately preceding question was whether the household owned a color TV, and the immediately following question was whether the household owned a sewing machine. Later in the survey, the surveyor asked to visually inspect the latrine. Afterwards, the survey returned to the household member roster, asking “Now I want to ask you about the defecation practices of members of your household. Some people defecate in the open, and some people use a toilet. Does NAME usually go in the open or in the toilet?”. This balanced question was repeated for every household member, by name. Because the names were asked about in the order of the original household roster, males and older members – who are more likely to defecate in the open than other household members – were asked about first, contributing to a norm that surveyors understood that some people defecate in the open and some people use a toilet.

Coffey et al. (2014b) conducted a qualitative investigation of defecation behavior and its cultural context in northern South Asia. They conducted 100 detailed semi-structured

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<sup>1</sup>In a finding that will be a common refrain among these recent studies, Barnard et al. (2013) note a culturally-influenced preference for open defecation, even among many latrine owners: “The most common reason reported for not using a latrine was that people prefer open defecation. Open defecation is a cultural practice that is deeply engrained in communities in India.”

interviews in Haryana, Gujarat, Uttar Pradesh, and the southern plains of Nepal, just north of Bihar; districts and villages were purposively sampled to match state-level rural sanitation. They asked similar balanced and disaggregated questions about each household member as in the SQUAT Survey, but these were embedded in an in-depth conversation about sanitation that attempted to achieve an empathetic understanding of participants’ own ideas about open defecation and sanitation. Although this qualitative approach to research would not be a realistic option for a large-scale government survey organization, we include it in our analysis to demonstrate that even careful quantitative survey methods may miss open defecation that is observable to more attentive empirical methods.

## 2.3 Intermediate disaggregation

Several other studies learned about open defecation within households by asking questions of intermediate disaggregation. A typical approach is to ask whether, for example, adult men, adult women, and children use the latrines. We note that while the three fully disaggregated studies had measurement of sanitation behavior as their central or only goal, the studies reviewed here often had additional goals, such as estimation of an experimental treatment effect.

Perhaps the most important of these studies for India’s Swatchh Bharat Abhiyan – and the motivation for our note – is the 69th round of the National Sample Survey (NSSO, 2014). In a survey schedule that includes questions about sanitation, water access, bathing, and hygiene, the section on “latrine” includes four items on which we focus:<sup>2</sup>

- “access to latrine” (6 categories)
- “type of latrine” (10 categories)
- “reason for not using latrine” (6 categories)
- “whether all household members of categories specified are using latrine” (yes, no, not applicable)
  - “male of age below 15 years”
  - “male of age 15 years and above”
  - “female of age below 15 years”
  - “female of age 15 years and above”

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<sup>2</sup>The published survey schedule is as we quote; items are not phrased as questions to be asked by surveyors to respondents.

Therefore, this survey approach offers partial but not full disaggregation. Although the exact survey questions are not reported, this text is not balanced: only latrine use is mentioned, not open defecation.

Patil et al. (2014), in a study of a randomized sanitation experiment in rural Madhya Pradesh, asked about open defecation by demographic categories. Of their measurement strategy, they write that “[t]o assess defecation behavior for men, women, and children (< 5 years), interviewers asked households separately for each group whether they openly defecate daily/always, occasionally/seasonally, or never... Field staff also observed whether the IHLs (of any type if present) were being used on the basis of worn path, closable door, odor, anal cleaning material, and water to flush. Field staff also recorded any observed human or animal feces in the household living area.”<sup>3</sup> They, too, find much open defecation among latrine owners.<sup>4</sup>

Clasen et al. (2014) report a randomized trial in rural Orissa, designed to study the effects of a particular sanitation intervention on health and nutrition. Although they do not report their exact survey procedures, we infer from the following descriptions that they used direct surveyor observations of latrines and measured semi-disaggregated behavior by demographic categories, but did not measure individual-level latrine use:

- “We confirmed present latrine use on the basis of several indicators: smell of faeces, wet pan except when rainy, stain from faeces or urine, presence of soap, presence of water bucket or can, presence of a broom or brush for cleaning, or presence of slippers.”
- “Latrine functionality is an objective measure of some use by the household; however, it cannot discern use by individual householders.”
- “1729 (63%) of 2732 households with any latrine in the intervention group reported that household members were using the latrine; of these, 1690 (98%) of 1724 reported that women were using it, 1364 (79%) of 1725 reported that men were using it, and 903 (79%) of 1140 households with children reported that children were using it.”

Jenkins et al. (2014), in an important empirical study complementary to this note and recommended to anyone planning a sanitation survey in rural India, report on a set of 15 survey questions that can be used to construct scales of household-level sanitation behavior.

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<sup>3</sup>We compute open defecation among latrine owners from the following figures: “Amongst the 630 households in intervention villages that had JMP defined improved sanitation facilities at follow-up, 41% reported that adult men or women still practiced daily open defecation; this same figure was 28% among the 339 control village households at follow-up (not reported in results table).”

<sup>4</sup>They explain, again citing culture and preference: “A follow-up debriefing question to households who had IHL identified that the main reasons for daily open defecation in spite of having IHL were culture, habit, or preference for defecating in open followed by inadequate water availability.”

Their scale disaggregates sanitation behavior by demographic groups (e.g. “elders,” “married women who are not yet elders”). If a large survey organization is indeed willing to devote enough survey time to ask this range of questions, Jenkins et al.’s (2014) approach deserves careful consideration. Although the data that they report are unable to be converted into the measure that we use in our quantitative analysis below, they too find much open defecation among latrine owners.<sup>5</sup>

Although no citable working paper is yet available, the authors of this note are also involved in a survey project in rural Tamil Nadu which asked about latrine use. An initial exploratory survey used partial disaggregation. The survey asked about latrine ownership within an asset index and surveyors personally inspected latrines before asking about sanitation behavior. Sanitation behavior was asked about with a trigger:

- “Do you usually defecate out in the open or use a latrine/toilet?”
- “Does everyone in your household follow the same practice as you?” (if no, then)
- “Does NAME usually defecate out in the open or use a latrine or toilet?”

Although this series of questions has the advantage of balanced phrasing and use of household members’ names, almost every household is recorded to have reported that all household members follow the same practice as the respondent. This suggests that the survey design may have promoted a default skip pattern of responses that was simpler and faster for surveyors and respondents.

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<sup>5</sup>In what follows ‘LUF’ is their constructed Latrine Use Frequency measure and ‘SSI’ is their Safe San Index. “Among study households with a functioning latrine ( $n = 71$  at F1), mean ODR7 was 27 (on average 27% of members openly defecated at least once a day), mean LUF was 64 (‘sometimes’ use range), and mean SSI was 51 (51% of defecation events safely captured). Only 2 households (3%) had ODR7 = 0 and LUF = 100, necessary for an SSI of 100. In some latrine owner households, every member defecated openly at least once on each of the last 7 days (ODR7 = 100), resulting in SSI = 0. The majority of owners (51% [ $n = 36/71$ ]) had LUF scores in the mostly use range (6799) where ODR7 ranged from 0 (no open defecation) to 50 (50% of members open defecated daily) and SSI ranged from 39 to 90. ODR7 variability within each LUF range is visible in Figure 2. Households who on average sometimes used their latrine (LUF: 3366 range [ $n = 26/71$ ]) showed the greatest variability in recent open defecation rates, spanning the full ODR7 range from 0 to 100.”

Later they write: “In just 3% (95% CI 0.5% to 8%) of study households with a functioning improved latrine was the facility consistently used by all members at all defecation and feces disposal occasions (i.e., SSI = 100). This is considerably lower than reported in rural Puri District based on less precise methods of assessing latrine use. Overall, the mean SSI score among latrine owners was 51 (95% CI 44 to 57), meaning only about half of excreta disposal occasions were safely disposed, with rates significantly lower among those with a government subsidized latrine (SSI = 41; 95% CI 39 to 48) compared to those with a self-financed latrine (SSI = 72; 95% CI 63 to 81). On any given day at the time of the survey, an estimated 27% (95% CI 20% to 33%) of the study population with access to a functioning household latrine none-the-less defecated in the open.”



Table 1: Open defecation among rural latrine owners, by survey question type

study/survey	place	individual	groups	balanced	observed	any OD among owners
Coffey et al. (2014b) (qualitative)	HR GJ Nepal UP	✓		✓	✓	56
Coffey et al. (2014a) SQUAT	BR HR MP RJ UP	✓		✓	✓	43.9
Barnard et al. (2013)	Orissa	✓		✓	✓	39
Clasen et al. (2014)	Orissa		✓	✓	✓	37
Patil et al. (2014)	Madhya Pradesh		✓	✓	✓	36.5
in progress	Tamil Nadu		✓	✓	✓	23
NSS 69th round	all rural India		✓			21.4
NFHS/DHS	all rural India					unmeasured
IHDS	all rural India					unmeasured
2011 census	all rural India					unmeasured

Table 2: Open defecation among rural latrine owners, comparing NSS with SQUAT

	NSS 69th round			SQUAT	
	no latrine	all use latrine	OD among owners	OD among owners	
Bihar	72.8	18.8	30.9		54.2
Haryana	25.4	63.9	14.3		35.7
Madhya Pradesh	79.0	15.3	27.1		40.8
Rajasthan	73.0	21.5	20.4		66.2
Uttar Pradesh	75.3	19.5	21.1		42.5
average of SQUAT states			22.8		43.9
all India	59.4	31.9	21.4		

### 3 Question type matters

It is clear that question design is associated with study findings. Table 1 compares results across the seven studies which report (or from which we can compute) the fraction of households with one or more members who defecate in the open, among households that own a latrine. We focus on this variable both because it is highly relevant to the behavior change challenges faced by the sanitation sector in rural India and because it is an indicator of the sensitivity of a survey to open defecation behavior that may be hard to observe.

The three studies that asked balanced questions about defecation behavior of each individual household member all found more open defecation among latrine owners than all of the four studies that partially disaggregated households into demographic groups. This difference is statistically significant, meaning that it is highly unlikely to have occurred due to chance alone.<sup>6</sup> We note that the NSS – the only study to not have asked a balanced question, but rather to have defaulted in favor of latrine use – found the least open defecation among latrine owners.

These seven studies occurred in different places. Figure 1 plots open defecation among latrine owning households against rural open defecation rates from the 2011 Census of India.<sup>7</sup> A slight downward trend is observed, where open defecation among latrine owners is less common where the census reports fewer latrines; this gradient may reflect an absence of unwanted latrines, but it is not statistically significant, meaning that we cannot statistically rule out that the line is flat. The three dots for the studies that asked individually are all above the other four dots.<sup>8</sup>

One way to separate effects of different questions from possible differences across places is to compare results when different question types are asked in the same place. Table 2 directly compares data from the NSS 69th round with the SQUAT survey, state by state. We use table 3.22 of NSSO (2014) to compute the fraction of households in which at least one person defecates in the open, among rural latrine owners.<sup>9</sup> In every state the SQUAT

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<sup>6</sup>To see this, note that there are 5,040 distinct ways to randomly order 7 items, but only 144 ways to do so such that a particular three items come first; thus the probability is 0.029. Alternatively, a two-sided non-parametric Wilcoxon rank-sum (Mann-Whitney) test finds a  $p$ -value of 0.034.

<sup>7</sup>Open defecation is matched at the state level. For the two Coffey, et al. studies an average is used among the places sampled; data for the Nepali terai is taken from the DHS.

<sup>8</sup>In a simple regression with seven unweighted observations, one for each study, the studies which asked about latrine behavior individually found 16.8 percentage points more open defecation among latrine owners [ $s.e. = 6.5$ , two-sided  $p = 0.049$ ]; when a control is added for census open defecation, this coefficient is unchanged at 16.4 [ $s.e. = 7.3$ , two-sided  $p = 0.087$ ]. The NSS data are also exceptional for being unbalanced in the question wording; if we include a dummy variable control for this imbalance, the coefficient on individual-person questions just loses statistical significance [ $p = 0.13$ ].

<sup>9</sup>NSS table 3.22 reports the first two columns in our table 2: the fraction of households (expressed as per 1,000) with a latrine and where everyone uses a latrine. Using Bihar as an example, we compute open

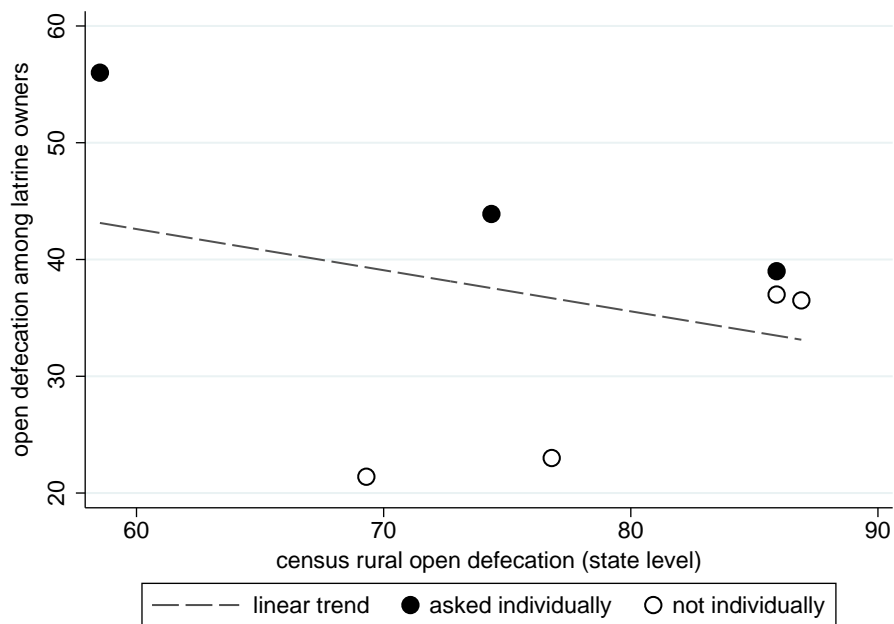


Figure 1: Outcomes and question types, by census open defecation

survey found more open defecation among latrine owners than did the NSS – indeed, almost twice as much, overall.<sup>10</sup>

Therefore, these comparisons make the unsurprising suggestion that disaggregated survey questions will find more open defecation among people living in households that own latrines. However, we must also note that the three studies which found the most open defecation were specifically designed to study sanitation behavior as their principal goal (rather than evaluate a health impact, or also survey other dimensions of water, hygiene, or human development). In these three studies, surveyors were presumably especially well trained and motivated to implement survey questions about open defecation. Any large-scale survey organization considering an India-wide survey to monitor sanitation behavior must pay careful attention to surveyor training and motivation, especially if urban surveyors personally disapprove of open defecation. Surveyors who make respondents aware of their personal disapproval will record less accurate information about open defecation among latrine owners.

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defecation among latrine owners as follows

$$\frac{\text{open defecators among latrine owners}}{\text{latrine owners}} = \frac{(100 - 18.8) - 72.8}{100 - 72.8} = \frac{8.4}{27.2} = 30.9\%$$

This computation ignores the possible existence of rural households that do not own a latrine, but where all members use a toilet or latrine; these would increase the fraction by increasing the numerator.

<sup>10</sup>The NSS figure for rural Tamil Nadu, 18.5 percent, is similar to the 23 percent found in the Tamil Nadu data with a balanced question and latrine observation, but with triggered disaggregation.

## 4 Recommendation

Based on these results, we make the following recommendations to any organization considering a large-scale, India-wide sample survey to monitor open defecation, latrine use, and progress towards the Swatchh Bharat Mission in rural India:

1. Ask about open defecation as part of an existing survey that already includes a household roster.
2. Ask about open defecation and latrine use separately for each household member, in the order that household members are listed on the household roster.
3. Ask about latrine ownership separately and earlier, in an asset index.
4. Ask a balanced question on latrine use (“Does X defecate in the open or use a latrine?”) rather than a biased yes/no question that privileges one outcome (“Does X use a latrine?”). We emphasize that the least open defecation was detected in the one study with an unbalanced question in which the default response was latrine use.
5. Well-trained, motivated surveyors, who do not show personal disapproval of open defecation, are important for ensuring accurate data.
6. Latrine observation can be a useful part of the survey. However, many surveyors in rural India may be reluctant to look at a latrine; this may cause them to skip or hurry through the section. It is an open empirical question whether attempting to require surveyors to inspect latrines would be effective in a large government-style survey organization, rather than in a small academic survey.

We note that implementing these suggestions could be quite inexpensive in an organization that already collects household survey data which includes household rosters. As India focuses on eliminating open defecation, the data that such a survey could produce would be an invaluable contribution to this national priority.

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