Author's response to reviews

Title: Failures in the quality, quantity, and reliability of water provided through an informal distribution system in a slum in Mumbai, India

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Author's response to reviews: see over
October 5, 2012

Dear Dr. Panigrahi and other BMC Public Health editors:

Thank you for facilitating peer review of our manuscript entitled “Failures in the quality, quantity, and reliability of water provided through an informal distribution system in a slum in Mumbai, India.” We have extensively modified our manuscript draft based on the helpful feedback from the reviewers. Below is a point-by-point response to the specific questions raised by the reviewers. The reviewers’ original comments are in italics, and our responses are in regular font. We have also attempted to highlight the places where changes have been made in the text of the manuscript in response to specific points of feedback.

Sincerely,

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Robert Gilman

To the authors – this paper is well written and mirrors other papers that demonstrate the economic inequality present in water cost and quality present in non municipal or government water supplies to communities.

Thank you for this kind feedback.

Specific questions that are not answered are: If 14% of the adults only defecate in open air – where do the other 86% go.

Of the remaining adults, 3% use toilet seats that are located within their homes, as is already noted in the paper. The remaining 83% are forced to use pay-for-use toilets. Four small pay-for-use toilet blocks exist within KB, three of which were built by slum residents themselves with informal support from local politicians. However, given the lack of a reliable water supply, excessive use (due to high population density) and lack of maintenance, many of the toilets in these blocks have rapidly become dysfunctional. There are in theory a total of 19 toilet seats for the entire population in these pay for use toilet blocks, but in fact there are far fewer functioning seats. Given the paucity of pay-for-use toilet seats within the community, some adults, especially women, often travel great distances to access other pay-for-use toilets outside of KB.

We apologize for not making this point clear in the paper, and we have modified our draft as follows in the “Methods/Study site” section: “As a result, the vast majority of children and 14% of adults engage in open defecation, while the remainder of adults use a handful of pay-for-use toilets in the community or travel long-distances to access pay-for-use toilets outside of the slum.”

If water hoses go thru the ocean how then is water not saline if there are holes in the hoses.

This is an excellent question. While we had not mentioned this in the initial draft of the paper, for the first season that we performed testing (the winter season), we requested that salinity also be tested on all KB motor samples and all KB hose samples, as we suspected that these...
samples might have high salinity levels. Remarkably, all of these samples came back with salinity levels that were well within the normal limits for human consumption. For example, if 0.8 dS/m is considered the normal desirable salinity limit for human consumption, all of our hose samples came back with salinity levels around ~0.02 dS/m, which is well below the allowable limit.

It is not clear why the hose samples did not have elevated saline content. Our best guess is that any initial saline contamination that may occur is rapidly washed out of the hoses when water starts flowing through the hoses during water delivery timings. It is likely that when we collect our water samples (usually at least a couple of minutes after water has started to flow through the hoses), all of the high saline content water has been flushed out. Since the water pressure is very high in the hoses during water delivery timings, this high pressure prevents further inflow of saline ocean water into the hoses during water delivery timings. The high pressure within the hoses may also explain why the hose water is not more frequently contaminated with coliform bacteria, given that the ocean water samples were all highly contaminated.

We have added the following sentence of clarification to our manuscript in the “Results/Water quality and storage” section: “During winter season, we also specifically tested the point-of-source water samples (e.g., KB motors, Dharavi taps, and chawl taps) as well as the KB hose samples for salinity levels, given the risk for ocean water contamination of KB motor and hose samples. All of these samples had salinity levels of ~0.02 dS/m, which is well within the normal limit for human consumption of 0.8 dS/m.”

It is not at all clear what water is used for drinking.

Thank you for pointing out that this is not sufficiently clear. In response, we have re-written a paragraph, under the section entitled “Methods/The informal water distribution in KB”:

“Within each household, water is stored in two types of containers. Large plastic drums with capacities of 100 to 300 liters are placed outside the home and hold ‘storage water,’ which is used for bathing, toileting, and washing clothes (Figure 2). Water from these larger storage containers is used for drinking only during times of severe water scarcity. Smaller containers with a capacity of one to 50 liters are kept inside the home and are used to store ‘drinking water’ (Figure 3). Notably, nearly all of the drinking water containers in KB are wide-mouthed and allow people to directly access water with their hands, a detail that has major implications for household-level water contamination.”

To further clarify this question, we will also add photos to the revised manuscript. These photos (in the new manuscript as Figure 2 and Figure 3) will help the reader to see what “drinking water” and “storage water” containers look like. We have included these specific photos below, with the captions that will accompany them.
Figure 2: Large 300-liter plastic drums commonly placed outside of the home to hold “storage water.” This water is used for bathing, toileting, and washing clothes (non-drinking purposes).

Figure 3: A woman in Kaula Bandar fills smaller metal and plastic containers used for storing drinking water. Nearly all drinking water containers used in the community are wide-mouthed, allowing for contamination of water by people’s hands.

*Is this water boiled.*

This finding was already in Table 3 of the original draft, but we have also added this point to the “Results/Water quality and storage” section in the following sentence: “According to the
BNA, most households, 568 (59.2%), do not use any method of water purification, while
25.8% use a cloth filter and 17.2% boil their drinking water prior to consumption (Table 3).”

*Is there a cost to this.*

There is definitely a cost associated with boiling water, as most households in KB (84%) use relatively expensive kerosene as their main cooking fuel (only 16% use less expensive but more unhealthy biomass fuels). We do have figures from another study on the mean monthly spending on kerosene per household in KB; however, we do not have a good sense of what proportion of the monthly kerosene quota would go towards boiling water. Moreover, given that only a minority (17%) of households boil their water (and those that do probably do so inconsistently), it is difficult to assess how substantial the cost of boiling water is for the community as a whole.

*If stored differently from other water how is this in storage containers that permit hands to get in or not.*

We have clarified this point in the paper by adding a sentence to the “Methods/The informal water distribution in KB” section:

“Notably, nearly all of the drinking water containers in KB are wide-mouthed and allow people to directly access water with their hands, a detail that has major implications for household-level water contamination.”

In addition, we had already mentioned that most drinking water storage containers were wide-mouthed in the following sentences in the “Discussion” section:

“In KB, the vast majority of homes store drinking water in wide-mouthed containers that allow contamination when water is accessed with hands or vessels. Some studies suggest that encouraging safe storage of water in narrow-mouthed containers that minimize hand contact along with household water treatment (e.g., chlorination) may reduce diarrhea rates [21-24].”

Finally, we have included a photo (Figure 3) of the wide-mouthed drinking water containers as noted above, with a caption that also emphasizes that drinking water containers in KB are usually wide-mouthed.

*How was income obtained- is this just by asking -notoriously misleading.*

First off, I should note that the household income data (i.e., the mean monthly household income cited in paragraph 2 of the “Water Costs and Hardships” section) used in this study come from a 2012 Mental Health Survey, in which we collected our broadest based income data from 521 randomly selected households in the community. We should note that in our prior draft, we used income data from 400 households in a prior 2011 Diarrheal Illness study, but we are using the 2012 Mental Health Survey Data in this resubmission because these data are more robust. Households were selected using a random number generator and then selecting the corresponding households from a complete database of all household codes in the community. This survey was performed only a few months after collecting all of our water samples and household surveys for the water study. Our income data were obtained by directly asking the respondent. In nearly all cases, the respondent (whether a man or woman) had a good idea of the household income. In the case of men, they usually know their incomes because they are the wage earners. In the case of women, they tend to be the ones who manage household expenditures, and so they have quite a good sense of their husband’s monthly income. In rare cases where someone did not know the income (occasionally the case for a female respondent), we actually asked the respondent to check with the other
household occupant (e.g., the husband) to confirm the monthly income.

I should note that we had no other choice but to collect household income data by asking, since the vast majority of community residents work in the informal sector, where there is very little or no formal paper documentation of monthly pay. It is very reassuring to us that incomes in the community follow a normal distribution, with 71.2% of households falling in the middle 3500 to 7500 income range.

How was total water estimated and how was usage determined.

In the “Methods/Study design for the 2011 Seasonal Water Assessment” section, we have the following explanation for how total water usage was estimated:

“Quantity of water used was assessed through a detailed inventory of every drinking and storage water container in the household. Researchers estimated the capacity in liters of each container and the number of times it had been filled in the last week. These numbers were tabulated to estimate the total weekly water use for each household.”

We have now expanded this a bit to emphasize that researchers had been carefully trained to be able to recognize the volume of water held by containers of various sizes and shapes commonly used to store water in the community, prior to initiation of the study:

“Quantity of water used was assessed through a detailed inventory of every drinking and storage water container in each household. Prior to starting data collection in the field, researchers were uniformly trained to recognize the volume of water held by containers of various sizes and shapes commonly used to store water in the community. In each household surveyed, researchers carefully estimated the capacity in liters of each container and the number of times it had been filled in the last week. These numbers were tabulated to estimate the total amount water used in the last week by each household.”

What was the ratio of male to female respondents - especially in regard to missed interviews. If mainly female was the females account of income really accurate since often they do not know the income of their husbands.

The respondents were female in 12 of 21 households (57.1%). There were no missed interviews, as we made sure to follow-up with the same household and same respondent in every season. We believe our information is accurate despite the mixed gender of the respondents for a few reasons. First, in nearly all cases, we asked the survey questionnaires around water collection timings in the community. This helped to ensure that we were asking the questionnaire to the family member who was most likely to regularly collect water for the household. Since water vendors tend to collect their monthly and weekly fees around water collection timings (and vendors are often present in the community during water collection timings), this means that the person who was asked the questionnaire was also the family member who was most likely to pay the monthly and weekly fees to the water vendors. Therefore, all the respondents had strong confidence in the figures they provided when asked about the fees they paid for water in the last month or the last week. This was true regardless of the gender of the respondent.

We had already made this point in the previous draft of the paper, under the “Study design for the 2011 Seasonal Water Assessment” section:

“Since questionnaires were administered around the time of water collection, they were usually administered to the adults who most commonly interact with water vendors and who
therefore were most likely to provide accurate information on water spending.”

We have already discussed our income data above. We believe that, in nearly all cases, the respondent (whether a man or woman) had a good idea of the household income. In the case of men, they usually know their incomes because they are the wage earners. In the case of women, they tend to be the ones who manage household expenditures, and so they have quite a good sense of their husband’s monthly income. In rare cases where someone did not know the income (occasionally the case for a female respondent), we actually asked the respondent to check with the other household occupant (e.g., the husband) to confirm the monthly income.

*The amounts of INR should be put in terms of either dollars or euros.*

Thank you for noting this, and we agree that converting the currency figures is important for an international journal. We now have the monetary figures in both Indian rupees (INR) and US dollars (USD) so that our figures will make sense to both Indian and international audiences.

*Drinking water should be separated from non drinking water and how it is stored and in what type of containers detailed – ie open to hands or does not permit hands to enter.*

As noted above, we have tried to clarify the difference between containers that hold “drinking water” and containers that hold “storage water” (i.e., water used for bathing, washing clothes, etc.). We have included two new figures that have photos that clarify the differences between the different containers. We have also emphasized multiple times in the new draft that drinking water is almost always held in wide-mouthed containers that allow entry of hands, which may contribute to household level contamination of water.

*How was drinking water used – raw, in teas or after boiling.*

Our general observations suggest that some drinking water is consumed in tea and coffee in the community; however, the majority of drinking water is consumed “raw,” without being boiled in these beverages prior to consumption, especially for children, who are most likely to suffer from diarrhea illnesses and helminth infection. We have now included this informal observation in the “Results/Water quality and storage section”:

“Of note, our informal observations suggest that many adults also boil water prior to consumption in beverages such as tea or coffee; however, the majority of water is consumed ‘raw’ without being boiled in beverages, especially for children, who are most likely to suffer from diarrheal illness.”

*If boiled what was the fuel consumed and was that cost also considered.*

As noted above, there is definitely a cost associated with boiling water, as most households in KB (84%) use relatively expensive kerosene as their main cooking fuel (only 16% use less expensive but more unhealthy biomass fuels). We do have figures from another study on the mean monthly spending on kerosene per household in KB; however, we do not have a good sense of what proportion of the monthly kerosene quota would go towards boiling water. Moreover, given that only a minority (17%) of households boil their water (and those that do probably do so inconsistently), it is difficult to assess how substantial the cost of boiling water is for the community as a whole. Therefore, adding estimates of the cost of boiling water into the paper might be relatively low-yield, since this is not a practice performed by the majority of the community and the estimates may be inaccurate.
I am not at all sure that intermittent chlorination will function and suggest that the only way to get pure water to this community would be thru government supply which appears to function well in other govt approved communities.

We completely agree with you that provision of water through a formal government supply is by far the most crucial intervention needed to improve the water situation in this community. The core part of our argument is a critique of the structural deficiencies of an informal water supply, and the primary remedy for these deficiencies is the provision of a formal water supply. We have heavily emphasized this point multiple times in the “Discussion” section. For example, we said,

“If this study highlights household level issues, the structural problems with KB’s core water supply are probably more detrimental to health and social equity outcomes, given their impact on water quality, quantity and cost . . . Since point-of-source quality and quantity of water used are functions of these structural issues, these problems can only be remedied by providing equitable access to the municipal water supply, including a new pipeline, public water taps, and improved water provision timings . . . In summary, extending formal water infrastructure to slums such as KB would be a “win-win” situation for everyone. It would improve quality of life, reduce water costs, and improve health outcomes for slum dwellers while also decreasing waterborne disease burden in municipal hospitals, generating revenue for the municipality, and decreasing conflicts between the government and slum residents (i.e., by averting government raids on water motors).”

Therefore, we are in agreement with you on this point. However, the water quality data from our study suggest that household-level contamination is a major problem, and this problem would likely persist even if a formal water supply were extended to the community in the future. A formal water supply with abundant community taps and improved water provision timings would still require daily household storage of drinking water. Without interventions to encourage use of safe storage containers and household chlorination, there would likely be some degree of household-level contamination of water. Therefore, we believe that our findings suggest that both infrastructural interventions (i.e., provision of a new water supply to the community) and household-level interventions (i.e., safe storage and point-of-use chlorination) are needed to improve the water situation in the community.

There usually is a water mafia in these distribution schemes that controls access and this will not disappear unless government installations occur.

We completely agree with you on this point. In fact, the entire “informal water distribution system” that we have described is run by people we have referred to as “water vendors,” but who some people would refer to as a “water mafia.” We have avoided this term, as it has a somewhat pejorative and negative connotation. We feel that this term places an unfortunate value judgment on informal systems that are created out of necessity, when the government fails to provide this fundamental service. We completely agree with you that the water mafia will not disappear unless the government places a new water supply.

In our revised draft, in the “Methods/Informal water distribution system in KB” section, we now emphasize that the “water vendors” are residents of KB:

“The sources of KB’s water supply are two underground pipes that were installed decades ago by the fire department for emergency use. Water vendors, nearly all of whom are residents of KB, have created entry points in the fire brigade pipes from which water is extracted using motorized pumps . . . Tracing each vendor’s water distribution area (i.e., the households receiving water from a particular vendor’s motor and hose system) formed the basis for sample selection in the SWA, as is described further below.”
In the “Conclusions” section, we have also added a few sentences that emphasize that the “informal distribution system” arises out of necessity, given the absence of government provision of water:

“While we have presented data from a single slum community, we would argue that this case study sheds light on circumstances faced by a significant proportion of urban dwellers in India and other cities in developing countries. Approximately half of urban slums in India are non-notified (i.e., not recognized by the government), making it extremely difficult, if not impossible, to access formal municipal water supplies [9]. In the absence of provision of water by the government, informal distribution systems, like the one we have described, arise out of necessity. Provision of water is taken over by water vendors (who in KB’s case are residents of the community) or other suppliers, with resulting deterioration in water-related health and social equity indicators.”

Who controls and pays for the pumps – and how the distribution system of payments for the water is not detailed here and may not only be difficult to obtain but somewhat dangerous – this should however be mentioned in the article.

We have talked to water vendors in the community extensively as part of this study, and we obtained very interesting information from them regarding the regular costs required to operate various components of the distribution system, including the pumps and hoses. We have now included this information in the “Methods/Informal water distribution system in KB” section:

“The water vendors who run the informal water distribution system incur significant costs to maintain the system, all of which are passed on to community residents who purchase this water. For example, based on interviews with multiple water sellers, we estimated that they pay Indian rupees (INR) 15,000 to 20,000 for a new motorized pump (used for extracting water from underground pipes), which is US dollars (USD) 273 to 364. A used motorized pump costs INR 10,000 to 12,000 (USD 182 to 218); however, these require frequent repair every few months, which generally costs INR 500 (USD 9) per repair. When local officials confiscate motorized pumps every few months, water vendors pay bribes of INR 500 to 1000 (USD 9 to 18) to get motorized pumps back, though they are often unable to get the pumps back and are forced to buy new ones. The rubber hoses used to distribute water to community lanes cost INR 5000 (USD 91) per 100 meters, and a few hundred meters of hose are often required to provide water to community lanes from each motorized pump. Finally, each water vendor usually hires one or two other people to facilitate water distribution, and these individuals are remunerated by receiving free water.”

These costs reflect the high cost of water obtained under informal circumstances and does not take into account the high cost of disease that occurs due to lack of potable, high quantity water and sewage available with in house connection.

We completely agree. While we have highlighted high costs associated with the informal water distribution system, this system probably exacts an even higher economic toll at the household level due to an increased risk for diarrheal illness secondary to failures of water quality and quantity. This is an important area for future research; indeed, we have engaged in some fieldwork related to this question which we hope to publish in the future. To address your point, we have highlighted this as a limitation of our study, by adding the following lines to the “Discussion” section:

“In addition, our data on the economic costs borne by community residents only reflects the
high cost of obtaining water under informal circumstances. The lack of an adequate quantity of uncontaminated, potable water likely exacts additional costs by greatly increasing the burden of diarrheal, upper respiratory, helminthic, and skin diseases. These diseases may take an economic toll on households by contributing to lost days of work, increased spending on medications, increased health care provider visits, and decreased productivity [32]. Indeed, while we have already highlighted a substantial economic toll on the community secondary to the informal water distribution system, if anything, our calculations are likely to be an underestimate of the overall costs.”

We should note that, even if we had calculated and included household costs associated with episodes of diarrhea illness, it would be very difficult to clearly say what proportion of those costs (or what proportion of diarrheal episodes) are attributable to the lack of a functioning water supply, as opposed to other causes such as lack of sanitation and behavioral issues (i.e., lack of appropriate hand hygiene). In the end, we thought it was safest to provide a conservative estimate (and a likely underestimate) of the costs associated with the informal water distribution system, since it is already clear that the economic and social costs are substantial.

_ I think this article with somewhat better costing and more specific costing has the potential to make an important point to governments._

We agree with you. Given that a significant proportion of India’s urban slum population lives in similar circumstances, we hope that our paper uses rigorous methods to make a point to government officials and policymakers regarding the economic toll of the failure to provide equitable access to formal municipal water supplies in slums.

_Statistical review: No, the manuscript does not need to be seen by a statistician._

 Alan Kolok

_**General:** The authors need to consider the primary hypotheses or questions that they are addressing, then definitively answer them. As it is currently written, the manuscript reads like an annual report, that provides a great deal of relatively unsophisticated and unanalyzed data, but does little to synthesize the data into any meaningful information that other might use._

Thank you for this feedback. This entire study was based on an extensive research proposal with numerous aims, research questions, and hypotheses. In fact, we had formulated multiple research questions and hypothesis that integrated with our evaluation of each major water-related indicator, and our study design was carefully planned to attempt to answer every research question. For example, for the water quality indicator, we wanted to identify the specific point along the distribution system at which most of the bacterial contamination was occurring, which is why we mapped out the entire distribution system and collected multiple water samples along the entire chain of distribution.

Since we had numerous questions, we did not specifically clarify all of our research questions in the “Introduction” section in the prior draft. We have now corrected this problem based on your feedback by adding a new table (Table 1) to this new draft. Table 1 now includes the most critical research questions around which our study was designed. Thank you so much for this feedback, as it reminded us to clarify our original research questions for the reader.

_Abstract: Results There are no real results here, but only a list of proportions and percentages. What do these data actually tell us with respect to the overall..._
The primary aim of our paper was to obtain descriptive data on an issue that is little studied. While a few studies have obtained water quality data (specifically with regard to bacterial contamination of household water) in urban slum communities, we know of no other studies that have systematically obtained data on multiple key water-related indicators for an informal water distribution system in the manner that we have in this study. To obtain these data, we had to develop relationships with community residents over a couple of years, as well as relationships with illegal water vendors in the community over a period of months, to gain their trust so that we could get access to water samples directly from their motors and hoses. We had to develop new methods for quantifying water use at the household level, so that we could provide the basic water quantity data that is presented in this paper. The data on water costs were gathered very systematically.

As such, our primary aim was to present rich descriptive data on this informal water distribution system. While descriptive data (i.e., the “proportions and percentages” in our manuscript) may be considered to be unsophisticated by some, we believe that these descriptive findings answer our primary research questions as outlined in Table 1. We also feel that the descriptive findings are the primary point of the paper and that experts in water, sanitation, and urban public health will find these to be of significant interest.

When it seemed appropriate and relevant to answer our research questions, we performed more sophisticated analyses. For example, to evaluate predictors of water quantity, we performed a multivariate linear regression analysis based on variables noted in Table 2 of the new manuscripts, with the following results:

“In the multivariate linear regression model ($R^2=0.329$), total money spent on purchasing water was positively associated with the quantity of water consumed ($\beta$-coefficient=0.569, $p<0.001$), while the cost of water in INR per 1000 liters was negatively associated with the quantity of water consumed ($\beta$-coefficient=-0.691, $p<0.001$).”

Similarly, to evaluate predictors of drinking water contamination, we performed a multivariate logistic regression analysis based on the variables in Table 2, with the key results noted in Table 6. Therefore, we performed specific analyses to answer particular research questions, but many of our questions were answered by the descriptive findings alone, and we believe that these are of significant interest in and of themselves.

Conclusions: “A large proportion” is not quantitative, and as heart-wrenching as the problem is, there is little to no concrete statistically validated data presented here to support anything.

Per our understanding, the “Conclusion” section of an abstract usually does not repeat figures and findings from the “Results” section of the abstract; rather, this section is usually a verbal interpretation of the data reported in the “Results” section. This is why we used the phrase “a large proportion,” as this phrase was referring back the finding in the “Results” section that as much as 76% of household stored drinking water was contaminated with coliform bacteria, despite an absence of point-of-source contamination in most seasons. We apologize for being so vague. In response to your comment, we have adjusted that sentence in the “Conclusion” section of the abstract to say the following:

“All bacterial contamination of drinking water occurs due to post-source contamination during storage in the household, except during the monsoon season, when there was some contamination of point-of-source water.”
Format of paper: While there is a background statement as well as a Methods, there is no introduction per se, nor are there any hypotheses or objective statements. As such, I have no idea what the authors are trying to say.

We have tried to address the absence of hypotheses/research questions in the “Background” section by including a new Table 1, which states all of our key research questions. We hope this clarifies the purpose of our study.

Given that the water is being delivered in an informal distribution system within a slum, it seems logical and likely (though heart-wrenching) that the water quality and possibly also the expense would be inadequate or prohibitive. So what is your question or point? How does this transcend simply being a report on an injustice rather than a scientific treatise?

We believe that the findings in our paper are not foregone conclusions, and we found that many of our findings contradict basic assumptions that people who work in public health, water, and sanitation may have about water issues in urban slums. For example, we found that many public health officials in Mumbai (and the general public and even water engineers) believe that most slum dwellers are obtaining point-of-source water that is always contaminated. Our study shows that this is not the case. While point-of-source water was contaminated in the monsoon, our study suggests that the bulk of contamination actually happens at the household level during storage of water.

This findings has implications for improving water quality and safety in slums. While non-notified slums such as KB obviously need a secure, formal water supply, residents may also benefit from household-level interventions such as safe storage and chlorination, which help to eliminate post-source contamination.

In addition, our study highlights the severity of deficiencies in water quantity provided through the informal distribution system. We found no recent studies that looked systematically at water quantity issues. The failures of water quantity through the informal distribution system are quite dramatic. The cost data are similarly dramatic. While people may assume that water in slums would be expensive, we put concrete numbers to this issue. For example, we were able to estimate that the money paid by the community ever year to by water through the informal distribution system could pay to place a new formal water supply five times over every year.

Therefore, we agree with the other reviewer of this paper, Dr. Gilman, when he said in his review that this paper “has the potential to make an important point to governments.” In the end, our target audience is public health specialists and urban planners in developing country cities, as we believe that it makes a concrete and convincing argument regarding the high economic and social costs of allowing—indeed requiring—large proportions of city populations to access water through informal distribution systems.

The study design for the BNA and the SWA are too brief and do not present enough detail. For example it is stated that water quality measurements were taken, but there are not enough details regarding what was measured or why. (This is briefly mentioned in the results and it is stated that none of the common chemical parameters were in excess of internationally accepted limits (which are not given). If so, then why mention this at all?)
Thank you for this feedback. We have now added the following sentences to the “Methods” section:

“The chemical parameters tested included pH (normal 6.5-8.5), total dissolved solids (normal <500 mg/L), turbidity (normal < 5 NTUs), total hardness (normal <300 mg/L), calcium (normal <75 mg/L), magnesium (normal <30 mg/L), and sulphates (normal <200 mg/L). Given the fact that water from the motorized pumps and distribution hoses in KB is at risk for contamination with ocean water, we also tested these samples in the winter season for salinity (normal <0.8 dS/m).”

In the “Results/Water quality and storage” section, we have changed that paragraph in question as follows:

“All of the above samples were also tested for common chemical parameters such as pH, total dissolved solids, turbidity, total hardness, calcium, magnesium, and sulphates. All samples were found to be within internationally accepted limits for all chemical parameters (normal ranges are noted above in the Methods section). During winter season, we also specifically tested the point-of-source water samples (e.g., KB motors, Dharavi taps, and chawl taps) as well as the KB hose samples for salinity levels, given the risk for ocean water contamination of KB motor and hose samples. All of these samples had salinity levels of approximately 0.017 to 0.021 dS/m, which is well within the normal limit for human consumption of 0.8 dS/m.”

It is reasonable to wonder why we have included the chemical parameter results if none of them were abnormal. The reason we have included them is that these indicators are usually assessed by public health experts when evaluating the quality of drinking water. In our minds, it was just as important to include information on what was normal in our water quality evaluation as it was to highlight the abnormal findings (microbiological contamination). We are afraid that water specialists may wonder why we didn’t discuss chemical parameters in our paper if we do not mention these normal results.

Furthermore, if it is important to mention, QA/QC or at least quantification methods have to be given in the paper.

We have added the following information into the paper regarding QA/QC procedures:

“All 229 water samples were transported to Equinox Lab, which is certified by the International Organization for Standardization (ISO 9001:2008) and the National Accreditation Board for Laboratories (NABL), within four hours of collection. Equinox Lab performs external quality testing by cross-checking multiple samples with five other NABL certified labs at least once a year, and internal quality checks for water testing are carried out on a daily basis.”

We have modified the section on microbiological testing to discuss quantification methods as follows:

“Microbiological testing was performed as follows: 100mL of each sample were filtered through a 0.22-micron, 47mm diameter membrane using a vacuum pump. The filter was subsequently transferred to an m-Endo agar plate for culturing. Samples were incubated at 35°C for 24 hours, at which time coliform bacterial colonies were counted using an automated colony counter. E. coli was reported as being present or absent after interpretation of indole, methyl red, Vogues Proskaur, and citrate tests.”

We have therefore mentioned the methods for quantification of colonies of coliform bacteria; however, as we note above, E. coli was assessed qualitatively in the above assay (i.e.,
“present” or “absent”), and a colony count was not performed.

The results is written primarily as a list of percentages of households in excess of limitations, however this is not an appropriate way to approach these data.

With regard to water quality, our primary concern was estimating what percentage of households were exposed to contaminated drinking water in a given season. We felt that answering this question was of significant public health relevance. For this reason, we have represented our data as percentages of households in excess of limitations for either coliform contamination or E. coli contamination.

It is interesting that the water quality (and microbe load) changes seasonally, but why isn’t the data presented in the results (Figures) in that fashion? The Tables that do represent these data are confusing and difficult to read. The data can be presented in a much more approachable fashion. Because the results are not presented in a strongly persuasive manner, the discussion is not adequate. There is actually much more to be said favorably about these studies and these data, however the presentation of the data in this paper does not do the data justice.

Thank you so much for this feedback. In response to your comments, we have extensively rewritten the section on water quality and storage where we discuss the microbiological testing results as represented in Table 5. We should note that the study design was a bit complex given that we were testing samples along the entire informal water distribution system (i.e., motorized pumps, hoses, and household water) as well as testing comparison samples from chawls (low-income housing) and Dharavi (a notified slum with legal water access). Given the complexity of the study design, we can understand that our presentation of the results may have been confusing in the original draft. We have rewritten the current draft to include some interpretation of the patterns of water contamination in different seasons:

“Table 5 shows the SWA’s microbiological testing results. The monsoon season had a different pattern of water contamination as compared to the pattern in the winter season, the summer season, or during the episode of ‘system failure.’ We will first discuss the pattern of contamination in the winter and summer seasons.

During winter and summer, there was no coliform or E. coli contamination of any of the point-of-source samples from the two comparison groups, chawls (low-income housing) and Dharavi (a notified slum with legal water access). In winter and summer, none of the water samples collected from KB’s motorized pumps (which represent the point-of-source) or from KB’s hoses (which represent the distribution network) showed any evidence of contamination with coliforms or E. coli. Despite the absence of bacterial contamination of water at the point-of-source or in the distribution network of hoses in KB, there was significant contamination of drinking water and storage water at the household level (i.e., the point-of-use). For example, in the summer, 52.4% of drinking water samples were contaminated with coliform bacteria, and 42.9% were contaminated with E. coli. This suggests that all bacterial contamination of water during the winter and summer was happening at the household-level (i.e., the point-of-use) and not at point-of-source or in the distribution hoses.

During the episode of ‘system failure,’ the pattern of water contamination was similar to the pattern in the winter and summer seasons, in that all contamination of water happened at the household level. The Reay Road tap, which represents the point-of-source for water during the episode of ‘system failure,’ was not contaminated with coliform bacteria or E. coli. Again, despite receiving uncontaminated point-of-source water, 23.8% of drinking water samples were contaminated with both coliform bacteria and E. coli.
In contrast, during the monsoon season, we found multiple point-of-source samples to be contaminated. In the comparison groups, there was no contamination of any point-of-source samples from Dharavi, but one sample (25%) from the chawls was contaminated with both *E. coli* and coliforms. Two samples from KB’s motorized pumps (50%) were contaminated with coliforms but not *E. coli*, highlighting significant point-of-source contamination of water in KB in the monsoon season. During the monsoon, three hoses (50%) were contaminated with coliforms and one (16.7%) was contaminated with *E. coli*. Of note, all three of these contaminated hoses were connected to the motors in KB that showed evidence of contamination with coliform bacteria, suggesting that the water in these hoses became contaminated at the point-of-source and not secondarily as it ran through the distribution hoses. During the monsoon, at the household level, there was a very high rate of contamination of drinking water and storage water, with 76.2% of drinking water samples being contaminated with coliform bacteria. Of note, 72% of these contaminated drinking water samples were from households receiving water from uncontaminated distribution hoses. This suggests that, even in the monsoon, when there was significant point-of-source contamination of water, there was also superimposed household-level contaminated of stored drinking water at the point-of-use.”

We hope that this revised text above more clearly explains the key results with regard to microbiological contamination represented in Table 5. We believe that the revised text above will make the conclusions that we draw in the “Discussion” section much clearer to the reader.

*The authors have done very little to make these data accessible to the reader and as such this paper is in need of a complete and total rewrite based upon the suggestions above.*

Thank you for this feedback. We hope that our extensive edits in response to both your feedback and that of Dr. Gilman has helped to make this paper more accessible.