Author's response to reviews

Title: Designing a handwashing station for low-income communities in Bangladesh using the Integrated Behavioural Model for Water, Sanitation and Hygiene Interventions (IBM-WASH)

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Author's response to reviews: see over
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Dear Editors,

Thank you for providing valuable feedback for this manuscript. Please find attached an item-by-item response to the comments from the editor and the two reviewers.

In addition to the requested revisions to the manuscript, we have also made extensive edits to the manuscript to improve the clarity and accessibility of both the methods and interpretation of results.

Comments from the editor:

1. **Please complete your Competing Interest Section.**
   We have added a section as requested. It reads: *The authors declare that they have no competing interests.*

2. **For reporting qualitative studies, please adhere to RATS guidelines.**
   RATS: Qualitative Studies [http://www.biomedcentral.com/info/ifora/rats](http://www.biomedcentral.com/info/ifora/rats)
   We have reviewed the RATS guideline and have revised in order to ensure that our reporting adheres to these criteria. In particular, we have added further description of our methodology including household recruitment, a table of interview questions, and a specific subsection documenting informed consent.

Comments from Reviewer 1 – Julie Harris

1. **Statements such as ‘Curtis et al found that handwashing behavior was determined by environmental and cognitive factors’ is pretty general – please think about what point is intended and make it more specifically.**
   In the background, we attempt to describe the range of behavioural factors that affect handwashing. Curtis, Danquah, et al. have summarized some of these factors into categories. We have clarified their findings to discuss the sub-elements of these groupings. It now reads:

   *Curtis et al. organized factors that affect handwashing behaviour into two categories: environmental and “brain” factors [4]. Environmental factors include social, physical and biological influences that shape handwashing behaviours. Physical factors, in particular, include the cost of soap, water, and access to handwashing stands [4, 5]. In Kenya, Schmidt et al. [6] found that “structural constraints” – such as access to water inside, rather than outside, the home - influences the likelihood of handwashing at key times. Findings from Zimbabwe suggest that altering norms and community structures in support of positive hygiene behaviours can have a positive impact on behavioural outcomes [7]. The “brain” – or cognitive – factors that influence behaviours include an individual’s habits, planning and motivation for behavioural change[4]. Research in Kenya found that study participants reporting a higher degree of handwashing habit and past experience with handwashing had improved handwashing practices during structured observations compared to those who reported less-developed habits [8]. Past behaviours along with motivational factors such as disgust, social concerns, and feelings of being a good mother were found to influence*
individual handwashing practices in Ghana [9]. Planned behaviours – those behaviours intended to avoid a specific negative health outcome – are often associated with health and disease knowledge. Studies have demonstrated an increase in handwashing practices with improved knowledge of key moments for handwashing [10].

2. It’s not really true that few studies have assessed the role of technology in shaping handwashing practices; it feels like the authors were using this to justify their study. There are several published reports evaluating handwashing stations and options in resource-limited settings that should be cited here. It’s true that there are few in Bangladesh, and perhaps that should be the point?

Since the purpose of this study was to identify a locally acceptable and feasible handwashing station, we have modified the framing of the background section to reflect the range of factors that affect handwashing, highlighting the role of design in facilitating behavior change. Though several studies report on the presence or absence of these elements, pilot testing of handwashing stations—and factors that affect behavior change—are underreported in the peer-reviewed literature. As the reviewer suggests, we are including additional references that discuss options for low-tech handwashing stations:


And reports of the design process:


3. Page 5, second paragraph: grammar – ‘focus’ should be ‘focuses’; the word ‘to’ is missing between ‘linked’ and ‘behavior’. The statement that ‘a handwashing station facilitates behavior by providing the elements necessary to wash hands’ is also a highly general statement. What point are the authors trying to make? It would seem that they want to emphasize the individual elements of a handwashing station all in one place rather than single elements as facilitators of handwashing practices, but this isn’t stated clearly.

Thank you for pointing out the grammatical errors. We have edited accordingly. Also, as you suggest, we have clarified this statement to emphasize the importance of having the components of handwashing together in one place:

A handwashing station may facilitate behavior by providing soap and water together in an established location convenient to the behavior, such as near a toilet or in a food preparation area.

4. Methods, Study Design. The flow here is unclear to someone unfamiliar with this study. Is Phase 1 the lottery and Phase 2 is providing the second handwashing station, or are both of these Phase 1 and the formative research is Phase 2? In the last
paragraph on page 8, there is a line saying ‘after selecting the study site’, but it seemed that the study site was already selected. This section is rather confusing and could use some cleaning up. There is a run-on sentence at the bottom of page 8 / top of page 9.

Given the iterative nature and goals of this formative research, the methodology is somewhat complex. We have edited and reorganized this section extensively to provide clarification. The phases refer to phases of testing specific handwashing stations designs. Phase 1 tested an initial round of handwashing station designs. This phase was iterative and included participant feedback regarding design modifications. Phase 2 tested modified or suggested handwashing station technologies. Phase 1 included a lottery for selection. In Phase 2, handwashing station designs were assigned to participants.

5. Methods, Study design: A diagram to explain how urban and rural sites were assigned / selected their water containers would help clear up the confusion, and perhaps a timeline as well showing what was tried in Phase 1, how things were modified, and what was tried in Phase 2.

As we mention above, we have edited this section to provide more clarity. Phases in urban and rural sites were not directly in sync with one another. In this case, a timeline adds additional complexities to an already iterative study design process. We have modified the text to describe the design selection lottery. Table 4 describes which designs were tested in each site and how many households tested these.

6. Data collection: Two to nine week is a widely varying time. People can get used to most things and feel differently about them over time. Why was the time so varied? Also, more detailed information here about what information people were collecting / what questions were being asked during formative research would be very helpful, so that the results have a context. I realize this is a qualitative and not a quantitative study, but the results and methods could still be presented in a more rigorous manner.

We have modified our description of follow-up visits and separated the number of follow-up visits by Phase. The text now reads:

During Phase 1, follow-up semi-structured, qualitative interviews were completed with the participants within the week of installing the handwashing station, and then at days 7, 15, 30 and 45.

And later:

Data collection procedures were similar during Phase 2, however, there were fewer follow-up visits and shorter follow-up periods: two follow-up visits in the urban area over a two week period, and three or four follow-up visits in the rural area over a three week period.

Detailed information about the types of questions asked during the interviews has been added as a supplementary table (5). Questions here were used as a guide to be followed up with prompts.
7. Technological factors at the Habitual level: First sentence needs grammatical help.

Thank you. We have edited this sentence.

8. Page 17, middle: The soapy water bottle was too heavy for children to lift and so was modified – is this in Phase 1 or 2? This is where a timeline would really help.

This finding was part of Phase 1. The sentence now reads:

*Many participants expressed concerns about children using the soapy water bottle (phase 1) because it was too heavy for young children to lift and they preferred the modified design with a pump (phase 2) instead.*

9. The Conclusions don’t seem to support the findings. For example, in one section of the paper, it’s noted that capacity is very important. If so, why did the soapy water bottle make it through the selection process? It’s likely that these are related to unreported results, but it has the feeling of a ‘gestalt’. If the authors are making these conclusions, please provide specific results to support them.

We have edited this section and link all key discussion points to our results. Cost and availability were major factors in keeping soap designated for handwashing in the household. The detergent powder used in soapy water was lower cost than bar soap and more ubiquitously available. As we outline in the Technology: Factors at the interpersonal/household level section on page 14, the soapy water bottle was also less likely to be stolen and was therefore more feasible in a communal setting. The advantages of the soapy water bottle outweighed the disadvantages and are described on pp 17-18:

*Due to the numerous advantages that the soapy water bottle designs presented over bar soap — low cost, easy to make, and not easily stolen, we included the soap water bottle as the method of soapy delivery for use in our final handwashing station designs.*

Minor revisions from this reviewer:

1. The abstract is filled with jargon and extra words. It’s unclear from the abstract if the objective was to select options for a clinical trial or just to find out what might be locally acceptable in Bangladesh. The conclusion is a highly general statement that doesn’t seem to really relate to the results. More specific information and less jargon would make this more intriguing for readers interested in the topic.

We have edited the abstract to remove jargon and clarify our research aims.

2. Background: Second paragraph is missing commas. The last sentence of the second paragraph is incomplete.

Thank you. We have edited this sentence.

3. Methods: Study area, last sentence has grammar and spelling issues.

Thank you. We have also edited this sentence.
4. Overall: Please use italics when quoting someone.

The convention we were using is to only italicize block quotations of greater than 3 lines of text. As the reviewer requests, we have changed all quotations (both block quotes and in-line) to be italicized.

5. Discussion: In general, both background and data not reported in the results are distributed throughout the discussion. The Discussion should be an interpretation of the results. Please modify.

We have reviewed and edited this section to ensure factors in the discussion are grounded in our results.

Comments from Reviewer 2 – Rima Habib

1. The paper adopts the IBM-WASH model to assess factors influencing hand washing practices yet it focuses mainly on the interpersonal, individual, and habitual levels (a limitation admitted within the text). However, I would like to see a greater discussion of how some of the community and societal/structural issues play a part in determining technology use as the paper is focused on resource poor neighborhoods.

Thank you for this suggestion. Though the focus of this study was the household level, there are several larger factors at play that impacted both the design of the study as well as handwashing behaviours within the study. Therefore, we have tried to tie in larger level factors throughout the manuscript. We discuss the Community and Societal/Structural level factors in the selection of candidate handwashing station designs. Factors operating at the community level are discussed in results of the Contextual domain (p. 16) emphasizing how the built environment, infrastructure for water resources, and access to markets influence preference for handwashing station designs. Again, community level factors come into play in our discussion. P 16 and p 20 mention water access due to intermittent power supply in the urban site.

On page 22 the paper “One key determinant of feasibility that varied by location was the physical environment: it affected access to handwashing stations and access to water.” If the main recommendation for the study was the use of a 40L bucket, would households in rural environments without easy access to water be able to bring in enough water for this and other household needs? Moreover, a discussion about the role of community and regional/national policy water infrastructure development programs and their relationship to the feasibility of these technologies would strengthen the paper by having it address all levels of the theoretical model. Already some of the qualitative data you supply suggests these societal constraints.

In Bangladesh, water resources are plentiful. In the rural areas, water is available via tubewells either in or near family compounds. Households have easy access to this water source for washing, cooking and drinking the 40L capacity was advantageous for facilitating handwashing. In another context, where this water had to be carried a distance (and probably also used for multiple purposes), this capacity may be less feasible.
2. On page 4 paragraph 2, the last sentence “and among that 14 percent...” is not complete.

Thank you. We have edited this sentence.

3. Comment 3: Page 7, five is misspelled as “fiv” in the last sentence of the setting.

Thank you. We have edited this sentence.

4. On page 10, the following sentence is a little unclear: “Field research officers conducted semi-structured, qualitative interviews with household participants up to five times over the course of 2-9 weeks.”

We have edited this section and provided greater detail. See Reviewer 1, Comment 6.

5. Please write out the full meaning of the acronym of “icddr,b” as it is the first time you mention it in the paper.

Thank you. We have edited to include the full acronym. It may be of interest to the reviewer to note that icddr,b is re-branding itself as the acronym, since the scope of the organization has expanded so much beyond diarrhoeal disease research.