PEER REVIEW HISTORY

ARTICLE DETAILS

TITLE (PROVISIONAL)	Health workers' perspectives of a mobile health tool to improve diagnosis and management of pediatric acute respiratory illnesses in Uganda: A qualitative study
AUTHORS	Ellington, Laura; Najjingo, Irene; Rosenfeld, Margaret; Stout, James; Farquhar, Stephanie; Vashistha, Aditya; Nekesa, Bridget; Namiya, Zaituni; Kruse, Agatha; Anderson, Richard; Nantanda, Rebecca

VERSION 1 – REVIEW

REVIEWER	Mehmood, Hana Maternal, Neonatal and Child health research network, Public Health
REVIEW RETURNED	12-Mar-2021

GENERAL COMMENTS	• Your key words should also have mobile health. • It is not clear what the methodology was in qualitative approach. Was it phenomenological or grounded etc. and no justification of why this methodology was employed. • Not clear how the sample size was reached up to the stated one • Authors need to justify why a mix of in-depth interviews and FGDs was selected. • Aspects of reflexivity have not been catered. • It is not clear whether mPneumonia was created by the same team or was the algorithm taken from somewhere else. • Not clear if the educational videos were developed by the team or they used already developed ones. If it's the former, how were they developed and validated. If the latter then how were they sourced. • Although I am sure the algorithm must have used the WHO classification of pneumonia, however, the diagnosis does not truly reflect that. 'The final diagnoses include severe disease, pneumonia, wheezing illness, and upper respiratory illness' If not used WHO classification then state why not? • In data collection, were the guides pretested. • Not much detail has been included in the data management and confidentiality aspect of the data. • In the discussion section, the authors state that they engaged stakeholders in the study. Stakeholder engagement in research and including stakeholder as subjects or participants in research are two different things. This has to be revisited and discussion rewritten in paragraph 4 of the discussion section. • The methodology and outcome of the individual usability evaluations were not clearly explained. • Strengths have not been spelled out clearly.

REVIEWER	Pandya, Shivani Johns Hopkins University, International Health
REVIEW RETURNED	25-Mar-2021

GENERAL COMMENTS	This paper emphasizes the importance of user-centered and stakeholder-involved approaches when developing digital health interventions prior to intervention implementation. This can significantly help in improving the utilization and sustainability of such interventions. This paper provides critical insight into Ugandan health workers and administrators perspectives on a mobile tool, and how to integrate user-centered design early on in the process. I think the paper was very well written and clear. I had a few comments regarding additions with methods primarily and some word-choice-related suggestions.
	
	<u>Abstract</u>
	
	• In the intervention section, it would be beneficial to add that the ALRITE smartphone app was demonstrated during the focus groups with healthcare workers, and that none of the participants had use of the platform prior to.
	
	<u>Strengths and Limitations</u>
	
	• Small typo – second bullet point should be “Health worker***s***”
	
	<u>Background</u>
	
	• Looks great, and sets up the paper quite well.
	
	<u>Methods</u>
	
	• Might be beneficial to clarify what a “technology probe” is
	• Clarification on what “informal” semi-structured interviews mean?
	• Were the qualitative usability evaluations occurring as part of FGDs? It might be helpful to clarify that in the text.
	  o Did all FGD participants participate in these evals? Did the evaluations occur after the FGDs? It’s not immediately clear within the text.
	• Add information about:
	  o How many participants per FGD.
	  o How many data collectors were present for the FGDs.
	  o How long the FGDs and interviews were.
	• I see the FGD Guide for the health workers. Was there one for the administrators? Would it be possible to share that in supplementary, or indicate types of questions asked within text.
	• I know it says that no coding software was utilized, but if possible, please share information on how data was analyzed? Was it using Excel or through paper-methods?
	• “Patient and Public Involvement”
	  o Maybe add the word “initial” here: “While not involved in the ***initial*** design…”.

	Results • For Table 1, what were the IDI participant / administrator characteristics? • Results were presented well! Discussion • On page 22, Line 5: should it be "towards" instead of "of" in the following sentence: "… we identified key determinants ***of (towards)*** successful implementation…" given that ALRITE has not been implemented yet? • Otherwise, looks great and contextualizes results well.

VERSION 1 – AUTHOR RESPONSE

Reviewer Reports:

Reviewer: 1
Dr. Hana Mehmood, Maternal, Neonatal and Child health research network

Comments to the Author:
• Your key words should also have mobile health.
We added "mobile health" to key words as suggested

• It is not clear what the methodology was in qualitative approach. Was it phenomenological or grounded etc. and no justification of why this methodology was employed.

Thank you for this question. There are several qualitative methodologies the co-authors have used for other studies. Grounded theory for collecting data in order to develop new theories, Ethnography to understand an organization's culture.
For this study, we used qualitative data to allow for deeper exploration into usability, feasibility and acceptability of the tool (an exploratory QUAL design). The co-authors agreed that quantitative data (e.g., survey) would have been inadequate to answer our research questions due to lack of depth and concern for social desirability bias. This qualitative data will be used 1) to improve the mHealth tool, 2) identify barriers/facilitators beyond the tool itself to inform feasibility and implementation strategies, and 3) quantitative outcomes to measure in future studies.
We edited the Study Design section as follows to explain our rationale:

"We used an exploratory qualitative study design to allow for deeper exploration into feasibility, usability, and acceptability for the purposes of 1) improving the mHealth tool, 2) identifying barriers/facilitators beyond the tool itself to inform feasibility and implementation strategies, and 3) determining quantitative outcomes measures for future studies (qual to QUAN mixed methods approach).23 The research team determined that quantitative survey data would have been inadequate to answer our research questions due to lack of depth, opportunity to probe, and concerns about social desirability bias.

We conducted in-depth semi-structured interviews with health facility administrators to understand clinic context, availability of resources, challenges, day-to-day operations, and feasibility of ALRITE from a systems standpoint (Supplementary Material). We conducted focus groups with primary care health workers (clinical officers and nurses) to understand how participants respond to peer

responses and the forces that may influence their thinking and behavior around the app, how this would affect patient-provider interactions, and their reactions towards technology."

• Not clear how the sample size was reached up to the stated one

Sample size was determined by the health workers eligible and willing to participate in the study at each study site. Sample size was limited by study conduct at 2 health centers, which was the number of sites feasible for this pilot study with limited grant funding. We added text in the participants section to clarify this. We also took every measure to encourage maximal participation for all those eligible and willing to participate by partnering with the district health office and health administrators on site to coordinate information and data collection well in advance.

"Prior to data collection, research team members met with officials at the Jinja District Health Office for approval, plan for disseminating study information to participating study sites, and scheduling days for recruitment and data collection. Information sessions were coordinated with help from health administrators at each study site to maximize participation. All health workers were notified about the session dates one week in advance and were invited to attend the information session even if not scheduled to work that day. The study team employed in-person information sessions for recruitment using convenience sampling. Sample size was determined by the number of health workers available on the scheduled days of data collection with the goal of recruiting all eligible health workers at each study site."

• Authors need to justify why a mix of in-depth interviews and FGDs was selected.

Focus groups are better able to reveal how participants respond to group dynamics and the forces that may influence their thinking and behavior around the app, usability, how this would affect patient-provider interactions, reactions towards technology. By excluding health administrators from FGDs with health workers, we hoped to encourage more candid group dynamics without site leadership present.

In depth interviews with directors (vs. care providers), yield more detailed answers per question, and we asked a different set of questions to learn more about clinic context, availability of resources, challenges, day to day operations than we did during focus groups.

The following was added to study design:
"We conducted in-depth semi-structured interviews with health facility administrators to understand clinic context, availability of resources, challenges, day-to-day operations, and feasibility of ALRITE from a systems standpoint (Supplementary Material). We conducted focus groups with primary care health workers (clinical officers and nurses) to understand how participants respond to peer responses and the forces that may influence their thinking and behavior around the app, how this would affect patient-provider interactions, and their reactions towards technology."

We have added the interview guide to the supplemental materials.

• Aspects of reflexivity have not been catered.

Reflexivity generally refers to the examination of one's own beliefs, judgments and practices during the research process and how these may have influenced the research. If positionality refers to what we know and believe and a power hierarchy, then reflexivity is about what we do with this knowledge during the research process.

Thank you for bringing up this important point. We added this in the Study Team section and Strengths & Limitations bullet points.

Study Team: “We acknowledge that key team members who participated in all aspects of this project are American physicians and researchers who bring a different set of experiences and lens to this work, and that our positionality may have influenced participants’ responses and interpretation. Working in partnership with our Ugandan team was critical to ensure shared decision-making and our ability to work closely with the clinicians.”

Strengths & Limitations: “We acknowledge that key team members who participated in all aspects of this project are American physicians/researchers who bring a different set of experiences and lens to this work, which may have influenced participants’ responses and interpretation, but American team members worked in close partnership with Ugandan team members to ensure shared decision-making and engagement with study participants.”

• It is not clear whether mPneumonia was created by the same team or was the algorithm taken from somewhere else.

In study teams, a line was added to illustrate the development of mPneumonia by RA and colleagues. “RA was instrumental in the design of mPneumonia and senior author on both manuscripts.” Manuscripts referenced

• Not clear if the educational videos were developed by the team or they used already developed ones. If it’s the former, how were they developed and validated. If the latter then how were they sourced.

Educational videos were edited clips taken from WHO IMCI training videos, with permission. These videos were meant to be temporary placeholders in order to seek feedback from health workers as to what types of videos and content they would find most beneficial. The aim of this study was to obtain feedback on the ALRITE tool and understand feasibility of use rather than evaluate the diagnostic accuracy/validity of the tool itself. As part of our next phase of ALRITE development and evaluation, we will create our own videos and validate them to incorporate into the final ALRITE tool. We will also generate more educational materials for families/caregivers as requested by participants.

We added this parenthetical statement by the mention of educational videos in the ALRITE mHealth tool section: "(brief clips providing examples of children in respiratory distress)"

• Although I am sure the algorithm must have used the WHO classification of pneumonia, however, the diagnosis does not truly reflect that. ‘The final diagnoses include severe disease, pneumonia, wheezing illness, and upper respiratory illness’ If not used WHO classification then state why not?

We edited the section on ALRITE mHealth Tool to clarify distinct diagnosis groups in accordance with WHO classification and included an adapted table of WHO classification. There is no separate diagnosis of wheezing illness in WHO classification but rather the diagnosis of pneumonia and cough/cold with separate instructions if wheezing is also present. The term “wheezing illness” was added onto the diagnoses in the ALRITE tool to prompt health workers to provide bronchodilators and refer for further assessment as necessary.

“The final diagnoses include severe pneumonia or very severe disease, pneumonia +/- wheezing illness, and cough or cold +/- wheezing illness The WHO classification does not include a separate diagnosis of “wheezing illness” (Table 1). The term “wheezing illness” was added to the ALRITE

diagnoses to prompt health workers to provide bronchodilators and refer for further assessment as necessary."

• In data collection, were the guides pretested.

Research assistants underwent training on study protocols and FGD/IDI guides. The research team conducted simulations using the FGD/IDI guides and edited as needed. We added the following to the beginning of the data collection section:

"Prior to data collection, research assistants were trained and pretested focus group/interview guides through simulations with the research team."

• Not much detail has been included in the data management and confidentiality aspect of the data.

Based on your feedback, we have added information about data management and confidentiality in Data Collection and Management section of the methods:

"Demographic information was collected first on paper forms, then transferred to REDCap (Research Electronic Data Capture). Unique identifiers were used for each participant."

"Hard copy data were securely transported to Makerere Lung Institute (Kampala, Uganda) for secure storage. No personal data will be transferred from the primary institution in Kampala, Uganda."

and to ethics:
"Written informed consent was obtained in accordance with international and local regulations."

• In the discussion section, the authors state that they engaged stakeholders in the study. Stakeholder engagement in research and including stakeholder as subjects or participants in research are two different things. This has to be revisited and discussion rewritten in paragraph 4 of the discussion section.

We agree with this reviewer that we do not engage community in the sense of community-based participatory protocol; rather, we do include community stakeholders as project participants. Participants did not help design the study, ask the overarching research questions, design the focus group guide, think through how to interpret and disseminate results. This type of community participation will be a focus of future work as is highlighted in the last paragraph of the discussion before the conclusion.

The sentence in paragraph 4 of the discussion now reads:
"Therefore, we included health administrators and frontline health workers early in the development of ALRITE as participants to better inform acceptability, appropriateness, and feasibility of its use in Ugandan health centers."

• The methodology and outcome of the individual usability evaluations were not clearly explained. complicating the manuscript and sharing of results –

We agree that the terminology and descriptions for usability testing complicated the manuscript without adding significantly to the results or conclusions. Therefore, we made the decision to reframe the research activity to describe exactly what we did and the rationale instead of using the term "usability testing", which is more commonly associated with quantitative data collection. Our edits are as follows:

Study design: “Prior to focus groups, health worker participants were given time to practice using ALRITE by going through at least 2 clinical scenarios individually or in small groups of up to 3 people (Supplementary information), while members of the study team (LEE, IN, MR, SAF, BN, ZN) asked for specific feedback, answered questions about the app, and took notes.”

• Strengths have not been spelled out clearly.

We believe the major strengths of this study are:

- Use of technology probes (or more broadly using human-centered approaches) early-on to build underpinning knowledge of factors that are pivotal to success of a mHealth application
- Inclusive recruitment process to encourage participation from all eligible health workers at each site to provide a more complete and accurate, on-the-ground assessment of the opportunities and challenges in respiratory assessment, diagnosis and treatment of ALRI in young children.
- inclusion of health administrators to provide broader understanding of the clinic context, challenges, day-to-day operations, and feasibility of ALRITE from a systems standpoint

Added second paragraph of discussion:
“Additional strengths of the study include using a technology probe and human-centered, participatory approach early in mHealth development to engage participants and gather information not only about the specific mHealth tool but also to build an underpinning knowledge of factors that are pivotal to the ultimate success of a mHealth application. We partnered with local health officials in the planning phase to encourage health worker attendance to information sessions, which translated in almost all eligible health workers at each site participating in the study to provide a more accurate and complete on-the-ground assessment at each study site. We also included health administrators as participants to provide a broader understanding of the clinic context, challenges, day-to-day operations, and feasibility of ALRITE from a systems standpoint, adding a unique perspective to the health workers’ responses.”

- importance of local partnerships (existing text in paragraph 5 of discussion)

“An early human-centered approach to evaluation is critical to better understand determinants of successful implementation and to guide further mHealth design. Therefore, we included health administrators and frontline health workers early in the development of ALRITE as participants to better inform acceptability, appropriateness, and feasibility of its use in Ugandan health centers. Through stakeholder interviews and health worker focus groups, we not only received important feedback to improve ALRITE, but also gained a richer understanding of the health setting and potential systems-based and individual level challenges to implementation.”

Results of the study that contribute to the literature, commented on in discussion:
- Identified a wide array of social, technical, clinical, logistical factors that impact the feasibility, acceptability, and usability of ALRITE application
- Identified challenges in using short-acting inhaled bronchodilators in the treatment of wheezing illnesses ALRI in young children, through medication supply and workflow concerns
- Inform the design of mHealth tools that support clinicians' needs, aspirations, challenges, and workflows.

Reviewer 2

This paper emphasizes the importance of user-centered and stakeholder-involved approaches when developing digital health interventions prior to intervention implementation. This can significantly help in improving the utilization and sustainability of such interventions. This paper provides critical insight

into Ugandan health workers and administrators perspectives on a mobile tool, and how to integrate user- centered design early on in the process. I think the paper was very well written and clear. I had a few comments regarding additions with methods primarily and some word-choice-related suggestions.
Abstract
• In the intervention section, it would be beneficial to add that the ALRITE smartphone app was demonstrated during the focus groups with healthcare workers, and that none of the participants had use of the platform prior to.

We clarified this activity as follows:
“We performed a demonstration of ALRITE for participants at the beginning of interviews and focus groups. No participant had used ALRITE prior.”

Strengths and Limitations
• Small typo – second bullet point should be “Health workers”

This has been corrected.

Background
• Looks great, and sets up the paper quite well.

Thank you for your feedback.

Methods
• Might be beneficial to clarify what a “technology probe” is

We defined technology probes in the methods:

“Technology probes are defined as instruments to “[collect] information about the use and users of the technology in a real-world setting”, improve the intervention’s design by meeting the needs and wishes of the user, and field-test.” Reference moved to highlight that it references information on technology probes

• Clarification on what “informal” semi-structured interviews mean?

We changed the wording to in-depth semi-structured interviews.

• Were the qualitative usability evaluations occurring as part of FGDs? It might be helpful to clarify that in the text.
Did all FGD participants participate in these evals? Did the evaluations occur after the FGDs? It’s not immediately clear within the text.

Based on feedback from both you and Reviewer 1, we felt that the terminology and descriptions for “usability evaluations” complicated the manuscript without adding significantly to the results or conclusions. Therefore, we made the decision to reframe the research activity to describe exactly what we did and the rationale instead of using the term “usability testing”, which is more commonly associated with quantitative data collection.

These “evaluations” took place prior to focus groups to allow for participants to have practice with the app to provide more informed responses in focus groups and to assess for major challenges using the app. All focus group participants also participated in these evals.

Our edits are as follows:

Study design: “All health worker participants had time to practice using ALRITE with clinical scenarios (Supplementary Material) before focus groups to give participants a better understanding of the app, its content, and usability to better inform their focus group responses.”

Data collection: “Prior to focus groups, all health worker participants were given time to practice using ALRITE by going through at least 2 clinical scenarios individually or in small groups up to 3 people (Supplementary information), while members of the study team (LEE, IN, MR, SAF, BN, ZN) asked for specific feedback, answered questions about the app, and took notes.”

• Add information about:
How many participants per FGD.
How many data collectors were present for the FGDs.
How long the FGDs and interviews were.

We clarified the specifics of the FGDs and interviews as follows:
Results: “Based on recommendations from the health administrators from each site, we conducted separate focus groups for clinical officers (n=3) and nurses (n=10) at the peri-urban site to limit concern for potential power dynamic, but this was not deemed a concern at the rural site where one focus group was recommended. Interviews were approximately 30 minutes long, while focus groups were approximately 1.5 hours in length.”

Data collection: 3 members of the study team participated in data collection for focus groups and interviews, as is reported towards the end of the data collection section: “Members of the study team (IN, MR, SAF) took notes during focus groups and interviews to augment and clarify the transcribed notes.”

• I see the FGD Guide for the health workers. Was there one for the administrators? Would it be possible to share that in supplementary, or indicate types of questions asked within text.

Yes, thank you for bringing this up. We have since clarified in the text and added the interview guide in the supplement.

• I know it says that no coding software was utilized, but if possible, please share information on how data was analyzed? Was it using Excel or through paper-methods?

We clarified the analysis as follows:
“Codes were aggregated into major themes and subthemes by first annotating an online document of transcripts, then reorganizing into a separate document, similar to but without the use of coding software.”

• “Patient and Public Involvement”
Maybe add the word “initial” here: “While not involved in the initial design...”.
Results .

Thank you for the suggestion. This has been addressed

• For Table 1, what were the IDI participant / administrator characteristics?

We added role and gender information to Table 1 but did not want to add additional potentially identifiable information to preserve anonymity as there were only 3 participants in that group.

• Results were presented well!

Thank you.

Discussion
• On page 22, Line 5: should it be “towards” instead of “of” in the following sentence: “... we identified key determinants of (towards) successful implementation...” given that ALRITE has not been implemented yet?

Thank you for the suggestion. We made that correction.

• Otherwise, looks great and contextualizes results well.

Thank you for your feedback!

VERSION 2 – REVIEW

REVIEWER	Mehmood, Hana Maternal, Neonatal and Child health research network, Public Health
REVIEW RETURNED	15-May-2021

GENERAL COMMENTS	The authors addressed the queries raised and responded clearly to my responses. However, the explanation should also be reflected in the actual manuscript rather than just in reviewer responses e.g for videos it is not clearly mentioned that they were taken from IMCI with permission. Once these minor revisions are added. The manuscript is good to go.

VERSION 2 – AUTHOR RESPONSE

Reviewer Reports:

Reviewer: 1 Comments to the Author:

The authors addressed the queries raised and responded clearly to my responses. However, the explanation should also be reflected in the actual manuscript rather than just in reviewer responses e.g for videos it is not clearly mentioned that they were taken from IMCI with permission. Once these minor revisions are added. The manuscript is good to go.

We edited the manuscript as follows: “educational videos (brief clips providing examples of children in respiratory distress, taken from WHO IMCI training videos with permission)”. We reviewed the previous comments from reviewers and feel that we have otherwise addressed the reviewers' comments and made appropriate edits to the manuscript.