Original Article

Adapting a water, sanitation, and hygiene picture-based curriculum in the Dominican Republic

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Abstract: Water, sanitation, and hygiene issues present barriers to health in rural Dominican Republic. Limited access to adequate water, sanitation, and hygiene accompanies a prevalence of water, sanitation, and hygiene-related diseases. To address these issues, an education and behavior change program using community health clubs has been adapted for areas at greatest risk of water, sanitation, and hygiene disease transmission. To support this initiative, a protocol was created to evaluate 147 images from a community health clubs toolkit for Dominican agricultural communities, or bateyes, to determine image comprehension and cultural appropriateness, as well as the demographic variables associated with visual literacy. A total of 112 interviews were completed across seven bateyes located near the city of La Romana; 60 images were determined to require additional adaptation. Further analyses demonstrated that age and education were significantly associated with greater visual literacy. These results reinforce that educational visual aids require testing for cultural appropriateness and that future work should be conducted to investigate factors that contribute to visual literacy.

Keywords: sanitation/hygiene, community health club, health education, community-based research/participatory research

Introduction

Between 2000 and 2015, access to basic drinking water sources and at least basic sanitation facilities in rural Dominican Republic increased from 81% to 86% and 70 to 74%, respectively (1). Despite this progress, inadequate water, sanitation, and hygiene (WASH) continues to contribute to a preventable burden of disease. According to the most recent demographic and health survey (DHS), the incidence of diarrhea within 48 hours in children under the age of five in the Dominican Republic in 2013 was 18% (2). In 2015, there were 5.7 cases of cholera per 1000 people amounting to 9637 estimated cases of cholera and at least 138 deaths due to cholera in the Dominican Republic (3). Risk factors for diarrhea and cholera transmission include poor adherence to WASH practices such as consistent hand washing, living in rural localities, and having disadvantaged socio-economic status (4, 5). In addition, poor WASH knowledge and practices have the potential to undermine the health benefits of better WASH infrastructure (6).

Available data do not accurately represent the realities of the most vulnerable rural localities in the Dominican Republic: *bateyes*. Bateyes are isolated and underdeveloped farming communities owned and controlled by agricultural corporations. These companies employ undocumented Haitian migrants and Dominicans of Haitian descent as low-skilled agricultural laborers. According to the 2013 DHS for the Dominican Republic, the estimated 500,000

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people living in bateyes are at high risk of preventable morbidity and mortality due to poverty, low education, and limited access to healthcare (2). For example, approximately 29% of children under five living in bateyes had diarrhea in 2013 (2). This preventable disease burden is exacerbated by the fact that only 25% of batey residents have access to an improved water source, 52% have access to an improved sanitation facility, and 31% are reported to openly defecate.

A community health club (CHC) program to address these issues in the sugarcane bateyes surrounding La Romana, Dominican Republic, is being developed. The CHC model leverages 'group knowledge, consensus building, and peer pressure' within a tight-knit population to instigate and perpetuate changes in WASH behaviors (7). Pioneered in Zimbabwe in 1995, CHCs have been successfully implemented and evaluated across 14 countries and social contexts in Africa, Asia, and the Caribbean (7–9). The club model uses participatory education activities to stimulate discussions about common health threats and help participants reach consensus about locally appropriate behaviors and solutions to prevent disease. The impact of the CHC model on WASH knowledge, behavior change, and social change has been documented elsewhere (9, 10).

One reason this model achieves sustainable WASH behavior change is the use of a visual aid toolkit in combination with participatory and adult learning techniques. The WASH toolkit is a customized deck of over 200 cards featuring images of common WASH practices including hand washing, kitchen hygiene, personal hygiene, sanitation, and environmental management. The toolkit is designed to highlight specific cultural practices, behaviors, and norms in each country and context. Local artists hand-draw the images to ensure the deck features culturally appropriate and visually recognizable elements unique to each community. With the CHC model, trained facilitators use the toolkit to engage program participants during the weekly meetings using participatory activities like three pile sorting, storytelling, and blocking the route of disease transmission (9).

A WASH toolkit was developed for Barahona, Dominican Republic in 2011 as part of a pilot CHC project launched in five bateyes (11). While developing a new CHC project in La Romana, it was determined that the existing WASH toolkit should be tested to identify any contextual and cultural differences between bateyes in the two localities. The goal of this study was to evaluate selected images from this previously developed toolkit for comprehension and cultural appropriateness in a new population and then to refine the entire toolkit for use in La Romana. In this paper, we reflect upon the utility of evaluating visual aids through structured interviews, and examine the data within the context of health literacy.

Methods

To evaluate the WASH toolkit, methods were adapted from a previous evaluation of a CHC toolkit in South Africa. These methods included structured interviews with heads of household to collect information about basic WASH behaviors as well as those respondents' recognition and ease of understanding of the images. The interviews included open-response questions to collect suggestions about how the images could be adapted to reflect local culture and context.

In the Dominican Republic, individual and collective WASH behavioral data, including types of latrines and available water supplies, handwashing and defecation practices, kitchen hygiene practices, and environmental management, were collected by the principle investigator (PI) from a sample of households in La Romana bateyes in 2014 (12). For the present study, we used the data from the 2014 study to identify images from the existing WASH toolkit that were applicable to the La Romana bateyes, but potentially required revision and contextualization.

Finally, specific images that appeared complex or ambiguous were also selected for evaluation through the following process.

The lead research assistant, a dual MD/MPH degree student from the University of Texas Health San Antonio's (UT Health SA) Long School of Medicine, who was unfamiliar with the WASH toolkit, examined and interpreted the existing 255 images. The research assistant recorded the details she observed in each image and recorded her interpretations of the behaviors portrayed in each image. The PI, a faculty member at UT Health SA with over 10 years of experience designing, implementing, and evaluating CHC programs globally, then reviewed the research assistant's

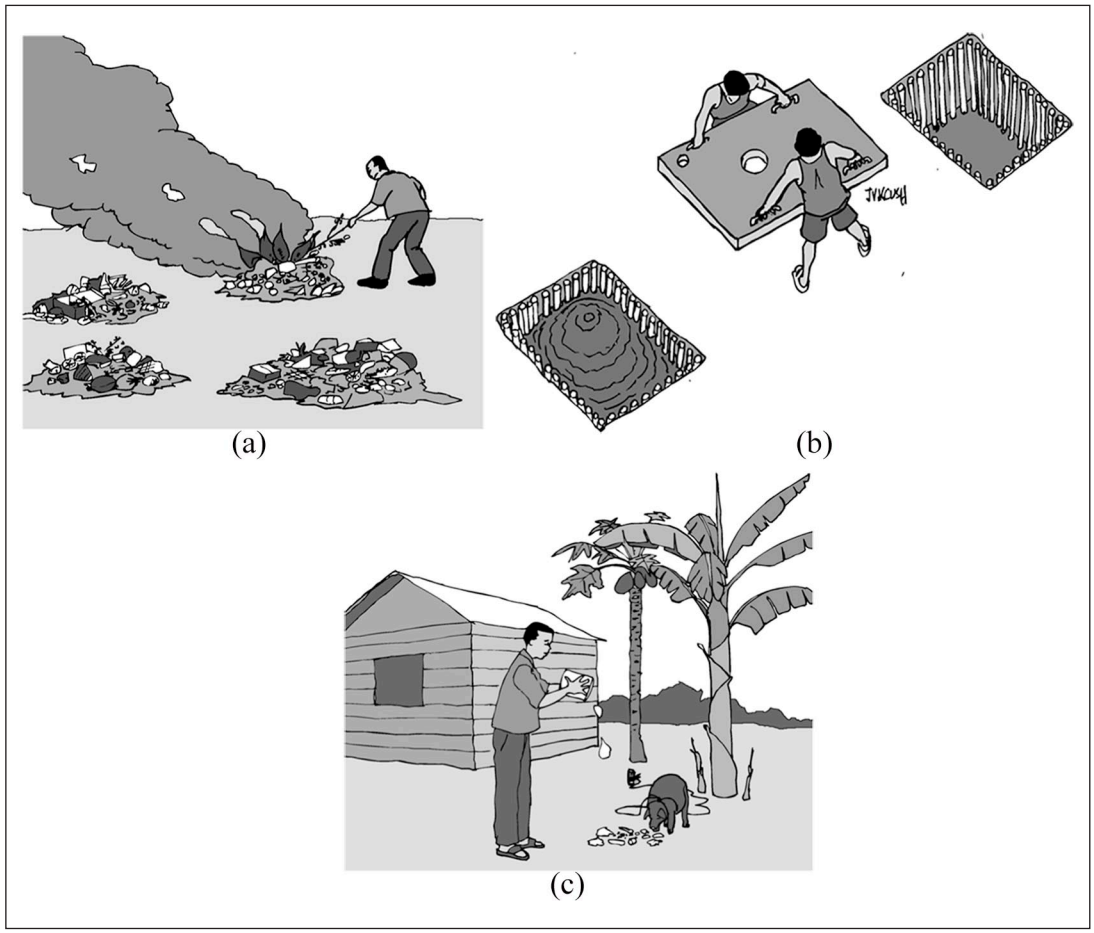

Figure 1. WASH toolkit image examples.
Figure 1a: WASH toolkit image of a man burning trash. From the WASH toolkit (Licensed under CC by 2.0).
Figure 1b: WASH toolkit image of building a new latrine. From the WASH Toolkit (Licensed under CC by 2.0).
Figure 1c: WASH toolkit image of a man feeding slops to a pig. From the WASH toolkit (Licensed under CC by 2.0).

interpretations to determine whether they matched the original intent of the images. Images that were determined to be unclear or incorrectly interpreted by the research assistant were selected for evaluation.

Figures 1a–c show a sample of evaluated images, with the following rationale for inclusion in the evaluation. The research assistant interpreted Figure 1a to depict steaming piles of waste, as the gray cloud above the pile of garbage was unclear. The intent of this image was to portray an individual burning trash. The research assistant interpreted Figure 1b to show two men simply moving a cement block. The intent of this image was show construction of a pit latrine, specifically the use and placement of a cement slab that covers the latrine pit. For Figure 1c, the artist intended to portray a man feeding scraps to a pig, but the research assistant was unsure of the pig's significance and thought the man was simply disposing of waste.

An interview script was developed to collect respondent demographics and to assess a maximum of 10 images per interview. Each card was used in at least 7 and in up to 10 interviews. The interview questions (Figure 2) assessed the respondent's ability

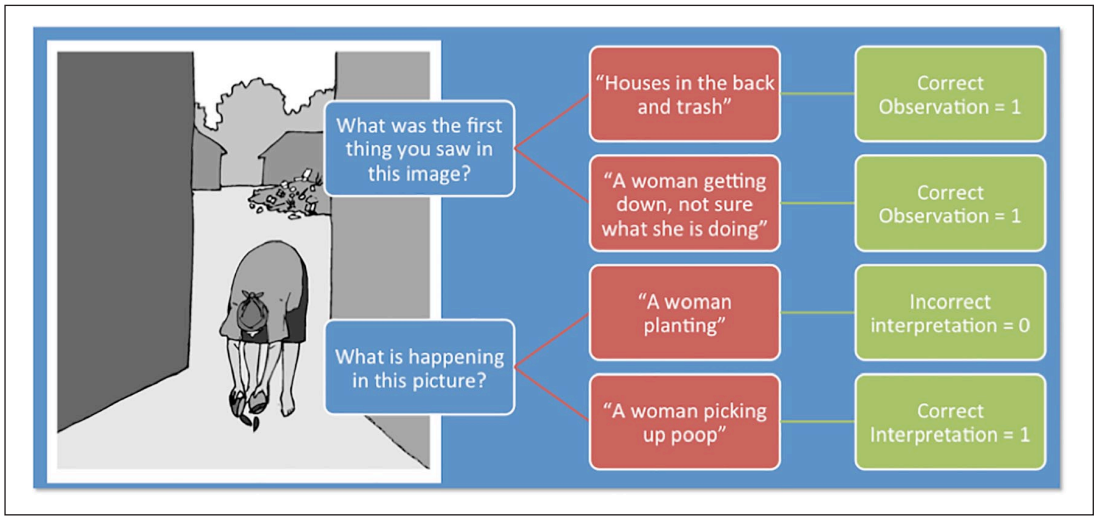

Figure 2. Flowchart for how image responses were evaluated. Images were evaluated according to observation ('What was the first thing you saw?'), which was counted correct as long as the respondent named something in the image. They were also evaluated for interpretation ('What is happening in this picture?'), which was counted correct if the action or behavior intended by the image was correctly identified (Image licensed under CC by 2.0).

to identify elements in the image, demonstrate understanding of the image's content, and interpret a meaning or an action implied by the image. Interviews also included open-response questions designed to measure the cultural and contextual appropriateness of the images. These questions included: 'Do you see this happen in your community?', 'Does this happen in your household?', and 'How could this picture better represent your community?'. The script was written in English and translated into Spanish and Haitian Kreyol.

In designing the interview protocol, we looked at other image assessment models. Bell and Morse, researchers in technical communication and environmental strategy, describe pictorial efficacy through an art-based analytical framework. Two of the parameters in their model are 'descriptive features and structures', or the pictures' content, and 'low-level interpretation', which describes 'the meaning or content of the picture in basic form' (13). The questions in our protocol reflected these parameters. In doing so, the interview responses provided data about how applicable the image content would be to communities using the WASH toolkit and how well program participants could interpret the images' meaning. The selected communities where the study was conducted were a convenience sample chosen by Hospital Buen Samaritano's batey outreach coordinator in La Romana. The coordinator chose these communities based on batey ownership (the Central Romana Corporation versus small, private landowners), distance from La Romana, and UT Health SA faculty's previous work and relationships in each community. Respondents represented a convenience sample of 112 individuals who were at home in one of the seven communities during the study team's visit, were 18 years of age or above, and were available for the duration of the interview. All respondents were consented prior to participating in the study. Data were collected over four days in June 2015 by a team of eight medical students, a faculty member from UT Health SA, and five interpreters of Spanish, Kreyol, and English from Hospital Buen Samaritano. Each team carried multiple printed sets of 10 images and conducted 21 to 25 interviews within the study period, alternating between the different image sets. A total of 147 images were selected and randomly grouped into 15 sets of 10 images, with some images repeated across sets to cross-validate responses.

This protocol was submitted to and approved by the UT Health SA Institutional Research Board as Exempt Human Research (HSC20150483N). This protocol was also reviewed and approved by

Hospital Buen Samaritano. Data were collected via the Magpi Mobile Application, which was downloaded on the students' personal smart phones (Magpi, Washington D.C.).

A binary grading system (0 = incorrect; 1 = correct) was developed to assess the respondent's ability to interpret each image, or their ability to correctly state the meaning or action implied by the image (Figure 2). Rounding down to the nearest whole percentage, images that received 50% or fewer correct responses for interpretation were recorded as requiring alteration. Qualitative responses about the practices portrayed in the images were compiled and analyzed for those images where revisions were deemed necessary.

The image grades were totaled to create two summative scores per respondent that ranged from 0–10, one score representing the number of images correctly recognized (e.g., 0 = no images correctly recognized and 10 = all images correctly recognized) and the other score representing the number of images correctly interpreted (e.g., 0 = no images correctly interpreted and 10 = all images correctly interpreted). These scores were analyzed using SPSS v.24 (IBM, Armonk, NY) to explore the relationships between respondent demographics, including age, education level, and gender, and level of visual literacy. To facilitate analyses, the continuous age variable was categorized into quartiles, while the categorical education variable (no education, primary school, secondary school) was converted into a dichotomous variable (no education and any education) due to the small percentage of sample respondents who had completed secondary school. Interpretation scores were normally distributed, which allowed for the use of independent samples *t*-tests to test differences between mean interpretation scores and level of education, and an ANOVA to assess difference in scores between the age quartiles.

Results

The study sample included a total of 112 respondents, 24 men and 88 women, with an average age of 42.8 years (47.3 years for men and 41.6 years for women). The majority of respondents (60.7%) had completed primary school, while 31.3% had no formal schooling. The reported occupations ranged from manual labor to teaching, whereas 40.2% reported that they were unemployed. Respondent demographics are provided in Table 1.

Of the 147 images assessed, 60 were found to require revisions. These images were frequently misinterpreted or misunderstood by the majority of respondents. After asking respondents to observe and interpret an image, they were asked to provide input to improve the quality of the images. Respondent suggestions included improving the quality of the images ('the fire looks like leaves' in Figure 1a), making components of the images more explicit ('difficulty recognizing full latrine' in Figure 1b), and changing components of the images to better reflect cultural practices ('not allowed to have pigs' for Figure 1c).

Education and age were found to have a statistically significant association with average interpretation scores (Table 1). The two-thirds of respondents that reported having completed primary or secondary school had an average score of 7.12 images correctly interpreted, while respondents who had not completed any schooling had a mean score of 5.03 ($t(63.159) = -4.883$, $p \leqslant 0.005$). In addition, respondents in the youngest age quartile had significantly higher scores than respondents in the oldest age quartile (7.23 versus 5.41, respectively), ($F(3, 108) = 3.569$, $p = 0.017$). There was no significant difference between respondents within the other age quartiles or between male and female respondents (Figure 3a–c).

Discussion

We determined that the majority of images assessed under this study were understood by the majority of respondents and were appropriate for the local context of the sampled bateyes. While 60 images were determined to require revisions, the recommended revisions were minor and predominantly due to differences in local practices. We also observed statistically significant differences in image interpretation accuracy between the youngest and oldest respondents and between educated and uneducated respondents. Many of the suggestions for individual image improvement were consistent between subjects, but we included all responses in the image revision notes.

As per Bell and Morse's model of pictoral efficacy, the results of this study reinforce the link

Table 1. Demographic variables and average interpretation scores.

	N (%)	*Mean interpretation score*	*Mean difference (CI)*	*p-value*
Total	**112 (100)**	**6.59**	**–**	**–**
Gender**				
Male	24 (24.4)	6.54	0.140	0.788
Female	88 (78.6)	6.40	(–0.891, 1.171)	
Education**				
No	37 (33.1)	5.03	2.093	< 0.005*
Yes	75 (66.9)	7.12	(1.236, 2.949)	
Age†				
18–27	30 (26.8)	7.23	0.519 (–0.97, 2.01)	0.800
			0.974 (–0.53, 2.48)	0.335
			1.826 (0.32, 3.33)	0.011*
28–40	28 (25.0)	6.71	–0.591 (–2.01, 0.97)	0.800
			0.455 (–1.08, 1.99)	0.865
			1.307 (–0.22, 2.84)	0.122
41–56	27 (24.1)	6.26	–0.974 (–2.48, 0.53)	0.335
			–0.455 (–1.99, 1.08)	0.865
			0.852 (–0.69, 2.40)	0.478
57+	27 (24.1)	5.41	–1.826 (–3.33, –0.32)	0.011*
			–1.307 (–2.84, 0.22)	0.122
			–0.852 (–2.40, 0.69)	0.478

*Statistically significant p-value ($p < 0.05$).
**Mean difference determined using a Student's *t*-test.
†Mean difference determined using an ANOVA test.

between image content and interpretation. The majority of images determined to require revisions (where respondents had difficulty interpreting the meaning) were those where the descriptive features and structures of the image and the content were unclear or culturally inappropriate. For example, Figure 1a features a man burning trash, which was difficult for some to interpret. The smoke, the way the fire looked like leaves, and the ambiguity of the man's action with the trash piles were confusing to the majority of respondents. Figure 1b depicts the construction of a new latrine next to an old latrine filled to capacity with feces. However, respondents had trouble discerning that the first latrine was full. These two images demonstrate issues related to image clarity, feedback that will be given to the artist who will redraw the images. Figure 1c shows a man feeding food scraps to a pig. Since many batey residents explained that owning pigs is illegal, this image will be omitted or redrawn to depict a different animal.

We also found an association between education and visual comprehension and interpretation. This corresponds with the findings in the study conducted by Paasche-Orlow *et al*. who found that education level was one of the most common demographic characteristics associated with health literacy (14). Another important finding from our study was that younger individuals demonstrated better visual interpretation abilities than the more senior members, who also tended to have lower education levels than younger individuals. Paasche-Orlow *et al*. also identified age as a contributing factor to health literacy (14). This observation in our study is possibly due to young people achieving higher levels of education in the batey communities. Gender was not found to have a statistically significant association with literacy levels in our study, but the predominance of females in our sample population was a limitation. Based on our survey findings, CHC facilitators should be prepared to explain unclear images for the less educated and older population participating in the intervention.

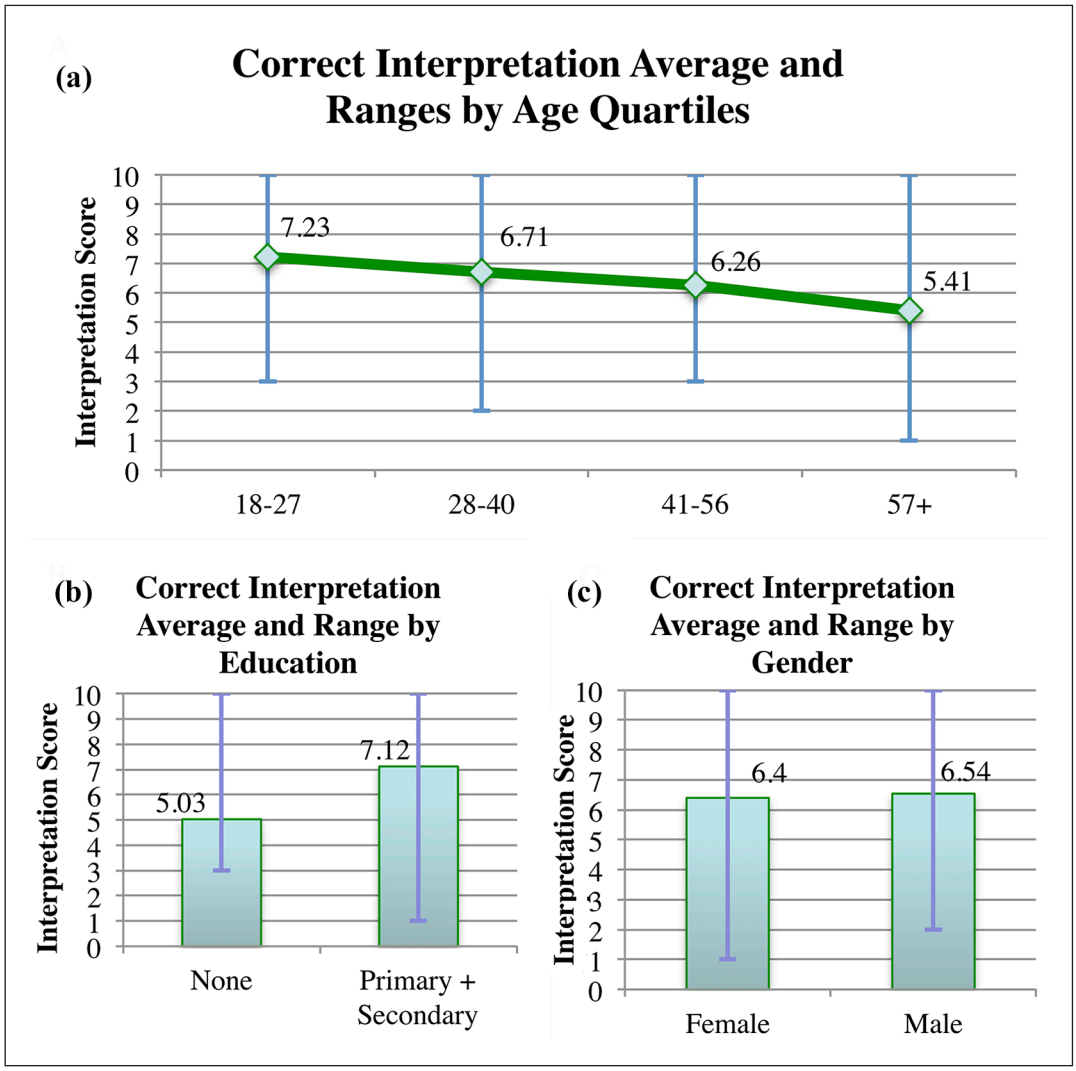

Figure 3a–c. Mean correct interpretation scores by (a) age, (b) education, and (c) gender.

Our study and results were limited by both time and logistical constraints. The student interviewers were only available for four days of data collection. This time frame limited the scope and scale of the research. Data were also collected during the day, when the working members of the household, who tend to be younger adult males, were unavailable. This resulted in a less representative study population.

Our study population was overrepresented by the less educated, older, and female respondents. According to DHS batey census data, 54% of the batey population is male and 46% is female (2). In our study, 21% of respondents were male and 79% were female. Further, 37% of the batey population is less than 15 years old, but our study was restricted to individuals who were 18 years or older (2). Finally, according to the census data, 15% of the population has no education, while more than 31% of our study population was uneducated (2). The study was also limited in that interviewers were often required to provide further clarification or

explanations to assist respondents in providing constructive suggestions for revisions for unclear or culturally inappropriate images. While this potentially created bias about image content, this was necessary to obtain substantial feedback that could be used to improve image quality and content.

Our team's access to the study communities was also limited, resulting in the use of convenience sampling techniques. Transportation to the bateyes was provided by our host organization, Hospital El Buen Samaritano, who, as previously described, pre-selected the bateyes to participate in this study. Although the study team requested access to a wide range of communities, including bateyes that were privately owned and those further away from large population centers, we had no control over this selection process. Based on the limited number of sites our team visited, it is possible that the selected bateyes and sampled residents were different from the overall batey population outside of La Romana in significant ways. Overall, these limitations mean that our findings may not be generalizable to all bateyes in the region.

The next steps in the WASH toolkit development and revision process will be to revise the tested images and finalize the toolkit. Once all necessary changes have been made and irrelevant and redundant images have been removed, the PI plans to utilize the finished toolkit as part of a CHC program in bateyes surrounding La Romana. As with other CHC programs in Africa and the Caribbean, the PI, with support from future research teams, will periodically survey program participants to obtain suggestions for image improvement. Future work should include resampling the bateyes to incorporate a better balance of males and females, and testing the entire set of WASH images to further refine the toolkit. An evaluation of the WASH toolkit program should also be conducted after implementation to examine the toolkit's effect on WASH knowledge and behaviors. Further research should also explore how age, education, and other demographic factors contribute to individual understanding and interpretation of health-related images to create more effective and accessible visual aid tools.

In this study, we assessed the utility of an assessment protocol for visual aids in a community-based WASH education program in the Eastern Dominican Republic. We determined ways that the visual aid toolkit could be tailored for application in this new region. Our results should encourage public health educators and behavior change specialists working to implement a visual aid-based education system to understand the target communities' contextual and demographic variables influencing each individual's comprehension of health-related images.

This study fills an important gap in the literature by providing a systematic method to assess visual aids for other public health educators designing and adapting community-based health education programs. The results of our protocol reinforce the link between image content and interpretation. The majority of images determined to require revisions (where respondents had difficulty interpreting the images' meaning) were those where the descriptive features and the image content were unclear or culturally inappropriate. This is significant because to the best of our knowledge, this is the first published protocol that demonstrates this link. Therefore, others wishing to assess images used in health education programs could replicate this protocol.

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Declaration of conflicting interest

The authors declare that there is no conflict of interest.

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