Qualitative exploration of effectiveness, feasibility and self-efficacy for methods to prevent Zika Virus Disease in Guatemala, Central America

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Contents

Abstract

Zika is a communicable disease transmitted by the *Aedes aegypti* (*A. aegypti*) mosquito and by sexual transmission that disproportionally affects the fetuses of pregnant women. Several countries in Latin America and the Caribbean, including Guatemala, experienced a surge of cases beginning in 2016. We conducted a qualitative exploration of perceptions of seriousness of Zika and how it changed over the course of the outbreak as well as the effectiveness, feasibility and self-efficacy for Zika prevention actions (avoid mosquito bites, eliminate mosquitoes, larvae, eggs and breeding sites, and prevention of sexual transmission of Zika).

Using a free listing technique, we elicited the preventive actions that were salient for 68 participants who were either pregnant women, men with a pregnant partner, or women likely to become pregnant. We explored the other concepts through 12 focus group discussions (6 in a highlands town and 6 in a lowlands town), which included rank orderings for effectiveness, feasibility and self-efficacy of prevention practices depicted on cards.

Participants reported being very concerned about Zika at the beginning of the epidemic based on their recent previous experience with chikungunya and the related messaging. Concern diminished due to mild symptoms and reduced messaging but remained considerable, given the danger to their babies. Participants identified 32 salient preventive actions, 20 of which overlap with current Zika prevention recommendations. Few of those actions, though salient, also ranked high on effectiveness. Participants ranked large water container cleaning as highly effective, feasible and self-efficacious, however lacked the specificity of how to clean in order to effectively destroy *A. aegytpi* eggs. Community-level removal of tires and smaller containers that may collect rain were ranked more difficult than household-level implementation of these same actions, due to the municipal and community cooperation needed. Feasibility for daytime bed net use during pregnancy, window screens, repellent, and long sleeves was equivocal depending on climate, access and high empirical efficacy.

The findings indicate space for increasing self-efficacy for fathers-to-be for condom use at first suspicion of pregnancy and during pregnancy. Other recommendations include abandoning non-specific terms such as “cleaning” and “standing water,” increasing people’s skills to eliminate mosquito eggs and larvae, such as using bleach as an ovicide, and improving enabling technologies such as designing a mosquito proof water storage container, a mosquito proof lid, window screens compatible with the house construction and adapting mosquito nets and materials for daytime use especially for pregnant women.

Introduction

Zika is a communicable disease transmitted by the *Aedes aegypti (A. aegypti)* mosquito, which is common to Latin America, Guatemala included, and also transmits dengue and chikungunya. *A. aegypti* is highly anthropophilic and bites mostly during the day. It breeds in clean water found in containers, to a large extent, in and around people’s homes. In the context of Guatemala, households typically store water large drums and cement laundry wash basis, referred to as “pila(s)”. While Zika typically has mild or no symptoms, in contrast with dengue and chikungunya, Zika disproportionately affects the fetuses of pregnant women causing neurological birth defects. There is no vaccine or treatment for Zika. In addition, Zika is also sexually transmitted. The World Health Organization therefore pronounced Zika an international health emergency in the Latin America and the Caribbean (LAC) region from February to November 2016, and an endemic health problem ever since.

Guatemala experienced a surge of Zika cases in 2015 and 2016 and cases continued to register, with 1,000 confirmed cases up to June 2017 (PAHO Zika Epidemiological Report, June 28, 2017). As of epidemiological week 19 of 2017, a total of 140 confirmed cases of congenital syndrome associated with Zika had been reported by the Guatemalan health authorities (PAHO, Zika and congenital syndrome cumulative case reporting, September 14, 2017). National health authorities and local organizations have been providing information about the threat of Zika and recommend actions to take at the individual, household and community levels to prevent Zika. These fall into three main categories: actions that avoid mosquito bites, actions that eliminate mosquitoes in various life-stages (eggs, larvae, pupae, and adults in and around the home), and actions that prevent the sexual transmission of Zika. Emphasis is placed on protecting women during pregnancy.

The extended parallel processing model (Cho 2005; Rimal 2006) posits that preventive behaviors are most likely adopted when an appropriate balance of perceptions of risk/threat and efficacy/control are attained. Existing research indicates that Zika knowledge and risk perception has been studied considerably, however, perceived efficacy and control to practice prevention behaviors has not. Perceptions of efficacy and control are influenced by a host of factors, including but not limited to empirical efficacy based on tangible results of performing the behavior, level of skill to perform the behavior, ease and convenience, access to enabling technologies (such as window screens or repellent), household and community collaboration, community norms, and periodic encouragement praising positive behaviors practiced, all of which in turn increase self- and community-confidence in continuing to practice these behaviors. Promotion of preventive behaviors may be more effective if it strategically addresses these influencing factors in increasing perceptions of efficacy and control.

The Center for Communication Programs (CCP) funded by USAID has been providing technical assistance in the LAC region, including in Guatemala, advising the development of a national Zika communication strategy. However, in-depth information on the population's perceptions of efficacy and control to perform the recommended preventive actions is scarce. This qualitative study aimed to provide much needed contextual data, in order to further improve social and behavior change communication (SBCC) efforts.

Aims

We aimed to gain insights on five concepts among study participants in Guatemala: 1) The perceived seriousness of Zika illness and how it may have changed over the course of the outbreak; 2) The cultural salience of freely elicited actions that people in the community take to avoid Zika; 3) The perceived relative effectiveness of Zika prevention recommendations; 4) The perceived feasibility of Zika prevention recommendations; and 5) Relative self-efficacy to perform Zika prevention recommendations. The Zika prevention recommendations considered fall under three main categories: 1) Actions that avoid mosquito bites; 2) Actions that eliminate mosquitoes in various life-stages (eggs, larvae, pupae, and adults in and around the home); and 3) Actions that prevent the sexual transmission of Zika. Three groups were studied: 1) Women currently pregnant; 2) Male partners of women currently pregnant; and 3) Women likely to become pregnant in the near future.

Methods

Selection of study sites

In collaboration with USAID/Guatemala and APROFAM, a USAID-funded Zika implementing partner in Guatemala, we selected two study sites: Barberena, Santa Rosa, a town in the pacific lowlands at 371m above sea level, and Mazatenango, Suchitepequez, a town in the highlands of the Sierra Madre Mountains at 1221m above sea level, referred to here as the lowlands town and the highlands town, respectively. Both towns had experienced Zika cases according to Ministry of Health reporting, and the partner organization was implementing Zika-related home visits, community-level intervention activities, or other Zika prevention activities in both towns, through community outreach workers or clinic staff who integrated Zika into their regular counseling on family planning, reproductive health, or antenatal care. Differences in climate, and therefore mosquito infestation levels, between the two towns could influence Zika preventive behavior differentially in each town.

Selection of study participants

A community outreach worker in each town who engaged urban or peri-urban communities in the organization's intervention activities, extended invitations to interested clients through convenience sampling, according to the following selection criteria: women 18 and over currently pregnant, male partners 18 and over of women currently pregnant, or women 18-30 years old with a steady partner and no children or a single child. The latter we considered likely to become pregnant in the near future.

Data collection

Between July 27 and August 1, 2017 we conducted 2 focus groups with each population group per site, for a total of 12 focus groups, 6 per site, during mostly rainy weather. All data collection team members were experienced in qualitative methods, fluent in Spanish and familiar with Zika. The focus group moderator was a Guatemalan national. We used a structured focus group discussion guide, touching first on the perceived seriousness of Zika, followed by 3 (and on one occasion 4) collective rank-ordering tasks of a series of 19 cards, each depicting a recommended Zika prevention method, informed by the Strategic Communication for Zika Prevention: A Framework for Local Adaptation developed by the HC3 project. The cards covered actions that avoid mosquito bites, actions that eliminate mosquitoes in various life-stages, and actions that prevent the sexual transmission of Zika. The moderator introduced the cards to the participants not as methods to prevent Zika, but as a series of actions to discuss during the rank ordering tasks. In some focus groups, participants expressed that some relevant actions were missing from the card set. In these cases, we used a hand-drawn image to depict the method and let participants insert it in the rank order. Participants rank-ordered each card first according to relative effectiveness; second according to relative self-efficacy; and third on relative feasibility to perform the action, all dimensions of perceived efficacy and control. The moderator stimulated discussion to gain insights on why a depicted action was ranked higher or lower than another, as well as discussion to illuminate disagreements among participants when applicable. All discussions were audio recorded with two voice recorders simultaneously.

Upon participant arrival, we asked them to individually free-list (Quinlan, 2005) all the actions that people in the community take to avoid Zika and recorded their responses in writing, in the sequence in which they were mentioned. We probed further to gain more detail on the nature of the action mentioned, and to ensure all potential responses that the participant was aware of were mentioned.

The data collection locale was the conference room on the top floor of the local organization's clinic in one town, and a private events hall above a restaurant in the other town. Both locales were private with enough room to spread out during the individually administered free listing, and data collection proceeded undisturbed.

Sample size

Sample size in qualitative research is tied to reaching data saturation. We calculated that 2 focus groups of 6-8 participants each, per target group per site would be adequate to elicit all relevant variation in our themes of interest. The community outreach workers recruited 8-10 participants per focus group to allow for attrition.

Informed consent

Recruiters obtained preliminary oral informed consent upon inviting the participants. We obtained informed oral consent using a consent script from each participant again upon their arrival to the data collection locale, and handed out copies of the consent scripts for participants to keep a copy for their records. The research protocol, recruitment and consent scripts were approved by the Johns Hopkins Bloomberg School of Public Health, Institutional Review Board (IRB) in the US and by Zugueme, an independent Ethics Committee in Guatemala. Both IRBs granted exempt status under category 2.

Data analysis

A team of five persons fluent in Spanish and familiar with Zika and the Guatemalan context analyzed the data, three of which were also present for all data collection activities. We entered free listing data by participant and order in which they were mentioned into an Excel worksheet. We consolidated similar wordings of the same action into a single wording that best described that action. We then calculated Individual salience for each action mentioned by each participant, and (mean) Smith's Salience (Quinlan, 2005) for each action across all participants in each target group and study site. Smith's Salience is a statistical accounting of rank and frequency that describes the relative importance of items, in this case actions to prevent Zika, included in a cultural domain, or a mental category of a set of items of the same type.

Each focus group discussion recording was transcribed. The ranked order of the 19 cards plus any additional suggested by the participants, were photographed and later entered into an Excel worksheet. We assigned a shared (mean) rank in the case of tied ranked cards. We then calculated a separate overall mean rank for each card-depicted action, by the same three dimensions of effectiveness, self-efficacy and feasibility, in each target group and study site. We did not include the ranks of the added hand-drawn images in the rank calculations, as not every focus group was given the opportunity to include them in their rankings, but report such rankings separately when applicable. We conducted thematic analysis on the textual transcript data providing the context on perceptions of seriousness of Zika illness, and on why a certain action was ranked higher or lower than another action in the card set. We developed topical codes, first by action and then by effectiveness, self-efficacy and feasibility, as well as by whether relevant to Zika seriousness; we then coded the data using these topical codes in MaxQDA, a qualitative data analysis software. Finally, we summarized the textual data by theme.

Findings

Demographic description of study participants

A range of 5-9 participants showed up per focus group, for a total of 70 participants, a mix of Ladino and Indigenous ethnicities. Two participants arrived late and we did not have a chance to collect their demographic and free listing data; therefore, only 68 participants are represented in Table 1.

Table 1. Demographic description of study participants

Participant Group		Range	Median	Mean
Pregnant Women (*n*=20)	*Age*	18-36	22	23.4
	Years of schooling	0-12	9	7.2
	Number of Children	0-5	1	1.1
Male Partners of Pregnant Women (*n*=20)	*Age*	17-54	30	31.85
	Years of schooling	4-17	11.5	10.1
	Number of Children	0-3	1	1.5
Women Likely to Become Pregnant (n=28)	*Age*	18-31	26	25.7
	Years of schooling	2-17	11	9.9
	Number of Children	0-4	1	1.2

The majority of the pregnant women did not work outside the home (n=15). A few participants listed their occupation as domestic workers (n=3) and food vendors (n=2). The majority of women likely to become pregnant did not work outside the home either (n=17). The remaining participants were teachers (n=3), students (n=2), a social worker, a secretary, and a sales associate. One individual did not provide any occupation. Male partners of pregnant women were from a variety of occupations, including farmers (n=3), security guards (n=2), mechanics (n=2), students (n=2), a lawyer, a cook, a salesman, a supermarket employee, a credit inspector, a commercial driver, a lab technician, and an ornamental flower grower. One individual was recently unemployed.

Perceived seriousness of Zika illness during the course of the outbreak

A majority of female participants described that their community was seriously concerned when they first heard about Zika because it appeared soon after a *"horrible"* outbreak of chikungunya. Widespread chikungunya infection meant that almost everyone had suffered from its severe symptoms. As a result, when Zika first appeared they believed it would bring the same dramatic symptomology as chikungunya:

"... Todos comenzaron a preguntar qué era el Zika. Decían es lo mismo que el chikungunya, pero más fuerte, porque también lo transmite un zancudo…"
Focus Group, Women likely to become pregnant, lowlands site

"…yo lo vi [Zika] *igual…nos preocupó bastante porque…imagino que va a ser más fuerte lo otro* [chikungunya]*…porque afectó…a muchas personas. En mi casa…todos pasamos…"*
Focus Group, Women currently pregnant, lowlands site

Despite the initial perception of high severity, the milder symptoms or lack of symptoms associated with Zika reduced the public's concern.

"*Zika no tuvo la misma difusión como la tuvo el chikunguya…como el Zika ya no se oía tan fuerte como la chikunguya, la gente lo fue dejando atrás."*
Focus Group, Men with a pregnant partner, highlands site

Another reason given for reduced concern for Zika was due to a decline in messaging, leading participants to believe that the worst was perhaps over.

"Pues, ahorita se oye menos… [Zika] empezó se oía más, más peor, en cambio ahorita ya es calmado."
Focus Group, Women likely to become pregnant, lowlands site

However, pregnant women participants still expressed considerable levels of fear due to the consequences for their babies. While many pregnant participants indicated Zika was serious for them, they also voiced that people in their communities did not believe that Zika was real but rather *"inventos de los del centro de salud".* Some male participants also mentioned that others did not know or educate themselves on Zika, dengue, or chikungunya, and that these persons did not perceive these diseases to be serious. They also expressed that women were principally the ones at risk, that people did not believe that they could transmit it in the absence of symptoms, or that individuals just had to "wait it out" when symptoms were present:

"A*hh, es como un dengue, es como un chikungunya, no pasa nada, es un dengue, es una enfermedad más que no tiene consecuencias de otra naturaleza.*"
Focus Group, Men with a pregnant partner, lowlands site

Participants spoke about a vaccine for Zika in two ways: Some pregnant women thought that they had already received a Zika vaccine in the arm when they received vaccines for tetanus and other communicable diseases at antenatal care. Participants also referred to a vaccine as an injection of strong pain medicine to calm the symptoms of chikungunya. Male participants noted that clandestine "vaccine" vendors sold injections during the chikungunya outbreak.

Overall, women believed Zika was serious, and expressed more concern for Zika than the men. While both men and women cited concerns about the impact that Zika could have on pregnant women and babies, men seemed to place the primary responsibility of preventing Zika on the women. There was uncertainty overall about the differences between Zika, dengue, and chikungunya and whether Zika was the same as the other two diseases.

Cultural salience of actions taken by people in the community, to avoid Zika

Sixty-eight (68) participants mentioned 214 different actions taken by the people in the community to avoid Zika, during the individually administered free listing task, further grouped into 88 actions, according to similarity. A mean of 7.06 actions were elicited per participant. Table 2 shows the first 32 elicited actions in order of overall salience (rounded up to two decimal digits).

No one action showed a very high salience, due to the large number of actions elicited from each participant, therefore the salience data are more meaningful in comparative terms. The use of a mosquito net had the highest salience (0.40/1.00), mentioned by 45 participants, and was more salient for the pregnant women than the other groups, perhaps reflecting recent exposure to health communication, though in further discussions participants recommended it more for babies and young children at night time. The elimination of containers that accumulate "agua del cielo" or rain water, also popularly known as "deschatarrización," had the second highest salience, mentioned 26 times, another 7 elicitations mentioning getting rid of bottles, and another 3 getting rid of plastic bags. In support of this, participants often explained that the mosquito larvae locally known as "sangijuelas"or "sandijuelas" come in the rainwater, or that rainwater calls the attention of the mosquito to place its eggs and larvae in that water. Third most salient was repellent use, and was more salient for the residents of the lowlands than the highlands study site, who later explained that the coast had generally many more mosquitoes than the rest of the country and was to be avoided during pregnancy compared to other less infested locales in the interior.

The fourth most salient action was general cleaning of the house and its surroundings, which included sweeping dust away, sweeping under beds, keeping the yard clean. These actions are not effective for Zika prevention unless they include elimination of water collecting containers.

Fifth came condom use to prevent the sexual transmission of Zika, mentioned by 32 participants, more salient for the men partners of pregnant women, followed by the pregnant women participants, and less for the women likely to become pregnant. Antenatal counseling currently taking place in the two study sites includes this recommendation. Cessation of sexual relations during pregnancy was mentioned by 10 participants, and prevention of pregnancy altogether during the Zika epidemic was mentioned by 4 participants, but with much less salience.

Other notable findings were that burning of mosquito repelling coils came 8th, mentioned by 17 participants, even though this is not a Zika prevention recommendation. A detailed cleaning of the pilas ranked 9th in salience. Participants described how detergent, bleach, and a brush should be used, from constantly and daily, to three times a week to once a week, i.e. very frequently. No participant mentioned the ovicidal effect of undiluted bleach when directly dabbed on *A. aegypti* eggs deposited on the upper parts of the container's interior walls. In contrast, several participants mentioned (23rd in salience) the adding of a few drops of bleach directly to the stored water to purify it from Zika and to protect it from the mosquitoes.

Table 2. Cultural Salience of free-listed community actions to avoid/prevent Zika

	Actions mentioned by 68 participants	Overall Mean Salience	Number of participants mentioning the action
1	Use a mosquito net	0.40	45
2	Eliminate/throw away containers exposed to the rain	0.31	26
3	Use skin repellent	0.24	34
4	Clean the house and all around it	0.21	22
5	Use a condom to prevent sexual transmission	0.19	32
6	Burn or take garbage to its place	0.14	14
7	Fumigate outside the homes or in the community	0.14	18
8	Burn mosquito coils at night	0.13	17
9	Wash pilas well	0.12	13
10	Treat pilas with Abate	0.09	13
11	Empty the water from the containers you want to keep	0.09	8
12	Remove/sell bottles exposed to the rain	0.08	7
13	Use clothing that covers the whole body	0.08	11
14	Eliminate tires exposed to the rain	0.08	9
15	Make smoke / burn incense to shoo off the mosquitoes	0.07	10
16	Abstain from sexual contact during pregnancy/when you have Zika	0.07	10
17	Fumigate the house	0.07	12
18	Wash the tires	0.06	5
19	Use plug-in tablets	0.06	6
20	Cover drums	0.06	6
21	Do not keep standing water (dirty or clean)	0.06	5
22	Keep containers clean	0.05	5
23	Pour chlorine drops in pilas and drums	0.05	5
24	Install screens on doors and windows	0.05	4
25	Wash drums well	0.04	5
26	Cover water storage containers	0.04	5
27	Overturn bottles exposed to the rain	0.04	4
28	Cut the brush around the house	0.04	4
29	Eliminate puddles around the house	0.04	4
30	Clean/drain the humidity or mud around the house	0.04	4
31	Inject/vaccinate for the strong pains of chikungunya/ dengue/Zika	0.04	6

	Actions mentioned by 68 participants	Overall Mean Salience	Number of participants mentioning the action
32	Spray insecticide aerosols indoors	0.03	7

Salience for all elicited responses, and by participant group and field site is reported in Annex 1.

Interpretation of the Zika-related actions depicted on the ranking cards

Generally interpretation of the cards was as intended, with two exceptions. The card set included two pictures of using household bleach in large water storage containers promoted by some programs and organizations[1] with the purpose of directly destroying *A. aegypti* eggs deposited on the interior walls of the container, above the water line(s). One first picture illustrated mixing detergent and bleach and dabbing the mixture onto the wall surfaces, waiting 10 minutes, scrubbing the container with a brush and, finally rinsing off. The other picture illustrated dabbing bleach onto the container wall just above the water line, waiting 15 minutes and then covering the container. Neither picture was recognized by the participants as a specific way to directly destroy mosquito eggs, except for perhaps one participant. Participants interpreted the first picture as the correct steps to clean a pila well, using detergent and bleach diluted in water and a brush, and they interpreted the second picture as the steps to chlorinate water by adding a few drops of bleach directly into the water after cleaning the container, followed by covering. Since both of these actions had also been free-listed by the participants, we retained them in the card set for the ranking activities, and used them according to the participants' interpretation of the actions. Hence, in subsequent sections, the picture depicting the application of detergent and bleach in pila is referred to as "The steps of pila cleaning" and the picture depicting the application of bleach to a drum is referred to as "Chlorinate the water in the drum."

Perspectives on the relative effectiveness of Zika prevention recommendations

Table 3 presents the ranking data of the card-depicted prevention measures according to their relative effectiveness by participant group, as an average of 4 focus groups, 2 for each study site. The measures ranked as most effective have the lowest scores (since they were placed first in the rank order) and those ranked as least effective have the highest scores (since they were placed last in the rank order). We characterize the effectiveness of the measures as high (ranked from 1-6.33), in-between (ranked from 6.34-12.66), and low (ranked from 12.67-19). Some of the women's focus groups had difficulty in rank ordering some of the cards that they had previously separated out in three piles (high, low, and moderate). As a result a mean rank was calculated for those cards grouped together.

Measures perceived as highly effective

The pregnant women ranked the elimination/emptying of various containers from the yard, the elimination of any container-like objects from public spaces (deschatarrización), and outdoor sweeping, high in effectiveness (mean rank 3.42-5.04), along with some men partners of women currently pregnant and some women likely to become pregnant. The following quote summarizes the reasons why:

[1] A technique known as "La Untadita" is promoted in Honduras and as "Cloro Untado y Tanque Tapado" is promoted in the Dominican Republic

"Entonces, estas cuatro que tomamos en cuenta, para nosotros son casi lo mismo. ¿Por qué? Porque así pues prevenimos las enfermedades, ¿verdad? haciendo limpiezas y recolectando las basuras que están cerca, ¿verdad?…"

Focus Group, Women currently pregnant, lowlands site

The steps of pila cleaning ranked high in effectiveness by women likely to become pregnant (mean rank 6) and by men partners of women currently pregnant (mean rank 3.75). Participants in almost all focus groups identified the steps of pila cleaning, but without the dabbing of undiluted chlorine directly onto the walls as an ovicide, though mention of the use of bleach in the traditional way to disinfect water was common:

"Ya de último, primero cepillamos bien la pila con detergente y ya después la lavo, después echo cloro, después la vuelvo a lavar, después de eso limpio, ya lleno la pila y le echo cloro"

Focus Group, Women currently pregnant, highlands site

Three focus groups of women likely to become pregnant ranked condom use during pregnancy as higher in effectiveness (rank 2-5) than the other participant groups.

Measures perceived as least effective

In contrast, condom use to prevent sexual transmission of Zika during pregnancy, family planning to delay pregnancy during the epidemic, abstinence, and wearing long sleeves generally ranked low in effectiveness (e.g. mean rank 11.25-16 among pregnant women, 13.3-16.5 among men partners of pregnant women). This was true for condom use during pregnancy for 9 of the 12 focus groups. Many participants of both genders chuckled at the card depicting condom use during pregnancy, and although the task was to rank the measure for its effectiveness in Zika prevention, their ranking was inevitably also driven by other factors that may be barriers to using condoms, such as silent Zika infections, gender norms, identifying condoms as a birth control measure not applicable when one is already pregnant, considering pregnancy a special period during which women have less or no sex, or contraindication of having sex if a pregnancy were at risk of losing the baby. However, in several focus groups there were testimonies by individual participants on the importance of condom use during the Zika epidemic.

"Ella está embarazada y el único método de planificación familiar que lo protege a uno de cualquier enfermedad es el preservativo, ¿verdad?... Es el único, de ahí otro, no, ¿verdad?... Porque hay muchos [métodos más]."

Focus Group, Men with a pregnant partner, highlands site

The card depicting a male and a female condom (not in the context of pregnancy) was also ranked low for effectiveness by a majority of focus groups (mean rank for pregnant women 12.63, for men partners 14) including those which had given the male condom during pregnancy a higher rank, because the participants did not have much knowledge about the female condom.

The card depicting various family planning methods, not in the context of pregnancy, was ranked low in effectiveness and considered irrelevant for Zika prevention (mean rank 13.75 for pregnant women, 16.5 for men partners of pregnant women and 13.3 for women likely to become pregnant). However, two focus groups with women likely to become pregnant ranked it high, citing the effectiveness of the

methods to prevent pregnancy in general. A very small number of participants in these groups said that the methods were effective in helping to delay pregnancy during the Zika epidemic.

Abstinence was ranked low by the great majority of focus groups as difficult to practice (mean rank 15.5 for pregnant women, 16.3 for men partners of pregnant women and 13.3 for women likely to become pregnant):

"Participante 4: Para mí la abstinencia es lo último porque nadie te va a dejar de tener relaciones porque le digas que pueda contagiarse de Zika. Eso nunca va a pasar. Dile que mejor use un preservativo… Eso es bien complicado; es como a ese que está engordando y le dicen, no coma nada.
Participante 1: No lo puede dejar de hacer.
Participante 4: Esa sería como la última, la cero será la penúltima."

Focus Group, Men with a pregnant partner, lowlands site

Wearing long sleeves was ranked low in effectiveness (mean rank 16 by pregnant women, 13.3 by men partners of pregnant women), because one or two mosquitoes always managed to bite through, although it seemed to also be driven by its perception as an unfeasible practice, due to the prevailing hot climate. The women likely to become pregnant ranked it slightly higher (mean rank 12.75).

Lastly, outdoor fogging ranked last among pregnant women (mean rank 16), and varyingly high and low among men partners of pregnant women (mean rank 7.5) and women likely to become pregnant (mean rank 12.75), because although they considered the measure effective, they cited it rarely took place, while other participants discussed its only temporary effect in reducing the mosquito population.

Measures perceived as variable or moderately effective

Elimination of exposed tires ranked sometimes high and sometimes low, with a mean rank of 7.67 for pregnant women, 7.13 for men partners of pregnant women and 8.31 for women likely to become pregnant, though participants were aware that tires lead to mosquito infestation, describing the difficulty in eliminating them or desire for something to be done about them:

"Las llantas sería una buena iniciativa; sabemos que una llanta puede retener agua por dentro y sabemos que en aguas reposadas es donde se propaga este mosco."

Focus Group, Men with a pregnant partner, lowlands site

Emptying of buckets also ranked at times high and low, with a mean rank of 9.13 for pregnant women and men partners of pregnant women, and a mean rank of 7.44 for women likely to become pregnant. Some participants thought that emptying the water out of containers did not solve the problem because it only transferred standing water in containers to puddles on the ground.

Water chlorination in the drum followed by covering the drum was another moderately ranked measure among pregnant women (mean rank 8.25) and men partners of pregnant women (mean rank 9.75), and last among women likely to become pregnant (mean rank 14), except for one men's focus group which ranked this measure high (2.00). Here again the dabbing of undiluted chlorine directly onto the walls as an ovicide was not recognized, except by a single male participant who seemed to have heard about this somewhere in the past. A related card showing the covering of the water storage drums was similarly ranked (mean ranks 6.5, 9.13, and 11.88, respectively) because while useful as a measure it was not

considered consistently effective.

The use of temephos (Abate) as a larvicide, while recognized as effective by many participants its collective rank was moderate because of problems with access, ranking 10 among pregnant women, 7.5 among their male partners and 13.56 among women likely to become pregnant. Participants cited that temephos was rarely handed out or not at all by health centers. Furthermore, some participants identified it as a chemical dangerous to health and less preferable to other more "natural" measures like larvivorous fish.

Bed-net use for pregnant women was ranked moderately effective by focus groups with men and with pregnant women (mean rank 12.13 and 8.88, respectively), and higher by the focus groups with the women likely to become pregnant (mean rank 7.38). Individual participants, however, sometimes disagreed with their group's collective rank. Their opinions seemed to depend on whether they themselves already owned and used a bed-net, i.e. their experience of efficacy versus perception of efficacy for a measure that they had not yet experienced, and many of the focus groups had mixed bed-net experience. When participants assigned it low effectiveness it was because of the net's apparent inability to stop the mosquitoes:

"Participante 1: El pabellón no funciona porque igual se meten los zancudos
Participante 5: Pero sí para proteger; porque ella [la embarazada] podría poner [lo] allí…
Participante 4: Pero eso es como no hacer nada..."
Focus Group, Women currently pregnant, highlands site

Repellent use during pregnancy received a wide range of rankings (from 2.50 to 17) averaging to 10.63 among pregnant women, 13.63 among their male partners and 10.25 among women likely to become pregnant). Despite being recognized as effective in most discussions, participants who assigned it low effectiveness cited access problems, such as the cost, and not being practical having to reapply it in a constant manner.

Window screens also received a wide range of rankings (1-16) averaging to 9.88 among pregnant women, 11.63 among men partners of pregnant women and 6.63 among women likely to become pregnant). Like with bed nets, opinions seemed to depend on whether they themselves owned window screens, i.e. their empirical efficacy, and on whether they could afford the cost. Obstruction of airflow in a hot environment was also a problem.

Women participants in two focus groups seemed to think that the effectiveness of measures taken in the home (bed net, condom use during pregnancy) depended on whether any measures have been taken in the yard, which in turned depended on whether any measures were taken at the community level. If the health center had fogged outdoors, and the community members had cleaned up the environment from containers at risk for accumulating rainwater, then the elimination or emptying of containers in one's own yard would be more effective. And if the latter had happened, in turn use of bed net and condoms in the home, would be effective in reducing any residual risk. They, therefore, ordered the cards in that sequence.

"Si limpiamos adentro y no limpiamos afuera igual nos da porque entonces van a entrar los animalitos"
Focus Group, Women likely to become pregnant, lowlands site

Table 3. Effectiveness Ranking Summary Data – Mean rank by participant group				
Prevention method depicted on card	**Women currently pregnant**	**Men with a pregnant partner**	**Women likely to become pregnant**	**Overall mean rank**
Removing any container-like objects from public spaces	3.42	4.75	10.25	6.14
Eliminating/emptying containers in the yard	4.25	9.13	8.56	7.31
Outdoor sweeping	5.04	4	9.13	6.06
Eliminating exposed tires	7.67	7.13	8.31	7.70
The steps of water container (pila) cleaning	7.75	3.75	6	5.23
Chlorinate the water in the drum (and cover)	8.25	9.75	14	10.67
Bed net use during pregnancy	8.88	12.13	7.38	9.46
Covering water drums	9.13	6.5	11.88	9.17
Emptying buckets	9.13	9.13	7.44	8.56
Screens for windows and doors	9.88	11.63	6.63	9.38
Temephos application	10	7.5	13.56	10.35
Skin repellent use during pregnancy	10.63	13.63	10.25	11.50
Condom use during pregnancy	11.25	15.13	6.81	11.06
Technician spraying indoors	11.38	8.63	8.69	9.56
Condom use outside of pregnancy	12.63	14	8.5	11.71
Family planning methods	13.75	16.5	13.13	14.46
Abstinence	15.5	16.13	11.06	14.23
Outdoor fogging	16	7.5	12.75	12.08
Wearing long sleeves	16	13.13	12.75	13.96

Effectiveness ranking for each focus group and field site is presented in Annex 2.

Comparative self-efficacy norms to perform the Zika prevention recommendations

Table 4 presents the ranking data of the card-depicted prevention measures according to the participants' reporting on the norms in their community for relative self-efficacy to perform them, by participant group, as an average of 4 focus groups, 2 for each study site. Similar to the effectiveness ranking data, the measures ranked with the highest self-efficacy have the lowest scores and those ranked with the least self-efficacy have the highest scores. Some of the women's focus groups had difficulty in rank ordering some of the cards which they had previously separated out in high, low and moderate self-efficacy piles. As a result a mean rank was calculated for those cards grouped together.

Measures of high self-efficacy

The pregnant women ranked the community self-efficacy norms as high for outdoor sweeping (3.63) and eliminating any container-like objects from public spaces (deschatarrización) (4.63), as well as for the steps of pila cleaning (4.5). The card interpreted as water chlorination in the drum followed by covering it, and a related card showing the covering of water storage drums were also ranked with high self-efficacy by this participant group (5.38 and 6.25). High self-efficacy by the women likely to become pregnant had some similarities with that by the women currently pregnant, regarding outdoor sweeping (6.38) and the steps of pila cleaning which they ranked as highest at 2.00/19, although neither participant group recognized the specific technique of dabbing of bleach directly on the mosquito eggs. Importantly, participants pointed out that there was a right way and a wrong way to clean the pila and that not everyone did it correctly, however they expressed high self-efficacy to do it the correct way:

Participante 1: Aunque, [hay que] enseñarles bien cómo se hace la limpieza. Porque hay personas que sólo dejan ir el agua de la pila y piensan que ya la limpiaron, pero ahí [en la tarjeta de los 5 pasos] está ilustrado que hay que echar cloro, y raspar bien con el cepillo.
Moderador: ¿Eso se hace aquí?
Participante 1: Sí, al menos yo si lo hago.
Participante 2: En mi casa con nosotros, sí.
Participante 3: A diario.
[…]
Moderador: ¿Y ustedes, [participante 7] y [participante 8]?
Participante 7: También como la pila es pequeña, a diario.
Participante 8: A diario. "
Focus Group, Women likely to become pregnant, lowlands site

In addition, the non-pregnant women conveyed further high self-efficacy for the emptying of buckets (4.63) because they saw the positive aspects of this action and no negative consequences, such as creating other breeding sites on the ground that the pregnant women saw (8.75).

The women's focus groups further justified the community norm of high self-efficacy to perform these cleaning and eliminating measures because of their felt effectiveness and importance in eliminating the mosquitoes.

In contrast, the men with a pregnant partner conveyed a community norm of high self-efficacy in eliminating/emptying multiple containers in the yard (5.5) as opposed to from public spaces (deschatarrización) (14.13) because it was a measure under their control, whereas broader community collaboration was needed to perform this measure in public spaces. The men generally conveyed high self-efficacy for the steps of pila cleaning (6.13) and the covering of the water storage drums (6.5), in agreement with the majority of the women's focus groups. In contrast to the women's groups, the men in the highlands study site conveyed high self-efficacy for using a bed-net during pregnancy (3.5) whereas the men in the lowlands study site conveyed lower self-efficacy (9.75) due to the excessive heat prevalent in their geographic location. However in the discussion they pointed out how important the bed net was with so many mosquito borne diseases that they were trying to get their own children used to sleeping under a net from the start because it was much more difficult to get used to it as an adult.

Measures of low self-efficacy

Self-efficacy for outdoor fogging ranked mostly low (12.50-16.63) by all focus groups because implementation depended on the health centers and not on the community.

"Al final es más fácil abstenerse que obligar al Estado que te fumigue. A ese nivel de inoperantes están las instituciones del Estado."

Focus Group, Men with a pregnant partner, lowlands site

Self-efficacy for condom use for Zika prevention outside of pregnancy (the card with male and female condom) was ranked low by all women's focus groups (13th and below), as did for use during pregnancy by the women not currently pregnant (13.17). This was at least in part due to lack of familiarity with the female condom, but primarily because of the women's difficulty to negotiate condom use with a steady partner. Men stated additional factors such as cost, lack of access and embarrassment to purchase condoms.

Moderador: Respecto al preservativo, ¿por qué la gente no tiene la capacidad de utilizarlo?
Participante 1: Una, porque tiene un costo...
Participante 3: Y en las comunidades a veces dan charlas, pero si en la comunidad hay centro de salud, pero no hay para [condones]... no los regalan se podría decir, verdad... Y daría pena tal vez ir a pedirlos, ir a la farmacia...
Moderador: ¿Los hombres no van al centro de salud?
Participante 2: No... Yo vivo en una aldea y ahí no hay centro de salud ni nada, hay que venir hasta acá, pero... Eso de venir a pedir preservativos aquí... Todavía se da lo que es la vergüenza... ¿Qué dirán las demás personas? Entonces por miedo al qué van a decir, mejor no pido nada y por eso es que mejor se hace... sin el uso del preservativo
Moderador: ¿Las ideas que tiene alguna gente que no se siente igual?...
Participante 1: puede aplicar... porque... machismo, "ah no, yo no uso eso porque no se siente lo mismo"... machismo, entonces sí, puede aplicar esa idea
Participante 3: Igual, "es mi mujer y nadie más la toca, entonces para qué voy a usar eso si es mi mujer", entonces [no se usa]
Focus Group, Men with pregnant partners, lowlands site

Self-efficacy to practice abstinence for Zika prevention was ranked low by most focus groups (14 and lower). Women participants expressed doubts that they would be able to propose abstinence to their husbands. The men also discarded the measure. However, despite the low rankings some women may have a bit higher self-efficacy to enforce abstinence during pregnancy:

Moderador: ¿Se sienten más capaces de no tener relaciones, que hacer que el esposo use el condón durante el embarazo?
Participante 4: Tal vez sí… pero que el esposo se cuide, no creo yo
Participante 2: Es más fácil que acepten a [nuestro] decir no
Participante 6: Yo pienso que tal vez no sería lo más difícil de proponerse uno, de evitarlo… Porque tal vez se siente que como que no es lo más importante… que hay que cuidar su hijo… Eso pienso yo que tal vez no es difícil de evitarlo…
Focus Group, Women likely to become pregnant, lowlands site

Measures of moderate and variable self-efficacy

Self-efficacy for removal of exposed tires and elimination/emptying of containers in the yard was ranked moderately by all focus groups. The men's rankings of other mosquito source reduction actions, along with some of the women's showed many moderate values (5-10 range) perhaps revealing the men's secondary role in these actions, and the women's relative difficulty to complete them compared with the pila cleaning. This was especially the case if broader community cooperation was needed. Self-efficacy of treatment with temephos uniformly ranked moderately (7.88-15.13) because although it was easy to apply, use depended on its availability from the health centers. Indoor spraying ranked moderately (7.88-12.52) because it either depended on the health centers or a private initiative would imply cost.

With the exception of the men's groups in the highlands site, all other groups ranked self-efficacy for bed net use during pregnancy as moderate (8.00-9.75). Some expressed ability to use it because of their pregnancy; others did not feel capable of using it because of the heat. There was agreement that everyone used nets for babies and young children, but no agreement for adult use.

Self-efficacy for window screens ranked moderately by most groups (7.25-15.25) stating that many people in the community did not have them and that they were costly. One focus group by women likely to become pregnant was the exception and ranked it high (1.50) citing that it was a measure that several better off participants already had in their homes, and were more vocal than the others who were not in agreement.

Repellent use during pregnancy and as a means for general Zika prevention had moderate self-efficacy rankings (5.75-14.25) due to the need for frequent reapplication and because of the cost implied. Furthermore, because as a male participant explained, during pregnancy and after giving birth, the mothers of new mothers look after them, and will not let them use repellent, which they perceive as a dangerous chemical product not to be used when the pregnant woman/young mother and her new baby are most vulnerable.

"Entonces es un choque de cultura."
Focus Group, Men with a pregnant partner, highlands site

Self-efficacy for condom use for Zika prevention was ranked moderate (8.50 to 11) among women currently pregnant and men with a pregnant partner because it was seen as a compromise for the sake of pregnancy but not applicable for Zika prevention among the general application:

"Éste método... lo colocamos ahí [en el medio] por la capacidad que puede ser [tener contra el Zika], porque durante el embarazo se bajan las defensas de muchas formas; porque yo lo analicé ahorita que lo comentaron y lo voy a aplicar ahorita en el embarazo [uso de condón] pero a nivel poblacional, general, no lo estoy tratando yo, porque sólo es únicamente para embarazadas, no es para la población en general"
Focus Group, Men with a pregnant partner, highlands site

Some of the pregnant women participants felt higher self-efficacy to use a condom during pregnancy

because they expressed the needs to take their health in their own hands:

"Participante 3: La verdad es que como mujeres, verdad, tenemos capacidades más para pensar, digamos, que un hombre que… La verdad es que los hombres son muy…por decirle más machistas… [ríe], porque ellos piensan sólo en ellos y no en uno. Y uno, si no piensa en uno, ¿quién va a pensar por uno? Entonces, para uno es uno."

Focus Group, Women currently pregnant, lowlands site

Table 4. Self-Efficacy Ranking Summary Data – Mean rank by participant group

Prevention method depicted on card	Women currently pregnant	Men with a pregnant partner	Women likely to become pregnant	Overall mean rank
Removing any container like objects from public spaces	4.63	14.13	11.50	10.08
Eliminating/emptying containers in the yard	7.63	5.50	9.75	7.63
Outdoor sweeping	3.63	10.50	6.38	6.83
Eliminating exposed tires	10.63	11.38	8.00	10.00
The steps of water container (pila) cleaning	4.50	6.13	1.75	4.13
Chlorinate the water in the drum (and cover)	5.38	8.88	10.00	8.08
Bed net use during pregnancy	8.00	6.63	8.25	7.63
Covering water drums	6.25	6.50	6.56	6.44
Emptying buckets	8.75	7.88	4.38	7.00
Screens for windows and doors	15.13	10.88	5.06	10.35
Temephos application	8.00	7.88	9.63	8.50
Skin repellent use during pregnancy	8.00	13.75	7.75	9.83
Condom use during pregnancy	10.38	9.00	12.94	10.77
Technician spraying indoors	12.50	7.88	13.81	11.40
Condom use outside of pregnancy	13.00	10.38	14.69	12.69
Family planning methods	15.63	14.88	13.94	14.81
Abstinence	15.88	15.75	14.31	15.31
Outdoor fogging	16.63	12.50	14.44	14.52
Wearing long sleeves	15.50	9.63	12.13	12.42

Self-efficacy ranking by focus group and field site is presented in Annex 3.

Comparative feasibility insights on performing Zika prevention recommendations

Table 5 presents the ranking data of the card-depicted prevention measures according to their relative feasibility by target group, as an average of 4 focus groups, 2 for each study site. The measures ranked

as most feasible have the lowest scores and those ranked as least effective have the highest scores and used the same method as above to categorize the feasibility of measures: high (ranked from 1-6.33), moderate (ranked from 6.34-12.66), and low (ranked from 12.67-19).

Measures of high feasibility

Most focus groups generally ranked the elimination of water collecting containers from the yard (range: 2.50-9.00, mean 5.42), cleaning the laundry wash basin known as the pila (range: 1.00-14.00, mean 4.18), outdoor sweeping (range: 2.00-13.50, mean 6.46), and emptying buckets (range: 2.00-17.00, mean 6.87) as highly feasible activities.

Although ranked as a highly feasible behavior, there was little distinction between elimination of water collecting containers from the yard and general cleaning around the home. Furthermore, in order for both of these to be removed, there was a necessity for community organizing as well as reliance on local municipalities for the service without which households would throw their garbage away in unspecified locations.

Cleaning the pila ranked first in feasibility and many participants indicated that their community members took part in cleaning the pila and there was a strong desire to have "clean" water in the pila. Only one group of pregnant women gave the cleaning of the pila a low feasibility ranking.

"Yo creo que lavar la pila, quien no lo hace. Creo que sería hasta la primera [en factibilidad], lavan más la pila que tirar los recipientes, casi todo el mundo lava la pila. Lavar la pila, los recipientes."
"Yo pienso que la pila puede ir en segundo lugar porque todos pueden lavar una pila."
Focus Group, Men with a pregnant partner, Highland site

For some cleaning the pila was considered cost effective while it implied certain cost for others, having to buy soap and bleach. Participants indicated a multitude of methods for cleaning the pila most of which included bleach. However, bleach was not always recommended:

P1: "*Pero, depende de cómo llegue el agua porque si el agua llega clorada, es demasiado, afecta, cuando uno le echa, afecta más.*"
P5: "*Más que todo siempre lleva demasiado cloro por eso uno la tiene que guardar, bien tapadita, para que se deshaga el cloro para tomarla. Porque si no, muy feo el olor, muy feo, hasta para tomar*."
Focus Group, women currently pregnant, highlands site

In reference to who actually cleans the pila and with what frequency was varied between genders. Men thought the women should do it, once a week while female participants indicated that the frequency of cleaning the pila should be daily. The idea of maintaining one's home "clean" was a recurring theme, but the definition of clean in respects to Zika prevention lacked specificity. Nearly all groups indicated that outdoor sweeping, which did not depict the sweeping up or removing any containers, was highly feasible. In many instances outdoor sweeping embodied the perspective of maintaining a clean home. Two participants indicated in reference to the outdoor sweeping card:

"La limpieza. Es lo principal."
Focus Group, Women currently pregnant, lowlands site

Emptying buckets was consistently ranked as a highly feasible activity most likely due to its low level of

investment and because it was within the locus of control of the household. However, water scarcity was a barrier to emptying buckets. Many participants indicated that they must store their water and collect rainwater, due to the lack of infrastructure to deliver consistent water to their households for them and for their animals. Emptying the buckets was more palatable if it leveraged alternative uses of the household's stored water, such as outdoor washing/cleaning:

"Yo diría en este caso si se tira afuera, mejor aprovechar para lavar afuera"

Focus Group, Men with a pregnant partner, highlands site

Measures of low feasibility

Most focus groups generally ranked the use of family planning methods (range: 13.50-19.00, mean 16.2), abstinence from sexual relations (range: 8.00-19.00, mean 14.66), outdoor fumigation (range: 1.50-19.00, mean 12.83), and wearing long sleeves (range: 6.00-18.00, mean 12.75) as activities with low levels of feasibility. There was lack of consensus among participants on the feasibility of using family planning during a Zika outbreak. A majority of participants did not relate the use of family planning methods with Zika, while for a few this was feasible:

"…pero por ese sentido de poderse cuidar y poder tener un hijo… debe pensar en esos métodos primeramente, hasta que llegue el proceso de que ya no se escuche [de Zika] o que ya esté tranquilo, verdad, el ambiente para poder llevar un embarazo bien…"

Focus Group, Women currently pregnant, lowlands site

The feasibility of using family planning methods was also impacted by a lack of accessibility (not always available at the health centers), costs, and fear of the methods. Considerable debate occurred among pregnant women as to whether or not family planning methods such as injections or oral pills were effective, which may be a reflection of the varying levels of education and socio-economic status in each focus group. Gender roles may have a considerable impact on the feasibility of using family planning methods during a Zika outbreak. Participants indicated that many men did not permit their partners to use such methods, and some women who used them did so in secret. This may highlight that there is a lack of discussion and equity in decision-making among couples with respects to family planning in general.

Abstinence was ranked low in terms of feasibility across a majority of groups despite it being recognized as an effective method for preventing sexual transmission of Zika. The low feasibility may be attributed to the gender roles and power dynamics of partners in Guatemala. Participants indicated that men had a larger role in determining when sexual intercourse would occur, which limits the locus of control of female participants using abstinence as a preventative behavior. Some participants indicated that they had not had a dialogue with their partner about this method. This reinforces a possible disconnect between partners in discussing themes such as sexual and reproductive health.

Outdoor fogging was consistently ranked with low feasibility, with the exception of two focus groups (men with pregnant partners and women with a high probability of becoming pregnant) in the highlands. For the majority of groups, outdoor fogging was considered to be outside of their locus of control as it is an activity that is typically implemented by the government and the ministry of health. However, many participants expressed doubt about the frequency of fumigation and their power to request the government to fumigate sufficiently.

Wearing long sleeves as a Zika prevention method was also principally ranked with low feasibility, but some groups ranked it in the middle and one group (men in the lowlands) ranked it as highly feasible. Factors influencing the feasibility of this behavior across groups included the comfort barrier of wearing long sleeves in hot weather, the lower cost of wearing long sleeves when compared with other methods, and the perception of its effectiveness. Many participants indicated if they used long sleeves, more often than not, it was at nighttime.

Moderate or variable measures of feasibility

There were a variety of prevention behaviors that possessed a great frequency of rankings between high and low feasibility. These behaviors included, covering water storage barrels (range: 2.00-13.50, mean 7), identifying and removing tires (range: 1.00-14.00, mean 7.75), eliminating junk and garbage from public spaces (range: 1.00-16.00, mean 7.87), using a mosquito net (range: 1.00-14.00, mean 8), water chlorination in the drum following by covering (range: 3.50-17.50, mean 9.79), temephos use (range: 3.00-17.00, mean 10.62), condom use during pregnancy (range: 3.00-17.00, mean 10.66), indoor residual spraying (range: 1.50-16:00, mean 11), use of mosquito repellent (range: 1.50-19.00, mean 11.58), placing screens in one's windows (range: 2:00-18:00, mean 12.54) and the use of condoms in general to prevent sexual transmission (range: 2.00-18.00, mean 12.54).

Covering water storage barrels was ranked high among six focus groups as it was perceived effective in preventing objects and mosquitos from entering the water, but lower among others. Factors affecting the feasibility of implementing this activity included access to a proper cover, lack of clarity defining a proper cover, and the desire to maintain the water in the storage container clean. Due to the lack of covers or funds to cover all water storage barrels, households may be opting to cover the water that must remain clean as opposed to water used in activities in which clean water is not necessary.

Identifying and removing tires was also ranked as a highly feasible activity by six focus groups, while three focus group ranked it with a lower feasibility compared to other methods. There was debate over what activity the image of the tires was related to. Many participants associated the tires with their elimination or the removal of water that remains trapped in the tire. There were a multitude of methods for removing tires based on individual actions and those of the local government. Individually, burning tires was mentioned as a method for their removal, but the hazards and adverse smell associated with burning were barriers to its implementation. Tire removal most commonly relied on the local government's waste services. This dependence reduced the feasibility of this preventive behavior. Other participants indicated that some households don't take care of their tires. Furthermore, each town has locations known as "Pinchazos" or tire repair shops, which possess a large quantity of tires and take part in little to no action to properly store them. This may cause a fatigue on behalf of households to consider the behavior feasible because they have little to no control over the large quantity of tires stored at these shops, which tend to be prevalent in the towns.

The elimination of container-like objects from public spaces was ranked as a highly feasible activity in five groups, while 3 focus groups ranked the activity with low feasibility. Pregnant women and women with a high probability of becoming pregnant in highlands consistently ranked it as feasible. Whereas pregnant women and women with a high probability of becoming pregnant in the lowlands comparatively ranked this behavior as less feasible. Most men ranked this activity less feasible also. However, one group of men ranked it as highly feasible provided that a community leader could motivate others to take action. While home households were reported to burn their trash, many

indicated a reliance on the local municipality to coordinate waste pickup. It is evident that the feasibility of collective community cleanup is dependent upon local leadership and delicate management and coordination. However, one group of men indicated that one day of clean up per week in the community would be possible.

The use of a mosquito net during pregnancy was ranked highly feasible relative to other measures in only four focus groups (three of which were located in the highlands). Factors affecting its feasibility were related to cost, who the nets are expected to be used by, the lack of confidence that the net will keep out mosquitoes, and the expected time to be used. Responses may indicate that individuals in the lowlands may find it less feasible to use the mosquito net because it is too hot. There was general agreement that mosquito nets are to be used primarily by children, though pregnant women and the elderly also qualified as vulnerable groups. Furthermore, the mosquito net was typically used at night-time, possibly because it was cooler than during the day, highlighting its limitations vis-à-vis the behavior of the mosquito that transmits Zika as it primarily feeds during the day.

As mentioned above, applying bleach to the sides of water containers was unknown to many of the groups. Participants associated the application of bleach with pouring a few drops in the water, with the idea of maintaining clean drinking water. As a water chlorination method, five groups ranked this method as highly feasible, while 4 groups ranked it low. Feasibility was affected by custom, effort to apply it to all the water not just the drinking water, and the cost of bleach.

The feasibility of temephos use was ranked with a low feasibility in five focus groups, but with high feasibility in four focus groups. All latter groups were located in the highlands, while the former in the lowlands. This could have been due to differential access between the highlands and lowlands as it cannot be purchased locally. Thus the locus of control for the product used was outside of the sphere of control of household members. However, some participants indicated they received a non-specific amount of temephos to apply it themselves. Participants reported a wide range of periods of application including weekly, monthly or every three months.

Condom use during pregnancy was ranked as a low feasibility for five focus groups, but was ranked with high feasibility by two groups in the highlands (pregnant women and men). Pregnant women in the highlands ranked this preventative behavior more feasible in comparison to all other highland and lowland groups, with exception of one highland group of men. Factors influencing the feasibility of condom use during pregnancy include cultural and social expectations, gender and partner power dynamics as well as access and cost of condoms. Condoms were viewed for use for partners outside a stable relationship such as with a mistress or sex worker or for individuals who do not have a stable partner. The concept of stable partners using condoms invoked many themes of infidelity and trust. Female partners may have considerable fear that requesting to use condoms may drive their partner to search for another partner as he may expect to have unprotected intercourse with his stable partner. For this reason, the image of a couple with a pregnant woman about to use a condom sparked considerable discussion, especially among male participants.

"…cuando ya la mujer está embarazada pues obviamente no se tendría que estar usando el preservativo porque obviamente ya está embarazada…"

Focus Group, Men with a pregnant partner, highlands site

"Podría decirte yo, si tienen relaciones, por ejemplo, los jóvenes con una adolescente, te vas a cuidar pensando, en el VIH, en una ETS, enfermedad de transmisión, no, en la mente de los muchachos no está, me voy a cuidar por el zika."

Focus Group, Men with a pregnant partner, lowlands site

Furthermore, the use of condoms in stable couples was viewed to be used principally for family planning rather than prevention of diseases. Most participants indicated they had heard some information related to sexual transmission of Zika but indicated that they had never taken sexual transmission of Zika or use of condoms during pregnancy into account. Some indicated condoms should be used when their partner is symptomatic, while others understood that many individuals are asymptomatic. This lack of clarity about the proper time to use condoms and sexual transmission in general may have lead individuals to rank this preventative behavior less feasible. Despite misunderstanding with respects to sexual transmission of Zika, most participants of both genders expressed a clear desire to protect their unborn or future children. This desire to protect their children may be leveraged to increase the feasibility of using condoms during pregnancy. It appears that this would require breaking certain taboos between partners with respects to sexuality, gender norms and power dynamics.

"…sería muy bueno la utilización de usar preservativo durante el embarazo…"
Focus Group, Men with a pregnant partner, highlands site

"Lo que a mí me enferma, le puede enfermar a ella y por ende, a la criatura."
Focus Group, Men with a pregnant partner, highlands site

"…sí corre riesgo el bebé también por la enfermedad del zika. Ahorita no lo hemos usado, pero sí le voy a empezar a decir que lo usemos…"
Focus Group, Women likely to become pregnant, lowlands site

Moderator: *"Que sería la mejor manera de…motivarlos [hombres] a usarlos preservativos?"*
P1: *"Primero romper tabúes, hablar con los hombres de sexualidad y de manera espontánea y abierta...mantener preservativos para que el hombre se acerque sin ninguna pena al centro de salud de su comunidad"*
Focus Group, Men with a pregnant partner, lowlands site

Access and cost of condoms to be used during pregnancy also may have lowered the perceived feasibility of this preventative behavior. Condoms were reported to be both economic and costly, which will largely depend on the socio-economic status of the participant as well as their ability to reach a health center or pharmacy. Condoms appeared to be accessible for free in most health clinics, but men typically did not attend the health clinics. This may leave the responsibility to obtain condoms to the female partner who regularly attends local health clinics. This may be in a juxtaposing with cultural gender roles as indicated earlier.

"…uno a veces no va por el tiempo, porque obviamente ellos tienen un horario… no puede ir uno a decirles, miren regálenme mi bolsada de preservativos"
Focus Group, Men with a pregnant partner, highlands site

The feasibility of indoor spraying was ranked considerably low by 7 focus groups. Only two focus groups (men and women with probability of becoming pregnant) in the highlands ranked this behavior as highly

feasible. Majority of groups considered this prevention behavior less feasible because it relied on special chemicals. The cost, access, the knowledge of proper use and possible environmental damage caused by spraying affected its feasibility rankings. Furthermore, when conducted, spraying was implemented by the local health center or government, which remained outside of the locus of control of households. There existed private entities that provided such fumigation services, but these were costly. Many times this support from local entities was considered unreliable.

"…Sí pasan en las casas, pero de ahí no vuelven a pasar…"
Focus Group, Women currently pregnant, lowlands site

"…eso no lo podemos hacer nosotros…ellos [health center] tienen los instrumentos…"
Focus Group, Men with a pregnant partner, highlands site

"…considero de eliminar lo de la fumigación porque ahí matamos uno, pero contaminamos el medio ambiente…"
Focus Group, Men with a pregnant partner, lowlands site

Placing screens on a household's windows and doors was ranked consistently as a mid to low feasibility activity. Only one group of men from the highlands ranked it high. The factors affecting the feasibility of this behavior included, principally the large cost associated with installing such screens and the lack of adaptability of screen with metal roof tops. Participants indicated the screens were not visually pleasing and typically there was a gap between the roof and the wall where mosquitos could enter even if windows and doors were covered.

The use of both male and female condoms was typically associated more with the methods of family planning, and was ranked with mid to low feasibility by all focus groups except highlands men. Moreover, the feasibility of using female condoms was considered lower than male condoms due to lack of access to these condoms, lack of knowledge of correct use and gender dynamics between sexual partners. Negotiation of condom use was a difficult topic for both sexes as was mentioned above, because it invoked the concept of infidelity among stable partners rather than viewed as simply a preventive measure for Zika and to protect an unborn child.

"…a veces sí, quiere más ponerse de acuerdo con su pareja, y como se puede dar uno cuenta, que hay esposos que no les gusta protegerse y cuesta trabajo convencerlos que lo hagan y sí cuesta más, porque no están muy de acuerdo con que uno se proteja o ellos protegerse"
Focus Group, Women likely to become pregnant, highlands site

Table 5. Feasibility Ranking Summary Data – Mean rank by participant group

Prevention method depicted on card	Women currently pregnant	Men with a pregnant partner	Women likely to become pregnant	Overall mean rank
Removing any container-like objects from public spaces	5.88	9.38	8.38	7.88
Eliminating/emptying containers in the yard	5.88	5.75	4.63	5.42
Outdoor sweeping	6.13	9.13	4.13	6.46

Eliminating exposed tires	10.75	4.75	7.75	7.75
The steps of water container (pila) cleaning	5.13	4.13	3.38	4.21
Chlorinate the water in the drum (and cover)	8.63	10.63	10.13	9.79
Bed net use during pregnancy	7.25	5.75	11.00	8.00
Covering water drums	6.50	7.13	7.38	7.00
Emptying buckets	9.38	7.25	4.00	6.88
Screens for windows and doors	14.00	10.63	13.00	12.54
Temephos application	12.25	11.25	8.38	10.63
Skin repellent use during pregnancy	8.13	14.25	12.38	11.58
Condom use during pregnancy	8.50	11.50	12.00	10.67
Technician spraying indoors	9.88	9.63	11.38	10.29
Condom use outside of pregnancy	13.25	10.25	14.13	12.54
Family planning methods	14.88	17.13	16.63	16.21
Abstinence	12.25	16.50	15.25	14.67
Outdoor fogging	13.63	13.88	11.00	12.83
Wearing long sleeves	15.63	11.13	11.50	12.75

Feasibility ranking by focus group and study site is presented in Annex 4.

Discussion

The study generated in-depth insights as to which Zika prevention measures were more salient to the community versus those which were considered more effective. Furthermore, the study explored the relationship between perceived effectiveness (response efficacy), self-efficacy and feasibility of commonly promoted Zika prevention measures.

Though the sample size achieved was slightly lower than the minimum intended (70 vs. 72) we feel that we achieved data saturation, because no new information was revealed in the free listing and focus groups towards the end of the data collection.

There was a good degree of agreement between the salience of the freely elicited actions and recommended Zika prevention behaviors (20 recommended out of 32 free-listed). Among them was condom use during pregnancy, indicating that this new Zika-specific recommendation was coming across to the participant groups. However, 20 mutually valued actions are still a large number of actions for the study's target groups to consistently perform for a single public health problem, no matter how important it may be to them, and likewise for a program to promote successfully. This represents an inherent difficulty for the community's response to Zika, dengue and chikungunya, given that the actions to avoid mosquito bites and to eliminate mosquito larvae and eggs are shared for these diseases, and the community needs consistent guidance and encouragement from highly trained community outreach staff in order to achieve high adherence.

The remaining 12 actions that were of high salience for the participants are not considered effective Zika prevention behaviors, yet these actions represent a great deal of effort and expense on the part of the

community to keep implementing them. Some of these may have high empirical efficacy against nuisance and night-time mosquitoes felt more in the community, but ineffective for *A. aegypti*. Hence the challenge remains on how to focus programmatic efforts exclusively on *A. aegypti* when people are bothered by many other non-vector mosquitoes at the same time. Lastly, there were many other actions of comparatively low salience (full data shown in Annex 1), yet revealing that many people conflate the role of mosquitoes with the role that flies and other pests play in disease contagion (e.g. cleaning the kitchen utensils, plates and cutlery, or keeping the bathrooms clean, expressing that the mosquito "can put its virus there").

The salience of using a mosquito net was high, mainly as an action to protect vulnerable babies and young children rather than adults, or due to exposure to recent health communication at the health center/partner clinic. In contrast, mosquito net use during pregnancy was not ranked as high for effectiveness nor for self-efficacy in the card rank ordering tasks, unless the participants already owned one and used it, because adults needed to be accustomed to a mosquito net since childhood in order to tolerate it in a hot climate.

The elimination of containers exposed to rain was much more salient (4th) than cleaning the larger water storage containers deliberately filled with water most of the time (9th), indicating that the latter may not be perceived as productive of mosquitoes as the former. However, cleaning of large water storage containers was ranked as more effective than elimination of containers exposed to rain. The fact that general unspecified house cleaning was so salient may reflect at least in part, its frequent mention by programs when they fail to clearly specify the type of cleaning to practice, i.e. the elimination of containers where water has inadvertently accumulated, and the specific ovicidal cleaning of deliberate water storage containers. The fact that no one mentioned the ovicidal technique depicted in two cards by its name ("Untadita"), nor described the dabbing of bleach directly on the *A. aegypti* eggs (except a single participant) indicates that people were neither aware of this important method nor knowledgeable of where the *A. aegypti* eggs are found. In addition, the method of cleaning large water containers described by participants, was directed at the cleaning of green residue of the pila or drum, which tends to be at the bottom of the container, thus leaving mosquito eggs undisturbed on the upper parts of the container's interior walls (Sherman, 1998). Furthermore, there seemed to be a conflation of recommendations from diarrheal disease control programs, which promote the addition of a few drops of bleach to protect the stored water from diarrhea causing bacteria. *A. aegypti* larvae are much larger than any bacterium and are not killed by such small quantities of bleach (Sherman 1998), yet water chlorination was consistently the last step described of an effective pila cleaning for Zika prevention.

Whether a method was considered effective was often colored by feasibility. Participants could not bring themselves to rank a measure high, even when they said it was effective, if they were not able to practice it. Even though so many methods had high salience, few of them ranked high for effectiveness, meaning that community members know all the important methods of Zika prevention yet they do not see them as effective in reducing their risk.

Self-efficacy was a difficult concept for participants to distinguish from effectiveness and feasibility. If a measure was effective and feasible there was no trouble in developing high self-efficacy to perform it. The difference between effectiveness and self-efficacy was most evident when discussing condom use for Zika prevention during and outside of pregnancy.

Repellent use was the third most salient measure especially in the lowlands site, yet it did not rank high for self-efficacy due to the cost implied and need for frequent re-application. The focus group discussions established factors such as gender and relationship norms that may cause women with a steady partner to feel less self-efficacy in using condoms before or during pregnancy. However, pregnant women and some men partners of pregnant women did recognize that preventing transmission of the Zika virus to an unborn child might be an acceptable reason to use condoms with their partners during pregnancy.

Recommendations

While there is a need to reduce the number of preventive behaviors to promote, this is challenging to do for a vector that breeds in such a variety of habitats and is a day-biter. One recommendation for reduction is to bring greater precision to the recommended behaviors. The examples below are based on the findings of this study. Additional qualitative formative research can further help social and behavior change programs fine-tune and focus promoted behaviors based on what communities express that most clarification and specificity is required.

- Abandon the term “to eliminate standing water” from program recommendations. Standing water also means puddles, open sewage, flooded fields and other habitats not attractive to *A. aegypti*. Instead, specify that the type of standing water to be eliminated is that found in useful containers when they are not in use.
- Abandon the term “cleaning” from program recommendations. Specify the targeted steps and actions instead.
- Ordinary scrubbing with a brush during the typical cleaning process dislodges the eggs but does not kill them (Sherman 1998). Clarify and demonstrate the use of detergent and household bleach, or bleach alone, as an ovicide against *A. aegypti* eggs (Sherman 1998; Fernandez 1998). Demonstrate where the eggs are and what they look like. Demonstrate the difference between dabbing and wiping, and point out the need to wait to give bleach a chance to act (Albaine 2002; Leontsini 2004).
- Distinguish between mosquito types and for which mosquitoes, high salience actions such as burning coils, incense, smoke, or puddle elimination, are effective.
- Clarify that rain water as well as tap water can become infested with larvae because *A. aegypti* lay eggs equally well in a container in which rain water has accumulated and in one where tap water is stored (“agua del cielo” vs. “agua de la llave”).
- In this context, “repellent” has two meanings: skin repellent and space repellent. Recommendations should therefore be clear on which type of repellent to use.
- Similarly, “vaccines” have two meanings, referring to traditional vaccines, but also to injections of any type. Health communicators should therefore be alerted on how to use the term “vaccine” and trained to recognize its meaning when used by their constituents, so as to minimize the community’s impressions that a vaccine for Zika exists.
- Where possible, increase the effectiveness and feasibility of recommended methods, by improving the enabling technology, such as designing a mosquito proof water storage container, a mosquito proof lid, window screens compatible with the house construction and adapting mosquito nets and materials for day-time use especially for pregnant women.
- Increase self-efficacy for condom use among young adults who are not planning a family.

- Increase self-efficacy for condom use at the suspicion of pregnancy and during pregnancy, capitalizing on the concern of the fathers-to-be for their coming baby. Encourage couple communication on this topic at the first suspicion of pregnancy.
- To influence pregnant women, it is essential to also target their mothers and mothers-in-law, since they play an important role caring for their pregnant daughters and generally make decisions about how to best protect them from mosquitoes or other adversities during that period.
- Engage community leaders and organizations to take an active role in *A. aegypti* control and be vocal about their collective efforts to reduce breeding sites in communal areas, to stimulate community members to do the same in and around their homes.

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Annexes

1. Cultural Salience for all 88 elicited Zika prevention actions, and by participant group and field site.

2. Effectiveness rankings by focus group, participant group and field site.

3. Self-Efficacy rankings by focus group, participant group and field site.

4. Feasibility rankings by focus group, participant group and field site.

5. Image names in English and Spanish.

ANNEX: Supplementary Tables

Annex 1: Cultural Salience for all 88 elicited Zika prevention actions, and by participant group and field site.

Actions mentioned by 68 participants		Overall Mean Salience	Lowlands			Highlands			Number of participants mentioning the action
			Men with a pregnant partner	Women currently pregnant	Women likely to become pregnant	Men with a pregnant partner	Women currently pregnant	Women likely to become pregnant	
1	Use a mosquito net	0.40	0.40	0.60	0.55	0.38	0.42	0.12	45
2	Eliminate/throw away containers exposed to the rain	0.31	0.47	0.18	0.34	0.36	0.31	0.25	26
3	Use skin repellent	0.24	0.49	0.08	0.40	0.21	0.13	0.19	34
4	Clean the house and all around it	0.21	0.18	0.28	0.17	0.23	0.10	0.26	22
5	Use a condom to prevent sexual transmission	0.19	0.40	0.23	0.13	0.08	0.38	0.08	32
6	Burn or take garbage to its place	0.14	0.11	0.05	0.12	0.20	0.04	0.25	14
7	Fumigate outside the homes or in the community	0.14	0.32	0.03	0.03	0.11	0.04	0.28	18
8	Burn mosquito coils at night	0.13	0.10	0.09	0.01	0.23	0.19	0.16	17
9	Wash pilas well	0.12	0.10	0.17	0.18	0.07	0.00	0.18	13

10	Treat pilas with Abate	0.09	0.15	0.05	0.01	0.04	0.03	0.22	13
11	Empty the water from the containers you want to keep	0.09	0.00	0.23	0.05	0.03	0.09	0.11	8
12	Remove/sell bottles exposed to the rain	0.08	0.21	0.00	0.06	0.00	0.08	0.17	7
13	Use clothing that covers the whole body	0.08	0.08	0.06	0.09	0.19	0.11	0.00	11
14	Eliminate tires exposed to the rain	0.08	0.00	0.07	0.07	0.15	0.00	0.15	9
15	Make smoke / burn incense to shoo off the mosquitoes	0.07	0.05	0.05	0.09	0.21	0.00	0.03	10
16	Abstain from sexual contact during pregnancy/when you have Zika	0.07	0.16	0.09	0.10	0.10	0.00	0.00	10
17	Fumigate the house	0.07	0.03	0.02	0.23	0.03	0.09	0.00	12
18	Wash the tires	0.06	0.00	0.00	0.06	0.11	0.00	0.13	5
19	Use plug-in tablets	0.06	0.00	0.00	0.00	0.15	0.06	0.12	6
20	Cover drums	0.06	0.00	0.00	0.00	0.09	0.08	0.14	6
21	Do not retain standing water (dirty or clean)	0.06	0.00	0.00	0.00	0.08	0.00	0.18	5
22	Keep containers clean	0.05	0.00	0.00	0.07	0.06	0.10	0.08	5
23	Pour chlorine drops in pilas and drums	0.05	0.11	0.00	0.08	0.00	0.00	0.08	5
24	Install screens on doors and windows	0.05	0.09	0.00	0.11	0.08	0.00	0.00	4
25	Wash drums well	0.04	0.00	0.03	0.00	0.06	0.05	0.10	5
26	Cover water storage containers	0.04	0.00	0.00	0.00	0.00	0.12	0.11	5
27	Overturn bottles exposed to the rain	0.04	0.00	0.14	0.00	0.06	0.00	0.05	4

28	Cut the brush around the house	0.04	0.00	0.00	0.05	0.05	0.00	0.09	4
29	Eliminate puddles around the house	0.04	0.11	0.07	0.08	0.00	0.00	0.00	4
30	Clean/drain the humidity or mud around the house	0.04	0.00	0.00	0.04	0.06	0.00	0.09	4
31	Inject/vaccinate for the strong pains of chikungunya/ dengue/Zika	0.04	0.01	0.07	0.08	0.02	0.03	0.01	6
32	Spray insecticide aerosols indoors	0.03	0.00	0.07	0.02	0.06	0.02	0.03	7
33	Store your containers safely	0.03	0.08	0.00	0.05	0.00	0.00	0.06	3
34	Keep good general hygiene to avoid diseases	0.03	0.13	0.00	0.00	0.02	0.10	0.00	3
35	Keep good food hygiene	0.03	0.06	0.08	0.00	0.00	0.00	0.06	3
36	Empty / do not keep water in drums and tanks	0.03	0.00	0.10	0.08	0.00	0.00	0.00	2
37	Place containers upside down	0.03	0.00	0.00	0.06	0.10	0.00	0.00	3
38	Take acetaminophen (for the fever, pains)	0.03	0.00	0.10	0.01	0.06	0.00	0.00	4
39	Fill in tires with soil	0.02	0.00	0.00	0.00	0.06	0.00	0.07	2
40	Eliminate plastic bags	0.02	0.00	0.00	0.03	0.06	0.06	0.00	3
41	Remove/bury food left overs	0.02	0.00	0.00	0.00	0.03	0.00	0.09	3

42	Vaccinate yourself against Zika, tetanus, flu and other diseases during pregnancy	0.02	0.00	0.00	0.00	0.06	0.08	0.00	2
43	Do not have flower pots out in the open	0.02	0.11	0.00	0.05	0.00	0.00	0.00	2
44	Keep clothing and towels clean	0.02	0.00	0.00	0.00	0.00	0.00	0.10	2
45	Eradicate the mosquito	0.02	0.18	0.00	0.00	0.00	0.00	0.00	2
46	Chlorinate, boil or purify drinking water	0.02	0.00	0.08	0.01	0.00	0.00	0.03	4
47	Cover buckets holding water	0.02	0.13	0.00	0.00	0.04	0.00	0.00	2
48	Eliminate buckets	0.02	0.00	0.00	0.00	0.08	0.00	0.03	2
49	Wash well/keep good hygiene of dishes	0.02	0.11	0.00	0.00	0.04	0.00	0.00	2
50	Keep baby and children areas clean	0.02	0.00	0.00	0.00	0.00	0.00	0.09	2
51	Cover drains	0.02	0.00	0.00	0.08	0.00	0.00	0.01	2
52	Go to the health center if you have symptoms	0.02	0.00	0.01	0.00	0.08	0.01	0.00	4
53	Use agrochemical/ veterinary insecticides	0.02	0.00	0.00	0.00	0.04	0.00	0.05	3
54	Keep trash cans covered/closed	0.02	0.00	0.09	0.00	0.00	0.00	0.02	2
55	Keep children away from puddles, sewage, mud	0.02	0.00	0.00	0.00	0.00	0.06	0.03	2
56	Keep out of humid places / grass	0.01	0.00	0.00	0.08	0.00	0.00	0.00	1
57	Clean out drains	0.01	0.00	0.00	0.00	0.00	0.09	0.01	2
58	Prevent pregnancy during the epidemic	0.01	0.00	0.02	0.05	0.01	0.00	0.00	4

59	Fill in flowerpots with soil	0.01	0.00	0.00	0.00	0.00	0.00	0.06	1
60	Wash plastic bags	0.01	0.00	0.00	0.00	0.07	0.00	0.00	1
61	Clean the bathrooms	0.01	0.00	0.03	0.00	0.00	0.00	0.03	2
62	Keep the streets clean	0.01	0.00	0.08	0.00	0.00	0.00	0.00	1
63	Use oils/pomades on the skin to prevent mosquito bites	0.01	0.00	0.00	0.00	0.03	0.00	0.03	2
64	Eliminate out of use tanks/drums/barrels	0.01	0.09	0.00	0.00	0.00	0.00	0.00	1
65	Sleep with clothing or sheets covering the whole body	0.01	0.05	0.00	0.00	0.03	0.00	0.00	2
66	Install sewage pipes to avoid water pouring in the open	0.01	0.00	0.00	0.00	0.00	0.07	0.00	1
67	Pour motor oil in sewage wells	0.01	0.00	0.00	0.00	0.00	0.07	0.00	1
68	Keep your water containers clean	0.01	0.00	0.01	0.00	0.00	0.06	0.00	2
69	Keep good personal hygiene	0.01	0.00	0.00	0.00	0.00	0.00	0.04	2
70	Close the windows when it's becoming night	0.01	0.06	0.00	0.00	0.01	0.00	0.00	2
71	Spray gardens/animal pens with aerosol insecticides	0.01	0.00	0.05	0.01	0.00	0.00	0.00	2
72	Cover pilas	0.01	0.00	0.00	0.00	0.05	0.00	0.00	1
73	Burn discardable containers	0.01	0.00	0.00	0.05	0.00	0.00	0.00	1
74	Channel sewage to a mosquito protected place	0.01	0.00	0.00	0.00	0.05	0.00	0.00	1

75	Use cream on the mosquito bite to eliminate the virus	0.01	0.00	0.06	0.00	0.00	0.00	0.00	1
76	Teach our children good personal hygiene	0.01	0.07	0.00	0.00	0.00	0.00	0.00	1
77	Educate and share information	0.01	0.00	0.00	0.02	0.00	0.00	0.02	2
78	Sleep with a fan	0.01	0.06	0.00	0.00	0.00	0.00	0.00	1
79	Kill the mosquitoes (with your hand)	0.01	0.00	0.00	0.00	0.00	0.05	0.00	1
80	Use a plug-in racquet	0.01	0.00	0.00	0.00	0.00	0.00	0.03	1
81	Wash bottles	0.01	0.00	0.00	0.00	0.03	0.00	0.00	1
82	Disinfect mosquito bite with alcohol	0.01	0.00	0.00	0.03	0.00	0.00	0.00	1
83	Stop midday naps and keep yourself moving to prevent the mosquitoes from biting you	0.01	0.00	0.00	0.03	0.00	0.00	0.00	1
84	Bathe 3x/day to keep healthy (and from the heat)	0.00	0.00	0.03	0.00	0.00	0.00	0.00	1
85	Do not come close to people with Zika	0.00	0.00	0.00	0.00	0.03	0.00	0.00	1
86	Use the female condom	0.00	0.04	0.00	0.00	0.00	0.00	0.00	1
87	Go to the doctor more frequently	0.00	0.00	0.00	0.00	0.01	0.00	0.00	1
88	Lower a curtain over the house entrance to block mosquito entry	0.00	0.00	0.00	0.00	0.01	0.00	0.00	1

Annex 2: Effectiveness rankings by focus group, participant group and field site.

Prevention Method depicted on card	Pregnant Women				Men with a pregnant partner				Women with probability of becoming pregnant				Overall Mean Rank
	Highlands		Lowlands		Highlands		Lowlands		Highlands		Lowlands		
	G3	G4	G7	G8	G5	G6	G9	G12	G1	G2	G10	G11	
Removing any container like objects from public spaces	1.00	2.50	4.50	5.67	10.00	6.00	2.00	1.00	12.75	9.25	10.00	9.00	6.14
Eliminating containers in the yard	2.00	2.50	4.50	8.00	7.00	10.00	17.50	2.00	12.25	8.50	10.00	3.50	7.31
Outdoor sweeping	7.50	2.50	4.50	5.67	6.00	5.00	2.00	3.00	13.25	9.75	10.00	3.50	6.06
Eliminating exposed tires	4.00	16.50	4.50	5.67	9.00	11.00	4.50	4.00	11.25	8.50	10.00	3.50	7.70
The steps of pila cleaning	7.50	2.50	10.00	11.00	1.00	1.00	6.50	6.50	0.00	7.25	6.00	3.50	5.23
Chlorinate the water in the drum and cover it	9.00	5.50	7.50	11.00	11.00	2.00	17.50	8.50	15.00	14.50	10.00	16.50	10.67
Mosquito net	10.00	10.00	13.00	2.50	16.00	13.00	8.50	11.00	5.25	9.25	2.00	13.00	9.46
Covering water drums	6.00	5.50	7.50	17.50	8.00	3.00	6.50	8.50	16.75	8.25	6.00	16.50	9.17
Emptying buckets	3.00	7.50	18.00	8.00	5.00	9.00	17.50	5.00	12.50	7.75	6.00	3.50	8.56
Screens for windows and doors	13.00	11.00	14.50	1.00	16.00	12.00	8.50	10.00	7.75	8.75	1.00	9.00	9.38
Temephos application	5.00	9.00	18.00	8.00	2.00	4.00	17.50	6.50	14.50	10.25	13.00	16.50	10.35

Skin repellent use during pregnancy	17.00	12.00	11.00	2.50	16.00	15.00	10.50	13.00	5.75	10.25	16.00	9.00	11.50
Condom use during pregnancy	16.00	13.00	1.50	14.50	16.00	16.00	12.50	16.00	3.50	11.25	3.50	9.00	11.06
Technician spraying indoors	18.00	7.50	9.00	11.00	4.00	8.00	4.50	18.00	5.25	11.00	15.00	3.50	9.56
Condom use outside of pregnancy	15.00	16.50	1.50	17.50	12.00	17.00	12.50	14.50	5.50	12.00	3.50	13.00	11.71
Family planning methods	11.00	16.50	14.50	13.00	16.00	18.00	14.00	18.00	3.50	12.00	18.00	19.00	14.46
Abstinence	19.00	16.50	12.00	14.50	16.00	19.00	15.00	14.50	6.50	10.75	18.00	9.00	14.23
Outdoor fogging	12.00	16.50	18.00	17.50	3.00	7.00	2.00	18.00	9.50	11.00	14.00	16.50	12.08
Wearing long sleeves	14.00	16.50	16.00	17.50	16.00	14.00	10.50	12.00	10.25	9.75	18.00	13.00	13.96

Annex 3: Self-Efficacy rankings by focus group, participant group and field site

Prevention Method depicted on card	Pregnant currently pregnant				Men with a pregnant partner				Women likely to become pregnant				Overall Mean Rank
	Highlands		Lowlands		Highlands		Lowlands		Highlands		Lowlands		
	G3	G4	G7	G8	G5	G6	G9	G12	G1	G2	G10	G11	
Removing any container like objects from public spaces	1.00	6.00	2.50	9.00	13.50	14.00	11.50	17.50	5.50	15.00	8.00	17.50	10.08
Eliminating containers in the yard	3.00	9.50	2.50	15.50	4.00	10.00	7.00	1.00	4.00	14.00	8.00	13.00	7.63

Outdoor sweeping	2.00	6.00	2.50	4.00	13.50	15.00	11.50	2.00	5.50	5.50	8.00	6.50	6.83
Eliminating exposed tires	17.50	16.00	2.50	6.50	13.50	11.00	2.00	19.00	4.50	13.00	8.00	6.50	10.00
The steps of pila cleaning	6.00	2.00	6.00	4.00	1.00	9.00	10.00	4.50	0.00	1.00	4.00	2.00	4.50
Chlorinate the water in the drum and cover it	7.00	2.00	6.00	6.50	13.50	8.00	5.00	9.00	6.50	19.00	8.00	6.50	8.08
Mosquito net	9.00	9.50	12.00	1.50	5.00	2.00	13.50	6.00	12.50	5.50	2.00	13.00	7.63
Covering water drums	8.00	2.00	6.00	9.00	13.50	7.00	1.00	4.50	12.75	3.00	4.00	6.50	6.44
Emptying buckets	4.00	9.50	17.50	4.00	13.50	12.00	3.00	3.00	5.00	2.00	4.00	6.50	7.00
Screens for windows and doors	14.00	16.00	15.00	15.50	13.50	1.00	13.50	15.50	13.25	4.00	1.00	2.00	10.35
Temephos application	5.00	4.00	14.00	9.00	7.00	6.00	6.00	12.50	4.00	16.00	12.00	6.50	8.50
Skin repellent use during pregnancy	11.00	9.50	10.00	1.50	13.50	13.00	16.00	12.50	10.00	8.00	11.00	2.00	9.83
Condom use during pregnancy	10.00	12.00	8.50	11.00	3.00	16.00	8.00	9.00	12.25	9.50	17.00	13.00	10.77
Technician spraying indoors	17.50	6.00	11.00	15.50	6.00	4.00	4.00	17.50	6.25	17.00	13.00	19.00	11.40
Condom use outside of pregnancy	12.00	16.00	8.50	15.50	2.00	18.00	9.00	12.50	16.25	11.50	18.00	13.00	12.69

Family planning methods	15.00	16.00	16.00	15.50	13.50	19.00	18.00	9.00	14.25	9.50	19.00	13.00	14.81
Abstinence	13.00	16.00	19.00	15.50	13.50	17.00	17.00	15.50	16.75	11.50	16.00	13.00	15.31
Outdoor fogging	17.50	16.00	17.50	15.50	13.50	5.00	19.00	12.50	8.25	18.00	14.00	17.50	14.52
Wearing long sleeves	17.50	16.00	13.00	15.50	13.50	3.00	15.00	7.00	13.50	7.00	15.00	13.00	12.42

Annex 4: Feasibility rankings by focus group, participant group and field site.

Prevention method depicted on card	Women currently pregnant				Men with a pregnant partner				Women likely to become pregnant				Overall Mean Rank
	Highlands		Lowlands		Highlands		Lowlands		Highlands		Lowlands		
	G3	G4	G7	G8	G5	G6	G9	G12	G1	G2	G10	G11	
Removing any container-like objects from public spaces	1.00	1.50	14.00	7.00	12.00	14.00	9.50	2.00	5.00	4.50	8.00	16.00	7.88
Eliminating/emptying containers in the yard	4.00	7.00	5.50	7.00	4.00	9.00	7.00	3.00	6.00	4.50	5.50	2.50	5.42
Outdoor sweeping	2.00	13.50	2.00	7.00	10.00	13.00	9.50	4.00	4.00	4.50	5.50	2.50	6.46
Eliminating exposed tires	14.00	13.50	5.50	10.00	5.00	10.00	3.00	1.00	8.00	4.50	5.50	13.00	7.75

Prevention method depicted on card	Women currently pregnant				Men with a pregnant partner				Women likely to become pregnant				Overall Mean Rank
	Highlands		Lowlands		Highlands		Lowlands		Highlands		Lowlands		
	G3	G4	G7	G8	G5	G6	G9	G12	G1	G2	G10	G11	
The steps of pila cleaning	14.00	1.50	1.00	4.00	1.00	8.00	1.00	6.50	---	4.50	2.00	2.50	4.18
Chlorinate the water in the drum (and cover)	14.00	4.50	3.50	12.50	14.00	6.00	5.00	17.50	10.00	14.00	5.50	11.00	9.79
Bed net use during pregnancy	14.00	4.50	9.00	1.50	6.00	1.00	8.00	8.00	14.00	14.00	9.00	7.00	8.00
Covering water drums	5.00	13.50	3.50	4.00	13.00	7.00	2.00	6.50	12.00	4.50	2.00	11.00	7.00
Emptying buckets	3.00	13.50	17.00	4.00	9.00	11.00	4.00	5.00	7.00	4.50	2.00	2.50	6.88
Screens for windows and doors	14.00	13.50	10.50	18.00	17.00	2.00	14.00	9.50	14.00	14.00	10.00	14.00	12.54
Temephos application	6.00	13.50	17.00	12.50	8.00	5.00	18.00	14.00	3.00	4.50	15.00	11.00	10.63
Skin repellent use during pregnancy	14.00	4.50	12.50	1.50	11.00	15.00	12.00	19.00	16.00	14.00	12.50	7.00	11.58
Condom use during pregnancy	7.00	4.50	7.50	15.00	3.00	17.00	15.00	11.00	10.00	14.00	17.00	7.00	10.67

Prevention method depicted on card	Women currently pregnant				Men with a pregnant partner				Women likely to become pregnant				Overall Mean Rank
	Highlands		Lowlands		Highlands		Lowlands		Highlands		Lowlands		
	G3	G4	G7	G8	G5	G6	G9	G12	G1	G2	G10	G11	
Technician spraying indoors	14.00	13.50	10.50	10.00	7.00	3.00	13.00	15.50	1.50	14.00	14.00	16.00	11.00
Condom use outside of pregnancy	14.00	13.50	7.50	18.00	2.00	16.00	11.00	12.00	17.50	14.00	18.00	7.00	12.54
Family planning methods	14.00	13.50	17.00	15.00	17.00	18.00	16.00	17.50	17.50	14.00	16.00	19.00	16.21
Abstinence	8.00	13.50	12.50	15.00	17.00	19.00	17.00	13.00	10.00	14.00	19.00	18.00	14.67
Outdoor fogging	14.00	13.50	17.00	10.00	17.00	4.00	19.00	15.50	1.50	14.00	12.50	16.00	12.83
Wearing long sleeves	14.00	13.50	17.00	18.00	17.00	12.00	6.00	9.50	14.00	14.00	11.00	7.00	12.75

Annex 5: Image Names in English and Spanish

Image	English Name	Spanish Name
1	Removing any container-like objects from public spaces	Deschatarrización espacios públicos
2	Eliminating/emptying containers in the yard	Eliminando/vaciando recipientes patio

3	Outdoor Sweeping	Limpieza seca
4	Eliminating exposed tires	Llantas
5	The steps of pila cleaning	Los pasos de la limpieza de la pila
6	Chlorinate the water in the drum (and cover)	Clorar el agua del tonel y Tapar
7	Bed net use during pregnancy	Pabellón para embarazadas
8	Covering water drums	Tapado toneles agua
9	Emptying buckets	Vaciando baldes
10	Screens for windows and doors	Cedazo
11	Temephos application	Abate
12	Skin repellent use during pregnancy	Repelente para la piel durante el embarazo
13	Condom use during pregnancy	Preservativo durante el embarazo
14	Technician spraying indoors	Técnico rociando adentro
15	Condom use outside of pregnancy	Preservativos en general
16	Family planning methods	Anticonceptivos/ Métodos de Planificacion Familiar
17	Abstinence	Abstinencia/no tener relaciones sexuales
18	Outdoor fogging	Fumigación en calle
19	Wearing long sleeves	Manga larga
20	Burning mosquito coils	Aután / Quemar espirales

21	Plug-in space repellents	Plaquitas enchufadas
22	Plug-in Racket	Raqueta
23	Sleeping with a fan on	Ventilador / Dormir con ventilador
24	Citronella	Citronela
25	burning eucaliptus	Quemar eucalipto
26	Fish in pilas	Peces en pilas