Published in final edited form as:

Glob Public Health. 2018 January ; 13(1): 65–82. doi:10.1080/17441692.2016.1178317.

To spray or not to spray? Understanding participation in an indoor residual spray campaign in Arequipa, Peru

Valerie A. Paz-Soldán^{a,b}, Karin M. Bauer^a, Gabrielle C. Hunter^c, Ricardo Castillo-Neyra^{d,e}, Vanessa D. Arriola^f, Daniel Rivera-Lanas^d, Geoffrey H. Rodriguez^d, Amparo M. Toledo Vizcarra^f, Lina M. Mollesaca Riveros^f, Michael Z. Levy^{d,e}, and Alison M. Buttenheim^{g,h}

^aDepartment of Global Community Health and Behavioral Sciences, Tulane University School of Public Health and Tropical Medicine, New Orleans, LA, USA

^bFacultad de Salud Pública y Administración, Universidad Peruana Cayetano Heredia, Lima, Perú

^cDepartment of Health, Behavior and Society, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, USA

^dDepartment of Biostatistics and Epidemiology, University of Pennsylvania Perelman School of Medicine, Philadelphia, PA, USA

^eFacultad de Ciencias y Filosofía, Universidad Peruana Cayetano Heredia, Lima, Perú

^fDepartment of Epidemiology, Tulane University, New Orleans, LA, USA

^gDepartment of Family and Community Health, University of Pennsylvania School of Nursing, Philadelphia, PA, USA

^hCenter for Health Incentives and Behavioral Economics, University of Pennsylvania, Philadelphia, PA, USA

Abstract

Current low participation rates in vector control programmes in Arequipa, Peru complicate the control of Chagas disease. Using focus groups ($n = 17$ participants) and semi-structured interviews ($n = 71$) conducted in March and May 2013, respectively, we examined barriers to and motivators of household participation in an indoor residual spray (IRS) campaign that had taken place one year prior in Arequipa. The most common reported barriers to participation were inconvenient spray times due to work obligations, not considering the campaign to be necessary, concerns about secondary health impacts (e.g. allergic reactions to insecticides), and difficulties preparing the home for spraying (e.g. moving heavy furniture). There was also a low perception of risk for contracting Chagas disease that might affect participation. The main motivator to participate was to ensure personal health and well-being. Future IRS campaigns should incorporate more flexible hours, including weekends; provide appropriate educational messages to counter concerns about secondary health effects; incorporate peer educators to increase perceived risk to Chagas in community; obtain support from community members and leaders to build community trust and

Correspondence to: Valerie A. Paz-Soldán.

Disclosure statement

No potential conflict of interest was reported by the authors.

support for the campaign; and assist individuals in preparing their homes. Enhancing community trust in both the need for the campaign and its operations is key.

Keywords

Chagas disease; IRS; vector control; community participation; developing country

Introduction

Vector-borne diseases such as Chagas disease, malaria, and yellow fever currently represent an estimated 17% of the burden of all infectious diseases globally, annually causing more than 1 million deaths (World Health Organization [WHO], 2014). Moreover, 2.5 billion people, primarily in low- and middle-income countries, live in regions where vector-borne diseases are endemic (WHO, 2014). Among vector-borne diseases, Chagas disease is caused by the parasite *Trypanosoma cruzi* transmitted by contact with the *T. cruzi*-infected faeces of triatomine insects (WHO, 2015a). Between 7 and 8 million people are currently infected with *T. cruzi* and another 25–90 million are at risk of infection, primarily in Latin America (Hotez, Bottazzi, Franco-Paredes, Ault, & Periago, 2008; WHO, 2015a), where indoor residual spraying (IRS) is used to control the triatomine insect populations (Dias, Silveira, & Schofield, 2002).

Indoor residual spraying of insecticide is a critical evidence-based intervention for reducing transmission of vector-borne disease by eliminating or controlling the insect vector, and is a central feature of publicly funded disease prevention strategies in endemic areas (Dias et al., 2002; WHO, 2015b). IRS has been demonstrated to be the most cost-effective method of preventing new cases of Chagas disease (Ferro et al., 1995; Moncayo, 2003; Rojas de Arias, Ferro, Ferreira, & Simancas, 1999; Schofield & Dias, 1991). However, IRS requires high levels of household participation to be effective and cost-effective. A suboptimal level of participation will permit vector populations to rebound from untreated households, and eventually recolonise already-treated communities (Barbu et al., 2014). Therefore, understanding the household's decision to participate in IRS campaigns is crucial to the success of the campaign. In this study, we explore decisions to participate in a Chagas disease vector control campaign in Arequipa, Peru to inform strategies to improve the effectiveness of this and similar vector control campaigns worldwide.

Prior research on vector control campaigns has identified a long list of potential determinants of refusals to participation, including limited knowledge of the disease (Atkinson, Vallely, Fitzgerald, Whittaker, & Tanner, 2011; Winch, Lloyd, Hoemeke, & Leontsini, 1994), low perception of risk (Atkinson et al., 2011; Avila Montes, Ponce, Ponce, Martínez Hernández, & Flores, 1999; Paz-Soldán et al., 2011), poor communication by campaign personnel (Montgomery, Munguambe, & Pool, 2010; Winch et al., 1994), lack of trust in government services (Paz-Soldán et al., 2011; Winch et al., 1994), stigma associated with vectors or control activities (Atkinson et al., 2011; Winch et al., 1994), perceived limited effectiveness of control activities (Avila Montes et al., 1999; Montgomery et al., 2010; Paz-Soldán et al., 2011; Winch et al., 1994), lack of involvement by community

members (e.g. churches, associations) (Atkinson et al., 2011), wariness to allow workers to enter the home (Das, 1991; Montgomery et al., 2010), and perceived high cost of IRS (Atkinson et al., 2011; Paz-Soldán et al., 2011; Winch et al., 1994). In the context of an IRS campaign, household participation means assenting to having the household sprayed with insecticide, adhering to requirements to prepare the home for spraying, and being available to let the spray brigade into the home at the scheduled time.

A systematic review of 33 studies on the socio-cultural aspects of Chagas disease found that people in Chagas-endemic communities are generally knowledgeable about the disease, but that vector control programmes may fail to account for socio-cultural factors in their design, including local health practices, and beliefs and experiences related to Chagas disease (Ventura-Garcia et al., 2013). Other studies on vector control have demonstrated that participation is increased when communities are engaged early in the campaign (Adalja, Sell, Bouri, & Franco, 2012; Buttenheim et al., 2014; Das, 1991); when a body of community-led promoters is engaged in the campaign (Chaki, Dongus, Fillinger, Kelly, & Killeen, 2011); when neighbouring households participate in the campaign (Bryan, Balderrama, Tonn, & Dias, 1994; Buttenheim et al., 2014); when activities are integrated into other health services and development programmes (Bryan et al., 1994; Buttenheim et al., 2014); when households are able to choose when and how to implement the control activities (Buttenheim et al., 2014; Winch et al., 1994); and when there is face-to-face contact with government officials and health workers (Buttenheim et al., 2014). To extend this body of evidence, the purpose of this study was to specifically examine motivators and barriers to participation in a Chagas disease IRS campaigns in Arequipa, Peru. The findings will enable regional health authorities to encourage greater community participation to improve the vector control campaign and achieve the ultimate goal of elimination of *T. infestans* from the region.

Methods

Study setting and Chagas control campaign

The study took place in the Mariano Melgar district of Arequipa, Peru's second largest city with 852,807 people, situated at ~2300 metres above sea level (Instituto Nacional de Estadística e Informática [INEI], 2016). In 2003, the Ministry of Health of Arequipa began a Chagas disease IRS campaign in the Arequipa metropolitan area, after the death of an infant from acute Chagas in the district of Hunter (Bayer et al., 2009). The Arequipa IRS programme for control of *T. infestans* is implemented in various phases. Prior to and after spraying, the IRS programme conducts a preliminary entomological survey and surveillance for *T. infestans*. The attack phase consists of two rounds of insecticide application (spraying) that occur at a six months interval.

The Arequipa IRS campaign originally focused on peri-urban districts, where 4.7% of children had become infected prior to control activities (Bowman et al., 2008; Levy et al., 2007). Based on unpublished data, we know that in these localities (treated prior to 2009) campaign participation rates were consistently above 80% (Barbu et al., 2014; Levy et al., 2006). The campaign has since progressed to more urban districts where infection prevalence is estimated at 2.28% (Hunter et al., 2012). Although the spray campaign is free

to residents, increasing percentages of the population are choosing not to allow their households to be treated with insecticide. As the campaign has entered more urban districts participation rates have fallen sharply.

In the most recent campaign (March–May 2012) in the district of Mariano Melgar (hereafter, MM), which has an estimated population of 52,985 (INEI, 2016), participation rates averaged only 66% for the first round of insecticide application (Buttenheim et al., 2014). MM has about 14,500 houses spanning the different stages of urbanisation in Arequipa, from old established communities to recent invasions. Within this gradient of development, the most recent localities usually have lower levels of infestation with triatomines compared to the older localities (Levy et al., 2014).

Study design

We employed qualitative research methods to examine the factors that motivate and discourage participation in IRS campaigns among MM residents who had either accepted or refused participation in the second spray of the IRS campaign that took place one year earlier, between March and May 2012. We focused on refusal in the second round of spraying, as refusal in the first spray alone did not preclude participation in the second spray, in which case, such households would be considered ‘acceptors’. However, refusal in the second spray, irrespective of participation in the first spray, indicated either reinforcement of an initial refusal, or a changed status in participation to refuse. Those individuals who participated in the first spray but refused in the second spray were of particular interest due to this shift in participation: we sought to examine whether experiences in the first round of spraying might have affected their decision to not participate in the second round of spraying. We specifically recruited the household member responsible for making the final decision regarding IRS campaign participation (even if most consulted with other family members). Two focus groups (FGs, $n = 17$) were conducted with individuals who had not participated in the second round of spraying to explore these themes. We then conducted semi-structured interviews (SSIs) with individuals from 71 households that had accepted (28) or refused (43) the second round of spraying of the MM campaign.

Sampling and sample size

FG participants (FGPs) and semi-structured interview participants (SSIPs) were recruited from a sampling frame of 4667 households in two localities of MM that we were already working in and that had experienced the second round of spraying one year earlier (March 26–30 July 2012): Pueblo Tradicional and Santa Rosa. For the FGs, held prior to the SSI, we determined that the in-depth and interactive conversation that the FG would afford would be particularly well-suited to hearing about barriers to participate from refusers, and to eliciting ideas for improving the campaign and campaign participation going forward. Therefore, we recruited only refusing households for the two FGs. From the total refusing households in the sampled districts, we drew a simple random sample of 199 households, expecting a 15% response rate to the invitation to the FG and 20% attrition (defined as not showing up for the FG). We also used convenience sampling for the FGs: these were held at the neighbourhood health centre, and health centre staff who had not participated in the campaign and were available for the FGs were also invited to attend (6 out of the 17). This group of health care

and public health professionals was of interest to us as they had refused to participate in a campaign they promote to the general public, despite their higher awareness of the risk for and severity of illness associated to Chagas disease compared to the general population.

For the SSI, we aimed to have a mix of accepting, refusing, and 'closed' households (households that did not answer the door during any visits from campaign staff, and therefore did not participate although they did not outright refuse). While we determined *a priori* that approximately 15–20 interviews from each group (acceptors, refusers, and closed) would be sufficient to reach thematic saturation (Guest, Bunce, & Johnson, 2006), our partners in the Ministry of Health requested that we complete at least 70 interviews. Given our interest in barriers to participation, we oversampled refusers; a conservative response rate of 15% for refusers and closed households and 30% for accepting households was used to determine number needed to sample. From the sampling frame, we therefore randomly sampled 452 households (67 acceptors, 267 refusers, and 100 that had been closed) to approach for interviews. Our research team went door-to-door to these homes to seek consent for participating in the short SSI until we reached 71: mostly refusers (43), but some acceptors (28). Of these 71 households, 33 had participated in the first round of spray as well.

Data collection

The FG guide was initially informed by the Theory of Planned Behavior (Ajzen, 1991). We began with conventional elicitation questions about the target behaviour of interest (participation in the most recent attack phase of the campaign), exploring behavioural, normative, and control beliefs about participation or lack of participation. We expanded the questions on normative beliefs to examine how well participants knew their neighbours, their awareness of their neighbours' campaign participation decisions, and the potential influence of their neighbours' perceptions of their own participation decisions. There was also a question about social aspects of the participation decision: with whom did participants discuss whether to participate or not.

Using preliminary findings from the FG, as well as issues identified in similar studies, we developed, piloted, and implemented a brief SSI guide on similar topics but comprising 11 primarily open-ended questions. There were some topics that we felt had been addressed sufficiently in the FG (i.e. closeness to neighbours), and other topics that we wanted to explore further with a larger sample (i.e. main motivators and barriers). We briefly explored the decision-making process by asking if they made the decision on their own or following consultation with other family members, and whether they knew of their neighbours' participation in the campaign, and how they knew. To assess perception of risk, we asked whether the participants knew anyone who had disclosed to them they had Chagas disease, and whether they felt they were at risk for Chagas. Our main topics of interest were the barriers and motivators to participating in an IRS campaign. With the intention of reducing social desirability bias associated with giving a personal explanation, we asked about the decision to reject or accept IRS using indirect questioning (e.g. what motivates people to participate in IRS campaign? What barriers might keep them from participating?), as well as with direct questioning (e.g. what was your main reason for participating, or not) (Krebs et

al., 2011). For overall motivators or barriers (indirect questioning), SSIPs provided multiple responses, hence these add up to more than our SSI sample size of 71. Finally, because of our interest in using this data to design a future study to increase participation, we ended with a discussion of types of activities or incentives that respondents felt could increase participation in future IRS campaigns.

After explaining the aims of the FGs or SSI, written informed consent was obtained from all participants. We documented the age and gender of each FG and SSI participant, as well as the campaign participation status for all SSI participants (by design, all FGPs had refused the second round of spraying). FG discussions and SSI were conducted and digitally recorded by our research team. All digital recordings were transcribed verbatim. In addition, flip chart notes taken during the FG discussions were photographed. This study was approved by the Institutional Review Boards of the Universidad Peruana Cayetano Heredia and the University of Pennsylvania.

Data analysis

The research team first reviewed all of the transcripts and discussed main themes emerging from each question. FG data were then summarised based on themes of interest, and is presented using relevant quotes. For the SSI, the lead social scientist (VPS) developed a codebook for coding open-ended responses, which was discussed and modified with the rest of the team. Two team members coded each interview transcript manually using the codebook. All discrepancies between the coders were reviewed, discussed, and resolved. Team members met to review after every ten transcripts for the first two rounds, and then after every 20 transcripts, to reassess if categories were missing and whether there were any overlapping or unclear categories.

All analyses were conducted in Spanish by native or bilingual Spanish speakers. During the coding process, we also highlighted content representative of key thematic categories; select content is included in the results section to illustrate results. For the interviews, we stratified the analysis by those who had participated in the second round of spraying and those who had not; there were minor differences in a few questions that are mentioned in text. Selected quotes were translated into English by a bilingual researcher (VPS) during manuscript preparation. Finally, we also estimated frequencies of categorical responses to applicable interview questions using Microsoft Excel (Redmond, WA).

Results

Socio-demographic characteristics (see Table 1)

The FGPs were 53% female ($n = 9$); 35% were health-care workers at the clinic where the FGs were conducted. For the SSI, the research team visited 261 houses in the MM district: At 95 of these houses, no one answered after three visits. Among household residents who answered the door, 50 were not interested in participating, 3 were functioning as public facilities (i.e. stores, Internet), 42 could not locate an eligible household member to complete the interview, and 71 were willing to be interviewed about their participation in IRS campaigns. Respondents were primarily female (59%, $n = 42$), with a mean age of 52 (range

20–83). The majority did not know someone who had disclosed they had Chagas disease (96%, $n = 68$). Only 4% ($n = 3$) knew someone close to them who had told them they had Chagas disease (two of these individuals participated in both rounds of the IRS campaign, but one did not participate in the second round).

Experiences with and decision-making related to IRS campaigns

The majority of interview participants (66%, $n = 47$) had heard about the IRS campaign from a previous visit by a campaign personnel; the second most common source of information (16%, $n = 11$) was hearing about the campaign from personnel who came to spray the home (see Table 2). When asked what they recollected most from the information covered in the introduction to the IRS campaign, participants mentioned the ‘chirimacha’ (the local name for *T. infestans*) (49%, $n = 35$), Chagas disease (9%, $n = 6$), or both (16%, $n = 11$).

Nearly two-thirds (61%, $n = 43$) of participants responded that they consulted with family members about whether to accept IRS. One interview participant explained that she spoke ‘with my family, my mom, my brothers, with several people and we all agreed that it was important, that [the vector] was found in other districts of Arequipa. These are deadly pests’. It was clear, both from the FG and SSI, that the family discusses many aspects of the campaign in making a decision, including issues of safety (e.g. is it safe for young, old, or sick family members?), logistics/practicality (e.g. who will be available to let sprayers in?), and trust (e.g. could sprayers be trusted not to remove valuables from the home while spraying?).

Interviewees were also asked if they spoke with neighbours in general and more than half reported that they did (55%, $n = 39$). In total, 65% ($n = 46$) of participants reported knowing that their neighbours allowed IRS. When asked how they knew that their neighbours allowed IRS, nearly one-third (32%, $n = 23$) reported that they knew because they had spoken about it with their neighbours; 14% because they had seen the neighbours allow IRS; and 18% did not have details for how they knew.

Perceived risk for Chagas

In the interviews, when asked about their risk for contracting Chagas, one quarter of participants (27%, $n = 19$) consider themselves to be at risk for Chagas and stated, ‘it is very dangerous’. Another 17% did not consider themselves at risk; as one explained, ‘I don’t think so, I feel fine, and the patriarch of the family is about to turn 80 years old and has lived with the chirimachas [triatomine] and has not died.’ The largest group (32%, $n = 23$) did not know enough about Chagas to respond. A typical response in this group was: ‘I am not very informed about the disease because I do not see it here.’

Perceptions of IRS campaign effectiveness

The majority of SSIPs perceived IRS to be effective (80%, $n = 57$), reporting that IRS is ‘very good, excellent for eliminating insects’. FGPs supported this conclusion, stating that they knew the IRS was effective because ‘it eliminated the cockroaches’ and ‘the bugs, now there aren’t any’. However, 13% ($n = 9$) of SSIPs felt IRS was not effective, or as two FGPs

mentioned ‘it only works for a while’ because ‘sometimes eggs are left behind’. While acknowledging that IRS was effective, FGPs also noted that it could be made more convenient. One FGP commented that lack of awareness and knowledge of the importance of IRS limited the sustainability for the programme: ‘We have to provide education in our community, and then [the campaign] will be sustainable.’

Motivators and reasons to participate in IRS campaign

The top three benefits of spraying with insecticide were: for good health (38%, $n = 27$), to eliminate insects (30%, $n = 21$), and for cleanliness (17%, $n = 12$) (Table 3). One interviewee summarised these findings by stating, ‘I feel my family is safer, that we don’t have these diseases ... that there are no parasites.’ Some SSIPs and FGPs mentioned specifically that this would protect their children’s health and well-being, and that the IRS was free.

Among SSIP ‘acceptors’ ($n = 28$), the three most common reasons given for why they accepted IRS of their homes included personal health and well-being (17%, $n = 12$), to maintain cleanliness in the home (7%, $n = 5$), and civic duty (6%, $n = 4$) (see Table 3). Regarding cleanliness, many respondents noticed that IRS affected the presence of other insects in addition to triatomines: ‘it’s a benefit that the place is clean, there are no pests’. FGPs who participated in the first round of spraying also mentioned that it provided them with an opportunity to clean the house and organise belongings, particularly when moving furniture and other possessions away from the walls (a requirement for preparing the home to be sprayed). Finally, a sense of civic duty was described by interview participants: ‘the reality is that one should take advantage of this campaign, because it is good, not only for a home, but on a national level’.

Barriers to participating in the IRS campaign

The top three barriers mentioned among SSIPs for why people in their communities might reject spraying were: preparing the home was difficult (26%, $n = 38$); lack of trust (concern that sprayers would steal from them, as mentioned above) (18%, 27); and having concerns (13%, $n = 19$) (see Table 4). All participants reported that it was difficult to prepare the home for IRS because, as one SSIP mentioned, ‘moving [furniture and belongings] is complicated’. FGPs agreed, with one stating that

for the first [spray round], yes, we sprayed because there were people who could help us move the furniture ... For the second time, no, because of my work and my daughter was pregnant and we didn’t have anyone to ask to help us move the things.

Several also mentioned that it was not only hard to prepare the house for the spray, but also, as one SSIP expressed it: ‘it is a headache to put everything back in place without help when it is over’.

Regarding lack of trust in sprayers, one SSIP echoed FGP concerns that ‘they [sprayers] would return in the night and steal’ from the household (18%, $n = 27$). One FGP mentioned, ‘those who come to spray look at what we have, they tell thieves, and so there is lack of

trust'. One SSIP mentioned privacy concerns as well: 'I don't like that people come into my house and invade my privacy.' FGPs were also worried that the government officials accompanying the sprayers were valuing the items in their home to adjust their taxes:

Many people on my block have said this, and it seems right, that they have seen the municipality and Ministry of Health workers write something down on a piece of paper [while in their house], and what a coincidence! Soon after, they get the 'autovaluo' [property tax bill]. That is why many people have not wanted their houses to be sprayed.

Another FGP suggested either training residents to spray their own homes or providing masks for individuals who want to supervise the vector control personnel within their homes at the time of the spraying. Despite the fact that distrust of sprayers came up in FG and in the SSI, only two interviewees (3%) mentioned trust issues (as associated to potential theft) as their main barrier to participation – both participants had not participated in the second round of spraying.

Health concerns also came up both in SSI and FG. FGPs were concerned about the health of family members, particularly grandchildren and elderly family members who may use the walls to support themselves when walking and might therefore touch the walls where insecticide had been sprayed and then ingest it. One stated:

I didn't [spray] because I have my grandchildren, 1, 2, and 3 years old, and they constantly pass their hands on the wall to hold on so they don't fall down. So I said, how am I going to allow spraying if they are in direct contact [with the walls]? So I was scared.

Other FGPs decided not to participate because of concerns that the insecticide would exacerbate asthma symptoms in other family members, and because their doctor recommended against it: 'I live with my daughter and I have two grandchildren, they are asthmatics ... I consulted with the doctor, and the doctor said no.'

The inconvenience of spray hours (usually in the morning and during the week), particularly for those who work, was also discussed by SSIPs and FGPs. One interviewee explained that he would have participated if the hours had been more convenient; others added that this was exacerbated by the fact that sometimes one made time for the spray, and then the sprayers were late. FGPs also reported that hours were inconvenient and weekend hours should be added to increase feasibility. One FGP reported telling the IRS campaign team:

I have a job where I am not free during the day. I have to program what day I will be at home. Also, children go to school from Monday to Friday, so if [IRS personnel] spray, it is not possible for the children to then be around in the home. I told them to come on Saturday to [spray], then the children could go to my family, where my mom is, to spend the day. But they didn't accept my request. They told me they only work until Friday and that I had to figure it out.

Other topics that emerged as barriers included the residual odour of the insecticide and/or a lack of ventilation (9%, $n = 13$), the lack of timeliness of sprayers (9%, $n = 13$), or that 'it was not necessary' to do IRS (11%, $n = 8$). Reasons given for it not being necessary

included: 'I clean every day' or 'I don't have animals' or 'I have not seen chirimachas in my house.' FGPs also discussed the difficulty of coordinating with all household residents to accept IRS and to be there on the same day to make their room or portion of the house available, particularly in a home where some of the rooms are rented to unrelated individuals. FGPs were told that they 'couldn't spray only our part [of the house], it had to be the whole house'.

When IRS campaign 'refusers' were asked specifically about their main reason for not allowing their houses to be sprayed, the four most common reasons were that the hours were inconvenient for them (17%, $n = 12$); they did not feel it was necessary (11%, $n = 8$); they had concerns about health impacts (9%, $n = 6$); and that it was difficult to prepare their homes for IRS (7%, $n = 5$).

Recommendations for future IRS campaigns

The majority of SSIPs (42%, $n = 53$) reported that providing more information would help increase participation in future IRS campaigns to 'make the people aware, communicate the problems, the causes that can come from these bites' (see Table 5). FGPs recommended that the information campaign be conducted 'through the schools because the children influence the decisions of their parents'. Other ideas reported by SSIPs included increasing available spray days/times, particularly on weekends (22%, $n = 28$), and helping people prepare their homes for spraying (e.g. moving furniture) (7%, $n = 9$). In the FG, some mentioned the possibility of fining those who did not allow their houses to be sprayed.

More than half of the SSIPs reported that incentives would not work to encourage IRS, with many raising the potential for real or perceived coercion. Some responses focused on normative beliefs about responding to incentives vs. civic duty: 'I wouldn't [spray] for [an incentive] but for the good of the home'; 'No, it shouldn't be [an incentive], it should be done because the person is conscientious and thinking about his and his family's health.' Others noted that an incentive would not overcome specific objections or barriers to spraying (their own or others'): 'No, I would not [accept an incentive] because my child's health is more important.' Only 20% ($n = 14$) of SSIPs reported that an incentive would work, with some responding, 'why wouldn't a person accept an incentive?' or 'I think [people would do spray for an incentive] – let's be realistic.' Those who believed incentives might be effective were quick to point out that incentive design required community input. For example, when discussing possible raffle prizes as an incentive, FGPs reported that different neighbourhoods would respond to different prizes depending on socio-economic status. For poorer communities, food items or a day pass to a pool were recommended. For wealthier neighbourhoods, a tax rebate, a school scholarship, or a tablet computer was recommended.

Of those SSIPs asked what new or additional information they would like about the IRS campaign ($n = 45$), 42% reported that they wanted information about 'what is bad about Chagas, photos, death rates'. A third (33%, $n = 15$) wanted information about IRS such as 'how spraying is done, so that each person would see and would make his/her decision about allowing spraying'. And 13% wanted information about the triatomine vector, including 'is it poisonous or not, how does it look ... where does it come from?' In one of the FGs,

someone mentioned wanting to ‘see or hear of someone who has had Chagas because we don’t know anyone who has had it’.

In summary, among our study participants, in which we oversampled households that had refused to participate in a recent IRS campaign (by study design, 61% or $n = 43$ of the SSIPs and all of the FGPs had refused to participate in a recent IRS campaign), we found that only a quarter ($n = 19$) considered themselves to be at risk of Chagas disease and very few ($n = 3$) participants knew someone who had shared their Chagas disease diagnosis with them, which could influence one’s decision to allow spraying of insecticide in one’s home. The reported reasons for rejecting IRS focused on: difficulties preparing the home/moving furniture, concerns about health/side effects of IRS, inconvenient hours, and lack of trust in IRS personnel. The most commonly reported reasons IRS was accepted were personal health and well-being, cleanliness of the home, and elimination of insects. Over half (63%, $n = 45$) stated that providing additional information would help increase participation in future IRS campaigns, particularly about Chagas disease (e.g. symptoms, risks), IRS campaigns (e.g. logistics, preparation, effects), and triatomines (e.g. what they look like, how they infect people).

Discussion

This study sought to identify the motivators and barriers to community participation in an IRS campaign to control Chagas disease in Arequipa, Peru. Although 80% of respondents felt IRS campaigns are effective and can benefit them by protecting their family’s health and eliminating insects, there were several types of barriers that need to be addressed to improve participation. First, only 4% in our sample knew someone close to them who had Chagas disease, an expected finding due to the long asymptomatic period of the infection (Bern, 2015), the absence of consistent population screening for infection (Levy et al., 2009), and short history and low prevalence of transmission in the area (Levy et al., 2011). Given the study participants’ unfamiliarity with infected individuals, it is likely residents of Mariano Melgar perceive a low risk of getting Chagas. According to a number of theoretical models, such as the Health Belief Model, perception of risk for a disease can contribute to preventive health behaviours (Champion & Skinner, 2008). The fact that most study participants did not know anyone who has had Chagas (or did not know if they did) might translate into a low perception of Chagas to be a threat to their health and influence participation behaviours, even if they know Chagas exists and can be a life threatening illness (Orenstein & Seib, 2014). At the same time, the perception of low risk is actually correct in the case of Arequipa, where most residents live far from infested households. To raise awareness about Chagas and increase visibility of the problem in the community, health education campaigns could consider incorporating peer educators who are either infected themselves or related to infected people, to share their stories. Additional screening for and diagnosis of Chagas disease in Arequipa could also increase familiarity with this disease.

Our findings also highlight the importance of logistical issues to participants who refuse to spray their homes. Among those who rejected IRS, most did so because of inconvenient hours, difficulty in preparing the home, not being home at the time that the IRS personnel arrived, inability to unlock all the doors because there were tenants, or IRS personnel that

did not arrive at the scheduled time. These findings are consistent with other recent studies of IRS participation in both Chagas disease and malaria campaigns reporting logistical problems, such as moving furniture, as deterrents to participation (Ediau et al., 2013; Rodríguez et al., 2006). Nearly a quarter of participants in a study in Uganda refused to move their furniture, stating that it was an invasion of privacy, interfered with the security of their property, or was tiresome to do (Ediau et al., 2013). Our recent study based on surveillance data captured by field staff during the attack (spray) phase of the Chagas campaign in Arequipa also found that the most common reason given for refusal was that the participant could not wait at home all day for the IRS personnel to arrive, usually due to work commitments (Buttenheim et al., 2014). These consistent results across multiple settings and campaign types suggest that health authorities, and their funders, should consider reducing the logistical burden on households by: scheduling a narrow time window for the spraying and being punctual (vs. the current practice of specifying a day without providing a time frame); spraying on weekends and later into afternoon on weekdays; and offering assistance in moving large furniture in homes.

Beliefs about the possible harmful effects of the insecticide were also described as a deterrent to allowing spraying in one's home, particularly if residents include children, elderly or those who suffer from conditions such as asthma. These findings related to health concerns are consistent with previous research that has demonstrated that beliefs about both allergies and asthma triggers are culturally specific (Koinis-Mitchell et al., 2008; Pachter et al., 2002) and that concerns about negative effects (e.g. allergies, cancers, respiratory issues) were common (Buttenheim et al., 2014; Ediau et al., 2013).

Our participants stated that one motivator for accepting IRS was that it eliminated all insects, not just triatomines. Other studies in Uganda and rural Mozambique found that participants perceived IRS for malaria control to be beneficial because it killed the vector, mosquitoes, and other insects immediately, which was a reason to accept the spray (Ediau et al., 2013; Munguambe et al., 2011). For some, the fact that IRS can eliminate other nuisance insects from their home might be perceived as a more relevant benefit of IRS.

Our recent study on socio-economic predictors of participation in the Chagas campaign in Arequipa revealed that participation was higher among those whose neighbours participated (controlling for household infestation and neighbourhood wealth) (Buttenheim et al., 2014). As was the case in that study, we also found that most people reported talking to their neighbours about the IRS campaign and almost two-thirds knew whether their neighbours sprayed their houses or not. Strategies that incorporate social aspects of participation – that is, in which it is obvious which neighbours have participated in IRS or feel positively about IRS – might also stimulate participation. This may be through visible signs that neighbours are participating, or by involving community members as peer recruiters during the campaign.

The issue of lack of trust in allowing vector control personnel into houses is not unique to Arequipa (Castro Ramos, 2014). In the time this article was in review, one of the authors (VPS) who lives in Lima received a warning about a theft scheme that involved supposed vector control officials using falsified identification cards who gain entry into one's home

and proceed to remove valuables. People are wary of strangers, even if properly identified, with reason. One FGP suggested allowing residents to spray their own house to overcome issues of distrust, which would require training in the safe use and disposal of insecticides. This approach has been implemented successfully in a community-based IRS programme in rural Argentina (Cardinal et al., 2007), albeit with only a small number of individuals trained; however, providing such training to residents themselves in a large city is infeasible. Moreover, the perception that their property tax bill ('autovaluo') arrived soon after the campaign and that their homes were possibly being 'assessed' was seen as another reason to not trust sprayers by FGPs. FGPs who worked for the local Ministry of Health admitted that, while unintentional, the timing coincidence was unfortunate. Development and testing of new strategies for gaining community trust – such as working with the municipality to better coordinate schedules, or having peer educators 'open doors' to the IRS campaign – is needed.

Incentives were also explored as a means to encourage participation in the campaigns; more than half of SSIPs reported that incentives would not work. However, it is possible that due to social desirability bias, SSIPs were reluctant to admit to our team that a financial incentive would be persuasive to them, which they might worry would convey that their motivation to participate is 'getting something' rather than participating out of civic duty. Interviewees and FGPs who discussed the issue of incentives further indicated that incentives would have to be specific and meaningful to the target community depending upon socio-economic status, for example, food items and supplies for poorer communities vs. a reduction in taxes or a computer for wealthier communities.

We note several important limitations to our study. We focused on a single district in one city in Southern Peru, potentially limiting generalisability. Our sample size was small (17 FGPs and 71 SSIPs). However, as a qualitative study, the objective of this analysis was to identify important issues to explain barriers to participation in IRS campaigns, and we observed saturation of these topics in the interviews. Future studies could focus on quantifying the importance of the identified issues, and examining individual level (i.e. socio-economic status, education, rent-status) and community level (i.e. newer vs. older neighbourhoods, density of neighbourhood networks) factors that might influence participation in IRS in Arequipa. Also, three SSIPs responded they rented their properties and that the owner made the decision about spraying the property or not. The issue of how rented properties or partial rentals (i.e. houses with several rooms rented out to unrelated individuals) affects participation in IRS campaigns is also one that should be explored in future research so that strategies to increase participation in these cases can be examined and tested. Finally, while we elicited compelling input from respondents about future campaigns, including the feasibility, acceptability, and effectiveness of hypothetical participation incentives, future behavioural responses to actual incentives may differ substantially from these best guesses and will require additional empirical testing.

Conclusion

Current low participation rates in vector control programmes in Arequipa threaten the control of Chagas disease in Peru. Households cannot undertake vector control individually

or in isolation; it must be implemented in a coordinated fashion across a community to prevent rapid re-infestation. Refusal to participate in a Chagas disease vector control campaign appears to be driven primarily by perception of low risk (e.g. not having anyone close to them disclose having Chagas disease, not having seen triatomines in their home) and logistical issues, including inconvenient hours and difficulty in preparing the home for indoor residual spray (e.g. moving furniture). Our results demonstrate general willingness to accept IRS based on civic duty and desire to prevent disease that is often overcome by logistical limitations that make participation difficult if not impossible, as well as concerns about adverse effects of insecticide. Specific strategies to increase participation that should be evaluated going forward include adding additional hours and days to spraying schedules; providing financial incentives to counter perceived costs of spraying; employing peer educators who are infected with Chagas or who know someone infected with Chagas to educate communities about the disease and increase perceived risk of contracting Chagas; and employing trusted community members who help promote the IRS campaign by conveying understandable and accurate information about the spray process and how to avoid adverse reactions from insecticide.

Acknowledgments

Funding

This work was supported by the Eunice Kennedy Shriver National Institute of Child Health and Human Development [grant number R01HD075869] and the National Institutes of Health Fogarty International Center [grant number K01TW008414-01A1] (to VAPS).

References

- Adalja AA, Sell TK, Bouri N, Franco C. Lessons learned during dengue outbreaks in the United States, 2001–2011. *Emerging Infectious Diseases*. 2012; 18:608–614. DOI: 10.3201/eid1804.110968 [PubMed: 22469195]
- Ajzen I. The theory of planned behavior. *Organizational Behavior and Human Decision Processes*. 1991; 50(2):179–211.
- Atkinson JA, Vallye A, Fitzgerald L, Whittaker M, Tanner M. The architecture and effect of participation: A systematic review of community participation for communicable disease control and elimination. Implications for malaria elimination. *Malaria Journal*. 2011; 10:225.doi: 10.1186/1475-2875-10-225 [PubMed: 21816085]
- Avila Montes GA, Ponce C, Ponce E, Martínez Hernández M, Flores M. Insecticidal paint and fumigant canisters for Chagas' disease control: Community acceptance in Honduras. *Revista Panamericana de Salud Pública*. 1999; 6(5):311–320. [PubMed: 10626473]
- Barbu CM, Buttenheim AM, Hanco Pumahuanca ML, Quintanilla Calderón JE, Salazar R, Carrión M, Levy MZ. Residual infestation and recolonization during urban *Triatoma infestans* Bug Control Campaign, Peru. *Emerging Infectious Diseases*. 2014; 20(12):2055–2063. DOI: 10.3201/eid2012.131820 [PubMed: 25423045]
- Bayer AM, Hunter GC, Gilman RH, Cornejo Del Carpio JG, Naquira C, Bern C, Levy MZ. Chagas disease, migration and community settlement patterns in Arequipa, Peru. *PLoS Neglected Tropical Diseases*. 2009; 3:e567.doi: 10.1371/journal.pntd.0000567 [PubMed: 20016830]
- Bern C. Chagas' disease. *The New England Journal of Medicine*. 2015; 373(5):456–466. DOI: 10.1056/NEJMra1410150 [PubMed: 26222561]
- Bowman NM, Kawai V, Levy MZ, Cornejo del Carpio JG, Cabrera L, Delgado F, Bern C. Chagas disease transmission in periurban communities of Arequipa, Peru. *Clinical Infectious Diseases*. 2008; 46(12):1822–1828. DOI: 10.1086/588299 [PubMed: 18462104]

- Bryan RT, Balderrama F, Tonn RJ, Dias JC. Community participation in vector control: Lessons from Chagas' disease. *American Journal of Tropical Medicine and Hygiene*. 1994; 50:61–71. [PubMed: 8024086]
- Buttenheim AM, Paz-Soldán VA, Barbu C, Skovira C, Quintanilla Calderón J, Mollesaca Riveros LM, Levy MZ. Is participation contagious? Evidence from a household vector control campaign in urban Peru. *Journal of Epidemiology and Community Health*. 2014; 68(2):103–109. DOI: 10.1136/jech-2013-202661 [PubMed: 24062411]
- Cardinal MV, Lauricella MA, Marcet PL, Orozco MM, Kitron U, Gürtler RE. Impact of community-based vector control on house infestation and *Trypanosoma cruzi* infection in *Triatoma infestans*, dogs and cats in the Argentine Chaco. *Acta Tropica*. 2007; 103(3):201–211. [PubMed: 17686448]
- Castro Ramos X. Intervenciones ecosistémicas para el control de la enfermedad de Chagas: las experiencias de participación comunitaria en un proyecto desarrollado en el oriente de Guatemala. [Ecosystemic interventions for the control of Chagas disease: Community participation experiences in a project developed in Eastern Guatemala]. *Espacio Abierto*. 2014; 23(2):325–338.
- Chaki PP, Dongus S, Fillinger U, Kelly A, Killeen GF. Community-owned resource persons for malaria vector control: Enabling factors and challenges in an operational programme in Dar es Salaam, United Republic of Tanzania. *Human Resources for Health*. 2011; 9:21.doi: 10.1186/1478-4491-9-21 [PubMed: 21955856]
- Champion, VL., Skinner, CS. The health belief model. In: Glanz, K.Rimer, BK., Viswanath, K., editors. *Health behavior and health education: Theory, research, and practice*. 4th. San Francisco, CA: Jossey-Bass; 2008. p. 45-62.
- Das P. Community participation in vector borne disease control: Facts and fancies. *Annales de la Société Belge de Médecine Tropicale*. 1991; 71:233–242. [PubMed: 1793274]
- Dias JC, Silveira AC, Schofield CJ. The impact of Chagas disease control in Latin America: A review. *Memórias do Instituto Oswaldo Cruz*. 2002; 97(5):603–612. [PubMed: 12219120]
- Ediau M, Babirye JN, Tumwesigye NM, Matovu JK, Machingaidze S, Okui O, Waiswa P. Community knowledge and perceptions about indoor residual spraying for malaria prevention in Soroti district, Uganda: A cross-sectional study. *Malaria Journal*. 2013; 12:170.doi: 10.1186/1475-2875-12-170 [PubMed: 23705591]
- Ferro EA, de Arias AR, Ferreira ME, Simancas LC, Rios LS, Rosner JM. Residual effect of lambda-cyhalothrin on *Triatoma infestans*. *Memórias do Instituto Oswaldo Cruz*. 1995; 90(3):415–419. [PubMed: 8544744]
- Guest G, Bunce A, Johnson L. How many interviews are enough? An experiment with data saturation and variability. *Field Methods*. 2006; 18:59–82.
- Hotez PJ, Bottazzi ME, Franco-Paredes C, Ault SK, Periago MR. The neglected tropical diseases of Latin America and the Caribbean: A review of the disease burden and distribution and a roadmap for control and elimination. *PLoS Neglected Tropical Diseases*. 2008; 2(9):e300.doi: 10.1371/journal.pntd.0000300 [PubMed: 18820747]
- Hunter GC, Borriani-Mayorí K, Ancca Juárez J, Castillo Neyra R, Verastegui MR, Malaga Chavez FS, Levy MZ. A field trial of alternative targeted screening strategies for Chagas disease in Arequipa, Peru. *PLoS Neglected Tropical Diseases*. 2012; 6(1):e1468.doi: 10.1371/journal.pntd.0001468 [PubMed: 22253939]
- Instituto Nacional de Estadística e Informática. Población y Vivienda. Estimaciones y Proyecciones de Población. Población total al 30 de junio del 2013, por grupos quinquenales de edad, según departamento, provincia y distrito. 2016. Retrieved from <https://www.inei.gob.pe/estadisticas/indice-tematico/poblacion-y-vivienda/>
- Koinis-Mitchell D, McQuaid EL, Friedman D, Colon A, Soto J, Rivera DV, Canino G. Latino caregivers' beliefs about asthma: Causes, symptoms, and practices. *Journal of Asthma*. 2008; 45:205–210. DOI: 10.1080/02770900801890422 [PubMed: 18415827]
- Krebs CP, Lindquist CH, Warner TD, Fisher BS, Martin SL, Childers JM. Comparing sexual assault prevalence estimates obtained with direct and indirect questioning techniques. *Violence Against Women*. 2011; 17(2):219–235. DOI: 10.1177/1077801210397743 [PubMed: 21307031]
- Levy MZ, Barbu CM, Castillo-Neyra R, Quispe-Machaca VR, Ancca-Juarez J, Escalante-Mejia P, Chagas Disease Working Group in Arequipa, Peru. Urbanization, land tenure security and vector-

- borne Chagas disease. *Proceedings of the Royal Society B: Biological Sciences*. 2014; 281(1789): 20141003.doi: 10.1098/rspb.2014.1003 [PubMed: 24990681]
- Levy MZ, Bowman NM, Kawai V, Plotkin JB, Waller LA, Cabrera L, Bern C. Spatial patterns in discordant diagnostic test results for Chagas disease: Links to transmission hotspots. *Clinical Infectious Diseases*. 2009; 48(8):1104–1106. DOI: 10.1086/597464 [PubMed: 19278335]
- Levy MZ, Bowman NM, Kawai V, Waller LA, Cornejo del Carpio JG, Cordova Benzaquen E, Bern C. Periurban *Trypanosoma cruzi*-infected *Triatoma infestans*, Arequipa, Peru. *Emerging Infectious Diseases*. 2006; 12(9):1345–1352. [PubMed: 17073082]
- Levy MZ, Kawai V, Bowman NM, Waller LA, Cabrera L, Pinedo-Cancino VV, Bern C. Targeted screening strategies to detect *Trypanosoma cruzi* infection in children. *PLoS Neglected Tropical Diseases*. 2007; 1(3):e103. [PubMed: 18160979]
- Levy MZ, Small DS, Vilhena DA, Bowman NM, Kawai V, Cornejo del Carpio JG, Plotkin JB. Retracing micro-epidemics of Chagas disease using epicenter regression. *PLoS Computational Biology*. 2011; 7(9):e1002146.doi: 10.1371/journal.pcbi.1002146 [PubMed: 21935346]
- Moncayo A. Chagas disease: Current epidemiological trends after the interruption of vectorial and transfusional transmission in the Southern Cone countries. *Memórias do Instituto Oswaldo Cruz*. 2003; 98(5):577–591. [PubMed: 12973523]
- Montgomery CM, Munguambe K, Pool R. Group-based citizenship in the acceptance of indoor residual spraying (IRS) for malaria control in Mozambique. *Social Science and Medicine*. 2010; 70(10):1648–1655. [PubMed: 20199837]
- Munguambe K, Pool R, Montgomery C, Bavo C, Nhacolo A, Fiosse L, Alonso P. What drives community adherence to indoor residual spraying (IRS) against malaria in Manhica district, rural Mozambique: A qualitative study. *Malaria Journal*. 2011; 10:344.doi: 10.1186/1475-2875-10-344 [PubMed: 22111698]
- Orenstein W, Seib K. Mounting a good offense against measles. *The New England Journal of Medicine*. 2014; 371(18):1661–1663. DOI: 10.1056/NEJMp1408696 [PubMed: 25354100]
- Pachter LM, Weller SC, Baer RD, de Alba Garcia JE, Trotter RT 2nd, Glazer M, Klein R. Variation in asthma beliefs and practices among mainland Puerto Ricans, Mexican-Americans, Mexicans, and Guatemalans. *Journal of Asthma*. 2002; 39:119–134. [PubMed: 11995676]
- Paz-Soldán VA, Plasai V, Morrison AC, Rios-Lopez EJ, Guedez-Gonzales S, Grieco JP, Achee NL. Initial assessment of the acceptability of a push-pull *Aedes aegypti* control strategy in Iquitos, Peru and Kanchanaburi, Thailand. *American Journal of Tropical Medicine and Hygiene*. 2011; 84:208–217. DOI: 10.4269/ajtmh.2011.09-0615 [PubMed: 21292886]
- Rodríguez AD, Penilla RP, Rodríguez MH, Hemingway J, Trejo A, Hernández-Avila JE. Acceptability and perceived side effects of insecticide indoor residual spraying under different resistance management strategies. *Salud Pública México*. 2006; 48(4):317–324.
- Rojas de Arias A, Ferro EA, Ferreira ME, Simancas LC. Chagas disease vector control through different intervention modalities in endemic localities of Paraguay. *Bulletin of the World Health Organization*. 1999; 77(4):331–339. [PubMed: 10327712]
- Schofield CJ, Dias JC. A cost-benefit analysis of Chagas disease control. *Memórias do Instituto Oswaldo Cruz*. 1991; 86(3):285–295. [PubMed: 1842419]
- Ventura-García L, Roura M, Pell C, Posada E, Gascón J, Aldasoro E, Pool R. Socio-cultural aspects of Chagas disease: A systematic review of qualitative research. *PLoS Neglected Tropical Diseases*. 2013; 7(9):e2410.doi: 10.1371/journal.pntd.0002410 [PubMed: 24069473]
- Winch PJ, Lloyd LS, Hoemeke L, Leontsini E. Vector control at the household level: An analysis of its impact on women. *Acta Tropica*. 1994; 56:327–339. [PubMed: 8023756]
- World Health Organization. Fact Sheet No 387: Vector-borne diseases web page. 2014. Retrieved from <http://www.who.int/mediacentre/factsheets/fs340/en/>
- World Health Organization. Fact Sheet No 340: Chagas disease (American trypanosomiasis). 2015a. Retrieved from <http://www.who.int/mediacentre/factsheets/fs340/en/>
- World Health Organization. Global technical strategy for malaria 2016–2030. 2015b. Retrieved from http://apps.who.int/iris/bitstream/10665/176712/1/9789241564991_eng.pdf

Table 1

Socio-demographic characteristics of participants in Arequipa, Peru.

Socio-demographic characteristics	Frequency	Percentage
<i>SSIs</i>		
Age	52 (median)	20–83 (range)
Sex		
Male	29	41
Female	42	59
Knows someone with Chagas		
Yes	3	4
No	68	96
<i>Focus groups</i>		
Sex		
Male	8	47
Female	9	53

Note: SSI, $n = 71$; focus group participants, $n = 17$.

Table 2Experiences with IRS campaign by participants in Arequipa, Peru ($n = 71$).

Experiences with the IRS campaign	% (n)
<i>How they heard about the IRS campaign</i>	
Previous visit from campaign personnel	66 (47)
Sprayers arrived on the spot to do IRS	16 (11)
Conversation with a family member	6 (4)
Loudspeaker on the street	4 (3)
Previous experience with another IRS campaign	1 (1)
Other	3 (2)
Not addressed in interview	4 (3)
<i>Recollection of information covered in introduction about IRS campaign</i>	
Focused on the dangers of the 'kissing bug'	49 (35)
Both Chagas disease and 'kissing bug' mentioned	16 (11)
Focused on the dangers of Chagas disease	9 (6)
Respondent wasn't sure, seemed unclear	9 (6)
Information about the IRS itself (e.g. logistics)	1 (1)
Good for one's health in general	1 (1)
Not addressed in interview	16 (11)
<i>With whom did respondent consult to decide whether or not to allow IRS in their homes</i>	
Consulted other family members	61 (43)
Respondent did not consult others	17 (12)
Not present at the time of IRS	7 (5)
Consulted other residents	6 (4)
Rented property – the owner made the decision	4 (3)
Not addressed in interview	6 (4)
<i>Talks with neighbours?</i>	
Yes	55 (39)
No	45 (32)
<i>Do neighbours allow IRS?</i>	
Yes, we have spoken about it	32 (23)
Yes, I have seen that they allowed it	14 (10)
Yes, but no details about how they know	18 (13)
No	13 (9)
Don't know	23 (16)
<i>Perception of effectiveness of IRS</i>	
Feel it is effective	80 (57)
Feel it is not effective	13 (9)
Don't know/No opinion	7 (5)

Table 3Reasons for accepting IRS in Arequipa, Peru. ($n = 71$).

<i>Overall motivators for accepting IRS^a</i>	
For health reasons (e.g. feel more secure)	38 (27)
Eliminate insects	30 (21)
Cleanliness	17 (12)
For children	6 (4)
Necessary	3 (2)
Participant didn't know	7 (5)
<i>Main personal reasons for accepting IRS</i>	
Personal health and well-being	17 (12)
Cleanliness of the home	7 (5)
Civic duty	6 (4)
Child's health and well-being	3 (2)
'Necessary' to do IRS	3 (2)
IRS was free	1 (1)
Kills all insects in the home	1 (1)
Security	1 (1)
N/A – did not accept IRS	61 (43)

^aParticipants were allowed to give more than one response.

Table 4

Barriers and motivators one may have to participating in an IRS campaign, described by SSIPs in Arequipa, Peru ($n = 71$).

Barriers to IRS ^a	% (n)
Preparing home is difficult (e.g. moving furniture)	26 (38)
Lack of trust: concern that sprayers might steal from them	18 (27)
Concerned about any health side effects	13 (19)
IRS leaves a strong odor/lack of ventilation	9 (13)
Sprayers arrive late	9 (13)
IRS hours limited; need to increase time options (including weekends)	7 (11)
Not necessary/not at risk	7 (10)
Spraying left stains on the walls	3 (4)
Not at home at the time of spraying	3 (4)
Closed room – no ventilation to let fumes out	2 (3)
Bothersome to have to wait outside while spraying happens	2 (3)
No barriers to IRS	2 (3)
Main personal reasons to reject IRS	
Everyone works and the hours are inconvenient	17 (12)
Does not feel is necessary to do IRS	11 (8)
Concerned about health impacts of IRS	9 (6)
Difficult to prepare the home (e.g. move furniture)	7 (5)
Not at home when IRS team came	6 (4)
Could not open all rooms of the home (e.g. tenants)	4 (3)
IRS personnel did not come at the scheduled time	3 (2)
Do not trust IRS personnel (e.g. concerns about theft, that personnel are checking out their homes)	3 (2)
Strong odor/inadequate ventilation in the homes	1 (1)
N/A – Accepted IRS	39 (28)

^aParticipants were allowed to give more than one response ($n = 148$).

Table 5Ideas and incentives for increasing participation in IRS campaigns in Arequipa, Peru. ($n = 71$).

Ideas for increasing participation ($n = 127$ responses)	% (n)
Provide more information: talks in community, health workers, mass media, community meetings	42 (53)
Increase schedule of available spray days/times	22 (28)
Help people prepare houses for spraying (e.g. move furniture)	7 (9)
Spray only houses at risk (e.g. houses where chirimachas are found, houses that have animals)	6 (7)
Use different insecticide (e.g. less toxic, less odorous)	5 (6)
Give fines to those who refuse to participate	4 (5)
Increase frequency of sprays; make campaign annual	3 (4)
Ensure all IRS staff show proper identification (e.g. increase trust, avoid theft)	2 (3)
Ensure IRS team punctuality	2 (3)
Return to those homes that refused the first time	2 (2)
Ensure local government continues caring for the health of the community	2 (2)
Other	4 (5)
If asked for more information, what new or additional information is needed? ($n = 45$)	
Information about Chagas (e.g. symptoms, risks)	42 (19)
Information about IRS (e.g. logistics, preparation, effects)	33 (15)
Information about triatomines (e.g. what they look like, how they infect people)	13 (6)
Information about the IRS campaign in general	4 (2)
Deliver information more calmly	4 (2)
Make the information easier to understand	2 (1)
Would an incentive work?	
Yes	20 (14)
Maybe	27 (19)
No	54 (38)
Do they consider themselves at risk for Chagas	
Yes	27 (19)
No	17 (12)
'It can be acquired anywhere'	9 (6)
Feels worried about Chagas	7 (5)
Not as much at risk if you get treated quickly	4 (3)
Doesn't know enough about Chagas	32 (23)
Not discussed	4 (3)