***Project Title:** Assessing ZIKV transmission dynamics and mitigation strategies. A multidisciplinary approach.

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***Location of study:** Argentina, Colombia y Ecuador.

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***Report type:** Final Technical Report

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ii) Executive summary

This project was performed in three Latin American countries that have different epidemiological and ecological settings of Zika virus transmission: Colombia, Argentina and Ecuador, with the objective of characterizing the ecological transmission dynamics of Zika virus (ZIKV) and designing integrated intervention approaches. In each country entomological, socioeconomic and climate data were collected monthly over 12 months in neighborhoods of different socioeconomic status. *Aedes aegypti* and *Aedes albopictus*, the main vectors of dengue, chikungunya and Zika viruses, were collected and females were processed for viral molecular detection. Additionally, a disease history model to quantify the population-level ZIKV burden was developed.

In Colombia, *Ae. aegypti* was collected in all sampled neighborhoods and a greater abundance of mosquitoes was collected in low compared to high socioeconomic status neighborhoods, more mosquitoes were captured in the intradomicile space, and females were more abundant than males. In total, four *Ae. aegypti* pools (0.888%) were positive for dengue virus serotype 1 (DENV-1) and one pool was positive for chikungunya virus (0.222%). Infected females were only collected in neighborhoods of low socioeconomic status, and mainly in the intradomicile space. Zika virus was not detected in mosquitoes, three years after its introduction to the country.

In Ecuador, *Ae. aegypti* mosquitoes were collected in the four neighborhoods of Manta city. When considered the socioeconomic status (SES), middle and high SES neighborhoods presented the highest abundance of adult and immature *Ae. aegypti* collected mosquitoes. Furthermore, higher abundance of *Ae. aegypti* mosquitoes were collected in the intradomicile space, no statistical differences were found between the number of males and females collected. When considering the collecting method, the aspirator captured the highest number of specimens. Two pools were positive for dengue serotype 2 (DENV-2) and for chikungunya virus (CHIKV), giving a percentage of positive pools of 1.1% and a M.I.R. of 5.35 for both DENV-2 and CHIKV. Positive pools were from the same low SES neighborhood (2 de Agosto), and were mainly collected in the intradomicile space. Zika virus was not detected.

In Argentina, adults *Ae. aegypti* were collected every fortnight throughout 2019 in four neighborhoods of Posadas, alongside with a household questionary. Mosquito abundance, in this case, was lower in the two low SES neighborhoods compared with records in high SES areas. More females than males were collected using four trap methods, being aspirators the most efficient one (65%), particularly in capturing fed females. None of the 37 *A. aegypti* female pools tested positive for Zika, dengue and chikungunya qPCR assays.

A multicountry analysis based on entomological and socioeconomic data collected in the field in the three countries identified risk factors for *Aedes* mosquito density as a proxy for arbovirus transmission risk. Higher household wealth, better knowledge of arboviruses, and use of protective measures (e.g. empyting of containers) were associated with lower density of adult female *Aedes* mosquitoes, while a higher number of household occupants, presence of points of entry for mosquitoes into the household, and the presence of decorative or ornamental plants were associated with higher vector density. A complex relationship between household wealth and neighborhood poverty was observed, highlighting the importance of neighborhood level factors in addition to household-specific risk factors.

A ZIKV disease history model was developed to quantify the population-level ZIKV burden of disease for Colombia using simulation. So far, the individual risk of infection has been calculated and a preliminary calibration of the model has been performed.

iii) The research problem

This project was proposed with the objective of characterizing the ecological transmission dynamics of ZIKV and design integrated intervention approaches. The project was formulated after the detection of ZIKV in Brazil in 2015, and its rapid spread between 2015-2016 to 48 countries and territories in the Americas, with approximately 1.5 million cases. In February 2016, the World Health Organization (WHO) declared a Public Health Emergency of International Concern, considering patterns of rapid spread, broad geographical distribution of ZIKV vectors, scientific consensus that ZIKV is a cause of congenital malformations and neurological complications, lack of vaccines, and the absence of population immunity in newly affected areas. Since the spread of ZIKV and the original formulation of this project, studies have been performed that have contributed to understanding the nutritional factors and medical conditions that influence the outcome of the disease. Research has also been done concerning the capacity and competence of ZIKV vector species. However, knowledge gaps in relation to ecoepidemiology transmission dynamics of ZIKV remained and the effectiveness and cost-effectiveness of interventions is poorly understood. In this project, we studied ZIKV ecological transmission dynamics in three Latin American countries (Argentina, Colombia, Ecuador) that have different eco-epidemiological settings. As the mosquitoes, *Ae. aegypti* and *Ae. albopictus* are also dengue and chikungunya vectors, additionally we studied transmission dynamics of these two arboviruses.

iv) Progress towards milestones

The objective of this project was to characterize the ecological transmission dynamics of Zika virus (ZIKV) and design integrated intervention approaches. In order to develop this objective, the project had two aims: 1) Characterize ZIKV vector populations, viral genetic diversity and ecological transmission dynamics in three different eco-epidemiological settings (Argentina, Colombia, Ecuador), and predict areas at risk for ZIKV transmission across the Latin American region and 2) Identify a range of integrated ZIKV intervention strategies and assess their comparative effectiveness, economic impact and cost-effectiveness using computer simulation.

Aim 1: In each country, entomological, socioeconomic and climate data were registered. In houses where entomological collections were performed, a questionnaire was applied regarding characteristics such as access to public services, household construction type, demography, mosquito prevention and control and disease knowledge.

Monthly collections of *Ae. aegypti* over 12 months in low and high socioeconomic status neighborhoods provided information for the characterization of vector populations and ecological transmission dynamics. *Aedes* mosquitoes were processed for viral molecular detection (dengue, chikungunya and Zika). Also, factors that may increase the risk of arboviral transmission were identified

Data from mosquito collections and from the household questionnaire are being incorporated in a multicountry analysis using mixed effects statistical regression models in order to investigate the associations between household characteristics and mosquito abundance and to identify determinants of arbovirus vector density.

Aim 2: In each country, entomological, socioeconomic and climate data provided information of intervention strategies.

A ZIKV disease history model was developed to quantify the population-level ZIKV burden of disease for Colombia using simulation. This is a stochastic individual-level microsimulation model. This model incorporates key clinical outcomes related with Zika virus infection (e.g. Neurological and congenital syndromes) and pregnancy loss. Validation of the model is being performed against clinical outcomes from Colombian surveillance system.

v) Synthesis of research results and development outcomes

Aim 1: Characterize ZIKV vector populations, viral genetic diversity and ecological transmission dynamics in three different eco-epidemiological settings (Argentina, Colombia, Ecuador), and predict areas at risk for ZIKV transmission across the Latin American region.

Colombia:

Mosquito sampling: Sampling was performed between June 2018 and May 2019 in Ibagué, Tolima. Neighborhoods in Ibagué were stratified by high/low socioeconomic status (SES) using data from Alcaldía Municipal de Ibagué. Four neighborhoods were randomly selected, with two in each SES stratum, for mosquito collection. Every month, two high and two low SES neighborhoods were sampled and in each neighborhood eight different houses were inspected, to achieve a total annual number of 96 households per neighborhood. In high SES neighborhoods as it was not possible to obtain the desired number of households (96), additional randomly selected high-SES neighborhoods were inspected during the course of the study to achieve the target sample size (Figure 1).

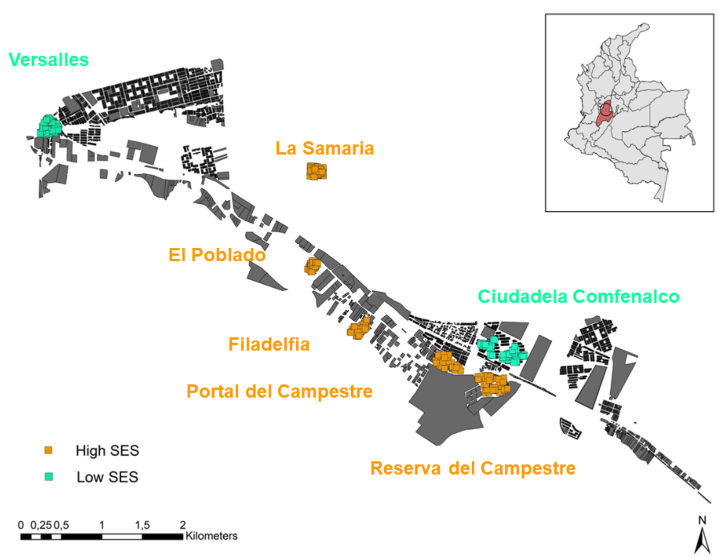


Figure 1. Sampled neighborhoods in Ibagué, Tolima, Colombia

Mosquito abundance: In total, 1,463 *Ae. aegypti* adult mosquitoes were collected, in addition to 7 *Ae. albopictus* individuals, representing the first report for this species in Ibagué. Due to the low number of collections for *Ae. albopictus*, data analyses correspond to *Ae. aegypti*, unless otherwise specified. The average *Ae. aegypti* abundance (mean ± standard deviation; SD) was 3.83 ± 5.31 mosquitoes/household, and more females than males were collected: 2.09 ± 2.97 females/household vs 1.73 ± 2.94 males/household ($Q = 12.44$, $p < 0.001$, $df = 1$). In total, 307 houses (80.36%) were positive for *Ae. aegypti,* and there was a large variation in the number of mosquitoes that was captured per household, as indicated by a coefficient of variation (CV) ≥ 1 (CV= SD/mean = 1.38).
In total, 1,182 *Ae. aegypti* mosquitoes were collected using the aspirator, 243 with the BG sentinel trap, 25 with the resting trap and 13 with the CDC trap. Specifically, 605 females were captured with the aspirator, of which 42.48% corresponded to fed females, and 170 females were collected using BG sentinel traps, of which 8.24% were fed females.

Intradomicile and peridomicile spaces: More mosquitoes were collected using the aspirator in the intradomicile than in the peridomicile space ($Q = 106.67$, $p < 0.001$, $df = 1$) (Figura 2), and additionally, more females ($Q = 138.19$, $p < 0.001$, $df = 1$) and blood fed females ($Q = 98.84$, $p < 0.001$, $df = 1$) were collected in the intradomicile space.

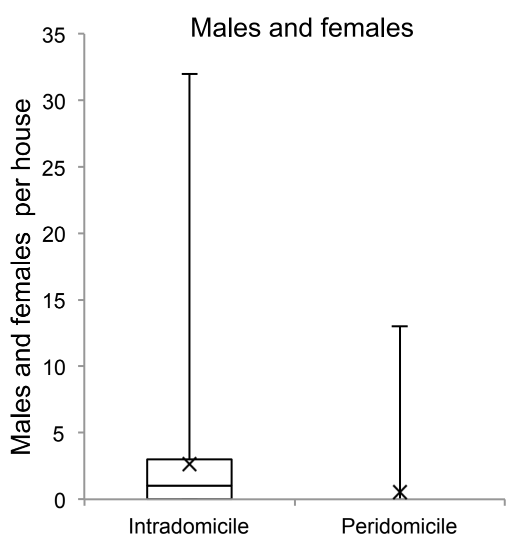


Figure 2. *Aedes aegypti* adults collected per house in intradomicile and peridomicile. The box plot shows the median and interquartile range, mean (x), and maximum (upper bar) values for each category.

In total, 90 breeding sites positive for *Ae. aegypti* and/or *Ae. albopictus* were found in 75 houses, and in most of them (90%), only *Ae. aegypti* was found. In the rest of the breeding sites, the following species were identified: 1.11% only *Ae. albopictus*, 5.56% *Ae. aegypti* and *Ae. albopictus*, 2.22% *Ae. aegypti* and *Culex spp.*, 1.11 % *Ae. albopictus* and *Wyeomyia* *spp*. A higher number of *Ae. aegypti* positive breeding sites were found in the peridomicile than in the intradomicile space (76% in the peridomicile vs 24% in the intradomicile; $p < 0.001$). Most breeding site corresponded to open top water tanks mainly used for laundry (37.5%) (known in Colombia as "albercas"), followed by aquatic plant pots, flower vases or plant pot base plates (26.13%) and buckets (9.09%). The rest of the breeding sites were found in a diverse type of containers such as decorative fountains, bottles, and animal feeders, among others.

Most containers associated with breeding sites were filled by house owners in order to store water (open water tanks and buckets) or to keep ornamental plants (aquatic plant pots, flower vases or plant pot base plates). This means that people help to create these larval habitats, and thus the household residents could also contribute to their control. This highlights the importance of the role of the community on breeding site control, keeping in mind that this requires extensive health education and outreach.

While more adult *Ae. aegypti* mosquitoes were observed in the intradomicile, a higher number of breeding sites was located in the peridomicile, which suggests that oviposition takes place mostly outside the dwelling and mosquitoes come indoors to feed, mate, and digest blood. This suggests that interventions should be addressed towards measures that reduce the entrance of mosquitoes indoors, such as using screens in windows and doors, keeping doors and windows closed, and breeding site control in the peridomicile.

<u>Low and high socioeconomic status neighborhoods</u>:

Mosquitoes were collected in all sampled neighborhoods. However, more *Ae. aegypti* mosquitoes (males and females) were collected in low than in high SES neighborhoods (Mann-Whitney test, $U = 12{,}318$, $p < 0.001$, d.f. = 1) (Figure 3). Analysis performed only with females (Mann-Whitney test, $U = 13{,}087$, $p < 0.001$, d.f. = 1) and with blood-fed females (Mann-Whitney test, $U = 12{,}140$, $p < 0.001$, d.f. = 1) also show a higher abundance in low SES neighborhoods. We did not find significant differences between low and high SES neighborhoods according to the number of households positive for *Ae. aegypti* breeding sites (Fisher test $p = 0.07$).

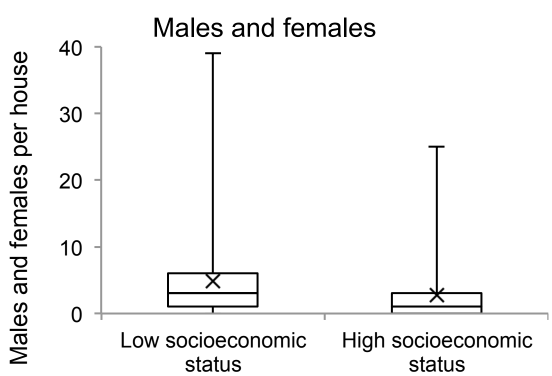
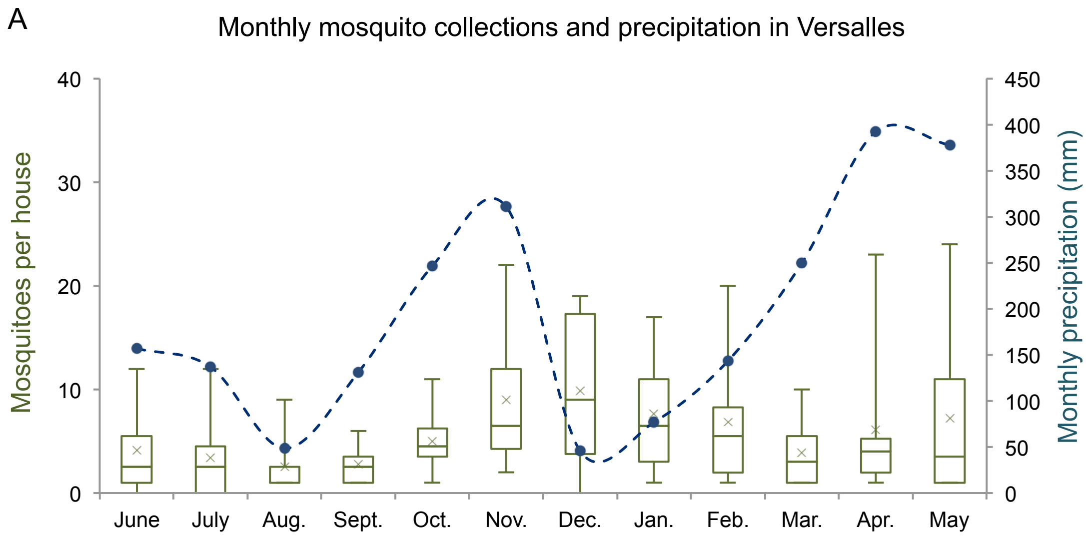


Figure 3. *Aedes aegypti* collected per house in low and high socioeconomic status neighborhoods. The box plot shows the median and interquartile range, mean (x), and maximum (upper bar) values for each category.

Mosquito abundance variation over time:

The analysis of mosquito abundance over time was restricted to the two low-socioeconomic status neighborhoods: Versalles and in Ciudadela Comfenalco, where sampling was performed every month during the study period. Monthly *Ae. aegypti* abundance in Versalles showed a slight bi-modal pattern with peaks in November-January and April-June, while in Ciudadela Comfenalco there was no observable pattern (Figure 4). There were no significant differences in monthly mosquito abundance in either neighborhood (Versalles: H = 15.79, p = 0.139, d.f.= 11; Ciudadela Comfenalco: H = 9.63, p = 0.53, d.f. = 11). In addition, no differences were found in the number of houses positive for presence of breeding sites per month (Versalles: H = 6.24, p = 0.333, d.f. = 11 (Ciudadela Comfenalco: H = 8.22, p = 0.55, d.f. = 11).

Mosquito abundance was not significantly correlated with temperature (Versalles, ρ = 0.020, p = 0.79; Ciudadela Comfenalco, ρ = 0.07, p = 0.85), humidity (Versalles, ρ = 4.80E-5, p = 0.99; Ciudadela Comfenalco, ρ = 5.2E-6, p = 0.88) and precipitation (Versalles, ρ = 0.015, p = 0.41; Ciudadela Comfenalco, ρ = 0.082, p = 0.091). Similarly, these three variables did not show significant associations with breeding site presence (Temperature, Versalles, p = 0.74, R^2 = 0.001, d.f. = 1; Ciudadela Comfenalco, p = 0.6, R^2 = 0.002, d.f = 1; humidity, Versalles, p = 0.95, R^2 = 0.0009, d.f = 1; Ciudadela Comfenalco, p = 0.8, R^2 = 0.001, d.f. = 1; precipitation, Versalles, p = 0.62, R^2 = 0.0031, d.f. = 1; Ciudadela Comfenalco, p = 0.1, R^2 = 0.0071, d.f.= 1).



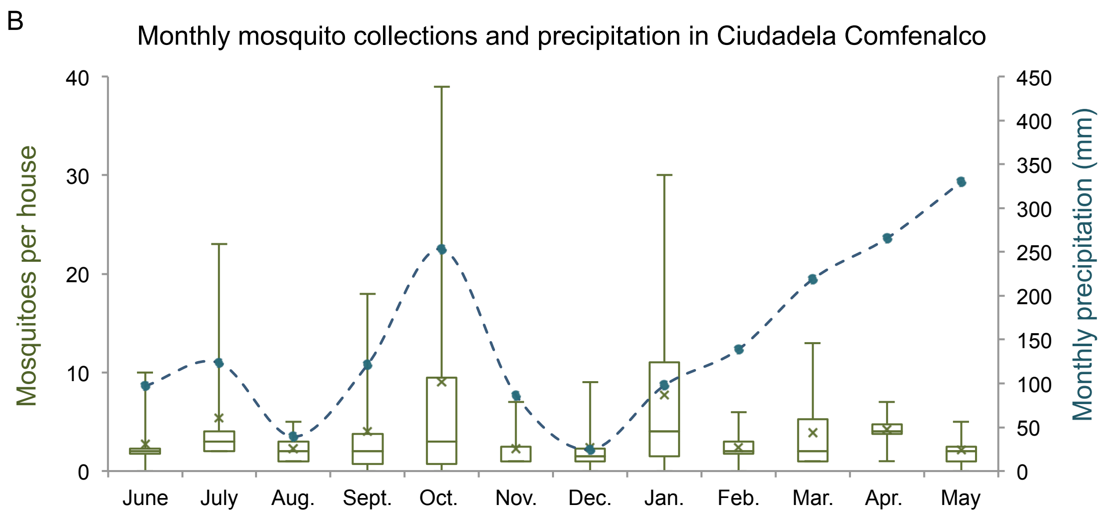


Figure 4. *Aedes aegypti* collected during one-year of monthly collections and monthly precipitation between June 2018 and May 2019. A. Versalles. B. Ciudadela Comfenalco. The box plot shows the median and interquartile range, mean (x), and maximum (upper bar) and minimum values (lower bar) values for each category.

-Virus detection assays:

Virus detection assays were performed on 799 *Ae. aegypti* females, grouped in 450 pools, and seven *Ae. albopictus* individual females. In total, four *Ae. aegypti* pools were positive for DENV-1 and one *Ae. aegypti* pool for CHIKV. Zika virus was not detected. All positive mosquitoes were collected in low SES neighborhoods. Most of the infected females were collected indoors (Table 1). The percentage of positive pools was 0.888% for DENV and 0.222% for CHIKV. The Minimum Infection Rate (M.I.R.) was calculated as number of positive pools/number of processed individuals x 1,000 and the following values were obtained; DENV: 5.006 (4 positive pools/799 total processed individual mosquitoes × 1,000) and CHIKV: 1.256 (1 positive pool/799 total processed individual mosquitoes × 1,000).

Table 1. *Aedes aegypti* mosquitoes positive for arboviruses by neighborhood and location of collection (intra/peridomicile) in Ibagué, Colombia.

Neighborhood	Month	Mosquitoes per pool	ZIKV	DENV	CHIKV	Number of positive individuals per pool	Household area
Versalles	Nov. 2018	2	-	+ (DENV-1)	-	1	Intradomicile

Versalles	Dec. 2018	2	-	-	+	N/A	Intradomicile
Versalles	Feb. 2019	13	-	+ (DENV-1)	-	2	Intradomicile
Versalles	March 2019	3	-	+ (DENV-1)	-	N/A	Intradomicile
Ciudadela Comfenalco	March 2019	6	-	+ (DENV-1)	-	2	Peridomicile

N/A= Undetermined

Blood feeding preferences:

A total 148 *Ae. aegypti* females were processed for blood meal analysis. Human blood was found in 77.7% of the processed samples, with no amplification or inconclusive results in the remaining 22.3% of the samples.

Ecuador

Mosquito sampling: Sampling was performed between February 2019 and February 2020 in Manta, Manabí. Neighborhoods in Manta were stratified by socioeconomic status (SES) using data provided by the National Institute of Statistics and Censuses. Four neighborhoods were selected based on temperature, precipitation and number of reported cases of dengue and Zika. Two neighborhoods were from low SES (2 de Agosto and Urbirríos), one from middle SES (Santa Martha), and one from high SES (Umiña) (Figure 5). Every month, all four neighborhoods were inspected. The aim of the project was to sample eight houses per neighborhood per month, nonetheless this was not possible for Umiña (high SES) where data was collected from five houses on average (ranging from 3 to 7 houses per field trip). Hence, sampling was done in a total of 343 houses between February 2019 until February 2020 in Manta city.

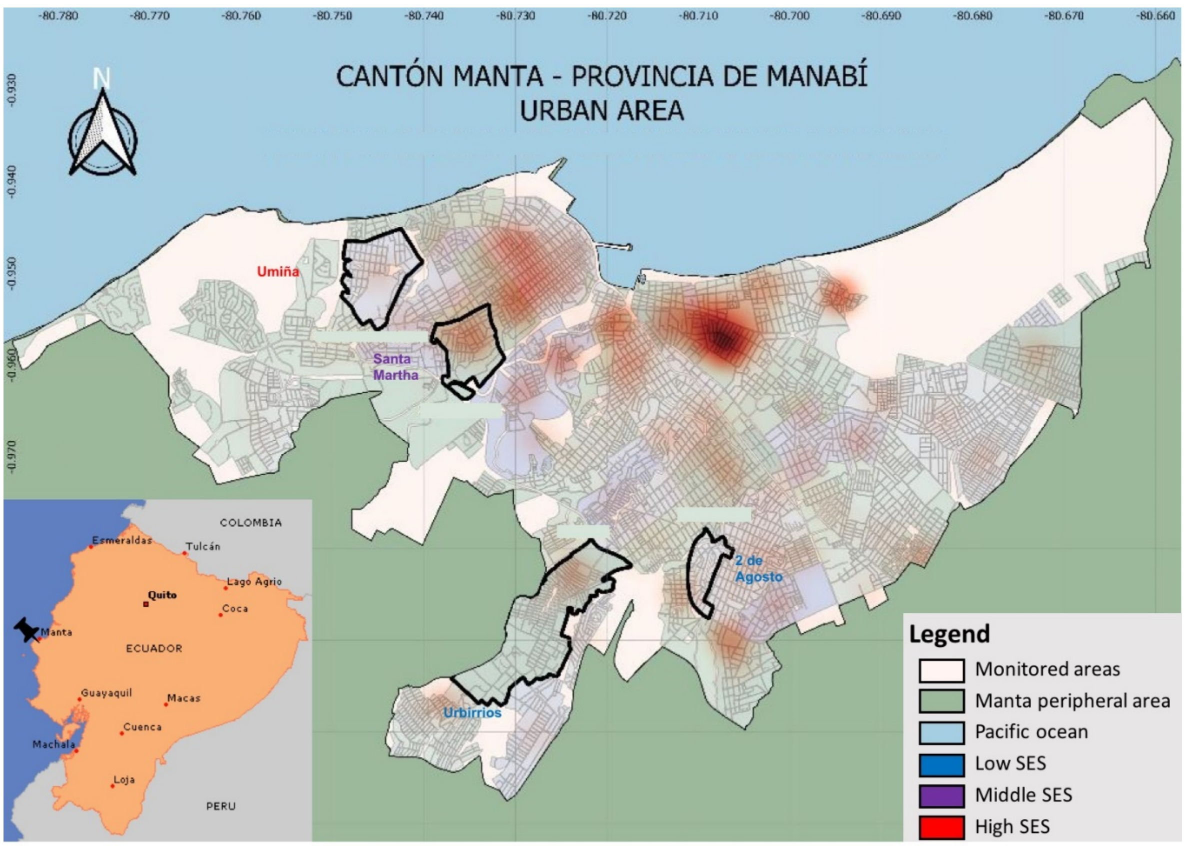


Figure 5. Location map of Manta City (Ecuador) and the four neighborhoods where the collection was carried out between February 2019 until February 2020

Mosquito abundance: In total, 796 *Ae. aegypti* adult mosquitoes were collected, no *Ae. albopictus* individuals were found in Manta. The average *Ae. aegypti* abundance (mean ± standard deviation; SD) was 3.72 ± 4.21 mosquitoes/household. Equal number of females

(2.71 ± 2.75) and males (2.58 ± 2.49) were collected (p= 0.687). In total, 271 houses (58.0%) were positive for *Ae. aegypti,* and there was a large variation in the number of mosquitoes that was captured per household (CV = 1.13).

When considering the collecting method, 378 *Ae. aegypti* mosquitoes were captured using the aspirator, 296 with the BG sentinel trap, 65 with the resting trap and 58 with the CDC trap. Specifically, 225 females were captured with the aspirator, of which 52.89% corresponded to fed females, and 137 females were collected using BG sentinel traps, of which 58.39% were fed females.

Intradomicile and peridomicile spaces: More *Ae. aegypti* mosquitoes were collected using the aspirator in the intradomicile (2.39 ± 2.75) than the peridomicile space (1.76 ± 1.87); however, this difference lacked statistical significance (p= 0.0596). When comparing the amount of female *Ae. aegypti* mosquitoes collected by aspiration, no statistical differences (p= 0.1097) were found between intradomicile (2.21 ± 2.17) and peridomicile space (1.53 ± 1.70). Higher number of fed female *Ae. aegypti* mosquitoes were collected by aspiration in the intradomicile (1.96 ± 1.33) than the peridomicile space (1.07 ± 0.27) (p = 0.0169; Figure 6).

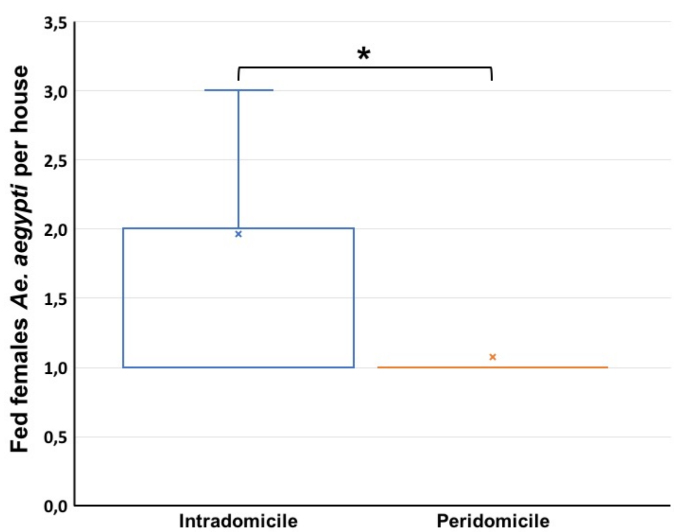


Figure 6. Fed females *Aedes aegypti* collected per house by aspiration in intradomicile and peridomicile. The box plot shows the median and interquartile range, mean (x), and maximum (upper bar) values for each category. *p < 0.05.

We sampled 310 houses for presence of artificial breeding containers for *Ae. aegypti* mosquitoes. A total of 59 houses were positive for *Ae. aegypti* larvae, where 127 positive containers were found. Breteau index (total positive containers / number of houses inspected; BI = 40.97%) showed that the amount of immatures found in the sampled houses represents a medium risk of arbovirus infection. The most common breeding containers were plastic tanks (63.77%), followed by metal tanks (15.94%), and cement tanks (13.04%). The rest of the breeding sites (7.25%) were pots and natural fountains, among others.

Most of the containers were filled by house owners to store water or to keep ornamental plants. Even when people know that keeping open water containers increases the reproduction of mosquitoes (data obtained by analyzing the socioeconomic survey), it seems like better educational campaigns are needed to encourage residents to reduce the risk of contamination by eliminating artificial breeding sites.

Low and high socioeconomic status neighborhoods: More *Ae. aegypti* mosquitoes were collected in high SES ($t = 3.4395$, $df = 151$, SE of difference = 0.674, $p = 0.0008$) and middle SES ($t = 2.6984$, $df = 175$, SE of difference = 0.583, $p = 0.0076$) neighborhoods compared to low SES neighborhoods (Figure 7A). When considering only the females *Ae. aegypti* collected, more mosquitoes were captured in high SES compared to low SES ($t = 2.9825$, $df = 107$, SE of difference = 0.512, $p = 0.0035$). No statistical differences were found between the number of fed females *Ae. aegypti* collected between the three SES ($p > 0.05$). Finally, more breeding sites positive for *Ae. aegypti* were found in high SES ($t = 2.3051$, $df = 49$, SE of difference = 0.089, $p = 0.0254$) and middle SES ($t = 2.1545$, $df = 37$, SE of difference = 0.139, $p = 0.0378$) neighborhoods compared to low SES neighborhoods (Figure 7B).

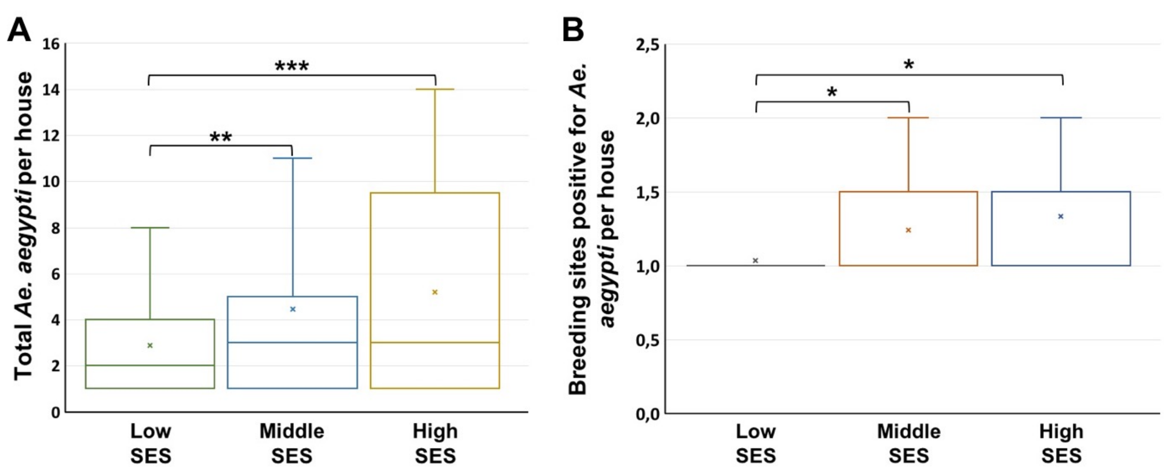


Figure 7. *Ae. aegypti* collected per house in low, middle and high socioeconomic status (SES). A) Total number of adult mosquitoes collected, regardless of sex. B) Breeding sites positive for *Ae. aegypti*. The box plot shows the median and interquartile range, mean (x), and maximum (upper bar) values for each category. *$p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

There is no clear reason as to why there was higher amounts of adult and immature *Ae. aegypti* collected in high and middle SES neighborhoods. According to our observations, within each neighborhood, houses present different SES. Our team is working towards analyzing the information from the survey from the houses that presented more than 10 mosquitoes (outliers).

Mosquito abundance variation over time: Monthly *Ae. aegypti* abundance per house for the four neighborhoods in Manta showed a bi-modal pattern with peaks in March to May and December 2019 to February 2020 (Figure 8). No significant relations were found between mosquito abundance and temperature ($p = 0.0760$, $R^2 = 0.2586$, d.f. = 1.11) or precipitation ($p = 0.0603$, $R^2 = 0.2849$, d.f. = 1.11).

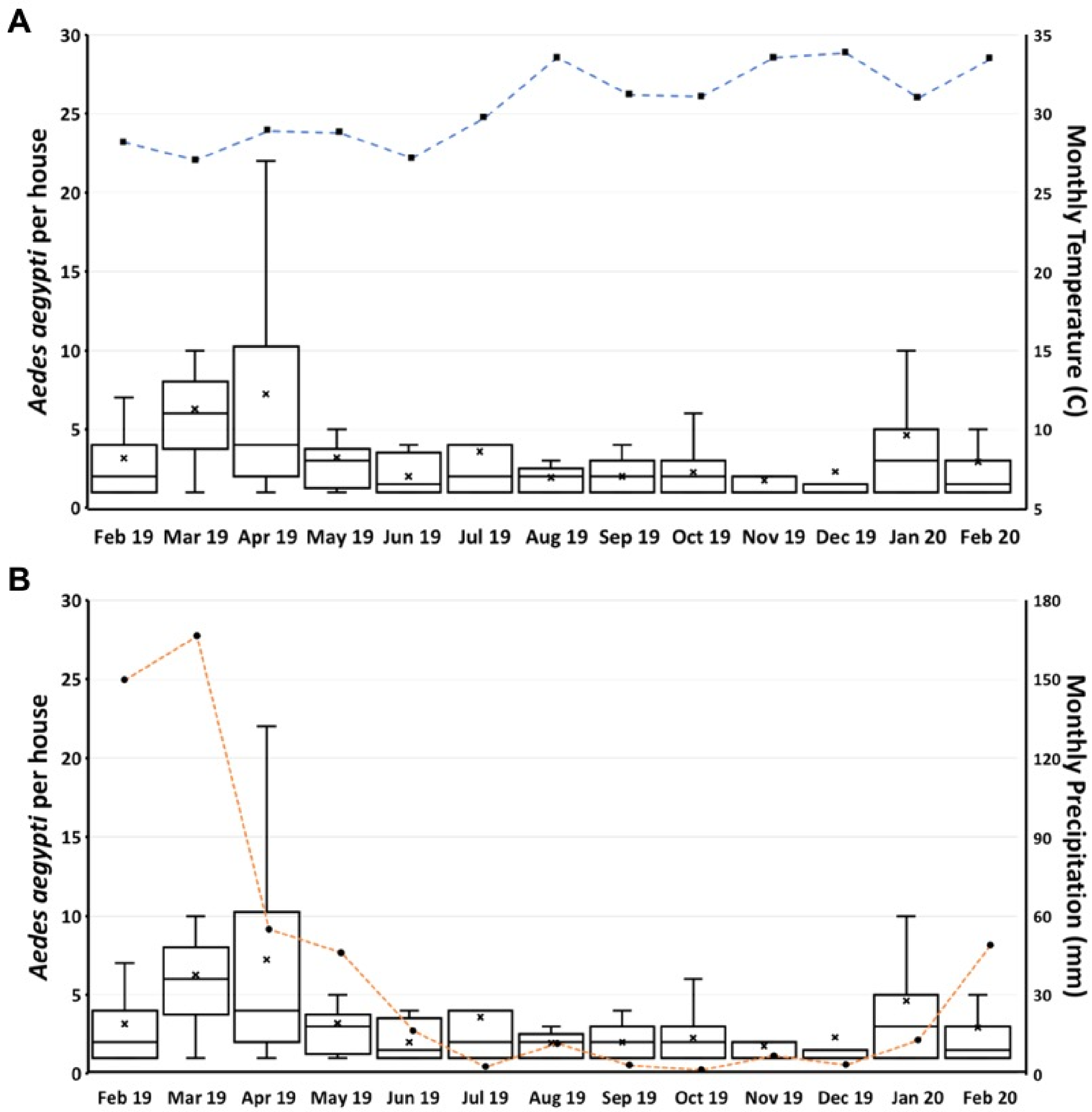


Figure 8. *Aedes aegypti* collected between February 2019 and February 2020 in four neighborhoods of Manta. Comparison between mosquitoes collected per house and monthly temperature (A; blue dotted line) and precipitation (B; orange dotted line). The box plot shows the median and interquartile range, mean (x), and maximum (upper bar) and minimum values (lower bar) values for each category.

Virus detection assays: A total of 374 females *Ae. aegypti* were used for molecular detection of Zika, dengue, and chikungunya viruses. These samples were grouped in 181 pools. From which, two pools tested positive for dengue serotype 2 (DENV-2) and two pools tested positive for the CHIKV. Zika virus was not detected (Table 2). All positive samples were collected in 2 de Agosto, a low SES neighborhood, and most of the collected females were indoors. The percentage of positive pools was 1.1% for DENV and CHIKV, while the M.I.R. was 5.35 for both DENV and CHIKV.

Table 2. Females *Ae. aegypti* that tested positive for arbovirus in Manta, Ecuador.

Neighborhood	Collection Date	Mosquitoes per pool	ZIKV	DENV	CHIKV	Type of trap
2 de Agosto	27/02/2019	1	Negative	Positive DENV-2	Negative	BGS, Intradomestic
2 de Agosto	23/04/2019	3	Negative	Positive DENV-2	Negative	BGS, Intradomestic
2 de Agosto	30/01/2019	3	Negative	Negative	Positive	Aspiration, Intradomestic
2 de Agosto	31/07/2019	2	Negative	Negative	Positive	CDC, Peridomestic

Blood feeding preferences: A total 40 *Ae. aegypti* females were processed for blood meal analysis using the mitochondrial gene cytochrome B (Cyt b). Human blood was found in 77.5% of the processed samples, 5% of the samples were determined as domestic birds, while inconclusive results were found in the remaining 17.5% of the samples.

Argentina

Study site:

The Argentinian study was carried out in Posadas, the capital of Misiones province, NE of Argentina. Field collections were implemented during the first and third week (Monday to Friday) each month from January to December 2019 by setting mosquito traps and completing the household survey in 8 houses /month/neighborhood. The selected 384 houses are evenly distributed across two "Low SES" neighborhoods, San Lorenzo (SL) and Nueva Esperanza (NE), and two "High SES" neighborhoods, Villa Sarita (VS) and Palomar (BP) (Figure 9). The four neighborhoods are located in the riverside where the recorded house distance from the river ranged from 30m to 1700m.

Figure 9. Sampled neighborhoods in Posadas, Argentina. A. Localization of Low SES (blue: SL & NE) and High SES (red: BP & VS) neighborhoods. B. Distribution of collection sites (selected houses in black dots) in NE

Entomological collections:

-Mosquito abundance: In total, 1,020 *Ae. aegypti* adult mosquitoes were collected throughout 2019. The average *Ae. aegypti* abundance was 2.66 ± 4.84

mosquitoes/household, collecting more females (695) than males (325). We found breeding sites positive for *Ae. aegypti* in 63 houses.

Less adult *Ae. aegypti* were captured in Low SES compared with the number of mosquitoes collected in High SES (Figure 10). High SES had higher *Ae. aegypti* counts.

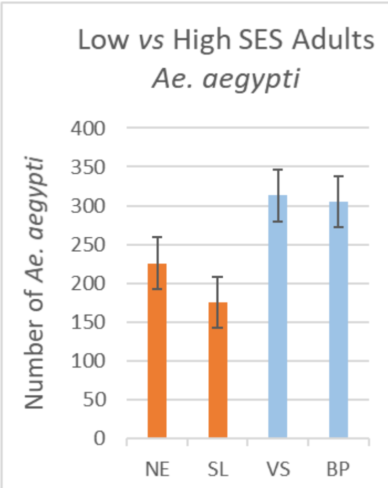
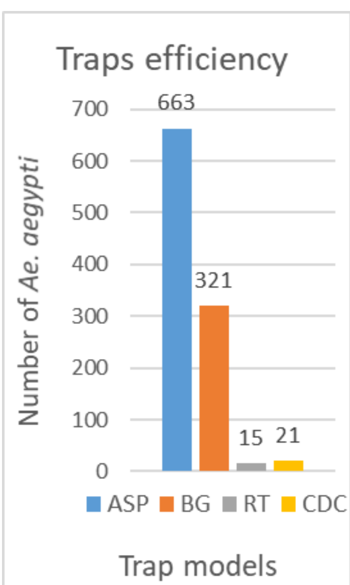


Figure 10. Distribution of mosquitoes captured in four neighborhoods representing two SES.
Amount of *Ae aegypti* sampled in Low (orange) and High (blue) SES neighborhoods.

Efficiency of collecting methods: The performance of four adult mosquitoes collecting methods showed consistent results in all four neighborhoods (Figure 11a). The Prokopack Aspirator model 1419 captured 65% of the adults and 31.5% were collected with the BG-Sentinel trap. When looking at the proportion of fed and unfed females caught using these two collecting methods, the aspirator showed a clear bias towards fed females whereas the BG-Sentinel trap was more efficient in capturing unfed females (Figure 11b).



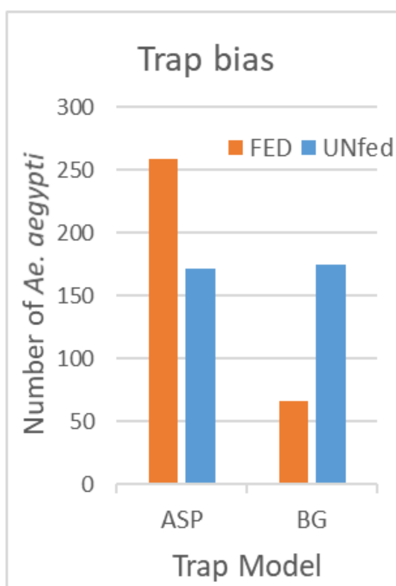


Figure 11: Performance of mosquito collecting methods. A. *Aedes aegypti* captured using Prokopack Aspirator (ASP), BG-Sentinel trap (BG), Resting trap (RT) and CDC (light) mosquito traps.
B. Aspirator captured more fed *Ae. aegypti* females, BG-Sentinel trap captured more unfed.

Monthly mosquito distribution: *Aedes aegypti* abundance showed a bimodal distribution with raising peaks in summer and autumn as expected. We understand this is the first longitudinal adult *Aedes* survey. The relevance of these data resides in the records of late autumn and winter decay in the number of mosquitos, demonstrating the actual presence/proportion of adults in winter, conditioning and shaping the raising slope in springtime (Figure 12). Furthermore, the presence of fed females in June is in line with the tail of dengue cases distribution observed in 2019, and the low but crucial number of fed females in July and August clearly shows the potential of arboviral infections to become endemic.

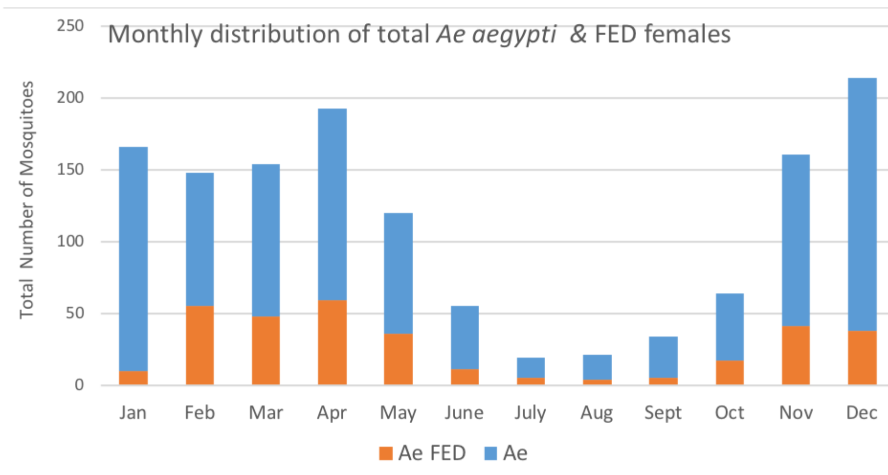


Figure 12. Monthly distribution of adult *Ae. aegypti* collected in all neighborhoods along 2019.
Blue bars indicate total adult *Aedes* counts, and orange bars the proportion of fed females.

Virus detection: Head and thorax of 695 adult females (fed + unfed) were distributed in 37 pools containing up to 20 individuals. Abdomen and two legs were individually kept in microtubes for confirmation assays and feeding preference study. The presence of Zika, dengue and chikungunya viral RNA in pools was evaluated by qPCR using the BioRad ZDC multiplex RT-qPCR kit. We find no evidence of Zika, dengue or chikungunya in any of the 37 pools. Given that all positive ZDC controls and the internal kit control for RNA extraction worked as expected, we considered testing for different potential scenarios leading to negative qPCR results. To evaluate the capacity of ZDC kit in identifying a natural source of viral RNA, we spiked in 2ul of DENV1 and DENV4 virus derived from cell culture extractions resulting in normal qPCR amplification. Also, to test the presence of potential inhibitors in the insect RNA extraction process, we assayed adult *Ae. aegypti* fed females pools collected in the premises of dengue seropositive patients (project and consent forms approved by the Local Ethical Committee), and identified mosquito samples positive for DENV and negative for ZIKV and CHIKV. We conclude that the ZDC RT-qPCR kit is properly working, at least with dengue as access to a source of Zika virus genetic material was not feasible due to the pandemic restrictions, and therefore confirming the absence of Zika, dengue and chikungunya viral RNA in all evaluated pools. We have nevertheless started a revision process of each individual sample carried out by a different person. We did not perform a limit of detection assay for the BioRad ZDC kit. The number of mosquitos in each pool could be a dilution factor for the viral RNA, however protocols and references in the literature demonstrate the identification of a single infected individual in pools of 25 and up to 50 mosquitos.

Feeding preference: The abdomen of 329 fed *Ae. aegypti* females were kept at -80ºC as a potential source of viral RNA and host blood. The feeding preference study has not been carried out in Argentina yet. We will do perform this study after finishing with the re-analysis of each qPCR plot individually as samples may first need to be tested for viral RNA.

Multicountry analysis

The multicountry regression analysis identified several factors that were associated with an increased density of adult female *Aedes* mosquitoes, which represent important risk factors for arboviral disease transmission that can be considered in the design of disease prevention and control strategies. Vector density was found to be lowest in households in the least poor wealth tertile relative to households in the poorer tertiles, however an interaction between household wealth and neighborhood poverty was observed, with the poorest households situated within wealthy neighborhood bearing a disproportionately high density of *Aedes* mosquitoes relative to their wealthier neighbors. This relationship may be confounded by other factors, such as the targeting of vector control measures to poorer neighborhoods; however, this highlights the complex relationship between socioeconomic status and arbovirus risk, and will be explored further in the manusciprt that is in preparation. Household level factors that were associated with vector density, after accounting for differences between neighborhoods and countries and the month of mosquito sampling, include the number of household occupants (RR = 1.08, p = 0.012), knowledge of arboviruses (RR = 0.94, p = 0.042), emptying of containers (RR = 0.79, p = 0.003), and presence of ornamental plants (RR = 0.86, p = 0.034). The importance of household-level risk factors, including the presence of potted plants and other containers as breeding sites for *Aedes* mosquitoes, differed between countries, indicating that knowledge of local population characteristics and practices is needed in developing appropriate disease control strategies.

Aim 2: Identify a range of integrated ZIKV intervention strategies and assess their comparative effectiveness, economic impact and cost-effectiveness using computer simulation.

Colombia:

It is very relevant that several factors that may increase the risk of arboviral transmission were identifed, such as an association of *Aedes* mosquitoes with the intradomicile, their preference for human blood, and a relatively constant abundance of mosquitoes throughout the year. Even though, Zika virus was not detected in collected mosquitoes, the presence of *Ae. aegypti* and *Ae. albopictus* make the population to be at risk of acquiring this virus. An integrated intervention strategy should include housing improvements to reduce mosquito entry, and community participation for the elimination and control of peridomestic breeding sites.

Ecuador:

Several factors could be increasing the risk of arboviral transmission in Manta. For instance, householders keeping water containers outside their homes will provide artificial breeding sites for *Ae. aegypti* mosquitoes. Furthermore, most of the mosquitoes were collected inside the houses and females *Ae. aegypti* mosquitoes preferred to feed on human blood. Considering all these factors, a strategy to mitigate the vector's propagation depends on community participation. A collaborative effort between the community, reducing the amount of artificial breeding sites, as well as the local governments with strategic fumigation campaigns could help reduce the risk of arboviral diseases.

Argentina:

Proactive diagnostics and vector control activities are the most effective strategies in diminishing Zika and other arboviral transmission rates. It is also evident, from the household questionnaire survey, that the number of mosquitos is linked to cultural decisions/behavior. Therefore, the evaluation of these integrated interventions shall be assessed. For instance, how the winter bottleneck in the *Aedes* population, and in the fed females counts, will affect the "seeding" for the next season and the slope of the forthcoming vector population growth and its associated arboviral transmission. The effect is known, but having an actual measurement of the correlation could turn the mosquito counts in July-August into a useful prediction tool.

The lowest mosquito abundance recorded in both Argentinian low SES neighborhoods may well be a consequence of more intensive and dedicated City Council interventions in peripheral poorer areas. We shall investigate the dynamic of interventions in the four neighborhoods in previous years.

Zika natural history model

The structure of the model is finished.

To understand the possible health outcomes related to infection and inform model parameter values, we have conducted five systematic reviews. Two systematic reviews are published, and three are in the final stages.

The Disease History Model is dependent on the individual risk of infection, we therefore developed a SIR (Susceptible, Infected, Removed) transmission model to calculate the force of infection and consequently obtain the individual risk of Zika infection per week in Colombia.

We are currently finishing the 6-parameter calibration process using as target the population growth, the total number of symptomatic infections, the number of GBS cases and other neurologic complications, and the number of congenital zika syndrome for Colombia.

Once we finish the calibration, given the costs and utilities already obtained, we will be able to obtain the results for the Zika burden in Colombia.

vi) Methodology

In each dwelling, mosquitoes were captured using Prokopack (John Hock®) aspirators. In addition, BG sentinel traps (Biogents®) using BG-lure and CDC (John Hock®) and resting traps (BioQuip®) were set up for 24 hours. Differences in mosquito trapping efficiency among the trap models evaluated were consistent in all three countries. These data represented a major learning and helped us to select the right model focusing in project aims and performance of collecting methdos.

In each house, a household questionnaire (Annex 2) was applied and temperature and humidity were registered. In the field, using a dissecting microscope, the species *Ae.*

aegypti and *Ae. albopictus* were identified. Female mosquitoes were kept in RNAlater until reaching the lab and then placed at -80°C in a Revco freezer.

As the mosquitoes *Ae. aegypti* and *Ae. albopictus* are also dengue and chikungunya vectors, we also performed molecular detection of these two viruses. RNA extraction was performed in females with a commercial kit following manufacturer's instructions. For detection of Zika, dengue and chikungunya viral RNA, ZDC Multiplex Real Time RT-PCR Assay (Bio-Rad) was used. Samples that were positive for dengue virus (DENV), were analyzed for serotype determination.

For the multicountry analysis,_mixed effects Poisson regression analysis models were applied to detect associations between household characteristics and adult female *Aedes* mosquito abundance, controlling for clustering by neighborhood and country and the month of sampling, in order to identify determinants of arbovirus vector density across all three study sites. A wealth score was computed for each household using a Principal Components Analysis (PCA) based on ownership of household assets, following the the Demographic and Health Survey (DHS) approach. Households were categorized into tertiles to examine associations between wealth and vector density. Analyses were conducted using the R programming language.

vii) Project Outputs

Colombian results were presented in a Colombian national congress held by the Asociación Colombiana de Parasitología y Medicina Tropical (ACPMT) in December 2019. Results were also shared at the American Society of Tropical Medicine and Hygiene (ASTMH) in November 2020:
-Carrasquilla, M.C., Ortiz, M.I. León, C.M., Rondón, S.Y., Sander, B., Talbot, B., Kulkarni, M., Vásquez, H., González, C. Distribución vectorial e infección por los virus dengue, Zika y chikungunya en Ibagué, Tolima. ACPMT, Cali, Colombia, Dec, 2019. The abstract is open access and it is found at https://revistabiomedica.org/index.php/biomedica/issue/view/171
-Carrasquilla, M.C., Ortiz, M.I. León, C.M., Rondón, S.Y., Sander, B., Talbot, B., Kulkarni, M., Vásquez, H., González, C. Entomological characterization of *Aedes* mosquitoes and arbovirus detection in Ibagué, Colombia. Virtual meeting ASTMH. Nov, 2020.

The following manuscript is in preparation and will be submitted to an open access, peer-reviewed online journal (Parasites & Vectors): Carrasquilla, M.C., Ortiz, M.I. León, C.M., Rondón, S.Y., Sander, B., Talbot, B., Kulkarni, M., Vásquez, H., González, C. Entomological characterization of *Aedes* mosquitoes and arbovirus detection in Ibagué, a Colombian city with co-circulation of Zika, dengue and chikungunya viruses.

Results from Ecuador were presented as an access-free virtual conference entitled "Zika virus transmission dynamics and mitigation strategies: a multidisciplinary approach, in the city of Manta, Manabí-Ecuador". Dec, 2020. This conference was organized by INSPI

(Instituto Nacional de Investigación en Salud Pública "Dr. Leopoldo Izquieta Pérez"), and was attended by people from Quito, Guayaquil and Cuenca.

The following manuscript is being prepared by the Ecuadorian group and will be submitted by the end of March 2021: Villota, S.D., Cotera, M., Benítez, D., Ponce, P., Espinel, M., Cevallos V. Population dynamics of *Aedes aegypti* (Diptera: Culicidae), arboviral vector, a multidisciplinary approach towards mitigation strategies.

Multicountry results from Argentina, Ecuador and Colombia were presented at the ASTMH meeting:
-Talbot, B., Sander B., González, C., Cevallos V., Miretti, M., Espinel, M., Wu, J., Carrasquilla, M.C., Ortiz, M. I., Benítez, D., Ponce, P., Gauto, N., López, K., Carissimo C., Zelaya, F., Litwiñiuk, S, Kulkarni, M.A. Determinants of Arbovirus Vector Density as a Measure of Transmission Risk in Regions of Recent Zika Virus introduction in the Americas. ASTMH virtual meeting. Nov, 2020.

An article is in preparation by Talbot et al. based on the results of the multicountry analysis. The manuscript will be submitted to Parasites & Vectors, an open access, peer-reviewed online journal dealing with the biology of parasites, parasitic diseases, intermediate hosts, vectors and vector-borne pathogens.

Also, the group published the following manuscript in an open access journal:

-Jones R, Kulkarni MA, Davidson TMV, RADAM-LAC Research Team, Talbot B. 2020. Arbovirus vectors of epidemiological concern in the Americas: A scoping review of entomological studies on Zika, dengue and chikungunya virus vectors. *PLoS ONE* 15(2): e0220753. https://doi. org/10.1371/journal.pone.0220753

In relation to the Zika natural history model, when the model is finished, it is planned to publish a manuscript about the ZIKV disease history model to quantify the population-level ZIKV burden of disease for Colombia using simulation. A second manuscript will be about the analysis of potential interventions on the disease and the cost-effectiveness for these different interventions. The following manuscripts have been published in open-access journals:
-Ximenes, R., Ramsay, L. C., Miranda, R. N., Morris, S. K., Murphy, K., & Sander, B. 2019. Health outcomes associated with Zika virus infection in humans: a systematic review of systematic reviews. *BMJ open*, 9(11). https://doi:10.1136/ bmjopen-2019-032275.
-Miranda, R. N., Ximenes, R., Gebretekle, G. B., Bielecki, J. M., Sander, B., Rosas, C. G., ... & Cevallos, V. E. 2020. Health-Related Quality of Life in Neurological Disorders Most Commonly Associated With Zika-Virus Infection: A Systematic Review. *Value in Health*, *23*(7), 969-976.
https://doi.org/10.1016/j.jval.2020.03.004 .

Presentations:

-Ximenes, R., Morris, S., Murphy, K., Ramsay, L., Sander, B. (2018, October). Development of a Disease History Model for Zika Virus (ZIKV) Infection: A Microsimulation Model. In 40th Annual Meeting of the Society for Medical Decision Making. SMDM. Oct, 2018. (Top-Rated Abstracts).
https://smdm.confex.com/smdm/2018/meetingapp.cgi/Paper/12051

-Ximenes, R., Morris, S., Murphy, K., Ramsay, L., Naimark, D.M.J. David MJ. Naimark, Wong, W.L., Sander B. Development and calibration of a dynamic microsimulation of disease history model for Zika virus (ZIKV) infection. Canadian Mathematical Society Winter Meeting. Toronto, ON, Canada. 2019.

-Ximenes, R., Morris, S., Murphy, K., Ramsay, L., Sander, B. Seminar: Zika Team Research: Development of a disease history model for Zika virus infection - A microsimulation model. Maternal-fetal medicine rounds Mount Sinai Hospital. 2019.

Posters:

-Ximenes, R., Naimark, D., Wong, W.W. Sander, B. Calibration of dynamic disease history microsimulation model for Zika virus (ZIKV) infection. 7th International Conference on Infectious Disease Dynamics, Charleston, SC, USA, 2019.

-Miranda RN, Ximenes R, Gebretekle GB, Bielecki JM, Sander B on behalf of the RADAM-LAC Research Team. Impact of Zika virus-associated neurological disorders on health-related quality of life: a systematic review. Poster presentation at the Toronto General Hospital Research Institute Research Day, Toronto, Canada. Oct, 2019.

-Halani, S., Tombindo, P., O'Reilly, R., Bielecki, J. M., Boyle, J., Erdman, L., ... & Sander, B. Clinical Manifestations and Health Outcomes Associated with Zika Virus Infections in Adults: A Systematic Review. In 41st Annual Meeting of the Society for Medical Decision Making SMDM. Oct, 2019.
https://www.ammi.ca/Annual-Conference/2019/Abstracts/JAMMI%202019.pdf

-Miranda, R.N., Ximenes, R., Gebretekle, G.B., Bielecki, J.M., Sander, B. on behalf of the RADAM-LAC Research Team. Impact of Zika virus-associated neurological disorders on health-related quality of life: a systematic review. Poster presentation at the CADTH Symposium. Aug, 2020

In Argentina five reports (local TV and newspaper) were generated to get people informed and involved, about the project activities to be carried out in selected neighborhoods.

-http://www.primeraedicion.com.ar/nota/100076158/estudiaran-aedes-de-posadas-para-ver-si-tienen-dengue-zika-o-chikungunya/

-http://posadas.gob.ar/2019/01/22/dengue-el-municipio-instalo-trampas-para-atrapar-mosquitos-adultos-y-determinar-si-estan-infectados/

-https://www.conicet.gov.ar/crean-un-sistema-para-predecir-brotes-de-dengue-y-zika/

-https://misionesonline.net/2019/05/22/dengue-instalan-trampas-determinar-la-carga-viral-los-mosquitos-adultos/

-http://www.noticiero12.com/index.php/salud/16720-control-de-vectores.html

Also, the Argentinian group participated in the following meetings:

-Litwiñiuk, S., Buemo, C., Argüelles, C., Ferreras, J., Miretti, M. Alerta temprana de potenciales brotes epidémicos de Dengue, Zika y Chikungunya mediante la detección de virus en *Aedes*. Argentina, Posadas. Workshop. Taller internacional. Estrategias de Control del *Aedes aegypti*. CEDIT Ministerio de Industria Provincia de Misiones. Maestría en Salud Pública y Enfermedades Transmisibles, FCEQyN, UNaM, Ministerio de Salud Pública Provincia de Misiones, Municipalidad de Posadas. 2018.

-Gauto, N., Litwiñiuk, S. López, K., Fay, J., Mortada, A., Caríssimo C., Larrondo M., Tressens B., Ferreras, J., Zelaya, F., Mirret, M., RADAM-LAC. Monitoreo en tiempo real de la presencia de arbovirus en mosquitos adultos en Posadas. Argentina. Posadas. Jornada. II Jornada de Virología Aplicada.FCEQyN, Universidad Nacional de Misiones. 2019.

-Miretti, M. Panel de expertos. Salud ambiental en la era del cambio climático. Argentina. Posadas. Workshop. 1 º Workshop regional - Gestión sostenible de residuos/recursos y economía circular. Universidad Nacional de Misiones. Facultad de Humanidades y Ciencias Sociales. 2019.

-Miretti, M. Monitoreo de la circulación de arbovirus en mosquitos adultos de Posadas. Presentation at "Virus Zoonóticos: monitoreo e implicancias en la salud humana y la biodiversidad" Webinar organized by Instituto Misionero de la Biodiversidad –ImiBio– 16/11/2020.
https://m.facebook.com/story.php?story_fbid=1073321119783090&id=152676702081651

In Argentina these activities were not originally planned but were developed as a consequence of being engaged in this project:

1. Research projects:

a– Survey of knock down resistance (kdr) mutations associated with pyrethroid resistance in *Aedes aegypti* populations of Posadas.

b- Identification of dengue virus in patients and *Ae. aegypti* females captured at the dengue case houses. An epidemiological study.

2. Agreements, collaboration and innovation

a– Social and Technological Development Project (PDTS CONICET and Postdoctoral fellowship): A method for real time monitoring of Zika and dengue viral circulation as a tool for epidemic prevention and mitigation.

b–Research collaboration agreement (RCA) between CONICET and Posadas City council to carry out arboviral surveillance.

c– Developing and validation of a novel cheap, portable an scalable CRISPR based diagnostic tool for Zika and Dengue viral infections and epidemiology. Research collaboration results published https://doi.org/10.1080/22221751.2020.1763857

d- Instituto de vectores, Posadas City Council incorporates Adult mosquito surveillance as part of its current protocol, in collaboration with laboratory GIGA, IBS, UNaM - CONICET

3–Community Engagement

Community-based surveillance of *Ae aegypti* in Posadas using ovitraps. A citizen science project. Dr. J. Ferreras, member of this project and director of Café Cientifico Posadas https://sites.google.com/view/cafecientificoposadas/inicio/

4-Training: three undergraduation thesis (Genetics, FCEQyN, UNaM), 1 postdoctoral PDTS fellowship (*Proyecto Desarrollo Tecnológico Social*) from CONICET started in June 2020 under development. A Postdoc, Dr. Buemo, has attended the *Genomics and Clinical Virology* course at the Wellcome Trust Genome Campus, Cambridge, UK.

viii) Problems and Challenges

In the three countries, the standardized sampling was performed monthly during 12 months, however each country started the sampling in a different date, this was mainly due to delays in the establishment of agreements between Latin American institutions.

The Colombian team had technical issues applying the household questionnaire using the software EpiInfo: Difficulty creating the questionnaire template (e.g. Not possible to create a template that showed questions that were not answered), and downloading the data from the tablet to the computer.

In Ecuador, household questionnaires were applied using the app CommCare HQ and a physical registration form. This difference was due to health and safety protocols as some neighborhoods were more dangerous than others. Physical forms were typed into the app once in the lab, this meant that information could be mistyped. Hence, information from household questionnaires needed more work before the analyses could be done.

In Argentina, molecular detection was delayed as the lab in Argentina had a One-Step Plus qPCR machine (Applied Biosystems) that was unable to identify the chikungunya probe in the Primer Design kit. The decision was then to acquire a qPCR equipment with additional light filters to detect the ZDC (Zika, dengue and chikungunya) multiplexed qPCR probes. New equipment (BioRad CFX96 qPCR) and reagents arrived in September 2020.

ix) Administrative Reflections and Recommendations

It would be recommended that contracts are signed directly between IDRC and each one of the participating institutions. This would facilitate contract signing, beginning of activities and money transfer.

ANNEX 1: TRACKING PROGRAM LEVEL INDICATORS

Please provide identifying project information below:	
Project number: 108409-001 **Project title:** Assessing ZIKV transmission dynamics and mitigation strategies. A multidisciplinary approach. **Date this report was prepared:** January 22nd, 2021	
1a. What innovations is your project testing, assessing or adapting to reduce the burden of chronic or infectious diseases? A definition of an innovation is provided in the footnotes for your reference.[1] If your project has been contributing to multiple innovations, please describe them individually.	Ind.#2
In each country (Argentina, Ecuador and Colombia), it was established the socioeconomic and entomological factors that define dengue, chikungunya and Zika transmission dynamics.	0
1b. Of the innovations described in 1a), have any of them been applied at scale? For example, has the innovation been adopted for wide-scale use by a large population, by government, or applied in different contexts, countries, or markets? Explain how this innovation is being applied at scale and what processes have enabled wide-spread use and/or scale-up.	Ind.#3
This project has been performed in three Latin American countries, Argentina, Ecuador and Colombia, which have different arboviral transmission settings. In houses where the project was performed, inhabitants learned about vector borne-diseases prevention and control strategies. Additionally, in each country, this study was performed with public local health authorities.	0
1c. Approximately how many individuals are benefiting from the innovation?	**Ind.#3**
The study was performed in around 384 houses in each country. The inhabitants of each of these houses have benefited as they have learned about vector borne diseases prevention and control strategies. Additionally, local public health authorities have participated during the development of this	

[1] Innovations can be understood as new and significantly improved ways of doing or organizing something, and include the adaptation of existing products or processes to new contexts. They include: products (a market and/or publically distributed good); processes or practises (a new method, skill or behaviour that creates positive change); programs (organizational arrangements or system of services that meets a need for a defined community). Examples of innovations related to reducing the burden of infectious and chronic diseases could include testing: the use of screens in preventing Dengue and other Aedes mosquito transmitted diseases; the potential of community kitchens to provide healthier meals to low-income populations; applying a new methodology to assess food policies and food environments.

project.	
2. Is your project assessing policy effectiveness? If yes, please list and briefly describe what policies the project is assessing, and briefly comment on the relevance and potential impact.	Ind.#4
No	0
3a. List and describe the key activities/mechanisms your project engaged in to inform/influence practice or policy (e.g. multi-stakeholder and community processes, participation in policy dialogues or policy-setting processes, engagement in making policy recommendations, or other relevant actions).	Ind.#5
In each country, researchers went to different houses every month, performed entomological collections and talked about different aspects of vector-borne diseases, such as mosquito life cycle, breeding sites and arbovirus transmission. In houses, positive for breeding sites, these ones were shown to family members, and it was explained how to control them. This interaction between researchers and the inhabitants generated community processes that involved people in the prevention and control of dengue, Zika and chikungunya. In Argentina, kids were involved in the mosquito trap setting and larvae collecting in each house, increasing the chances of a longer term "clean" house.	Choose an item.
3b. Have any of the efforts described in 3a) contributed to new practices or policies *being implemented* or *existing policies/practices being changed* based partly or wholly on the work of the project? How were strategic stakeholders involved in these processes?	Ind.#5

Inhabitants have learned key aspects of mosquito life cycle and the way they can be involved in prevention of Zika, chikungunya and dengue specifically through control of breeding sites. In houses that have positive breeding sites, researchers have taught people how to control them. In Colombia, field activities were performed in collaboration with the Ibagué Health Department. In Ecuador, activities were carried out by Instituto Nacional de Investigación en Salud Pública, which corresponds to the Ecuadorian National Institute of Health. In Argentina, activities have been performed in collaboration with Posadas city council "Instituto de Vectores" and more recently with the provincial Ministry of Health, introducing the new "Adult Mosquito Monitoring Programme" as these institutions only surveyed *Ae. aegypti* larvae and eggs.	0
3c. What was the level of jurisdiction of the policy/policies implemented or changed?	Ind.5

	Identify the policy *e.g. regulation of TV food advertising to children in Peru*	**Select level of jurisdiction** 1= local/municipal/district 2= provincial/sub-national 3= national 4= multinational/international
1.	Identification and control of mosquito breeding sites.	1, 4
2.	Determination of arboviral transmission risk inside the house.	1, 4
3.		

Choose an item.

4a. Did your project intend to specifically benefit women, men, boys or girls or a marginalized group?	Ind.3

Please place an x in the box corresponding to the target group:

Intended to benefit mostly men/boys	
Intended to benefit mostly women/girls	
Intended to equally benefit women/girls and men/boys	x
Intended to primarily benefit a marginalized group	

Choose an

(name of the group):______________	
No intentional focus on gender or a marginalized group	
Not applicable	

item.

4b. Did you investigate how sex, gender, age, education, income, ethnicity, social standing, or other social determinants impact the health of your target population? What did you do to address these factors (for example: collecting disaggregated data, conducting gendered analyses, considering differential impacts to women, men, girls, and boys, using participatory research approaches, etc.)? How did these approaches influence the results and impacts (e.g. research, policies, and innovations)?	Ind.6
Entomological collections, including dengue, chikungunya and Zika viral detection were performed in low and high socioeconomic status neighborhoods. A household questionnaire regarding characteristics such as access to public services, household construction type, demography, mosquito prevention and control practices and disease knowledge, was applied in each of the sampled houses. It is being investigated the association between household characteristics and mosquito abundance, to identify determinants of arbovirus vector density. The research project established how different social, economic and cultural factors influence the dynamics of dengue, chikungunya and Zika transmission in three Latin American countries: Argentina, Ecuador and Colombia.	0
5. Did your project include economic analyses/modeling (e.g. costing, cost-benefit analysis, etc.)? If yes, what was the purpose of including these elements and how are they contributing to achieving your project objectives?	Ind.#1
It is being developed a ZIKV disease history model to quantify the population-level ZIKV burden of disease for Colombia using simulation. The purpose is to determine ZIKV burden in terms of costs and QALYs. It is contributing to our objective as an analysis of potential interventions on the disease is being performed in order to assess the cost-effectiveness of these interventions.	0
6. List all *peer-reviewed* articles that your project has published? Please do not include other types of publications here.	Ind.#11,12

Please list:

	Title	Journal name	Primary author	Open access (Yes/ No)
1.	Arbovirus vectors of epidemiological concern in the Americas: A scoping review of entomological studies on Zika, dengue and chikungunya virus vectors	PLOS ONE	Reilly Jones	Yes
2.	Health outcomes associated with Zika virus infection in humans: a systematic review of systematic reviews.	BMJ open	Raphael Ximenes	Yes
3.				
4.				
5.				

Choose an item.

7. Have individuals involved in your project accomplished one of the following achievements listed below, due in part to their involvement in this project? Is yes, please list the name and sex of the individual and describe the accomplishment. Indicate if any of these individuals are Canadian placing an 'x' in the box labelled 'CAD'.

Ind. #10a, 10b, 10c

a) received awards and other honours;

b) influenced or advised policies;

c) expanded the adoption of effective practices, including in new settings/populations;

d) other significant achievements

Please list:

0

	Name	Female/ Male	CAD	Brief description of accomplishment
1.	Sergio Litwiniuk	Male		d) Volunteering scheme. Sequence Analyses

2.	Marcos Miretti	Male		b) and c)
3.	María C. Carrasquilla	Female		a) ASTMH (American Society of Tropical Medicine and Hygiene) Young Investigator Award - International Student Travel Award, 2020
4.	Marcos Miretti	Male		a) Award obtained due to "Excelencia en método, aspectos éticos y resultados aplicables en políticas sanitarias en Misiones". Presentation: "Monitoreo en tiempo real de la presencia de arbovirus en mosquitos adultos en Posadas" Awarded by the Comité de Etica e Investigación provincial, Ministerio de Salud, Provincia de Misiones. 17/10/2019.
5.	Marcos Miretti	Male		a) Award obtained due to contributions made by the project: "Proyecto *Aedes* Adultos" to the Instituto de Vectores. Awarded by Municipalidad de Posadas. Posadas (Posadas city council) 10/12/2019.

8. Has your project supported any Masters students, PhD students, or post-doctoral fellows? If yes, please list the name, sex, and nationality of the individuals, and their status as Master's students, PhD students or post-docs. Indicate if any of these individuals are Canadian by placing an 'x' in the box labelled 'CAD'. Ind. #8, 9

Please list: 0

	Name	Female/ Male	CAD	Master/PhD/ Post-doc
1.	María Cristina Carrasquilla, Colombian	Female		Post-doc
2.	Mario Iván Ortiz, Colombian	Male		Post-doc
3.	Jessica Vanina Fay, Argentinian	Female		Post-doc
4.	Dennise Benítez, Ecuadorian	Female		Post-doc
5.	Stephany Villota, Ecuadorian	Female		Post-doc
6.				

9. Has your project or its findings been cited in the media? Please provide the title of the media

citation and an accompanying web-links for the *most relevant* citations *linked to important achievements of the project*.	
Please list:	0

	Title	Description in English (optional)	Website link
1.	**Dengue: instalan trampas para determinar la carga viral de los mosquitos adultos**	Dengue: Setting up traps to investigate viral load in adult mosquitoes	https://misionesonline.net/2019/05/22/dengue-instalan-trampas-determinar-la-carga-viral-los-mosquitos-adultos/
2.	**Dengue: instalan trampas para determinar la carga viral de los mosquitos adultos**	Dengue: Setting up traps to investigate viral load in adult mosquitoes	https://www.elterritorio.com.ar/dengue-en-posadas-instalan-trampas-para-determinar-la-carga-viral-de-los-mosquitos-adultos-30381-et
3.	**Control de Vectores.**	Vector Control.	http://www.noticiero12.com/index.php/salud/16720-control-de-vectores.html
4.	**Estudio de *Aedes* de Posadas para detección de dengue, Zika o chikungunya**	*Aedes* studies in Posadas to investigate if they carry dengue, Zika or chikungunya	http://www.primeraedicion.com.ar/nota/100076158/estudiaran-aedes-de-posadas-para-ver-si-tienen-dengue-zika-o-chikungunya/
5.	**Dengue: El municipio instaló trampas para atrapar mosquitos adultos y determinar si están infectados**	Dengue: Mosquitoes were collected and virus detection was performed.	http://posadas.gob.ar/2019/01/22/dengue-el-municipio-instalo-trampas-para-atrapar-mosquitos-adultos-y-determinar-si-estan-

			infectados/
6.	**Zika project**	Explanation of IDRC Zika project	https://www.youtube.com/watch?v=Q8bb3yVGr2o
7.	**Crean un sistema para predecir brotes de dengue y Zika**	Mosquito and arbovirus surveillance	https://www.conicet.gov.ar/crean-un-sistema-para-predecir-brotes-de-dengue-y-zika/
8.	**Zika project in Colombia**	Interview at a local radio station. Project activities, basic mosquito ecology and biology are explained.	Radio interview at local radio station: Informativo 4:30 con Germán Cediel, Tolima Stereo 92.3 F.M, Ibagué, Colombia.
9.			
10.			

For internal use only: **To be completed by IDRC's responsible Program Officer**

Please complete the relevant sections directly within the FEH database:
http://ic.idrc.ca/sites/feh/_layouts/15/DocIdRedir.aspx?ID=IC16-1689834993-197

Identify the project as: Gender neutral, Gender sensitive, Gender specific, Gender transformative

- Gender neutral (not applicable): gender is not an operative variable or concept for this project.
- Gender blind: ignored gender variables and did not promote gender equity.
- Gender sensitive: considers gender variables, but does not (yet) involve action to address them.
- Gender specific: acknowledges gender norms, roles and responsibilities and promotes gender-specific improvements.
- Gender transformative: examines, questions and aims to change norms, roles and inequalities toward greater equity

Transformative organizations:

From the organizations involved in this project, indicate which ones were supported to build organizational capacity so that they are now in a position to play a more transformative role in their field or community? Place a check in the 'CAD' column if they are a Canadian organization.

Name of organization	Brief description of the specific means/activities by which the project supported increased organizational capacity	CAD

Contribution to IDRC's development outcomes

If the project contributes in a significant way to one or more of the 3 development outcomes, provide a short description of its contribution below. There is no need to complete this section for all projects, but only those with the most relevant stories that are of interest for the program to highlight.

Health for all:

Economic empowerment:

Gender empowerment:

Do any of the achievements described in this report or in relation to the development outcomes have the potential as a **communications story**? If so, briefly describe:

Annex 2

Assessing ZIKV transmission dynamics and mitigation strategies. A multidisciplinary approach.	FORMATO 01: RECOLECCIÓN DE DATOS SOCIO-ECONÓMICOS EN VIVIENDAS		Código:	001
	Macro-Proceso: Centro de Investigación de Vectores Artrópodos	Proceso Interno: Dinámica de Zika	Edición:	03 DV
			Fecha aprobación:	08/03/2018

Fecha de colecta	Código Geográfico	Localidad	Fuente Georeferenciación	Altitud	Colectores	Página
20__ __ __ (AÑO MES DÍA)	__ __ __ __ (PRV DST CRC SBC)					1/4

Número de casa	Número de muestras colectadas															

CARACTERÍSTICAS DEL HOGAR

Código	Pregunta	Opciones								
HC1	Años viviendo en esta residencia	años								
HC2	Su casa cuenta con: (Escriba 0/1 para cada item)	a) Radio b) Televisión c) Refrigerador d) Aire acondicionado e) Computador f) Generador, batería, panel solar g) Bicicleta h) Motocicleta i) Auto o Camión	a) b) c) d) e) f) g) h) i)	a) b) c) d) e) f) g) h) i)	a) b) c) d) e) f) g) h) i)	a) b) c) d) e) f) g) h) i)	a) b) c) d) e) f) g) h) i)	a) b) c) d) e) f) g) h) i)	a) b) c) d) e) f) g) h) i)	a) b) c) d) e) f) g) h) i)
HC3	Su vivienda es	a) Propia b) Arrendada c) Familiar	a) b) c)	a) b) c)	a) b) c)	a) b) c)	a) b) c)	a) b) c)	a) b) c)	a) b) c)

CARACTERÍSTICAS OBSERVADAS EN EL HOGAR

Código	Pregunta	Opciones								
OB1	Coordenadas GPS	Latitud Y (Norte-Sur)								
		Longitud X (Oeste)								
OB2	Tipo de residencia	a) Casa independiente b) Edificio	a) b)	a) b)	a) b)	a) b)	a) b)	a) b)	a) b)	a) b)
OB3	¿Cuántos pisos y núcleos familiares tiene el hogar?	Pisos								
		Núcleos familiares								
OB4	Distancia en metros de la casa más cercana	Metros								
OB5	¿Tiene electricidad?	a) No b) Si	a) b)	a) b)	a) b)	a) b)	a) b)	a) b)	a) b)	a) b)
OB6	Tipo de material del techo de la casa	a) Temporal bambú, paja, hierba, heno, hojas b) Permanente Madera, concreto, ladrillo, piedra, hierro/ aluminio galvanizado, fibrocemento, otras hojas de metal	a) b)	a) b)	a) b)	a) b)	a) b)	a) b)	a) b)	a) b)
OB7	Material principal del piso de la casa	a) Natural: tierra, arena, arcilla b) Rudimentario: madera, palma, bambú c) Terminado: Parqué o madera lacada, vinil, asfalto, cerámica, cemento, baldosa.	a) b) c)	a) b) c)	a) b) c)	a) b) c)	a) b) c)	a) b) c)	a) b) c)	a) b) c)
OB8	Material principal de las paredes de la casa	a) Temporal bambú, paja, hierba, caña, tierra, materiales rescatados, heno, hojas b) Permanente Madera, concreto, ladrillo, piedra, hierro/ aluminio galvanizado, fibrocemento, otras hojas de metal	a) b)	a) b)	a) b)	a) b)	a) b)	a) b)	a) b)	a) b)
OB9	Presencia de contenedores que puedan acumular agua en el jardín	a) No b) Si	a) b)	a) b)	a) b)	a) b)	a) b)	a) b)	a) b)	a) b)
OB10	Tipo de contenedores	a) Tanques de agua sin protección b) Contenedores grandes usados para almacenamiento de agua c) Botellas d) Otros contenedores	a) b) c) d)	a) b) c) d)	a) b) c) d)	a) b) c) d)	a) b) c) d)	a) b) c) d)	a) b) c) d)	a) b) c) d)

DISPONIBILIDAD DE AGUA

Código	Pregunta	Opciones								
WS1	Principal fuente de agua potable para tomar	a) Agua entubada b) Agua de pozo c) Agua de manantial d) Lluvia e) Embotellada f) Otra (especificar)	a) b) c) d) e) f) ___	a) b) c) d) e) f) ___	a) b) c) d) e) f) ___	a) b) c) d) e) f) ___	a) b) c) d) e) f) ___	a) b) c) d) e) f) ___	a) b) c) d) e) f) ___	a) b) c) d) e) f) ___
WS2	Principal fuente de agua usada para otros propósitos (limpieza, lavado y cocina)	a) Agua entubada b) Agua de pozo c) Agua de manantial d) Lluvia e) Embotellada f) Otra (especificar)	a) b) c) d) e) f) ___	a) b) c) d) e) f) ___	a) b) c) d) e) f) ___	a) b) c) d) e) f) ___	a) b) c) d) e) f) ___	a) b) c) d) e) f) ___	a) b) c) d) e) f) ___	a) b) c) d) e) f) ___

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Fecha de colecta	Código Geográfico	Localidad	Fuente Georeferenciación	Altitud	Colectores	Página
20__ __ __ AÑO MES DÍA	__ __ __ __ PRV DST CRC SBC					2/4

Número de casa	Número de muestras colectadas									
WS3	¿Tiene problemas de abastecimiento de agua?	a) No (ir a WS5) b) Si	a) b)	a) b)	a) b)	a) b)	a) b)	a) b)	a) b)	a) b)
WS4	¿Con qué frecuencia tiene el servicio de agua en la casa?	a) Más de una vez al día b) Diario c) Pasando un día d) Semanal e) Impredecible	a) b) c) d) e)	a) b) c) d) e)	a) b) c) d) e)	a) b) c) d) e)	a) b) c) d) e)	a) b) c) d) e)	a) b) c) d) e)	a) b) c) d) e)
WS5	¿Almacena agua?	a) No (fin de la sección) b) Si	a) b)	a) b)	a) b)	a) b)	a) b)	a) b)	a) b)	a) b)
WS6	¿Para qué propósito almacena agua? (seleccione todos los que aplican)	a) Tomar b) Limpieza c) Lavado d) Cocinar e) Otra (especificar)	a) b) c) d) e)____	a) b) c) d) e)____	a) b) c) d) e)____	a) b) c) d) e)____	a) b) c) d) e)____	a) b) c) d) e)____	a) b) c) d) e)____	a) b) c) d) e)____
WS7	¿Cepilla los contenedores después de remover el agua?	a) No b) Si	a) b)	a) b)	a) b)	a) b)	a) b)	a) b)	a) b)	a) b)
MANEJO DE DESECHOS										
WD1	¿Cómo se eliminan las aguas negras en su hogar?	a) Alcantarilla b) Letrina c) Pozo séptico d) Otro (especificar)	a) b) c) d)____	a) b) c) d)____	a) b) c) d)____	a) b) c) d)____	a) b) c) d)____	a) b) c) d)____	a) b) c) d)____	a) b) c) d)____
WD2	¿Cómo elimina la basura en su hogar?	a) recolección municipal o privada b) desecho en una ubicación dentro de la propiedad c) desecho en una ubicación fuera de la propiedad d) desecho irregular e) Otro (especificar)	a) b) c) d) e)____	a) b) c) d) e)____	a) b) c) d) e)____	a) b) c) d) e)____	a) b) c) d) e)____	a) b) c) d) e)____	a) b) c) d) e)____	a) b) c) d) e)____
WD3	Frecuencia de recolección de basura	a) Diario b) Pasando un día c) Semanal d) Mensual e) Impredecible	a) b) c) d) e)	a) b) c) d) e)	a) b) c) d) e)	a) b) c) d) e)	a) b) c) d) e)	a) b) c) d) e)	a) b) c) d) e)	a) b) c) d) e)
PREVENCIÓN DE MOSQUITO Y MEDIDAS DE CONTROL										
MP1	¿Utiliza insecticida en su hogar por su propia cuenta?	a) No (ir a MP5) b) Si	a) b)	a) b)	a) b)	a) b)	a) b)	a) b)	a) b)	a) b)
MP2	¿Con qué frecuencia?									
MP3	¿Cuándo fue la última vez? (DD/MM/AAAA)		__/__/____	__/__/____	__/__/____	__/__/____	__/__/____	__/__/____	__/__/____	__/__/____
MP4	¿Cuál fue el producto utilizado?		____	____	____	____	____	____	____	____
MP5	¿Cuándo fue la última visita del Ministerio/Secretaría de Salud para fumigación/abatización? (DD/MM/AAAA)	Fumigación	__/__/____	__/__/____	__/__/____	__/__/____	__/__/____	__/__/____	__/__/____	__/__/____
		Abatización	__/__/____	__/__/____	__/__/____	__/__/____	__/__/____	__/__/____	__/__/____	__/__/____
MP6	¿Cuál de las siguientes medidas utiliza para prevención de picadura de mosquito?	a) Repelente b) Repelente en espiral c) Aerosol d) Toldo e) Tratamiento de cortinas con insecticida f) Malla para ventanas g) Cobertura para contenedores de agua h) Lavado y limpieza de contenedores Frecuencia DD/MM/AAA i) Vaciado de contenedores de agua Frecuencia DD/MM/AAA j) Manejo de desechos en la casa k) Mata moscas l) Ropa protectora m) Otro (especificar)	a) b) c) d) e) f) g) h) __/__/____ i) __/__/____ j) k) l) m)____	a) b) c) d) e) f) g) h) __/__/____ i) __/__/____ j) k) l) m)____	a) b) c) d) e) f) g) h) __/__/____ i) __/__/____ j) k) l) m)____	a) b) c) d) e) f) g) h) __/__/____ i) __/__/____ j) k) l) m)____	a) b) c) d) e) f) g) h) __/__/____ i) __/__/____ j) k) l) m)____	a) b) c) d) e) f) g) h) __/__/____ i) __/__/____ j) k) l) m)____	a) b) c) d) e) f) g) h) __/__/____ i) __/__/____ j) k) l) m)____	a) b) c) d) e) f) g) h) __/__/____ i) __/__/____ j) k) l) m)____

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20__ __ __ (AÑO MES DÍA)	__ __ __ __ (PRV DST CRC SBC)					3/4

	Número de casa	Número de muestras colectadas								
MP7	¿Utiliza malla protectora en ventanas y puertas?	a) No b) Si	a) b)	a) b)	a) b)	a) b)	a) b)	a) b)	a) b)	a) b)
MP8	¿En dónde está ubicado el baño?	a) Dentro del hogar b) Fuera del hogar c) Baño comunitario d) Otro (especificar)	a) b) c) d)____	a) b) c) d)____	a) b) c) d)____	a) b) c) d)____	a) b) c) d)____	a) b) c) d)____	a) b) c) d)____	a) b) c) d)____
MP9	Existen puntos de ingreso de mosquitos aparte de ventanas y puertas	a) No b) Si	a) b)	a) b)	a) b)	a) b)	a) b)	a) b)	a) b)	a) b)
MP10	¿Tiene área verde alrededor de la propiedad?	a) No b) Si	a) b)	a) b)	a) b)	a) b)	a) b)	a) b)	a) b)	a) b)
MP11	¿Existen fuentes de agua cercanas al hogar? Especifique la distancia en metros	a) Ninguna b) Estanque c) Lago d) Zanja e) Canal f) Río	a) b) c) d) e) f)	a) b) c) d) e) f)	a) b) c) d) e) f)	a) b) c) d) e) f)	a) b) c) d) e) f)	a) b) c) d) e) f)	a) b) c) d) e) f)	a) b) c) d) e) f)
MP12	¿Tiene vegetación (natural o cultivada) en su propiedad?	a) No b) Si	a) b)	a) b)	a) b)	a) b)	a) b)	a) b)	a) b)	a) b)
MP13	¿Tiene plantas en macetas en partes altas?	a) No (ir a MP15) b) Si	a) b)	a) b)	a) b)	a) b)	a) b)	a) b)	a) b)	a) b)
MP14	¿Qué tipo de vegetación tiene?	a) Hierba b) Arbustos c) Viñedos d) Huertos e) Árboles f) Otro (especificar)	a) b) c) d) e) f)____	a) b) c) d) e) f)____	a) b) c) d) e) f)____	a) b) c) d) e) f)____	a) b) c) d) e) f)____	a) b) c) d) e) f)____	a) b) c) d) e) f)____	a) b) c) d) e) f)____
MP15	¿Existen criaderos con larvas en la propiedad?	a) No b) Si	a) b)	a) b)	a) b)	a) b)	a) b)	a) b)	a) b)	a) b)
DEMOGRAFÍA DEL HOGAR										
HD1	¿Cuántas personas viven normalmente en el hogar?	a) Adultos b) Niños	a) b)	a) b)	a) b)	a) b)	a) b)	a) b)	a) b)	a) b)
HD2	¿Cuántas personas trabajan/ estudian en el hogar?	Trabajan								
		Estudian								
HD3	¿Cuántas personas saben leer o escribir?									
HD4	¿Cuántas personas son mayores de edad?									
RESPUESTAS DE CONOCIMIENTO (DENGUE)										
RK1	¿Ha escuchado del dengue?	a) No (ir a RK6) b) Si	a) b)	a) b)	a) b)	a) b)	a) b)	a) b)	a) b)	a) b)
RK2	¿Algún mienbro de la familia ha tenido alguna vez dengue?	a) No (ir a RK4) b) Si ¿Cuándo? (mm/aaaa)	a) b) __/____	a) b) __/____	a) b) __/____	a) b) __/____	a) b) __/____	a) b) __/____	a) b) __/____	a) b) __/____
RK3	¿Cuántas personas en el hogar han tenido dengue en el último año?									
RK4	¿Cuántas personas en el hogar han solicitado atención médica por infección con dengue en el último año?									
RESPUESTAS DE CONOCIMIENTO (CHIKUNGUNYA)										
RK5	¿Ha escuchado de chikungunya?	a) No (ir a RK11) b) Si	a) b)	a) b)	a) b)	a) b)	a) b)	a) b)	a) b)	a) b)
RK6	¿Algún miembro de la familia ha tenido alguna vez chikungunya?	a) No (ir a RK9) b) Si ¿Cuándo? (mm/aaaa)	a) b) __/____	a) b) __/____	a) b) __/____	a) b) __/____	a) b) __/____	a) b) __/____	a) b) __/____	a) b) __/____
RK7	¿Cuántas personas en el hogar han tenido chikungunya en el último año?									

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Fecha de colecta	Código Geográfico	Localidad	Fuente Georeferenciación	Altitud	Colectores	Página
20__ __ __ (AÑO, MES, DÍA)	__ __ __ __ (PRV, DST, CRC, SBC)					4/4

Número de casa	Número de muestras colectadas								
RK08	¿Cuántas personas en el hogar han solicitado atención médica por infección con chikungunya en el último año?								

RESPUESTAS DE CONOCIMIENTO (ZIKA)

Código	Pregunta	Opciones								
RK09	¿Ha escuchado del zika?	a) No b) Si	a) b)	a) b)	a) b)	a) b)	a) b)	a) b)	a) b)	a) b)
RK10	¿Ha tenido alguna vez zika?	a) No (ir a RK14) b) Si ¿Cuándo? (mm / aaaa)	a) b) __/____	a) b) __/____	a) b) __/____	a) b) __/____	a) b) __/____	a) b) __/____	a) b) __/____	a) b) __/____
RK11	¿Cuántas personas en el hogar han tenido zika en el último año?									
RK12	¿Cuántas personas en el hogar han solicitado atención médica por infección con zika en el último año?									
RK13	Como se transmite el dengue / zika / chikungunya	a) Identifica los mosquitos como modo principal de transmisión b) No identifica los mosquitos como un modo de transmisión, o lo identifica como un modo secundario de transmisión (Especificar)	a) b) ____	a) b) ____	a) b) ____	a) b) ____	a) b) ____	a) b) ____	a) b) ____	a) b) ____
RK14	¿Cómo se protege de la infección con dengue / zika / chikungunya? (Seleccione toda las que corresponden)	a) Nada b) Elimina agua estancada sin protección dentro/cerca de la casa c) Se protege contra los mosquitos d) Otro (especificar)	a) b) c) d)	a) b) c) d)	a) b) c) d)	a) b) c) d)	a) b) c) d)	a) b) c) d)	a) b) c) d)	a) b) c) d)
RK15	¿Lleva a cabo la comunidad (barrio/conjunto) actividades para prevenir y controlar dengue / chikungunya / zika?	a) No b) Si	a) b)	a) b)	a) b)	a) b)	a) b)	a) b)	a) b)	a) b)
RK16	¿Su familia ha participado en actividades para prevenir y controlar dengue / chikungunya / zika?	a) No b) Si	a) b)	a) b)	a) b)	a) b)	a) b)	a) b)	a) b)	a) b)
RK17	¿Cuáles son los principales problemas en su barrio que contribuyen a la transmisión de dengue / chikungunya / Zika? (Seleccione todos los que aplican)	a) Presencia de contenedores que almacenan agua b) Alta densidad de población humana c) Grandes poblaciones de mosquitos d) Otro (especificar)	a) b) c) d) ____	a) b) c) d) ____	a) b) c) d) ____	a) b) c) d) ____	a) b) c) d) ____	a) b) c) d) ____	a) b) c) d) ____	a) b) c) d) ____

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