

## Major Article

# Assessment of the Housing Improvement Program for Chagas Disease Control in the Northwestern municipalities of Rio Grande do Sul, Brazil

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### Abstract

**Introduction:** The Housing Improvement Program for Chagas Disease Control (HIPCDC) was established in 2001 in Northwestern Rio Grande do Sul State, aiming to improve the conditions of the domiciliary and peridomiciliary environments to make them resistant to triatomine colonization. This study aimed to assess the impact of the HIPCDC on triatomine control by developing local population and authority awareness on the issue. **Methods:** The study was conducted by means of questionnaires applied to local authorities and the program beneficiaries. Three municipalities - Ajuricaba, Coronel Barros, and Crissiumal - were visited. **Results:** A program coordinator from each municipality and 62 individuals from selected households were interviewed. The authorities reported difficulties in the implementation of the program due to differences between the project development period and financial resource availability, in addition to a lack of understanding by the community not included in the program. As for the houses, most improvements were made in the peridomiciliary environments; moreover, construction of 4 new residences, as well as the renovation of others, was also reported. Regarding suggestions to the program, requests for better planning (44.9%) and renovation quality (36.7%) were highlighted. With reference to the presence of triatomine bugs, prior to the HIPCDC adaptations, 12.9% of the respondents reported coming across at least one specimen at home, as compared to 22.6% who found these insects in peridomiciliary areas. **Conclusions:** Despite reports of difficulties in carrying out the HIPCDC, there was an improvement in the housing conditions, with no triatomine occurrence reports after the program implementation.

**Keywords:** Epidemiological surveillance. Triatomines. *Trypanosoma cruzi*.

### INTRODUCTION

Chagas disease (CD), also known as American trypanosomiasis, whose etiologic agent is the protozoan *Trypanosoma cruzi*, is considered a neglected tropical disease by the World Health Organization<sup>(1)</sup>. The main transmission mechanism of CD remains vectorial; however, congenital, transfusion, and, more recently, oral transmission, are also epidemiologically relevant<sup>(2)</sup>.

To prevent disease transmission by eliminating domiciled vectors, it is extremely important to consider that vectorial trypanosomiasis spreads more easily in places that present favorable conditions for triatomine infestations, such as wattle-and-daub houses, clay-covered inhabitations, and wooden homes with ill-fitting boarding or brick walls with cracks,

that is, places that have openings and cracks that can offer hiding places for these insects, in addition to attracting wild animals that can serve as triatomine food sources<sup>(3)(4)</sup>.

Regarding the control of vector-borne transmission of CD in Brazil, the Program of Chagas Disease (triatomine) Control (PCDC) was developed in the 70s by the Superintendency of Public Health Campaigns [*Superintendência de Campanhas de Saúde Pública* (SUCAM)], and is considered one of the main control programs of endemic diseases in the country. Later, the program activities were transferred to the National Health Foundation [*Fundação Nacional de Saúde* (FUNASA)] and, in 2000, decentralization of these actions was initiated, consequently becoming the individual municipalities' responsibility<sup>(5)(6)</sup>. During the PCDC surveillance phase, which focuses on the use of residual insecticides and the improvement of dwellings, the benefits must be strengthened by educational activities that need to be concurrently developed with the participation of the benefited communities<sup>(7)(8)</sup>. As part of this program, housing improvement is an essential control

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measure, owing to the limitations associated with the use of insecticide control only. While such insecticide activities have been able to dramatically reduce insect populations in the households, by obeying the natural history of native species, triatomines still manage to recolonize the houses as a result of infestation of wild specimens or by the spreading of insect survivors. In addition, this measure helps to fight not only CD but also several other infectious and parasitic diseases, thereby improving the overall life quality of the dwellers. Therefore, entomological surveillance, educational actions, and improved environmental conditions are all important control measures to prevent colonization of houses<sup>(9) (10)</sup>.

Thus, as part of the PCDC, the FUNASA - Housing Improvement Program for Chagas Disease Control (HIPCDC) was developed in Brazil with the purpose of improving the physical and sanitary housing conditions in domiciliary and peridomiciliary areas, consequently making these areas refractory to triatomine colonization<sup>(11)</sup>.

The HIPCDC was established in 2001 in Northwestern Rio Grande do Sul State by FUNASA-RS, with the support of the State Department of Health, and triggered a process that involves training, household surveys, municipal proposal adjustments, educational workshops, and administrative and technical reorganization, as well as Unified Health System authority integration<sup>(11) (12) (13)</sup>.

In addition, from the efforts aimed at vector control, together with the implementation of the HIPCDC in Rio Grande do Sul in 2005, the state received a certification of interruption of *T. cruzi* vector-borne transmission by *Triatoma infestans* after studies of the CD epidemiological condition in the state, performed by technicians from the State Department of Health and the committee of Ministry of Health and by Pan American Health Organization officials. However, there are still municipalities with residual infestations by *T. infestans*, mainly restricted to the northwestern region of the state, largely as a result of the vectors biology and the cultural habits of the dwellers<sup>(12) (13) (14)</sup>.

More than 10 years have passed since the HIPCDC was first implemented in Rio Grande do Sul, and it is of importance that the target population is contacted during the health interventions to discuss the plans and concepts thereof<sup>(15)</sup>. With this in mind, the aim of the present study was to evaluate the HIPCDC impact on triatomine control through assessment of the perceptions of the local people and administrators towards the housing improvement process in the last decade after the implementation of interventions in this region.

## METHODS

After meeting with researchers from the Federal University of Pelotas and the State Center for Health Surveillance [Centro Estadual de Vigilância em Saúde-Rio Grande do Sul (CEVS-RS)], a cooperation agreement was signed in order to assess various HIPCDC aspects. Following this meeting, the three towns included in the HIPCDC, under the supervision of the 17<sup>th</sup> Regional Coordination of Health of Rio Grande do Sul State, head quartered in Ijuí county – Ajuricaba, Coronel Barros, and Crissiumal – were visited (**Figure 1**).

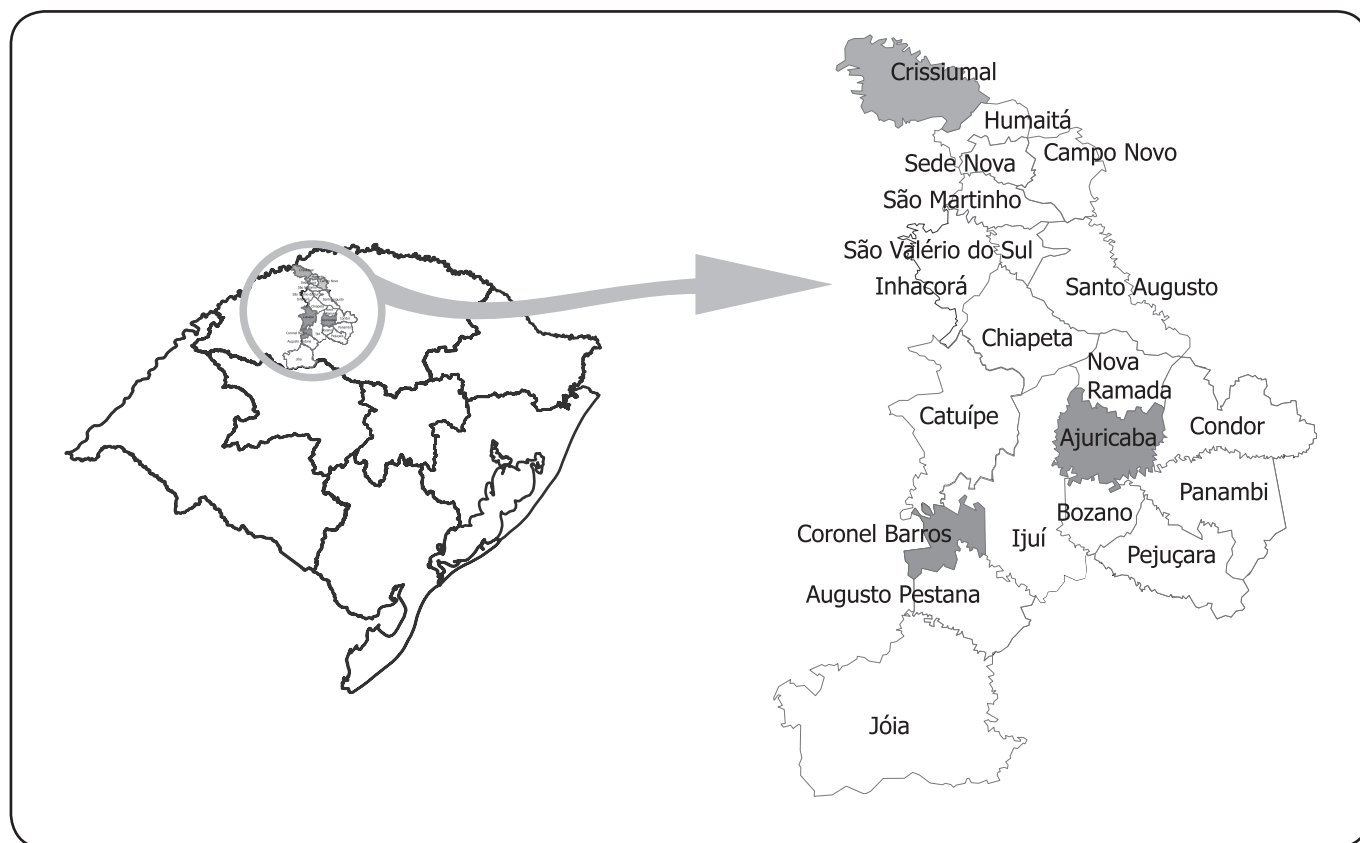
The participating municipalities of this study were those that complied with the HIPCDC and the criteria specified in Ordinance no. 106/2004 of the FUNASA, that is, the municipalities that possessed areas of persistent infestation of *T. infestans* in the last 5 years previous to the program implementation, and consequently have a risk of vectorial transmission of *T. cruzi* to humans. As for the selection of the domiciliary Units (DUs) to be tested, this was performed through the positive identification of *T. infestans* in the DU (mainly in the peridomicile) during the mentioned period, which was normally notified by the dweller and investigated by the vigilant epidemiologic team, which subsequently traced a distance of 20km<sup>2</sup>; only the DUs contained within this perimeter were assessed for the program improvements.

Coronel Barros has an area of 163km<sup>2</sup> and a total population of 2,459 inhabitants, 1,093 and 1,366 of whom reside in urban and rural areas, respectively. The Human Development Index (HDI) of the municipality is 0.744. Crissiumal has an area of 363km<sup>2</sup> and 14,084 inhabitants, 6,124 and 7,960 of whom reside in urban and rural areas, respectively. The HDI of Crissiumal is 0.712. Finally, Ajuricaba has a population of 7,255 inhabitants, 4,108 and 3,147 of whom live in urban and rural areas, respectively. The HDI of Ajuricaba is 0.753<sup>(16)</sup>. Thus, out of the total population of the three municipalities, 52.4% live in rural areas.

Two questionnaires were used as the research tool: one was applied to the project coordinator of each municipality, and the other to the individuals whose households were included in the program. The purpose of the study was explained to those involved, who were asked to provide free and informed consent upon agreeing to participate in the study by answering the questionnaire.

The questionnaire applied to the coordinators included questions based on the project implementation, such as whether there was a specific coordinator or department in charge; whether there had been difficulties in the program implementation and, if so, what these difficulties were; whether there had been resistance by the residents to the adaptations proposed; whether there had been integration with other sectors; and whether there had been real contributions to the improvements of quality of life and health of the population, especially regarding triatomine infestation control, among others. The questions applied to the participating individuals concerned the specific types of materials used in their house before and after the adaptations, health improvement issues, descriptions of the peridomiciliary areas, presence of domestic animals, presence or absence of triatomine bugs before and/or after the program, and any HIPCDC suggestions or criticisms, among others.

The selection of the owners of the housing units (Hus) - consisting of the main house and peridomiciliary annexes - to be interviewed was performed randomly, following a sketch attached to the project that mapped the area and the HUs included in the program. Trips were taken with the support of the Municipal and State Health Departments, which offered a car and a surveillance professional to facilitate locating the HU and the follow-up activities, thus making contact with the community easier. Data analysis was performed using EPI INFO



**FIGURE 1.** Map of the 17<sup>th</sup> Regional Health Coordination of Rio Grande do Sul State highlighting the municipalities of Crissiumal, Ajuricaba, and Coronel Barros included in the Housing Improvement Program for Chagas Disease Control.

software version 7, through which a database was created to obtain the frequencies, means, and standard deviations ( $\sigma$ ) for data description and discussion.

### Ethical considerations

This study followed all ethical guidelines from Resolution 466 (December 12, 2012) of the National Health Council. The questionnaires had their writing, language, and question sequencing adjusted so that the interview could be performed as a dialogue, providing more comfort to the target participants. The study was approved by the University Ethics Committee (no. 287.362).

### RESULTS

A coordinator responsible for the program in each municipality and 62 people who had their housing units included in the HIPCDC, were interviewed.

To implement the HIPCDC and officialize the joint intention to carry out a program of mutual interest and cooperation, the municipalities signed agreements with the FUNASA Rio Grande do Sul State Superintendency. When there are enough financial resources available, the program will be carried out in 100% of the selected location, and cases where total coverage of the area has not been achieved should be given priority by means of provision of new resources, i.e., a new agreement should be signed<sup>(17) (18)</sup>.

The municipality of Ajuricaba signed three agreements in 2001, 2003, and 2008, while Crissiumal and Coronel Barros signed one each in 2008. The three towns all stated that the projects had been concluded, that is, that the agreements had expired. Moreover, in all municipalities, the proposed interventions were initiated in the years following the signing of the agreements.

The local Health Department was in charge of the HIPCDC coordination in the municipalities of Coronel Barros and Ajuricaba, while the Planning Department was responsible for this coordination in Crissiumal. Only in Coronel Barros, the HIPCDC coordinator in charge of the information changed offices during the time of formulation, planning, and implementation of the project.

According to the present administrations, the implementation of the program was laborious, especially because of the differences in the project development periods and the availability of financial resources to begin the work, owing to bureaucratic demands by other parties. Difficulties were also reported in the purchase of building materials and the hiring of workforce, in addition to the communication with the excluded community members, who often did not understand the purpose of the program, which prioritized households with higher probability of infestation and triatomine colonization, and thus felt discriminated for not being entitled to such reforms.

TABLE 1

Household components before and after the implementation of the Housing Improvement Program for Chagas Disease Control in three municipalities of the Northwestern region of Rio Grande do Sul, Brazil.

Variables		Before HIPCDC	After HIPCDC
		n (%)	n (%)
<b>Wall material</b>	Wood	29 (46.8)	19 (30.6)
	Brick	16 (25.8)	19 (30.6)
	Mixed (wood/brick)	17 (27.4)	24 (38.7)
	<b>Total</b>	<b>62 (100.0)</b>	<b>62 (100.0)</b>
<b>Roof material</b>	Clay	30 (48.4)	24 (38.7)
	Asbestos-cement	21 (33.9)	26 (41.9)
	Zinc	3 (4.8)	4 (6.4)
	Mixed (clay/asbestos)	8 (12.9)	7 (11.3)
	Other	0 (0.0)	1 (1.6)
<b>Total</b>	<b>62 (100.0)</b>	<b>62 (100.0)</b>	
<b>Floor material</b>	Tile	11 (17.7)	19 (30.6)
	Cement	2 (3.2)	0 (0.0)
	Floor boarding	33 (53.2)	24 (38.7)
	Soil floor	1 (1.6)	0 (0.0)
	Mixed (tile/cement)	15 (24.2)	19 (30.6)
<b>Total</b>	<b>62 (100.0)</b>	<b>62 (100.0)</b>	
<b>Sanitary installation</b>	Stream	1 (1.6)	0 (0.0)
	Septic tank	56 (90.3)	59 (95.2)
	Swallow hole	4 (6.4)	1 (1.6)
	Public sewage	0 (0.0)	1 (1.6)
	Other	1 (1.6)	1 (1.6)
<b>Total</b>	<b>62 (100.0)</b>	<b>62 (100.0)</b>	

HIPCDC: Housing Improvement Program for Chagas Disease Control Program for Chagas Disease Control.

To counterbalance these issues, integration between the construction sector and the educational project staff in the three municipalities was carried out, with the educational staff helping the workers to contact the local dwellers who would benefit most from the implementation of improvements to their households. The educational staff consisted of FUNASA members, who made speeches to and guided local residents, and who were responsible for training the health workers to continue interacting with the population in terms of the importance of triatomine control in the different municipalities. According to the administrators, the program contributed to improving the quality of life and health of the beneficiaries, who showed no resistance to the changes proposed by the project.

The included households had an average of 5 rooms ( $\sigma = 0.88$ ) and 3 residents ( $\sigma = 1.12$ ). Before the program implementation, the house walls were usually made of wood (46.8%), the roof had clay covering (48.4%), and there was floor boarding (53.2%). It was also reported that, prior to the renovations, 90.3% ( $n = 56$ ) of the households had septic tanks, 6.4% ( $n = 4$ ) had swallow-holes, and 3.3% ( $n = 2$ ) had other types of sewage disposal, as shown in **Table 1**. After the program was implemented, 30.6% of the homes were made of bricks only, while the roofs were predominantly made of

asbestos cement (41.9%) and clay (38.7%) tiles, and there was still floor boarding in 38.7% of HUs. In addition, 95.2% ( $n = 59$ ) of households had septic tanks (**Table 1**).

Regarding the condition of the HUs, the program coordinators reported that 4 houses needed to be demolished due to structural fragility, subsequently being replaced by new brick units with asbestos-cement tile roofing and ceramic floor tiles, besides the addition of a bathroom in each unit, as shown in **Figure 2**.

The persistent infestation in the Northeast region is determined by the habits and customs of environmental handling, such as wood and utensil storage, and the maintenance of several annexes in the peridomicile. *T. infestans* can stay in the peridomicile environments and in houses as a result of these physical conditions, which allow the colonization of the triatominae and make it difficult to spray insecticide, thereby favoring re-infestation and persistence of CD transmission. In the Northeast region of the State of Rio Grande do Sul, the vector persistence is not only related to cracks in the houses, which are very common in houses made of clay, but also to the peridomicile conditions and the lifestyles of the people in such a rural region.

From the questionnaires conducted in the studied population, it was found that most improvements occurred





FIGURE 2. Representative house before and after the implementation of the housing improvement program for Chagas disease control.

in the peridomiciliary areas, including painting (59.7%) and renovations (62.9%). Moreover, the teams intensified their work in hen houses and storerooms by changing board planks, as well as rebuilding and placing screens around any empty spaces under the sheds as a meansto prevent the entry of animals that could serve as *T. cruzi* reservoirs or triatomine food sources. As for the houses, 24.2% were given at least one coat of painting, timber battens were used for closing gaps, poor condition boarding was changed, foundations were built, and precarious openings were changed. Additionally, 6.5% of households that either did not offer safe residential structure or were too fragile to withstand any kind of change were replaced by new brick buildings with 4 rooms (including bathroom), tile flooring, and asbestos-cement roof tiles (Table 2).

All units had at least one of the following peridomicile attachments before and after the intervention: barn, stable, vegetable garden, henhouse, and pigsty. In addition, 95.2% (n = 59) of the respondents kept domestic animals (dogs and/or cats). As for the triatomine occurrence in the households prior to the HU modifications by the program, 12.9% (n = 8) of the respondents reported that they had found at least one specimen inside their home, and 22.6% (n = 14) reported finding them in the peridomiciliary area. After interventions by the HIPCDC, no resident reported any triatomine bug occurrence.

When asked for suggestions and/or criticisms concerning the implementation of the program, 79% (n = 49) of the respondents expressed their opinions. Of these, 44.9% mentioned a lack of good planning (Table 3), claiming that the proposed budget had not been met and that parts of the renovations had been left unfinished, as well as the poor quality of the materials used, and inadequate labor. They also referred to the need for monitoring and/or supervision by local authorities after completion of the renovations to check whether the beneficiaries were following the health surveillance professional guidelines on triatomine control. Finally, the need for further information on triatomine control measures was also reported.

TABLE 2

List of improvements made in households by the Housing Improvement Program for Chagas Disease Control in three municipalities in Northwestern Rio Grande do Sul, as reported by the residents.

Improvements	Times cited	
	n	%
Housing unit painting	15	24.2
Peridomicile painting	37	59.7
Housing unit renovation	18	29.0
Peridomicile renovations	39	62.9
New housing unit	4	6.5

TABLE 3

Suggestions and/or criticisms from residents of three municipalities in Northwestern Rio Grande do Sul who were included in the Housing Improvement Program for Chagas Disease Control.

Suggestions/criticisms	Times cited	
	n	%
Better planning	22	44.9
Better renovation quality	18	36.7
Higher project investments	10	20.4
Greater population awareness/clarification	6	12.2

## DISCUSSION

In Brazil, the extensive preventive measures promoted by the HIPCDC have led to a sharp decline in the household *T. infestans* frequency, including the number of specimens captured in the state of Rio Grande do Sul<sup>(19)</sup>(20). As a result of the adopted

monitoring measures, the *T. infestans* occurrence has been restricted to residual foci isolated in the Northwest of Rio Grande do Sul, without a trend of infestation growth<sup>(13)</sup>. According to Bedin et al.<sup>(21)</sup>, triatomine persistence in Northwestern Rio Grande do Sul is not just related to house cracks, but also to the peridomiciliary conditions and dwelling habits in the area.

The present study showed that by implementing the HIPCDC, there were infrastructure improvements in all evaluated households, both in relation to the residence itself and its peridomiciliary area. As for the peridomiciliary areas, it was perceived that both the officials who carried out the changes and the population that was entitled to them were attentive to the important changes made in this environment, once the improvement indications referred mainly to this part of the HU (**Table 2**). These improvements are important because bad peridomiciliary structure conditions favor triatomine colonization; besides, the occurrence of wild animals in burrows in these places can serve as a triatomine food source<sup>(22) (23) (24)</sup>.

Although the greatest number of insects usually captured inside the house, the peridomiciliary area, as a rule, presents higher infestations, although these cases are usually detected by HIPCDC agents; moreover, the population is generally not attentive to the search of suspicious insects in this environment, as they do not consider it as part of their household<sup>(25) (26) (27)</sup>. Diotaiuti<sup>(28)</sup> stated that the presence of peridomiciliary vectors should be controlled in order to interrupt infestation close to human dwellings; adoption of this attitude is a preventive measure against the establishment of household colonies, which corroborates the importance of improvements in the peridomicile verified in this study.

As for the program criticisms and suggestions, it is worth mentioning that 44.9% of the respondents who expressed their views reported that better planning in the program implementation was warranted, while 36.7% reported that the quality of the repairs should have been higher, and 12.2% mentioned that there should be further explanations to the affected population. There are always difficulties in obtaining a full response in terms of actions that promote structural community changes; however, a greater effort to monitor the work by supervision and quality control by the municipal authorities was considered needed, as provisional aspects were observed in some renovations.

According to Dias<sup>(29)</sup>, evaluations of public health programs are essential for their consolidation, and these evaluations must be serious, frequent, and objective, and require maximum community participation, owing to their high educational value. In addition to technical and epidemiological parameters, the evaluations have to consider the degree of satisfaction and community interest, in particular in regards to the potential problems and negative factors that might arise during the process, which is in agreement with the aims of this investigation.

Measures that call for the promotion of health, which includes improved housing, in addition to solving specific problems, also generate improved well-being, life quality, and individual health<sup>(29)</sup>. Social health determinants improve when there is an intersectoral action; furthermore, participation of the

population, health services, and education help sustain these actions and housing programs that do not include participatory procedures should not be promoted<sup>(30) (31)</sup>.

A positive factor found in the present study was that, while part of the respondents reported the presence of triatomines in their homes prior to the implementation of the renovations, especially in the peridomiciliary areas, after these renovations were executed, no resident reported triatomine occurrences in their dwellings. Even though the housing improvements may not be the only reason for this finding, it has certainly helped to achieve this positive result, since it is widely accepted that activities that promote housing improvements contribute to reducing their triatomine infestation index<sup>(32) (33) (34) (35)</sup>.

Thus, although the HIPCDC evaluated in the three municipalities pointed out certain problems or difficulties for its implementation during the course of the activities, the involvement of the work and education sectors in addition to the health departments should be noted, which agreed to improve the health, housing, and quality of public education for a better understanding of the improvements in CD control. The area under study will continue to be monitored in the coming years as a maintenance strategy of municipal and community interest to determine the importance of preventing triatomines and CD in these places. As observed in other studies, after evaluation of surveillance activities, the population and local professional interest tends to rise, as reflected by a greater number of triatomine notifications in the years following the research<sup>(26) (27)</sup>.

In conclusion, based on the present survey, we consider that, as the next step of this research, similar studies should be conducted in other municipalities that have also been granted funds from the HIPCDC as a means to describe the process as a whole.

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#### Conflict of interest

The authors declare that there is no conflict of interest.

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