



## Decision support system for control of the Chagas disease

Sistema de apoio à decisão para controle da doença de Chagas

Sistema de apoyo a la decisión para el control de la enfermedad de Chagas

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### ABSTRACT

**Keywords:** Chagas Disease; Health Information Systems; Information Management

**Objective:** This paper presents the DSS-Chagas information system for activities management of control and combat of Chagas' disease. The system was developed to provide organization and optimization in the data tabulation activities, infestation index monitoring, identification of the disease vector behavior and domiciles research. **Methods:** DSS-Chagas was developed with methods and tools of agile development with the Scrum methodology, based on protocols, guidelines and policies for disease eradication and control in the Tocantins State. **Results:** The construction and implantation of a tool to support the decision-making process in health surveillance through technical reports based on information recorded about the disease. **Conclusion:** DSS-Chagas ensures organization and accuracy of information, as well as effective monitoring and optimization in the processes, allowing more assertive decisions making in disease prevention and control.

### RESUMO

**Descritores:** Doença de Chagas; Sistemas de Informação em Saúde; Gestão da Informação

**Objetivo:** Este artigo apresenta o sistema de informação DSS-Chagas para gestão das atividades de controle e combate da doença de Chagas. O sistema foi desenvolvido para proporcionar organização e otimização nas atividades de tabulação de dados, monitoramento do índice de infestação, identificação do comportamento do vetor da doença e pesquisa de domicílios. **Métodos:** O DSS-Chagas foi desenvolvido com métodos e ferramentas de desenvolvimento ágil com a metodologia Scrum, a partir de protocolos, diretrizes e políticas de controle e erradicação da doença no Estado do Tocantins. **Resultados:** Foi realizada a construção e implantação de uma ferramenta para apoio ao processo de tomada de decisão na vigilância em saúde através de relatórios técnicos construídos a partir das informações registradas sobre a doença. **Conclusão:** O DSS-Chagas garante organização e precisão das informações, assim como um monitoramento efetivo e otimização nos processos permitindo tomada de decisões mais assertivas no controle e prevenção da doença.

### RESUMEN

**Descriptores:** Enfermedad de Chagas; Sistemas de Información en Salud; Gestión de la Información

**Objetivo:** este artículo presenta el sistema DSS-Chagas para la gestión de las actividades de control y combate de la Chagas. El sistema proporciona organización y optimización en las actividades de tabulación de datos, monitoreo del índice de infestación, identificación del comportamiento de la enfermedad e investigación de residencias. **Métodos:** DSS-Chagas fue desarrollado con métodos y herramientas de desarrollo ágil con la metodología Scrum, con protocolos, directrices y políticas de control y erradicación de la enfermedad en el Tocantins. **Resultados:** Se realizó la construcción e implantación de una herramienta para apoyar el proceso de toma de decisión en la vigilancia en salud a través de informes técnicos construidos a partir de las informaciones registradas sobre la enfermedad. **Conclusión:** DSS-Chagas garantiza la organización y precisión de las informaciones, así como un monitoreo y optimización en los procesos permitiendo la toma de decisiones más asertivas en el control y prevención de la enfermedad.

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## INTRODUCTION

Since antiquity is evidenced the importance of the information for the behavior study of a particular disease. This premise is observed due to the existence of records stored in different formats in the most varied areas of science over time<sup>(1)</sup>. In Brazil, the information generated by the analysis and research is largely responsible for the formulation of health policies. They are sources used by the government for determining health indicators. The information is a crucial resource to carefully evaluate evidences that are used to develop and maintain better decisions in the health policies<sup>(2)</sup>. In health, information should be understood as a reducer of uncertainties, an instrument for detecting priority focus, leading to responsible planning and execution of actions that condition the reality of the necessary transformations<sup>(3)</sup>. For help with this planning is necessary that the information be made available appropriately. In this sense, the implantation of information systems has great importance, because they promote readability, accessibility, opportunity, topicality, and information coverage. These characteristics highlight the importance of the implantation of an epidemiological surveillance system to support the decision-making process. In this way, the information has a primordial role to subsidize an intelligent decision to the necessary transformations.

Chagas disease was discovered in 1909, due to the malaria crisis in the north of Minas Gerais, by Brazilians Carlos Chagas and Oswaldo Cruz. Chagas disease had the discovery involving the identification in three areas: human disease or American trypanosomiasis, causative Protozoan (*Trypanosoma cruzi*) and the transmitting insect (Barbers)<sup>(4)</sup>. In the world, it is estimated that 10 to 15 million people are infected, and in Brazil of 2 to 3 million of people<sup>(4)</sup>. Of these sick people, it is estimated that around 14.000 people die every year in the world. A research published in the journal *Lancet Infectious Diseases* showed that global spending with Chagas disease exceed 7 billion dollars per year, that is, the spending with this disease exceeds rotavirus (2 billion) and cervical cancer (4.7 billion)<sup>(5)</sup>.

Paul Michels and Wim Hol<sup>(4)</sup> highlighted the importance of surveillance: "More effective methods will be launched soon, but in parallel with the scientific developments, also control measures for these diseases (sanitary surveillance), effective distribution of medicines and, of course, the introduction of public health policies in South America, where the great threat is Chagas disease". Brazil is the only country in the Americas that has neglected disease incidence greater. Therefore, the monitoring system of the vector of the Chagas disease is essential to the work of health surveillance in Brazil. In Brazil, the cases of Acute Chagas Disease are notified by the Notification Disease Information System (SINAN), having its predominance in the states of the Legal Amazon and in other isolated states. However, the chronic cases of the disease are not quantified due to the inexistence of an information system, which reinforces the need to monitor and control the disease vector. In addition,

through the information system, it is possible to plan new health public policies, in order to provide greater effectiveness for the society. Historical series obtained of DATASUS presents of acute cases of the disease in the period from 2007 to 2014, where each Member State: Pará, Amapá, Amazonas, Tocantins, and Goiás holds 77.91%, 6.75%, 6.15%, 2.08% and 1.93%, respectively, totaling 94.81% of reported cases in the country.

Since 2005, the Chagas disease surveillance in Brazil was focused on risk stratification of cities for transmission of the disease. From 2012, it was conducted through different epidemiological scenarios determined by the relationship between man, environment and reservoir vector of *Trypanosoma cruzi*, which indicate decision-making with interventions that ensure the complete epidemiological investigation, treatment, and follow-up of the patient to check the cure of disease. In 2013, in the city of Paranã in the Tocantins some triatomines were captured in rocks and invaded houses, with similar characteristics to the *Triatoma costalimai*, however, the quality control identified that they do not fit with any of the species described in the literature, what evidences the importance of monitoring the vectors in the state<sup>(6)</sup>. The specimens of these triatomines were sent to Fiocruz in Rio de Janeiro, where after the necessary analyses, they verified a new specimen described in the Tocantins: *Triatoma jatai* sp.

In this way, this paper presents an information system developed to monitor the vector of Chagas disease, so that all information is made available in an enriching way to the planning of health policies, as a tool to support decision-making of this disease, highlighting the importance of the information. The purpose is to automate the information flow management about the vector of Chagas disease, contributing to the planning of health actions in endemic areas, making the work process between the municipalities and the Nucleus Management of the Chagas Disease of the Tocantins more convenient and efficient. Therefore, methods set, tools and good practices were adopted for the development and implementation of the Information System called Decision Support System (DSS-Chagas) applied to the activities management related to guidelines and policies for the control and eradication of the Chagas disease in the Tocantins State.

## MATERIALS AND METHODS

During the process of contextualization and data collect, several problems related to the management of data and information of the technical area responsible for the control of Chagas disease in the State of Tocantins were identified. This problem is mainly due to the fact does not have access to an Information System that assists technicians in the control of activities and processes related to data and disease control. The data of 139 municipalities are collected in a paper form to be synthesized in simple decentralized spreadsheets and without support for any analysis tool. This process is susceptible to problems of inconsistency, redundancy and data loss, challenges that

have long been overcome by the databases adoption.

The manual data collection makes it difficult the production of consistent information, that is necessary for the evaluation of public health actions. In addition, these problems result in delays in the diagnosis of the disease in the state and, consequently, make it impossible to produce important reports for the construction of guidelines and policies in public health in the Tocantins. Therefore, these problems were the major motivators for the development of the DSS-Chagas to assist the process of collect and management of Chagas disease data in the Tocantins State.

DSS-Chagas was built by adopting the agile development process Scrum, adding several techniques to guide the system construction in an organized way, fast (efficient) and meeting the needs of the customer (effective). Scrum consists of 03 generic steps (planning, execution, and conclusion) executed in short development cycles that respond well to possible adaptations for inclusion, exclusion and change of requirements during the project. The Scrum methodology was adapted for this project through an activities set distributed in 04 general steps.

§ Product Backlog: It consists of building a list of requirements and their priorities. The requirements define the functionality to be delivered to the customer. Priorities determine the risk and development order. More risks are treated as a priority.

§ Sprint Backlog: it is composed of an items list selected of the Product Backlog that will be developed during the next Sprint. This list is agreed during the Sprint Planning Meeting, where development team decides what will be done on Sprint.

§ Sprint: It is effectively composed of system development activities (analysis, design, construction, and testing). It is characterized by short duration (between 7 and 30 days). A 15-minute meeting is held daily to identify what has been done at Sprint, what is the schedule for the day, and if there is any problem affect development progress. Development monitoring and control mechanisms are applied to maintain the schedule within the stipulated period. At the end, the Sprint is closed.

§ Product Increment: Is an increase of a delivery

within a given period. Increments are software functional pieces that attend to functional requirements set.

**Product Backlog Stage**

In the first stage of development, the functional and non-functional requirements of DSS-Chagas were defined. Development risks and feasibility for the system construction were detected. This stage was developed with the support of the technical team of the Health State Department of the Tocantins, which presented all documents and worksheets used for the monitoring, control, and management of the Chagas disease. The requirements survey generated enough information for the Product Backlog definition. The documentary analysis was realized from the forms adopted by the health agents in the execution of their daily activities. For example, the forms of Figure 1, called SIOChagas-02 is used for the identification of the insects found during a field visit. This form records the insect evaluation data, classifying the species and genus, capture place, and the positivity for the *T. Cruzi*. The data contained in this form are decisive for the definition of the continuation of the service in the locality where the insect was found, especially when the result of the analysis of this insect points to a positive for *T. Cruzi*. This information determines the need for residents investigation and inclusion of the locality in the subsequent year in the annual programming.

The main functional requirements obtained from interviews and documentary analysis are presented in the use case diagram of Figure 2. The diagram shows the interaction between actors and use cases. Use cases represent how the execution of the functional requirements are planned in the system. It is possible to observe that some use cases have a stereotype called <<CRUD>>. This stereotype is an acronym that represents the functions create, read, update and delete the data records.

In the diagram, the user actor interacts with 03 use cases: request access, system authentication, and password change. The state manager actor subsidizes the main functions of system configurations such as: define access level to users and determine the settings of the daily bulletin. Use case of types management, classifications, products,

**SIOChagas-02**  
**Chagas Disease Field Operation System**

**1 - Identification info**

|             |                            |                  |           |
|-------------|----------------------------|------------------|-----------|
| District:   | Localization:              | Property number: | Amount:   |
| Tag service | District of the laboratory | Date of entry    | Exam date |
|             |                            |                  |           |

**1 - Triatomine examination data**

| Species of triatomines |       | Capture                                                   | Local capture    | Stage                                                                                                             | Result                                                                                                             |
|------------------------|-------|-----------------------------------------------------------|------------------|-------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|
| Code:                  | Name: | <input type="radio"/> Intra<br><input type="radio"/> Peri | where?<br>Where? | <input type="radio"/> 1 - Nymph<br><input type="radio"/> 2 - Adult Male<br><input type="radio"/> 3 - Female Adult | <input type="radio"/> 1 - Positive<br><input type="radio"/> 2 - Negative<br><input type="radio"/> 3 - Not examined |
|                        |       |                                                           |                  |                                                                                                                   |                                                                                                                    |

**Figure 1 - Chagas disease vector identification form.**

results and agreement percentage in the scheduling recording information for the daily bulletin configuration.

Information provided by the state manager actor is important for the characterization of the daily bulletins and entomological monitoring. The “manage product” use case defines types of insecticides used for spraying in home units. The “results” use case classifies the data in terms of positivity or negativity of the insect at home. The “locality type” use case determines construction types (wood, masonry, and others). The data managed by these use cases are important information for the monitoring and control activities management of Chagas. For example, in order to define an “intradomiciliary spray” rule, can be considered the positivity in the identification of the barber associated to the intradomiciliary location, with the system informing the mandatory of the spraying by adopting an insecticide registered in the “product” use case.

The “computer operator” actor interacts with the system through the “etymological monitoring” and “bulletin management” use cases. In the monitoring, investigations are performed through the collection of blood samples for serological tests of the residents. This use case is activated from the identification of a positive insect for *T. Cruzi* within the residence. This monitoring detects cases of the diseases early to initiate the specific treatment in each resident. It is important to highlight that the faster the diagnosis, the greater the cure probability of the patient, justifying the importance of the efficiency of the data management.

The “daily bulletin” use case records the surveillance and control activities of the disease in 04 activities types: (a) Active search: scheduled home research performed by endemic or community agent; (b) Passive search: attendance to a notification made by the resident to any insect similar to the vector of Chagas disease; (c)

Notification attendance: a research to investigate a passive search; and (d) Spraying: the health agent performs the spraying when a triatomine of colonizing species, nymph, and some species captured in the intradomicile is found.

The use case “definition of the agreement percentage” defines the actions planning in Chagas campaigns in certain localities performed by the technical area. The agreement percentage follows criteria set based on the results in the previous year. When notification of a *Triatoma Sordida* species occurs, the agreement is set at 100 %. When colonizing species occurs, such as *T. pseudomaculata*, *T. brasiliensis*, and *Panstrongylus megistus*, the agreement is 40%. Finally, when non-colonizing species occur or when there is no notification, the agreement is set at 20%. When a municipality has a value of fewer than 100 localities, its agreement is 10%. The localities are microregions within the municipalities and are defined by the geographical registry for every 450 properties. This information determines the area of action of a health.

The “entomologist” actor interacts with the use cases responsible for the management of the disease vector (insect). He executes the use case “vector quality control” that interact with the “laboratory” actor, which is the main responsible for the identification process of the collected insects. The etymologist executes the use cases genus characterization, species and stage management in the analysis of each blade. The use case examines triatomine is performed by the laboratory worker actor. When a triatomine infected is found, the resident serology is performed, for which the quality control of the slides is exclusive of the Central Laboratory actor.

**Sprint Backlog Stage**

The requirements identified in section 2.1. have been mapped to more detailed development Sprints. The

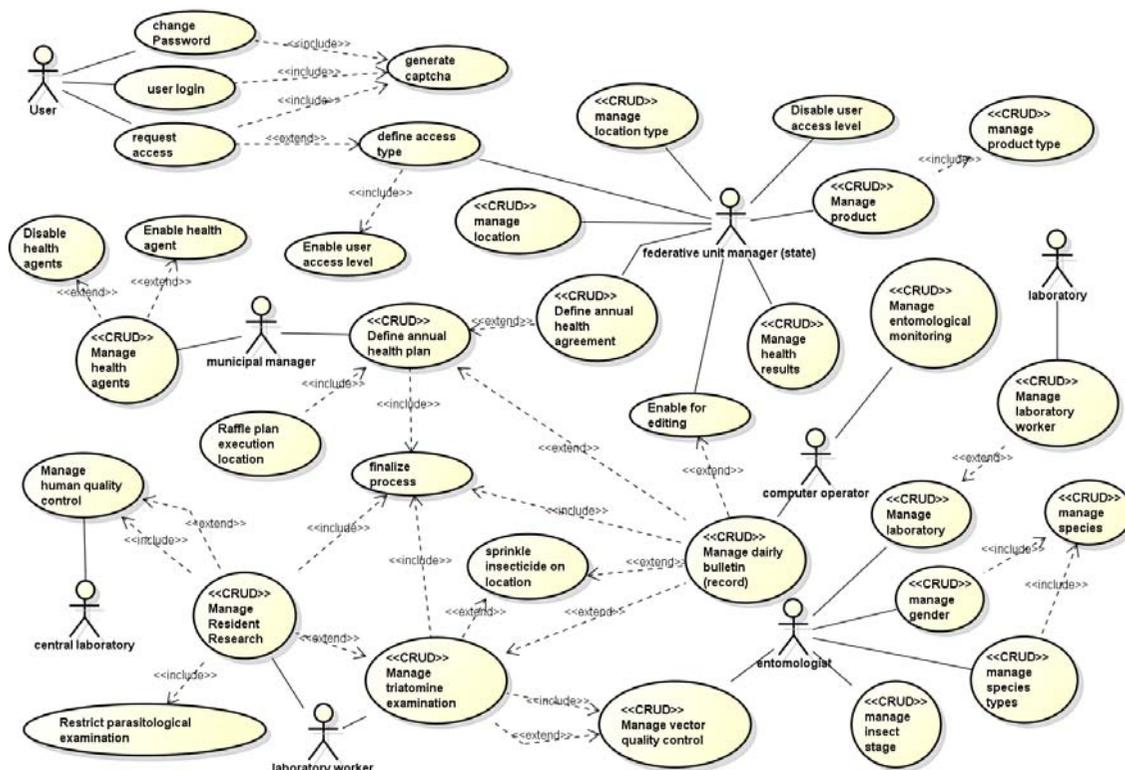


Figure 2 - Use case diagram showing the main functions of the system.

sequence of the Sprints construction was based on the requirements priority that detail the system operating behavior. We also considered the development risks to decide the implementation priority of the Sprints. The Sprints development was realized by adopting free tools and technologies to reduce development costs. The object-oriented technology was adopted for the system construction, a decision that guided the adoption of the following methods and tools:

§ The project models/diagrams (activity, use cases, class) were developed with the Unified Modeling Language, using the student version of the Astah Community tool.

§ Netbeans environment for the development of system code in PHP 5.5 language. PHP is a server-side scripting language designed for web development;

§ Hypertext Markup Language, Cascading Style Sheets, JavaScript is three of the core technologies for building Web pages. HTML provides the structure of the page, CSS the (visual and aural) layout, for a variety of devices and JavaScript is a high-level, dynamic, untyped, and interpreted programming language.

§ MySQL is an open-source relational database management system (RDBMS) adopted for the storage and management of the DSS-Chagas data.

§ JasperReports is an open source reporting engine which uses data coming from any kind of data source and produce documents that can be viewed and printed.

In this stage, the infrastructure of the DSS-Chagas system was designed. The resources selection considered the limitations of the client’s data center structure and the forecast of the average number of users and software clients 139 Tocantins cities with a population of 1.532.902 people describe by Brazilian Institute of Geography and Statistics (2016). The client-server architecture was adopted, separating the solution into two computing units, one for the database server and one for the application server. The first unit hosts the MySQL Database System under an Ubuntu Linux operating system. The second unit hosts the application server with Internet Information Service (IIS) under the Windows 2012 Server 64-bit operating system.

The application clients access the system through web browsers from the internet or internal network of the Tocantins Health Secretary. Access can be realized by ordinary users or by the managers of the federative and municipal units. When access occurs internally, data traffic uses the fiber-optic connection, making data transfer more efficient. The infrastructure has several mechanisms to protect the data and system, such as data security system with the adoption of firewalls, backup mechanisms to

prevent data loss and recovery mechanisms to application and database failures.

**Sprints**

Sprints are development cycles that adopt software engineering tools and methods. Activities of this stage were composed of phases of requirements analysis, design, implementation, and testing. Each Sprint represents a building cycle of the DSS-Chagas functional increments by adopting these 04 phases. The requirements analysis phase generated abstract models of the storage structure and components, as well as the expected behavior for the execution of the system functions.

The design phase was adopted for the definition of the data, architecture, components, and interface. The project supported the system implementation stage, adopting the technologies mentioned in section 2.1. The data structures were properly stored in the MySQL Database System, being the main input for the data design. The interface design generated the style and pattern of interfaces presented in Section 3, focusing on usability solid concepts.

**Product Increment and Delivery**

The product increments were verified and validated by the technical teams of the public health control section of Chagas Disease. As the functionalities were finalized (Sprints), the validation activities were performed with the Tocantins Health Department until the complete construction of the requirements list proposed in the first step Product Backlog. The result and the complete development cycle are presented in Section 3 that effectively presents the results of this paper discussing the main characteristics and advantages of the automation of the activities management related to Chagas disease in the state.

**RESULTS**

The results describe the design and implantation of the DSS-Chagas. It’s currently deployed in the data center of the Federal University of Tocantins. The system is being populated, initially, with information from previous years along with the data captured in the current context. The main interfaces will be presented with the DSS-Chagas reports and registration forms together with an automation process explanation.

One of the main processes performed by the health department involves the localities draw where campaign actions of the disease combat and control will be performed. At the beginning of the year, the state

**Table 1** - Example of the localities draw done manually.

|    | C1 | C2 | C3 | C4 | C5 | C6 | C7 | C8 | C9 | C10 | C11 | C12 | C13 | C14 | C15 | C16 | C17 |
|----|----|----|----|----|----|----|----|----|----|-----|-----|-----|-----|-----|-----|-----|-----|
| l1 | 4  | 1  | 6  | 1  | 6  | 1  | 0  | 2  | 3  | 6   | 7   | 6   | 2   | 0   | 9   | 9   | 8   |
| l2 | 3  | 0  | 7  | 2  | 6  | 3  | 9  | 5  | 5  | 3   | 4   | 8   | 8   | 0   | 9   | 3   | 0   |
| l3 | 1  | 9  | 8  | 4  | 7  | 7  | 8  | 6  | 5  | 2   | 7   | 8   | 1   | 0   | 0   | 7   | 5   |
| l4 | 2  | 2  | 6  | 3  | 7  | 5  | 0  | 1  | 9  | 8   | 7   | 6   | 3   | 0   | 0   | 1   | 2   |
| l5 | 0  | 3  | 4  | 5  | 6  | 8  | 9  | 0  | 2  | 0   | 3   | 1   | 0   | 1   | 1   | 2   | 1   |
| l6 | 8  | 8  | 0  | 8  | 9  | 2  | 3  | 6  | 3  | 7   | 3   | 7   | 8   | 9   | 4   | 3   | 9   |

managers hold a meeting for the localities draws with each of the 139 municipalities. Without automation, the process was quite expensive, because it was done manually on a printed table to sort out the locality identifying the number. Table 1 shows an example of the locality draw structure. In this case, the draw of column *C10* and line *L5*, which gets the number *0*, is being exemplified. Later it was necessary to choose two houses to the right to obtain the chosen locality number *031*. For each code, it was necessary to repeat the draw process to obtain a locality correct number. This same problem occurred for the localities cases that were marked with the positive identification of the barber in the residence in the previous year. It is important to note that in the latter case, the inclusion of these localities is obligatory in the agreement, according to the methodology defined by the state manager.

DSS-Chagas performs the automation of the draw process. For example, the municipality of Brejinho de Nazaré has 200 active localities and has scheduled for the year 2017 a goal of 33%. This is the minimum number of localities that must be worked during the year, as defined by the state managers in the agreement and based on the work done in the municipality in the previous year. Therefore, this percentage corresponds to a sampling of 66 localities, according to the information presented in the report of Figure 3. Therefore, with just one click you can sort the localities. With this, the time has been gained to: include positive locations, because it is not necessary to move the municipality to carry out the localities draw,

the municipality to wait its turn, to occupy all the managers, among other benefits. It is important to highlight that for the draw with all the existing localities, it is necessary that all locations are updated, although it is possible to replace them.

DSS-Chagas allows analysis with geographical recognition in all coverage areas to identify which areas are most affected by the insect, as shown in Figure 4(A). In addition, it allows to carry out analyzes of vector predominance in the localities. The Figure 4(B) gives an example of this information for the Brejinho de Nazaré municipality. The reports presented in the figure allow to improve the information presentation, supporting decisions for the efforts intensification in vector control and health prevention measures promoted by the information analysis offered by the tool.

Problems such as the collected samples discard, when sent to the laboratory, samples captured inside and outside of the residence sent in the same tubes, were constant in the day to day of the technical sector. Such problems caused inconsistency in planning and time demand to fill in the information needed in SIOChagas-02. With the automation of this process, it was possible to reduce and even to avoid problems of this nature, mainly due to the fact that the daily bulletin recorded data-informed at the captured place as shown in Figure 5.

The daily bulletin is responsible for managing the control of the disease vector transmission. It is through the bulletin that is performed measures of educational actions, passive and active research, chemical control and



Figure 3 - Localities draw results by DSS-Chagas.

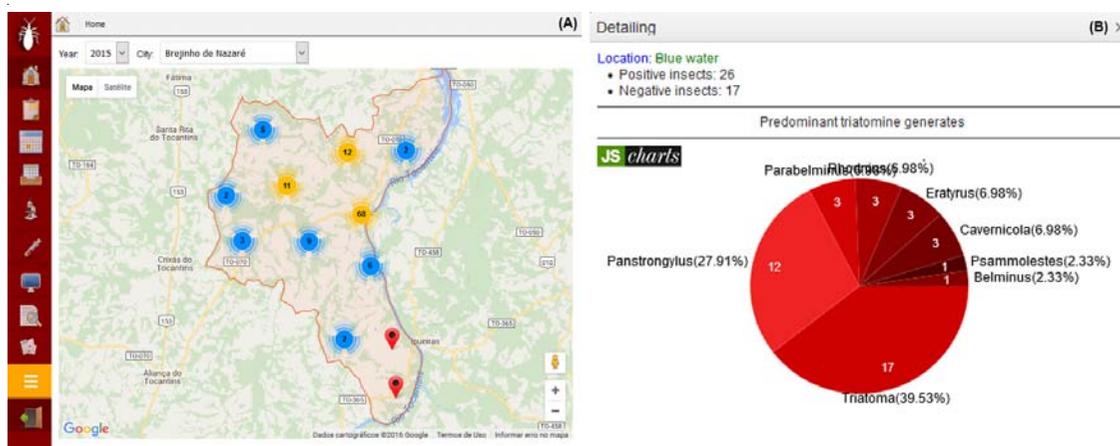


Figure 4 - Geographic points of cases in the Brejinho de Nazaré city and predominance gender graph in the Blue Water locality.

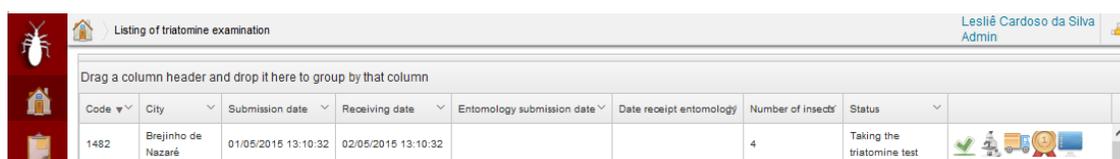


Figure 5 - Triatomine exams screen on every daily bulletin.

environmental management. With the information contained in the bulletin, it is possible to elaborate and improve the control strategies to eliminate the vectors that are domiciled with people. The main strategy for fighting the disease is the transmission prevention that is expressed from the infestation indicators, natural infection, and colonization.

The Figure 6 presents samples collected in the daily bulletin number 55. This bulletin presents the samples in

Paoli (PD) and in the Kitchen (ID) of the location 05. Therefore, when submitting for analysis, DSS-Chagas enters 06 records automatically. Each record corresponds to an insect's blade. This flow optimizes the insects' identification, detects the samples discard when transcribed in SIOChagas-02 and, mainly, identifies the information inconsistency perceived through the observation analysis proposing to the managers the insects' separation.

During the requirements analysis, a deficiency in the

Figure 6 - DSS-Chagas daily bulletin.

| 1 - IDENTIFICATION INFO:             |                     |                |                   |                                                                  |             |                                                                             |                                                                             |            |
|--------------------------------------|---------------------|----------------|-------------------|------------------------------------------------------------------|-------------|-----------------------------------------------------------------------------|-----------------------------------------------------------------------------|------------|
| Tag:                                 | City:               | City Location: | Number Residence: | Complemento:                                                     | Quadra:     |                                                                             |                                                                             |            |
| 91                                   | Brejinho de Nazaré  | OLD DOOR       | 3                 | 5                                                                | 12          |                                                                             |                                                                             |            |
| 2 - DATA ON TRYATOMINAL EXAMINATION: |                     |                |                   |                                                                  |             |                                                                             |                                                                             |            |
| Code:                                | Triatomine species: | Capture:       | Local Capture:    | Live:                                                            | Stage:      | Exam Fresh air:                                                             | Result (Exam Coloring):                                                     | Date Exam: |
| 28                                   | Rhodnius robustus   | Peri           | Chiqueiro         | <input checked="" type="radio"/> Yes<br><input type="radio"/> No | Male adult  | <input checked="" type="radio"/> Positive<br><input type="radio"/> Negative | <input type="radio"/> Positive<br><input checked="" type="radio"/> Negative | 01/05/2015 |
| 28                                   | Rhodnius robustus   | Peri           | Madeira           | <input type="radio"/> Yes<br><input type="radio"/> No            | - OPTIONS - | <input type="radio"/> Positive<br><input type="radio"/> Negative            | <input type="radio"/> Positive<br><input type="radio"/> Negative            | dd/mm/yyyy |
|                                      |                     | Intra          | Área              | <input type="radio"/> Yes<br><input type="radio"/> No            | - OPTIONS - | <input type="radio"/> Positive<br><input type="radio"/> Negative            | <input type="radio"/> Positive<br><input type="radio"/> Negative            | dd/mm/yyyy |
|                                      |                     | Intra          | Área              | <input type="radio"/> Yes<br><input type="radio"/> No            | - OPTIONS - | <input type="radio"/> Positive<br><input type="radio"/> Negative            | <input type="radio"/> Positive<br><input type="radio"/> Negative            | dd/mm/yyyy |

Figure 7 - DSS-Chagas Performing quality control screen.

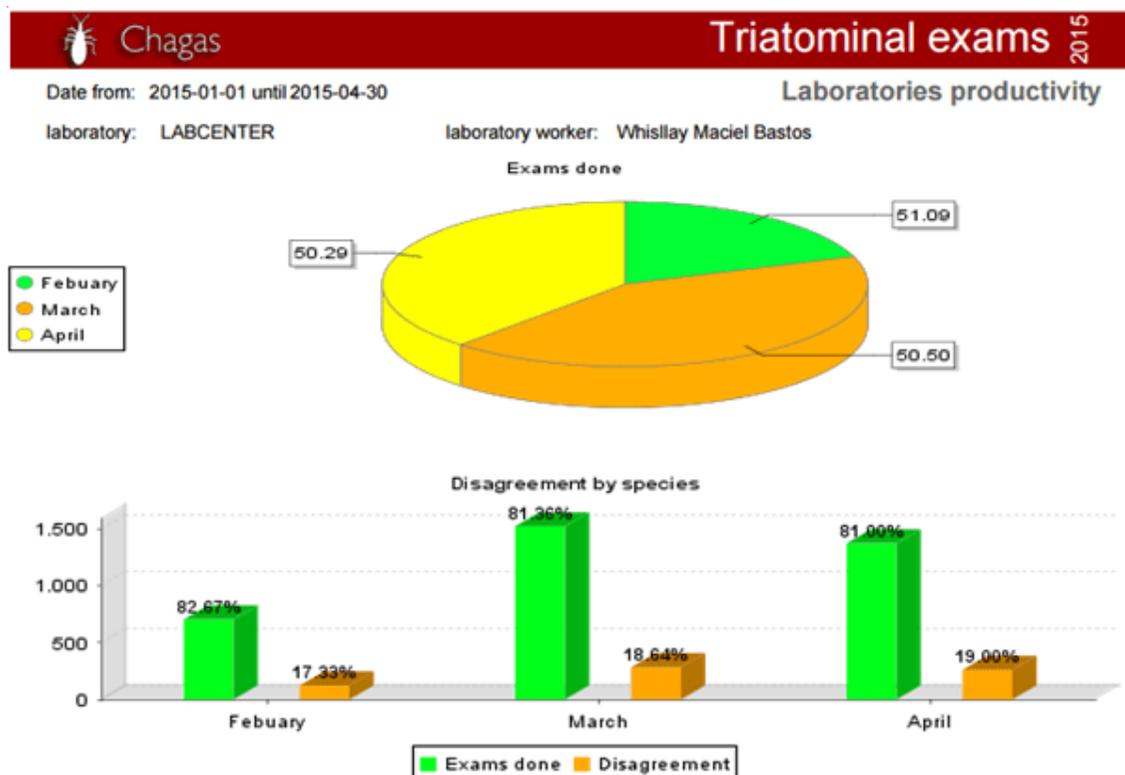


Figure 8 - DSS productivity report laboratory technician.

insect identification process was identified. The form used for this process did not describe the procedures for quality control by the Medical Entomology Management. This control is necessary for the analyzes validation performed by laboratories. Previously, it was reported only the disagreement or not of the slide, that is, it was verified if the results achieved by the quality control were divergent in the taxonomic and/or parasitological analysis.

DSS-Chagas allows us to determine the taxonomic (species and stage) and parasitological identification (positivity for *Trypanosoma cruzi*) misconceptions for optimization of quality control. It also enriches the training with laboratory worker of the municipality, providing specific training for each laboratory worker in the context of its misconception. In this process, the disagreements are informed by the GEM, by altering the divergent data (can be done in relation to the species, stage, and parasitological result), as shown in Figure 7. Once the disagreement has been reported, the DSS-Chagas adopts only the records that have been altered and inserts them into a structure responsible for storing the discordant data.

At the end, with the registration of all data of the daily activity in DSS-Chagas, it is possible to generate the Productivity Report of the laboratory worker. The Figure 8 displays this report. The first graphic (pizza) represents the number of tests performed monthly by the laboratory worker. The second graph (bars) is part of the taxonomic discordance, classified as species. In this case, the total number of exams performed (green) and the misunderstandings percentage (orange) are presented.

## CONCLUSIONS

Health management systems have received wide prestige due to the benefits of each specificity of the tools used. They have provided satisfactory assistance to health professionals for the decision-making process, control and detection of endemic outbreaks or cases, monitoring of the programmed goals, health promotion, and prevention. Through this, information systems help managers to provide quality public services to the population, mainly in the production of tools that assist in the monitoring of essential health services. After identifying evidence about the fragility in the control and management of the information about the vector of Chagas' disease, as well as all the damages that can cause indirectly for the population health, and considering that the manual control and the prevention are inefficient and ineffective, it is concluded that DSS-Chagas is a tool that ensures better organization and accuracy of the information, effective monitoring, and optimization in the processes.

DSS-Chagas contribute significantly to public managers and coordinators have complete and accurate information, impacting directly in more assertive decisions in the projects of control and prevention against Chagas disease. However, it is recommended to create a mobile application that will expedite the daily bulletin by the community agent still in the field. This requirement allows greater speed and accuracy in the work processes, removing completely the problems of ineligibility and inconsistencies in the forms filling.

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