UNIVERSITY OF OXFORD

A novel diagnostic strategy for Chagas disease

Policy brief

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- Introduction
- Current challenges in tackling congenital Chagas disease

A policy proposal for the integration of a cell-free diagnostic kit for congenital Chagas disease in Bolivia

Chagas disease is a neglected tropical disease, endemic to 21 countries in Latin America including Bolivia. The disease can be transmitted by (1) the bite of the triatomine vector, (2) blood transfusions, (3) orally via ingestion of contaminated fluids and (4) vertically from mother to child. Strategies to reduce the impact of Chagas in endemic countries have largely focused on preventing transmission through vector control programmes and blood banks. Although these achievements have significantly reduced its incidence, they are not sufficient to combat the spread of the disease vertically from a mother to her child. Therefore, congenital Chagas disease is growing in epidemiological importance, and it is now one of the most persistent forms of the transmission among the human population, with prevalence in some rural areas of Bolivia being as high as 70.5%. Infected newborns detected at birth or before one year old, if treated, can be completely cured. This report reviews the key challenges faced in tackling congenital Chagas disease and how they can be overcome through the integrated implementation of a cost-effective point-of-care diagnostic that can be used to screen all newborns.

The national congenital Chagas program, led by the National Program of Chagas and Belgian cooperation from 2004 to 2009, has been the biggest efforts to tackle congenital Chagas disease in Bolivia thus far. The program strategy involved conducting a serological test during pregnancy and three follow up micromethod tests on children born from positive mothers until one year old. Any positive newborns were treated with Benznidazole, 10 mg/Kg/day/30 days. Throughout the length of the program, 318,479 pregnant women and 42,538 children born from positive mothers were analyzed at birth by micromethod. The program demonstrated that it is possible to implement, a National Congenital Chagas Program and integrate it into the Bolivian health system with limited resources. However, the implementation of the program highlighted several challenges in tackling congenital Chagas using current diagnostic tools and infrastructure. These challenges are summarised in the table shown in figure 1.

Challenge	Why is it a problem?
Insufficient infrastructure	The micromethod test for newborns requires a laboratory in order to be analysed, making it difficult to carry out in small clinics and rural hospitals. This means people living in dispersed rural areas of the 164 endemic municipalities, which represent around 37% of the national population remain out of reach.
Sensitivity of blood smears	Blood smears require a lower limit of 40 parasites/ml, which is considerably high. Detection of the parasite also requires a highly trained professional and the accuracy depends on their technical capacity and motivation.
Lack of follow up	Mothers stay in the clinic for 12-24 hours after birth but the results for the micromethod test take far longer. After their departure from the maternity unit it is difficult to locate the mothers to advise them regarding the monitoring or treatment of their baby, often because there is no personnel available to look for them, and in many cases because the home details are ambiguous or incomplete.

Figure 1: A table summarising the main challenges faced in the National Program for congenital Chagas disease

In June 2016, the WHO and experts on Chagas disease based in Latin America regarded a point of care diagnostic for congenital Chagas as their top priority in terms of the diagnostic needs for Chagas disease. Current rapid serological test based on the detection of antibodies cannot be used for newborns, as they lack a fully developed immune system and the result of the test could be influenced by the presence of maternal antibodies. We propose a cell-free protease detecting system in a rapid diagnostic kit that could be used by any medical professional able to take a prick of blood from a newborn. The rapid diagnostic kit does not require any laboratory equipment, allowing it to be carried out in any clinical setting including rural areas with limited resources. The diagnostic test is expected to only take 8 minutes, consequently allowing treatment of positive newborns to begin before they leave the hospital. It also allows the mothers impacted to be advised about the monitoring and further treatment of their baby, reducing the need for extensive follow up. The protease detection system is also more accurate and sensitive than blood smears.

The flowchart, shown in figure 2, describes the ideal diagnostic strategy to optimise the number of infants diagnosed and treated for Chagas disease before 12 months. The strategy involves treating all infants at birth and during a medical consultation between 1-2 months of age with the rapid protease detecting kit. To ensure the highest turnout during the second screening of infants, the medical consultation could be aligned to coincide with the first dose of the pentavalent vaccine, as the National Program for congenital Chagas disease observed a significantly larger percentage of children going into the health facilities for the pentavalent vaccine opposed to a medical consultation for Chagas screening alone. An infant diagnosed positive for Chagas at any point during the screens would begin treatment immediately.

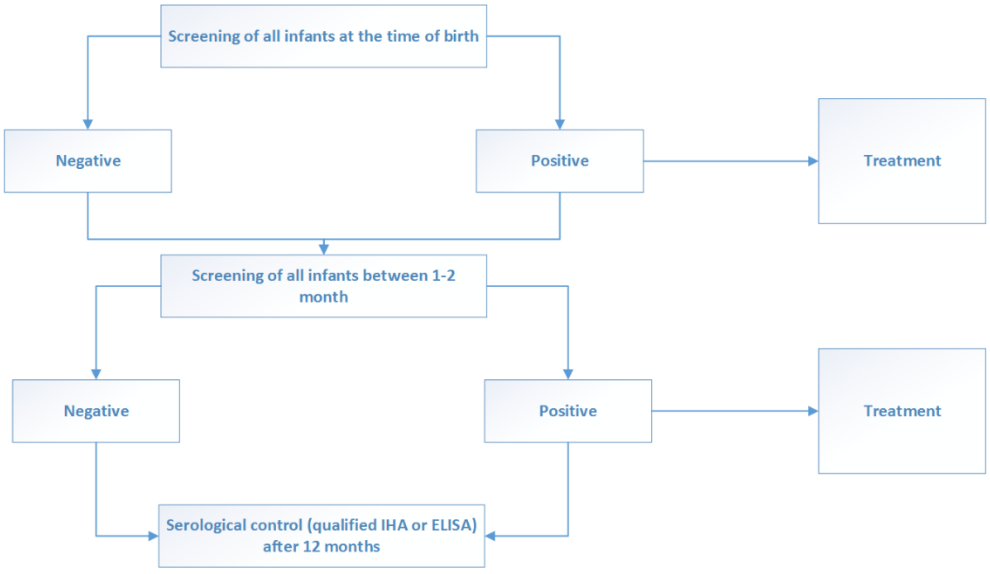

Figure 2: A flowchart showing the optimal diagnostic strategy for congenital Chagas disease using a rapid protease detecting kit.

Implications and recommendations

The application of the optimal diagnostic strategy using a rapid protease detection kit, would result in a significantly larger proportion of infants being diagnosed and treated consequently reducing the medical burden of Chagas caused by chronic infection. Other measures to optimise the diagnosis and treatment of congenital Chagas disease would involve better database records of patients in Bolivia, to ease follow up and ensure all children complete the treatment. The databases would also need to be secure to maintain patient confidentiality. In order for the most efficient diagnosis of newborns, a rapid protease detection kit would be both cost effective and viable for even rural locations with limited resources. However, to ensure the kit is widely available throughout Bolivia the appropriate legislations for the import of the cell-free DNA system must be in place. Transport costs can be reduced by manufacturing the outer casing of the device within Bolivia itself.

Conclusion

Vertical transmission of Chagas disease remains of high epidemiological importance and reducing the number of infants impacted through efficient diagnosis and treatment would significantly reduce the medical burden of Chagas in Bolivia. A rapid protease detection kit would allow infants to be tested in a cost-efficient way that can be applied throughout Bolivia, even in rural areas with limited resources. Initiative to improve follow up through more thorough and secure patient records and appropriate legislation to allow the import of cell-free DNA into Bolivia would aid with the process. Integration of effective diagnosis and treatment of congenital Chagas disease into the Bolivian health care system would allow it to act as an example to other Latin American countries also affected by Chagas disease.

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