Leptospirosis in the Americas – Surveillance and Drivers

Cristina Schneider, DVM, MSc, ScD
Advisor Animal Human Health Interface
PAHO Health Emergencies Department

GLEAN Meeting, Malaysia October 2016
Leptospirosis framework from an outbreak perspective in the Americas Since 2011

Importance of the animal/human interface

Risk and drivers analysis

One Health

Natural disaster analysis

WHO Burden of Leptospirosis
Support countries to **predict, detect, prevent and respond** to outbreaks of leptospirosis, thereby **reducing mortality and severe cases during outbreaks**, as well as reduce the number of cases in risk areas, especially related to the environment.
Leptospirosis is an epidemic-prone disease in the Americas. Lepto alerts = 341, Floods = 99.

Global Situation of Leptospirosis

Morbidity = 1.03 million cases/year
Mortality = 58,900 deaths/year

Source: HealthMap and Dartmouth Flood Observatory; analysis by PAHO/CHA/IR

Costa, 2015
Leptospirosis alerts

- 535 alerts for leptospirosis in HealthMap (outbreak monitoring and real-time surveillance of emerging public health threats) from 2010-2014
- More than half (341 alerts) were in the Americas, particularly in Brazil (165 alerts), Nicaragua (45) and Argentina (43)

Source: HealthMap; analysis by PAHO/CHA/IR
Cases of Leptospirosis in Latin America and the Caribbean, 2014

- Brasil: 38%
- Peru: 22%
- Ecuador: 7%
- Colombia: 8%
- Costa Rica: 4%

Total: 10,702 cases (95% reported in Latin America)

Source: PAHO Core Data, based on country official information
Latin Americas: Leptospirosis Situation

Leptospirosis human cases (2014), cumulative incidence rate (2014), and leptospirosis alerts (2010-2014), Latin America over ecoregions background

Cases: 10,000/year
Rate = 2 per 100,000 pop

This 3 indicators were used as criteria to select priority countries for technical cooperation

Source:

Human cases: PAHO based on country information. Cumulative incidence rates: calculated by authors. Alerts: HealthMap. Terrestrial ecoregions: FAO

Countrires Profiles

LEPTOSPIROSIS: HONDURAS
Reina Velasquez
Zoonosis Surveillance, Health Surveillance Unit, Ministry of Health of Honduras;
Analysis by PAHO

Perfil de País

El programa de Leptospirosis en Honduras está bajo la coordinación de Vigilancia de Enfermedades Zoonóticas de la Unidad de Vigilancia de la Salud. Existen 20 regiones de salud que realizan acciones de prevención y control de leptospirosis y notifican a zoonosis.

Dentro de las medidas de prevención y control implementadas están:

Medidas de Prevención: 1) Promoción de la salud (Educación para la salud, participación social, comunicación educativa); 2) Saneamiento básico; 3) Protección de grupos de riesgo; 4) Protección de animales domésticos y de interés económico.

Medidas de Control: 1) Diagnóstico y tratamiento del los enfermos; 2) Estudios y procedimientos para confirmación de casos e reservorios de la enfermedad; 3) Medidas de control aplicables a la población: Rx específico de casos, búsqueda de contactos, realizar medidas preventivas.

Country Profile

The Leptospirosis program in Honduras is under the coordination of the Zoonotic Disease Surveillance Unit. There are 20 health regions that perform actions of prevention and control of leptospirosis and notify to the zoonosis unit.

Among the prevention and control measures are:

Prevention measures: 1) Health promotion (Health Education, social participation, educational communication); 2) Basic sanitation; 3) Protection of groups at risk; 4) Protection of domestic animals and of economic interest.

Control Measures: 1) Timely diagnostic of patients; 2) Tests and procedures for the confirmation of cases and disease reservoirs; 3) Measures to monitor the population: Timely screening of specific cases, search for contacts, take preventive measures.
Regional strengths and challenges

- Several countries already recognize leptospirosis as a public health problem and have programs in place
- Several countries already coordinate efforts among health, agriculture and others sectors

- Complex cycle with many species involved in a favorable transmission condition
- Limited surveillance in humans and in animals
- Misdiagnosis with dengue and other diseases
- Not yet a “tool ready” disease

Outbreak simulation exercise Health and Agriculture, Choluteca/Honduras, October 2013

Source: Ministry of Health Brazil
Indirect exposure through water and soil contaminated by urine from infected animals is the most common route of exposure of this worldwide disease, which is a perfect example of the animal-human-ecosystem interface.
Possible Environmental Drivers

Natural disasters and communicable diseases in the Americas: contribution of veterinary public health

Maria Cristina Schneider(1), Maria Cristina Tirado(2), Shruthi Rereddy(3), Raymond Dugas(4), Maria Isabel Borda(5), Eduardo Alvarez Peralta(1), Sylvain Aldighieri(1) & Ottorino Cosivi(1)

Natural disasters by type, Latin America, 2010 - 2012

Ecosystems: Tropical and subtropical

Type of soil

Ecoregion

Rain

Pan American Health Organization
Leptospirosis Outbreaks in Nicaragua: Identifying Critical Areas and Exploring Drivers for Evidence-Based Planning

Maria Cristina Schneider 1,* , Patricia Nájera 1 , Sylvain Aldighieri 1 , Jorge Bacallao 2 , Aida Soto 3 , Wilmer Marquiño 3 , Lesbia Altamirano 3 , Carlos Saenz 4 , Jesus Marin 4 , Eduardo Jimenez 4 , Matthew Moynihan 1 and Marcos Espinal 1

Photo: G Moreno
Objective

Document the known areas of outbreaks and analysis possible drivers in Nicaragua.

Methodology

- Ecological-type study by second subnational level (153 municipalities), from 2004 to 2010
- Secondary sources and data, sources from the country’s information system, the 2005 Nicaragua Census, and other different sources
- Definitions and criteria
- Description of the epidemiological situation and risk stratification
- Created from scratch a database (GIS) with cases, socioeconomic and environmental variables (by municipality)
- Exploratory analysis (statistic and GIS)
Monthly distribution of precipitation and cases of leptospirosis, Nicaragua, 2004-2010

Total # of cases: 1980

Cases after the month of highest precipitation were close to 10x higher.

Corr: $p < 0.01$

Poisson: $p < 0.01$
Critical areas and drivers of leptospirosis in Nicaragua, by municipality, 2004-2010

% of municipal surface area covered by cambisol and andosol soils

Corr: p < 0.01
Poisson: p < 0.01
Critical areas and drivers of leptospirosis in Nicaragua, by municipality, 2004-2010

% of rural population

Corr: p < 0.01
Poisson: p < 0.01
Conclusions and recommendations

- Outbreaks do not occur on a yearly basis and the risk is different between the departments and municipalities.
- Some possible drivers were suggested.
- This methodology use in the country Plan and could further assist other countries.
- Addition studies suggested.
- The limitations of ecological study are highlighted.
- Importance of multidisciplinary study team and One Health approach.
Possible Socioeconomic Drivers

Rural poverty and lack of sanitation
Slums in urban areas

Productive process: Agriculture and livestock

Rice paddy
World = 740 million tons
Americas = 360 million tons
(48.6%)

Cattle raising
World = 63 million tons
Americas = 30 millions tons
(47.6%)
Socioeconomic Factors and Vulnerability to Outbreaks of Leptospirosis in Nicaragua

Jorge Bacallao¹,* †, Maria Cristina Schneider²,* †, Patricia Najera² †, Sylvain Aldighieri² †, Aida Soto³ †, Wilmer Marquiño³ †, Carlos Sáenz⁴ †, Eduardo Jiménez⁴ †, Gilberto Moreno⁴ †, Octavio Chávez⁴ †, Deise I. Galan² † and Marcos A. Espinal² †
Study Objective

To construct and validate a vulnerability index based on municipal socioeconomic indicators that could be used as a criteria to identify priority areas for intervention in the high risk departments.

Methodology

Departments investigated in the study: León, Chinandega and Managua

Leptospirosis cases, Nicaragua, 2007 to 2010

Source: Cases MINSA/NIC; analysis authors
Results

Relative importance of the variables in defining the clusters

The Unsatisfied Basic Needs (UBN) of Quality of Household was the variable with the highest relative importance, followed by poverty.

Legend: Solid Waste Disposal: households with solid waste disposal; UBN Education: unsatisfied basic needs- access to education; UBN Crowding: unsatisfied basic needs- crowding; Piped Water: households with piped water; Illiteracy: illiteracy; UBN Sanitary Services: unsatisfied basic needs- access to sanitary services; Extreme Poverty: extreme poverty; UBN Quality Household: unsatisfied basic needs- quality of the household.

The model explains 56% which is considered very good.
Results

Classification tree according to the local vulnerability index (LVI)

Out of the 32 municipalities analyzed, none with a low or medium LVI presented with high incidence rate for leptospirosis.

The municipalities with the high LVI presented high or medium incidence rates for leptospirosis (with one exception).

- 12 mun. low incidence rates for leptospirosis
- 10 mun. medium incidence rates
- 10 mun. high incidence rates
- 32 total municipalities
Conclusions

1. The underlying distinction between risk (given mainly by environmental factors) and vulnerability to risk (given mainly by socioeconomic conditions) was reinforced.

2. This distinction also applies to the “causes of outbreaks” and “causes of cases”.

3. The basic components of the index were the unsatisfied basic needs in relation to:
   - the construction material conditions of the household
   - access to sanitary services
   - extreme poverty.
Leptospirosis in Rio Grande do Sul, Brazil: An Ecosystem Approach in the Animal-Human Interface

Maria Cristina Schneider, Patricia Najera, Martha M. Pereira, Gustavo Machado, Celso B. dos Anjos, Rogério O. Rodrigues, Gabriela M. Cavagni, Claudia Muñoz-Zanzi, Luis G. Corbellini, Mariana Leone, Daniel F. Buss, Sylvain Aldighieri, Marcos A. Espinal
Objectives of this study

Analyze the distribution of human cases of leptospirosis in the State of Rio Grande do Sul, Brazil, and to explore possible drivers.

Additionally, provide further evidence to support interventions and to identify new research topics at the human-animal-ecosystem interface.

Methodology

- Ecological type study, all state, by second subnational administrative level (496 municipalities)
- Using only secondary data
- Created a data base (GIS) by municipality (26 independent variables)
Results

Human cases of leptospirosis by area, Rio Grande do Sul, 2008-2012

Total of cases = 2141; average by year = 428 cases; 46% rural area

Source: SINAM/MS Brazil, analysis by PAHO
Results - Environmental

Incidence rate for leptospirosis and ecoregions, Rio Grande do Sul, 2008-2012

Multivariable analysis:
Ecoregion Parana-Paraiba
RR (CI 95%) = 2.25 (2.03-2.49)
p<0.001
Results- Environmental

Incidence rate for leptospirosis and type of soil, Rio Grande do Sul, 2008-2012

Multivariable analysis:
Neossolo Litolítico
RR (CI 95%) = 1.93 (1.26-2.96)
p = 0.006
Results - Productive Process

Incidence rate for leptospirosis and rice paddy plantation, and tobacco plantation Rio Grande do Sul, 2008-2012

**Multivariable analysis:**

- Productions of rice per tons
  - RR (CI_{95%}) = 1.003 (1.002-1.04), p<0.001

- Productions of tobacco per tons
  - RR (CI_{95%}) = 1.10 (1.09-1.11), p<0.001
Results - Productive Process

Incidence rate for leptospirosis and number of bovines per property, Rio Grande do Sul, 2008-2012

Univariable analysis:
More than 50.1% of municipality's properties had up to 10 bovine
RR (CI_{95\%}) = 1.00 (1.00-1.00)
p = 0.002

Proportion of bovine farms per km²
RR (CI_{95\%}) = 1.32 (1.13-1.55)
p<0.001
Conclusions/Recommendations

- Average of 428 human cases of leptospirosis annually. Risk in rural populations is 8 times higher. Urban cases are more in the metropolitan region of the state capital.

- For this areas save lives and reduce the number of severe cases are the major goal. Collaboration with Civil Defense and Natural Disaster team.

- The rural cases are more concentrated in certain type of productive process. Collaboration with Agriculture and civil organization related to rice and tobacco plantation and small farmer is suggested to prevent cases.

- Major drivers identified in this study were related to environmental and production processes that will continue to be present in the state. Development of a vaccine is urgently needed to prevent cases in high risk areas.
Acknowledgments to PAHO team:

Sylvain Aldighieri, Deputy Director PHE
Patricia Najera, GIS Analyst
Deise Galan, Consultant

Thank you very much!