RABIES CASE FOR GLOBAL ELIMINATION

Dr Bernadette ABELA-RIDDER
Team Leader, Neglected Zoonotic Diseases
Department of the Control of Neglected Tropical Diseases
17 Neglected Tropical Diseases

Helminth Infections
- Soil-transmitted helminth infections
- Ascariasis-Trichuriasis-Hookworm
- Lymphatic filariasis
- Onchocerciasis
- Schistosomiasis
- Dracunculiasis (guinea-worm disease)
- Cysticercosis
- Echinococcosis
- Foodborne trematodes infections

Bacterial Infections
- Leprosy
- Trachoma
- Buruli ulcer
- Endemic treponematoses

Protozoan Infections
- Leishmaniasis
- Human African trypanosomiasis
- Chagas disease

Viral Infections
- Dengue
- RABIES
WHO Roadmap for rabies…. Can we commit to go further?

<table>
<thead>
<tr>
<th>Elimination/Intensified control</th>
<th>Targets and milestones by 2015</th>
<th>Targets and milestones by 2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rabies</td>
<td>Regional elimination</td>
<td>Regional elimination</td>
</tr>
<tr>
<td></td>
<td>(Americas)</td>
<td>(South East Asia and Pacific)</td>
</tr>
</tbody>
</table>
Rationale for investment: Freedom from dog-mediated human rabies is a global public good

WHO, FAO, OIE, GARC unite to eliminate human rabies and control the disease in animals

1. Rabies disproportionately burdens poor rural communities

2. Dog-mediated human rabies can be eliminated by vaccinating dogs

3. Rabies is preventable yet continues to kill

4. Rabies elimination is feasible
Start small: Make the case

KZN Project Success 2007-2014

2010

BMGF 23%

KZN 77%

2013

BMGF 4%

KZN 96%

Suspect Human Rabies Cases, Visayas Regions, 2009-2013

Philippines, 2007-2015

Dr Bernadette ABELA-RIDDER abelab@who.int - Webinar on Rabies Prevention and Control Tools in Asia - 30 June 2015
1. Swaziland
2. Eastern Cape
3. Mozambique
4. Mpumalanga
5. Orange Free State
6. Lesotho
7. Other Countries
   – Kenya
   – Congo
   – Senegal
Rabies Free Zones
9 of the 15 Visayas group of islands declared jointly by DA and DOH rabies free

Region 6:
1. Guimaras
2. Boracay

Region 7:
1. Siquijor
2. Apo Island
3. Camotes
4. Malapascua Island
5. Olympia

Region 8:
1. Biliran
2. Limasawa

Rabies Free Zones
9 of the 15 Visayas group of islands declared jointly by DA and DOH rabies free

Region 6:
1. Guimaras
2. Boracay

Region 7:
1. Siquijor
2. Apo Island
3. Camotes
4. Malapascua Island
5. Olympia

Region 8:
1. Biliran
2. Limasawa

Rabies Free Zones
9 of the 15 Visayas group of islands declared jointly by DA and DOH rabies free

Region 6:
1. Guimaras
2. Boracay

Region 7:
1. Siquijor
2. Apo Island
3. Camotes
4. Malapascua Island
5. Olympia

Region 8:
1. Biliran
2. Limasawa

Rabies Free Zones
9 of the 15 Visayas group of islands declared jointly by DA and DOH rabies free

Region 6:
1. Guimaras
2. Boracay

Region 7:
1. Siquijor
2. Apo Island
3. Camotes
4. Malapascua Island
5. Olympia

Region 8:
1. Biliran
2. Limasawa

Rabies Free Zones
9 of the 15 Visayas group of islands declared jointly by DA and DOH rabies free

Region 6:
1. Guimaras
2. Boracay

Region 7:
1. Siquijor
2. Apo Island
3. Camotes
4. Malapascua Island
5. Olympia

Region 8:
1. Biliran
2. Limasawa

Rabies Free Zones
9 of the 15 Visayas group of islands declared jointly by DA and DOH rabies free

Region 6:
1. Guimaras
2. Boracay

Region 7:
1. Siquijor
2. Apo Island
3. Camotes
4. Malapascua Island
5. Olympia

Region 8:
1. Biliran
2. Limasawa

Rabies Free Zones
9 of the 15 Visayas group of islands declared jointly by DA and DOH rabies free

Region 6:
1. Guimaras
2. Boracay

Region 7:
1. Siquijor
2. Apo Island
3. Camotes
4. Malapascua Island
5. Olympia

Region 8:
1. Biliran
2. Limasawa

Rabies Free Zones
9 of the 15 Visayas group of islands declared jointly by DA and DOH rabies free

Region 6:
1. Guimaras
2. Boracay

Region 7:
1. Siquijor
2. Apo Island
3. Camotes
4. Malapascua Island
5. Olympia

Region 8:
1. Biliran
2. Limasawa

Rabies Free Zones
9 of the 15 Visayas group of islands declared jointly by DA and DOH rabies free

Region 6:
1. Guimaras
2. Boracay

Region 7:
1. Siquijor
2. Apo Island
3. Camotes
4. Malapascua Island
5. Olympia

Region 8:
1. Biliran
2. Limasawa

Rabies Free Zones
9 of the 15 Visayas group of islands declared jointly by DA and DOH rabies free

Region 6:
1. Guimaras
2. Boracay

Region 7:
1. Siquijor
2. Apo Island
3. Camotes
4. Malapascua Island
5. Olympia

Region 8:
1. Biliran
2. Limasawa

Rabies Free Zones
9 of the 15 Visayas group of islands declared jointly by DA and DOH rabies free

Region 6:
1. Guimaras
2. Boracay

Region 7:
1. Siquijor
2. Apo Island
3. Camotes
4. Malapascua Island
5. Olympia

Region 8:
1. Biliran
2. Limasawa

Rabies Free Zones
9 of the 15 Visayas group of islands declared jointly by DA and DOH rabies free

Region 6:
1. Guimaras
2. Boracay

Region 7:
1. Siquijor
2. Apo Island
3. Camotes
4. Malapascua Island
5. Olympia

Region 8:
1. Biliran
2. Limasawa

Rabies Free Zones
9 of the 15 Visayas group of islands declared jointly by DA and DOH rabies free

Region 6:
1. Guimaras
2. Boracay

Region 7:
1. Siquijor
2. Apo Island
3. Camotes
4. Malapascua Island
5. Olympia

Region 8:
1. Biliran
2. Limasawa

Rabies Free Zones
9 of the 15 Visayas group of islands declared jointly by DA and DOH rabies free

Region 6:
1. Guimaras
2. Boracay

Region 7:
1. Siquijor
2. Apo Island
3. Camotes
4. Malapascua Island
5. Olympia

Region 8:
1. Biliran
2. Limasawa

Rabies Free Zones
9 of the 15 Visayas group of islands declared jointly by DA and DOH rabies free

Region 6:
1. Guimaras
2. Boracay

Region 7:
1. Siquijor
2. Apo Island
3. Camotes
4. Malapascua Island
5. Olympia

Region 8:
1. Biliran
2. Limasawa

Rabies Free Zones
9 of the 15 Visayas group of islands declared jointly by DA and DOH rabies free

Region 6:
1. Guimaras
2. Boracay

Region 7:
1. Siquijor
2. Apo Island
3. Camotes
4. Malapascua Island
5. Olympia

Region 8:
1. Biliran
2. Limasawa

Rabies Free Zones
9 of the 15 Visayas group of islands declared jointly by DA and DOH rabies free

Region 6:
1. Guimaras
2. Boracay

Region 7:
1. Siquijor
2. Apo Island
3. Camotes
4. Malapascua Island
5. Olympia

Region 8:
1. Biliran
2. Limasawa

Rabies Free Zones
9 of the 15 Visayas group of islands declared jointly by DA and DOH rabies free

Region 6:
1. Guimaras
2. Boracay

Region 7:
1. Siquijor
2. Apo Island
3. Camotes
4. Malapascua Island
5. Olympia

Region 8:
1. Biliran
2. Limasawa

Rabies Free Zones
9 of the 15 Visayas group of islands declared jointly by DA and DOH rabies free

Region 6:
1. Guimaras
2. Boracay

Region 7:
1. Siquijor
2. Apo Island
3. Camotes
4. Malapascua Island
5. Olympia

Region 8:
1. Biliran
2. Limasawa

Rabies Free Zones
9 of the 15 Visayas group of islands declared jointly by DA and DOH rabies free

Region 6:
1. Guimaras
2. Boracay

Region 7:
1. Siquijor
2. Apo Island
3. Camotes
4. Malapascua Island
5. Olympia

Region 8:
1. Biliran
2. Limasawa
Demonstrate
Decrease in bites, decrease in PEP use, decrease in rabies (Tanzania)
Surveillance data for planning, monitoring and evaluation

- Knowing the extent of the problem and where

- Breaking the transmission in high risk communities and corridors

- Forecasting of vaccine needs (animal and human)

- Monitoring and evaluation of interventions & their impact

- ....
Lessons learnt:
Think big, start small, scale up

• Vaccinate the dogs and break the cycle

• Cross sectorial collaboration - *One health*
• Surveillance (also to show absence of disease)
• Awareness and education
• Wound cleaning and post-exposure prophylaxis
Global conference

Global elimination of dog-mediated human rabies - The Time Is Now
10-11 December 2015, WHO Headquarters, Geneva, Switzerland

1. Disseminate results of the proof of concept for the elimination of dog-transmitted rabies in different settings and explore expansion and sustainability in other endemic areas;

2. Build support and case for investment to progress towards rabies elimination from national, regional, global and other stakeholders including the private sector;

3. Promote a One Health inter-sectoral collaboration approach between the human and animal health and other sectors;

4.Shape the forward vision agenda with shared purpose including with donors and stakeholders for the elimination of dog-transmitted human rabies.
Rationale for investment: Freedom from dog-mediated human rabies is a global public good
WHO, FAO, OIE, GARC unite to eliminate human rabies and control the disease in animals

1. Rabies disproportionately burdens poor rural communities
2. Dog-mediated human rabies can be eliminated by vaccinating dogs
3. Rabies is preventable yet continues to kill
4. Rabies elimination is feasible
The Blueprint for Rabies Control
Per capita human death rates from canine rabies

Hampson et al., 2015
Global burden of dog rabies

- 59,000 people die every year from rabies
- Over 99% of human cases are due to the bite of a dog.
- 160 people die from rabies every single day
- Every 10 minutes, somewhere in the world, someone dies of rabies.
- 100% of human rabies cases can be prevented
- 84.7% of the world’s population is living with a risk of canine rabies
'Preventable rabies kills 160 people per day'

The New York Times

Rabies Deaths Higher Than Previously Thought

The Telegraph

Rabies still kills 5,000 every month. Vaccinations should be a no-brainer

Rabies jabs could save 60,000 killed by dog bites a year - first global study - TRFN

What Does Dog Rabies Cost the World Today?

Vaccinate dogs to save lives

Over a third of global rabies deaths take place in India
Rabies

• Ancient!
• Most Fatal Disease!
• Completely Preventable

Why Neglected?

Rural communities:
- Poverty
- Remote location
- Poor infrastructure
- Negligible health care
Who is responsible?

1. Dogs not economically vital
2. Public health impact not appreciated
Veterinary neglect of free roaming dogs.

Underreporting:
Laboratory diagnosis non-existent and misdiagnosis common

Global health agenda:
Dog rabies in developing world
Less newsworthy than novel strains of influenza or coronaviruses etc.
Rabies:
- Most Fatal Disease
- Completely Preventable

Why Neglected?

Who is responsible?
1. Dogs not economically vital
2. Public health impact not appreciated

Rural communities:
- Poverty
- Remote location
- Poor infrastructure
- Negligible health care

Veterinary neglect of free roaming dogs.

Underreporting:
Laboratory diagnosis non-existent and misdiagnosis common

Global health agenda:
Dog rabies in developing world
Less newsworthy than novel strains of influenza or coronaviruses etc.
The Cost of Rabies:

The economic cost of rabies is $8.6 bn annually

1. Premature Death 55%
2. Direct Costs of Post-Exposure Prophylaxis (PEP) 20%
3. Loss of income while seeking PEP 15.5%

(source: Dr. Katie Hampson, Glasgow University)

BUT we need:

1. Mass dog vaccination campaigns;
2. Information campaigns aimed at local populations;
3. Medical and Veterinary sectors working together;
4. Improved surveillance to monitor control efforts;
5. Improved access to human health care (vaccines and anti-rabies sera).

Investment in **dog vaccination** is the single most effective way of reducing the disease burden. At the moment, dog vaccination accounts for just **1.5% of rabies costs**.
Global Alliance for Rabies Control

2007
World Rabies Day

2008
Partners for Rabies Prevention

2010
2011-2015
Rabiesblueprint.com
Burden of rabies

2013-2015
HE of rabies
The Blueprint for Rabies Prevention and Control has been developed by global rabies experts to serve as a guide for countries that would like to prevent human rabies by eliminating animal rabies within their borders.

It provides access to all relevant international guidelines for rabies control and prevention, together with practical information, advice and case studies on how rabies control can be achieved.

What area of rabies are you most interested in?

- Canine rabies
  Visit caninerabiesblueprint.org

- Fox rabies
  Visit foxrabiesblueprint.org

- Rabies Surveillance
  Visit rabiessurveillanceblueprint.org
Welcome to the Rabies Surveillance Blueprint

The First version of the Rabies Surveillance Blueprint is now complete

The Rabies Surveillance Blueprint has been developed by global rabies experts to serve as a guide for countries that would like to improve surveillance for rabies in any species.

The Blueprint brings together relevant information on rabies surveillance in an easily accessible format. It is not meant to replace existing material or national guidelines but rather is meant to serve as an easy to use guide to assist countries in understanding how to conduct rabies surveillance, as well as how to report and use the data generated to improve rabies control in any species.
CanineRabiesBlueprint.org

Very collaborative effort

Online, freely available

Third version completed Sept 2014

Promoted through the networks

Google analytics suggest that usage is increasing
# Overview of the Site

<table>
<thead>
<tr>
<th>CANINE RABIES BLUEPRINT</th>
<th>PAGES</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Introduction</td>
<td>9</td>
</tr>
<tr>
<td>2. Roles and Responsibilities</td>
<td>2</td>
</tr>
<tr>
<td>3. Infrastructure, legislative framework, costs and funding</td>
<td></td>
</tr>
<tr>
<td>3.1. Infrastructure</td>
<td>11</td>
</tr>
<tr>
<td>3.2. Legislation</td>
<td>15</td>
</tr>
<tr>
<td>3.3. Costs and Funding</td>
<td>7</td>
</tr>
<tr>
<td>4. Communications plan</td>
<td></td>
</tr>
<tr>
<td>4.1. Importance of an effective communication plan</td>
<td>1</td>
</tr>
<tr>
<td>4.2. Developing a communication plan</td>
<td>8</td>
</tr>
<tr>
<td>4.3. Evaluating the campaign and its impact</td>
<td>4</td>
</tr>
<tr>
<td>5. Operational activities</td>
<td></td>
</tr>
<tr>
<td>5.1. What do we need to know before we start planning a programme?</td>
<td>17</td>
</tr>
<tr>
<td>5.2. What do we need to buy?</td>
<td>6</td>
</tr>
<tr>
<td>5.3. Who do we need to train and in what?</td>
<td>4</td>
</tr>
<tr>
<td>5.4. What are we going to do – dog component?</td>
<td>20</td>
</tr>
<tr>
<td>5.5. What are we going to do – human component?</td>
<td>6</td>
</tr>
<tr>
<td>5.6 Evaluation</td>
<td>5</td>
</tr>
<tr>
<td>5.7. How do we ensure sustainability of the programme?</td>
<td>1</td>
</tr>
<tr>
<td>6. A stepwise approach to planning and evaluation</td>
<td>10</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>LINKS</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Case studies</td>
<td>22</td>
</tr>
<tr>
<td>Documents</td>
<td>112</td>
</tr>
</tbody>
</table>
3.3. Costs and Funding

Click [here](#) for a PDF version of this section.

- 3.3.1. How much is a dog vaccination programme going to cost?
- 3.3.2. What are the costs involved in sterilisation programmes?
- 3.3.3. What are the costs associated with post-exposure treatment?
- 3.3.4. To what extent is rabies prevention and control a priority and has secure funding?
- 3.3.5. What sources of funding might be available for dog rabies control?
- 3.3.6. What resources are needed to set up a rabies control programme?
- 3.3.7. How is the budget determined?
Searching and by component

**canine_rabies_blueprint.org**
a blueprint for the control of rabies
in dog populations

**SEARCH RESULTS**
**POST EXPOSURE**

**Articles found: 49**

5.5.1. What is the difference between pre- and post-exposure prophylaxis?
Tuesday 6 April 2010 by Contact - English

5.6.4. Has the programme had an impact on human rabies deaths, bite exposures and demand for human post-exposure treatment?
Tuesday 6 April 2010 by Contact - English

5.5.6. Are there any conditions that might affect post-exposure prophylaxis?
Tuesday 6 April 2010 by Contact - English

5.2.3. What supplies are needed for a clinic administering human pre- and post-exposure prophylaxis?
Tuesday 6 April 2010 by Contact - English

**COMPONENTS**

- Train personnel
- Raise awareness
- Get the supplies you need
5.4.1. What techniques are available to estimate the number of dogs?

If information on the number of dogs present in the community is not available, it is recommended, but not required, that a dog population survey be conducted before implementing a canine rabies control programme. These surveys assist with more accurate campaign planning, assessing the needs of dog population management programmes, and evaluating the effectiveness of intervention. If the campaigns need to be implemented with some urgency, first rapid population estimates can be made, as described here, and additional surveys can be implemented post-vaccination (e.g. combined with surveys for estimation of vaccination coverage, described here).

The options for estimating the number of dogs to vaccinate are as follows:

- Expert opinion based on historical data of previous campaigns or on registration records if available.
- Expert opinion based on estimations made in other geographic areas/demographic settings.
- Commonly used census techniques:
  - **Questionnaire surveys** can be used to establish the mean number of owned dogs per household and dog:human ratios. Since the total human population or number of households is generally known through national population censuses, an estimate of the owned dog population can then be extrapolated. These surveys can be conducted before, during or after campaigns (e.g. combined with post-vaccination surveys to estimate vaccination coverage, described here). Households for interview should be selected randomly. Additional information can be obtained on:
4.2.3. Identifying and understanding who needs to be involved

Who could be involved and who could be consulted?

Consultation is necessary to decide on the intended audience and specific stakeholders. You need to know the characteristics of the people that you want to reach, such as their socio-demographic characteristics, their media or communication preferences and accessibility to rabies information sources.

Your messages will always depend on the people you are trying to convince, but there may be other groups who can influence them, both now and in the longer term. All these potential participants should be identified in the planning stages. One way of doing this is to conduct a stakeholder analysis in the community. You can then learn more about the potential stakeholders and consult at all levels. This identifies the people you need to reach, the people who can help you reach them and how important they are to the success of your campaign. It can also serve as a basis for involving them in the messages and solutions, so that they become their messages and solutions. Click here for how to conduct a stakeholder analysis.

If you are working in a specific locality, and only have a general idea of the people you need to speak to, it may be useful to hold community consultation meetings to help identify the key people you need to involve.
Guidelines on human prophylaxis

- WHO short guidelines:

- WHO PEP Prophylaxis Guidelines 2013

- WHO human vaccination position paper - wer8532: 309 - 320
  (August 10):
  http://www.who.int/wer/2010/wer8532

- Human prophylaxis
  WHO position paper

- WHO Expert Consultation on Rabies, Second Report, 2013, see Section
  8.3 Post-exposure prophylaxis
  http://apps.who.int/iris/bitstream/10665/85346/1/9789240690943_eng.pdf

- WHO Expert Consultation 2013

- The Immunological Basis for Immunization Series: Module 17: Rabies
  WHO, 2011:
A Case Study

House-to-house rabies vaccination campaigns using schoolchildren in Istanbul, Turkey

In urban areas of Turkey, dog rabies mostly affects the underprivileged. People living in these areas are often reluctant to participate in activities associated with the local or national government. This results in their unwillingness to provide information on whether they own dogs and to make their dogs available for vaccination (fearing that they may be culled rather than vaccinated). It was therefore decided to use elementary public school children in selected areas to guide vaccination teams through these sites. Local children only attend school half-day and they are therefore available for the rest of the day in these settings. These children have a deep understanding of their areas and would generally know the location of houses with dogs. They would also be able to indicate whether free-roaming dogs had an owner and, if so, where the owner would live. They could accurately locate hiding spots of these dogs. These dogs could also be much more easily approached when children were part of the vaccination teams. Children were extremely willing to accompany the teams, but only one or two of them would be selected each day; most dogs would
Another Case Study

Strategic Plan for the Elimination of Human Rabies in Kenya

An inter-ministerial collaborative effort between the Kenyan Ministry of Agriculture, Livestock and Fisheries and the Ministry of Health’s Zoonotic Disease Unit produced a rabies elimination strategy for Kenya that would eradicate human cases of rabies by 2030. The strategy, which was generated by government ministries as well as community stakeholders, was modeled after the Canine Rabies Blueprint and focuses on controlling dog-mediated rabies through comprehensive and sustained dog vaccination campaigns.


previous page: Interministerial collaborations for Rabies Elimination
next page: A puppet show on rabies prevention
3.3.4. To what extent is rabies prevention and control a priority and has secure funding?

In the majority of rabies-endemic countries, rabies is often not considered a priority because information on its local and global burden and impact is lacking. This has led to limited resources being allocated to rabies control.

However, rabies control is now accepted as a global health priority. It is now globally recognised that rabies greatly affects human and animal health sectors and has a large economic impact as shown in these studies. National and international policy makers should therefore be informed about the burden of rabies and the need for well-planned and sustained rabies control efforts and allocation of adequate resources.

In persuading policy makers to allocate funds to rabies control, arguments about cost-effectiveness of control interventions may be very powerful. Even without a goal of elimination, dog vaccination is a cost-effective strategy, as demonstrated here for African settings. There are also studies demonstrating the cost-effectiveness of PEP, see here.

A toolkit in how to approach policy makers to make argument for better rabies control is available here.
Rabies Educator certificate

South Africa

Philippines

Crucell
The Rabies Educator Certificate (REC) program is a free online course for community educators, public health workers and anyone interested in learning how to prevent rabies in their communities.
A stepwise approach to planning and evaluation

The Stepwise Approach towards Rabies Elimination (SARE) has been developed as a template that countries may use to develop activities and measure progress towards a national programme and strategy for sustainable rabies prevention, control and eventually elimination.

See here for a PDF version of this section.
Canine Rabies Blueprint

A blueprint for the control of rabies in dog populations

**Country Free from Dog Transmitted Rabies**

**Stage 5**
- Freedom from human and dog-transmitted rabies being monitored
  - No dog-to-dog transmitted rabies for a consecutive 12 months
  - Maintenance of human rabies freedom, elimination of dog rabies

**Stage 4**
- Full-scale implementation of the national rabies control strategy
  - No deaths due to indigenously acquired human rabies for a consecutive 12 months

**Stage 3**
- National rabies prevention and control strategy endorsed and funded
  - Development of the national rabies prevention and control strategy

**Stage 2**
- Assessment of the local rabies epidemiology, elaboration of a short term rabies action plan
  - Functional intersectoral rabies task force in place, rabies is a notifiable disease

**Stage 1**
- Rabies occurrence in any species is reported to international agencies
  - No information on rabies available but rabies is suspected to be present

**Stage 0**
- Country endemic for dog transmitted rabies
MEEREB: at the forefront of the fight against Rabies

Rabies still kills humans

April 7-9 2015: Lyon (France) 3rd Edition of the Middle East and Eastern Europe Rabies Expert Bureau Meeting.
GARC LAUNCHED ITS FIRST FREE ONLINE COURSE:
The Rabies Educator Certificate

GO TO PAGE

©Daniel Stewart
Rabies Control and Elimination?

We need to stand together
Developing a Stepwise Approach towards (Dog-Transmitted) Rabies Elimination (SARE)

Katinka de Balogh
Senior Officer – Veterinary Public Health
Animal Health Service
Food and Agriculture Organization of the United Nations
Global Rabies Burden: A Public Health Concern

- Neglected and re-emerging zoonotic disease
  - 50-70,000 estimated human rabies cases per year
  - Rabies is closely linked to poverty

- Over 95% of all human rabies deaths are observed in Asia and Africa

- Over 99% of the human rabies cases reported are due to dog-bites
• Rabies control best to follow the One Health approach
  – Rabies requires coordinated response by veterinary and public health services
  – It is a human health problem which has social and economic dimensions as well as costs in the animal health sector

*Human rabies transmitted by dogs can be eliminated!*
Surveillance and laboratory diagnostics
Post exposure prophylaxis
Animal bite reporting and wound treatment
Municipal & community engagement
Surveillance and laboratory diagnostics
Dog population control
Animal vaccination
Public awareness

LEGISLATION, POLITICAL SUPPORT AND FUNDING

Human Health Sector

Animal Health Sector
Rabies is a vaccine preventable disease

**Challenges:**

- Making Post-exposure prophylaxis accessible and affordable
- Increasing vaccination of dogs against rabies
- Importance of animal bite clinics
In your country are people more at risk of dying of rabies?

1. In urban areas
2. In rural areas
3. Don’t know
Countries/municipalities are often overwhelmed when dealing with (human) rabies outbreaks….

- Fear
- Political/social pressure,
- Lack of resources
- Lack of available and accessible Post-exposure prophylaxis (PEP)
- Low vaccination rate of dogs…..
Why develop a stepwise approach?

- **Goal of SARE:**
  1. Provide a structured approach
  2. Enable countries to define the “Stage” of rabies control they are in
  3. Provide defined “keys” to move to a next stage (measure progress)
  4. Indicated links to relevant sections of the rabiesblueprint

- **Role of FAO:**
  1. To assist countries in getting started and implement SARE
Rabies Stakeholder Consultations
Kick-starting integrated rabies control

DRC
Cameroun
Gabon
Georgia
Regional Meetings
Kenya
Cameroun
Republic of Congo
Vietnam
Stepwise Approach: How does it work?

6 stages to move from endemic to free from human rabies transmitted by dogs

List of achievements (keys) essential to move to the next stage
COUNTRY FREE FROM
DOG TRANSMITTED RABIES

STAGE 5
Freedom from human and dog-
transmitted rabies being monitored

- No dog-to-dog transmitted rabies for a consecutive 12 months
- Maintenance of human rabies
  freedom, elimination of dog rabies

STAGE 4

COUNTRY ENDEMIC FOR DOG
TRANSMITTED RABIES

STAGE 3
Full-scale implementation of the
national rabies control strategy

- National rabies prevention and
  control strategy endorsed and funded
- Development of the national rabies
  prevention and control strategy

STAGE 2

STAGE 1
Assessment of the local rabies
epidemiology, elaboration of a
short term rabies action plan

- Rabies occurrence in any species is
  reported to international agencies
- No information on rabies available but
  rabies is suspected to be present

- Functional intersectoral rabies task force
  in place, rabies is a notifiable disease
The table below lists acronyms used for each suggested topic. The next section will provide a detailed description of each individual stage of the SARE.

**Structure of individual stages:**

- Short description of each stage
- List with suggested activities by topics:

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>LEG</td>
<td>Legislation</td>
</tr>
<tr>
<td>DCA</td>
<td>Data collection and analysis</td>
</tr>
<tr>
<td>LAB</td>
<td>Laboratory diagnosis</td>
</tr>
<tr>
<td>IEC</td>
<td>Information, education and communi</td>
</tr>
<tr>
<td>PCO</td>
<td>Prevention and control</td>
</tr>
<tr>
<td>DPO</td>
<td>Dog population related issues</td>
</tr>
<tr>
<td>CCI</td>
<td>Cross cutting issues</td>
</tr>
</tbody>
</table>

- Links to the [Canine Rabies Blueprint](#) which details information on topics and the majority of activities listed
- List of key achievements (keys) essential to progress to the next stage
COUNTRY ENDEMIC FOR DOG TRANSMITTED RABIES

**Stage 0**

*No information on rabies available but rabies suspected to be present*

**Key to move from Stage 0 to Stage 1:**
*Rabies occurrence in any species is reported to international agencies*
**Description:**
No systematic recording of clinical rabies or animal bite events occur, but suspicion of rabies being present (any species) is based on episodic clinical description (in animals or humans) or historic confirmation (many years ago). There is no or no recent laboratory confirmation of rabies (by a laboratory inside the country or by an international reference laboratory). No national rabies-specific guidelines available or if available, are not implemented or inappropriate to the country’s situation.

A Checklist in Annex 1 may assist in defining the progress that has been made so far and where there is a need to invest more efforts.

**During stage 0 the following needs to be implemented:**

<table>
<thead>
<tr>
<th>Topic</th>
<th>Activities &amp; achievements</th>
<th>Blueprint or other links</th>
</tr>
</thead>
<tbody>
<tr>
<td>LEG</td>
<td>A national rabies case definition (both, for human and animal rabies) is available</td>
<td>2, 5</td>
</tr>
<tr>
<td>LAB</td>
<td>Contacts to an international rabies reference laboratory or international organizations are established</td>
<td>3.1.7 Which laboratories are available, OIE-ref-laboratories, WHO-coll-centres, FAO reference, 2</td>
</tr>
<tr>
<td>LAB</td>
<td>Several rabies suspect samples are submitted to a national laboratory, if available</td>
<td>Simple-techniques-for-brain-sample</td>
</tr>
<tr>
<td>LAB</td>
<td>At least one rabies suspect sample of either animals or humans is submitted to an international rabies reference laboratory for confirmation</td>
<td>Simple-techniques-for-brain-sample, 6, WHO guide inf sample shipping</td>
</tr>
<tr>
<td>IEC</td>
<td>Result of rabies sample(s) are shared appropriately with local and national authorities</td>
<td></td>
</tr>
</tbody>
</table>

**Key:**
- Notification of at least one rabies case (any species) has been confirmed by an international reference laboratory- and has been notified to global organizations: WHO (human rabies) and OIE (animal rabies).
Stage 1

Assessment of the local rabies epidemiology, elaboration of a short term rabies action plan

Key to move from Stage 1 to Stage 2:
Functional intersectoral rabies task force in place, rabies is a notifiable disease (in humans and animals)
**Description:**
At this stage the government assesses the structures that have been put in place, activities that have been initiated and resources that are available. The country starts collection and analysis of existing and new data on rabies, such as animal bite-related events and assessments of existing prevention and control activities in at least some parts of the country. Some follow-up of outbreaks and cases (including special studies, such as active surveillance in some areas or local dog vaccination campaigns, dog population management and public awareness initiatives) are already conducted or have been initiated. Collated information and experiences lead to a short term action plan regarding first needs and success stories. It is considered important to gain insight into the potential stakeholders involved in rabies prevention and control in the country and to understand the needs of rabies affected communities. This stage includes activities to lay out the foundation for the elaboration of a future national rabies prevention and control programme and strategy. Typically at this stage there is no or only limited funding allocated

---

**Essential activities and infrastructure that need to be put in place during stage 1:**

<table>
<thead>
<tr>
<th>Topic</th>
<th>Descriptive list of activities &amp; achievements</th>
<th>Blueprint or other links</th>
</tr>
</thead>
<tbody>
<tr>
<td>LEG</td>
<td>The legal framework has been reviewed</td>
<td>3.2. Legislation</td>
</tr>
</tbody>
</table>
| LEG   | A work plan for the adaptation of the legal framework on rabies is proposed, at least:  
- Rabies is a notifiable disease in humans and animals (especially in dogs)  
- Legislation on dog keeping and compulsory rabies vaccination  
- Outbreak declaration and response | 3.2. Legislation, 3.2.3-Why-does-rabies-need-to-be-notifiable, 2, 5 |
| LEG   | Rabies case definition (human and dog rabies) is available and has been disseminated to relevant professionals | 2, 5 |
| DCA   | Reporting and data analysis capacity has been established | 3.1.3-Infrastructure-surveillance, 12 |
| DCA   | Dog bite reporting and documentation have been reviewed and data compiled | 5.3.1-Rabies-surveillance |
| LAB   | Laboratory capacity has been established       | 3.1.8 Minimum laboratory requirements, 6, Laboratory biosafety management/ |
| LAB   | Rabies diagnostic capacity has been established in at least one national laboratory | 3.1.8 Minimum laboratory requirements, 6, Laboratory biosafety management/ |
Stage 1

Assessment of the local rabies epidemiology, elaboration of a short term rabies action plan

Key to move from Stage 1 to Stage 2:

- Functional intersectoral rabies task force in place, rabies is a notifiable disease (in humans and animals)

| PCO | Vaccines and biologics for human rabies prophylaxis are available in the country | 5.5.3-human-biologics
Human-vaccination-supply |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>PCO</td>
<td>A first assessment on access to PEP (and PreP) has been carried out, e.g. distribution of functional rabies treatment centres in the country, number of patients per day, number doses currently used</td>
<td>3.1-Infrastructure</td>
</tr>
<tr>
<td>DPO</td>
<td>Dog population studies to determine size, turn-over and accessibility have been conducted in pilot areas</td>
<td>5.4.1-estimate the number of dogs</td>
</tr>
<tr>
<td>DPO</td>
<td>Local initiatives on promoting responsible dog ownership, particularly in outbreak situations have been initiated</td>
<td>5.4.16-dog-population-management</td>
</tr>
<tr>
<td>CCI</td>
<td>Identification of main national stakeholders in rabies prevention and control has been carried out</td>
<td>2. Roles-and-Responsibilities</td>
</tr>
<tr>
<td>CCI</td>
<td>Stakeholder consultation held</td>
<td>12</td>
</tr>
<tr>
<td>CCI</td>
<td>Intersectoral rabies task force, committee or working group established</td>
<td>2. Roles-and-Responsibilities</td>
</tr>
<tr>
<td>CCI</td>
<td>Based on annexed checklist and experience from pilot areas a short term rabies action plan has been elaborated</td>
<td>5.1-What-do-we-need-to-know-before</td>
</tr>
<tr>
<td>CCI</td>
<td>Mechanisms for mobilizing emergency funds in case of an outbreak have been identified</td>
<td>3.3-Costs-and-Funding</td>
</tr>
<tr>
<td>CCI</td>
<td>A short term rabies action plan was refined and endorsed by relevant stakeholders at national and local levels</td>
<td>1.8-What-measures-are-available 2. Roles-and-Responsibilities</td>
</tr>
</tbody>
</table>

Direct links to the rabies blueprint

**Keys:**

- Proof on the establishment of an intersectoral rabies task force that meets on a regular basis is provided
- Rabies is a notifiable disease in humans and animals
- Major gaps and required actions were identified and a short term rabies action plan has been formulated
- A functional, basic rabies surveillance system was established, including regular reporting and notification (increased availability of surveillance data)
- Dog vaccination is initiated in some parts of the country
- PEP is available in some parts of the country
- There is evidence on increased number of awareness campaigns
Stage 2

Development of the national rabies prevention and control strategy

Key to move from Stage 2 to Stage 3:
National rabies prevention and control strategy endorsed and funded
COUNTRY FREE FROM DOG TRANSMITTED RABIES

STAGE 5
Freedom from human and dog-transmitted rabies being monitored
- No dog-to-dog transmitted rabies for a consecutive 12 months
- Maintenance of human rabies freedom, elimination of dog rabies

STAGE 4
No deaths due to indigenously acquired human rabies for a consecutive 12 months

STAGE 3
Full-scale implementation of the national rabies control strategy
- National rabies prevention and control strategy endorsed and funded
- Development of the national rabies prevention and control strategy

STAGE 2
Functional intersectoral rabies task force in place, rabies is a notifiable disease

STAGE 1
Assessment of the local rabies epidemiology, elaboration of a short term rabies action plan
- Rabies occurrence in any species is reported to international agencies
- No information on rabies available but rabies is suspected to be present

STAGE 0
COUNTRY ENDEMIC FOR DOG TRANSMITTED RABIES

FAO-GARC SARE-TOOL (version July 2014)
The animal rabies case definition has been reviewed and was endorsed (intersectoral approach)

<table>
<thead>
<tr>
<th>STAGE</th>
<th>ACHIEVEMENTS / ACTIVITIES</th>
<th>OTHER IMPORTANT INFORMATION (please include in REMARKS)</th>
<th>STATUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>National case definition for animal rabies is available</td>
<td>Agencies the case definition was disseminated to relevant professionals</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>The animal rabies case definition has been disseminated to relevant professionals</td>
<td>Agencies and lowest local government unit</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>The animal rabies case definition has been reviewed and was endorsed (intersectoral approach)</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>National case definition for human rabies is available</td>
<td>Agencies the case definition was disseminated to relevant professionals</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>The human rabies case definition has been disseminated to relevant professionals</td>
<td>Agencies and lowest local government unit</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>The human rabies case definition has been reviewed and was endorsed (intersectoral approach)</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>Legal framework</td>
<td>Title of the framework and the year it was passed</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>If there is a legal framework, the framework has been reviewed in terms of how current it is.</td>
<td>Year the framework was reviewed</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>Rabies is defined as a notifiable disease in humans and animals in the framework</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>Legislation includes dog keeping and compulsory rabies vaccination</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>Legislation includes SOPs on outbreak declaration and response</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>Legal frameworks are in the process of being updated to include specifications on international movements of animals, preferably also compulsory vaccination of dogs</td>
<td></td>
<td>0</td>
</tr>
</tbody>
</table>
WHANT TO LEARN MORE ABOUT SARE?
Access SARE Online

http://caninerabiesblueprint.org/The-Stepwise-Approach-towards
Thank You

Questions?

Contact: katinka.debalogh@fao.org
RABIES

The International Standards

Dr Gregorio Torres - g.torres@oie.int

LinkTADs webinar on rabies prevention and control tools in Asia
World Organisation for Animal Health

Established in 1924
5 regions 180 countries

http://www.oie.int

Mandate of the OIE

“to improve animal health and animal welfare world-wide”
Our mandate

• Transparency (WAHIS)

• Veterinary scientific information (disease control)

• Safe Trade (WTO)
• Standard setting procedures

• Terrestrial animal health code
  • Rabies
  • Stray dog population control

• Manual of diagnostics and vaccines

• One Health and vaccine banks
• *Terrestrial Code*: Standards for disease control and safe international trade

• *Terrestrial Manual*: Standards for laboratory diagnostic methods and requirements for the production and control of vaccines

http://www.oie.int/en/international-standard-setting/overview/
OIE standard setting procedure

- Democratic
- Transparent
- Rapid & flexible
- Science based
- Well-established
- Member participation
- International collaboration
Development of international standards

Request

Specialist Commissions (Scientific & Code)

Support (Expert Advice: Ad hoc Groups)

Specialist Commissions (Scientific & Code)

Draft text

ASSEMBLY

Adoption

OIE INTERNATIONAL STANDARD

Commissions, OIE delegates, stakeholders

Member Countries Comments
OIE international standards on rabies

- Terrestrial Animal Health Code
- Manual of Diagnostic tests and Vaccines for Terrestrial Animals
OIE international standards on rabies

Vertical
- Chapter 8.12 Infection with Rabies virus
- Chapter 5.11 Certificate
- Chapter 2.1.13 Rabies (Manual)

Horizontal
- Chapter 7.7 Stray dogs population control
- Chapter 1.1 Notification
- Chapter 1.4 Surveillance
Cap. 8.12. Infection with Rabies virus

- General provisions
  - Case definition, hosts, incubation period

- Control rabies in dogs
  - Notifiable, surveillance, diagnostic, stray dog management

- Rabies Free Country (self-declaration)
  - Surveillance, notification, preventive measures
  - No indigenous case in the last 2 years

- Recommendation for importation
  - Certification Chapter 5.11
  - Dogs, cats, ferrets, ruminants, equids, camelids, suids, rodents, wildlife

AIM: Mitigate the risk of rabies transmission to human and to prevent the international spread of the disease
Cap. 7.7 Stray dog population control

- Within the OIE animal welfare section
- It addresses humane methods for the control of dog populations and the prevention of zoonotic diseases
- It is not exclusively for rabies
- Outline:
  Dog ecology, programme components, control measures

Responsible Ownership it is key in rabies control
Cap. 2.1.13. Rabies

• Summary

• Section A. Introduction (aetiology)

• Section B. Diagnostic techniques
  • Sample Collection and shipment
  • Identification of the agent
  • Serological test

• Section C. Requirement for vaccines
  • For injectable use
  • For oral use
... rabies control is a Public Good to be considered a priority model to apply the One Health concept...

The OIE is committed to supporting the efforts of the international community to achieve worldwide elimination of dog mediated rabies in humans
Vaccine banks

- **Benefits**: quality (*OIE Manual*), costs vs benefits, speed and logistics, better coordination


- **Africa**: Mali, South Africa*, Togo

- **Cooperation**: (*) WHO Global Procurement and Logistics
Conclusions

- International Standards agreed by Member Countries
- Technical texts for international trade (WTO)
- Provide guidance and support on disease control measures and surveillance
- Dynamic and adjusting to new circumstances
Thank you for your attention!
Principles and Practices for Rapid Rabies Control

30 June, 2015

Eric Brum, DVM, MSc
Team Leader – FAO ECTAD Bangladesh
Principles and Practices for Rapid Rabies Control
Epidemiological foundation of disease control

- To control an infectious disease, must decrease the rate of new infections
- \( R_0 = \text{basic reproductive number} = \text{the expected number of secondary infections resulting from one single infection in a completely susceptible population} \)
  - Example: 1 person with measles spreads the disease to 10 other people \( \Rightarrow R_0 = 10 \)

- \( R_0 > 1 \) \( \Rightarrow \) number of new infections will **increase** over time
- \( R_0 = 1 \) \( \Rightarrow \) number of new infections will **remain stable** over time
- \( R_0 < 1 \) \( \Rightarrow \) number of new infections will **decrease** over time
What’s the $R_0$ of rabies in humans?

Zero. Humans are a dead-end host! 😊

Thus, the $R_0$ of rabies cannot be decreased by dealing only with humans 😞

Dogs are the virus reservoir and source of 99% of the infections to humans and other “non-flying” mammals.
Why is the rabies virus different in dogs? Why is the rabies $Ro > 1$ in dogs?

1. Dogs are **social** animals.
Why is the rabies virus different in dogs? Why is the rabies $Ro > 1$ in dogs?

1. Dogs are social animals.

2. Dogs interact with the world through their teeth.
What are ways to decrease $R_0$?

- $R_0$ is directly proportional to 3 factors:

\[
R_0 \propto \left( \frac{\text{infection}}{\text{contact}} \right) \cdot \left( \frac{\text{contact}}{\text{time}} \right) \cdot \left( \frac{\text{time}}{\text{infection}} \right)
\]

<table>
<thead>
<tr>
<th>Tools</th>
<th>Transmissibility</th>
<th>Contact Rate</th>
<th>Duration of Infection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stamping out</td>
<td>no change</td>
<td>↓</td>
<td>no change</td>
</tr>
<tr>
<td>Vaccination</td>
<td>↓</td>
<td>no change</td>
<td>↓</td>
</tr>
<tr>
<td>Sterilization</td>
<td>no change</td>
<td>↓</td>
<td>no change</td>
</tr>
<tr>
<td>Rapid response to suspect dogs</td>
<td>no change</td>
<td>no change</td>
<td>(if you’re fast!)</td>
</tr>
</tbody>
</table>

*from J.H. Jones 2007*
Why is it so challenging to rely on case detection to control rabies in dogs?

1. The incubation period can be very long.
Why is it so challenging to rely on case detection to control rabies in dogs?

1. The incubation period can be very long.

2. Clinical rabies is actually quite difficult to detect. **Biting** may be the only obvious sign.
Ok, so why not just cull dogs to control rabies?

1. **Only temporary decrease in contact rate** achieved (e.g. only temporary decease in $R_0$).

2. **Dogs are social animals** so contact rate does not decrease in direct proportion to decreased density.

3. **Decreases community support** for rabies control activities, making disease eradication difficult.
So how can we decrease the $R_0$?

- $R_0$ is directly proportional to 3 factors:

$$R_0 \propto \frac{\text{infection}}{\text{contact}} \cdot \frac{\text{contact}}{\text{time}} \cdot \frac{\text{time}}{\text{infection}}$$

<table>
<thead>
<tr>
<th>Tools</th>
<th>transmissibility</th>
<th>contact rate</th>
<th>duration of infection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stamping out</td>
<td>no change</td>
<td>↓</td>
<td>no change</td>
</tr>
<tr>
<td>Vaccination</td>
<td>↓</td>
<td>no change</td>
<td>↓</td>
</tr>
<tr>
<td>Sterilization</td>
<td>no change</td>
<td>↓</td>
<td>no change</td>
</tr>
<tr>
<td>Rapid response to suspect dogs</td>
<td>no change</td>
<td>no change</td>
<td>↓</td>
</tr>
</tbody>
</table>

*from J.H. Jones 2007*
Effective dog vaccination

1. Efficacious vaccine

2. Long-lasting immunity

3. Herd immunity
   - vaccination threshold
   - Sufficient immune animals within the target population to protect even those individuals that are not immune (e.g. maintain $R_0 < 1$)
   - Percentage of immunity required to achieve herd immunity is based on the $R_0$

4. Access to target population
So what’s the $R_0$ of rabies in dogs?

The $R_0$ is between 1 – 2 in dogs.
What percentage of the herd needs to be immune to decrease $R_0 < 1$?

$$\% \text{ immune} = 1 - \left(\frac{1}{R_0}\right)$$

If $R_0 = 1.5$, then $\%$ of immune dogs $= 1 - (1/1.5) = 33\%$

The lower the $R_0$, the lower the herd immunity required.
Rabies in comparison to other diseases

- Smallpox: $R_0 = 3-5$
- Canine Rabies: $R_0 = 1-2$
- Measles: $R_0 = 10-15$
- FMD: $R_0 \approx 10$
- Polio: $R_0 = 5-7$
- Rinderpest: $R_0 \approx 5$
If the $R_0$ of rabies is so low, why has it not been eliminated yet like the other diseases?

Good question! 😊

Simply not enough focus on dog vaccination
So once the vaccination coverage is high, what else can be done?

Keep the vaccinated dogs alive!

The lower the population turnover, the slower the decline in vaccination coverage over time.
And how do we decrease population turnover?

- Decrease death rate
  - Provide better care (e.g. food, water)
  - Do not intentionally kill dogs
- Decrease birth rate
  - Surgical sterilization (permanent)
  - Chemical sterilization (temporary)
Effective vaccination

1. Efficacious vaccine

2. Long-lasting immunity

3. Herd immunity
   - = vaccination threshold
   - Sufficient immune animals within the target population to protect even those individuals that are not immune (e.g. maintain $R_0 < 1$)
     - Percentage of immunity required to achieve herd immunity is based on the $R_0$

4. Access to target population
Which dogs are the most important to vaccinate in order to have the greatest impact on $R_0$?

Dogs with the highest likelihood of encountering the rabies virus.
Which dogs have the highest likelihood of encountering the rabies virus?

Dogs that are not kept in enclosed areas.

- Roaming owned dogs
- Stray dogs
What’s the best way to vaccinate these outside dogs?

1. Vaccinate them when they’re still puppies!
2. Use collars
What’s the best way to vaccinate these dogs?

1. Vaccinate them when they’re still puppies!
2. Use collars
3. Use nets
4. Work hard and work together!
The power of teamwork

Day 1: 50 dogs per team
The power of teamwork

Day 1: 50 dogs per team
The power of teamwork

Day 1: 50 dogs per team

Last day: **210 dogs per team**
Effective vaccination

1. Efficacious vaccine
2. Long-lasting immunity
3. Herd immunity
   - = vaccination threshold
   - Sufficient immune animals within the target population to protect even those individuals that are not immune (e.g. maintain $R_0 < 1$)
     - Percentage of immunity required to achieve herd immunity is based on the $R_0$
     - **Reduce population turnover via sterilization and no dog culling** to maintain herd immunity as long as possible.
4. Access to target population
   - **Roaming and stray dogs** are most important population to target
   - Dog catching with nets
   - Permanent collars for vaccinated dogs
   - **Puppy vaccination**
   - Teamwork!
Principles and Practices for Rapid Rabies Control
Human cases in 2013 decreased by 98% compared to 2010.
Dog vaccination and human cases

Dogs Vaccinated and Human Rabies Cases

- **Number of dogs**
- **Number of cases**

Legend:
- **Total Dog Vax**
- **Human Cases**
Impact of systematic mass dog vaccination

Mexico

30 years

Bali

3 years! 😊
The “bitter pill” of One Health

<table>
<thead>
<tr>
<th>Animal health services</th>
<th>Human health services</th>
</tr>
</thead>
<tbody>
<tr>
<td>Projected cost to eliminate rabies from Bali</td>
<td>$3,139,221</td>
</tr>
<tr>
<td>Projected 5-year savings as a result of successful elimination</td>
<td></td>
</tr>
</tbody>
</table>

- Internal rate of return = 98%
And what do we do globally?

Of the US$ 583.5 million spent annually:

- 83% is spent on post-exposure treatment
- 10% is spent on dog vaccination

Source: Knobel et al. 2005
The persistence of rabies is not due to our neglect. It’s due to our collective ignorance, an ignorance now entrenched within our separated health systems.