### Genus: Bartonella

22 species or subspecies

<table>
<thead>
<tr>
<th>Species</th>
<th>Vector</th>
<th>Disease</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>B. bacilliformis</em></td>
<td>Sand Fly</td>
<td>Oroya Fever</td>
</tr>
<tr>
<td><em>B. quintana</em></td>
<td>Louse</td>
<td>Trench Fever</td>
</tr>
<tr>
<td><em>B. henselae</em></td>
<td>Flea</td>
<td>Cat Scratch</td>
</tr>
<tr>
<td><em>B. bovis</em></td>
<td>Biting Flies</td>
<td>Endocarditis</td>
</tr>
<tr>
<td><em>B. vinsonii</em></td>
<td>Ticks</td>
<td>Endocarditis</td>
</tr>
<tr>
<td><em>B. elizabethae</em></td>
<td>Tick?</td>
<td>Endocarditis</td>
</tr>
</tbody>
</table>
Known vector transmitted Bartonella SPP.

B. bacilliformis - sandfly, Lutzomia verrucarum
B. quintana - human body louse, Pediculus humanus humanus
B. henselae - cat flea, Ctenocephalides felis
B. grahamii - rodent flea, Ctenophthalmus nobilis
B. bovis – horn fly, Haematobia spp

Source: www.earlham.edu
Cat Scratch Disease

Caused by Bartonella henselae bacteria
Usually transmitted through a cat scratch, lick, or bite
~40% of cats carry B. henselae at some point in their lives
Complications can occur, especially in young children and the immunocompromised
  Include bacillary angiomatosis, Parinaud’s oculolandular syndrome, and neurological problems
Found worldwide
Q Fever

Caused by Coxiella burnetii bacteria

Bacteria are shed in milk, urine, feces, amniotic fluids, and placental material

Human infection often due to inhalation of bacteria

Symptoms are usually non-specific

Flu-like febrile illness

About 1% of infected individuals develop chronic infection

Distributed worldwide; Netherlands’ outbreak
A Neglected Disease in the U.S.

From a recent seroprevalence study:

3.1% of the general U.S. population are seropositive

9.5 million people!

>22% of U.S. veterinarians are seropositive
Leishmaniasis

“...is the most important protozoan infection of humans after malaria” ~Dr. Peter Hotez

Mostly affects low and middle SES countries in areas of inadequate housing or poor sanitation

Higher prevalence in the very young and very old more than others

Common disease in patients with HIV/AIDS

Agent: Twenty different *Leishmania* species

Transmission: Bite of infected phlebotomine sandfly

Reservoirs: Humans, wild rodents, marsupials, hyraxes, edendates, wild and domestic dogs
Leishmaniasis epidemiology determined by complex interrelationships of:

<table>
<thead>
<tr>
<th>Host Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parasite</td>
<td>&gt; 20 <em>Leishmania</em> species associated with multiple clinical syndromes</td>
</tr>
<tr>
<td>Vector</td>
<td>&gt; 30 sandfly species, specific to <em>Leishmania</em> species and locale</td>
</tr>
<tr>
<td>Human host</td>
<td>Susceptibility depends on genetics, nutrition, immune status</td>
</tr>
<tr>
<td>(Animal host)</td>
<td>Wild rodents, canids, marsupials; domestic dogs</td>
</tr>
</tbody>
</table>
Leptospirosis

Caused by infection with *Leptospira* bacteria

Usually transmitted through contact between skin or mucous membranes and water contaminated with the urine of an infected animal
Global Incidence

More common in tropical areas
Leptospirosis incidence rates are underestimated
Early signs and symptoms are non-specific
Poor quality of surveillance data
Few laboratories use standard diagnostic methods
Potentially growing issue in peri-urban settings with large rodent populations

Figure 1  Global annual incidence of human leptospirosis. Colors reflect incidence, in declining order: red, pink, green, yellow. Gold reflects areas with probable, but not estimated, high incidence. White reflects absence of data.

Toxocariasis

Parasite of dogs and cats worldwide

Larva migrans disease in people
  Ocular larva migrans can result in vision loss
  Visceral larva migrans causes damage to internal organs, including liver or lungs
  Neurologic larva migrans (raccoon roundworm) with fatal or severe neurologic compromise outcomes

Disease burden is not quantified

Disease of poverty, disproportionately affecting poorest populations
Toxocara seroprevalence by age and race/ethnicity
Ages 6 years and older, NHANES III, 1988-1994

* Seroprevalence in this racial/ethnic group differed significantly (p<0.05) from the other two racial/ethnic groups in each age category.

Won et al, AJTMH 2008
Food-Borne Trematodes (FBTs)

Fascioliasis—zoonosis; ruminants, snails, larvae, plants, cysts, ingestion

South American highlands—endemic with 100% of school children infected

Common liver-fluke infection

“In the feet of cattle” snails move worldwide

Triclabendazole (Novartis, Pharma AG) free supply
Food-Borne Trematodes (FBTs)

Currently infects 40 million people with 10% of the global population at risk

Transmitted via food that is associated with vector

Etiology: 70 species of food-borne trematodes

Difficult names, complex life-cycles, specific geographic distribution add to their anonymity

Fascioliasis, Clonorchiasis, Paragonimiasis, Opisthorchiasis
Rickettsial Diseases

Includes several varieties of spotted fevers, typhus, and scrub typhus.

Diseases caused by related organisms such as Anaplasma, Ehrlichia, and Bartonella species, are often incorporated in this group.

Transmitted by ticks, lice, fleas, or mites.
Health Impacts

Toxocariasis: parasitic worm that can result in asthma and other symptoms like visceral and ocular migrans

Chagas’ Disease: severe heart disease, especially among hispanics

Cysticercosis: a parasitic worm that is now considered the leading cause of epilepsy among Hispanics

Ascariasis: a leading cause of impaired child development

Strongyloides: a helminth; leads to impaired development; severe among immunocompromised
Zoonoses and Poverty: a Double Burden

The lower down the income scale, the more likely is the high risk of multiple zoonotic infections. Impact is greatest on approximately 800 million food-insecure livestock keepers.
Why controlling NZs is highly cost-effective

The overall cost-effectiveness of control activities is determined by the relationship between these four key components:

- **DALYs averted**: Increase where the disease is under-reported, has a high case fatality rate and/or is difficult to diagnose.
- **Non-monetary benefits to human health (DALYs averted)**
- **Monetary benefits to human health ($)**
- **Monetary benefits to livestock health ($)**
- **Cost of control programme ($)**

Large savings in the costs of treating people and in costs incurred by patients are realised where treatment is expensive, diagnosis is difficult and/or expensive, patients require a lot of care and/or patients spend a lot on the disease.

Control costs are reduced where diseases are focalised or where groups at risk can be clearly identified.

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2nd International Conference on Neglected Zoonoses
Nairobi, 13 - 15 November, 2007
Why Invest in NZD?

1. NZG affect poor families and marginalized populations in both rural and peri-urban sites
2. These diseases are significantly under-reported
3. NZD often cluster together where integrated approaches can be cost effective
4. Dual burden – lives and livelihoods at risk
5. Tools and strategies already exist especially in education and controlling animal reservoirs
Key Challenge for NZD

Interventions to prevent and control NZD require concerted action between veterinary, livestock and human health sectors and thus a comprehensive, integrated and interdisciplinary approach is needed to address obstacles and challenges and effectively combat them. One of the most needed new skills is the ability to work across disciplines and professions; “Meta-Leadership”
Divided Constituencies: Medical Needs and Veterinary Responsibilities

The crux of the problem is that for many zoonoses, it is the risk to human health that is most important, while the most effective control route is via the animal.
Peri-Urban Slums
Critical Actions and Approaches

* Promote and implement One Health strategies
* Develop regional approaches and focus on multiple diseases not single diseases at a time
* Raise the profile and awareness of NZD
* Improve impact measures: DALYs; C/B analysis
* Systematically collect incidence data and populations at risk; implement surveillance
* Invest in better diagnostics in the field
* Build effective animal health infrastructure
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One Health is the collaborative effort of multiple disciplines – working locally, nationally and globally - to attain optimal health of humans, animals and our environment.
Neglected Zoonotic Diseases

* Part of the NTD Complex by definition but expanding
* Issue of dual burden – health and economics
* Human-animal interface – accelerating and more intensified
* Co-infection is the rule
* Disease agents on a continuum and so must be our understanding and interventional strategies
* Cost-benefit: a “two-for”; improve both human and animal health simultaneously
Neglected Zoonotic Diseases

* 800,000,000 poor livestock keepers at risk; controlling and investing in animal health benefits human health and well being

* Role of agriculture and trade in developing world and the global food system suggests more neglected zoonoses and transboundary diseases

* Need to close the gap between human and animal health and between veterinarians, other health professionals and ecologists

* One Health is the new paradigm – collaborative, holistic and integrated strategies
Best Practices of Integrated Strategies

HALI Project – Tanzania
Dual treatments with nomadic L/S keepers
World Bank investment in AH infrastructure
USAID projects on One Health
NGOs – multiple projects – Heifer Project
Nairobi peri-urban study comparing human and animal diseases
Poverty alleviation plan through improved AH and consolidation of producers for exports