Economics of One Health

Delia Grace, Bernard Bett, Karl Rich, Francis Wanyoike, Johanna Lindahl and Tom Randolph

Burdens of zoonoses
The challenge of defining zoonotic burden

Inter-epidemic period

Buffaloes/ungulates

Increased vector populations

Above normal precipitation

Hatching of infected mosquitoes

Livestock

Humans

Spillover from livestock through vectors or body fluids

Infected eggs waiting in dambos

DDDAC Lindahl et al., submitted
The challenge of multiple burdens

Direct impact
- Burden of illness in people (DALY’s)
- Losses in agri-food chains ($)
- Losses due to ecosystem impacts (?)

Treatment
- Costs of treating disease in people ($)
- Costs of responding to disease in food chains($)

Prevention
- Costs of preventing disease in people
- Costs of preventing disease in food chain

People
Animals
Ecosystem

DDDAC Shaw & Grace, 2014
The challenge of misdiagnosis

A total of 1,323 samples collected in cross-sectional surveys, 481 already screened.

Cases from Bura health centre:
- Malaria
- Typhoid

Cases from Hola health centre:
- Malaria
- Typhoid
- Brucellosis

Sero-prevalence:
- WNV
- Dengue
- RVF
- Q fever

Pathogens:
- Non-irrigated area
- Irrigated area

*DDDAC Bett, project results*
The challenge of under-reporting

Bovine brucellosis according to 440 surveys

Bovine brucellosis official reports 2008-2012

<table>
<thead>
<tr>
<th></th>
<th>Bovine brucellosis Predicted cases annual</th>
<th>Bovine brucellosis Cases reported 2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>East Africa</td>
<td>21,104,976</td>
<td>12</td>
</tr>
<tr>
<td>West Africa</td>
<td>30,646,060</td>
<td>37</td>
</tr>
<tr>
<td>South Africa</td>
<td>8,492,555</td>
<td>6305</td>
</tr>
<tr>
<td>North Africa</td>
<td>7,952,853</td>
<td>1073</td>
</tr>
</tbody>
</table>

Source: LRI report to DFID Mapping poverty and likely zoonosis hotspots
Burden of zoonotic disease

Source: adapted from IMHE and WHO FERG report
Burden of emerging infectious disease

Zoonoses make up 75% of EIDs and cost 6.7 billion a year

Source: LRI report to DFID Mapping poverty and likely zoonosis hotspots
Credible economic cost benefit studies on brucellosis control (n=13)
- Average benefit cost ratio 6:1
- Median 4:1
- Range 1.1-19.8

<table>
<thead>
<tr>
<th></th>
<th>Ex ante</th>
<th>Ex post</th>
</tr>
</thead>
<tbody>
<tr>
<td>Developing countries</td>
<td>3.7</td>
<td>7.4</td>
</tr>
<tr>
<td>Developed countries</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

DDDAC Grace, 2015
Burden (DALYs)

- Foodborne zoonoses
- Neglected tropical zoonoses
- Emerging zoonoses

Source: IMHE and WHO FERG report

Priority of state veterinary services in Africa

- Foodborne zoonoses
- Neglected tropical zoonoses
- Emerging Zoonoses

Source: Grace et al., 2015
Drivers of wellbeing outcomes
5. Women’s control over resources

2. Source of Income

3. Food Prices

Zoonoses

- Participation in the programme
- Technology adoption
- Household income
- Diet composition
- Food expenditure
- Caloric, protein and micronutrient intake
- Nutritional status
- 6. Women’s time and caring practices

1. Source of Food

4. Non-food spending

7. Women’s own nutrition and health

Source: Gillespie et al, 2012; Masset et al, 2012; Webb, 2013
System dynamics model

Interventions

Policy and implementation recommendations

Animal disease

Herd dynamics

Vector transmission

Market performance

Economic costs

Outcomes

DDDAC Rich et al., in progress
Effect of vaccination delay on cattle pop.

Immediate vax

1 wk delay

No vax

4 wk delay

DDDAC Wanyoike et al. project results
From drivers to decisions

Interventions

Outcomes

Policy and implementation recommendations
# Building a business case for zoonoses control

<table>
<thead>
<tr>
<th></th>
<th>Annual benefit</th>
<th>Annual cost</th>
<th>Confidence in investment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sharing resources</td>
<td>4 billion</td>
<td>1 billion</td>
<td>++</td>
</tr>
<tr>
<td>Controllable zoonoses</td>
<td>85 billion</td>
<td>21 billion</td>
<td>+++</td>
</tr>
<tr>
<td>Timely response</td>
<td>6 billion</td>
<td></td>
<td>++</td>
</tr>
<tr>
<td>Averting pandemics</td>
<td>30 billion</td>
<td>3.4 billion</td>
<td>+</td>
</tr>
<tr>
<td>Generating insights</td>
<td>?</td>
<td>?</td>
<td>+++</td>
</tr>
<tr>
<td><strong>Bottom line</strong></td>
<td><strong>125 billion</strong></td>
<td><strong>25 billion</strong></td>
<td><strong>+++</strong></td>
</tr>
</tbody>
</table>

*Grace, 2015*
Conclusions
Zoonoses & poverty

- Poor people get exposed to zoonoses (DDDAC, Dzingirai et al., submitted)
  - Ecosystem modification, gender, occupation can affect risk
  - But statistical relation between poverty and zoonoses often weak and relations between ecosystem and disease outcomes complex (DDDAC, Muriuki, 2015)

- Good evidence for high levels of multiple zoonotic infections
  - But high levels of under-reporting and misdiagnosis
  - And less data for specific health and livelihood outcomes related to this

- Expenditure on human and animal health prevention and cure a significant burden for poor people
  - But less evidence on the role of zoonoses in this or benefit for zoonosis control

- Official and public response to outbreak diseases impose a large part of the burden
Conclusions

• In developing countries, human sickness is a major cause of falling into and remaining in poverty

• Zoonoses are responsible for a substantial proportion of human illnesses in developing countries
  • Lack of agreed definitions and metrics hinders understanding of the impact of zoonoses on human health
  • Participatory and expert prioritisations of zoonoses are often misleading
  • Little information on multiple infections

• Neglected, endemic zoonoses have more important poverty impacts than emerging diseases

• Responses to zoonoses are often anti-poor, and may be more injurious than zoonoses themselves
Funded by the ESPA programme which is funded by the Department for International Development (DFID), the Economic and Social Research Council (ESRC) and the Natural Environment Research Council (NERC)

With additional Support from the CGIAR Research Program on Agriculture for Nutrition and Health is led by the International Food Policy Research Institute, Washington