Framework for assessing the economic costs and burdens of zoonotic disease

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The business case for One Health

This article outlines a pathway to develop the business case for One Health. It describes the origin and development of One Health and then identifies five potential areas where One Health can add value and reduce costs. These are: (1) sharing health resources between the medical and veterinary sectors; (2) controlling zoonoses in animal reservoirs; (3) early detection and response to emerging diseases; (4) prevention of pandemics; and (5) generating insights and adding value to health research and development. Examples are given for each category along with preliminary estimates of the potential savings from adopting the One Health approach. The literature reviewed suggests that one dollar invested in One Health can generate five dollars worth of benefits and a global investment of US$25 billion over 10 years could generate benefits worth at least US$125 billion. Conservation implications: the time has come to make the bigger case for massive investment in One Health in order to transform the management of neglected and emerging zoonoses and to save the lives of millions of people and hundreds of millions of animals whose production supports and nourishes billions of impoverished people per annum.

Introduction

This article is based on an invited keynote presentation given at the Southern African Centre for
Costs of zoonotic disease

- Zoonoses sicken 2.4 billion people, kill 2.2 million people and affect more than 1 in 7 livestock each year
- Cost $9 billion in lost productivity; $25 billion in animal mortality; and $50 billion in human health

Map by ILRI, from original published in an ILRI report to DFID: Mapping of Poverty and Likely Zoonoses Hotspots, 2012.
Benefits of controlling zoonoses in animals and along the value chain chain

• Credible economic cost benefit studies (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>
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<tbody>
<tr>
<td>Developing</td>
<td>5</td>
<td>6.6</td>
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<td>Developed</td>
<td>3.7</td>
<td>7.4</td>
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• Implies $85 billion losses could be averted by $21 billion expenditure
How can we model disease burden?

What do we include in the burden of disease?

• Disability-adjusted life years (DALYs)
• Economic impact
  • Society/nation
  • Personal
• Environmental impact?
Zoonoses have multiple burdens

• Disease in humans
• Economic consequences of disease in humans
  • For people and society
  • Loss of incomes, and costs for treatments
• Disease in animals
• Economic consequences of disease in animals
  • For people and society
  • Lost production, trade bans
Two trade offs

1. Between disease control expenditure and illness in humans and animals
2. Between ecosystem change and disease incidence
The vicious cycle - for people

Disease

Missed work/school

Less income, lower education

Reduced living standards/reduced nutrition

Increased exposure to pathogen/reduced immune defense
How can we model disease burden?

- Simplified situation
- Assessing what we can assess
  - Direct economic impacts
- Collecting more data on what we don’t know
- Creating a framework for assessing economic costs and burdens of zoonotic disease
Two aspects of costs of disease

1. Who pays (public or private sector)?
2. How easy is it to quantify them? (availability of information and applicability /availability of market prices).
## The multiple burdens of zoonotic disease: human, animal and ecosystem health

<table>
<thead>
<tr>
<th>Actors</th>
<th>Cost of Illness</th>
<th>Cost of prevention</th>
<th>Intangible and opportunity costs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Private</strong></td>
<td></td>
<td></td>
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<tr>
<td>Individual and household</td>
<td>(1) Treatment costs (e.g. medication)</td>
<td>(1) Risk mitigation such as boiling water, buying filters</td>
<td>(1) Disutility of ill health for individual (DALY)</td>
</tr>
<tr>
<td></td>
<td>(2) Loss of household production</td>
<td></td>
<td>(2) Disutility of ill health for friends, family, etc.*</td>
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<tr>
<td>Livestock sector</td>
<td>(1) Cost of treatment, Herd slaughter, product recall, mortality, morbidity,</td>
<td>(1) Costs of increased biosecurity, vaccination, practices and procedures to</td>
<td>(1) Cost of future emerging diseases*</td>
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<tr>
<td></td>
<td>lower production, loss of exports</td>
<td>control disease along the value chain</td>
<td>(2) Loss of animal genetic resources.</td>
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<tr>
<td><strong>Public</strong></td>
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<tr>
<td>Health (human and animal)</td>
<td>(1) Treatment costs (hospital provision, etc.)</td>
<td>(1) Risk mitigation such as water fluoridation, vaccination (Disease surveillance,</td>
<td>(1) Loss of opportunities occasioned by spending on disease prevention and care*</td>
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<tr>
<td></td>
<td>(2) outbreak costs, movement restrictions, culling, vaccination</td>
<td>research</td>
<td></td>
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<tr>
<td></td>
<td>(3)</td>
<td></td>
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<tr>
<td>Ecosystem</td>
<td>(1) Spill-over into wildlife, loss of ecosystem services</td>
<td>(1) Bio-security, avoiding wildlife and vectors, disease surveillance, research</td>
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<td></td>
<td>(2)</td>
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</tbody>
</table>
The cost of illness and burden of disease in people - how to measure

<table>
<thead>
<tr>
<th>Information needed</th>
<th>Type of data</th>
<th>Possible existing sources</th>
<th>Further investigations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reported cases of disease</td>
<td>Record of individuals diagnosed with disease</td>
<td>Hospital and clinic records, national and provincial health statistics</td>
<td>May be worth visiting local hospitals and clinics to collect data if it is not summarised at national level</td>
</tr>
<tr>
<td>Estimate of extent of under-reporting</td>
<td>Compare recorded cases with number actually found</td>
<td>Published/grey literature (PGL) studies or investigations</td>
<td>If field work involves testing people, or finding people with the disease then the prevalence or incidence can be compared to that reported. Often test high risk groups (people with fevers not responding to malaria, people working/living in close contact with relevant animals)</td>
</tr>
<tr>
<td>Burden of disease in affected individuals</td>
<td>Deaths</td>
<td>Hospital and clinic records, PGL data on death rates and DALYs – the years of life lost (YLL) component</td>
<td>Visit local hospitals and clinics to collect data, ask about it in household interviews</td>
</tr>
<tr>
<td>(Valued as Disability-adjusted life years – DALYs)</td>
<td>Disability</td>
<td>PGL studies and interviews and DALY estimates, including relevant disability weights – the years of life lived with disability (YLD) component of the DALY</td>
<td>Interview patients and families to find out about length of illness and extent of disability.</td>
</tr>
<tr>
<td>Impact on household incomes while person is ill</td>
<td>Estimated loss of household income generated by the patient during their illness</td>
<td>PGL studies</td>
<td>Interview patients and families</td>
</tr>
</tbody>
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# The cost of illness and burden of disease in animals- how to measure

<table>
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</table>
| Reported cases (incidence) of the disease over a certain period or prevalence (number or percentage with the disease at a given point in time) | Record of animals thought to have the disease | • Outbreak investigations  
• Incidence and prevalence studies  
• Reported cases from veterinary clinics  
• Other PGL studies | Animal sampling in the field (blood tests) |
| Estimate of under-reporting | Extrapolation to whole animal population. Difficult because studies focus on high incidence events or high prevalence sub-populations | Published/grey literature (PGL) studies or investigations. Local expertise | Compare results from sampling with other, pre-existing, estimates |
| Burden of disease in affected animals (Monetary values) | Mortality | PGL studies looking at individual diseases. Sometimes records from vet clinics and national veterinary statistics. For many animal diseases, the only impact that is recorded is deaths. | Focus group discussions. Livestock keeper surveys. |
| | Morbidity (lowered productivity) | PGL field-based studies comparing healthy and infected animals. There aren't many!  
Estimate and value disease impact on fertility, output (milk, wool, animal traction, etc.), slaughter rates and weights (meat), etc. Note that livestock keepers reactions (cull sick animals) form part of the impact. | Livestock keeper and dog-owner surveys. These are time-consuming and obtaining a suitable control group to estimate impact is difficult. Studying wildlife and companion animals is even trickier. |
The cost of treatment and control in people-how to measure

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<th>Further investigations</th>
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<tbody>
<tr>
<td>Private costs for treatment</td>
<td>• Health care seeking costs (often very high for these uncommon conditions)</td>
<td>• Local clinics and medical practitioners, hospitals</td>
<td>Patient and patient family interviews.</td>
</tr>
<tr>
<td>and hospitalisation</td>
<td>• Time spent by family looking after patient at home and when looking for care</td>
<td>• PGL studies</td>
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<tr>
<td></td>
<td>of being treated</td>
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<tr>
<td></td>
<td>• Patient expenditure on incorrect medication and diagnostics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Public costs for treatment</td>
<td>• Cost of hospitalisation, operations, drugs, diagnostic</td>
<td>Ministry of Health, hospital and clinic data</td>
<td>Interviews with care staff in specialist units</td>
</tr>
<tr>
<td>and hospitalisation</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Private costs for disease</td>
<td>• Patient and other members of the public - costs for vaccination, quarantine,</td>
<td>• Local clinics and medical practitioners, hospitals</td>
<td>Patient and patient family interviews. Interviews with target populations (e.g. of vaccination campaigns)</td>
</tr>
<tr>
<td>control</td>
<td>any other disease prevention or mitigation measures</td>
<td>• PGL studies</td>
<td></td>
</tr>
<tr>
<td>Public costs for disease</td>
<td>• Cost of surveillance</td>
<td>Ministry of Health, hospital and clinic data</td>
<td>Interviews with staff involved in this work</td>
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<tr>
<td>control</td>
<td>• Costs of vaccination</td>
<td></td>
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### Costs of prevention

**Humans and animals**

- **Mosquito nets**
  - Mean: 762
  - Range: 0-3150

- **Vaccines & routine clinic visits for kids**
  - Mean: 254
  - Range: 0-5000

- **Boiling or other water treatment**
  - Mean: 6.8
  - Range: 4 households paid between 150-600

- **Insurance (annual fee)**
  - Mean: 0.9
  - Range: 220 households paid nothing, one household paid 200

- **Other health prevention**
  - Mean: 586
  - Range: 0-6000

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How much did you spend last year on the following health protection (Kenyan shilling)?

**Deworming**
- Mean: 928
- Range: 0-11000

**Vaccinations (to prevent not to treat)**
- Mean: 437
- Range: 0-5000

**Tick and fly treatments**
- Mean: 599
- Range: 0-5000

**Insurance (annual fee)**
- Mean: 0
- Range: Not existing

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221 Kenyan households interviewed
Sharing resources for health delivery

• **Efficiency & effectiveness gains**
  – Shared infrastructure; training, services
  • Joined up services for zoonoses: Across a range of studies 5-15% reduction in costs +/- or improvement cover
  • World Bank (2012) estimates 25% savings across a range of joint services for AI and 7% additional costs = net savings of 18%

• Developing country health sector expenditure: 250 billion
• Developing country veterinary expenditure: 2 billion
  – Amenable to joined up services: $4 billion
In conclusion

- We need to show the multiple burdens of disease
- We need to show the money savings
- We need to show economical consequences

Because money talks.
Thank you

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