

A systematic review of zoonoses transmission and livestock/wildlife interactions- *preliminary findings*



International Livestock Research Institute

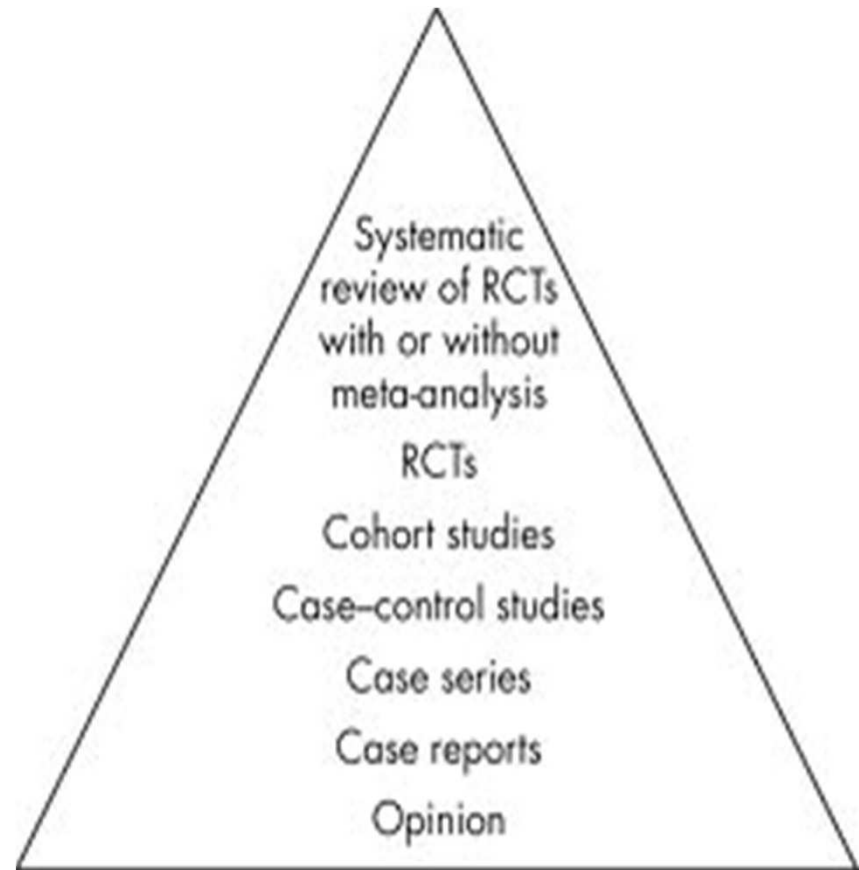
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Evidence....

- Attribution
- Impacts
- Implementation



Review question

- ...synthesise best available scientific knowledge about zoonotic disease transmission through direct or indirect interactions between domestic livestock and wildlife,
-with an emphasis on risk factors, drivers and trajectories of transmission,
-and promising interventions for controlling important zoonoses based on managing domestic livestock/wildlife interaction.

Review approach: Reduction and Integration

1. One over-arching issue identified by study commissioner (DFID)
2. Five questions set by study commissioner
3. Eight themes identified by review team
 1. Transmission routes & wildlife
 2. Pathogen recombination
 3. Risk factors for transmission
 4. Drivers influencing interaction
 5. Historical changes and trends
 6. Livestock production systems
 7. Socio-economic, institutional & political factors
 8. Risk management and control

**Livestock/wildlife interactions
implications for zoonoses**

Approach

- Multi-disciplinary team
 - Veterinary epidemiologists x 2
 - Veterinary public health x 2
 - Agricultural systems x 1
 - Gender specialist x 1
 - Economist x 1
 - Ecologist x 1
 - Virologist x 1
 - Research assistants x 2
 - Co-ordinator x 1
 - Collaboration with Health Map



50% female
25% DC

Methodology

1: Overview of relevant zoonoses

- Generate a data-base of non-trivial zoonoses
- From this develop a long-list of zoonoses which meet study criteria:
 - Involve domestic livestock
 - Involve wildlife
 - Relevant to developing countries
- Develop short-list of 'information-rich' zoonoses relevant to research themes

Methodology

2. Systematic review by experts

- Identify major research themes
- Develop set of search criteria for each theme
- Write algorithms for search
- Identify relevant literature databases
- Retrieve abstracts
- Blind review of abstracts by at least two experts
- Retrieve full papers where experts agree
- Evaluate quality and capture key findings from papers
- Interpret and present balanced summary

Problems encountered and how we dealt with them

- Too many papers, too little relevance
 - 3, 346, 224 papers identified by first search!!
- Trade-off
 - But when only original studies that matched all criteria and were high on the ‘hierarchy of evidence ladder’ were included, too few papers
- Response
 - Only key databases
 - Pre-screen by research assistants
 - Only recent time-periods
 - Apply more specificity
 - For themes with specific questions take narrow definitions and for broader themes, broader definitions

Process example

Theme 8 - management

- Pub Med search **106,557** abstracts identified
- Refining the criteria resulted in 1,000 abstracts
- Of these 94 were sent to experts – (74 from Obj 8 +7 additional from obj 3+13 additional from obj 1)
 - Reviewer 1 – 37 considered relevant
 - Reviewer 2 – 45
 - Both agreed – 24
 - Full paper was available - 22
- Additional papers identified by experts – 2 by first, 5 by second(sum of 7)
- Captured and synthesised - 22
- 6 of the 22 were original research papers

Preliminary findings for 5 key areas

1. Overview of the extent of the problem of zoonoses, setting the context for the relative importance of the wildlife: domestic livestock transmission route
2. Wildlife species implicated in the transfer of disease from livestock to humans and what are the key factors which influence the risk of transmission
3. Wildlife species which could become key candidates for transfer of disease in the future and why
4. Drivers changing interaction between wildlife and livestock and key characteristics influencing the risk of transmission
5. Interventions to limit interaction of wildlife with livestock and the potential impacts of those interventions.

1. Overview of the extent of the problem of zoonoses, setting the context for the relative importance of the wildlife: domestic livestock transmission route

- Zoonoses frequent, neglected but not burdensome-responsible for 1% DALYs in low income countries
 - Most of this transmission probably comes from domesticated animals, most *involves* wildlife
- Zoonoses are more important as emerging diseases responsible for 6% DALYs in low income countries
 - Most of this from wildlife
- Database of zoonoses which involve wildlife and livestock and identification of the most problematic
- No clear distinction between livestock, pets, pests, companions, ferals etc
- Third epidemiological transition? – low probability, but high impact

2. Wildlife species implicated in the transfer of disease from livestock to humans and what are the key factors which influence the risk of transmission
3. Wildlife species which could become key candidates for transfer of disease in the future and why

➤ **Example of BATS**

- Fly facilitating transmission within and between species
- Long life span relative to their size and metabolic rate
- Many live in large, dense populations
- Colonies may consist of mixed species
- Bats feeding generates leftovers for other species
- Bats living closer to people (Bangladesh, Australia)

- Hendra, Nipah, SARS, Ebola, Lyssa, RVF(?)

4. Drivers changing interaction between wildlife and livestock and key characteristics influencing the risk of transmission

- Human demography main driver and all it entails
– globalisation; urbanisation; demand driven food supply; changing behaviour; development yet persisting poverty
- Agriculture: land use change; production system change; environmental nutrient enrichment; resistance
- Wildlife: trade; bush-meat; fragmentation; biodiversity loss; localised increases in population
- Climate change overall good for disease but wealth probably trumps warmth
- **Saw tooth** – fragmentation good for some disease, bad for others; biodiversity reduces pathogen loads but increases assortment opportunities; extinction bad for some disease; pests good for pest disease; conservation & leisure good for disease

5. Interventions to limit interaction of wildlife with livestock and the potential impacts of those interventions

- Habitat change / culling / population control
- Biosecurity (e.g. bird flu)
- Vaccination livestock or wildlife to stop spread & humans to stop mixing
- Conservation (works best for 'charismatic' species)
- Regulation (e.g. wet markets in Hanoi)
 - Ecosystem-based control
 - Multi-sectoral assessment of control benefits (e.g. rabies, brucellosis)
 - From single disease to livelihoods focus and back again (e.g. big 3, ecohealth, NTZ)
 - Technology – reporting, diagnostics, treatment, prevention

Conclusions - overall

- Plethora of opinions but paucity of hard evidence
- Prediction is difficult, especially about the future – but 3 main scenarios can be suggested (third epidemiological transition; business as usual; ascent of EcoHealth)
- Better understanding of epidemiology emerging – (wildlife not a reservoir of disease but rather a co-sufferer, supply, sink, and sanitiser of zoonoses)
- Drivers complex, context relevant, shifting and quantitative changes becoming qualitative

- Management of many, but not all, zoonoses implies intervention at livestock and wildlife, and epidemiology will determine which
- Epidemiology should (but doesn't always) under-pin management
- Promising innovations – technologies and methods and policy context
- Most studies indicate livestock/wildlife zoonoses under-managed in relation to potential impacts and benefits

Conclusions - process

- Systematic review may not be the best tool for this type of broad and fuzzy question
(but generated new ideas, hypotheses for testing, opportunities for collaboration with other teams, e.g. healthmap, and better understanding of what we know and don't know)
- Experts were important in drawing opinion-based conclusions in the absence of strong evidence
- Clear need for more original and fundamental research; there is sufficient suggestive evidence to justify it

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