Cost-benefit analysis of brucellosis control

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OUTLINE

1. Rationale
2. What is a Cost-Benefit Analysis?
3. Methodology
4. Some other considerations
5. Conclusions
Rationale

- Economics is about making rational choices and decisions in the allocation of scarce resources with competing alternatives.
- All rational decision-making involves an evaluation of relevant pros and cons.
- Any investment in brucellosis control can be considered worthwhile if the additional outcome outweighs the additional costs.

Is the proposed brucellosis control strategy technically feasible, **economically beneficial** and socially and culturally acceptable?
The basis of an economic analysis

WHAT IS A COST-BENEFIT ANALYSIS?
An economic tool

- Practical application of economic theory
  ...adds up and compares all the plusses and minuses when faced with a decision

- Comparison of the costs of an activity such as brucellosis control to its benefits

- Frequently expressed as a ratio:
  \[
  \text{BENEFIT-COST RATIO} = \frac{\text{SUM OF ALL BENEFITS}}{\text{SUM OF ALL COSTS}}
  \]

- ...Or difference
  \[
  \text{NET PRESENT VALUE} = \text{SUM OF ALL BENEFITS} - \text{SUM OF ALL COSTS}
  \]

METHODOLOGY
Methodology

1. Define the objective of your analysis
2. Determine the baseline and define the comparators
3. Decide discount rate and time frame
4. Identify all costs and benefits then quantify them
5. Perform analysis
6. Account for data uncertainty and variability
7. Present results to target audience

Define the objective

- Question to be answered:
  - Will a national control strategy consisting of yearly vaccination of replacement small ruminants be economically beneficial over 10 years?
  - This will help determine
  1. Type of evaluation (CBA)
  2. Target audience
  3. Perspective – all of society, livestock sector, public health sector, households
  4. Comparators: what is the baseline?
  5. Time frame: duration of the analysis
Methodology

- Problem definition
- Determine the baseline and define the comparators
- Decide discount rate and time frame
- Identify all costs and benefits
- Quantify them
- Perform analysis
- Account for data uncertainty and variability

Baseline

When carrying out an economic analysis of a brucellosis control programme it is easy to forget what would have happened without the intervention

Typically some form of control is already being carried out
The estimated benefits of an intervention with no previous control efforts

The estimated benefits of a new intervention strategy accounting for current control efforts

Intervention investment

Net benefit of the intervention

With the intervention

Without the intervention

Benefits less costs (US$)

0 10

Years
Methodology

Problem definition
Determine the baseline and define the comparators
Decide discount rate and time frame
Identify all costs and benefits
Quantify them
Perform analysis
Account for data uncertainty and variability

Disease control scenarios

1. National whole flock vaccination of small ruminants only
2. Whole flock vaccination every three years
3. Vaccination of replacement sheep, goats and cattle
4. Vaccination of small ruminants, test-and-slaughter of cattle
5. Test-and-slaughter of small and large ruminants
6. Defining strategies on prevalence (Macedonia)
7. Certifying flocks or herds or farms for ‘freedom-from-disease’
Methodology

Problem definition
Determine the baseline and define the comparators

Decide discount rate and time frame
Identify all costs and benefits
Quantify them
Perform analysis
Account for data uncertainty and variability

TIME FRAME

- Brucellosis control requires INVESTMENT
- If assessing costs and benefits over two years, it is unlikely that benefits will be seen
- Typically at least ten years

DISCOUNT RATE

- People value health today rather than better health in the future
- People would rather spend money in the future than spend money now
- Discount rate accounts for this by discounting costs and benefits that occur later
- Health economists usually use 3%, Agricultural economists argue 5% or 10%
Methodology

Problem definition
Determine the baseline and define the comparators
Decide discount rate and time frame
Identify all costs and benefits
Quantify them
Perform analysis
Account for data uncertainty and variability

COSTS

EXTRA COSTS

• Basic costs of the new control program
• Increased livestock numbers (fewer abortions) = extra feed costs

REVENUE FOREGONE

• If Test-and-Slaughter intervention, a farmer with dairy cow culled half way through lactation loses revenue from her milk yield
• Unintentional consequences – abortion due to vaccinating pregnant cow
BENEFITS

COSTS SAVED

- Money saved from not implementing prior control efforts or surveillance
- Money saved from reduced human cases - reduced hospital fees

EXTRA REVENUE

- Improved livestock productivity from production losses avoided due to reduced prevalence
- Lost income avoided by reducing number of sick people

Impact of a health problem

Without the health problem

With control

Losses due to the health problem

Losses avoided with control

With the health problem

Output ($, €, ¥, £, DALYs)

Time

RVC

RVC
Methodology

- Problem definition
- Determine the baseline and define the comparators
- Decide discount rate and time frame
- Identify all costs and benefits
- Quantify them
- Perform analysis
- Account for data uncertainty and variability

What is the effect of the intervention on disease transmission?

Quantifying losses avoided
EX-POST

Evaluating a control intervention already completed
• Use surveillance data collected during the intervention

EX-ANTE

An appraisal of a proposed control intervention
• Use data from another country
• Use expert opinion
• Disease transmission modelling

Methodology

Problem definition
Determine the baseline and define the comparators
Decide discount rate and time frame
Identify all costs and benefits
Quantify them
Perform analysis
Account for data uncertainty and variability
Do the benefits of the control strategy outweigh the costs?

Economic analysis

DATA UNCERTAINTY AND VARIABILITY
BE AWARE of your assumptions.....

• Prevalence data – where did it come from?
• What effect estimates are you using? Where did the data come from?
• Vaccine efficacy – conflicting studies
• Vaccine effectiveness – cold chain
• Disease transmission: sheep-to-cattle
• Prices for livestock products – can vary

The list goes on...

What is the impact of brucellosis on livestock productivity?

For example:

Reduction in milk yield
1. Alton et al (1985) reported 28% in goats
2. Bernues et al (1997) suggested 15%
3. European commission report (2001) states 10%, however does not site any reference

Abortion
1. Al-Talafhah (2003) “specific incidence risk of abortion due to brucellosis [in sheep] was 13%”
2. McDermott et al (2002) estimated that seropositive cattle were 4.6 times more likely to abort
What can be done to understand the implications of these data gaps?

Sensitivity analysis

Testing assumptions.....

• Change parameter values from most likely to expected minimum and maximum
• Indication of best and worst case scenarios

EXAMPLE
Small ruminant prevalence
• Min = 0.5%
• Most likely = 7%
• Max = 15%
With extra resources…..

- Create distributions for uncertain parameters
- Link disease transmission model directly with economic analysis
- Perform integrated sensitivity analysis
- Challenge assumptions about the distributions

SOME THINGS TO CONSIDER
Economically beneficial BUT impractical

- May indicate intervention with greatest net benefit
  BUT
- By itself **CANNOT** determine best management choice
- Non-economic criteria – technical feasibility
- Are there enough veterinarians to vaccinate all small ruminants in the time between parturition and subsequent pregnancy???
- Otherwise may be unintended consequences – abortion storms when vaccinating pregnant animals

Test-and-slaughter

- Where do replacement animals come from?
  
  **disease free and in ready supply**
  
  - Are sufficient funds available to compensate farmers for the loss?
  - Are animals individually identified to ensure the seropositive animals are correctly identified?
  - Is it socially and culturally acceptable?
    
    culling cows in Hindu areas is not
Livestock movement

We need an integrated regional control strategy in the region!

WILDLIFE

- Do wildlife represent a reservoir of *Brucella* strains in livestock?
- *B. abortus* and *B. suis* isolated – US and Australia
- *B. melitensis* rarely reported

PIGS

- Has *B. suis* been isolated?
- Have pigs been tested?
**TAKE HOME MESSAGE**

**CONCLUSIONS**

1. CBA is based on estimates and assumptions
2. We are interested in comparisons NOT exact values
3. Disease and control are **CONTEXT SPECIFIC**
   - What works in Albania may not work in Georgia
4. Brucellosis is **dynamic** – the disease and subsequently best control methods change over time
5. Even with best efforts and substantial resources control will take decades and eradication closer to 100 years
ANCIENT DISEASE

Requires sustained efforts AND finance for control!

January 2012
Archeologists at Butrint found pathologies in human bones with DNA evidence of Brucella dating from the 10th century.

Thank you for listening!

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