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Vaccination
Back to Basics
Gavin Ramsay

Cover two areas

- First the relatively easy one – Clostridial diseases
- Second a hard one – Ovine Johne's Disease (OJD) – and why it is so hard

Why vaccinate

It is good management for:

- Financial reasons
 - Increase income
- Risk management
 - Insurance
- Animal welfare

What does vaccination do?

- Enables animals to develop immunity to an organism
- Or in some cases immunity to the toxin produced by an organism –diseases caused by clostridia (pulpy kidney, tetanus, black leg, Black's disease, malignant oedema) the components of 5 in 1 vaccines.

Disease impacts

- Death
- Production loss
 - Weight loss
 - Decrease in quality of meat
 - Reduced wool quantity and quality
 - Reproduction losses
- Loss of market access

Herd immunity

- Is important for diseases that are transmitted from one animal to another
- Examples
 - Scabby mouth
 - Johne's Disease (OJD) less so because of the environmental component

Vaccination as a form of insurance

- Takes a risk perspective
- But vaccines are better than insurance because the cost of vaccine is not related to the risk
- As a result vaccines are relatively cheap in comparison to an insurance premium and the cost of vaccines does not increase with the risk

Individual disease strategies

- Vaccines against all of the Clostridial diseases are packaged together at a relatively low cost
- Only need to yard the animals once per vaccination not once per disease
- Rarely will only one animal be affected by the disease

Important factors

- Timing
- Care of vaccine – temperature, expiry date and contamination
- Dose
- Care of equipment - vaccination guns
- Administration – site, technique, cleanliness

Timing

- When likely to generate protective immunity
- Before greatest disease challenge
- Align where possible with other activities
- Ensure not at times and under conditions that will cause other problems(wet yards and foot problems – heavily in lamb and pregnancy toxaemia)

Care of vaccines

- How you look after a vaccine varies with the type of vaccine
- Vaccines can be damaged and then they don't work
- Heat is biggest threat
- In some cases too much cold (freezing) is another threat while others must stored frozen

A decision makers compared with scientists perspective

- What scientists value and measure can differ from that valued and measured by decision makers
- What might be different?
 - Degree of precision required
 - Type of information and its mode of presentation

Financial analysis

- A useful tool to assist decision making
- Relatively simple for some diseases
- Very complex for others
- Mostly carried out to compare costs and benefits of a decision –a partial budget is one example
- In a spreadsheet you can quickly and easily compare multiple scenarios
- But, it involves a simplification of the disease processes

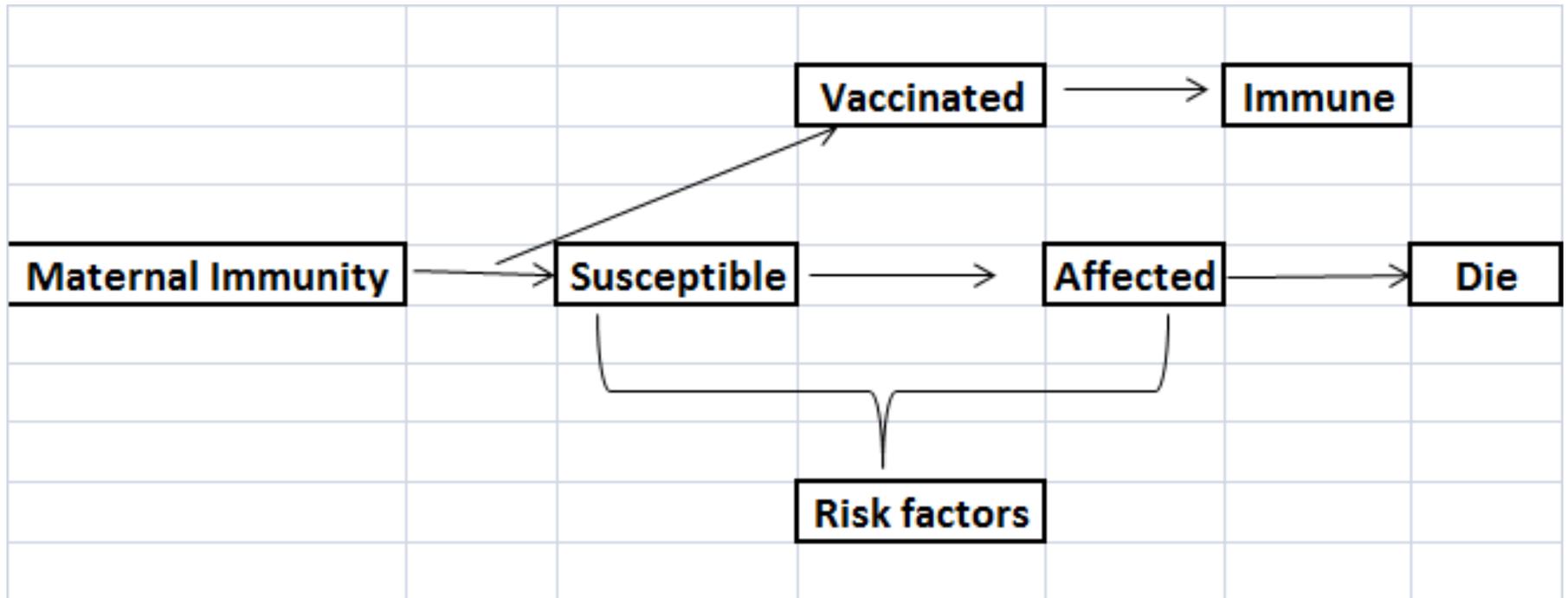
Models and financial analysis

- In financial analysis we often use a model
- Models are used to enable us to evaluate and compare alternatives

Modelling and models

- Multiple uses
- Do not tell us what will happen – they are a very simplified view of reality
- Enable us to run scenarios and evaluate what might happen
- Enable us to test various options
- Can be used to determine a focus for research

Simple disease model



Clostridial diseases

| Flock structure | Number | Value per head | Unprotected mortality % | Expected number of deaths | Deaths avoided by vaccination | Value of deaths avoided | Vaccinations (number per head per year) | Total vaccinations |
|---|--------|----------------|-------------------------|---------------------------|--------------------------------|-------------------------|---|--------------------|
| Mature ewes over 3 years old | 200 | \$80.00 | 0.5% | 1 | 1 | \$64.00 | 1 | 200 |
| 2-3 year old ewes | 300 | \$90.00 | 0.5% | 2 | 1 | \$108.00 | 1 | 300 |
| 1 to 2 year old ewes | 300 | \$90.00 | 2.0% | 6 | 5 | \$432.00 | 1 | 300 |
| lambs | 1040 | \$150.00 | 3.0% | 31 | 25 | \$3,744.00 | 2 | 2080 |
| 1-2 year old wethers | 0 | | | 0 | 0 | \$0.00 | 1 | 0 |
| 2+ wethers | 0 | | | 0 | 0 | \$0.00 | 1 | 0 |
| | | | | | | | | 2880 |
| Marking percentage | 130% | | | | Benefits | | | |
| | | | | | Deaths avoided | \$4,348.00 | | |
| | | | | | Other | | | |
| | | | | | Total | \$4,348.00 | | |
| | | | | | Costs | | | |
| Vaccine cost (per dose) | \$0.30 | | | | Vaccine | \$864.00 | | |
| Vaccine administration (per dose) | \$0.50 | | | | Labour | \$1,440.00 | | |
| | | | | | Total | \$2,304.00 | | |
| Vaccine coverage | | 100% | | | | | | |
| Vaccine efficacy | | 80% | | | | | | |
| | | | | | Benefit less costs | \$2,044.00 | Before interest and tax | |
| | | | | | Marginal rate of return | 89% | Acceptable if above 30% | |
| Based on MLA's "Health cost benefit calculator" | | | | | | | | |
| http://www.mla.com.au/publications-tools-and-events/tools-and-calculators/health-cost-benefit-calculator | | | | | | | | |

Clostridial diseases Part 2

| Flock structure | Number | Value per head | Unprotected mortality % | Expected number of deaths | Deaths avoided by vaccination | Value of deaths avoided | Vaccinations (number per head per year) | Total vaccinations |
|---|--------|----------------|-------------------------|---------------------------|--------------------------------|-------------------------|---|--------------------|
| Mature ewes over 3 years old | 200 | \$60.00 | 0.5% | 1 | 1 | \$48.00 | 1 | 200 |
| 2-3 year old ewes | 300 | \$80.00 | 0.5% | 2 | 1 | \$96.00 | 1 | 300 |
| 1 to 2 year old ewes | 300 | \$80.00 | 2.0% | 6 | 5 | \$384.00 | 1 | 300 |
| lambs | 1040 | \$100.00 | 3.0% | 31 | 25 | \$2,496.00 | 2 | 2080 |
| 1-2 year old wethers | 0 | | | 0 | 0 | \$0.00 | 1 | 0 |
| 2+ wethers | 0 | | | 0 | 0 | \$0.00 | 1 | 0 |
| | | | | | | | | 2880 |
| Marking percentage | 130% | | | | Benefits | | | |
| | | | | | Deaths avoided | \$3,024.00 | | |
| | | | | | Other | | | |
| | | | | | Total | \$3,024.00 | | |
| | | | | | Costs | | | |
| Vaccine cost (per dose) | \$0.30 | | | | Vaccine | \$864.00 | | |
| Vaccine administration (per dose) | \$0.50 | | | | Labour | \$1,440.00 | | |
| Vaccine coverage | | 100% | | | Total | \$2,304.00 | | |
| Vaccine efficacy | | 80% | | | | | | |
| | | | | | Benefit less costs | \$720.00 | Before interest and tax | |
| | | | | | Marginal rate of return | 31% | Acceptable if above 30% | |
| Based on MLA's "Health cost benefit calculator" | | | | | | | | |
| http://www.mla.com.au/publications-tools-and-events/tools-and-calculators/health-cost-benefit-calculator | | | | | | | | |

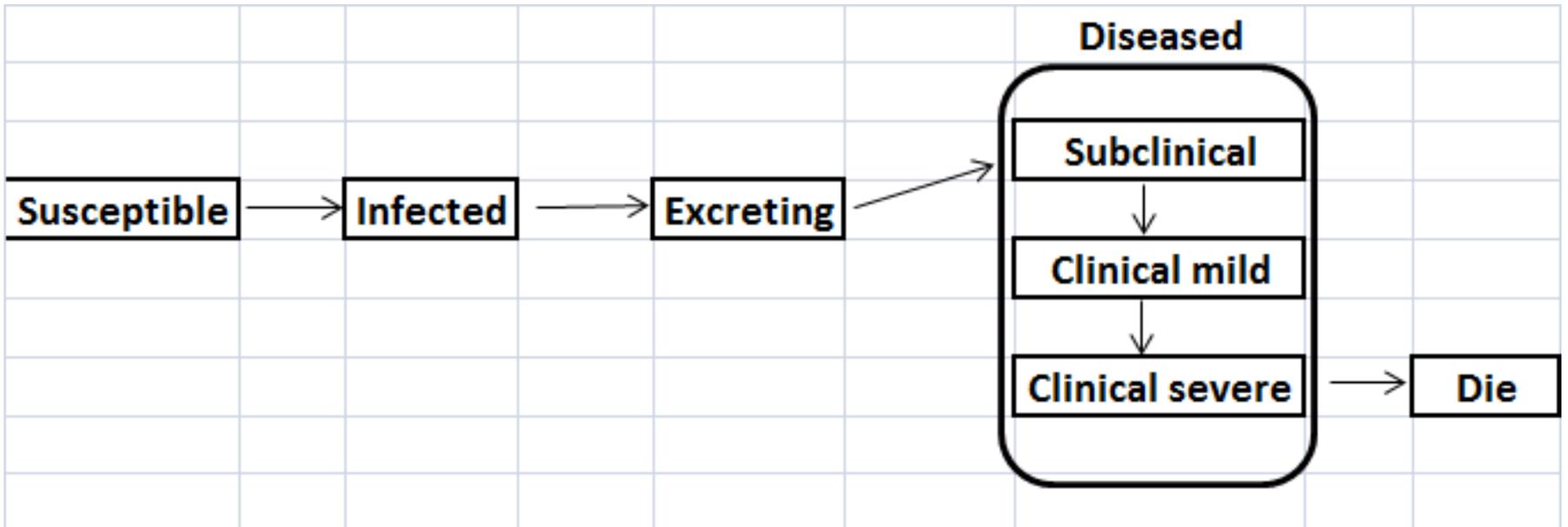
Clostridial diseases Part 3

| Flock structure | Number | Value per head | Unprotected mortality % | Expected number of deaths | Deaths avoided by vaccination | Value of deaths avoided | Vaccinations (number per head per year) | Total vaccinations |
|---|--------|----------------|-------------------------|---------------------------|--------------------------------|-------------------------|---|--------------------|
| Mature ewes over 3 years old | 200 | \$80.00 | 0.0% | 0 | 0 | \$0.00 | 1 | 200 |
| 2-3 year old ewes | 300 | \$90.00 | 0.0% | 0 | 0 | \$0.00 | 1 | 300 |
| 1 to 2 year old ewes | 300 | \$90.00 | 0.5% | 2 | 1 | \$108.00 | 1 | 300 |
| lambs | 1040 | \$150.00 | 3.0% | 31 | 25 | \$3,744.00 | 2 | 2080 |
| 1-2 year old wethers | 0 | | | 0 | 0 | \$0.00 | 1 | 0 |
| 2+ wethers | 0 | | | 0 | 0 | \$0.00 | 1 | 0 |
| | | | | | | | | 2880 |
| Marking percentage | 130% | | | | Benefits | | | |
| | | | | | Deaths avoided | \$3,852.00 | | |
| | | | | | Other | | | |
| | | | | | Total | \$3,852.00 | | |
| | | | | | Costs | | | |
| Vaccine cost (per dose) | \$0.30 | | | | Vaccine | \$864.00 | | |
| Vaccine administration (per dose) | \$0.50 | | | | Labour | \$1,440.00 | | |
| Vaccine coverage | | 100% | | | Total | \$2,304.00 | | |
| Vaccine efficacy | | 80% | | | | | | |
| | | | | | Benefit less costs | \$1,548.00 | Before interest and tax | |
| | | | | | Marginal rate of return | 67% | Acceptable if above 30% | |
| Based on MLA's "Health cost benefit calculator" | | | | | | | | |
| http://www.mla.com.au/publications-tools-and-events/tools-and-calculators/health-cost-benefit-calculator | | | | | | | | |

Johne's disease

- A bit more complicated
- Time is important
 - Disease processes can move slowly
- Depends on what we include in the analysis
- This is work in progress

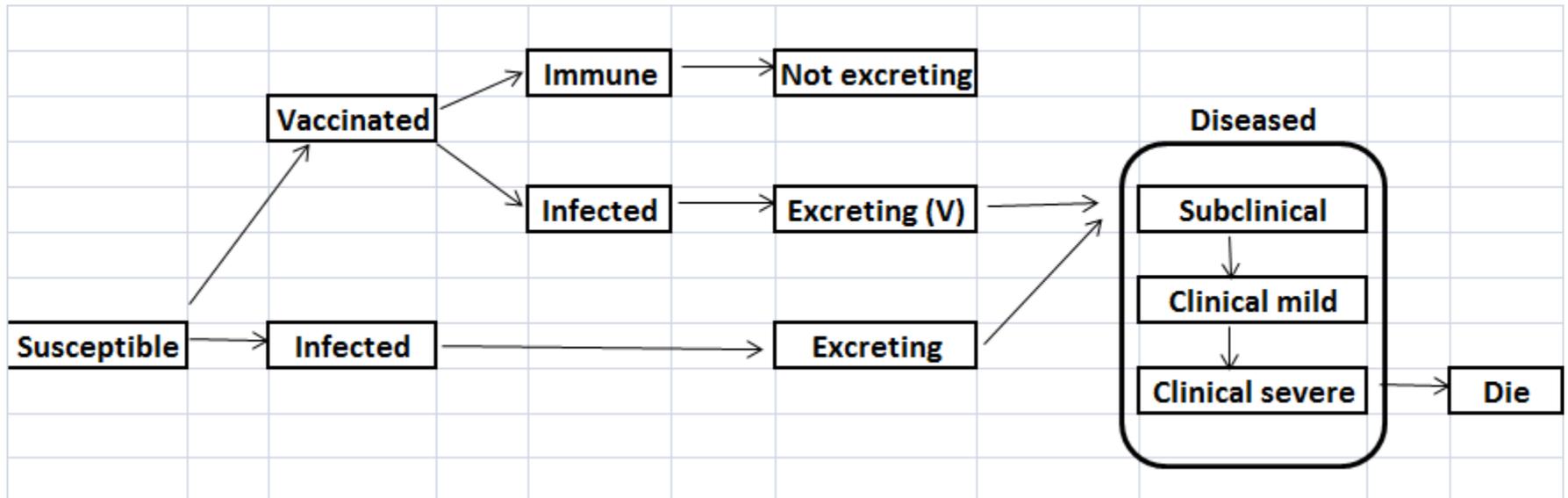
Basic transitions for OJD



Johne's Disease Vaccination

- Gudair[®] vaccine used to control Ovine Johne's Disease (OJD)
- Killed *Mycobacterium paratuberculosis*
- *Offers protection against development of clinical OJD* and reduced shedding of the organism in sheep faeces
- A single vaccination provides long lasting (perhaps life long) immunity

OJD vaccination before exposure



Vaccination in OJD

To prevent

1. infection from establishing
2. excretion of organisms, and
3. development of disease

With less certainty use as a form of treatment

- To prevent exposed and colonised animals from excreting organisms and developing disease

Impact of vaccination in OJD

From Reddacliff, Eppleston, Windsor, Whittington and Jones (2006)

- Reduced mortalities due to OJD by 90%
- Delayed faecal shedding for the first year post vaccination
- After first year the prevalence of faecal shedders was reduced by 90%
- Number of organisms excreted by shedders were also reduced by at least 90%
- But high levels of excretion occurred in some shedders at some times

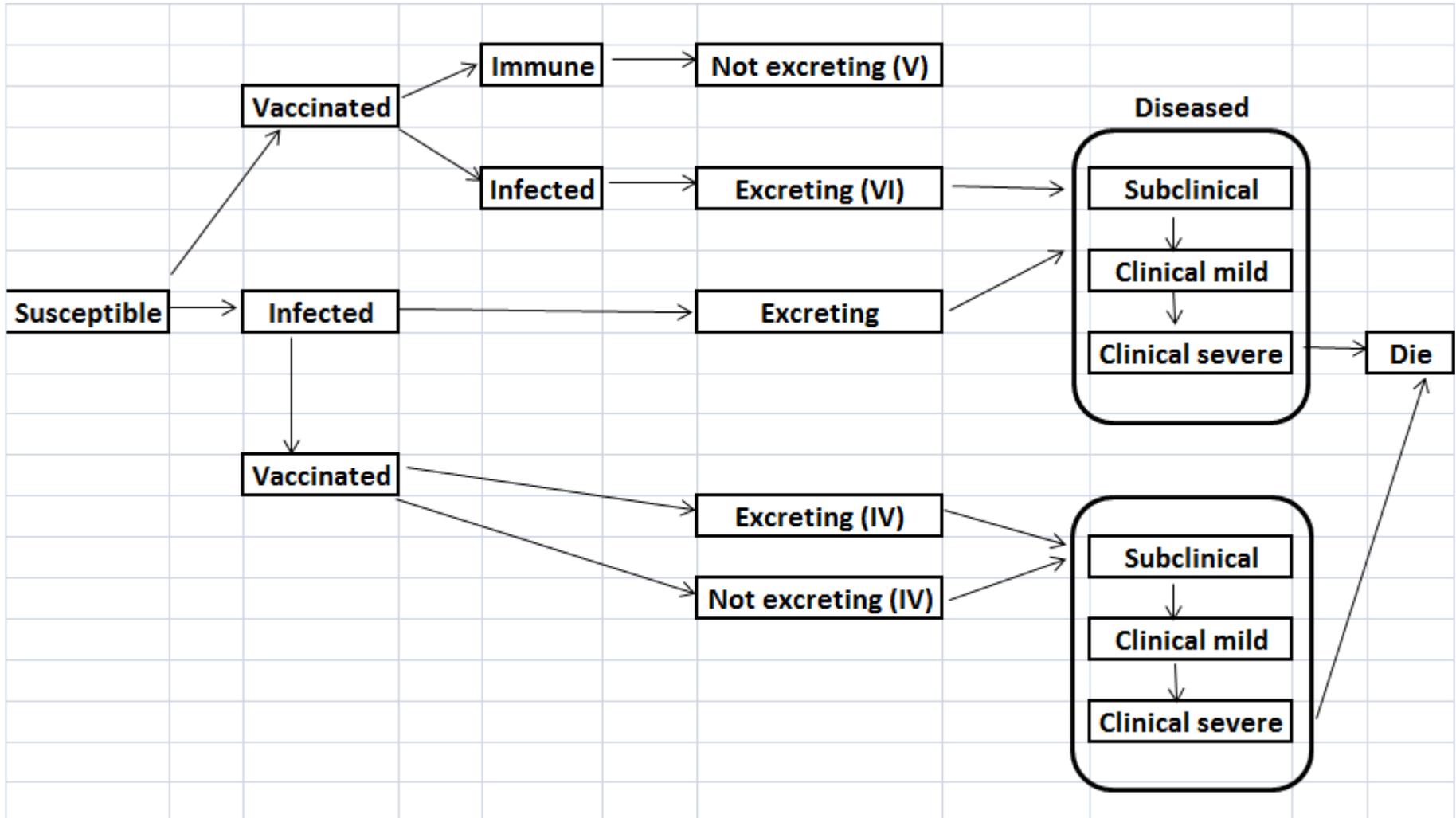
Impact of Vaccination

- Following vaccination of lambs producers should (over time) see:
 - Decrease in the number of clinically affected animals
 - Decrease in the number of deaths caused by OJD
 - Gradual decrease in prevalence of infection in the flock
 - Decrease in faecal *M. paratuberculosis* shedding
- Impacts of vaccination take place over several years

Negatives

- Vaccine injection sites were seen in around 50% of sheep after 2 months (persisted for at least 4 years in 20-25% of vaccinates)
- Small reductions in liveweight in vaccinated lambs in first year

Vaccination and exposure OJD



Benefits from vaccination

Production loss avoided - direct

- Deaths avoided
- Weight loss avoided
- Wool loss avoided (quantity and quality)
- Reproduction loss avoided

Benefits from vaccination

Production loss avoided - indirect

- Cases of infection (and disease) avoided due to reduced excretion of organisms due to vaccination (and with that the production loss avoided from those cases avoided)
- Flow on effects – for example reduced costs at slaughter (who gets the benefits?)

Comparison with other diseases

- There is a delay in time between OJD vaccination and visible benefit
OJD vaccine does not produce a financial return in the year in which it is given
- OJD vaccine is much more expensive than clostridial vaccines
- OJD vaccine is dangerous to the operator if they accidentally inject themselves

Delays in benefits

- For example, vaccinate at 6 weeks old and they do not get clinical OJD when they are 4 years old
- Unseen (and difficult to measure and value) benefits start fairly quickly because 90% do not become infected and colonised
- This reduces exposure of other animals

Some important questions

- Impact of environmental contamination
- What is the benefit of reduced excretion of the organism worth when I still need to vaccinate my lambs to protect them?

The outcome

- Which animals do I vaccinate?
- When do I vaccinate them?
- What are the returns from using various alternative strategies?

- Can I use vaccination to eradicate a disease?