Biosecurity and the threat of infectious disease to sheep flocks

Emily Gascoigne
MA VetMB MRCVS

Emily qualified from Cambridge University in 2012 and began a clinical training scholarship at Synergy Farm Health in association with the Royal Veterinary College, London. She has continued at the practice as an assistant with an interest in sheep health and production, knowledge transfer and developing sheep services in practice.

1.0 hours*

*Suggested Personal & Professional Development (PPD)

COMMUNITY REVIEWED ™

BIOSECURITY

Biosecurity is one of the current 'buzzwords' for the livestock industry, with the introduction of infectious disease on to stock units posing a significant threat to animal health, welfare and farm profitability. Despite its acknowledged importance, uptake of biosecurity measures is variable. In this article, we will be looking at the challenges of implementing strategies in the UK sheep industry and exploring the role the farm animal clinician can play.

In practical terms, biosecurity refers to the integrity of a unit with regards to (a) preventing introduction of infection from outside the unit (b) preventing the escape of infection from the unit and (c) preventing the spread of infection within the unit.

The sheep industry

Livestock movements play an integral part in the UK stratified sheep industry with the movement of prime breeding stock and draft ewes from hill farms to the lowlands and the movement of 'store' lambs to finishing facilities. The use of markets for the trade of sheep and practices such as the use of common grazing increase the probability of transmission of infection. If suitable controls are not in place, risks can be high.

Costs of disease

Having a thorough understanding of the flock's infrastructure and model is key to emphasising the importance of risks (**Table 1**).

Figure 1. *Identifying boundaries and managing risks here is essential. Boundaries may be insecure or non-existent, for example as common grazing or on public rights of way.*

Attitudes to biosecurity

The potential implications of suboptimal biosecurity status were documented in the 2001 FMDV outbreak; but despite this and the impact on the rural economy, the uptake of biosecurity measures has been relatively poor.

Attitudes to biosecurity vary across the agricultural industry – with farmers perceiving the positive implications of a good biosecurity strategy to be improved profitability and improved health and welfare (Gunn et al, 2008), as well as being associated with professional pride and recognised as important for longer term herd/flock performance.

Table 1. Costs of disease

Disease	Cost	Source
Orf	£3.09 reduction in profit per ewe in a lowland flock with 40% incidence in lambs	Lovatt et al, 2012
Foot rot	£8.38 per ewe in the flock	FAI, 2010
Anthelmintic resistance	Reduced productivity and delay in lamb finishing of 22-28%	Miller et al, 2010
Abortion	£10.90 per ewe	Bennett and Ijpelaar, 2003
Scab	£10.50 per ewe in the flock	Nieuwohf and Bishop, 2005
Liver fluke	£5.60 per lamb in the flock	Eblex Stock Briefing, 2011

Table 2. Potential pathogens of concern

	Disease/Condition	Clinical signs
Bacteria	Foot rot/scald	Interdigital dermatitis
	Contagious Ovine Digital Dermatitis (CODD)	Severe lameness
	Johne's disease	Wasting in clinical animals, subclinical disease
	Contagious lymphadenitis (CLA)	Abscesses, wasting in clinical animals, subclinical disease
	Enzootic abortion of ewes (EAE)	Abortion
	Campylobacter	Abortion
	Salmonella abortus ovis	Abortion, pyrexia
	Listeria monocytogenes	Neurological disease, abortion
	Coxiella burnetti	Abortion
Viruses	Orf	Scab lesions, typically on nose, tongue and udder
	Maedi visna (MV)	Wasting/neurological disease in clinical animals. Subclinical disease
	Ovine pulmonary adenomatosis (OPA)	Lung tumours. Recurrent pneumonia, sudden death or wasting in clinical animals. Subclinical disease
Parasites	*Psoroptes ovis*	Profound pruritus, fleece loss, weight loss
	Anthelmintic-resistant nematodes, including *Haemonchus*	Loss in performance, anaemia
	Liver fluke/triclabendazole-resistant *Fasciola hepatica*	Loss in performance, loss in performance despite drench use
	Toxoplasma gondii	Abortion, high barren rates
	Lice	Pruritus, fleece loss, weight loss
	TB	Wasting, may be incidental finding
	Tapeworm (*Taenia* spp.)	Incidental finding at PME or neurological disease in form of GID

Negative associations with implementing biosecurity protocols included lack of faith in biosecurity protocols in the absence of wider controls – public footpaths, for example – and national threats to disease status (**Figure 1**).

When sheep veterinary surgeons were asked about biosecurity in sheep flocks, a large proportion did not perceive that biosecurity was within their remit and they viewed that the main obstacle was cost of implementing any suggested strategies.

Farmer demographics also play a key role in attitudes – with younger farmers with larger flocks more likely to engage in eradication programmes. Not surprisingly, perhaps, the extent/severity of disease within a flock also plays a role in farmer perception of the problem – endemic versus epidemic – with the latter more noticeable to farmers (Toma et al, 2013). Organic status also affected positively perception of the need for good biosecurity.

Garforth et al (2013) compared attitudes of sheep and pig farmers to disease risk management in England; finding that pig farmers placed more emphasis than sheep farmers on controls on wildlife, staff and visitor movements and training with regards to health status. Key factors identified included perception of disease risk, cost and attitude towards control strategies, previous experience with control measures, and the credibility of the advice given.

Suggested mechanisms to improve uptake feature improved communication, emphasis on the hidden costs of disease, and the tailoring of advice to individual farmers.

Lessons can be learnt from other, more integrated industries, such as the pig and poultry sectors, although they may require flexibility of application given the structure of the industry.

Hazard analysis and critical control points (HACCP)

As called for in the literature by Garforth et al (2013), an evidence- and risk-based approach is essential for generating an effective protocol for sheep flocks.

HACCP is an infrastructure produced by the National Aeronautics and Space Administration (NASA) – initially to ensure the safety of food stuffs – which has since been adapted to the wider food production industry. The key phases rely on a methodical approach to risk identification, risk reduction, verifying the protocols and review the overall efficacy of the strategy.

To date this has been applied to other farm animal health problems (Bell et al, 2009; Gascoigne and Crilly, 2014). In essence it is a strategic approach to risk identification and management and is an ongoing process as outlined below:

- conduct a hazard analysis
- identify critical control points
- establish critical limits for each critical control point
- establish critical control point monitoring requirements
- establish corrective actions
- establish procedures for ensuring the HACCP system is working as intended
- establish record keeping procedures.

In the context of a sheep flock, the process should be initiated by conducting a hazard analysis – asking the question: "For my flock (or group within my flock) where are the opportunities for introduction/escape of infection(s) and what might those infectious agents be?"

Opportunities for infection
Between farms

'Between-farm' infection transfer can happen as a consequence of the following:

- open flock – buying in infected rams, ewes and/or young stock
- hiring/sharing rams
- showing sheep
- shared grazing, such as common land, sheep on dairy ground
- nose-to-nose contact with adjacent stock (particularly pertinent for sheep scab)
- sharing equipment or resources between farms – including people such as vets, shearers, scanners, working dogs
- sharing transport
- buying in infected feed stuffs (e.g. *Listeria monocytogenes*, *Toxoplasma gondii*)
- water-borne/aerosolised transmission (e.g. *Coxiella burnetti*).

Spread within farm

This can happen as a result of:

- co-grazing of infected and non-infected animals (e.g. foot rot, CODD, scald, OPA, CLA)
- colostral transfer of pathogens (e.g. Johne's disease, Maedi visna)
- transfer at routine handlings (e.g. lice, CLA, infectious lameness)
- housing in infected buildings (e.g. orf)
- delayed carcass disposal
- contaminated feed (e.g. soil/cat faeces)
- dung disposal from isolation areas on pastures
- transfer on equipment (e.g. infectious lameness, CLA/scab on shearing equipment) (**Figure 2**)
- failure to worm a scavenging farm dog.

Potential pathogens of concern

These are summarised in **Table 2**.

The veterinary surgeon is perfectly placed to conduct a risk analysis as he or she will have a comprehensive understanding of the disease status of the flocks in their care and an overview of the local or national prevalence of disease (**Figure 3** and **Table 3**).

Demonstrating disease status on farm may be helpful at this

Figure 2. Equipment can potentially play a role in disease transmission. A recent study found foot-trimming equipment was PCR-positive for infectious lameness agents, even after disinfection. (Sullivan et al, 2014)

Table 3. Risk analysis

HIGHER RISK	MEDIUM RISK	LOWER RISK
Buying in animals from mixed sources	Buying in animals direct from single producer, testing and isolating on arrival in designated facility	Closed flock
Shared grazing/nose-to-nose contact	3-metre boundary fences	
Sharing equipment	Sharing equipment but disinfecting between animals/premises, e.g. trimmers, shearers	No shared equipment
Routine gathering of sheep spreading infections, such as foot rot		Reduced routine catch up, e.g. no routine foot trimming, targeted drenching of sheep
Sharing rams	Buying own rams and checking disease status whilst in quarantine	Breeding your own rams/ET importation of genetics
Delayed carcass disposal		Prompt disposal of carcass
No quarantine of incoming animals		28-day quarantine in specific quarantine facility
Contaminated feed, e.g. soil/cat faeces		Covered forage/feed stores. Feed from known source
Dung disposal from isolation areas on pastures where sheep graze		Do not graze isolation paddock for 28 days after used
Leaving affected animals with main flock, e.g. lameness, Johne's, Maedi visna		Isolate infected/suspected animals
Attend show and sales without using isolation facility when returning	Attend show and sales using isolation facility when returning	Not using shows/sales
Unlimited access to the farm		Limited access to essential visitors
No clothing or equipment controls at farm boundaries	Disinfection of clothing or equipment at boundaries	Farm provides own clothing at boundary

Figure 3. Managing and reducing the risks from infectious disease is essential to managing a healthy flock.

Figure 4. Screening cull ewes for evidence of infectious disease can be helpful to establishing disease status on farm. (Photo: Kat Bazeley)

stage – if you know the flock is free from Maedi visna, it may facilitate emphasising the importance of screening infected animals/buying from high health flocks.

Once the hazard analysis has been performed, critical control points can be applied to this model as areas of potential pathogen introduction/movement where there are opportunities for control, and at this stage we can define our controls.

Our aim is to reduce the relative risk as far as is practical/financially possible. So, for instance, closing the flock may not be practical or cost effective for 'flying flocks', whereas introducing a quarantine protocol may be. Risk elimination may also not be possible.

We must then define the critical limits for our risk. In the food production industry, these are typically quantitative values which if exceeded, trigger a control mechanism. With our biosecurity application, ultimately we are looking for a quantitative target – protecting our flock from introduction/spread of disease and continued absence of diseases.

Monitoring our control point should be an ongoing process. The farmer plays a key role in monitoring his or her flock for evidence of disease; and, as veterinary surgeons, our involvement will vary depending on the relative threats to a flock – increases in lameness, new lesions when examining feet and evidence of sheep scab, for instance. There is invariably a key place for the veterinary surgeon in the screening process.

Measuring and monitoring the proportion of lame animals at flock health planning, performing cull ewe screens (**Figure 4**) to examine for evidence of endemic diseases, such as CLA and MV, and screening home-bred lambs for evidence of positive sheep scab antibody titres, can be used to evaluate efficacy of controls.

The flock health plan is ideally placed to define preventive and corrective actions should evidence of a breakdown occur. This may be recommending isolation of any suspect animals presenting as lame, calling for veterinary assistance if levels of lameness exceed a targeted threshold or defining the actions to be taken if an animal is positive on serology on quarantine testing.

Finally, the flock health plan/annual screening is an ideal time to review the above strategy and ensure that protocols are working. It provides valuable information for flocks selling to other premises, fulfilling stages 6 and 7 of the HACCP analysis.

Sourcing and quarantine

When sourcing animals, those with the highest health status should be sought. Maedi visna-/EAE-accredited free animals are available but largely confined to pedigree flocks or terminal sire breeds. Flocks can screen for evidence of the chronic diseases – Johne's, CLA and MV on serology or pooled faecal PCR (Johne's).

Obtaining and interpreting information is a challenging exercise, especially when buying from dealers or through markets; so, where possible, animals should be bought direct from the breeders.

Purchased animals should be placed in quarantine prior to introduction into the main flock. They should be quarantined for as long as possible and the opportunity used to establish them on similar preventive medicine protocols to the main flock, including vaccination and parasite control protocols. Ideally, newly purchased or returning sheep would be placed in isolation for 28 days prior to arrival with the first 48 hours spent on concrete.

Incoming animals should be drenched with a 'new derivative' drench ('orange' or 'purple' drench) to 'knock out' nematodes resistant to the original three classes of anthelmintics. This should be accompanied with scab treatments – dips or injectable macrocylic lactones (MLs). Be aware that different active ingredients may require different protocols. So, for instance, long-acting moxidectin (2%) only requires a single treatment at introduction in comparison with ivermectin injections requiring two doses given seven to 10 days apart (owing to the ability of sheep scab to survive off the sheep for 17 days). Note that MLs will not deal with lice infestations.

Given the documented cases of triclabendazole-resistant *Fasciola hepatica*, treatment with an alternative flukicide may be warranted depending on the origin of the sheep. Closantel is capable of achieving up to a 90 per cent kill in fluke seven weeks old and, therefore, any quarantine protocols where resistance is suspected should involve isolation for seven weeks followed by re-treatment.

Whilst in isolation, animals can be screened on serology for infectious diseases such as MV, CLA, Johne's (or faecal PCR), Border disease and toxoplasmosis/EAE. Where toxoplasmosis is endemic, emphasis should be placed on prophylactic vaccination and, given the behaviour of EAE serological titres – low until around time of abortion – greater importance should be placed on sourcing from accredited flocks or vaccination of all replacements in the flock.

Animals found to be positive for MV, CLA, Johne's or Border disease antigen should remain in isolation and are not candidates to enter the flock. Any cohorts also in isolation may need to be considered for re-bleeding.

Suggestions for monitoring and verification

Knowing the status of a flock with regards to infectious diseases and monitoring its ongoing status is imperative in order to validate the efficacy of concurrent controls and may be pertinent when selling stock – "Has your flock evidence of the presence/absence of disease?"

So:

- what is the current level of lameness on the farm? How has it changed? What (if any) new lesions have been identified in the last 12 months?
- ideally the level of lameness should be <5% and, hopefully, decreasing. We should aspire to there being no new lesions and that CODD continues to be absent/reducing in the flock
- what diseases are on farm and has this profile changed/increased?
- in this respect, cull ewe screens are an ideal opportunity to test for the presence of CLA, MV and Johne's disease
- which anthelmintics/flukicides work on the farm? Is this changing based on faecal egg count reduction testing, or coproantigen reduction testing for fluke?
- is there evidence of exposure to sheep scab – clinical disease or positive serology in lambs?
- has the level of barren ewes/abortion changed (target <5% and 2% respectively)? If yes, consider a barren ewe check?

If there is any evidence of disease breakdown, the risk analysis may need to be reviewed.

Conclusion

Infectious disease is threatening to the health, welfare and productivity of sheep production; yet, despite this fact and notable cases such as the 2001 FMDV outbreak, attitudes of sheep farmers and their veterinary surgeons vary as to biosecurity and its importance. A tailored, risk- and evidence-based approach should be employed in all flocks and the strategies should be practical and achievable.

Establishing disease status and implementing ongoing monitoring protocols are crucial to any risk-based strategy and are pivotal to the ongoing productivity of flocks. The sheep veterinary surgeon is in a position to oversee broad strategies on farm, and to offer and interpret monitoring and verification of progress. ■

References

Bennett R and Ijpelaar J (2003). Economic assessment of livestock diseases in Great Britain. Final report to Defra. ZZ0102, University of Reading)

Bell NJ et al (2009). The development, implementation and testing of a lameness control programme based on HACCP principles and designed for heifers on dairy farms. Veterinary Journal 180(2): 178-188.

Eblex (2011b). Stock Briefing Number 12/03 5th April 2011. www.eblex.org.uk/.../stock_briefing_12-03__liver_fluke050412.pdf (accessed 28.5.15)

FAI (2010). The Farm Animal Initiative. Ruth Clements FAI Lameness Reduction Trials 2009/10.

Garforth CJ et al (2013). Farmers' attitudes to disease risk management in England: a comparative analysis of sheep and pig farmers. Prev Vet Med 110: 456-466.

Gascoigne E and Crilly J (2014). Control of tapeworms in sheep: a risk-based approach. In Practice 36: 285-293.

Lovatt FM et al (2012). 'A case control study of orf in pre-weaned lambs and an assessment of the financial impact of the disease'. Veterinary Record 170: 673. Published Online 4 May 2012

Miller CM et al (2011 in press). Lamb productivity responses and benefits to monthly STARTECT treatment of grazing lambs exposed to mixed anthelmintic-resistant nematode parasite pasture challenge. NZVA Sheep & Beef Veterinarians Conference Proceedings.

Prev Vet Med (2013). Mar 1; 108(4): 321-333. doi: 10.1016/j.prevetmed.2012.11.009. Epub 2012 Nov 27. Accessed via www.startect.co.nz 28.5.15

Nieuwhof GJ and Bishop SC (2005). Costs of the major endemic diseases of sheep in Great Britain and the potential benefits of reduction in disease impact. Animal Science 81: 23-29.

Sullivan LE et al (2014). Presence of digital dermatitis treponemes on cattle and sheep hoof trimming equipment. Veterinary Record 175: 201.

Toma L et al (2013). Determinants of biosecurity behaviour of British cattle and sheep farmers – a behavioural economics analysis. Prev Vet Med 1; 110(3-4): 456-466.

PPD Questions

1. What are the alternatives to sharing rams that would reduce the risk of introducing infection?
2. What samples can be taken to screen for Johne's disease in sheep flocks?
3. What pharmaceutical treatments would you recommend for quarantined animals?

Answers

1. Quarantine rams (purchased or shared) before use and take samples to check disease status; buy in rams with known health status, direct from breeders; bring in embryos
2. Serology; faecal PCR/culture; impression smear at post-mortem on small intestine of suspect animals
3. New derivative anthelmintic (e.g. orange or purple drench); scab treatment (e.g. dip/macrocyclic lactone); fluke treatment (e.g. closantel if possibility of TBZ resistance)