**In Practice**

Targeting lamb survival in commercial flocks - inspiring and effecting change

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**The neonatal period is acknowledged to be the riskiest phase of rearing for the loss of lambs, with adaption to the extra-utero world, an appropriate environment, successful passive transfer, overcoming the threat of pathogen challenge and a strong maternal-neonatal interaction essential for success. The precise definition of the neonatal period and neonatal mortality varies between research studies, vets and farmers. Whilst the first 48 hours after birth is universally accepted to constitute part of the neonatal period, interviews with farmers have disclosed that some consider neonatal mortality to include abortions and all losses up to turnout (Adam et al., 2021). This article considers neonatal mortality as the death of live born lambs up to seven days old. Current industry figures for total lamb losses achieved range from 5-30%, with industry targets at less than 15% commonly used (AHDB, 2015). Unfortunately, there is clear evidence that despite significant research effort and developments focused on this area, lamb mortality has not significantly improved since the 1970s (Dwyer et al., 2016). We will consider the obstacles to implementing change on sheep farms and the evidence base for the recommendations used on farm.**

**Managing neonatal losses**

In the neonatal period, the common causes of lamb mortality include the starvation/hypothermia complex, watery mouth, predation, starvation secondary to mismothering, septicaemia, injury and congenital defects, most of which can be sequalae of dystocia (Gascoigne et al., 2017). Tailored farm advice is crucial, as the profile of losses is specific to the individual farm and hence a one size fits all strategy is not effective. Sheep flocks are hugely diverse, with factors such as breed, indoor versus outdoor lambing, terminal sire choice, staffing ratios and feed management varying significantly between flocks. Acknowledging this diversity and creating a bespoke series of recommendations and targets are key to successfully improving survival. This is in contrast to the management of diseases such lameness in sheep, where industry level recommendations are effective, given that footrot is the predominant cause of lameness in the vast majority of flocks.

Whilst neonatal mortality represents a significant challenge with respect to animal welfare, any plan to improve survival cannot ignore the narrow margins in lamb production. Lamb survival planning should therefore be part of a conversation with the farm team to discuss what is both practical and affordable. An understanding of the cost of production will facilitate this. Approximately 80% of all variable expenditure on a sheep farm is invested between weaning and the beginning of lambing, equating to £27.14 per neonatal lamb, before losses are accounted for (Gascoigne and Lovatt, 2017). In contrast to the sale value of a lamb, the loss of this investment is not immediately apparent and is often not factored into the financial cost of losing a lamb. There are also environmental consequences of this inefficiency, as lambs reared per ewe put to the tup is a key determinant of greenhouse gas efficiency (Jones et al., 2014). Whilst action to improve neonatal survival may require additional investment, in many instances, changes can be made to improve the effectiveness of a given input. For example, whilst forage analysis carries a cost, feed represents one of the largest variable costs in sheep production and hence investment in dietary precision can simultaneously reduce neonatal losses, whilst also ensuring that supplementary energy and/or protein are only purchased when necessary. Furthermore, implementing standard operating procedures to improve hygiene practices or colostrum management ensure that time is invested in productive activities based on clear evidence, rather than wasted on ineffective practices that do not improve survival.

One barrier to change often quoted by vets is the lack of a clear evidence base to justify changes to existing practice, with many recommendations often founded in anecdote. Understanding the potential effect size of an intervention is important when considering its tractability on farm. As such, where available in the literature, this article considers the expected effect size of recommendations to improve survival.

**Engaging farm managers in lamb survival**

Despite the demonstrable economic, environmental and welfare merits to improving neonatal losses, obstacles remain for achieving change. Fundamental to effecting change on farm are the stockpeople and working relationships within the team and with the veterinary professionals working within it.

Veterinary involvement in managing neonatal losses can be variable, and whilst vets are recognised by farmers as a key source of information, in many circumstances they are still perceived as fulfilling a fire fighting role (Kaler and Green, 2013). This can represent a barrier to the implementation of proactive health planning, however significant changes in the UK farm vet industry over the past decade have helped practitioners to better position themselves to fulfil this role. Despite the clear financial benefit of improving lamb survival, the motivators and obstacles to implementing change are multi-factorial and complex. That said, farmers demonstrate significant autonomous motivation to improve survival, with a strong desire to make improvements because “it’s the right thing to do”, rather than due to external factors such as judgement by other farmers or the advice of their vet. External factors such as the weather or lack of finance to invest in buildings are often given by farmers as barriers to change, however detailed interviews have shown that there is also an emotional barrier and stigma to considering losses, with clear impacts on mental health.

A primary challenge to be overcome is the individual farmer’s perceptions of lamb survival. These have been shown to be not well correlated with actual performance data collected on farm (see figure 1). Perceived performance is therefore not a reliable indicator of actual performance and highlights the importance of collecting accurate data on farm.

When considering attitudes to losses in more detail, it has been shown that farmers do not consider that “all losses are equal”. Losses that are seen to be unavoidable or accidental are perceived as more acceptable and this supports the common observation that many farms have a level of tolerated losses, below which intervention is not warranted. The threshold beyond which tolerated losses are no longer tolerated, hence triggering veterinary involvement, appears to vary hugely between farms, with experience, circumstances, and the relationship with the vet playing an important role (Adam et al, 2021).

It is therefore conceivable that a failure to collate reliable data, the absence of a correlation between true losses and farmers’ perception of losses, and the acceptance of some “types of losses” may blur the intervention threshold. Some farmers also report recording fatigue with recording of dead lambs, highlighting the issue further and contributing to the negative emotional impacts of lamb mortality. We therefore encourage practitioners to talk to their clients about “improving lamb survival” and to place less emphasis on “reducing lamb losses”. This may facilitate improved engagement, with a more positive emphasis on “maximising success”, rather than “limiting failure”. Ultimately, the lack of recording renders the intervention threshold highly subjective and vulnerable to the fraught schedule of the lambing period.

So how does the practitioner positively intervene? Appreciating the scale of the mortality challenge on farm is a crucial first step on farm. Whilst we have shown that 36% of sheep farms have no lambing data recorded, there are common and easily accessible data points on farm which can facilitate the beginning of the discussion i.e. scanning data (number of lambs at the start of the production year), number of lambs sold (legally required to be recorded in movement books) and number of lambs retained (tagged lambs are required to be recorded in the movement books). This can enable the advisor to assess scanning to sale survival. Whist this does not directly reflect neonatal losses, headline figures can be used to compare to similar flock types based on the practitioner’s experience and to industry figures such as AHDB Stocktake and facilitates the most valuable of comparisons - comparison to self year-on-year. Where scanning data is not recorded, the number of lambs sent as fallen stock can be estimated via knacker’s yard receipts or invoices to generate rudimentary figures.

For some flocks there may be readily accessible additional data points available such as the number of lambs tagged at lambing and the number of lambs at first drench, which would permit a more direct analysis of neonatal losses, whilst in some flocks, intricate records may be available detailing individual losses and presumptive causes. The veterinary practitioner may need to review what volume of data they really need in order to initiate a discussion- a headline loss percentage may be enough to commence. It is important to recognise that SMART (specific, measurable, achievable, relevant and time-based) targets cannot be set without objective data against which success can be quantified and hence “collecting appropriate data during the lambing window” may be the most appropriate action for the team in the first instance, before more detailed work to improve survival can begin.

**Engaging the whole team in lamb survival**

Recommendations, irrespective of how well evidenced they are, must fundamentally be implemented by the team on the ground. Understanding the dynamics and skillsets of team members is key for the veterinary surgeon when delivering flock health planning discussions.

The size of the team is a complex discussion. There are currently no industry recommendations for the number of breeding ewes to full time labour equivalents (FTE), however it is worth noting that the top third most profitable farms have more breeding females per FTE, hence illustrating the impact of labour costs on overall profitability (AHDB, 2016). However, we looked at 111 flocks (indoor and outdoor lambing) and found no association between neonatal survival and FTEs at lambing time, with up to 1,075 ewes per FTE.

Crucially, other authors have identified the training and experience of those individuals involved in ewe and lamb care to be a key predictor of survival. Lamb mortality is lower (odds ratio 0.83) when staff have 15 years or more experience sheep farming and the importance of relevant workplace training is recognised, with formal agricultural training in a Norwegian study associated with increased lamb mortality (odds ratio 1.15) (Holmoy et al., 2012), versus targeted workplace training in dairy cattle being shown to result in immediate field application (Schuenemann et al., 2013). In essence, it is not the size of the team which is key to effecting change, but the attitudes, competency and effectiveness of individuals within the team. Our emphasis as advisors should be on the management, resources or training that the team require to deliver their role, rather than on a headline ewe to FTE ratio. In essence, we should be asking whether the team has the right skillsets in the right posts.

Whilst the number of FTEs is not a predictor of survival, the degree of ewe supervision is recognised to have a significant impact on survival, with lamb mortality higher (odds ratio 1.3) when supervision is only provided during the daytime or when lambs are born in parts of the farm that are not monitored (odds ratio 2.7) (Nash et al., 2006). Therefore, it is crucial to optimise division of labour and appropriate implementation of skills. Where supervision is limited, it should be prioritised to groups known to contain females carrying multiple fetuses or to maiden dams who are at increased risk of dystocia (McHugh et al., 2016). In an extensive system, constant supervision may not be deliverable, particularly overnight, so focusing on other elements of maternal ability i.e. easy lambing, strong maternal instincts and colostrum production is essential. Strategies to improve ease of supervision include the convenient location of the highest risk cohorts, use of CCTV and night lambing staff.

Getting the whole team on board can be difficult with lambing flocks, especially where some labour units are transient, as is the case with lambing help, but clear communication of goals and protocols are essential. The autonomy and external perspective of the veterinary surgeon may facilitate this communication, especially if the content matter is sensitive. Interventions which may facilitate this could include a start of lambing team meeting with the veterinary surgeon in attendance, team inductions and revision of protocols, even when prior experience is extensive.

Whilst farm protocols are a helpful tool for facilitating standardisation of care across a team and managing the transition between team members, they need to be up to date and clear. For example, 74% flocks that we surveyed in 2019 were supplementing lambs with an insufficient volume of colostrum. Any discussion relating to neonatal lamb management should therefore review and update current practice to ensure that time and effort is invested in productive activities, rather than wasted on interventions that have a limited or even negative impact on survival.

**Identifying targets and action points**

As discussed above, neonatal survival is multi-factorial and hence any strategy to improve survival needs to put the farm team at the heart of the dialogue and must consider the whole flock health year. As a key performance indicator, neonatal mortality can potentially be influenced by sub-optimal management or disease ingress at any other point in the production year, either directly or by proxy i.e. where it has an influence for example on ewe mortality or results in disease sequalae in the neonatal period. The breadth of influences on neonatal lamb health therefore mean that the whole production year must be considered. This is especially pertinent when data are limited, hence prohibiting a focus on known previous issues. The farmer’s concerns and perceived prior experiences should be dealt with, as this often then permits broader discussion, but care should be taken to avoid over interpretation where data is limiting.

It is also important to identify through the course of the dialogue targets that are realistic and of relevance to the farm. Detailed interviews with farmers have shown that sheep farmers do not want to use industry level metrics and targets that they do not feel apply to their specific system (Adam, Bruce and Corbishley, 2021). It is therefore essential that the farm are encouraged to synthesise their own targets. This can be facilitated by showing the farm team the distribution of performance across a number of farms and allowing them to decide where within this distribution they wish to target. This approach is commonly used within producer groups within other livestock sectors e.g. dairy, and can be achieved at the practice level through anonymisation of data collected from other client farms or through the establishment of discussion and/or costings groups.

Whilst identifying all the possible areas for action is important for the vet as part of their comprehensive assessment of the farm, initially prioritising those that the farm team think are realistic and achievable is more likely to empower the team, than attempting a comprehensive review of all aspects of the farm’s management. Managing the expectations of the veterinary surgeon here is just as important to progress as managing the expectations of the team. Where the need for progress has been identified, implementing broad and radical change to achieve gold standard practice in a single season is highly unrealistic and may lead to a disconnect between the vet, farm management and farm team. Positively embracing any change and subsequently demonstrating quantifiable success is likely to be more effective than a complex web of best practice, which requires vast and sudden mindset or practice change. This can be a tricky mindset to adopt as an advisor, especially for complex, intertwined issues. Nutrition exemplifies this tension well, given that investing in a precisely prepared diet, supported by forage analysis, purchased feeds and metabolic profiling would be ineffective without appropriate management of feed space and presentation. Identifying the priority, suggesting a monitoring point (such as pre-lambing metabolic bloods) and using this discussion to identify next year’s target is likely to achieve greater traction and buy in and ultimately progress. Ultimately, defining what success will look like and being realistic about this is key, remembering that the team is at the heart of delivering this.

**Specific areas influencing neonatal survival**

A comprehensive review of all the factors that influence neonatal survival is beyond the scope of this article. It is however worth considering some of the factors within the key management domains that impact neonatal survival, namely: nutrition, the environment, infections, colostrum and breeding

Nutrition

The importance of dam nutrition to neonatal survival cannot be understated, with clear evidence of the impact of nutritional restriction on ewe and lamb survival and lactational performance of the ewe. Tailoring feeding plans to the number of lambs carried enables cost sensitive diets to be prepared that meet demand.

Of course presentation of the ration is just as important as its specification. There is limited evidence in sheep compared to that available for dairy cows, however lamb mortality has been shown to be reduced when ewes are offered forage more than once a day (odds ratio 0.78), presumably due to improved intakes of forage with increased frequency of feeding (Nash et al., 1996, Campion et al., 2019). Likewise, consistency of preparation and presentation is also key and thus reliant on the precision of the team member delivering this part of ewe care.

Blood betahydroxybutyrate (BOHB) concentrations can be used to monitor short term energy balance in late pregnancy and are particularly relevant, as they are indicative of twin lamb disease and an important predictor of lamb mortality. The amount of additional concentrate feeding ewes require in late pregnancy can be calculated using group mean blood BOHB concentrations, hence facilitating optimal use of expensive concentrates. Ewes that are not scanned and fed according to the number of fetuses they are carrying should target group mean blood BOHB concentrations of under 0.9 mmol/l to optimise lamb survival. In one study, 50% of ewes with BOHB equal to or above 1.2 mmol/l suffered from dystocia, whilst 37.5% of lambs born to these ewes also died, compared to 8.3% dystocia and 8.3% mortality in lambs born to ewes with BOHB under 1.0 mmol/l. This useful monitoring tool can be used to demonstrate the efficacy of strategies already implemented, or the need for further changes.

The environment

Protecting lambs from predation and exposure is of course of particular relevance for outdoor lambing flocks, however indoor lambing flocks must think about building use and ensuring that ewes are grouped appropriately, particularly to ensure that groups are not interfered with close to lambing.  Where predation is perceived as an issue by the farmer, this can be a highly emotive subject.

Predation is a significant, albeit highly variable (0-28.6%), cause of lamb loss (Moberley, 2004). Where buildings are available, housing is the most cost-effective way to reduce the probability and scale of predation. In addition, stillbirth is reduced in flocks lambing indoors versus outdoors (odds ratio 0.6) (Binns et al., 2002, Moberley et al., 2004), however it is unclear whether this is due to better supervision or reduced exposure. Where housing is not possible, increasing the level of lethal fox control can be effective, however the cost effectiveness is uncertain, particularly on larger farms (> 200 ha or 800 ewes).

Mortality rates in lambs up to 3 days old can exceed 70% in wet conditions with winds > 18 km/h, whilst cold exposure reduces live weight gains by 20% (De, K., Kumar et al., 2018, Obst et al. 1997, Bird et al., 1984, Lynch et al 1980). Effective shelter reduces lamb mortality by up to 50% in inclement weather and reduces shepherding interventions (Pritchard et al., 2021). However, it is important that shelters are appropriately designed and ewes given the opportunity to habitualise. For example, ewes from unsheltered paddocks that are then offered shelter do not make use of it, whilst use is reduced, and risk of desertion increased if shelters are widely dispersed. Field shelter designs must acknowledge that ewes separate from the flock at lambing and choose sheltered areas at the periphery of fields where other ewes have lambed previously, however ewes need good visibility and a potential escape route from predators and so shelters should not be positioned too close to field boundaries (De, K et al., 2018, Obst et al., 1977, Bird et al., 1984, Lynch et al., 1980). Recent work has suggested that if field shelters are to be constrcuted, they should have a height of over 70 cm, with 85 cm provided per ewe, with an X shape recommended to maximise protection from exposure (Pritchard et al., 2021).

Infection

Infectious diseases are a major cause of lamb mortality. Environmental pathogens become problematic when levels of colostral antibody transfer are insufficient and/or where hygiene deteriorates and the latter can be responsible for persistent “under the radar” losses, but can cause outbreaks when group immunity drops due to breaks in vaccination, disease eradication and reintroduction, intensification or malnutrition.

Infection can also be a highly sensitive topic, as it may require a review of hygiene practices or a change in approach, and conversations could easily escalate to become accusational or critical, which is unhelpful. Fundamentally, neonatal lamb care from an immunological perspective, demands a similar level of precision to other mammals and should be reflected in approach to pen, equipment and personal hygiene. Given the volume of neonates likely to come into contact with both fomites and the shepherds, especially in an indoor lambing environment, simple overlooked strategies may be easy to implement. Asking open questions of the lambing team may help to identify areas for improvement in a non-confrontational, creative way.

“E *coli*, the bacteria which causes watery mouth may be found everywhere within our lambing shed environment. It needs to be eaten by lambs to begin the infectious process. Can you suggest how in this lambing shed, a lamb might come into contact with this bacteria?” [Vet]

Once suggested…

“Can you suggest any practical ways that we could reduce this contact?”[Vet]

This might include increasing bedding up frequency (bedding mothering pens down less frequently than every day is associated with an increase in lamb losses (odds ratio 1.5)) (Binns et al., 2002), wearing of gloves, use of a disinfectant on stomach tubes between usage and the use of crooks to wake lambs rather than the farmer entering each individual pen where there may be infectious agents. The role of the veterinary surgeon in discussion should be seen as facilitating idea progression, rather than sheer knowledge transfer.

Infection control impacting on the neonatal window is broad ranging, from abortion agent control, endo- and ecto-parasite control and joint ill prevention, as well as clostridial and pasturellosis management, amongst others. Where prior data is limiting, this discussion could easily become all encompassing and overwhelming if not sufficiently focused. It may be that disease screening and further data collection are required before the key critical control points impacting on neonatal survival are identified. Conversely, there may be obvious areas of practice e.g. the lambing pens and ewes are visibly soiled, that are likely to yield significant improvements if appropriately addressed. As a general principle, working on the easy wins in the first instance will help to build trust and engagement, before a more comprehensive approach is adopted. Whilst this is applicable to all areas of management, it is well exemplified in the area of infectious disease control, where defensive practice and specialist knowledge tends to result in vets adopting a comprehensive and often unnecessarily expensive, rather than targeted approach.

Colostrum

Given the critical role of colostrum to protecting neonatal lambs from infectious diseases, it deserves specific focus in discussion. We have shown that there are vast differences in the volume of colostrum given to lambs in a commercial setting, despite industry wide campaigns.

It is prudent to consider an annual refresher of colostrum management, especially where transient labour is used at lambing. Demonstrations of how to use a Brix refractometer at a pre-lambing meeting can facilitate discussion about colostrum quality and colostrum alternatives. Furthermore, asking team members to “show me” (i.e. how much colostrum a typical 4kg lamb would have at the first feed, by 6 hours old, by 24 hours old) can aid discussion about providing the appropriate quantity of colostrum quickly, as well as providing aide memoires.

Empowering the team is going to be fundamental to effective change here, given the required stockmanship needed to identify those needing supplementation. Ask the team “which lambs are most likely *not* to get enough colostrum quickly of good enough quality” and encouraging them to suggest what is realistic to implement as a proposed surveillance and intervention protocol. Consider inviting the team to nominate a scribe to write the protocol for the lambing shed wall for all to see the agreed protocol. This is just one example of how the team can be encouraged to take ownership of an action, which is likely to be more effective than providing the farm with a printed protocol from the practice computer.

Breeding decisions

A short calving/lambing period has been traditionally recommended, however recent evidence has shown that whilst this may suit some farms, for others it presents unacceptable challenges with respect to labour availability, exhaustion and logistics. Furthermore, there is no reported association between neonatal survival and the length of the lambing period, hence suggesting that farms with a long lambing period can achieve comparable performance to those adopting a shorter period.

In sheep, the time of year can have a significant impact on survival e.g. lambs born in December in one Irish study had the greatest predicted probability of dying within 24 h of birth (14% compared to 7-9% for other months) (McHugh et al., 2016).  Choose a lambing period that is suited to the farm location, facilities and the available labour.

Reflecting with the team after lambing about the role of the ewe (or indeed choice of sire where determinable) in facilitating ease of lambing, although possibly subjective if not recorded, may facilitate broader discussions about the role of dystocia, ewe maternal behaviour and appropriateness of breed choice for the system. Whilst there are known breed impacts of ease of lambing, there are also estimated breeding values (EBVs) to reduce rates of dystocia, yet only 38% of flocks we worked with reported taking lambing ease into account when selecting their rams. If the dystocia rate is unknown, is this something which could be easily recorded (number of lambing glove boxes used, a tally chart) and reviewed?

**Summary**

The sheep vet has a crucial role in facilitating the discussion regarding lamb losses. As we have demonstrated, the solutions need to consider all elements of flock health and the whole flock health calendar can be an influencing factor of the success of any strategy. We should not underestimate the impacts of neonatal mortality on farmer (as well as animal) wellbeing and the complex emotional outlook with regards to this challenge and that the team is fundamental to all change.

As vets working with sheep farms, we need to use the data and observations they have to facilitate the farm to synthesise their own targets and agree data that the farm are willing to collect in future, identify which critical control points can be addressed now for the largest gain, focus on rate limiting steps, rather than trying to implement a comprehensive review all in one go, involve the team in the synthesis of the action plan and ultimately audit the efficacy of change made (see figure 5).

The task for the flock health vet is to motivate and inspire, whilst discussing a challenging issue. Every lamb counts is the ethos, flock health planning is the roadmap, “Target Survival” is the mantra.

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**Suggested Images**

Figure 1: Data analysis is important prior to setting interventions or targets. Be prepared to work with what is available to demonstrate progress.

Figure 2: A collaborative approach to health planning is key and involving the whole team.

Figure 3: Ewe and lambs in field- selection of lambing paddock for outdoor lambing flocks or turnout paddocks for indoor lambing flocks is key to minimising losses due to exposure.

Figure 4: Just 38% of flocks use EBVs in the selection of their male genetics.

Figure 5: See image