Improving the health and nutrition of dairy cows by investigating the farmer and stakeholder attitudes and behaviours that influence health in the transition period

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Abstract

During the transition from the dry period to lactation the dairy cow undergoes a period of physiological, metabolic and immunological change, and is at greater risk of developing disease, to the detriment of health, welfare and production. Many studies have been undertaken to determine appropriate management strategies to improve health and welfare during the transition period, however the incidence of disease during this period remains high. In this study, 22 dairy farmers calving all year round (AYR), 10 dairy farmers block calving herds, 12 veterinary advisors and 12 non-veterinary advisors were interviewed. A farm audit of the 22 AYR herds showed that 11 of the herds had more than 15% lame cows in the pre-calving or early lactation groups. Most dietary minerals were oversupplied in early lactation and pre-calving diets, although 12 out of 22 farms did not supply enough magnesium pre-calving as judged by NRC requirements. The qualitative data showed a lack of awareness of metabolic disease and potential risk factors in farmers with AYR calving herds. A key theme arising from the advisor interviews was a perceived lack of focused transition management advice provided by advisors, and a lack of cooperation between veterinarians and nutritionists. A nationwide questionnaire was also conducted, finding the majority of farmers (52%) were actively seeking advice to improve their transition management. The questionnaire demonstrated that many of the themes derived from the interviews can be applied to other dairy farmers in England, such as farmers having positive relationships with their veterinarians and nutritionists. Heterogeneity in farmer attitudes, management systems and infrastructure highlighted the difficulty in delivering a one-size-fits-all approach to metabolic disease control. Future initiatives should focus on a tailored approach, understanding the main priorities of the farmer, and acknowledging the farm-specific infrastructure and layout.

Declaration

I declare that this thesis has been written and composed by the author and has not been submitted for any other degree. The work and all pictures presented are my own and are original. I also acknowledge the assistance given to me during the design and execution of the study reported in this thesis and during its preparation. This thesis contains work that has been published by the author in peer-reviewed journals and presented in an international conference.

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Pictured: Cherry blossom, at sunset.

List of publications arising from the research:

Journal articles

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Conference proceedings

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Oral presentations

SVEPM 2021 Conference (online). 24-26 March 2021. Investigating the advisor and farmer relationships that influence dairy cow health and welfare in the transition period before and after calving.

UK Dairy Day. Telford. 15 September 2021. Transition cow management: Farm audit data from a regional study.

APHA Cattle veterinary expert group. Shrewsbury. 6 June 2019. Investigating transition cow management: A mixed methods approach.

List of abbreviations

ADF	Acid detergent fibre
BCS	Body condition score
Ca	Calcium
Co	Cobalt
Cu	Copper
CP	Crude protein
DIM	Days in milk
DM	Dry matter
DMI	Dry matter intake
EE	Ether extract or crude fat
Fe	Iron
K	Potassium
Mg	Magnesium
Mn	Manganese
Mo	Molybdenum
MPL	Maximum permitted level
NDF	Neutral detergent fibre
P	Phosphorous
PMR	Partial mixed ration
RFM	Retained foetal membrane
SARA	Subacute ruminal acidosis
TMR	Total mixed ration
VFA	Volatile fatty acids
Zn	Zinc

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1. Chapter 1: Literature review

1.1 Introduction

The transition period for a dairy cow is described by Grummer (2004) as the period from 3 weeks pre-calving until 3 weeks post-calving, a definition that has been widely accepted by other authors in this field (Drackley, 1999; Aleri et al., 2016; Atkinson, 2016). During this period important physiological, metabolic and nutritional changes take place, and it is when most metabolic disorders occur (Mulligan and Doherty, 2008). These metabolic disorders include ketosis, fatty liver syndrome, milk fever, metritis, mastitis, retained foetal membranes (RFM) and displaced abomasum (LeBlanc, 2010). How these physiological, metabolic and nutritional changes are managed is of great importance and is strongly associated with the incidence of metabolic diseases, milk yield and fertility in early lactation (Roche et al., 2018). Parturition is initiated by abrupt hormonal and physical changes, at the end of gestation of approximately 280 days (LeBlanc, 2010). In cattle, the first stage of parturition is marked by changes in feeding, rumination and lying behaviour (Matamala et al. 2021). Cows decrease their DMI by approximately 30% on the day of calving, possibly due to pain and discomfort, or a shift in motivational priorities, as cows seek to isolate themselves from other herd members to give birth in a calm place (Huzzey et al. 2007). Hormones such as oestradiol, progesterone, oxytocin and prolactin play a central role in activating maternal behaviour and stimulating milk production (Matamala et al. 2021). Rumination behaviour also changes around calving, with rumination time declining a week before parturition (Soriani et al. 2012). Additionally, cows also experience a reduction in lying time, and an increase in walking activity with more frequent changes of posture (Miedema et al. 2011). The process of calving is divided into 3 stages, ending with delivery of the calf and placenta (Schuenemann et al. 2011). Duration and frequency of contractions increase approximately 12h before the onset of the second stage (Mainau and Manteca 2011). The second stage of calving is characterised by the onset of rhythmical contractions, and distention of the birth canal causes further increases in oxytocin, extenuating further contractions (Noakes 2001). The amniotic sac appears, and the calf is expelled. The third stage of parturition should occur within 12-24h after birth and involves expulsion of the placenta and foetal membranes (Shuenemann et al. 2011). The concentration of androgens in cows increases during the periparturient period, and androgens and oestrogen is involved in the stimulation of prolactin from the pituitary gland. Prolactin is necessary for the secretion of milk, and it is also involved in the development and function of mammary tissue (Kurpinska and Skrzypczac, 2019). On the day of calving, the concentration of prolactin increases rapidly, stimulating milk production (Kurpinska and Skrzypczac, 2019).

There are a range of feed and management strategies that are specific to transition cow management (Atkinson, 2016; Grummer, 2004; Oetzel, 2015), however no single approach consistently results in cows successfully metabolically adapting to lactation with minimal disease events (O'Boyle, 2008). For example, a recent study by Macrae et al*.,* (2019) involving 1748 dairy herds in the UK confirmed the overall prevalence of subclinical ketosis in the first 20 days of lactation to be 28.5%, and the median herd prevalence of excessive negative energy balance (NEB) to be 59.8% (using a β-hydroxybutyrate threshold of 1.0 mmol/L). When addressing ketosis alone, Van Saun and Sniffen (2014) reported a mean incidence risk of subclinical ketosis at 43%, with Bobe et al. (2004) suggesting that approximately 50-60% of transition cows experience mild to severe fatty liver syndrome, a condition closely linked to the onset of ketosis (Herdt, 2000). These figures suggest that approximately half of the herd undergo at least one metabolic challenge indicating that either the management approaches are not working, or they are not being applied correctly. The risk of metabolic stress can be reduced by managing feeding, housing and reducing the risk of stress to the animal (Atkinson, 2016). Additionally, individual cow factors such as BCS, parity and milk yield, alongside dietary factors such as access to pasture can influence the risks of NEB occurring (Macrae et al. 2019b). Understanding the motivations and priorities of dairy farmers managing the transition cows, may help to reduce health problems, and elucidate why some approaches are not working.

During the last two decades extensive research has been conducted to attempt to better understand the biology of the transition cow in order to address nutrient requirements and ascertain management strategies to cope with the metabolic and physiological changes that occur during the transition period (Horst et al., 1997; Drackley, 1999; Huzzey et al., 2007; Van Saun and Sniffen, 2014; Zebeli et al., 2015). Despite this, dairy cows continue to experience high rates of metabolic diseases that are detrimental to animal welfare and productivity (and have significant financial impacts to the farmer) (Suthar et al., 2013; Macrae et al., 2019). An understanding of the opinions and priorities of farmers implementing nutritional and management strategies is important, or scientific research findings may not be appropriately applied on farm (Lund and Algers, 2003). As Garforth et al. (2004) suggested, there is little value in scientific research if the mechanisms to link farmers with new knowledge are ineffective. Understanding farmer communication with their advisors, local conditions and attitudes, and restrictions on applying best practice may also be helpful. While this does not on its own solve the problem of transition diseases occurring at high levels, it may help to enhance understanding of barriers to certain behaviours and help tailor knowledge and advice so that it acknowledges farmer attitudes, motivations and goals. In their review of transition cow management, Mulligan and Doherty (2008) highlighted a need to engage qualitative research methodologies to develop and implement practical methods centred on the prevention of metabolic diseases during the transition period. A better understanding of farmer knowledge and motivations which impact the decisions and strategies implemented to manage transition cows on farm may therefore benefit cow health and performance.

The use of social science and the application of qualitative research philosophies has been key in the exploration of farmer's perceptions of disease control in cattle. Additionally, many qualitative studies have sought to explore the influence of personal factors (e.g., attitudes, perceptions, knowledge, experience, skills, opinions) and interpersonal factors (e.g., farmer-advisor relationships). Although this literature provides insight into dairy farmers' perceptions of disease control, very few equivalent studies have been conducted that acknowledge the transition cow specifically, and none have been conducted in the UK. Understanding the factors affecting the implementation of optimal transition strategies, and factors affecting the success or failure of when strategies are implemented, is integral to driving forward the adoption of best practice and the reduction of metabolic disease. By exploring if, how and why dairy farmers manage their transition cows and the barriers to improvement, future messages and advisor knowledge-transfer could be actively framed around context-specific factors that motivate farmers to implement sustained long-term changes. As recent evidence suggests that metabolic disease incidence remains at similar levels than those published decades ago (Mulligan and Doherty, 2008), qualitative investigation is vital to ensure future promotion of optimal transition practices are aligned with farmer-centric and contextual factors that affect farmer decision-making.

1.2 Section 1: An introduction to social science

Some research questions are framed in such a way that quantitative methods cannot appropriately address (Silverman, 2016). In order to test the way that social factors influence behaviour, one must explore the inner experiences of participants, to understand their motivations and barriers (Merriam, 1998). The researcher must explore how logic and emotion combine to influence how people behave, handle problems and respond to events. This can only be done by connecting with research participants and trying to see things from their point of view using qualitative research methods (Corbin et al. 2014). Qualitative research is not simply a set of techniques, but a theoretically-driven process which can complement quantitative research (Merriam, 1998). It is rigorous and credible, considering the formation of social practices in real time, and it is not meant to have a lot of structure or have a rigid approach to analysis, as it is interpretive, dynamic and free-flowing (Silverman, 2016). If the researcher loses sight of this, then the research can become superficial and fail to provide the novel insights into human behaviour which gives qualitative research the edge (Corbin et al. 2014).

One unique characteristic about qualitative research is that the researcher becomes part of the research as much as the participants and the data provided (Kondo, 1986). This is particularly true when positionality becomes apparent, and the researcher can be viewed as either an 'insider' or an 'outsider' (Chavez, 2008). Semi-structured interviews rely on the interaction between the interviewer and interviewee, and the researcher's positionality can have an effect on the detail and honesty of the interviewee's answers (Kondo, 1986). When a researcher has a positionality which means that they share similar experiences and situated knowledge to that of the interviewee, they benefit from an 'insider' status (Chavez, 2008).

1.2.1 Semi-structured interviews

A popular form of qualitative research is to conduct semi-structured interviews. These are a verbal interchange where the researcher attempts to elicit information from another person through asking questions, which unfolds in a conversational manner (Clifford et al., 2016). Interviews are useful for investigating complex behaviours, perceptions and emotions as they offer the chance for participants to explore other areas of interest, and frame their answers in a way which is important to them (Richens et al., 2015). The semi-structured interview remains partially structured through a list of predetermined questions, with the focus on listening and paying attention to the participant in what they say, and also the way they say it (Clifford et al., 2016). The semi-structured interview however is flexible, allowing the researcher to move beyond the scope of predetermined questions, and follow where the interviewee leads, allowing for a dynamic and everchanging platform of different themes and concepts within each interview (Clifford et al., 2016).

The literature surrounding the use of social science investigation in farm animal health and welfare demonstrates the effectiveness of establishing farmer opinions, and therefore the motivations behind some of their behaviour and management approaches (Vaarst et al., 2002). Surveys and questionnaires have been proven to be an effective method of analysing opinions of large numbers of farmers in a specific area (e.g., 500 dairy farmer opinions on their intentions to improve foot health (Bruijnis et al., 2013)). As the area of investigation is specific, large numbers of farmers are required to provide answers for reliability purposes. Questionnaires and surveys can be sent out to multiple farmers or be carried out online. However, when investigating an area such as the transition period of the dairy cow, this area encompasses many different possible management approaches and nutritional strategies (Atkinson, 2016; Nordlund, 2008). Therefore, for an area of interest like this, semi-structured interviews could provide a more in-depth insight into how farmers are managing their cows, with plentiful detail which a questionnaire may not be able to include on its own (Ruston et al., 2016).

1.2.2 Qualitative interview research in animal health and welfare

There is an ongoing requirement for social science studies to evaluate farm animal health and welfare, and the use of qualitative interviews has become increasingly common as a way of determining whether the findings and recommendations are being applied on farm and to determine drivers for disease incidence at herd level (e.g. Shortall et al., 2018; Donadeu et al., 2020; Robinson, 2020). Determining farmer attitudes can help to establish the barriers to best practice by uncovering the diversity of views that people hold (May, 2018). Understanding the attitudes underpinning farmers' actions are essential pre-requisites for improving outcomes in disease control and animal welfare, and this has proven a fruitful research area for bovine husbandry and health in recent years (Robinson, 2020) and is therefore highly likely to have merit when considering transition cow management. For example, Palczynski et al., (2020a) determined that farmers were receiving inadequate instructions on calf feeding and weaning, and recommended that more consistent recommendations were required from veterinary and nutritional advisors. In the light of this, it is possible that farmers may also be receiving inadequate instructions, or a lack of focussed advice, on transition management from their advisors. Additionally, Fischer et al., (2019) established that antibiotic use and misuse was mainly determined by the strength of the farmer-veterinarian relationship, and the effectiveness of the veterinarians' communication skills within that relationship. This suggests that the farmer-veterinarian relationship and veterinary communication skills may also influence the way farmers treat their transition cows.

By conducting interviews during a lameness intervention study, Atkinson (2020) established that farmer attitude influenced incidence, and farmers that had the lowest lameness incidence in their cows felt that it was within their control, had a better understanding that lameness affected their business, and could better estimate the extent of it in their herd. These findings agree with a study by Leach et al., (2010), who determined that farmers' perceptions and awareness of lameness influenced their success in reducing its incidence, and that farmers often underestimate the extent of the problem in their herds. This suggests that farmer perception and awareness of metabolic diseases may influence their transition management success, particularly given the unseen nature of subclinical metabolic diseases. Social science studies therefore demonstrate that by determining farmer and related stakeholder opinions, one can elucidate possible barriers to the implementation of optimal transition cow management strategies and uncover ways of facilitating positive behavioural change and improved cattle health and welfare outcomes. It has been proven beneficial to use contrasting methodologies appropriately and allow them to complement one another (Corbin et al. 2014), particularly when researching lameness (Richert et al., 2013; Fabian et al., 2014) where farmer perception of lameness was investigated, and quantitative methods were used to determine the lameness prevalence on farm. The quantitative data supported the theory that farmers had a poor perception of what was happening on their own farms. The qualitative data gave deep insight into the reasons why farmers had a poor perception and were not treating dairy cows accordingly.

1.2.3 Studying farmer behaviour

Many behavioural studies aim to identify farmer attitudes in order to create a persuasive message or stage an intervention resulting in an intended change of behaviour (Kristensen and Jakobsen, 2011). An attitude is produced by emotional and behavioural beliefs (ideas that a person holds as being true, deeply held and difficult to change), and is an intrinsic frame of mind affecting one’s thoughts or behaviour (Ajzen, 1991). Only with a positive attitude towards a task will there be motivation, engagement and intention to complete it (Jain, 2014). This is not to be confused with an opinion, which is an external and explicit response to something, and that is changeable through experience, knowledge and persuasion (Tourangeau and Galešić, 2008).

Traditional methods of attempting to change farming practice and behaviour include the introduction of legislation to implement and enforce certain practices or standards (Barnes et al., 2013); financial penalties such as deductions in milk payments for high somatic cell counts (SCC) (or premiums for the reverse) (Vaarst et al., 2002; Valeeva et al. 2007); and advisor-based extension methods to educate farmers in new practices such as the BVD-Free England campaign (Armstrong et al., 2018). Although these traditional methods are effective at facilitating large scale changes quickly, they are not always popular or well implemented (Morgans et al., 2019). While penalties and premiums have been shown to be significant drivers for farmers to improve mastitis management, factors related to farm performance and the individual farmer were equally motivating, such as taking pleasure in having healthy animals (Valeeva et al., 2007) and being a ‘good farmer’ (Swinkels et al., 2015). This highlights the importance of understanding the intrinsic motivations of the farmer.

A systematic review investigating farmer behaviour by Rose (2018) emphasised the positive influence of trained facilitators on farmer decision-making and highlighted the importance of ‘knowledge exchange’ between advisors and their farm clients. This approach seeks to understand farmers’ local environments and barriers to change and create farmer-centred solutions based on their individual intrinsic motivations (Bopp et al., 2019). According to Kristensen and Jakobsen (2011), knowledge should be tailored to context, and when practices are more in line with farmer goals and priorities, farmers are more likely to adopt them (Derks et al., (2013). Important behavioural constructs affecting farmer behaviour include self-efficacy, feeling in control of decision-making (Ellis-Iversen et al., 2010; O’Kane et al., 2017) and self-identity, which is the extent to which the behaviour is considered to be part of one’s self (Terry et al., 1999). This is in line with recommendations from Bard et al., (2019) who outlined that influencing farmer behaviour involves understanding their rooted beliefs, and empowering them to make their own decisions, because behaviours associated with social identity are more likely to persist (Charng et al. 1988).

Farmer attitude, however, does not always match behaviour, as reported by Thompson et al., (2020), who observed space provided for housed dairy cows. Approximately half of the farmers in their study provided their cows with less space than their cited minimum value (Thompson et al., 2020). This suggests that other factors may play a part in management decision making, such as habits and social norms (Shortall et al. 2018). Thompson et al., (2020) established that although farmers believed loafing space was important, barriers exist which prevent implementation, and while exploring these barriers would be beneficial, they are likely to be centred around context-bound factors such as cost, practicality and the individual farm layout. The evidence emerging from the qualitative social science literature on farmer behaviour shows that interviewing farmers can provide a different way of approaching problems and providing possible solutions, with the overall aim of improving the wellbeing of the animals they care for.

According to Bellet et al. (2015), for optimal farming practices to take place and be implemented correctly, the formation of practices must acknowledge farmers’ perspectives and contextual challenges associated with those practices. Stakeholders and industry professionals such as veterinarians and advisors hold a significant amount of responsibility in knowledge transfer, to allow farmers to make the correct choices in management practices (Gunn et al. 2008). Studies have been conducted in order to establish the role of veterinarians in helping to maintain correct farm animal health and welfare by investigating the relationship between the farm animal veterinarian and the farmer (Shortall et al. 2018). Understanding the perception of both farmers and their relevant industry stakeholders is crucial to develop an effective proactive relationship, in order to maintain optimal farm animal health, by fulfilling the objectives of both parties (Bellet et al. 2015). This is important as studies have shown that farmers regard their veterinarians highly, with a significant level of trust (Ruston et al. 2016) and use their veterinarian as a primary source of information and advice on farm animal health (Garforth et al. 2013; Gunn et al. 2008). Richens et al. (2016) used semi-structured interviews to investigate how farmers perceive the role of veterinarians in the implementation of vaccination strategies on farm and found that the relationship between the veterinarian and the farmer was significantly important, with the veterinarian being a major facilitator in decision making and the vaccination process. In a qualitative study investigating farmer perception of biosecurity, Shortall et al. (2018) outlined that the relationship between the veterinarian and the farmer affects farmers' willingness to accept advice and adopt new practices. Therefore, a farmer's perception of their veterinarian and of their veterinarian's role could influence future business decisions. Shortall et al., (2018) suggested that if a veterinarian had close contact with the farmer, this led to the farmer having an improved understanding with the cultural value placed by veterinarians on the scientific understanding of disease developing. This meant that the farmer was more likely to take a veterinarian's advice on biosecurity measures. Studies have also shown that farmers are likely to be influenced by other advisors such as nutritionists and consultants, if their input is considered credible and the advisor has legitimacy (Sutherland, 2013; Eastwood et al. 2017). This was supported by Brennan and Christley (2013) who investigated farmer perception of biosecurity. In the study by Brennan and Christley (2013), while the veterinarian was the most preferred source, other advisors and information sources can be seen to have been considerably influential.

1.2.4 Uptake of management practices related to the transition dairy cow

To the author's knowledge there have been no social science studies conducted to understand the management of transition dairy cows in Europe. Recently, however, a qualitative North American study was published by Mills et al., (2020) where they used semi-structured interviews to identify barriers to optimal transition cow management in Canada. Mills et al. (2020) identified four main themes relating to barriers to improve transition management: farmer attitudes to the health and welfare of transition cows; farmer and stakeholder definitions of the transition period and information sources which could improve that; factors influencing transition cow management, with stocking rate being a key aspect; and finally, the involvement and influence of the farm veterinarian. Mills et al. (2020), while not including non-veterinary advisors in their study, emphasised a need to investigate the perspectives of nutritionists, feed representatives and business consultants. This has yet to be undertaken for transition cow management, but it is likely that these non-veterinary advisors exert a considerable influence over farmer decision-making in this area (Lowe 2009) that is likely to develop as the veterinarian becomes more consultancy-based, and farmers outsource farm services to other professionals (Woodward et al. 2019).

The animal feed industry promotes the use of different transition cow supplements including drenches, calcium binders, boluses, protected amino acids, choline, ‘fresh cow drinks’ for recently-calved cows (Fig 1.2.1), and a variety of methods for mineral supplementation (Sinclair and Atkins 2015). This variety and choice of products could be confusing to farmers. Ingram (2008) suggested that when farmers consider practices to be more knowledge-intensive and demand more attention to detail and observation than conventional practices, they can be off-putting to adopt. In addition to the variety of products being marketed, some transition cow management strategies also demand considerable attention to detail for implementation. For example, pre-calving cows on a dietary cation-anion balance diet to prevent milk fever must be fed a diet strictly monitored in anionic salt concentrations, which requires regular and time-consuming forage mineral analysis, and measurement of urinary pH (DeGaris and Lean, 2008).

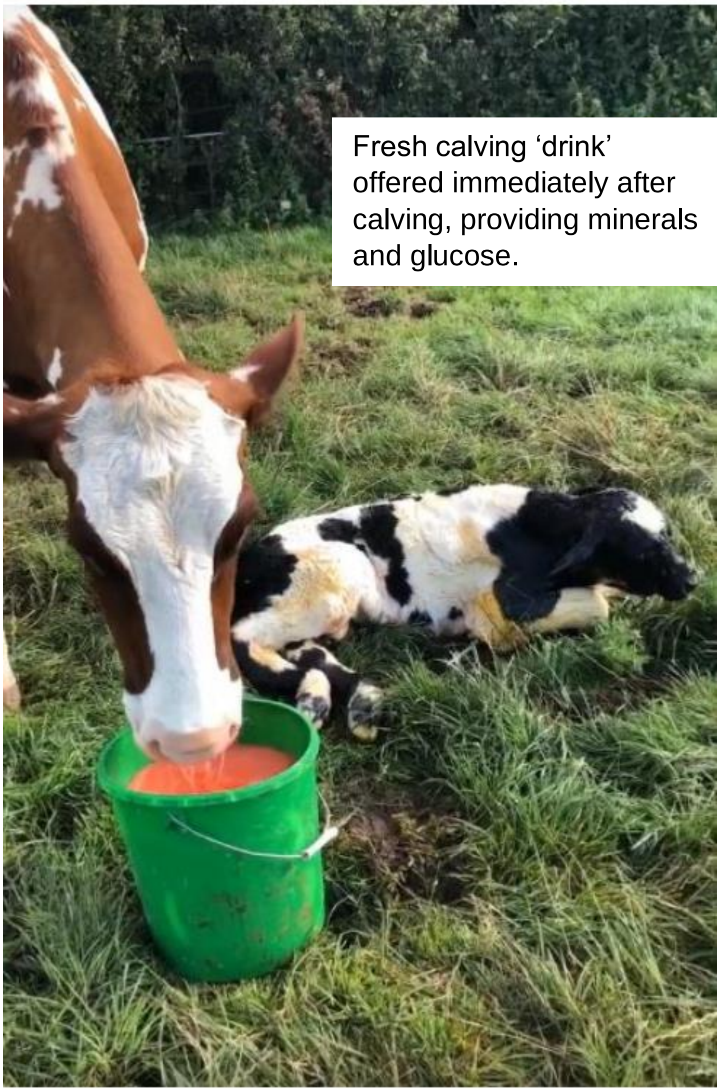


Figure 1.2.1: An example of a ‘drink’ for a freshly calved cow (Authors own).

Diet formulation and methods of feeding and housing differ between farms, so strategies may need to be adapted specifically to each farm based on its size, available labour, housing type, forage and other resources, and the associated knowledge must therefore be situated (Hassanein and Kloppenburg, 1995; Ingram, 2008). Knowledge has been shown to be better when it is anchored in a local situation, as it encompasses barriers and constraints that are specific to that area (Chenais and Fischer, 2018). Decontextualised knowledge is difficult for farmers to understand and enact as behavioural change (Hamilton, 2018). It is likely that there is no “one size fits all” approach to transition management, because the best decision depends on the internal logic and context-bound reality on each dairy farm (Kristensen and Jakobsen, 2011).

As concluded by Bard et al., (2019), veterinary advice was more likely to enact change if it was delivered from a trusted advisor, encompassed a shared farmer-veterinarian understanding, and was interpreted in a way that was meaningful to that farmer and his/her unique circumstances on a local level. Scientific knowledge also plays a role, as outlined by Ritter et al., (2019), who recently concluded that farmers with post-secondary education were more satisfied with veterinary consultancy, perhaps because they had a deeper understanding and/or were more confident, and therefore more likely to adopt veterinary advice. The literature outlines that different forms of knowledge, both situated and scientific, combine with motivation, and when the factors interlink, they construct the necessary steps of utilising the available knowledge, adapting it to the individual's needs, and building farmer confidence to aid in the decision-making process. This has been illustrated in Figure 1.2.2 (adapted from Valeeva et al., 2007, Rose, 2018 and Thomas et al., 2020).

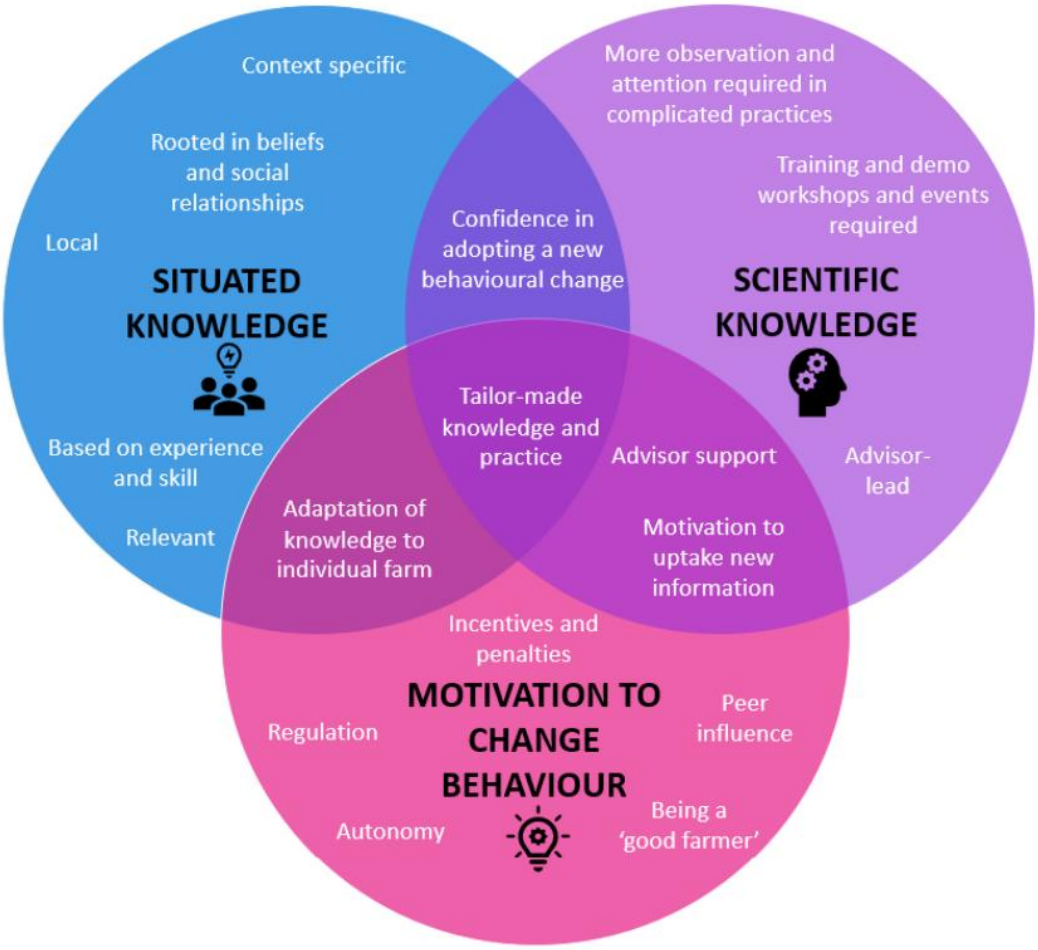


Figure 1.2.2: The role of knowledge in farmer decision-making

Farmers are also exposed to multiple sources of knowledge and advice to which they attribute varying levels of perceived influence and credibility. Veterinarians and non-veterinary advisors such as nutritionists, dairy business consultants and animal feed sales representatives with differing levels of scientific knowledge and practical experience will undoubtedly influence farmer decision-making (Ellingsen et al., 2012; Bruijnis et al., 2013). Although the veterinarian may be considered to be the farmer's most trusted advisor (Enticott et al., 2012), there are many unregulated consultants who visit farms and offer similar advisor services (Atkinson 2010; Ruston et al., 2016). Farmers are likely to be influenced by non-veterinary advisors if their input is considered credible and the advisor has legitimacy (Sutherland, 2013; Eastwood et al., 2017). Conflicting knowledge and different advice from multiple advisors can place farmers in a state of cognitive dissonance (Kristensen and Jakobsen 2011). This is an under-researched area, and although there are notable examples of research papers considering the influence of veterinary advice (e.g., Kaler and Green, 2013; Bellet et al., 2015; Robinson, 2020), there is a dearth of qualitative research examining non-veterinary advisors and their role and influence on livestock health (Mills et al., 2020). Interestingly, Bruijnis et al. (2013) reported that feed advisors and foot trimmers appeared to have most influence on farmers' intentions to improve dairy cow foot health, rather than veterinarians. The range of advisor-influencers on dairy farmer behaviour are illustrated in Figure 1.2.3 (based on Garforth et al., 2013; Ruston et al., 2016; Mills et al., 2020; Palczynski et al., 2020b; Burton, 2004; Rose, 2018; Fischer et al., 2019). No research has yet been conducted that investigates the influence of non-veterinary advisors such as nutritionists and dairy farm consultants on farmer decision-making regarding transition cow management. Conducting research in this area may help advisors to tailor their knowledge transfer to farmers, allow for maximum uptake of knowledge, and increase the probability of adopting optimal management practices based on scientific evidence.

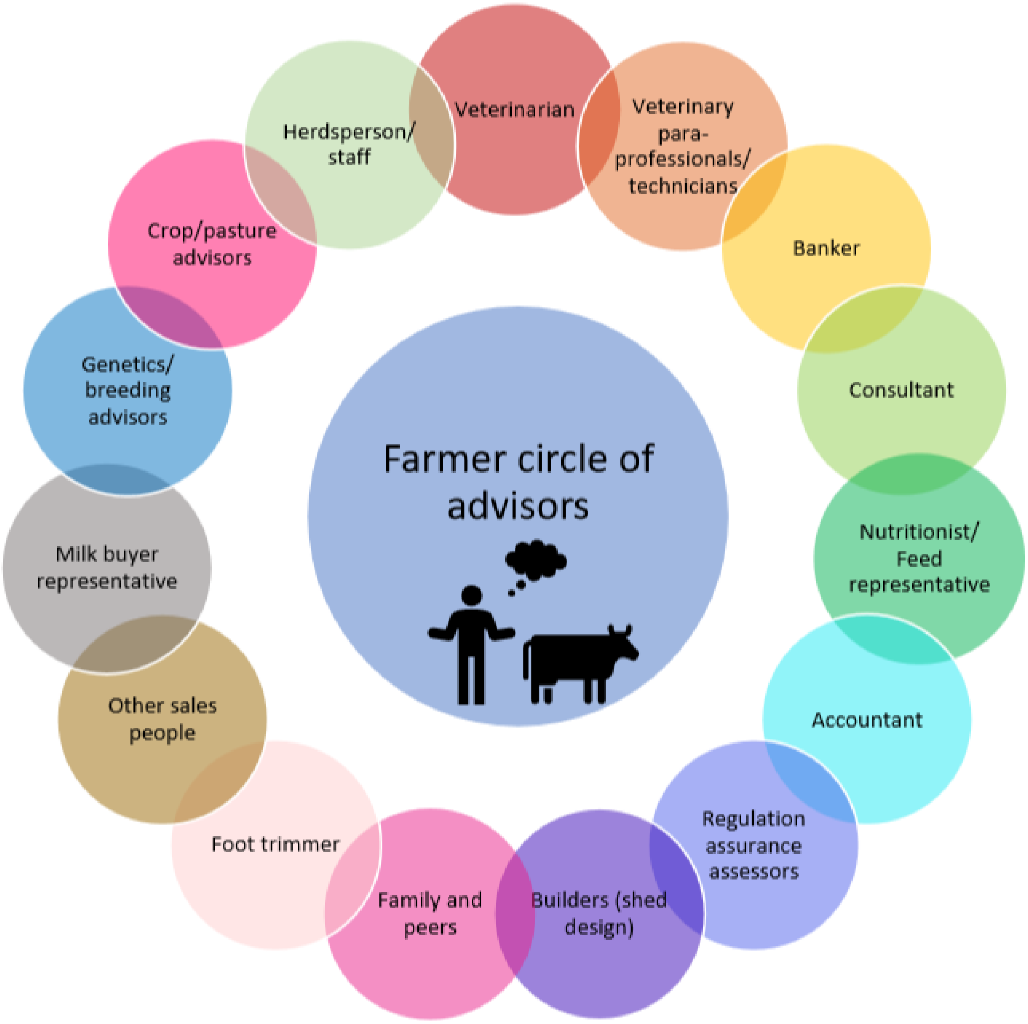


Figure 1.2.3: “The circle of trust”: Farm advisors influencing dairy farmer behaviour

Efforts to change farmer behaviour have been discussed by multiple researchers (e.g. Blackstock et al. 2010; Rose et al. 2018; Morgans et al. 2019). Some qualitative agricultural studies have incorporated behavioural models, such as the theory of planned behaviour (Ajzen, 1991; Daxini et al. 2019) and the transtheoretical model (TTM) (Prochaska et al. 2009) to establish drivers behind farmer behaviour change. For example, Michels et al. (2020) used the TMM to investigate farmer use of drones in precision agricultural techniques and Richens et al. (2018) applied the TTM and the Theory of Planned Behaviour to identify key variables to use for interventions focussed on the uptake of biosecurity measures. Limitations to the TTM model are that is does not acknowledge financial income, and the model assumes that individuals make logical and coherent plans during their decision-making process, which may not always be applicable to people. Limitations of the theory of planned behaviour include that it assumes the person has the required opportunities and resources to be successful in performing the desired behaviour (Ajzen, 2011).

West and Mitchie (2020) discussed the Com-B model of behaviour to identify what needs to change for a behaviour change intervention to become effective. Three factors were proposed as being required to be present for any behaviour change to occur; 1. Capability, 2. Opportunity and 3. Motivation. Individuals must have the capability and opportunity to engage in the behaviour and be more motivated to enact on that behaviour more than any other behaviour. The Com-B model may be more suited to dairy farmer decision-making because it acknowledges perceived barriers such as a lack of time or income as a 'capability'. The more capable we perceive ourselves to be in enacting a behaviour, the more conducive the environment is to acting on it, and the more we tend to want to do it (West and Mitchie, 2020). Conversely, if a behaviour is perceived to be difficult (such as believing transition cow management to be a confusing and complicated area of dairy cow management), the less motivated one may be to do it. Figure 1.2.4 illustrates the Com-B model as described by West and Mitchie (2020), which has been adapted to suit a dairy farmer's capability, motivation and opportunity to change.

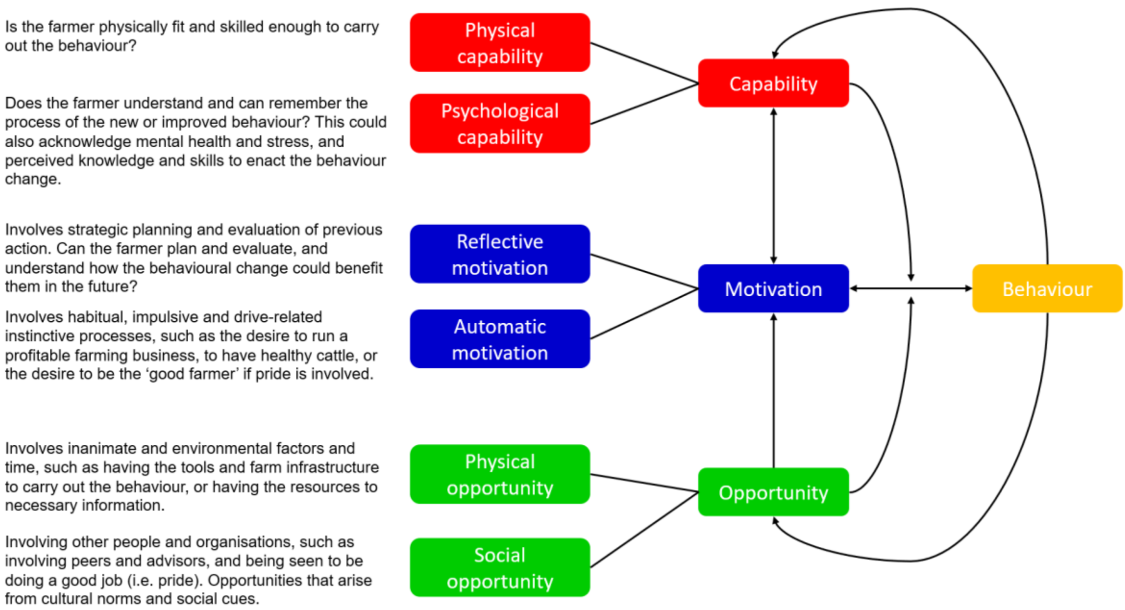


Figure 1.2.4: The Com-B model of behaviour change, adapted from West and Mitchie (2020) to acknowledge dairy farmer capability, motivation and opportunity

While qualitative agricultural studies often focus on farmer attitudes to decision-making (Rose et al. 2018), Yazdanpanah et al. (2015) explained that a one-size fits all behavioural model may not be suitable for those with differing backgrounds and actions, much like farmers who have a diverse range of farming types, systems and strategies. However, advisors have the platform and ability to help farmers develop their knowledge and skills, thus making them feel more capable to enact a behaviour change. If farmers perceive a change to be too challenging this may negatively impact their motivation to change, so helping them realise they have the capability to tackle an issue may positively impact motivation. Advisors can act as facilitators, to help guide and assist farmers through the process of change for improvement (Vaarst et al. 2017).

1.2.5 Studying advisor behaviour

Advisor communication has emerged to be a pertinent factor when addressing farmer adherence to advice and uptake of practices (Jansen et al., 2010). This was analysed by Ritter et al. (2019) who determined that farmer preparedness to adopt veterinary advice was positively associated with their satisfaction, and negatively associated with the dominance of the veterinarian during the farm visit. Behavioural models such as the theory of planned behaviour suggest that intrinsic motivation is important in achieving compliance (Ajzen, 1991), and when advice addresses the goals of the farmer it builds on their intrinsic motivation to implement change (Jansen and Lam, 2012). Derks et al., (2013) established that veterinarians were, however, reluctant to ask their clients about their goals. It was unclear why, but it was suggested that some veterinarians are reluctant to set targets as they feel they could be judged unfavourably if these goals are not met.

Veterinarians are aware of their influence and the requirement to be proactive, but they often struggle to maintain this in daily practice (Mee, 2007). The extent of this was highlighted by Ruston et al. (2016), where veterinarians reported difficulties in influencing farmer behaviour change, and despite coming under pressure to shift their role of 'fire-fighter' to a more preventative herd-health advisor, veterinarians were not promoting disease prevention services effectively to farmers. Jansen et al. (2010) outlined that veterinarians are poor at active listening, however as Kristensen and Jakobsen (2011) explained, communication skills are not part of the traditional veterinary curriculum, and the purpose is not to transfer their own knowledge, but to empower the farmer to make their own decisions, as discussed earlier. The literature therefore demonstrates a requirement for veterinarians (and other non-veterinary advisors) to invest in improving their communication skills, and to understand the different farmer learning styles and psychology behind behavioural changes and motivation (Atkinson, 2010).

Prevention of disease requires the engagement of the farmer, the veterinarian, and non-veterinary advisors (Garforth et al., 2004; DEFRA, 2012) to be coupled with effective and targeted knowledge exchange, training, and change of attitudes towards transition disease prevention (Mulligan and Doherty, 2008). This includes veterinary and non-veterinary advisors communicating with each other (Smith and Hollis, 2007). This is not always put into practice, as Ruston et al. (2016) found that veterinarians felt threatened by non-veterinary advisors that also offered preventative herd health measures. Although veterinarians perceived these non-veterinary advisors to be amateurish, little was done to ensure occupational dominance (Ruston et al., 2016). To the author's knowledge, no research has been conducted investigating communication between dairy veterinarians and livestock nutritionists. However, May et al., (2017) suggested that veterinarians and nutritionists can effectively work together in the American feedlot when 'blame' is removed, and the focus is primarily on how advisors can collectively solve farm challenges. When farmers frequently had a "round table discussion" with their veterinarian, their preparedness to adopt veterinary advice increased (Ritter et al., 2019).

1.3 Section 2: Managing the transition cow

Approximately 75% of the diseases in dairy cattle occur in the first month of lactation (Suthar et al. 2013). With a concurrent increase in genetic merit, UK milk production has been rising in the last seventeen years, alongside an increase of metabolic diseases which are occurring more regularly on dairy farms (AHDB, 2021; Van Saun and Sniffen, 2014; Mulligan and Doherty 2007). Ill health resulting from metabolic disease can be a costly problem for dairy farmers, with repercussions affecting the milk yield, fertility and general health (Drackley, 1999). The nutrition and management immediately before calving has a significant influence on postpartum health, therefore the health and welfare of dairy cows during the transition period can be seriously compromised if the management is not optimal (Atkinson, 2016; Goldhawk et al. 2009; Walsh et al. 2007).

1.3.1 Negative energy balance and disorders of lipid metabolism

Metabolic diseases are prominent during the transition period as they are associated with the negative energy balance that inevitably occurs right before calving and during early lactation (Oetzel, 2015). During the dry period when a cow is close to calving, the maintenance requirement of the cow increases due to the increase in glucose demand for foetal development, and colostrogenesis (Aleri et al., 2016; Mulligan and Doherty 2007). Post-calving, the amount of energy required for milk production and maintenance exceeds the amount of energy a cow can obtain from dietary sources, thus resulting in a negative energy balance that begins a few days before calving and continues 2-3 weeks into lactation (Kim and Suh, 2003). Therefore, cows rarely become sick before calving, and most ill health manifests post-calving (Atkinson, 2016). Freshly calved cows suffer double effects of having an increased requirement of energy for milk production, coupled with a decrease in energy intake due to a depressed appetite and dry matter intake (Atkinson, 2016). Modern dairy cows have been selected to re-partition nutrients for milk production, otherwise known as homeorhesis, where homeostatic mechanisms are temporarily overridden (Leblanc, 2010). This includes a period of insulin resistance which bares similarities with Type 2 diabetes in humans, with the important difference that cows have a low blood glucose (Lucy, 2004). Ingvartsen et al. (2003) suggested that irrespective of the milk yield, a cow may be likely to suffer from a metabolic disease if exposed to relevant nutritional or environmental factors, such as insufficient feed intake; and that the energy balance in early lactation is a function of both feed intake and milk yield.

The transition period, in particular the early lactation period can be characterised by the mobilisation of different tissues, specifically adipose tissue (Ingvartsen and Andersen, 2000) to meet the increasing energy demand post-calving. Cows require a moderate level of lipolysis of adipose tissue to transition successfully from the dry to lactating period, in order to produce free fatty acids which act as an important energy source for nonmammary tissues and a precursor for milk fat (Contreras et al., 2018). Adipocytes release triacylglycerols in the form of NEFA and βHBA in a process known as lipid mobilisation, which is brought on in early lactation due to an energy deficit resulting from a limited DMI and the onset of lactation (Bradford et al., 2015). This is governed by the endocrine system (Roche et al., 2009). Although lipolysis results in a supply of energy for the cow, if the lipolysis rate is too high this can predispose cows to inflammatory and metabolic diseases (Fronk et al., 1980), and affect immune response (Contreras et al., 2018). Excessive lipolysis can have serious health implications for dairy cows, with serum NEFA concentration ≥0.5mEq/L increasing the risk of dairy cows retaining their placenta by 80% (LeBlanc. et al., 2004). Negative impacts on fertility have also been reported (Walsh et al., 2007), with links to the development of cystic ovaries (Dohoo and Martin, 1984).

Excessive lipolysis can be exacerbated by a lack of dry matter and energy intake (Fronk et al., 1980). Factors affecting dry matter intake include environmental conditions such as 1) management and housing (Atkins et al., 2018), 2) group sizes (Jensen and Proudfoot, 2017) and 3) number of times feed is pushed up to the barrier per day (Oetting-Neumann et al., 2018), all of which are primarily determined by management, and are affected significantly by farmer behaviour. Nutritional factors also influence NEB, for example Macrae et al. (2019b) found that pre-calving cows fed grass silage and whole crop were significantly less likely to have elevated plasma NEFAs compared to those offered access to fresh grass. Hyperketonaemia otherwise known as ketosis, can develop as a consequence of a poor adaptive response to NEB, and occurs when the liver is overwhelmed with processing circulating NEFA released as a result of mobilising adipose tissue. This can result in weight loss, a decrease in milk yield and a drop in appetite (McArt et al., 2012). Dairy cows are more likely to suffer from the subclinical form of this disease, with prevalence rates reported at high levels of 43% in some herds (Suthar et al., 2013), and incidence rates up to 60% in others (Emery et al., 1964). Subclinical ketosis is defined as an excess of circulating ketone bodies without showing clinical signs of ketosis (Herdt 2000), and overall has a much higher herd prevalence and incidence rate than clinical ketosis, of which the latter has been reported to be between 2 to 15% (Duffield, 2000).

During the days immediately before and after calving, cows go through a significant depression in DMI, which is unavoidable (Mulligan and Doherty 2007). Maximising DMI pre-partum is important, because reduced feed intake pre-calving has been associated with the development of subclinical ketosis (Goldhawk et al., 2009; González et al., 2008) and metritis (Huzzey et al., 2007). Post-calving DMI is further reduced in cows with an excess of body condition (Douglas et al., 2006). Cows with a high BCS (>3) have more adipose tissue which secretes leptin, a hormone used to regulate energy balance by inhibiting hunger (Leury et al., 2003), therefore fatter cows eat less than moderately sized cows. This further exacerbates the state of NEB as fatter cows still have an energy requirement which cannot be met by feed intake (Drackley, 1999). NEB has also been associated with season, with Macrae et al. (2019b) establishing more cows suffering NEB during the summer.

1.3.2 Rumen Health

There is detailed scientific literature to support feeding for rumen health and rumen function in dairy cows (Lean et al., 2014) and there is evidence to support that rumen health is a key factor in encouraging a more positive energy balance, as optimal rumen function is required for efficient absorption of VFA of which some (mainly propionate) act as a glucose precursor (Duffield et al., 2008). Preconditioning the rumen pre-calving with the inclusion of starches, forages and other feeds which are to be given post-calving is important as it allows the rumen microbiome and the rumen surface area to adjust accordingly (Drackley, 2010). The addition of dietary starches produces VFA such as propionic and butyric acid, which stimulates the growth of rumen papillae. This increases the surface area of the rumen allowing for a larger rate of absorption of VFA, which are a product of fermentation and a source of energy (Dirksen et al., 1985; Steele et al., 2015). If the surface area of rumen papillae is not sufficient and the rumen cannot effectively absorb VFA at the rate at which they are produced, then it is likely that acidosis will occur (DeVries et al., 2008). This will further impede the efficiency of VFA absorption and overall rumen function, further suppressing DMI due to the acidic conditions within the rumen which is highly likely to exacerbate negative energy balance even further (Atkinson, 2015).

The rumen microbiome is required to adjust pre-calving, to allow for efficient feed utilisation post-calving (Jouany, 2006). It can take approximately three weeks for the bacterial populations to adjust to a different ration (Atkinson, 2015). Therefore, it is appropriate to make any dietary adjustments with the inclusion of some starches approximately three weeks prior to calving. This can complement the increase in energy requirements due to the increase foetal growth, however care must be taken not to overfeed the dry cows through the inclusion of too many non-fibre carbohydrates (Mann et al. 2016; Janovick-Guretzky et al., 2007).

In order to counteract the energy deficit post-calving, cows are often fed high energy concentrates, which can lead to the development of sub-acute ruminal acidosis (SARA) (Zebeli et al., 2015). This can be further exacerbated by the failure to pre-condition the rumen with starches and concentrates pre-calving (Steele et al., 2015). Early lactation cows are particularly susceptible to developing acidosis due to the abrupt transition from a diet fed pre-calving with minimal readily digestible concentrates to a milking cow diet which is higher in energy and higher in the proportion of concentrates and starches (Coon et al., 2019) which can be sorted in the TMR by the cow; resulting in the ration actually eaten being much higher in fermentable carbohydrates (DeVries et al., 2008). Adequate forage consumption is necessary for cows in early lactation to overcome this and reduce the risk of SARA forming, as forages increase rumination, and saliva production in the chewing process, which acts as a rumen buffer (Allen, 1996). Lower forage diets are consumed at a faster rate than high forage diets, and ruminated less, resulting in less saliva production (DeVries et al., 2008). Therefore, the onset of SARA can occur from either a shortage of physically effective fibre, or a quick or excessive consumption of rapidly fermentable carbohydrates. The ruminal fermentation of rapidly degradable carbohydrates results in the production of VFA, mainly propionate which out of all the VFA produces the highest proportion of lactic acid. The build-up of lactic acid causes the rumen pH to drop to below 5.5 where it then stops moving becoming atonic (Maekawa et al., 2002). This significantly depresses appetite and subsequent milk production (Plaizier et al., 2008).

1.3.3 Hypocalcaemia

Hypocalcaemia is a common metabolic disorder which leads to increased risks of other detrimental health problems, and can become life threatening if not treated (Venjakob et al., 2017). Due to the onset of colostrum production pre-calving, there is a consequential increase in calcium demand, where homeostatic mechanisms will attempt to mobilise and re-absorb bone calcium if dietary calcium is not available (Roche et al., 2003). Failure of calcium homeostasis at calving is associated with older cattle, as they have less exchangeable bone calcium and absorb less dietary calcium and too much dietary calcium being available in the pre-calving ration (Jorgensen, 1974). A plasma calcium deficiency of ≤2.0mmol/L reduces the ability for the periparturient cow to affect smooth and skeletal muscle contraction (Mulligan et al. 2006) therefore if the cow is unable to mobilise bone calcium immediately, she will become unable to stand and become a ‘downer cow’ (Littledike et al., 1981). This impact on muscle contraction can predispose the cow to other metabolic diseases such as metritis and mastitis (Whiteford and Sheldon, 2005). The reduction in smooth muscle function at the cervix and teat sphincter causes slower uterine involution (Borsberry and Dobson, 1989) and an easier route of pathogenic infection post-milking (Curtis et al., 1983).

Ducusin (2003) suggested that hypocalcaemia in both clinical and subclinical forms acted as ‘gateway diseases’. Similarly to ketosis, hypocalcaemia (total blood calcium <1.4 mmol/L (DeGaris and Lean, 2008)) is linked with many other metabolic disorders, with milk fever cows being up to three times more likely to retain their foetal membranes (Houe et al., 2001), having reduced blood flow to the ovaries impacting fertility (Jonsson and Daniel, 1997), and having a higher incidence rate of metritis (Whiteford and Sheldon, 2005) and mastitis (Curtis et al., 1983). This was supported by Kimura et al. (2006) and Goff (2003) who reported that hypocalcaemia exacerbated the level of immunosuppression experienced by periparturient cows, further increasing the risks of mastitis developing. Cows with clinical hypocalcaemia have been shown to be less active and had greater lying times compared to cows with subclinical hypocalcaemia and normal calcium levels, even following successful treatment (Barraclough et al. 2020). As with ketosis, the incidence rate of hypocalcaemia is far higher in its subclinical form (blood calcium 1.4-2.0 mmol/L (DeGaris and Lean, 2008)) reported by Roche (2003) to be as high as 33% in New Zealand grazing herds, and as high as 54% in some US herds (Reinhardt et al., 2011). Therefore, prevention strategies are essential. Mulligan et al. (2006) stated that it is common to find farms which have no control strategy for the prevention of hypocalcaemia, and that prevention strategies are essential on all farms. Strategies to prevent hypocalcaemia include restricting pre-calving calcium intake to <20g per day (Van Saun and Sniffen, 2014), managing the dietary cation and anion balance (Mulligan et al. 2006), and ensuring adequate magnesium supply (Goff, 2004) of 0.4% DM (Van Saun and Sniffen, 2014). Body condition also plays an important role, with Atkinson (2016) suggesting that over-conditioned cows with a BCS above 3.5 are at a greater risk of milk fever. This was also reported by Houe et al. (2001) who stated that over-conditioned cows are four times more likely to develop milk fever. It is unclear why, however it has been suggested that over- conditioned cows have a higher calcium output in milk (Mulligan et al. 2006) and a reduced DMI in relation to thinner cows (Allen et al., 2009; Leury et al., 2003).

1.3.4 Periparturient immunosuppression

Several metabolic processes occur right before and after calving that have an immunosuppressant effect, which are described by Aleri et al., (2016) in a paper focusing entirely on periparturient immunosuppression. Immunosuppression is one of the main causes of freshly calved cows retaining their foetal membranes (LeBlanc, 2008). Calving can be considered a ‘stressful event’ (Aleri et al., 2016), and changes in stress hormones such as cortisol levels are thought to play a critical role in immunosuppression, directly influencing the activity of neutrophils and lymphocytes (Kimura et al., 2002). Cortisol levels can also inhibit T-cell development, therefore affecting immune-responsiveness and increasing disease susceptibility (Lewis, 1997). During the transition period cows are often moved to different groups and sheds, or to calving pens which can contain a build-up of harmful pathogens if not cleaned out regularly (Nordlund, 2008). Also, the move itself can directly cause a social stress which can raise levels or cortisol (Aleri et al. 2016). Preisler et al. (2000) suggested that increasing circulatory glucorticoids such as cortisol are associated with decreased immune function. Exposure to unhygienic areas right before and after calving poses a particular risk of contracting infection or disease, particularly when the cow is subject to a stressful situation (Schreiner and Ruegg, 2003). Therefore, group moves should be minimised, and cows must only be moved to the calving pen at the point of calving, to minimise stress (Atkinson, 2016). Cockcroft (2015) suggested that while the immunological component in transition cow health is the most complex, the most important factors affecting the competence of the immune system are the energy and protein nutrition of cows pre- and post-calving, with additional influences from certain trace elements and vitamins.

Immunosuppression is multifactorial and is mainly associated with endocrine changes and a decreased intake of essential nutrients (Goff and Horst, 1997). Immunosuppression during the transition period has also been linked with decreased Vitamin E intake (Smith et al. 1984; Miller et al., 1993; LeBlanc et al., 2002) and selenium status (Julien et al., 1976). Selenium works alongside Vitamin E as an antioxidant via its role in producing the enzyme glutathione peroxidase (Julien et al., 1976) and can affect immune function through the ability of phagocytes to migrate towards a site of infection (Erskine et al., 1989). Selenium deficiency in dairy cows reduces the ability for neutrophils to kill bacteria (Hogan et al., 1990) and deficient cows have shown to have more severe cases of mastitis, with a longer time to clearance of infection when compared to selenium supplemented cows (Erskine et al., 1989). Dietary supplementation of micronutrients is important, although it is not solely responsible for the development of transition-related metabolic diseases. For example, LeBlanc et al. (2004) concluded that Vitamin E is a component of the pathway to a retained placenta, but other components include energy supply for immune function (Aleri et al., 2016), and cleanliness in the calving pen (Atkinson, 2016).

1.3.5 Energy and protein balance

Cockcroft (2015) suggested that while trace elements and vitamins play an important role in the periparturient period, the competence of the immune system is primarily governed by energy and protein nutrition. Energy balance can affect immune function, and dairy cows which are unfavourably conditioned such as over-fat or thin are also more likely to be immunosuppressed (Ingvartsen 2006; Ingvartsen et al., 2003). Ingvartsen and Moyes (2015) suggested that negative energy balance is the main contributor to immunosuppression, and that glucose is the preferred fuel for immune cells rather than fatty acids, therefore the reduction in glucose concentration during the transition period may partly explain the immunosuppression which occurs. There is little peer-reviewed evidence to support the notion that immunosuppression is directly associated with protein nutrition; however it has been suggested that a protein deficiency could lead to disorders which exacerbate immunosuppression (Cockcroft 2015). The demands for amino acids and glucose from the foetus and the mammary gland post-calving place the cow at risk of mobilising significant amounts of body protein, to account for a protein deficiency and release amino acids (Lean and DeGaris, 2010). Methionine and lysine are the first two limiting amino acids which many early-lactation cows are deficient in, and they are used for protein synthesis in the mammary gland (Zhou et al., 2016).

1.3.6 Metritis

The changes in hormonal, metabolic, digestive, immune and neurological systems increase the risk of not only metabolic disorders, but also infectious diseases such as mastitis and metritis during the transition period (Ingvartsen and Moyes, 2015). Post-partum uterine diseases can have a high incidence rate on farm (Van Saun and Sniffen, 2014) and have been shown to have negative effects on reproductive performance (Kelton et al., 1998; Fourichon et al., 2000), with an unfavourable effect on time returning to ovarian cyclicity (Sheldon and Dobson, 2004). Metritis is defined as a condition causing clinical signs of illness such as a fever and a reduction in milk yield and can be characterised by a foul-smelling vaginal discharge occurring within the first 21 days of lactation (Sheldon et al., 2006). This can be due to trauma to the uterine wall leading to a source of infection (Fishwick, 1997), and can be exacerbated by immunosuppression (Aleri et al., 2016; Cockcroft, 2015).

Metritis has been linked to the inevitable immunosuppression that a dairy cow undergoes at the point of calving (Cockcroft, 2015) and can be exacerbated by micronutrient deficiencies (LeBlanc et al., 2004). Cleanliness of the calving pen can also contribute to its incidence (Atkinson, 2016). The literature also outlines other multiple risk factors for metritis, supporting the theory that ‘gateway diseases’ such as milk fever (Kaneene and Miller, 1995), high plasma NEFA (Giuliodori et al., 2013) and dystocia (Dubuc et al., 2010) considerably increase the risks of dairy cows contracting metritis. All of these issues are more likely to occur in cows with an excess of body condition (Drew, 1986; Hoffman et al., 1996).

1.3.7 Mastitis

One consequence of immunosuppression is that cows can be hypersensitive to invading pathogens and be more susceptible to disease, in particular mastitis and metritis (Overton and Waldron, 2004). Mastitis is defined as an infection of the mammary gland with clinical signs of abnormal clotting in the milk, and a hard and swollen udder in the affected quarter

(Zadoks et al., 2001). This disease frequently occurs during the transition period due to several risk factors which exacerbate the chances of infection occurring and has reported incidence rates of up to 40% in different countries and housing types (Jamali et al., 2018). The incidence of clinical mastitis has been estimated to be 4.6 times higher in early lactation (the first 30 DIM), when compared to later in lactation (Hammer et al., 2012). Neutrophils are the main immune cell responsible for killing harmful invading microorganisms during mastitis and due to the periparturient immunosuppression which occurs around calving, the transition period is considered a high risk period for mastitis development (Green et al., 2002). However, risk factors for mastitis are not limited to periparturient immunosuppression. They include the onset of lactation and the management and hygiene practices associated with it (teat dipping, dry cow treatment), the hygiene of the calving pen, and open teats post-calving (Atkinson, 2016). As mastitis is brought on mainly by environmental pathogens, and exacerbated by immunosuppression, calving pens must be kept clean and strict teat and udder hygiene management practices should be maintained (Barnouin et al., 2004). It has also been suggested that mastitis incidence is linked to hypocalcaemia (Curtis et al. 1983; Van Saun and Sniffen, 2014), and micronutrient deficiency (Spears and Weiss, 2008).

1.3.8 Environmental stressors

Time spent feeding, DMI and social behaviour play a vital role in transition cow health, and special attention should be given to management and herd social factors that can negatively impact DMI and attendance at the feed trough (Cook et al., 2010). For every 10-minute decrease in average time spent at the feed trough pre-calving, the risk of developing subclinical ketosis increases by 1.9 times (Goldhawk et al. 2009) and the risk of developing metritis increases 1.6-1.7 times (Huzzey et al., 2007; Urton et al., 2005). Group changes can be significantly damaging to the health of a transition cow (Atkinson, 2016). Cows are regularly grouped at drying off, in a ‘far-off’ group and moved later on to ‘close-to-calving’ group. On some occasions they can be moved again to different sheds and to different groups of cows to facilitate a shortage of housing, and to prevent overstocking before transitioning to a calving pen at the point of calving (AHDB, 2012). If cows are moved to a different social group less than two weeks prior to the expected calving date this can have severe repercussions on dry matter intake, resulting from stress (Van Saun and Sniffen, 2014). This stress can be simply down to the move into another shed, or new competition for feed and resting space within the new social group (Cook and Nordlund, 2004). Although grouping pre-calving and freshly-calved cows improves cow health and enhances milk production (Bolton, 2010), the transition period is a time that can bring multiple group changes which can cause social stress, with reports that the impacts arising from movements can last up to three days (Grant and Albright, 1995). Regrouping cows has been shown by von Keyserlingk et al. (2008) to result in a lower production of milk and a lower time spent eating. Therefore, the influences of social pressure on feeding behaviour pre-calving may impact the susceptibility of metabolic diseases occurring post-calving (Goldhawk et al. 2009).

Traditionally in an all-year-round calving herd, the close-to-calving dry cow group has cows leaving at the point of calving and new cows entering the group at drying off, therefore maintaining a permanently unstable social group (Lobeck-Luchterhand et al., 2014). There is a period of approximately 2 to 3 days of social turmoil within a pen after a new cow enters (Nordlund, 2008), which can be characterised by a dramatic increase in the number of predominantly physical antagonistic interactions (Kondo and Hurnik, 1990). Each pen move requires the cow to familiarise herself with the new surroundings and re-establish the pecking order within the group (Hasegawa et al., 1997), which can create stress and can limit DMI when more time is spent establishing her rank, and fighting for feed space (Nordlund, 2008).

Keeping cows at the correct stocking rate is vital in order to maintain good welfare and hygiene. The amount of space available to a dairy cow can greatly affect behaviour and productivity and overstocking dairy cows can have negative impacts on their health, comfort and feed intake (Telezhenko et al., 2012). Krawczel et al. (2012) conducted a study on stocking rate in dairy cows, and short-term responses in behaviour milk yield udder and leg hygiene. Cows were housed at stocking densities of 100%, 113%, 131% and 142%. Lying time and time spent ruminating was significantly reduced at stocking densities of 131% and 142%. In an extensive Canadian study in 2014, accelerometers were used to measure lying behaviour of Holstein dairy cows on 111 commercial dairy farms with a cubicle housing system. It was concluded that no farm with a stocking rate greater that 100% achieved an average herd lying duration of at least 12 hours (Charlton et al., 2014) meaning that cows were not meeting their rest requirements. A more recent study investigating the impact of stocking rate on dairy cow health and productivity in the dry period split dry cows into groups of low stocking rate (L= 6m^2/cow) and high stocking rate (H= 12m^2 /cow) (Fujiwara et al, 2019). While energy metabolites and lying time were not affected in this study, H cows were less likely to start feeding within 5 minutes of feed delivery and spent 15 minutes less time feeding overall to cows in the L group. This study confirmed that high stocking rate increased competition at the feed face, with the feed-face becoming constantly crowded, and altered feeding behaviour with H cows spending more time standing inactive in the feeding alley.

1.4 Conclusion

Suggested management practices to reduce disease incidence include reducing movement to alternative cow groupings to minimise the influence of social stress, increasing cow comfort with adequately sized lying areas, having a minimum time in the close-to-calving pen, providing a spacious environment with adequate feed and water space and keeping the calving area as clean as possible (Cook and Nordlund 2004). Nutrition is also vitally important, and transition diets should ensure optimal balance of mineral and micronutrients (Sinclair and Atkin, 2015; Weeratilake et al., 2019; Atkins et al., 2020), and energy and protein (Lean et al., 2013). Nordlund (2009) outlined five key factors of transition cow management to be feed space; minimizing group moves and social stress, particularly during the 10 days prior to calving; increasing cow comfort with amply sized cubicles; using sand bedding and implementing a screening process to identify cows needing medical attention or additional care.

An overview of the nutritional and management factors which positively influence transition cow health and their potential solutions are illustrated in Figure 1.4.1 (based on literature from Cook et al., (2007), Mulligan and Doherty (2008), Lean et al., (2013) and Nordlund, (2009)). These various factors have been suggested as recommendations to help prevent transition cow diseases, but there appears to be conflicting findings between research studies. For example, Huzzey et al., (2006) found that decreasing stocking rate increased time spent feeding, whereas Proudfoot et al., (2009) demonstrated that overstocking transition cows, so that cows had access to 0.3m/cow of feed space instead of 0.6m in the control group, did not adversely affect dry matter intake when using individual electronic feeders and fed twice daily.

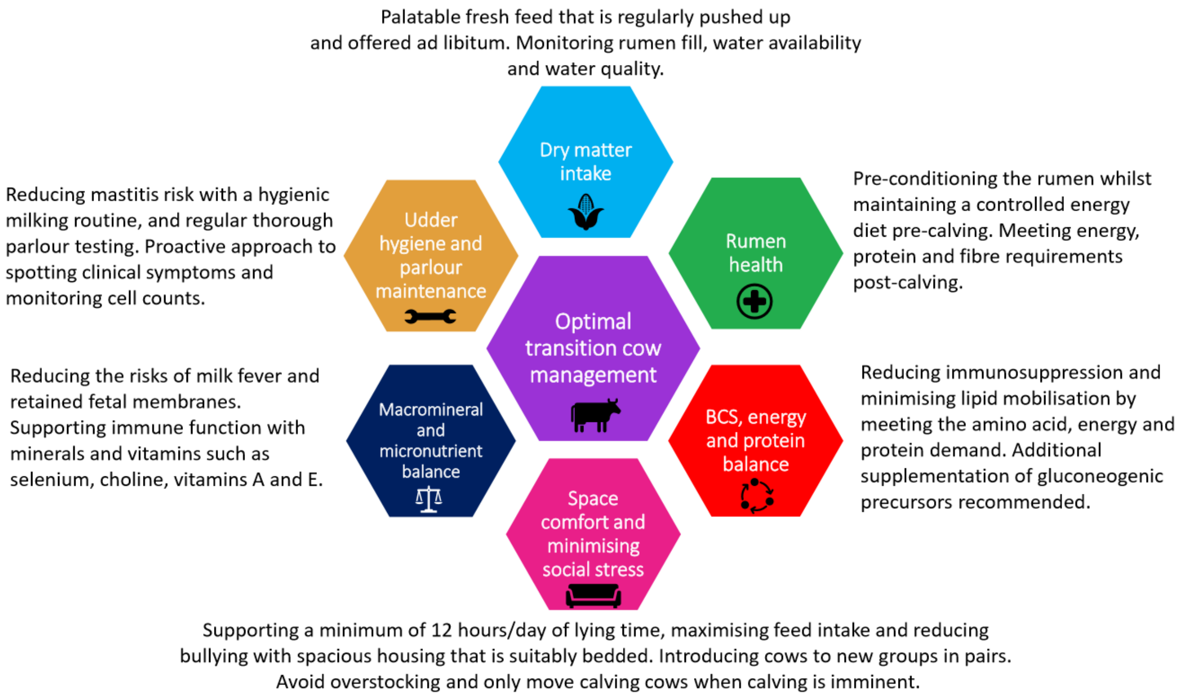


Figure 1.4.1: Six main management factors positively influencing transition cow health.

The success of these management practices in improving transition cow health and performance relies heavily on farmers correctly and consistently implementing them, and advisors effectively communicating knowledge to farmers in a way that they can interpret and specifically apply to their farm business (Bard et al., 2019). If farmer perception of transition cow diseases and the associated management practices is considered of little importance or significance to subsequent health and production, it is unlikely that they will be implemented correctly (Roche et al., 2019). It can also be hypothesised that farmers may be unaware that they have a transition cow problem, leading to inaction, as found, for example, when investigating farmer perception of dairy cow lameness (Richert et al., 2013). Considering the nature of metabolic diseases, many of which are subclinical and result in 'hidden' losses such as reduced milk yield, a lack of awareness of the scope of the problem is likely.

Transition cow diseases result in financial losses, where farmers are not only faced with the direct costs of treating dairy cows, but they often incur additional consequential costs resulting from further production and health disorders (Mulligan et al. 2006). For example, cows that develop sub-clinical milk fever are eight times more likely to develop mastitis (Curtis et al. 1983). Furthermore, aside from the losses arising from clinical disease, there can be 'hidden' losses as mentioned earlier, such as milk yield and compromised fertility, which can be difficult to see. If there is a clinical transition issue, then it is possible that subclinical disease can be present in herd-mates, which again can be less obvious than in cattle displaying clinical signs (Mulligan et al. 2006). The costs of transition cow diseases will vary from farm to farm, however McArt et al. (2015) estimated the average component cost per case of ketosis in US herds (blood BHBA's >1.2 mmol/L) to be $117, and the total cost was estimated to be $289, which included costs attributable to metritis and displaced abomasums following from the ketosis. In a recent paper by Puerto et al. (2021), costs of mastitis arising from a drop in milk production alone were estimated to be between $228 and $470 per case for US herds. Transition-related diseases also cost in time and labor to treat and can increase the risks of early and involuntary culling (Rollin et al. 2015; Aghamohammadi et al. 2018). This further impacts the need to replace cattle and the overall longevity and sustainability of the herd (Herzog et al. 2018). Transition-related problems are a complex issue that cost dairy farmers in several different ways and this highlights the importance of appropriate transition cow management and nutrition to decrease the risks and effects of transition health disorders.

Transition-related problems may not be straightforward to tackle because often there are multiple causes, and there is likely to be no single or simple solution which uniformly fits every dairy herd. Furthermore, if farmer-advisor relationships were explored in relation to transition cow management, this may reveal potential barriers to communication and knowledge exchange between the parties, and farmer-specific reasons as to why some advisor recommendations may not implemented successfully. There is evidence to suggest that dairy cow health during the transition period is sub-optimal with a significantly large incidence of metabolic diseases that are associated with the management of dairy cows 3 weeks pre-partum and 3 weeks post-partum (Van Saun and Sniffen, 2014; McArt et al. 2012; Mulligan and Doherty 2007),despite industry bodies publishing management practice 'ideals' aimed towards dairy farmers (AHDB, 2012b). It can be hypothesised that there is either a knowledge gap whereby farmers are either unaware of how to improve transition cow management, unaware that they have a problem (Richert et al. 2013) or that there are underlying behavioural drivers which influence farmers' decision making (Bellet et al. 2015) causing transition cow management to be suboptimal. In order for farmers to take advantage of the advice and findings from the research conducted, they need to be aware that it is available to them, have intent to improve their practices and spend time acknowledging it, and understand the information provided (Heider 2013; Ohlmer et al. 1998; Ajzen 1985). Therefore, an understanding of farmer motivations to uptake new information, and change their behaviour is required (Jones et al. 2016).

Mulligan and Doherty (2007) stressed the need to engage qualitative research methodologies, in order to develop methods of best practice formed around the prevention of metabolic diseases during the transition period. This was supported by other authors in the field of qualitative research investigating farm animal health (Jones et al. 2016; Bellet et al. 2018; Sutherland et al. 2018). Bellet et al. (2018) suggested that there is a need to better understand farmers' logics of practice, and motivations to behaviour, along with the roles of other players and industry stakeholders such as veterinarians and nutritionists. This literature review has demonstrated multiple effective uses of qualitative research in the investigation of farmer and stakeholder perception of dairy cow health and welfare. It has also highlighted the research gap, where the opinions of farmers and stakeholders on transition cow health have yet to be investigated. These social factors in transition cow health remain an important and unexplored area of research, which need to be addressed in order to determine why the ever-increasing volumes of scientific research findings are not improving dairy cow health and reducing the high disease prevalence during the transition period. While this review demonstrates that qualitative research is rigorous in its own right, the combination of quantitative assessment can only support the research further.

There are a multitude of factors both situational, social and economic that influence farmer behaviour and management strategies in various areas. Farmers with different farming systems, housing, finances and labour will therefore probably vary in their ability to adopt appropriate transition cow management techniques, due to their ability to adopt certain management practices. However, the willingness to adopt management practices should be investigated, along with farmer engagement as this specifically encompasses the social factors that influence behaviour and is specific to the individual and their farm. Therefore, the question should be asked: What are the social barriers to dairy farmers up-taking best possible practice in transition cow management on their farms?

2. Chapter 2: Research methodology

2.1 Introduction to data collection

Understanding farmer motivations that impact the decisions made on farm, and the strategies implemented to manage transition cows may contribute towards improving cow health and performance. In order to determine the influence of social factors on farmer and stakeholder behaviour and subsequent transition cow management, opinions must be gathered from dairy farmers along with their advisors such as veterinarians, and nutritionists. This can only be done by connecting with research participants to establish their greatest concerns, motivations and barriers to the management of transition cows, through the use of qualitative research methods such as semi-structured interviews (Corbin et al., 2014). Qualitative research methods have become an increasingly common way of determining whether findings and recommendations are being applied on farm (Robinson, 2020). Qualitative interviews are used to examine social process and meanings by capturing the depth and breadth of participants experiences and perspectives (Mason, 2006).

The current study utilised a critical realist paradigm (this distinguishes between the real world and the observable world) alongside constructivist epistemology (our knowledge is subjective, as it is constructed based on our own perceptions and experiences, resulting in different interpretations of reality) (Guba and Lincoln, 1994). Data collection and analysis were performed iteratively, following the principles of Grounded Theory. Grounded theory is unique in that the concepts out of which theory is constructed are not chosen before conducting the research but are derived and evolve from the data collected during the research process (Corbin et al., 2014). Whichever angles are deemed most important by the interviewee can be followed up on, and the researcher can then carefully construct theory based on the themes which emerge (Denzin and Lincoln, 2011). Additionally, there is a relationship between the collected data and the research analysis, as the concepts taken from the initial data analysis form the basis of further data collection. This approach was utilised, where the themes from the farmer and advisor interviews helped to shape and develop the basis on which the questionnaire was modelled. By understanding the local barriers and constraints experienced from an illustrative sample of regional farmers with different management styles and infrastructures, a list of transition cow management strategies that could be applicable to all dairy farmers was developed, regardless of the barriers expressed in the interviews, thus forming the basis of the questionnaire.

2.2 Central hypothesis

The attitudes and behaviours of farmers, veterinarians and other relevant stakeholders providing advice to dairy farmers influence the health and welfare of dairy cows during the transition period.

The primary research questions are as follows:
Firstly, why are there such high levels of metabolic diseases on UK dairy farms despite the ever-increasing volumes of scientific research conducted on optimal transition management practices?

Secondly, can such a mixed methodological approach to investigate this problem provide critical analysis and suggest realistic solutions?

To help answer these questions, the following subsidiary research questions are also highly relevant, and each of the following chapters of the thesis deals with one of them:

Can the use of quantitative farm measurements and nutritional analysis help to explain reasons for the high levels of metabolic diseases in the UK? (Chapter 3)

What are the farmer and stakeholder attitudes and opinions on transition cow management, and on farmer awareness of metabolic disease? (Chapter 4)

Does the advisor-farmer relationship influence knowledge exchange and subsequently affect transition cow management? (Chapter 5)

What are the farm-specific barriers that hinder optimal transition cow management and the uptake of optimal practices? (Chapter 6)

Do the themes derived from the all-year-round farmer interviews differ from block calving farmers? (Chapter 7)

Using the information derived from the interviews, can the regional findings be supported by a nationwide questionnaire? (Chapter 8)

What are the potential solutions to address these problems? (Chapter 9)

2.3 Objectives

The objectives of the current study are to establish the role of different industry stakeholders in optimising the health and welfare of dairy cows throughout the transition period by:

1. Undertaking case studies on all-year-round calving dairy farms, to determine the most significant issues these farmers and other stakeholders face, and their management strategies by conducting semi-structured interviews.

2. Investigate perception of success and failure with case study farmers by conducting a farm audit on how the transition cows are managed.

3. Repeat interviews with farmers from block calving herds, to determine if common themes and issues differ between different management types.

4. Conduct a nationwide questionnaire, based on the main themes found in the farmer interviews, to compare regional themes with national findings.

2.4 Ethical considerations

The interview research (and farm audit data collection) received ethical approval from the Research Ethics Committee at Harper Adams University (Project number: 0173-201901-PGMPHD). All participants signed a consent form and agreed to have their interviews recorded electronically and manually transcribed. Consent was also sought by the researcher to take photographs of some parts of the farms and cattle to use in the thesis as examples, and participants were made aware that their quotes and any findings may be published in academic journals, presented orally, in posters at conferences and to other interested organisations. All photographs in this thesis are the author's own, of which some have been altered for anonymity (e.g., cattle ear tags have been blurred so the herd number cannot be read). Participants had the right to withdraw their contribution for the research during or after the interview or farm audit. The researcher undertook qualitative interview training with Dr Karen Lumsden prior to developing the interview format on 17/04/2019. This covered the principles, types and benefits of qualitative interviewing, how to design a topic guide, the practicalities to consider, structuring an interview, building a relationship between the interviewer and interviewee, and ethical considerations.

2.5 Recruitment of interview participants

The author aimed to recruit farmer participants based on the diversity of their demographic information and their farming systems, and advisor participants based on their experience and areas of expertise, aiming to search for 'information-rich' cases (Baxter and Eyles, 1997). The author also aimed to include advisors who did not have a specific interest in transition cow management, and farmers who stated during the recruitment process that their transition cow management was suboptimal to ensure that the sample was not biased towards participants with a strong interest in transition cow management as this would influence the outcome of the project. In order for AYR calving farmers to take part in the study, they had to house their pre-calving cows for three weeks prior to calving during the winter months or all year round. For farmers that did not routinely house their pre-calving cows for three weeks before calving in the summer months, these farmers were visited during the winter months when those cows would be housed to ensure that farmers who grazed cows in the summer months were not excluded from the study. These criteria were employed to ensure that the researcher was able to take cattle and housing measurements, as farms where pre-calving cows were not housed would provide little quantitative data. Although employing these criteria created some bias towards farmers that house their pre-calving cows, the author made sure to include farmers that do not house their pre-calving cows in summer months and discussed the farmer's methods relating to this in the interview.

Participants were contacted over the phone, in person, via email or both, and were recruited using a combination of non-random purposive sampling (Given, 2008), convenience sampling (Vaarst et al., 2002), snowball sampling (Bayissa, 2015) and maximum variation sampling (Richens et al., 2015). While there is a possibility of recruitment bias, purposive heterogeneous sampling was utilised to reflect the variation in dairy farmers, such as herd size, type of milk contract and average annual milk yield, and the variation in advisors such as years of experience and areas of expertise. Dairy farmers and advisors in this study were recruited using cattle veterinarians, nutritionists and other farmers as the 'gatekeepers'. Gatekeepers were very important in facilitating interviewee access, as explained by Campbell et al. (2006), providing a range of farmers with various herd sizes and transition cow management systems, and a range of advisors with different roles and experiences. Farmers and advisors known to the author through the dairy farm community were contacted. The researcher aimed to represent farmers of different herd sizes and milk contracts and using different veterinary and non-veterinary advisors. For example, 10/22 AYR farmers in the sample had a supermarket contract, and the remaining 12 farmers had a direct-supply contract. Supermarket contracts provide a higher milk price but with more stringent targets to meet, and with more significant penalties and premiums, which subsequently also played a role in motivating farmers to maintain this premium milk price. The researcher purposely aimed to recruit farmers with both types of milk contract as milk price per litre can vary significantly between these groups (Franks et al., 2012) and this could indicate whether financial factors may impact the way cows are managed. Additionally, it was hypothesised that the way that supermarket contracts motivate farmers to benefit from premium milk prices by meeting targets (e.g., maintaining optimal udder hygiene practices to manage somatic cell counts) may influence the way that farmers manage their transition cows, or provide further insight into the ways that penalties and premiums motivate farmers to uptake certain management practices, as discussed by Vaarst et al. (2002). Additionally, by recruiting farmers that sought advice from different veterinarians and nutritionists allowed the researcher to gain insight into the different forms of advice and strategies promoted to farmers. This purposive and maximum variation sampling of farmers and advisors meant that the themes emerging from the interviews would not be biased towards farmers all using the same type of advisor, or farmers all seeking advice from dairy-specific veterinarians. This was considered important as the relationships that farmers have with their veterinary and non-veterinary advisors undoubtedly influence farmer adoption of practices (Richens et al. 2015; Mills et al. 2020).

The author recognises that the selection of participants in the current study may lend itself to bias, as they were geographically close, and the author knew a small number of participants prior to the research commencing. The use of semi-structured interviews however does not lend itself to be statistically relevant, as it is not possible to interview such a large demographic of participants within reasonable time. What they do provide is in-depth insight into the attitudes and opinions of participants, hence why the researcher must seek information-rich participants to facilitate this. It should however be noted that the attitudes and opinions reported in the current study may not be similar to that of all farmers and stakeholders in England but are likely to be indicative. There were no notable differences between the interviews conducted face-to-face and over the telephone.

2.6 Interviews

The semi-structured interviews followed four separate topic guides, one for AYR farmers (appendix 11.3), veterinary advisors (appendix 11.5), non-veterinary advisors (appendix 11.6) and block calving farmers (appendix 11.4). This was devised to standardise the interview process and to cover key concepts, using open-ended questions ensuring conversations were free-flowing and flexible, and to allow the participants' responses to guide the direction of the conversation, whilst remaining relevant to the topic of transition cow management. Sayer (1992) supported this approach, suggesting that a less formal and less standardised kind of interview, allows for a better chance of learning from respondents what the "different significances of circumstances are for them". Strategies were employed to eliminate researcher-bias, which included wearing the same clothes for every face-to-face interview, and where possible, phrasing the question in the same way each time, and only asking about one point of interest at a time (Driscoll, 2011). Leading questions were avoided at all times, and open questions were predominantly used. Specific closed questions were asked at times as a prompt, when responses to open questions did not acknowledge some important details. Questions were developed based on literature and industry experience. A funnel-shaped approach to questioning was adopted (Kvale and Brinkmann, 2009). Occasionally, wording of questions was altered depending on the context. Active listening techniques were employed, such as paraphrasing participants' words and reflecting them back, prompting discussion on certain topics ('Could you talk more about that please?') and revisiting earlier comments mentioned in conversation, for clarity. All interviews were piloted beforehand, to ensure interview guides were suitable, and because only minor refinements were made to the themes and interview guides, the responses remained relevant and were therefore included in the dataset. Interviews were audio-recorded with consent, manually transcribed in full, and analysed thematically using NVivo 12 software (QSR International Ltd, Australia). The researcher received training in qualitative methods prior to conducting the interviews.

The researcher piloted three interviews with participants that she knew either socially or through working previously as a nutritionist or veterinarian technician. Although these interviews proved insightful, and while the participants gave honest feedback, the researcher chose not to interview any more farmers or advisors that were known to her directly. This was because on one occasion it resulted a farmer skipping details and making comments such as "you already know this". Additionally, it was thought that despite the researcher maintaining anonymity between the participants, farmers and advisors that were not directly known to the author may be more comfortable sharing their attitudes and experiences, rather than participants known directly to the researcher. This resulted in honest and open responses.

Data saturation was achieved after interviewing 22 AYR farmers, 12 veterinary advisors, 12 non-veterinary advisors and 10 block calving farmers, and no new themes emerged. The final heterogeneous samples of farmers and advisors were considered to be illustrative but not necessarily representative of all dairy farmers in England.

2.6.1 All-year-round calving farmer interviews

Semi-structured interviews were conducted face-to-face with all AYR farmers in the sample as carried out by Vaarst et al. (2002), and included questions on feeding, health monitoring, health and routine, housing, use of advisors and personal perception of their management (appendix 11.3). The interviews were subsequently followed up by a farm audit of their transition cows, the transition cow housing and rations fed on the same day. Because feed samples were taken as the first feed was delivered out (this was in the early morning for all participating farmers), the feed samples would be taken first, and the interview would follow shortly after. The average AYR interview length was 73 min which included warm-up questions about their farm or respective role (range 22 – 140 min).

All interviews were one-off interviews and took place in the farm office or the farmer's home, at the farmer's discretion. As Casey (2001) explained, 'place' is regarded as fundamental to one's sense of self, therefore it was important along with convenient, to conduct the interviews with the farmer in a space of his or her choice on the farm, ensuring participants felt comfortable. The interviews were conducted prior to the farm audit. On one occasion during a pilot farm visit, the interview was conducted after the farm audit at the farmer's discretion. Although the responses remained relevant to use in the dataset, the researcher chose to conduct further interviews prior to the farm audit, as this prevented any potential knowledge of the farm and the cattle subconsciously influencing the researcher's behaviour during the interview. It also meant that farmers could describe their housing and systems in detail, rather than skipping important points based on what they thought the researcher had already seen. All of the interviews were one-to-one. Interviews with AYR farmers took place between August 2019 and September 2020. The systems run by AYR calving farmers varied, with 5 farmers operating robotic milking systems with high yielding Holsteins, 11 farmers milking twice per day, 6 farmers fully housing and milking three times per day, and 3 farmers utilising grazing during the summer months for the main milking herd. All of the herds in the study had black and white Holstein-Friesian cows and annual milk yields varied from 8500L to over 11700L.

2.6.2 Advisor interviews

Semi-structured interviews were conducted with 12 veterinarians (6 dairy-specific and 6 mixed veterinary practice) and 12 non-veterinary advisors (3 independent nutritionists, 7 compound feed company representatives and 2 mineral supplement representatives) across England. Interviews with advisor participants within daily travelling distance from the university were conducted face-to-face. Face-to-face advisor interviews were carried out in the participant's office, home, or at the researcher's home. The location of the advisor interviews was the choice of the participant at their convenience to fit in with their working schedules, and to ensure that they were comfortable having a discussion in their preferred place. Because of Covid-19 restrictions, 16 of the 24 advisor interviews were conducted by telephone. This allowed the author to recruit advisors further afield, to gain perspectives from advisors in different geographical locations of the UK that were not as densely populated with dairy farms, and where other local and context-specific factors may influence transition cow management (such as land type, milk contracts, weather), as highlighted in the following quote: "In Cheshire, I saw more farmers who would be successful businessmen in anything they would do. Around here in Devon, you know its full of lovely people but it's about farming being in their blood rather than the business side" (A10, farm veterinarian). The advisor interviews were conducted between January 2020 and September 2020 and the average advisor interview length was 86 minutes (range 36-170 minutes). Two advisor interviews were piloted, one with a nutritionist and one with a veterinarian (Advisor 1 and 2 respectively). Only minor amendments were made to the topic guides (appendix 11.5 and 11.6) and the data remained relevant, therefore both interview transcripts were included in the dataset. All of the advisors in the study advised both AYR and seasonal calving farmers.

2.6.3 Block calving farmer interviews

Semi-structured interviews were conducted with 10 farmers from block calving herds (3 spring calving herds, 3 autumn calving herds, and 4 combined spring and autumn herds). Details of the interview topic guide can be seen in appendix 11.4. All of the block calving farming participants were from the North-West or Midlands of England, and farmers that participated were herd owners, herd managers, or both. Seven of the block calving farmer interviews were conducted face-to-face, and at a social distance to prevent transmission of Covid-19 according to government guidelines. The interviews that were conducted over the telephone were done this way due to Covid-19 restrictions preventing in-person visits (e.g., Farmer 27 was isolating from Covid-19, but still wanted to participate in the study). The block calving farmer interviews were considerably shorter than the AYR interviews with an average length of 41 minutes (range 20-70 minutes) and took place between August 2020 - October 2020. All of the block calving herds ran low yielding grass-based systems. Five of the block-calving farmers had both spring and autumn calving herds, and utilised housing during the winter months for autumn calving herds when the weather prevented grazing. However the emphasis was to maximise milk yield potential from grazed grass where possible, on all seasonal calving herds in the study by operating a low input grass-based system.

2.6.4 Positionality

It is important to note the potential influence of the positionality of the author who conducted interviews, transcriptions and data analysis. The author had a background in dairy cow health and nutrition, dairy farming, and had knowledge of the dairy industry. This facilitated the research process, by having a network of contacts available within farming and veterinary communities, meaning the people that were approached were willing to be interviewed because they knew of her through family, mutual friends or previous work associates. At times however, there was a sense of embarrassment and defensiveness in the AYR farmer interviews, when farmers knew that their practices were not ideal, as highlighted in the following quote:

> "You're probably going to tell me that I'm doing it all wrong…you should really go next door, they do a much better job of it than me." (F22, AYR, herd size: 80).

This defensive attitude may have been exacerbated unknowingly by the researcher's 'insider' positionality as a ruminant nutritionist, however this was more often quickly neutralised by the researcher's dual positionality of being a dairy farmer and having an understanding of the problem ("That makes sense, we have the same issue at home"). It should be noted that there may have been potential bias in interviews due to researcher knowledge on dairy cow nutrition and being a dairy farmer. The influence of positionality on bias has been discussed by Jafar (2018), where it is noted that the backgrounds and experiences of the research can potentially distort the outcome of the research. The difficulties and complexities of interviewing farmers have been discussed more specifically by Chiswell and Wheeler (2015), who outline that the knowledge of farmers is largely cultural and situated. However, the benefit of sharing situated knowledge and having these dual positionalities became apparent, as the researcher was able to 'shift' between them. Having the positionality of a dairy farmer put farming participants at ease and having experience as an advisor (in a previous role) meant the researcher had a shared understanding of advisor participant experiences. In the farmer interviews, this led to farmers being open with their frustrations and barriers to certain transition management strategies, as highlighted in the following quotes from one AYR farmer discussing his low milk price on a direct supply contract:

> F18: "It's just so frustrating with this milk job. You'll know, you guys aren't on a supermarket contract, are you?"
>
> ER: "No, we are Muller direct."
>
> F18: "So you're like me then, getting slated! We're both being forced to do everything for the bare minimum margins. I can't afford investing a load more money into a fresh cow shed when I'm not getting paid for it, can I? I'm sure it would be better for [the transition cows], but I just can't afford it!"

It is impossible to fully understand what effect the researcher's positionality as a dairy farmer and ruminant nutritionist had on the participants. Robinson (2017) discussed the perceived hierarchy of power being an academic researcher and conducting farmer interviews with the influence of being a 'professional'. In the current study if there was a power hierarchy present, it sided with the farming participants, as they had the right to participate or refuse, and the researcher's position as an interviewer was as a student, one willing to listen and learn, rather than to advise.

During the interviews with advisors, the researcher was reminded that she was in the subordinate position on several occasions and was challenged if the question or comment was perceived to be controversial. For example, in the following excerpt when interviewing a veterinarian:

> ER: “I am trying to work out why we are still getting so many metabolic problems on farm, when there is so much existing information and research being conducted on how best to manage the transition cow.”
> Advisor 9 (veterinarian): “Do you have evidence that we are getting more metabolic or as many metabolic problems as we have had historically?”
> ER: “Yes, there was a 2019 UK study looking at 1748 herds, which found the overall prevalence of subclinical ketosis in the first 20 days of lactation to be 28.5% with a BHB threshold of 1.0”.
> Advisor 9: I'm sorry, but in my opinion…subclinical ketosis is not a metabolic disease, the fact that it is subclinical...we are only finding it because we are looking for it. I'm not aware of the 2019 study you're citing…who did that 2019 study? Was it in the Journal of Dairy Science?”
> ER: “Yes, it was Alistair Macrae.”
> Advisor 9: “Could you email that to me please?”

In the majority of advisor interviews, the researcher’s positionality acted beneficially, as there was a perceived shared understanding of what it was like to be a farmer and a farm advisor, between the advisors and the researcher, as outlined in the following excerpts:

> Advisor 1 (nutritionist): “You’ll know, from the beginning to end on some farms it’s a hellish long day.”
> Advisor 2 (veterinarian): “You'll know this, [farmers will] tell you one thing and they'll do something totally different.”
> Advisor 5 (nutritionist): “You're married to a farmer, you know how few minutes a day they get to stand still and think… but I describe myself as stupidly naively excited by cows, and you are too, I know you are, by the way you talk!”

On one occasion however, an independent nutritionist felt reluctant to share insight on his methods of feeding transition cows. It is possible that the researcher’s positionality as a ruminant nutritionist in a previous role may have contributed to a perceived competing interest with the advisor:

ER: “What metabolic problems do you see most on farm?”

Advisor 8 (independent nutritionist): “Retained cleansings, because of the strategies I have feeding transition cows”.

ER: “Do you want to explain that?”

Advisor 8: “[Reluctant pause] Well…I’m not going to share all my strategies of feeding cows with you, if that’s what you’re thinking?

2.7 Thematic analysis

When the interviewer determined that data saturation had occurred where no new information was discovered during data analysis and no new themes were being identified, data collection ceased (Guest et al., 2006). Transcripts were coded in NVivo 12 into common themes and topics, as explained by Miles et al. (2018) which accurately reflected the opinions and experiences of the participants (Guest et al., 2011) through an iterative process of reading and re-reading the transcripts while comparing to what themes had emerged previously. Coding took place as the data was collected and transcribed. In the first process of coding, interview quotes were arranged according to the topics, the advisor’s role, main areas of concern, and personal values. Coding was then repeated to further explore participant attitudes to transition management in depth, and relevant interview excerpts were chosen to represent the attitudes and opinions of participants relevant to the themes that were constructed (Miles et al. 2018). The study adhered to the criteria for reporting qualitative research (COREQ) guidelines Supervisors of the study read initial interview transcripts and codes in order to validate the interview analysis. (Booth et al. 2014). The initial codes from AYR farmer interviews constructed a basis for some other more specific topics in the subsequent advisor interviews– such as stocking rate, and advisor relationships, and helped form the basis of the questionnaire. The interview topic guides for both AYR and block-calving herds were based on issues and nutritional and management techniques arising from the literature.

2.8 Farm audit

2.8.1 Housing measurements

Measurements were taken for pre-calving and early lactation cows to include stocking rate, feed space, neck rail height, water trough space, lunging space, loose housing space and cubicle dimensions, which were compared to recommendations put forward by AHDB (2012). AHDB (2012) also specified that where pre-calving cows are housed in cubicles, they should be “extra-wide” but do not provide a measurement. For this reason, pre-calving cubicle width was compared to recommendations put forward by Hulsen (2017), where lactating cow cubicle recommendations agreed with those put forward by AHDB

(2012) but specified that pre-calving cubicle width should be ≥1.35m. Stocking rate was calculated for straw yards by measuring the total area (m^2), with $10m^2$/cow being the minimum requirement. and for cubicle housing where a minimum of 1 cubicle per cow was required (AHDB 2016).

Water trough cleanliness was also scored, using a four-point system as described by Moore (2016) (Table 2.8.1). Where there was more than one trough, the most contaminated trough was scored. Source water samples for mineral analysis were collected using a method adapted from Castillo et al. (2013) and stored at -20°C. The source water was analysed for mineral content using Inductively Coupled Plasma Mass Spectroscopy (ICP-MS). Source water samples were taken as close to the source as possible, usually in the dairy, and not from the troughs where saliva and faecal contamination could have affected mineral content, as outlined by Moore (2016).

Table 2.8.1: Description and examples of scoring of water trough cleanliness, adapted from Moore (2016). Pictures: Author's own.

Score	Example	Description
1		Water clean and clear, with no or very little floating and/or settled residue and no evidence of faecal contamination. No smell apparent from the water
2		Water relatively clean, some floating and/or settled residue and no evidence of faecal contamination. No smell apparent from the water.
3		Water moderately dirty and not clear, with evidence of floating and/or settled residue, suspected minor faecal contamination. Slight stale or unpleasant smell apparent.
4		Water very dirty and not clear, with a lot of floating and/or settled residue. Clear evidence of faecal contamination. Strong unpleasant smell apparent.

2.8.2 Cattle scores

The number of cows within the transition groups that were sampled was determined according to Bergman et al. (2014). Animal measurement scores were obtained from all lactating and dry cows for herds up to 50 (see Appendix 11.7). For larger herds, a randomly selected sample of 20% of lactating and dry cows were scored. Where possible, more animal measurements in a group were taken if it was safe and feasible to do so. An example of the farm audit data collection form can be found in the appendices. Comparisons of cattle measurements were made against recommendations put forward by AHDB (2019) because these recommendations are made available for all UK dairy farmers.

Transition cows were body condition scored using the method by Ferguson et al. (1994), on a scale of 1-5, where 1 = under-conditioned and 5 = over-conditioned (Table 2.8.2). Measurements of early lactation cows (0-21 days in milk) were included if they were separately housed and not mixed with the main milking herd. The number of animals measured that were outside the recommended BCS range was quantified. For example, AHDB (2019) recommends that no more than 20% of cows should be outside the ideal BCS range, depending on the stage in lactation.

Table 2.8.2: Target body condition scores depending on stage of lactation, extracted from AHDB (2019).

Stage of lactation	Target BCS
At calving	2.5-3.0
60 days post calving	2.0-2.5
100 days post calving	2.5-3.0
At drying off	2.5-3.0

Transition cows where mobility scored using the method by Whay et al. (2003), where 0 = normal gait, and 3 = very lame. AHDB (2019) specify that while a zero tolerance to lameness is recommended, a target is to have no more 15% of transition cows with a mobility score 2 or 3 in their respective groups.

Hygiene and hock condition were scored according to Lombard et al. (2010) on a 1–3 point scale (Table 2.8.3 and 2.8.4). Rumen fill scores were recorded using the scoring system by Burfeind et al. (2010), where 1 = very empty and 5 = very full.

Table 2.8.3: Description and examples of scoring hock condition. Adapted from Lombard et al. (2010). Pictures: Author's own.

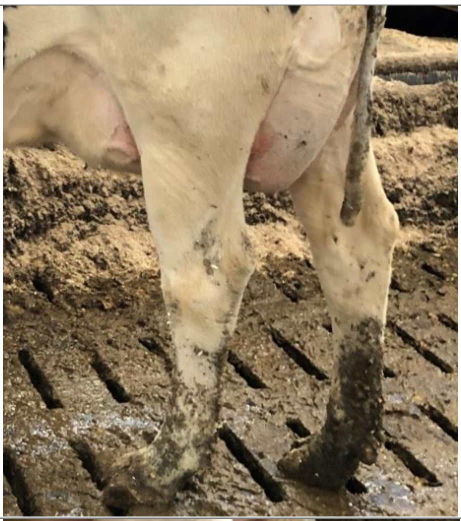
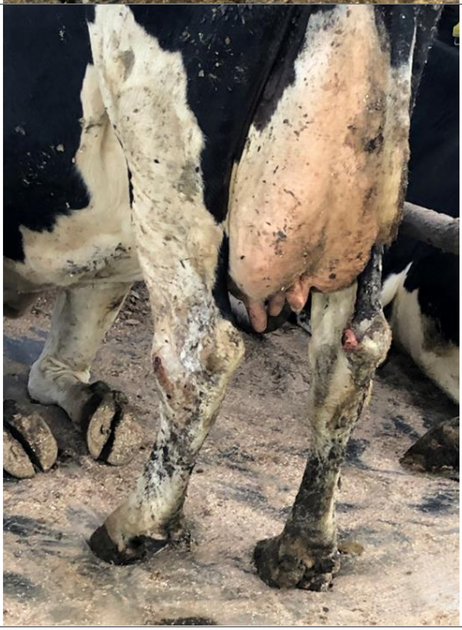
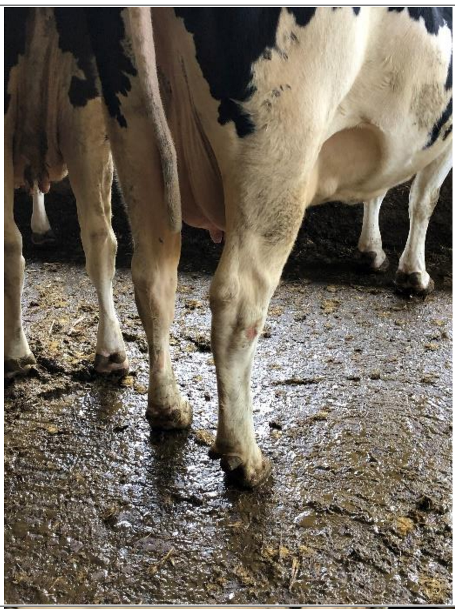
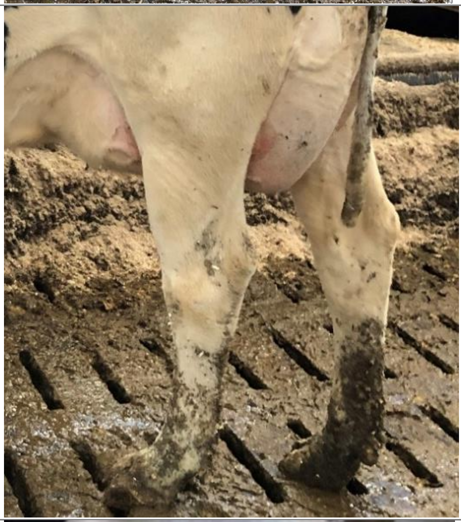
Hock condition		
Score	**Example**	**Description**
1		Cows without swelling or hair loss on both hocks
2		Cows with hocks with hair loss but no swelling.
3		Cows with hair loss and swelling or draining lesions.

Table 2.8.4: Description and examples of scoring hock hygiene. Adapted from Lombard et al. (2010). Pictures: Author's own.

Hock hygiene		
Score	**Example**	**Description**
1		Cows with no manure on their legs, udder or flank.
2		Cows with small amounts of manure on their legs, udder or flank.
3		Cows with large amounts of manure on their legs, manure or flank.

2.8.3 Feed and water analysis

Feed samples for pre-calver and early lactation diets were taken within 5 minutes of delivery to the cows when it was fresh and before they had a chance to sort through it (Sinclair and Atkins, 2015). On farms where feed was delivered more than once, the first feed (morning) was sampled. When sampling from a TMR, the TMR feed face was split into five equal sections. Within each section, a 30 cm × 30 cm quadrat was randomly placed over the TMR, all feed removed from the quadrant and thoroughly mixed (Endres and Espejo, 2010; Tayyab et al., 2018). The TMR/PMR was then subsampled to an appropriate amount depending on the analysis. Samples of concentrates fed separately from the TMR were collected for proximate and mineral analysis, and stored at -20°C.

When calculating rations, pre-calving cows were estimated to eat 12 kg DM (Grummer et al. 2004). Early lactation cows 21 DIM were estimated to eat 20 kg DM according to Thomas (2004). Free water intake (FWI) was calculated for pre-calving cows according to NRC (2001) where:

$$\begin{aligned}\mathrm{FWI,\ kg/day} = -10.34 + {} & 0.2296 \times DM\%\ of\ diet \\ & + 2.212 \times DMI\ kg/day \\ & + 0.03944 \times (CP\%\ of\ diet)^2\end{aligned}$$

2.8.3.1 Dry matter (DM)

The TMR/PMR, forage and concentrate samples were placed in a pre-weighed clean dry silica tray and dried in a hot air oven (Binder, Cole-Palmers, UK) at 105℃ overnight until constant weight (AOAC, 2012). The sample was cooled for 30 min in a desiccator and weighed. Samples were then hammer milled (Crompton Control Series 2000, Wakefield West Yorkshire UK) through a 1mm screen prior to analysis.

2.8.3.2 Crude protein (CP)

The crude protein content of the feeds was determined by nitrogen analysis using the Dumas method (AOAC, 2012) and a LECO FP528 machine (LECO Corp, Stockport, UK). Approximately 150 mg of dried ground sample was weighed into aluminium foil, and then placed into the auto analyser. The CP (g/kg DM) content was calculated by multiplying the nitrogen (g/kg DM) value by 6.25.

2.8.3.3 Ash

The ash content of feeds was determined according to AOAC (2012). Approximately 2 g of dried milled sample was weighed into a clean dried pre-weighed porcelain crucible. The sample was transferred to a muffle furnace (Gallenkamp Muffle Furnacne, Size 3, GAFSE 620, Gallenkamp, Loughborough, UK) at 550℃ for 5 hours. After ashing the sample was placed in a desiccator for 30 min to cool. The weight of the silica crucible and ash was then recorded.

2.8.3.4 Ether extract (EE)

The ether extract content of feeds was determined using a Soxtec apparatus (HT 1043 extraction apparatus, FOSS, Warrington, UK), according to AOAC (2012). Approximately 1 g of dried milled sample was weighed into a cellulose extraction thimble (Whatman Plc, Maidstone, UK). The thimble was plugged with fat-free cotton wool and the sample boiled in 25 ml (30-40℃) of petroleum ether (Fisher Scientific, UK) for 1 hour. Samples were then removed and rinsed for an additional 15 min and the solvent evaporated. After cooling, the extraction cup was re-weighed, and the ether extract content was determined.

2.8.3.5 Neutral detergent fiber (NDF)

The NDF content of feeds was determined using Fibertec™ (1020, FOSS, Warrington, UK) system using sodium sulphite and heat-stable α amylase (Sigma, Gillingham, UK) according to the procedure described by Van Soest et al. (1991) and expressed exclusive of residual ash. Alpha amylase solution was prepared by dissolving 2.8 g of α-amylase (α-1, 4-glucan 4-gluconohydralase, enzyme # 3.2.1.1 ~80EU/mg) from *Bacillus subtilis spp* (Sigma, Gillingham, UK) in 90 ml of distilled water, followed by the addition of 10 ml of tri-ethylene glycol. Approximately 0.5 g of dried milled sample was weighed into a glass crucible (porosity 1, Soham Scientific, Ely, UK) that was tightly fitted onto the Fibretech® (Foss UK Ltd, Cheshire,UK). Neutral detergent reagent (25 ml) and a few drops of octanol (reagent grade, Sigma, Aldrich, Dorset, UK) were added to the sample. The sample was then digested for 30 min. Another 25 ml of neutral detergent reagent and 2 ml of α-amylase solution and 0.5 g of sodium sulphite were added and the sample simmered for 30 min. The sample was then filtered and washed with 20-30 ml of hot distilled water (80ºC). Another 2 ml of α-amylase solution and 25 ml of hot distilled water were added to the samples and allowed to stand for 15 min. The sample was then filtered and washed 3 times with hot distilled water, and the crucible removed from the Fibertech® and dried overnight at 10ºC. After cooling in a desiccator, the crucible was weighed and placed in a muffle furnace at 550ºC for 4 hours. Afterwads, the crucible was cooled in a desiccator to room temperature and reweighed.

2.8.4 ICP-MS mineral analysis

Inorganic elements were quantified in water samples and pre- and post-calver diets by inductively coupled plasma mass spectrometry (ICP – MS). Feed samples were digested prior to ICP-MS analysis, as described by Cope et al. (2009).

2.8.4.1 Digestion of feed samples

Between 0.4-0.6 g of dried, milled feed sample was weighed into plastic DigiTubes and digested in 1 ml concentrated analytical grade hydrochloric acid and 6 ml concentrated analytical grade nitric acid, using a DigiPREP heating block, on a heated programme (see Table 2.8.5). In addition to the samples, a tube containing only the acid mix was also heated in each batch as a reagent blank. Following digestion, all samples including the reagent blanks were made up to 50 ml volume with ultra-pure water and mixed thoroughly.

Table 2.8.5: DigiPREP heating program for acid digestions of TMR, forages and compound feeds for ICP-MS mineral analysis.

Program	Time (minutes)	Temperature set point (ºC)
To temperature:	30	
At temperature:	01	45
To temperature:	25	
At temperature	05	65
To temperature:	15	
At temperature:	45	100

A blank solution was prepared to contain 2% nitric acid, by combining 500 ml of ultra-pure water and 20 ml of concentrated nitric acid and mixed thoroughly. Following this, a 1000 ppb gallium internal standard was prepared in ultra-pure water, 1 ml of concentrated nitric acid and 50 µl of 1000 ppm gallium stock solution, and made up to 50 ml, before mixing thoroughly.

Diluting acid was prepared by making up a blank solution, and then using an analytical balance to weigh 10.204g of 1000 ppb gallium internal standard and adding to the blank solution, giving a gallium concentration of 10.204 ppb.

Calibration standards were made to contain 400 ppb of each element analysed, by combining 10 ml of concentrated nitric acid with 200 µl of each individual element using the 1000 ppb stock solutions and made up to 500 ml using ultra-pure water in a volumetric flask. Working standards were then made as follows, using the blank solution made to dilute the standards, and an analytical balance to weight out 25.00 g of standard into a 50 ml tube, made up to 50 ml and thoroughly mixed:

Standard 5 400ppb of each element
Standard 4 200ppb of each element: 1:2 dilution of standard 5
Standard 3 100ppb of each element: 1:2 dilution of standard 4
Standard 2 50ppb of each element: 1:2 dilution of standard 3
Standard 1 25ppb of each element: 1:2 dilution of standard 2
Standard 1 25ppb: 1:2 dilution of standard 2

Using a 2-place balance, 19.80 g of each standard was weighed into a 50 ml tube along with 200 µl internal standard, giving a final concentration of 10 ppb of gallium in each standard. Standards were thoroughly mixed by shaking.

2.8.4.2 Preparation of feed samples

The digested samples were diluted to 1:50 prior to analysis. Duplicate 100 µl of digested sample were vortexed with 4.90 ml of the diluting acid containing the gallium internal standard, into 5 ml auto sampler tubes. Accuracy of dietary mineral analysis was checked by extraction and reference to certified European Union (EU) reference samples of hay (BCR-129) and dairy concentrate (BCR-185).

2.8.4.3 Preparation of water samples

Gallium internal standard (50 µl) was added to an empty 5 ml autosampler tube, followed by 100 µl of concentrated nitric acid, and 4.85 ml of each water sample in duplicate, and vortexed. An EU hay reference sample (BCR-129) and duplicates of the reagent blank were prepared in the same way.

2.8.4.4 ICP-MS analysis of samples

The mineral content of the feed and water samples were determined on an NexION 2000 ICP Mass Spectrometer (Perkin Elmer, Buckinghamshire, UK). Prior to analysis, calibration was run to ensure the machine was operating within normal parameters. After every 12 samples a standard and reference check were ran as a quality control to ensure that the ICP-MS machine was working correctly.

The following minerals were quantified: calcium (Ca, magnesium (Mg), potassium (K), molybdemum (Mo), phosphorous (P), manganese (Mn), iron (Fe), copper (Cu), cobalt (Co), and zinc (Zn).

Selenium and Iodine were not analysed as the ICP-MS machine was not optimised for this. Mineral concentration values for feed samples were corrected for the 1:50 dilution factor and converted from ppb to mg/kg.

Mineral concentration in feed samples (mg/kg) =

$$\frac{(Concentration\ of\ diluted\ sample\ (ppb) \times 2500)\ \div sample\ weight}{1000}$$

Mineral concentration values for water samples were corrected for the 1.03 dilution factor and converted from ppb to mg/L.

Mineral concentration in water samples (mg/L) =

$$\frac{Concentration\ of\ diluted\ sample\ (ppb) \times 1.03}{1000}$$

2.9 Questionnaire

The farmer questionnaire was conducted online using Jisc (https://www.onlinesurveys.ac.uk) and was approved by the Harper Adams ethics committee on the 15th April 2021 (Project number: 0321-202104-PGMPHD). The purpose of the questionnaire was to understand how farmers managed their transition cows, the challenges associated with this and the advisory relationships that farmers had with their veterinary and non-veterinary advisors. This was clearly stated to all participants, who were free to withdraw from the study at any time, and it was stated that all responses would be anonymised. The questions took several different formats and included multiple choice and ranking questions. Farmers were asked to provide information on their age, herd size, calving pattern, housing and grouping arrangements and their perception of transition cow problems in their herd.

2.9.1 Distribution and publicity

The questionnaire was open for farmers between 6th April 2021 and 31st August 2021. It was distributed through an advert in British Dairying magazine, and publicised through social media, and by the Farmers Guardian and the Dairy Farmer online.

2.9.2 Inclusion criteria

Respondents to the farmer questionnaire were required to be dairy farmers and from England. Responses from farmers outside of England were excluded. Participants could be farm owners, managers, or farm workers.

2.9.3 Potential confounding factors

Transition-related disorders vary by the genetic diversity, milk yield and breed of dairy cattle, as discussed in Chapter 1. Whilst average annual milk yield of the cattle owned by farmer respondents was collected, the questionnaire population is not necessarily balanced to reflect the yield profile of the UK dairy cattle population as a whole.

2.9.4 Data analysis

No free-text responses were required in the questionnaire, so no thematic analysis or categorical classifications needed to be carried out, as the responses were all 'tick-box'. Weighted averages were used in the analysis of questions 14, 15, 17, 19, and 34 (see appendix). Farmers were asked to rank answers from 1-5 in terms of perceived prevalence (q14), 1-5 in terms of importance (q15), 1-3 in terms of importance (q17 and q19), and 1-3 in terms of most impactful (q34). During analysis, the number of responses to each question in each number category were totalled individually, (e.g., total number of respondents scoring 'transition cow health problems' as 1, total number of respondents scoring 'transition cow health problems as 2, etc.). These totals were then individually multiplied by the score that related to them (e.g., number of farmers scoring 'transition cow health problems' as 3 was multiplied by 3). This gave scores for each possible response outcome, where they were then combined for each outcome. Each total was then divided by the total number of respondents to give a 'weighted average', with the lowest number representing the factor considered to be 'most important', and the highest number representing the 'least important' factor. This provided a 'mean rank' for each value. Statistical analysis was carried out on some aspects of the questionnaire. For example, the Kruscal-Wallis test was carried out using Microsoft Excel to investigate any significant differences in the farmer perceived prevalence of metabolic disorders, and farmer-perceived ranking of transition cow management compared to other herd health challenges. Fischers exact tests were used to investigate associations between farmer age category and the way they ranked their transition cow management, and their intentions to improve transition management, and associations between farming systems and whether their veterinarian was from a dairy specific or mixed practice.

3. Chapter 3: All-year-round farmer demographic information and quantitative assessment of transition cow housing, cattle and diets on 22 AYR farms across the North-West and Midlands of England

Chapter 3 presents the demographic information of the AYR farmers in the study. It also presents the data from the quantitative farm audit that was conducted on the 22 AYR herds, including the housing data, cattle measurements and nutritional analysis.

3.1 Demographic information

3.1.1 All-year-round calving farm demographic information

All-year-round calving farmer participants (n = 22) were located in the North-West and Midlands area and had a mean herd size of 376 cows (range 80-1500) with a mean farmer age of 41 years (Table 3.1.1). Holstein-Friesian was the main breed in all the herds. Of the 22 AYR farmers, 10 had a supermarket milk contract and 12 had a direct-supply contract. A total of 9/22 farms had a specific fresh cow shed (to house cows 0-21 days in milk), and 14/22 AYR farmers kept their cows housed all year round while 8/22 farmers allowed cows to graze during the summer months. All farmers grouped their pre-calving cows separately three weeks prior to calving. Annual milk yield was grouped accordingly; (1) 8500-9500L n = 3; (2) 9501 – 10500L n = 10; (3) 10501-11500L n = 5; (4) >11500L n = 4. Five of the AYR herds used robotic milking parlours, 6 herds milked 3 times per day and the remaining 11 milked twice a day. All farmers in this study sought advice from different nutritionists and different primary veterinarians across 10 practices in the area, 5 of which were mixed practice and 5 dairy-specific. Thirteen of the AYR farmers had post-secondary education qualifications.

Table 3.1.1: Demographic summary of participating AYR farmers (n = 22) from the North-West and Midlands of England.

Farmer	Age (years)	Location	Milk contract SM= supermarket D= direct	Herd size (cows)	Mean annual milk yield (L)	Times per day milking	Separate group for cows 0-21 DIM	Post - secondary education
1	33	Staffordshire	D	200	9500	2	✓	✓
2	35	Shropshire	SM	340	10500	3		✓
3	33	Staffordshire	D	110	10500	Robot		✓
4	45	Cheshire	SM	500	11700	3	✓	
5	42	Cheshire	D	139	10000	2		
6	34	Shropshire	D	400	11100	2	✓	✓
7	55	Cheshire	SM	124	9500	Robot		
8	32	Shropshire	D	450	10000	2	✓	✓
9	50	Staffordshire	SM	560	>10000	3	✓	
10	31	Cheshire	SM	730	12200	2	✓	✓
11	25	Shropshire	D	1500	11500	2	✓	✓
12	50	Derbyshire	D	500	10000	Robot	✓	✓
13	35	Cheshire	D	270	8500	2		✓
14	22	Staffordshire	D	450	10000	3	✓	✓
15	29	Cheshire	SM	195	9800	2		
16	45	Cheshire	SM	200	10700	2		✓
17	60	Staffordshire	D	254	>11000	2		
18	60	Staffordshire	D	546	10000	3		
19	50	Derbyshire	D	220	12000	Robot		
20	36	Cheshire	SM	290	12800	3		✓
21	26	Staffordshire	SM	220	10600	Robot		✓
22	65	Derbyshire	SM	80	10000+	2		

3.2 Transition cow housing

3.2.1 Pre-calving cow housing

Of the AYR farmers in the study, 16/22 housed pre-calving cows in a loose straw yard (Figure 3.2.1), and the remaining 6 housed them in cubicles with straw bedding (Figure 3.2.2), on rubber mats or mattresses with sawdust, or sand bedding. All farmers in the study operated a one-in-one-out system for their pre-calving cows, an example of this can be seen in Figure 3.2.1.

Figure 3.2.1: An example of pre-calving cow housing, with a loose straw yard, and gates to allow individual penning of calving cows e.g. on farm 1.

Figure 3.2.2: An example of pre-calving cows, housed in metal 'Dutch-comfort' cubicles and bedded on straw, e.g. on farm 22.

3.2.2 Early lactation cow housing

Of the AYR farmers in the study, 9/22 had a specific ‘fresh cow group’ for early lactation cows, where cows that were 0-21 DIM were housed separately from the main milking herd (Fig 3.2.3). This was stated to be to allow for easier monitoring of freshly calved cows, to prevent social stress and bullying, and in some cases to provide more space or a loose-housed straw yard. These fresh cow groups were housed either in a loose straw yard (n = 5) or in a separate shed or pen with cubicle beds (n = 4) with either mats or mattresses and bedded with sawdust, straw or sand.

Figure 3.2.3: An example of a newly installed loose-housed 'fresh cow group' for cows 0-21 DIM, with locking head yokes at the feed barrier to allow for easy cow handling, and close to the milking parlour for minimal walking distance, e.g. on farm 1.

For the farms that did not have a separate fresh cow group, when a cow calved it joined the main milking herd within 24 hours of calving. All of the main milking herds were cubicle housed. Types of cubicles varied between farms with one farm using older fashioned ‘Newton-Rigg’ wooden cubicles (Fig 3.2.4). The majority of the farms in the study (19/22) used ‘Dutch-comfort’ metal cubicles (Fig 3.2.6 and 3.2.7), however two farmers opted for plastic and rubber flexible cubicles (Fig 3.2.5).

Figure 3.2.4: An example of a cow in a main milking group, housed in a 'Newton Rigg' style wooden cubicle, below the current recommended width and bedded on mats and sawdust, e.g. on farm 20.

Figure 3.2.5: An example of an early lactation cow, housed in a 'Dutch comfort' flexible rubber cubicle, bedded on sawdust and chopped straw, e.g. on farm 21.

Figure 3.2.6: An example of a main milking herd, with wide passageways, and bedded on sand in metal 'Dutch comfort' cubicles, e.g. on farm 18.

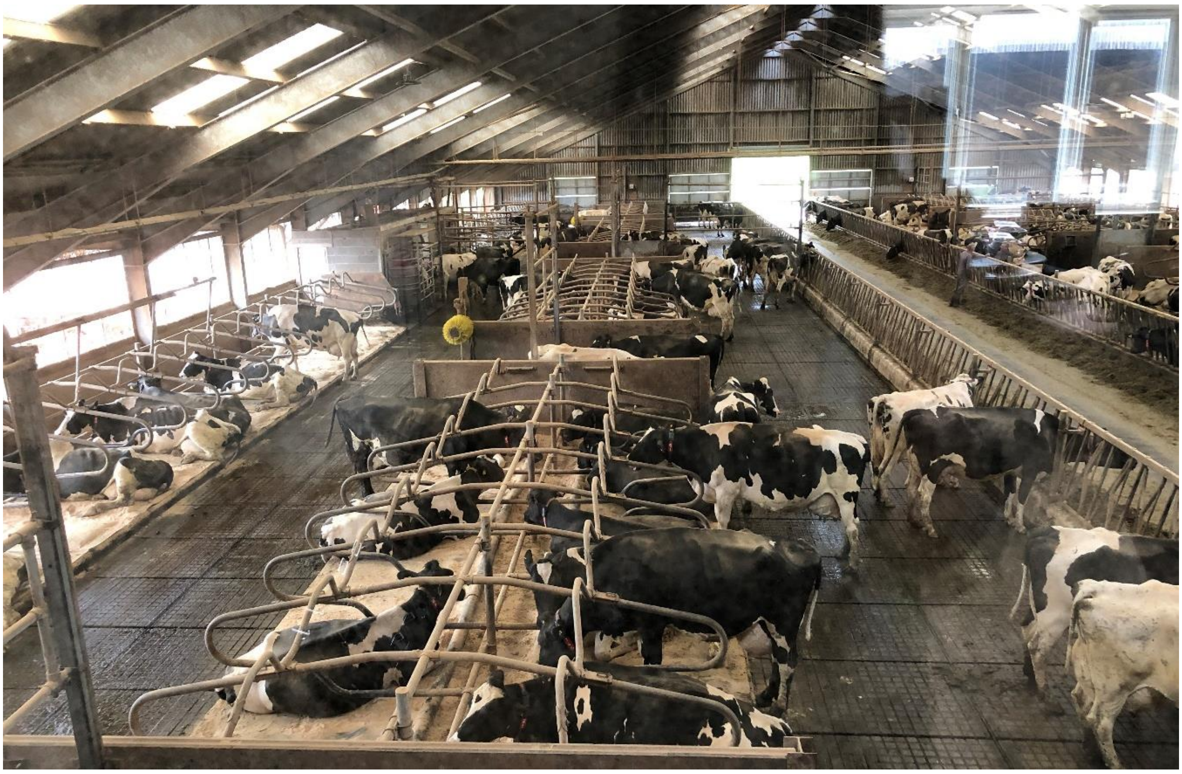


Figure 3.2.7: An example of a robot herd, with metal ‘Dutch comfort’ cubicles that have a raised curved structure, e.g. on farm 19.

There was variation in building cleanliness between farms. While the cleanliness of the floors and cubicle beds were not scored in the current study, they undoubtedly influenced the cleanliness of the cows, and hock hygiene, which is presented later in this chapter. Figures 3.2.8 and 3.2.9 highlight the differences in cleanliness and manure control strategies between some of the farms:

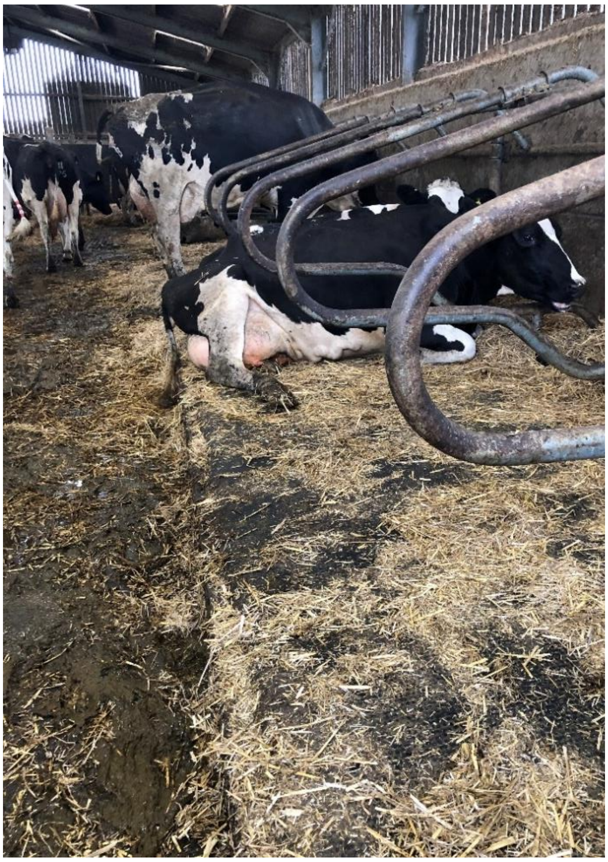


Figure 3.2.8 An example of a main milking herd housed on 'Dutch comfort' metal cubicles, with mattresses and straw, without automatic floor scrapers, e.g. on farm 22.

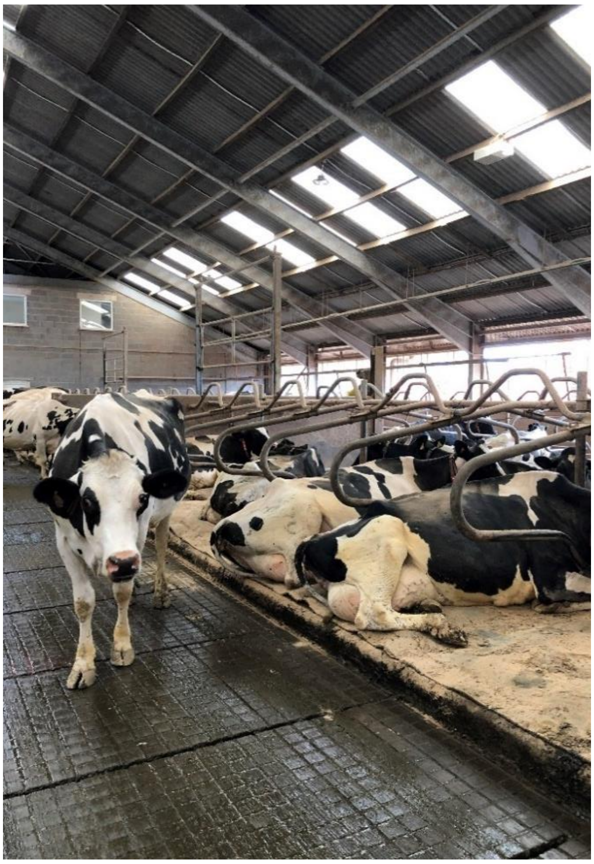


Figure 3.2.9: An example of a robot herd (main milking group) housed on 'Dutch comfort' metal cubicles, with mattresses and sawdust, and automatic floor scrapers on slats to ensure a clean floor at all times, e.g. on farm 19.

Types of cubicle bedding for the main milking and early lactation groups varied between farms, with the most popular being sawdust on mats or mattresses (n = 14) (Fig 3.2.10), sand (n = 6) and straw (n = 2). The following quotes highlight the affinity to sand bedding because it was considered to be the more comfortable option for their cows:

Farmer 2: “Put it this way, certainly deep sand beds are a no brainer. They’re so much more comfortable, and clean. The low [yielding] group are on sawdust and mattresses though and you can see a difference in the cows.”

Farmer 3: “We’re on sand, but [the company that built the robots] made me sign my warranty away because they hate it, it can cause issues with the robot. But I know other people with sand and robots, and it works fine, so I decided to do it anyway. I don’t like sawdust …. I see other peoples’ cows on sawdust, and they just have loads of hock issues. Not everyone can use sand though”

Farmer 8: “I’d love to have deep beds, but our system won’t handle anything other than sawdust”

Figure 3.2.10: An example of flexible 'Dutch-comfort' cubicles in a robotic milking herd, bedded on mattresses and sawdust, with rubberised floor slats for improved grip, e.g. on farm 12.

Figures 3.2.11 and 3.2.12 highlight the heterogeneity of milking cow housing in the study, with considerable differences in the shed layout, passageway widths and loafing areas. Some farms had modern purpose-built sheds, whilst some had re-purposed buildings that had been adapted to house cows.

Figure 3.2.11: An example of a main milking group, housed in a re-purposed building, previously used as an indoor silage clamp, bedded on sand cubicles with passageways below the recommended width (< 2.43 m wide). Additional cross-over passageways had been installed to off-set some cow-flow disruption arising from the narrow passageways, and to reduce bottle-necks, e.g. on farm 1

Figure 3.2.12: An example of a main milking group housed in a light and well-ventilated purpose-build shed designed with wide passageways (5.5m) e.g. on farm 18.

3.2.3 Cubicle dimensions

Pre-calving cows require wider cubicles than milking cows (AHDB 2012). Where cubicles were used to house pre-calving cows, cubicle width was on average 1.1m (SE ± 0.02) which is below the recommended width for pre-calving cows (1.22-1.37m) (AHDB 2012). None of the cubicles for pre-calving cows in the current study met the width requirement. Mean cubicle length was on average 1.8 m (SE ± 0.02) which was also below the recommended length of 1.85-2 m. An example of a cubicle below the recommended length can be seen in Figure 3.2.13. Pre-calving lunging space was also lower than the recommended requirement, with a mean value of 0.6m (SE ± 0.06) (recommended > 0.7m). Cubicles for early lactation cows met the recommended requirements with a mean width of 1.2m (SE ± 0.01), a mean length of 1.9m (SE ± 0.02) and a mean lunging space of 0.8m (SE ± 0.07).

Figure 3.2.13: An example of main-milking group housing, with cubicle beds below the recommended length, causing cows to not lie correctly and hang over the edge of the beds, e.g. on farm 3.

3.2.4 Stocking rate

Stocking rate was calculated for straw yards by measuring the total area (m^2), with $10m^2$/cow being the minimum space recommended, and for cubicle housing where a minimum of 1 cubicle per cow was suggested by AHDB (2019). Total pre-calving cow stocking rate was on average 59.1% (min: 20%, max: 116, SE ± 5.81) as seen in Table 3.3.1, and this included cows in straw yards and in cubicle housing. For early lactation cows, stocking rate averaged 94.1% (min: 64%, max 153%, SE ± 4.32). None of the robotic herds over-stocked the early lactation or main milking herds. An example of an early lactation group of cows stocked above the recommended level can be seen in Figure 3.2.14.

Figure 3.2.14: An early lactation group on a loose-straw yard with a stocking density of 153% of recommended area. Cows were competing for feed space, and there were many standing cows as they lacked lying space e.g. farm 9.

3.2.5 Feed provision

Methods of feed facilities varied between farms, with one farm using a ring feeder to provide a forage to pre-calving cows and 21 farms delivering a total mixed ration down a post and rail barrier (n = 14) or a in a trough (n = 7). On several farms, the whole feed space was not utilised (e.g., Fig 3.2.15), meaning that feed space per cow could have increased if the feed had been delivered down the entire feed table. An example of a pre-calving feed trough at the back of a pre-calving shed can be seen in Figure 3.2.16.

Figure 3.2.15: A pre-calving cow feed trough at the back of a loose straw yard, on farm 19

Figure 3.2.16: A pre-calving cow feed trough, where the feed had not been distributed down the entire feed table, on farm 12.

3.2.6 Feed space

Pre-calving cow feed space met recommendations of > 0.76 m/cow, with a mean measurement of 1.8 m/cow (min: 0.5 m, max: 9.2 m, SE ± 0.37) (Table 3.3.1). Early lactation feed space did not meet recommendations put forward by AHDB (2012) with an average of 0.7 m/cow (min: 0.3 m, max 1.06 m SE ± 0.04).

3.2.7 Neck rail height

Pre-calving neck rail height met recommendations of 1.2-1.4 m, with a mean of 1.3 m (min: 1.0 m, max: 1.52 m, SE ± 0.03) (Table 3.3.1). Early lactation neck rail height also met recommendations, with an average of 1.3 m (min 1.1 m, max 1.55 m, SE ± 0.02). The varying levels of neck rail height can be seen in Figure 3.2.17.

Figure 3.2.17: An example of a pre-calving cow feed barrier (left) where feed space and neck rail height did not meet recommendations, and a main milking group feed barrier (right), on the same farm (e.g. farm 18) where feed space and neck rail height met AHDB (2012) recommendations.

Two farmers had gone to additional efforts to improve their feed barrier, by installing a softer matted feeding area for cows to stand on and creating a smooth resin floor on the feed table (Figures 3.2.18 and 3.2.19).

Figure 3.2.18: A feed trough with a resin floor for the main milking group, on e.g. farm 20.

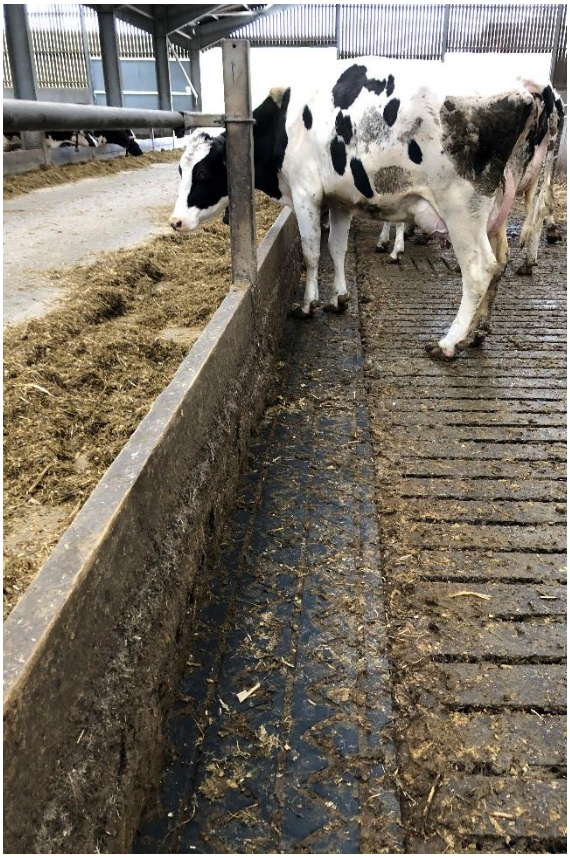


Figure 3.2.19: A matted feed area for cows to stand on when eating, e.g. on farm 12.

3.2.8 Water trough space

Pre-calver water trough space met AHDB (2019) recommendations of ≥ 10cm per cow, with a mean value of 19.3 cm per cow (min: 3.8 cm, max 65 cm, SE ± 3.60) (Table 3.3.1). Early lactation water trough space did not meet recommendations, with an average value of 9.2 cm per cow (min: 3.1, max: 32 cm, SE ± 1.31). Examples of water trough provision on two of the farms visited is presented in Figures 3.2.21 and 3.2.20.

Figure 3.2.20: An example of a small (30cm wide) water trough at the end of a cubicle run, e.g. on farm 19.

Figure 3.2.21: A malfunctioning pre-calver water trough, partly empty on a hot day, e.g. on farm 18.

3.2.9 Water trough cleanliness

Pre-calver and early lactation water trough cleanliness had a mean score of 2 (min: 1, max: 4) for both groups (Table 3.3.1).

3.3 Transition cattle measurements

3.3.1 Body condition

Pre-calver body condition was higher than the recommendations suggested by AHDB (2019), as seen in Table 3.3.1. An example of a pre-calving cow above optimal BCS can be seen in Figure 3.3.1, and an example of an early lactation cow with optimal BCS and rumen fill can be seen in Figure 3.3.2. The mean percentage of pre-calving cows above the ideal BCS range (2.5-3.0) was 35.8% (target < 20%), and cows below the ideal BCS range was 2.6%. Mean pre-calver BCS was 3.34 (SE ± 0.06). Early lactation body condition was also higher than recommendations, with the mean percentage of early lactation BCS above the ideal range (2.5-3.0) being 28.3% (target < 20%). The mean percentage of early lactation cows below the ideal BCS range was within recommended targets and was 5.2%. Mean early lactation BCS was 3.01 (SE ± 0.05).

Figure 3.3.1: An example of a pre-calving cow with a BCS above 3.5.


Figure 3.3.2: An example of an early-lactation cow in optimal body condition, with a rumen fill score of 5.

3.3.2 Rumen fill score

Pre-calver rumen fill score was lower than recommended by AHDB (2019) (Table 3.3.1). An example of a cow with a rumen fill score of 2 can be seen in Figure 3.3.3. The mean percentage of pre-calving cows with a rumen fill score < 4 was 15.3% (target < 10%). The mean percentage of early lactation cows with a rumen fill score < 3 was 35.8% (target < 10%).

Figure 3.3.3: A example of an early lactation cow with a rumen fill score of 2.

3.3.3 Hock hygiene

Pre-calver hock hygiene was within the recommended targets by AHDB (2019) with a mean of 10.1% cows scoring ≥ 2 (target < 20%) (Table 3.3.1). Early lactation hock hygiene was above target, with a mean of 26.2% of early lactation cows scoring ≥ 2 (target < 20%).

3.3.4 Hock condition

Pre-calver hock condition was higher than recommended by AHDB (2019), with a mean of 33.1% pre-calving cows scoring ≥2 (target < 20%) (Table 3.3.1). Early lactation hock condition prevalence was within the recommended target, with a mean of 7.3% of early lactation cows scoring ≥2 (target < 20%).

3.3.5 Mobility

Pre-calver and early lactation mobility was higher than recommended by AHDB (2019), with an average of 20% pre-calving cows and 28.4% early lactation cows with a mobility score ≥2 (target < 15%) (Table 3.3.1).

Table 3.3.1 Summary of quantitative assessment of transition cow measurements and housing, on 22 AYR farms across the North-West and Midlands area of England, based on recommendations put forward by AHDB (2012), AHDB (2019) and Hulsen (2017).

	Measurement	Recommended	Mean	Median	SD	Min	Max
Dry cow	Herd size		378.8	280	303.4	80.0	1500
	Stocking rate %	≤100	59.1	57	27.9	20.0	116
	Feed space per cow (m)	≥0.75	1.8	1.37	1.8	0.5	9.2
	Neck rail height (m)	1.2-1.4	1.3	1.22	0.1	1.0	1.52
	Water space per cow (cm)	≥10	19.3	11.7	17.3	3.8	65
	Water trough cleanliness score (1-4)		2.0	2	1.0	1.0	4
	Cubicle length (brisket - kerb) (m)	1.85-2.0	1.8	1.81	0.1	1.7	1.93
	Cubicle width (m)	≥1.35	1.1	1.16	0.1	1.1	1.2
	Lunging space (m)	≥0.7	0.6	0.6	0.2	0.4	0.81
	% Cows BCS > 3.0 (1-5)	0-20	35.8	34.5	23.5	0.0	87
	% Cows BCS < 2.5 (1-5)	0-20	2.6	0	4.9	0.0	15
	% Cows rumen fill < 4 (1-5)	0-10	15.3	1	15.7	0.0	55
	% Cows with hock hygiene ≥2 (1-3)	0-20	10.1	0	21.0	0.0	88
	% Cows with hock condition ≥2 (1-3)	0-20	33.1	25.7	25.3	0.0	81
	% Cows with mobility ≥2 (0-3)	0-15	20.0	23	18.7	0.0	64
0-21 DIM	Stocking rate %	≤100	94.1	91	20.3	64.0	153
	Feed space per cow (m)	≥0.75	0.7	0.6	0.2	0.3	1.06
	Neck rail height (m)	1.2-1.4	1.3	1.31	0.1	1.1	1.55
	Water space per cow (cm)	≥10	9.2	7.4	6.3	3.1	32
	Water trough cleanliness score (1-4)		2	2	0.9	1.0	4
	Cubicle length (brisket - kerb) (m)	1.85-2.0	1.9	1.85	0.1	1.7	2.3
	Cubicle width (m)	≥1.22	1.2	1.17	0.1	1.0	1.26
	Lunging space (m)	≥0.7	0.8	0.8	0.3	0.2	1.3
	% Cows BCS > 3.0 (1-5)	0-20	28.3	20	19.9	7.4	69.2
	% Cows BCS < 2.5 (1-5)	0-20	5.2	0	10.7	0.0	33
	% Cows rumen fill < 3 (1-5)	0-10	35.8	38.4	20.0	3.0	60
	% Cows with hock hygiene ≥2 (1-3)	0-20	26.2	23	22.0	0.0	60
	% Cows with hock condition ≥2 (1-3)	0-20	7.3	3.7	6.8	0.0	19
	% Cows with mobility ≥2 (0-3)	0-15	28.4	31	15.5	5.0	50

[a] BCS scored on a 1-5 scale, according to Ferguson et al. (1994)
[b] Rumen fill scored on a 1-5 scale according to Burfeind et al. (2010)
[c] Hock hygiene and condition scored on a 1-3 scale according to Lombard et al. (2010)
[d] Mobility scored on a 0-3 scale according to Whay et al. (2003).

3.4 Nutritional analysis

3.4.1 Pre-calver diets

Of the farmers in the current study, 17/22 fed a TMR to their pre-calving cows, the remaining 5 fed a PMR with a nut concentrate top dressed onto the forage. One farmer fed twice daily, 11 farmers fed once daily, 4 farmers fed every two days and 6 fed ≥ every three days. Thirteen farmers fed anionic DCAB salts to their pre-calving cows with 9 of those providing anionic salts in the TMR, 3 in a concentrate and 1 in the water trough. The nutrient content of the pre-calver diets is presented in Table 3.4.1. The mean DM was 474 g/kg, although there was a large variation, with some farms feeding diets as low as low as 257 g DM/kg or as high as 834 g DM/kg. The minimum NDF content of the pre-calver diets was above the minimum value of 350 g/kg DM recommended by NRC (2001), with a mean value of 495 g/kg DM. The minimum and mean CP content of the diets was 60 and 11 g/kg DM lower than that recommended by NRC (2001). In contrast, the highest CP content of 184 g/kg DM was 44 g/kg DM above that recommended by NRC (2001) at 184 g/kg DM.

Table 3.4.1: Summary of proximate analysis of pre-calver diets* from 22 AYR farms in the North-West and Midlands of England, compared to guidelines by NRC (2001).

Nutrient	**Recommended**	**Min**	**Max**	**Mean**	**Median**	**SD**
DM g/kg		257	834	474	433	145.8
Ash g/kg DM		45.7	117	84.2	83.2	16.14
NDF g/kg DM	(>350) 400-550	390	611	495	489	67.2
EE g/kg DM		7.12	25	15.7	15.4	4.91
CP g/kg DM	130-140	69.4	184	119	111	29.5

*Includes the mean amount of concentrates offered as part of a PMR

3.4.2 Early lactation diets

Nine out of 22 farmers housed their early lactation cows separately from the rest of the milking cows, and 4/22 offered specific early lactation diets at the feed trough or barrier that were different to the feed for the main milking herd. Twenty out of 22 farmers fed once per day, whilst the remaining 2 fed twice a day. Methods of feeding differed, with 5/22 farmers offering a TMR to early lactation cows with no in or out of parlour feeding, and the remaining 17 offering a PMR with additional concentrates in the parlour or robot. Five farmers had a robotic milking and feeding system, where early lactation cows were gradually offered increasing amounts of concentrates in the first 50 days of lactation (after this they were fed to yield) and offered 7 kg/cow/day of concentrates by 21 days in milk (DIM). Other farmers also offered concentrates gradually with 2 farmers offering no more than 4 kg of parlour concentrates by 21 DIM and six farmers offering 6 kg of parlour concentrates at 21 DIM. Four of the farmers in the study did not offer concentrates gradually, offering 6kg of concentrates on day one, and increased allowance up to 9 kg of parlour concentrates by 21 DIM. The nutrient content of the early lactation diets is presented in Table 3.4.2. The mean DM was 433 g/kg which was 83g higher than that proposed by Thomas (2004), however similarly to the pre-calver diets, there was variation with some farmers feeding diets with a DM content as low as 396 g/kg and as high as 579g/kg. The mean NDF content met recommendations, with a value 54 g/kg DM higher than that proposed by Thomas (2004). Mean CP levels were only 3 g/kg DM lower than recommended, however CP content varied with some diets being as low as 142 g/kg DM and as high as 180 g/kg DM.

Table 3.4.2: Summary of proximate analysis on early lactation diets* from 22 AYR calving farms in the North-West and Midlands of England, compared to guidelines proposed by Thomas (2004).

Nutrient	Recommended	Min	Max	Mean	Median	SD
DM g/kg	350	296	579	433	419	70.7
Ash g/kg DM		59.9	99	79.9	81.1	7.73
NDF g/kg DM	≥320	290	441	374	381	37.4
EE g/kg DM		13.9	45	25.7	25.4	7.09
CP g/kg DM	≥160	142	180	157	156	10.7

*Includes the mean concentrates offered in the parlour

3.4.3 Mineral concentration of the pre-calver diets

The sum of the daily supply of minerals from the forages, supplementary concentrates, TMR/PMRs (which included the forages, additional feed ingredients and minerals), and water was divided by the predicted daily DM intake for pregnant cattle of 12 kg DM (Grummer et al. 2004) to provide a mineral concentration (g or mg/kg DM intake). There were no other sources of minerals fed to the cows (such as boluses or mineral buckets). Mean and median dietary concentrations of trace elements were generally in excess of the recommended guidelines (Table 3.4.3) proposed by NRC (2001). Mg did not meet recommendations, whilst Ca and K exceeded recommendations. The macro-mineral that was closest to recommendations was Mg with a mean concentration of 3.42 g/kg DM, which was 0.08g/kg DM lower than that recommended, with twelve out of 22 farms not meeting the recommended pre-calver dietary Mg concentration. The mean content of K was 2.99 g/kg DM higher than the recommended maximum amount. The mean Ca content was 0.66 g/kg DM above the recommended maximum value. Mean Cu content exceeded recommendations, with a mean value of 20.89 mg/kg DM, equating to 240 mg per day (on a 12 kg DM basis). Fe content of pre-calver diets was over 5 times the recommended concentration, at 334 mg/kg DM. Co was also over 4 times the recommended concentration at 0.59 mg/kg DM and Zn was 18.8 g/kg DM above NRC (2001) recommendations. Drinking water made a minor contribution to the dietary concentration of macro and trace minerals.

Table 3.4.3: Mineral content of precalver diets* on 22 AYR farms in the North-West and Midlands of England, compared with recommended dietary nutrient concentrations suggested for pregnant nonlactating dairy cattle by NRC (2001).

	Recommended	Mean	Median	Min	Max	SD
Trace minerals mg/kg DM						
Macro minerals g/kg DM						
Potassium	<11	13.9	13.8	5.89	24.1	4.23
Calcium	< 5	5.66	5.01	3.15	10.1	2.067
Magnesium	>3.5	3.42	3.28	1.02	6.27	1.455
Phosphorus	2.5-3.3	2.76	2.7	1.7	5.17	0.765
Trace minerals mg/kg DM						
Manganese	50	89	84.8	38	138	28.7
Iron	60	334	301	170	674	148.7
Cobalt	0.12	0.59	0.53	0.09	1.93	0.461
Copper	12-18	20.8	18.6	3.15	81.8	17.42
Molybdenum	-	1.43	1.33	0.75	3.75	0.613
Zinc	50	68.8	62.9	17.6	189	41.31

Values represent the contribution from the diet, water and supplementary concentrates, and are expressed on a g or mg/kg DM intake basis.

*Calculated using the average DM intake for pregnant cattle of 12kgDM (Grummer et al., 2004), and predicted free water intake (FWI) by NRC (2001). The requirement for minerals can be affected by antagonists and may therefore be higher, or lower than outlined.

3.4.4 Mineral concentrations of early lactation diets

The sum of the daily supply of minerals from the forages, supplementary concentrates, TMR/PMRs (which included the forages, additional feed ingredients and minerals), and water was divided by the predicted daily DM intake for lactating cattle at 21 DIM of 20 kg DM (Thomas 2004) to provide a mineral concentration (g or mg/kg DM). Mean and median dietary concentrations of trace elements in early lactation diets were all in excess of the requirements recommended (Table 3.4.4) by NRC (2001). Similarly, to the pre-calver diets, Cu concentrations exceeded requirements by 17.9 mg/kg DM, with one farm exceeding the MPL (35 mg/kg DM) by more than twice, with a value of 79.3 mg/kg. The macro-mineral that was closest to recommendations was Mg with a mean concentration of 3.07 g/kg DM, which was 1.07 g/kg DM higher than that the recommended requirement. Similarly, to the pre-caver diets, the Fe content was over 5 times the recommended requirement in early lactation diets, at 298 mg/kg DM. Co was over 3 times the recommended concentration at 0.36 mg/kg DM, and Zn was 31.8 mg/kg DM over the recommended requirement.

Table 3.4.4: Mineral content of early lactation diets* on 22 AYR farms in the North-West and Midlands of England, compared with recommended dietary nutrient concentrations for lactating dairy cattle by NRC (2001).

	Recommended	Mean	Median	Min	Max	SD
Macro minerals g/kg DM						
Potassium	10.6	20.5	20.5	13.3	27.9	4.23
Calcium	6.2	8.08	8	4.11	11.6	1.827
Magnesium	2.0	3.07	2.9	1.7	4.41	0.643
Phosphorus	3.6	4.67	4.74	3.74	5.63	0.497
Trace minerals mg/kg DM						
Manganese	14	82.2	81.5	43.1	111	16.72
Iron	16	298	300	186	403	56.74
Cobalt	0.11	0.36	0.38	0.13	0.73	0.163
Copper	11	18.9	16	5.27	79.3	14.10
Molybdenum	-	1.72	1.20	0.6	4.07	1.043
Zinc	51	82.8	85.4	35	133	22.69

Values represent the contribution from the diet, water and supplementary concentrates, and are expressed on a g or mg/kg DM intake basis.

*Calculated using the predicted DM intake for pregnant cattle of 20kg DM (Thomas 2004) and predicted free water intake (FWI) by NRC (2001). The requirement for minerals can be affected by antagonists and may therefore be higher, or lower than outlined.

3.4.5 Mineral concentration of drinking water

The mineral concentrations of cattle drinking water was compared separately to NRC (2001) recommendations for the safe concentrations of potentially toxic nutrients and contaminants in water. None of the minerals present in the drinking water exceeded the upper-limit guidelines (see Table 3.4.5).

Table 3.4.5: Summary of mineral content of cattle drinking water on 22 AYR calving farms in the North-West and Midlands of England, compared to NRC (2001) upper-limit guidelines for potentially toxic nutrients (mg/L).

Mineral	Upper-limit guideline	Mean	Median	Min	Max	SD
	Trace minerals mg/L or ppm					
Manganese	0.05	0.02	0	0	0.49	0.102
Iron		0.01	0	0	0.08	0.023
Cobalt	1.0	0	0	0	0	0
Copper	1.0	0.02	0	0	0.35	0.074
Zinc	5.0	0.05	0	0	0.92	0.192
Molybdenum		0	0	0	0	0
	Macro minerals mg/L or ppm					
Potassium		3.11	2.24	0.29	17.7	3.735
Phosphorus		0.07	0.01	0	0.54	0.150
Calcium		68.4	44.66	0.85	430	83.75
Magnesium		0.01	0.01	0	0.05	0.015

3.5 Discussion

3.5.1 Herd characteristics

The mean annual milk yield (10540 kg) and herd size (376 cows/ herd) recorded in the current study were higher than the average values reported for the UK (yield of 8144 kg and 148 cows/ herd, respectively (AHDB 2021)). This difference is due to the selection criteria for the current study, with all herds recruited to be AYR calving and house pre-calving cattle at least 3 weeks prior to calving. As a consequence, block calving, grazed grass-based herds that have a lower mean milk yield (AHDB, 2021; Garcia and Holmes, 1999) were not evaluated. However, March et al., (2014) explained that the trend in the UK is for increased housing all-year-round and indoor feeding, rather than grazing, and AHDB (2021) reported only 4.5% of GB dairy farms operated a spring grass-based system (compared to 30.6% AYR, Autumn 4.7%, 6.7% 'other' or 'dual' block and 53.4% non-defined). Average reported dry period length in the current study was 51 days, which was 8 days lower than that reported by Bach et al. (2008). This could be due to the benefits of shorter dry periods recently being made more apparent (Atkinson 2016). Additionally, it should be noted that this figure is based on farmer estimations and could be subject to human error.

3.5.2 Feeding practices

All farmers in the current study provided the milking cows with a fresh feed daily, with two farmers feeding twice per day, whilst in 10 herds pre-calvers were fed every 2 days or more. Feeding twice per day compared with once per day has been associated with an increase in DMI and milk yield, and a reduction in sorting behaviour (Sova et al. 2013). All of the farmers that did not feed their cows in troughs or a ring feeder, pushed up the feed to the barrier throughout the day to ensure it was within reach of the cows. Farmers reported doing so on average 3.8 times per day for early lactation cows (range: 0-8) and 3.2 times per day for pre-calving cows. This is lower than findings by Tayaab (2018) (4.7 times per day) but higher than Bach et al. (2008) (twice per day) who found that regularly pushing up of feed had a positive impact on milk production. On average, 36% of the farmers who did not feed in troughs or ring feeders, pushed up feed less than 4 times per day, which agrees with findings by Sova et al. (2013).

3.5.3 Transition cow housing

Many UK herds operate a two-group dry cow system with ‘far off’ dry cows grouped for approximately 5 weeks, and ‘close to calving’ dry cows grouped usually for the remaining 3 weeks of pregnancy (Atkinson 2016). Fujiwara et al. (2018) reported 73% of UK dairy farmers managing dry cows in two groups according to gestation stage. Of the farmers in the current study 20/22 operated this system, with 2 operating a one group system for all dry cows, with all pre-calving cows were housed and grouped together approximately 21 days prior to calving. Interestingly Bach et al. (2008) reported that 57.5% of Spanish farms (47 surveyed in total) grouped and fed a pre-calving cow ration for an average of 11.2 days prior to calving rather than 21 days. All AYR farmers in the current study operated a one-in-one-out system. This was found to be the most common in loose housed straw yards by Robichaud et al., (2016) and Mills et al. (2020) in Canada. Traditionally in an all-year-round calving herd, the close to calving dry cow group has cows leaving at the point of calving and new cows entering the group at drying off, therefore maintaining a permanently unstable social group (Lobeck-Luchterhand et al., 2014). There is a period of approximately 2 to 3 days of social turmoil within a pen after a new cow enters (Cook and Nordlund, 2004), which can be characterised by a dramatic increase in the number of predominantly physical antagonistic interactions (Kondo and Hurnik, 1990). Lobeck-Luchterhand et al. (2014) compared an all-in-all-out approach, also known as a ‘stable dry cow group’ where cows are moved in one group with no additions during the close-to-calving period, to a traditional approach (a weekly entrance of new cows to maintain stocking rate) and found that cows in the stable group system had longer feeding times, reduced negative social interactions and a reduced number of displacements at the feed trough. Each pen move requires the cow to familiarise herself with the new surroundings and re-establish the social ranking within the group (Hasegawa et al. 1997), which can create stress and limit DMI when more time is spent establishing her rank and fighting for feed space (Cook and Nordlund, 2004). Maintaining stable dry cow social groups is not always possible for AYR herds unless additional housing is available, and it is particularly difficult for smaller herds to maintain (Atkinson, 2016). Stable group systems are often easier to achieve on block calving farms because farmers aim to have all cows calving within a 12-week period. Five of the 22 farmers housed their pre-calving cows in cubicles and all of those farmers attempted to operate a just-in-time calving approach. This involved moving cows from a cubicle shed to a loose-housed straw calving pen when second-stage labour was underway, meaning the cow was not disturbed at the last minute, the calving will not be delayed, and delivery takes place in a clean environment. This can be difficult to implement without 24-hour supervision, impractical on many UK dairy farms and can result in cows being moved prematurely which increases the risk of still births (Atkinson 2016).

Nine of the 22 AYR farmers (41%) housed their early lactation cows separately from the main milking herd, 5 of these were loose straw housing and 4 were cubicle sheds. This is double the proportion reported by Bach et al. (2008) where 19.1% of herds grouped fresh cows separately. In a study by Heuwieser et al. (2010), 21.6% of farmers had a designated ‘fresh cow’ pen, however this study is now 11 years old. Attempts to house transition cows to reduce social disruption is an area that has received more recent attention (Atkinson 2016), which may be why more farms were housing their early lactation cows separately. Despite early lactation cows being grouped separately, Bach et al. (2008) found the same ration was fed to the early lactation and main milking group on all herds. In the current study, of the 7 herds that grouped their early lactation cows separately, 4 fed early lactation cows a specific diet that was different to that fed to the main milking herd. Implementing specific groups for early lactation cows means they have a reduced milking time, allowing more time to be spent eating and resting. It also allows for more effective monitoring for metabolic diseases, which can regularly go unnoticed if fresh cows are introduced straight into the milking herd (Nordlund, 2008; Mulligan and Doherty 2007), but it can however increase milking times and labour requirements for feeding the additional group.

Poorly designed cubicles can lead to poor cubicle occupancy, soiled beds, an increased risk of lameness and mastitis and physical damage to the cows (Cook and Nordlund, 2004). Cubicles which are too short create an uncomfortable lying space and cause cows to lie diagonally, soiling the rear of the cubicle which results in dirty cows (O’Connell et al. 1993). Cubicle dimensions have a profound effect on lying times, and the number of cows standing in the stall instead of lying down (Lombard et al. 2010). Where pre-calving cows were housed in cubicles (n = 6), none of those farms met the recommended cubicle width or length and were on average 0.25 m narrower and 0.05 m shorter than that reported by Campler et al. (2018). This suggests that farmers may not be aware of the wider cubicle requirements for dry cows. Two of the pre-calver cubicle sheds had been repurposed from milking cow housing that was considered dated and inappropriate for lactating cows. This suggests that priority for comfortable housing may be given to milking cows rather than pre-calving cows. The other 4 sheds however were purpose built to house pre-calving cows.

It should be noted that the cows were not measured to determine height, girth or liveweight, and cubicles were measured and compared against standard recommendations. In the current study, early lactation cubicle width and length met the recommended requirements and were on average wider and provided more lunging space than cubicles measured by Langford et al. (2009) when assessing housing on organic and non-organic UK dairy farms, but 0.1 m narrower than that reported by Charlton et al. (2011). The mean cubicle dimensions and feed space from the current study can be seen in Table 3.5.1, and have been compared to current AHDB recommendations and findings by Langford et al (2009):

Table 3.5.1: A comparison of early lactation housing and cubicle measurements in the current study, with UK dairy cattle housing measurements found by Langford et al. (2009)

	Current study	Langford et al. (2009)	AHDB recommendations
Cubicles per cow	1.06	1.0	1.0
Cubicle width (m)	1.2	1.11	1.22
Cubicle length (m) (brisket to kerb)	1.9	1.95	1.85-2.0
Lunging space (m)	0.8	0.22	0.7-1.0
Feed space per cow (m)	0.7	0.55	0.75
Neck rail height (m)	1.3	1.21	1.2-1.4

and AHDB (2012) recommendations.

Types of cubicle bedding in the current study varied, with the most popular being sawdust on mats and mattresses (n = 14), followed by sand (n = 6), and straw (n = 2). Lombard et al. (2012) reported that bedding type and amount influenced lying behaviour, and that a lower percentage of cows lay in cubicles when they were bedded with organic materials (straw, sawdust or dry manure) compared with sand. Interestingly, sand was used more frequently than sawdust in the current study because it was considered the most comfortable, and it had the lowest risk of carrying udder infection.

Farms in the current study offered marginally more cubicles per cow than that reported by Sova et al. (2013) and supplied more feed space and neck rail height compared to measurements reported by Langford et al. (2009) (Table 3.5.1). Current findings were similar to Bach et al. (2008) who reported the average number of cubicles per cow to be 1.1 across 47 Spanish herds. Measurements from the current study were closer to AHDB (2012) recommendations than those reported by Langford et al (2009), and consequently farmers in the current study complied with current recommendations such as stocking rate, cubicle length, lunging space and neck rail height. Furthermore, where pre-calvers were kept in loose straw housing (n = 16), farms in the current study provided 7.4m² more space per cow than recommendations, and 6.3 m² more than that reported by Langford et al. (2009) and Robichaud et al. (2016) (see Table 3.5.2). This was also higher than the total space reported by Thomson et al. (2020) (mean: 8.3m²). Additionally, only 3/22 of these farms did not meet the recommendations for pre-calver lying space.

Table 3.5.2: Mean pre-calver total area per cow in straw yards, compared to recommendations, and findings from Robichaud et al. (2016) and Langford et al. (2009).

Mean pre-calver straw lying area per cow			
Current study	Buildings and Structures for Agriculture Code of Practice (BS5502) and AHDB (2016)	Robichaud et al. (2016)	Langford et al. (2009)
17.4m²	10 m²	11.1m²	11.1 m²

Keeping cows at the correct stocking rate is vital in order to maintain good welfare and hygiene and maintaining a stocking rate below recommendations can further benefit transition cow comfort, social stress and competition at the feed face (Atkinson 2016). Fujiwara et al. (2019) confirmed that a stocking rate above 100% (1 cubicle per cow) increased competition at the feed face, with the feed-face becoming constantly crowded, and altered feeding behaviour with cows spending more time standing inactive in the feeding alley. Mean stocking rate in the current study did not exceed 100% (1 cubicle per cow, or 10 m² total area in loose straw yards) in both pre-calver and early lactation groups and was considerably lower in pre-calver groups (59.1%). Pre-calving feed space per cow ranged from 0.5 to 9.2 m (mean: 1.8 m). This large variation was predominantly due to several farmers having a small number of dry cows in the pen on the day of measurement. Post-calving feed space per cow ranged from 0.3 m to 1.06 m, with a mean value of 0.7 m, similar to findings by Bach et al., (2008). The mean post-calving feed space was 0.14 m greater than that reported by Tayaab (2018), 0.16 m higher than that reported by Sova et al. (2013) and 0.24 m higher than that reported by Endres and Espejo (2010). The literature presents conflicting data with regards to feed space allocations for dairy cows. Increasing feed space has been associated with an increase in DMI and milk production in some studies (Sova et al. 2013). Rioja lang et al. (2012) recommended a minimum feed space of 0.6 m, establishing that some cows lower in social ranking are willing to sacrifice food intake to avoid close contact with dominant animals, and Devries et al. (2004) reported 57% fewer aggressive interactions when providing cows with 1.0 m of feed space per cow when compared to 0.5 m. In contrast to this, O'Connell et al. (2010) found no significant difference in milk production and DMI when providing cows with a 'high' feed space (0.56 m/cow) and a 'low' feed space (0.2 m/cow), with the total number of animals in the feed passage not being significantly affected by treatment. The study by O'Connell et al. (2010) however was conducted on mid-lactation dairy cows and did not include transition cows. Of the 22 farms, only 8/22 provided more than the industry recommendations (0.75 m). Post and rail feeder design was most common on farms (pre-calver n = 14, early lactation n = 16), with 6 farmers using head locks for early lactation cows, and 1 using a ring feeder for pre-calving cows. Huzzey et al. (2005) suggested that post-and-rail feed barriers provide the least physical barriers during feeding visits, with fewer aggressive displacements when compared to the use of headlocks. Farmers in the current study stated that they used head locks for management purposes, to ensure safe and easy handling during health checks.

Pre-calver water trough space exceeded recommendations with a mean value of 19.3 cm/ cow, (min: 3.8cm, max: 65cm) which was mainly due to a low pre-calver stocking rate on some farms, with one farm having a pre-calver stocking rate of 20% and a water space per cow exceeding recommendations by 55 cm/cow. Early lactation water trough space fell marginally short of requirements (mean: 9.2 cm) but was 2 cm more than that reported by Sova et al. (2013). Restricting water availability can negatively influence DMI (Holter and Urban 1992). Additionally, it has been shown that herds provided with unrestricted access to drinking water produced on average 1.7 L more milk per cow per day than herds with restricted access to drinking water (Daros et al., 2020), and cows in herds that had limited access to water were more likely to have sub clinical ketosis (Daros et al. 2017). There is a lack of research focussing on current UK cow housing measurements for transition cows, therefore there is little current scientific evidence to compare with the current findings.

3.5.4 Transition cattle measurements

Mean pre-calver and early lactation BCS was 3.34 and 3.01 respectively. Mean pre-calver BCS was 0.34 score higher than recommended by AHDB (target 2.5-3.0). Additionally, the average percentage of pre-calving cows above the ideal BCS range (2.5-3.0) was 35.8% (target < 20%), suggesting that pre-calving cows are either overfed during pregnancy, or are 'dried off' from lactation with a higher than recommended BCS. Over-conditioned cows are at a higher risk of developing ketosis (Bobe et al. 2004; Suthar et al., 2013) as fatter cows mobilise more body fat than moderately sized cows to meet their energy demands at the onset of lactation, which cannot be met by intake alone (Nogalski et al., 2012). Excessive BCS is also related to hypocalcaemia, with over conditioned cows having a significantly greater risk of contracting milk fever, and poor reproductive performance (Atkinson, 2016). Additionally, over conditioned cows eat less than moderately sized cows (Leury et al. 2003). This further exacerbates the state of NEB as fatter cows still have an energy requirement which cannot be met by feed intake (Drackley, 1999). Excessive amounts of body condition and the development of internal adipose tissue, otherwise known as visceral fat (which is not immediately obvious to the naked eye) can be promoted by over-feeding in late lactation and in the dry period (Atkinson 2016). Drackley (2007) suggested that even when cows do not appear excessively over-conditioned, if they consume energy over their requirements, it must either be dissipated or stored as visceral fat. When visceral fat and adipose tissue is broken down, fat metabolites accumulate in the liver rapidly, predisposing the cow to fatty liver disease (Atkinson 2016). Interestingly, pre-calver diet analysis in the current study did not show anything that may contribute to the excess in body condition. However a limitation of the study is that feed refusals were not measured, and although pre-calver diets may appear acceptable in nutrient composition, and the farmer-reported amounts fed were recorded, the actual amounts eaten by pre-calver, and early lactation cows were not recorded. This would have required weighing feed refusals, and because the main priority was to gain farmer opinions through conducting interviews, this was not conducted. This would have also proved difficult because 14 of the farmers fed their pre-calving cows daily, with 4 farms feeding every 2 days and 6 farms feeding ≥ every three days. Ten of the farmers chose not to feed daily which they stated was to save time, diesel and machinery wear and tear, by putting out feed to last 2 – 4 days, for a group of cows that may increase or decrease in size at any time depending on how many enter and leave the group. In doing so, these farmers would not know their daily refusals and would often judge by eye how much feed to put out. This unstructured and haphazard method of feeding may contribute to an inconsistent DMI and energy supply during the pre-calving period and influence BCS in some herds. The frequency of feeding however did not influence pre-calver BCS in the current study, with the mean pre-calver BCS on farms that fed daily, and on farms that fed every other day or less frequently being the same, with a value of 3.3.

Of the 22 farms surveyed, 9 fed a ‘controlled energy diet’ either through a TMR or PMR by feeding additional straw (within a TMR) or a low energy high roughage forage, with the aim to reduce energy density and prevent cows from becoming over conditioned. Ten farmers stated they fed a high-energy ‘conditioning’ diet, where pre-calvers were fed above their energy requirements to prime the rumen for the post-calving diet and to aim to reduce body fat mobilisation (Gerloff, 2000). The remaining 3 farmers did not employ a specific feeding strategy, and their diets were neither 'controlled energy' or 'conditioning'. Friggens et al. (2004) covered high energy pre-calver diets in more detail in a review on dry cow feeding strategies, outlining how it should reduce body fat mobilisation. While some studies showed a reduction in post-partum NEFA, the studies referred to by Friggens e al. (2004) are now over 19 years old. Although still implemented on farm, there is little evidence to support that high-energy 'conditioning' diets reliably improve production and health post-calving (Drackley, 2010) and they have recently shown to cause adverse health effects (Minuti et al. 2020). Drackley et al (2007) suggested a controlled energy diet, high in low-energy density fibre which reduces the level of insulin resistance post calving. Feeding controlled energy diets resulted in positive health impacts, such as a lowered plasma NEFA, BHBA, and a reduction in liver TG concentration (Janovick et al., 2011; Zenobi, 2018), but also a reduction in milk yield and milk fat when compared to high-energy dry cow diets (Silva-del-Rio 2010; Janovick et al., 2011). Feeding high energy diets can also contribute to unwanted weight gain during the dry period (Drackley, 2010). In the current study, mean pre-calver BCS of cows where farmers attempted to feed a controlled energy diet was 3.08 (SE ± 0.05) and for those attempting to feed a high-energy diet was 3.46 (SE ± 0.04). This suggests that pre-calving cows may have gained weight during gestation when fed high-energy diets. Further research is however required to investigate current UK dairy farmer feeding strategies in the dry period. Additionally, the BCS of late lactation cows could be recorded to determine whether the excess of pre-calver BCS occurs during late lactation or gestation.

Early lactation BCS in the current study was 3.01, which is lower than that reported by Sova et al. (2013) where mean BCS of lactating cows was 3.36 and was marginally higher than the target recommendation (2.5-3.0). It is expected that pre-calver BCS may be higher than early lactation BCS as cows mobilise body fat in early lactation to meet energy demand from the onset of milk production (LeBlanc 2010). AHDB (2019) advise that an acceptable amount of body condition for an early lactation cow to lose during the transition period is 0.5 of a BCS, although the aim should be to maintain body condition throughout the transition period and minimise excessive loss or gain. Kim and Suh (2003) suggested that the amount of BCS lost in early lactation has dramatic impacts on metabolic diseases, that it exacerbates the negative energy balance further. The current study found an average of 0.33 score loss over the transition period, which is within the guidelines stated by AHDB (2019). It should be noted that in the current study, fewer early lactation cows were recorded compared to pre-calving cows. This is because early lactation cattle measurements were only recorded when they were grouped or housed separately from the main milking herd (9 out of the 22 farms) and therefore caution should be exercised. Attempting to take cattle measurements from early lactation cows on the remaining 13 farms would have proved time consuming for the farming participants and cause considerable herd disruption to find all of the early lactation cows within the main milking herd. While this is a limitation of the study, insisting on this may have resulted in fewer farmers being willing to participate.

Pre-calving rumen fill score has been associated with early lactation energy status and conception at first AI in dairy cows (Kawashima et al. 2016). Kondo et al. (2019) reported that dairy cows with a pre-calving rumen fill score ≤3 had a lower energy status and increased disease risk, lower early lactation milk yield and delayed resumption of ovarian activity post-calving when compared to cows with a rumen fill score ≥3.5. AHDB (2019) advise that pre-calver rumen fill score to be ≥ 4.0, and early lactation rumen fill score to be ≥ 3. Pre-calver rumen fill score in the current study was lower than that recommended by AHDB (2019). The average percentage of pre-calving cows with a rumen fill score < 4 was 15.3% (target <10%), and the average percentage of early lactation cows with a rumen fill score < 3 was 35.8% (target <10%).

A visual rumen fill scoring system was developed on a scale of 1 to 5 to visually monitor changes in feed intake and was found to be statistically associated with an objective measure of feed intake (Burfiend et al. 2010). Visual rumen fill scoring could be considered a subjective measure however, if scorers are not regularly standardised and calibrated against industry professionals, so caution should be exercised when interpreting the results. Mean pre-calver rumen fill score was 3.65. Because only half of the farmers fed their pre-calving cows daily, it was speculated that rumen fill score would be more variable on farms where pre-calving cows were fed every other day or less frequently than farms where pre-calving cows were fed daily, because providing a fresh feed daily stimulates DMI (Sova et al. 2013) and would therefore be expected to result in an increased rumen fill. Mean pre-calver rumen fill on farms that fed daily was 4.22 (SE ± 0.07) and was 3.79 (SE ± 0.05) on farms that fed every other day or less frequently. It should be noted that rumen fill score will vary depending on the time of measurement and feeding times (Burfiend et al 2010). Mean early lactation rumen fill score was 2.6. It is expected that early lactation rumen fill score will be lower than pre-calver rumen fill score, due to the different diets fed and rate of passage of feed (Rossum 2009). In the current study, rumen fill score was measured approximately 2 hours after feed was delivered, after the interviews took place, so cows may not have eaten their requirement at the time of measuring. There is a dearth of research on rumen fill scoring in UK dairy herds, most likely due to its subjective nature, and more research could be conducted to examine the relationship between rumen fill score in transition dairy cows and frequency or methods of feeding.

Inadequately sized cubicles and lack of space per cow leads to abrasions, swelling and hair loss (Adams et al. 2017), and monitoring hock abrasions and hygiene can indicate significant discomfort. Hock injuries can range from hair loss to open sores and joint inflammation and are unfortunately relatively common (Lombard et al., 2010). In the current study pre-calver hock condition was higher than that recommended by AHDB (2019), with an average of 33.1% pre-calving cows scoring ≥2 (target <20%), whereas early lactation hock condition was within the recommended targets, and an average of 7.3% of early lactation cows scoring ≥2 (target <20%). The average prevalence of hock abrasions for early lactation cows in the current study was considerably lower than that found by Rutherford et al. (2008), where the overall prevalence was 49.1%, and lower than that found by Lombard et al. (2010) where an overall prevalence of 23% was reported. It should be noted however that early lactation cows were only scored on 9 AYR herds, because only 9 of the 22 AYR farmers (41%) housed their early lactation cows separately. It is also possible that farmers with specific housing for early-lactation cows had made the housing more comfortable and spacious than other herds where early-lactation cows were not scored and were mixed with the main milking herd. The prevalence of hock damage reported by Rutherford et al. (2008) reported measurements from cows in all stages of lactation and throughout the main milking herd. Rutherford et al. (2008) reported that the prevalence of hock damage increased with herd size, with the environmental factors that were positively associated with the prevalence of hock damage including a low feed space per cow and bedding type, where cows on sawdust had more hock abrasions than those on straw bedding. Unfortunately, cows on sand bedding were not assessed by Rutherford et al. (2008). Rutherford et al. (2008) also found a greater prevalence for hock damage in herds following a winter housing period compared to measurements taken following the summer period of access to pasture, suggesting that hock abrasions may be more prevalent in herds that are housed all year round. This could be due to extended exposure to cubicles and bedding increasing the risks of hock abrasions and damage occurring when compared to cows having more room and no restrictions of cubicles at pasture. In the current study however, average prevalence of pre-calver hock abrasions was 10.3% in herds housing all year round, and 33.1% in those that grazed during the summer months. The risk of hock injuries can be reduced by providing cows with a well bedded lying area and an adequate amount of space (Adams et al. 2017). Lombard et al. (2010) reported that hock injuries varied according to cubicle surface type, with those kept on rubber mats and mattresses having the most severe hock injuries in comparison to cows kept on a dirt base (recycled manure solids or sand). Sand bedding was associated with a lower percentage of severe hock scores compared with straw, sawdust and dry or composted manure (Lombard et al. 2010). In the current study, mean prevalence of pre-calver hock damage was 32.6% in herds on loose straw yards, 29.0% in herds on cubicles with mats/mattresses and sawdust, and 33.0% in those bedded on sand cubicles.

Improved cow hygiene reduces the risk of exposure to harmful pathogens (Schreiner and Ruegg, 2003). Pre-calver hock hygiene was within the recommended targets suggested by AHDB (2019) with an average of 10.1% cows scoring ≥2 (target < 20%). Early lactation hock hygiene was above target, with an average of 26.2% of early lactation cows scoring ≥2 (target <20%). This is less than that reported by Lombard et al. (2010), where 51% of cows were scored as 2 or 3 (dirty, or very dirty). Several factors affect cow hygiene, which include manure management, cubicle dimensions and bedding type (Fulwider et al. 2007). In the current study, average pre-calver prevalence of poor hock hygiene (score ≥2) was 7.2% in herds that housed in a loose straw yard, 18.5% in mattress cubicles with sawdust, 0% in herds with cubicles and straw, and 21% in deep sand beds.

Lame cows are in pain and have compromised welfare (Atkinson 2020). Cows with an impaired mobility (score 2 and above) have reduced feeding times and an increased risk of developing metabolic disorders (Daros et al. 2020). Pre-calver and early lactation mobility in the current study did not meet the targets recommended by AHDB (2019), with an average lameness prevalence (mobility score ≥2) of 20% in pre-calving cow groups, and 28.4% in early lactation groups (target < 15%, AHDB 2019). Estimates of lameness prevalence in the UK range from 21% (Clarkson et al., 1996) to 36% (Leach et al., 2010). More recent research focussing on lameness have reported UK prevalence to be 30-32% (Reader et al. 2011; Atkinson 2020), which is higher than in the current study. As discussed earlier, fewer early lactation cows were mobility scored (220 early lactation cows in total compared to 296 pre-calving cows) as only 9 out of the 22 AYR farms housed their early lactation cows separately, and caution should therefore be exercised when interpreting the current results.

3.5.5 Nutrient composition of diets

The mean DM of the pre-calver diets was 470 g/kg, which is within the recommendations proposed by Thomas (2004). While there are no specific requirements for CP and NDF, there are recommendations proposed by NRC (2001). The NDF content of the pre-calver diets met the recommendations suggested by NRC (2001), however the CP content did not meet these recommendations on 14/22 farms, with an average value of 119g/kg (target: 130-140g/kg).

The average DM of the early lactation diets was 430g/kg, which was lower than that reported in similar cross-sectional studies (Eastridge 2006) and 157 g/kg lower than that reported by Tayaab et al. (2018). Sova et al. (2013) reported a mean DM of TMR offered to lactating cows to be 477 g/kg across 22 Canadian herds, while Endres and Espejo (2010) reported a mean of 523 g/kg DM in the TMR of 50 herds in Minnesota, USA. The average NDF of early lactation diets in the current study was 374g/kg DM, which was 118 g/kg lower than that reported by Tayaab et al. (2018), 16g/kg DM higher than that reported by Bach et al. (2008), 61g/kg DM higher than that reported by Sova et al. (2013) and 76g/kg DM higher than that found by Endres and Espejo (2010). It could be suggested that the differences in NDF however may be due to differences in quantities of grass and maize silage in diets fed in other countries. Sova et al. (2013) did not report quantities of maize silage fed, and Bach et al. (2008) reported diets having an average concentration of 26.7% maize silage. This may also be affected by forage maturity at harvesting which increases NDF concentration (Dawson et al., 2002) and therefore affected by seasonal variations between countries. The NDF content of early lactation diets was higher than minimum recommendations put forward by Thomas (2004) (mean: 374 g/kg). The mean CP content of the early lactation rations in the current study (157g/kg DM) was also lower than that reported by Bach et al. (2008) from 47 Spanish herds, Endres and Espejo (2010) from 50 US herds (175 g/kg DM) and Sova et al. (2013) from 22 Canadian herds (165 g/kg DM). The mean CP content was 21g/kg DM higher than that reported by Tayaab et al. (2018). The CP content of early lactation diets was lower than recommendations by Thomas (2004) on 13/22 farms. Mean ether extract in the current study for early lactation diets was 25 g/kg DM, which was marginally lower than that reported by Bach et al. (2008) (33 g/kg DM).

3.5.6 Mineral composition of diets

<u>Pre-calver diets</u>

It should be noted that expressing mineral requirements as g or mg/kg DM is dependent on individual DM intake, which may vary between breeds, live weight, live weight change and is likely to be influenced by environmental factors (NRC 2001). Mineral feeding levels were generally well in excess of requirements, most notably for K, Fe, Mn, Ca and Cu, but also for Co and Zn. An excess of mineral feeding levels was also found in UK dairy herds by Sinclair and Atkins (2015) when evaluating mineral content of diets fed to lactating cows. Feeding an excess of Mn in pre-calver diets does not present a negative impact on cattle performance or health but may result in an increase of diet cost and environmental excretion (Sinclair and Atkins 2015). However, an excess of dietary K, Ca and Cu does present increased risks for hypocalcaemia and Cu toxicity, leading to increased risks of recumbency and death (Roche et al. 2003; Johnston et al. 2014). The MPL for Cu concentration in cattle feed equates to 34 mg/kg on a DM basis (Suttle 2016) and should not need to exceed 18 mg/kg DM under normal conditions, and in the absence of significant antagonists. Eleven out of 22 farmers exceeded the requirements for Cu concentration (>18mg/kg DM), with two farms exceeding the MPL.

The mineral in greatest excess in pre-calving diets was Fe exceeding recommendations by 274 g/kg DM. This may be primarily due to the high concentration of Fe in animal feeds and soil contamination (Suttle 2010). Average P concentration in pre-calving diets was 2.76 g/kg DM and met the requirements put forward by NRC (2001) and were similar to the average P levels reported by Frank Wright (2010) in grass silages which were 2.9 g/kg DM. The mean content of K was 2.99 g/kg DM higher than the recommended maximum amount. Van Saun and Sniffen (2014) recommended keeping pre-calver dietary K as low as possible, as this acts as an antagonist to Mg absorption, increasing the risk of hypocalcaemia, and suggested keeping dietary K below 11 g/kg. It has been reported by Goff (2004) to be very difficult to control hypocalcaemia if the K level of the total ration is > 18 g/kg. Of the 22 farms, 16 had dietary K levels above 11 g/kg. Furthermore, 4/22 farms exceeded dietary K concentrations of 18 g/kg.

The average K levels in UK grass silage in 2012 were 22.4 g/kg DM (Frank Wright, 2012), with some grass silages reported to be as high as 40 g/kg DM in K (Balsom, 2017), making it difficult for some farmers to achieve negative DCAB. Pre-calving cows require 40 g of Mg per day three weeks prior to calving (>3.5 g/kg DM) (Van Saun and Sniffen, 2014) and 12/22 farms did not meet this. Lean et al (2006) reported that supplementing with additional Mg was the most effective for the prevention of milk fever, and by increasing dietary Mg supplementation from 3 g/kg DM to 4 g/kg DM, the incidence of clinical hypocalcaemia reduced by 62%. Hypocalcaemia can also be avoided by restricting pre-calving Ca intake to 20 g per cow per day. None of the farms in the current study had pre-calver dietary Ca concentrations low enough to provide less than 20 g of Ca per day based on a 12 kg DM intake, with the mean Ca content 0.66 g/kg DM above the recommended maximum value. Oetzel (1991) reported that the highest risk of hypocalcaemia occurred with a dietary Ca concentration of 11.6 g/kg. Interestingly, the farmers in the current study with the highest pre-calver dietary Ca concentrations (farmers 3, 9 and 13, with a respective Ca concentration of 10.17, 9.72 and 9.38 g/kg) all reported clinical hypocalcaemia issues in their herds.

Early lactation diets

The mineral concentrations of early lactation diets were in excess of recommendations for all macro and trace minerals, with Fe being most in excess. Mean Fe concentration was 18 times higher than that recommended by NRC (2001), which is similar to the findings of Sinclair and Atkins (2015) where mean Fe exceeded recommendations by 19 times in early lactation diets. However, this may be because Fe has a comparatively high concentration in animal feeds and can be found in high levels in forage as a result of soil contamination (Suttle 2010). Mean Zn concentration in the early lactation diets was 4.2 mg/kg DM lower than that reported by Sinclair and Atkins (2015), exceeding recommendations by 31.8 mg/kg DM. Mean dietary K, Ca and Mg concentrations in the current study were very similar and marginally lower than findings by Sinclair and Atkins (2015) (0.8, 2.12 and 0.33 mg/kg DM lower, respectively). Mean dietary P concentration was 0.17 mg/kg DM higher than that reported by Sinclair and Atkins (2015). Furthermore, early lactation dietary Cu concentration exceeded recommendations by 7.9 mg/kg DM, with one farm exceeding the MPL by more than twice (with a value of 79.3 mg/kg DM). Interestingly, Cu deficiency is the most widely reported mineral deficiency in cattle, but also accounts for the greatest number of cases of mineral toxicity (AHVLA 2014). Of the 22 AYR herds sampled, 20 farms fed above the NRC (2001) maximum nutritional guideline of 11 mg/kg DM, with 4 farms feeding above the UK feed industry maximum guideline of 20 mg/kg DM (Advisor Committee on Animal Feed 2010). As the majority of forages and feed ingredients contain a low concentration of Cu (Suttle 2010) it could be suggested that the majority of dietary Cu present in TMRs, PMRs and concentrates were added. Herds that were feeding a high dietary concentration of Cu may have justified these levels if dietary Mo and S were high, as they have shown to act as antagonists to Cu absorption and function (Sinclair et al. 2013). However findings indicate that Cu may be over-supplied in other areas of England, and pose a threat of Cu toxicity to dairy cattle. The current study was conducted in a similar area of England to the study by Sinclair and Atkins (2015) (in central and northern England), and further research could be conducted to investigate whether the over-supply of all trace and macro minerals is commonplace in other areas of the country. Drinking water made a minor contribution to dietary macro and trace mineral concentrations (less than 10% dietary contribution) and none of the minerals present in drinking water exceeded the upper-limit guidelines.

3.6 Conclusion

Overall, quantitative assessment of the AYR farms in the current study has shown heterogeneity in transition cow management strategies, feeding methods and diet composition. Regarding housing, a notable factor that is likely to influence transition cow welfare and comfort is that pre-calver cubicle dimensions did not meet requirements on any farm where pre-calvers were housed in cubicle sheds. Stocking rate is repeatedly characterised as an important factor influencing overall dairy cow health, welfare, feed intake and performance, and while some herds overstocked above 100%, overall mean stocking rate showed that generally stocking rate was not a prevalent risk factor for suboptimal transition cow health in this study. The literature outlines BCS as an overwhelming factor influencing transition cow risk of metabolic disease, and mean pre-calving and early lactation BCS exceeded recommendations, suggesting that this may be a contributing factor to the levels of metabolic disease experienced in the UK. Lameness was also an issue, with 14/22 herds having >15% of either pre-calving or early lactation cows classified as lame. Regarding nutritional assessment, pre-calver diets were lower in crude protein than recommended, but other nutritional parameters assessed in the proximate analysis were similar to those reported in other studies with similar dietary analysis. There was however a general over-supply of all dietary minerals, apart from P, and Mg in pre-calver diets. Pre-calver dietary concentrations of Mg did not meet requirements, whereas K and Ca exceeded recommendations, all of which could contribute considerably to the onset of hypocalcaemia. Dietary Cu was oversupplied also, with 3 farms exceeding the MPL in either pre-calver or early lactation diets. This suggests that transition dietary mineral concentrations need to be assessed by the relevant stakeholders such as nutritionists, to reduce the risks of metabolic disease arising from the over- and under-supply of minerals pre- and post-calving.

4. Chapter 4: Farmer awareness of transition-related disorders

4.1 Introduction

Chapter 3 illustrated a wide variety of environmental factors on farms that related to housing, management and diet, all of which are likely to influence the health, welfare and performance of transition dairy cows. Quantitative assessment within Chapter 3 revealed that some farmers adopted optimal management practices to published standards, whilst others did not, with factors such as cubicle design, body condition and mineral concentration of the diets presenting potential risk factors for metabolic disease. Lack of awareness of metabolic disease and potential risk factors is possible, particularly due to the ‘hidden’ nature of some metabolic diseases. However, metabolic disease such as clinical hypocalcaemia where a ‘downer cow’ is presented, presents an urgent and tangible problem that requires immediate intervention, which is in contrast to the ‘hidden’ subclinical issues that could go unnoticed but can lead to clinical issues if they are not appropriately dealt with (LeBlanc et al. 2010). Farmer perception of performance could influence awareness of a transition cow health problem, with experience of coping with cattle health problems on the farm becoming normalised, as found by Vaarst and Sorensen (2009) when investigating calf mortality. The relationship between perception and awareness is dynamic (Merikle et al. 2001). Information perceived without awareness both biases what is perceived with awareness and influences how situations perceived with awareness are consciously experienced (Merikle et al. 2001). For this reason, this chapter presents findings arising from farmer and advisor interviews that relate to farmer awareness of metabolic diseases, because this may influence their perceived need to act or change behaviour. Semi-structured interviews were conducted with 22 farmers from AYR calving herds in the Northwest and Midlands of England, and 24 advisors (12 veterinary and 12 non-veterinary advisors) across England. Full details of the interview methodology can be found in section 2.6, and demographic information can be found in section 3.1 for the farmers of AYR calving herds, and 5.2 for the advisors. Figure 4.1.1 below highlights the themes and sub-themes that arose during interviews with farmers from AYR calving herds.

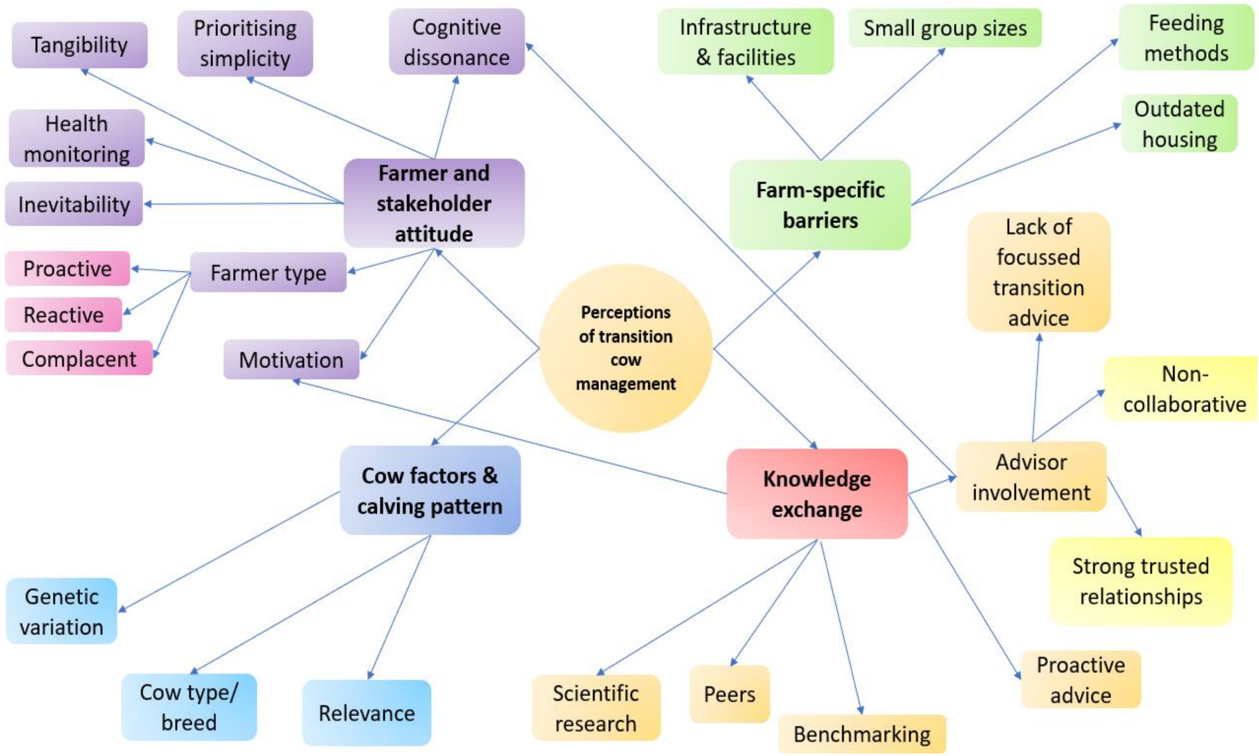


Figure 4.1.1: Thematic map depicting the four main attitudinal themes of transition cow management from interviews with 22 AYR farmers and delineated into subthemes.

4.2 Farmer awareness of the problem

4.2.1 Tangibility

One farmer and veterinarian explained that farmer awareness of transition health disorders and risk factors was further made more complicated by many of the losses relating to suboptimal transition management being hidden. When a clinical health problem arose, some farmers only thought of the clinical issue in isolation and did not acknowledge or accept that having one clinical issue could mean a relatively high prevalence of ‘hidden’ subclinical issues. The quotes below summarise this:

> ‘I think it’s about making some farmers aware that even when you do treat a clinical cow with a bottle of calcium, there is usually subclinical milk fever rumbling on in the background causing losses in milk yield, and by getting it right in the first place and avoiding using those things will actually result in cows being more productive. But it’s difficult to show that to a farmer because the losses are always hidden. We only see the one clinical cow and we think that’s the only cow with the problem’ (Farmer 1).

> ‘We see the tip of the iceberg...the end point of the disease as a DA [displaced

abomasum]. It's trying to get clients to realise that a DA isn't a DA, its loads of other stuff that's culminated into a DA' (A2- dairy specialist veterinarian).

Advisors perceived farmers to have difficulties in making the connection between sub-optimal management in the dry period leading to health problems later in early lactation. The notion that transition cow success or failure is not easy to see or always measurable (particularly in the dry period) meant that advisors perceived a lot of transition disorders to be missed because they were not immediately obvious to the naked eye, as highlighted in the following quotes:

> 'If they take it back to the dry cow management, they would reduce all of those problems but it's just trying to get them to see, isn't it?' (A17- independent dairy nutritionist).
>
> 'We are seeing them at routines more than anything, and that gets swept under, doesn't it?' (A11- dairy specialist veterinarian).
>
> 'Why do we always see the same? I think ketosis is one of those iceberg diseases where it doesn't necessarily smash them in the face… with busy people focusing on other things, it can just slip by the wayside.' (A6- dairy specialist veterinarian).
>
> **'**The [milk] tank is every day measurable, the success of dry cow feeding is not measurable on a daily basis. So that is one of the issues, a tank is something you can see today and tomorrow, and other things just disappear.' (A1- feed representative).

This was further complicated by there being a considerable amount of time between suboptimal dry cow management affecting the health and performance of early lactation cows. A lack of perceived association between farmers managing transition cows in the dry period, and the subsequent success or failure following this was reported by advisors. The quotes below summarise this:

> 'They've got no idea between this connect between doing it right and seeing it improve. They don't seem to be able to make this connect and keep it going.... and they're the most difficult ones to deal with.' (A3- independent nutritionist).
>
> 'One of the real issues and the real barrier when connecting farmers to transition

is, the whole transition issue they see is very instant and 'in the moment' …what tends to happen very often is if a farmer has cystic cows, that's todays problem, they don't link it with what was happening when those cows calved, what was happening during that time, was there ketosis or an overstocking problem? …That's the real difficulty of getting transition to the forefront of people's minds, they don't link that poor production with the milk fever that happened before. And if you make any changes to a dry cow diet the farmer won't have any indication of whether or not that will affect the cows for another 3 months, but you make a change to the milking cow diet and that could affect the tank in a couple of days' time.' (A17- independent nutritionist).

'You can't ignore a cow that goes down. And quite often, with ketosis they're so far past calving that when they do have a problem, they don't maybe associate it with the transition period. Milk fever is the one that's talked about most because they have to deal with it. A cow with ketosis can be ignored.' (A4- feed representative).

This contributed to advisors perceiving farmers to need to see an immediate return on any investment relating to transition cow management, with two veterinarians describing farmers to be 'short-term' in the way they think and react:

'They have to see a return on it, which means it has to be tangible and if it's just not getting onto that next level where they're getting DAs, those things like the metritis cases, they will struggle to make the connection with. I think farmers quite often can be quite short term …and dry cow management...they don't perceive it to earn them any money. It's not as tangible, it's not as easy to see.' (A6- dairy specialist veterinarian)

'They can't see the long run they only see the short term, and I think that's the mind-set of some farmers who have been farming the same way for the past 30 years... they don't have any foresight or thought process that if we sort this out our lives would be so much easier because we wouldn't be having sick cows and we wouldn't be dumping milk and we would spend less money. But they see it the other way that they have to spend more money to sort it out.' (A11- mixed practice veterinarian)

4.2.2 Transition-related diseases are inevitable: Bad becomes normal

Both farmers and their advisors reported becoming accustomed to experiencing transition cow health problems, with the attitude that poor performance relating to poor transition and health issues slowly became acceptable over time. In some cases, this led to an acceptance of health disorders occurring, with some farmers finding it amusing, as highlighted in the following excerpts:

> ‘We went to a meeting with our buying group run by [anon feed firm] saying how their dry cow rolls prevent all the issues and how in this day and age we shouldn't be getting any milk fevers, it won't happen because of the correct nutrition, and everyone’s just nodding along. Meanwhile I'm looking at my mate and we're both thinking, we get hundreds of milk fevers! Bottle it! [Laughs]… You get the problems, the consultant comes to sort the problems again, but costs out a different solution each time. There are always problems, its normal for us’ (Farmer 15).

> ‘Mastitis is a problem for us, we are probably sitting at 70 cases per 100 cows. We had 21 cases in a month last September. We can’t seem to get to grips with it, it’s been bad for a long time I suppose’ (Farmer 16).

> ‘Our current feeding approach is not working for us, because we are getting such a high weight loss in our cows… There is still... I think subclinical milk fever is a bit of an issue still…. certainly, fresh cow feed intake isn't what it is on paper. I can tell you that now’ (Farmer 11).

> ‘Visible problems, yes, I am getting retained cleansings, about 26% of them have retained cleansings. But I don’t think that’s to do with housing or stocking. There’s something else going on and it’s been like that for…well for a while now to be honest’ (Farmer 13).

The notion that suboptimal transition cow health and performance become normalised over time was also expressed by both veterinarians and nutritionists, as indicated in the quotes below:

> ‘They accept bad results in some cases, they just treat it as being normal which is where the problem is... It’s only when the twelfth cow has died that someone refers it to you, because it is accepted that things go wrong. And this is partially what it is

about the attitude isn't it? It is accepted that bad things happen. Bad becomes normal! …Even the bigger farmers accept poor results. When a vet rings me up and says a farmer has lost 4 cows on a herd of 400 cows, and the farmer hasn't mentioned anything to me what does that tell you? That it has been accepted!' (A1 - feed sales representative).

'People get too used to seeing problems, it's like lame cows. People just accept that it's the norm' (A3 - independent nutritionist).

'We all definitely still have those farms where poor performance or health issues are just an accepted thing… especially with transition, some farmers just don't get worried about a milk fever. It doesn't provoke much thought into why it might have happened… it just happened and that's a fact of life' (A24 – mixed practice veterinarian).

Some farmers and advisors speculated that this was partly due to some metabolic disorders like hypocalcaemia (milk fever) and ketosis that can be treated without veterinary intervention, and that day-to-day workload can prevent farmers acknowledging metabolic disorders as a problem that requires intervention, as summarised in the following quotes:

'Just imagine if you couldn't get calcium in a bottle and every time a cow had milk fever, she died. If that was the case every farmer would make damn sure that their dry cow ration was absolutely perfect. It's too easy to treat cows with bottles of calcium, mastitis tubes, [monensin boluses] and things like mono-propylene glycol, without a vet there. We just do it and hope the problem goes away' (Farmer 1).

'It's just become a norm now though really, another milk fever… I suppose it is something people can treat at home, so vets aren't being called out to it as much as what they were… they're almost the norm now milk fevers are' (A18 – feed sales representative).

One feed supplement representative described how it was easy for the day-to-day running of the farm to 'take over', by taking away the emphasis of a transition health problem, with farmers having to rapidly move on to the next task and the event potentially being forgotten or normalised:

> ‘That one cow with milk fever or a retained cleansing got sorted then something else came along and took over. I don’t know….it becomes the norm a bit’ (A19 – mineral supplement representative).

This notion of farmers becoming accustomed to having transition-related health disorders led to some advisors reporting that some dairy farmers tended to raise the threshold for intervention with sick cows. One veterinarian summarised this, explaining that it was difficult or impossible to help as an advisor because engaging farmers who had a poor perception of transition health disorders and who had become normalised to poor performance was difficult, as highlighted below:

> ‘They almost raise their threshold for intervention because they’re too busy, or because they’re fed up of all the problems they’ve been having. So, they start to get used to an animal that looks worse, and I don’t think that recovers after the transition problem ends. So, after the transition problem ends, we have staff who are intervening at a lower rate, they are ignoring cows that should have been drenched earlier just because they’ve got used to poorer performance. I think that’s really damaging. It’s hard to get them to recover from that. …I don’t know how you re-engage people when they’ve been through a difficult time, because it obviously makes more problems likely to happen in the future if they’re not dealing with animals quite the same’ (A14 – dairy specialist veterinarian).

Lameness was used as an example of farmers becoming accustomed to a health/welfare disorder, by several interviewees, with some advisors noting a transfer of attitude on lameness from one generation to the next. The following excerpts summarise this:

> ‘I have seen some herds with 80% lameness in some groups, it’s really bad. And then some people say the foot trimmer will see that cow in three weeks’ time when he is next here, and it annoys me’ (A15 – mixed practice veterinarian)
>
> ‘But farmers don’t want to look for problems, they very rarely look at how many lame cows there are in the dry pen, or why. Farmers generally do not understand how much pain a lame cow is in, no one has ever really explained to them that cows are stoic, and that when a cow shows you she is lame it is really hurting and damage has been done…. So, in one lifetime there has been this massive transition from ‘lame cows really matter’, to ‘lame cows are normal’. What worries

> me about the generational thing, when we talk about the three generations on farms, the third generation now has grown up seeing all of those lame cows, so to a certain extent the younger ones are more likely to think lameness is normal. Its normal to have lame cows therefore its normal for a cow to be lame. And we really, really can't allow that' (A5 – feed sales representative).

One farmer admitted that he had become 'lazy' when managing his freshly calved cows, owing to the generational transfer of knowledge and practices and subsequently leading to a mastitis problem:

> "I got a bit lazy. I did it my grandad's way, [be]cause I was taught by my grandad. I should have fetched my fresh calved cows out and penned them up. But I had got a bit lazy as I leave them in the yard, and you don't realise how many of these calves will suck another cow if they're left to it. Then they get mastitis!" (Farmer 9)

Participants expressed normative claims about what was considered best practice for transition cows. Furthermore, it was perceived by advisors that some farmers do not aspire to improve dairy cow health and welfare, and that this could be due to some farmers not knowing what optimal transition cow management appears to be, or because they have accepted their limitations and are not willing or able to change them. This perception of 'acceptance' of suboptimal performance or management was likened to other areas of dairy cow management, such as lameness and cow housing, and this was perceived to be impossible to change by advisors, as highlighted in the quotes below:

> 'The other thing I would say is basic standards. I go to some farms, and you just think how on earth can you think your stock look okay? I mean these people, they must have seen pictures of cows, or seen cows on TV and thought "mine look nothing like that". It's just wrong… hat rack thin dairy cows, swollen feet, things like that, I'm not sure if there is actually any way to fix that scenario, because he can look at that shed of cows and be ok with that. And I'm not saying everyone should have zero lameness and zero mastitis, and zero thin cows, of course not, but when you have a whole herd of cows that are sub-standard, if he can look at that and think it's alright, I don't think there is a way to fix that' (A12- mixed practice veterinarian).

> 'And I think if a farmer has always done something one way and had good results

that are ok… if someone doesn't know what normal or good looks like, they think they look fine and I'm looking at the dairy heifers with really hairy coats and they're all thin, and actually they aren't fine!' (A13 – mixed practice veterinarian).

'If [farmers] haven't got a big aspiration, they could be happy with average results because they're not aware of what else can be achieved…. or they themselves know they can't influence it. They know they have suboptimal sheds, suboptimal lots of things. So, they know it might not work, so they don't want that shame, maybe? There's nothing I can do about that' (A1 - feed sales representative).

Some farmers reported becoming 'blind' to metabolic disorders, as a result of becoming accustomed to having transition cow health problems. This led to difficulties in seeing metabolic disorders, and risk factors for metabolic disorders such as over-conditioned cows and overcrowding of housing and acting on them appropriately. Additionally, one farmer alluded to some advisors being 'afraid' to tell him the truth:

'You never notice what's in your face all the time. We have a routine vet visit every two weeks, and the vet won't say anything, and he goes on holiday and a new vet comes in and says your cows are a bit under-weight, aren't they? And you look at them and think they are! I never noticed! It's just because you're there all day every day, it takes someone fresh to see it, who isn't afraid to say it.' (Farmer 15)

The ability to see metabolic disorders and risk factors was also made more difficult during busy periods on the farm, and during periods of staff shortage, causing farmers to lack control of the situation, and being confused as to what caused the sudden onset of a crisis. This was compared to other areas of disease management such as Johne's management, as summarised in the following quotes:

'This is where I think I've gone a bit blind really because I've always blamed the ration for everything rather than looking at other things. Whereas you speak to the vet and if it has been a busy few months of calving, the vet might point out that the calving yards have been overstocked and that could be causing problems. We had a weekend with a lot of calvings, a weekend with two [displaced abomasums], and all my calves were down with Crypto[sporidiosis], but it took a vet to say that it screams out that the farm was over-crowded. And you think after...yes we were' (Farmer 8).

'We were really on the ball with our Johne's cows, we only had 3 before, but since the staffing issues we've had 17 J5 Johne's cows and you just think, how has this happened? It just runs away with you. That horse has bolted and it's going to take a lot of work to get that back down' (Farmer 4).

Advisors also commented on farmers being 'blind' to transition disorders, suggesting that some farmers had decided that a level of herd prevalence of transition diseases was acceptable. It was suggested by some advisors that this was more common with farmers that were more isolated and on smaller units, and with farmers that do not benchmark or compare their herd health and performance with other farmers:

'But people get blind, don't they? People with 50% lame cows .... they're probably not bad people... but at some point, they've decided that 50% lame cows is acceptable. But it's probably because they were at 20% and 30% then 40% and now they're here, and you think your cows are awful mate! But they can't see it can they?' (A2 – dairy specialist veterinarian)

'It's a job that has the real potential to become really isolated particularly on the smaller units that don't have any staff. If your average begins to skew, you may not be able to see it. It's going out looking at other farms and getting people in and talking makes people realise actually what's going on. Farmers can get a little blind to what's in front of them sometimes because it becomes their norm' (A19 – mineral supplement representative).

'You ask a farmer if he has any transition problems and he says no, nothing, then you walk around and he says actually she's had a DA, actually she had a retained cleansing, and going through the motions they forget. I think a lot of the incidences that we see, there are probably more happening than we are being told, but cows do get missed' (A19- mineral supplement representative).

4.2.3 Comparing farmer perception to on farm measurements: failing to appreciate or underestimating on-the-ground realities

Farmer perception of housing measurements and diets were compared to results recorded during the farm assessment (Table 4.2.1 and 4.2.2). The tables below highlight differences between the farmer's perceived value and the actual measurement recorded by the researcher.

Table 4.2.1: Examples of housing measurements on 22 AYR calving herds where farmer perception did not match researcher findings, or recommended value.

Farmer perception	Actual measurements on farm audit (per cow)	Measurements if housing was stocked at 100%
Feed space	**Recommended ≥ 0.76m /cow**	
F2: "We don't massively over-stock. I've never been in there and seen a problem. They've got enough feed space, it doesn't seem to bother [the early lactation cows]"	Early lactation feed space: 0.35m /cow	0.38m /cow
F9: "We're alright for feed space, cause most of ours are fed in troughs…they've actually got loads of trough space"	Precalver feed space: 0.69m Early lactation feed space 0.47m /cow	0.52m /cow 0.71m /cow
F7: "Most importantly, is feed space area. I admit we haven't got it quite right yet"	Early lactation feed space: 0.4m /cow	0.36m /cow
F14: "We've got good feed availability, feed and water."	Precalver feed space: 0.47m /cow Early lactation feed space: 0.68m /cow	0.48m /cow 0.62m /cow
F17: "Our feed space is fine"	Early lactation feed space: 0.58m /cow	0.61m /cow
Water space	**Recommended ≥ 10cm/ cow**	
F4: "Probably not enough on paper but there's a good foot of water trough per cow"	Pre-calver water space: 9cm /cow	4cm /cow
F9: "It's OK. We struggle with the freshest cows in hot weather. And we did have about 3 afternoons in June 2018 where we struggled to water everything. But it's mainly just the fresh cows."	Pre-calver water space: 4.7cm /cow Early lactation water space: 4.5cm /cow	3.5cm /cow 6.87cm /cow
F7: "I don't see a problem, as long as you've got [the water troughs] scattered about then its ok"	Early lactation water space: 6.2cm /cow	5.5cm /cow
F14: "The pre-calvers never run short of water… in the fresh group they have enough too"	Pre-calver water space: 3.8cm /cow Early lactation water space: 5.7cm /cow	3.9cm /cow 5.2cm /cow
F17: "We have lots of water space"	Early lactation water space: 5.1cm /cow	5.4cm /cow
Stocking rate	**Recommended ≤ 100%**	
F9: "Too full. [Laughs] We stock at about 105-110%	Early lactation stocking rate: 153%	

Table 4.2.2: Pre-calving mineral feeding rates on 22 AYR calving herds where farmer perception did not match actual practice or recommended feeding rate.

Farmer perception	Actual feeding rate
F1: "The close-ats normally get the same silage and some dry cow rolls …and ad/lib mineral buckets"	Feeding pre-calving cows additional minerals (>100% requirement) with additional supplementation of ad-libitum mineral buckets
F3: "They just get an elite dry cow mineral…that is added separate into the mix"	Feeding pre-calving cows > 200% recommended mineral rate, by feeding a separate bagged mineral alongside 2kg mineralised concentrates, and mineral lick tubs.
F5: "I give them a kilo and a half of the [anon] dry cow stuff"	Feeding pre-calving cows 75% recommended mineral rate.
F14: "Yes, they get just under half a kilo per head a day. They also have some ad lib minerals in a tub as well, in a drum. We tip a bag of minerals in there every so often just to lick. It hasn't been used too much really. You can over mineral them sometimes, can't you?"	Feeding pre-calving cows > 300% recommended mineral rate, by feeding 3x the recommended bag label instructions (450g instead of recommended 150g) and feeding additional free access minerals provided ad-libitum.
F15: "…The far offs and the close-ats [pre-calvers] get a mineral in the [total mixed ration] and the close-ats get a roll as well on top of that. They get both as its just ease of mixing. There are 21 dry cows on the farm, but only 3 pre-calvers. But even if there were 10 pre-calvers, we would still do that and double up on the minerals. It's probably not cost effective but at least you know they've all got it"	Feeding pre-calving cows 200% recommended mineral rate, by feeding a separate bagged mineral alongside 2kg mineralised concentrates.

4.3 Reasons for the problem

4.3.1 Day-to-day workload and busy periods on the farm

Some advisors discussed in detail how day-to-day workload influenced farmer awareness of transition disorders and farmers' ability to plan ahead. The term 'human sustainability' was reported as an important yet often-dismissed issue, where farmers can be so busy with essential daily activities, they fail to strategically plan ahead to reduce the risks of metabolic disease, and so they become accustomed to tolerating a certain level of disease, as summarised below in the following excerpts:

> 'When you are up to your eyes in alligators it's hard to remember you're there to drain the swamp. When there is so much going on they just think "Oh, I can't cope, I'll close my eyes to it and tolerate it. I think they recognise that as you go into [transition] it gets such a big deep subject that they know they can't do it. We have our own comfort zones, and we stay within them.' (A1- feed representative).
>
> 'There's a great acronym STOP, do you know that one? Stop, think, orientate and plan. Farmers are not very good at stopping and when they've got problems, they tend to bury themselves in the chores rather than stand back and assess what the problem is. And transition cows would be the pinnacle of that. We need to teach farmers that it's alright to stop, stop shovelling that muck for five minutes and think about it. … Nobody talks about human sustainability. Can you manage to do what we're asking you to do? Are we asking you to do the possible or not?' (A5- feed representative)

During the interviews, one feed representative (quoted below) went on to discuss the importance of the efforts of farmers, and how this can act as a 'reservoir'. If farmers do not get sufficient time, recuperation and motivation to replenish their efforts, they may only have enough effort to carry out the most essential day-to-day tasks (which will always take priority in the running of the farm), and secondary (deemed non-essential) tasks such as taking the time for proactive and strategic planning, learning opportunities such as travelling to farm discussion groups, will only occur if the farmer's efforts are replenished and sustained.

> 'We only have so many efforts in us, and we replenish our efforts with motivation, expectation, and recuperation. If you go to a farmer and try to talk to him about strategy but he can only do the bare essentials of milking and feeding, you won't get anywhere. People who find intrinsic motivation are more naturally a lot more

likely to think about strategy and other things like farmer politics because they are more driven and are in control' (A5- feed representative).

Some farmers discussed the desire to improve their transition management, however obstacles that prevented this were a perceived shortage of time and skilled labour. This was also mentioned by advisors to be a significant factor affecting farmer day-to-day workload, even if a farmer wanted to improve their transition management. This meant that some farmers prioritised doing things the 'cheap and easy' way if they could 'get away with it', because day-to-day workload was perceived to be very demanding, and if the farm lacked skilled labour to perform optimal transition strategies, then they would not be carried out. The following excerpts summarise this:

> 'It is very difficult here because there is very much me and my herd manager managing 1500 cows. We've got a whole team of milkers and that's about all they are. There's nobody...[pause]…it's me and him managing the cows and there's not that in between person to ask to drench those 5 cows with glycol. It ends up being us than do it and we don't have time in the day to do all that.' (Farmer 11)
>
> 'It's time, facilities and staff, and perhaps the extra costs associated with a proper diet. It's whatever is cheap and easy, and if you can do cheap and easy that's always the first option. If you can get away with doing things cheap and easy you would do it and you aren't going to make yourself the extra work unless you know the benefits and you've got people to help you do it.' (Farmer 3)

Advisors also reported a lack of time to be an issue hindering some farmer's ability to make transition management improvements:

> 'There are only so many hours in the day, there aren't enough staff to observe the cows, you do not see people in sheds anymore...but farmers...when they're awake, all they want to do is go to sleep! Because they're working 14 hours a day. So that is an issue, a social issue of agriculture. End of story. Even if the guy wants to, he might not be able to. So, we have the system that can't be improved, we have the guy's attitude that can't be improved, or we're working with cows that he can't manage.' (A1- feed representative).

‘And time is a big factor because you're asking a farmer to be so many things. You're asking him to do his paperwork, to do all his milking - they've got to be everything haven't they? I think a lot of it is money and time. Obviously in an ideal world, what you'd do and what is practical can be two very different things. And I think people listen to my advice and think, yeah, you're probably right but, my milk price is 25 pence.’ (A4 - feed representative).

4.3.2 Prioritising simplicity

Farmers in the current study mainly prioritised keeping transition cow management strategies as simple as possible, to save time and to manage the day-to-day workload. In some cases, farmers reported knowing that their transition management or dietary strategies were sub-optimal or could be improved, but were still reluctant to make beneficial changes because it required complicating matters, as highlighted in the excerpts below:

‘If it’s not perfect but you aren’t getting the actual clinical problems, some guys they can get away with it. Even if more gains can be made by a better diet, some farmers wouldn’t chase after that because they prioritise having an easier simple system and are happy to just not get clinical cases or deal with them if they get any and not have the benefits of the extra milk and improved fertility’ (Farmer 1).

‘I feed my pre-calvers every other day, to keep it simple’ (Farmer 5).

‘We used to have a black product like treacle, it cost a fortune, anyway we used to put that in a watering can and put it on the top of the fresh cow feed after we put the mix out…I liked it because It was simple and easy to do’ (Farmer 10).

‘If you can do it cheap and easy, that’s always the first option if you can get away with it. And you aren’t going to make yourself the extra work unless you really have to, are you? Who wants to make an extra mix on for a small group of cows if you can get away without doing it?’ (Farmer 2).

The theme that farmers could be reluctant to make changes or improvements based on complicating matters was also supported by one feed sales representative who explained that some farmers only do the absolute minimum for their transition cows:

> ‘It’s the knowledge that they can't do anything without creating an impossible cost or impossible workload, so they just tolerate it. If they can get away with doing the least without so many problems, they will tolerate it’ (A1 – feed sales representative).

4.3.3 Acceptance of over-conditioned cows

Over-conditioned cows were generally accepted by some farmers to be an inevitable problem that they either could not change, or were not willing to go to efforts to change, despite farmers recognising that over-conditioned or ‘fat’ cows were contributing to metabolic disorders, as summarised in the following excerpts:

> ‘The dry cows get [monensin] boluses. Ninety percent of the herd are getting [monensin] boluses because they're all too fat at drying off. We have cut the brewers grains down in the [low yielding group] diet [previously 27kg brewers grains fed per head to the lows]. That might just be helping a bit. But definitely our cows get too fat at drying off’ (Farmer 14)

> ‘All our cows are too fat. I find that the more milk they give the fatter they seem to get really. You’ll probably say that they’re all obese’ (Farmer 10)

> ‘On Christmas Eve, we had three [displaced abomasums]. We've done… maybe one in the last few months which is what you'd expect. But as a general pattern they are fat cows. Or fat cows before they calve’ (Farmer 2).

4.3.4 Reliance on alternative and reactive strategies

Monensin is an antibiotic used as a growth promoter in cattle, and increases milk production efficiency, allowing for a quicker return to positive energy balance in the transition period by manipulating the rumen microbes and volatile fatty acids to produce more glucose precursors (Duffield et al. 2008). They have a veterinary medicine license for the prevention of ketsosis and are only supposed to be administered to high-risk cows that are outside the ideal BCS or lame, to reduce the related risks of transition diseases. Farmers in the current study reported relying on alternative and reactive strategies such as administering monensin or calcium boluses as a way to compensate for sub-optimal transition management and not employing correct feeding strategies, as summarised in the following excerpts:

‘Milk fever is under control, we [calcium] bottle older cows because the diet is obviously not right. We get very few clinical cases’ (Farmer 13)

‘We [monensin bolus] everything, pretty much. I know they've all got it then. Because they’re all overweight because we feed all one diet for 42 litres. And now we're up to about 10500 litres so I just think it’s good for them all to have it. If I didn’t bolus them, I know I would get problems’ (Farmer 15)

‘We rely a lot on [monensin] boluses really, it’s easy just to bolus them and it sorts them out. We don't blanket treat cows with [monensin boluses], just fat cows thin cows lame cows and anything that is high risk, old cows get one as well....and any cows that didn't give a lot of milk last lactation or did give a lot of milk in the last lactation....so actually… near enough everything at the minute.’ (Farmer 14).

‘If we didn’t [monensin] bolus everything, we would have even more problems than we already do. Those [monensin] boluses are how we get away with it all, and the yield they are doing.’ (Farmer 19)

‘If [monensin] or calcium boluses and bottles weren’t available we would be forced into doing a better job. That’s pretty much what some farmers rely on, it’s not perfect, but you can understand why the guys that can’t feed a TMR are the guys will be happy to use a [monensin bolus] or a bottle of calcium, because they haven’t got the facilities to do a better job. Smaller farmers are never going to be able to do it properly.’ (Farmer 1)

4.3.5 Lack of health monitoring

There was heterogeneity in farmer attitudes towards health monitoring of transition cows. In the current study 15 farmers kept health records, of which 12 did so to meet the demands of their supermarket milk contracts. The remaining 8 farmers that did not keep health records chose not to because they did not find it important or useful, and because the data was historic, and the process was too time consuming. Farmers with smaller herds felt it was unnecessary as they were able to monitor and manage the health and performance of their herd without writing it down. Furthermore, when recording farm figures became more complicated, time consuming and in-depth, farmers were less likely to provide accurate results and were more likely to make up performance and health figures, as highlighted in the excerpt below:

> ‘The more figures they want the more people just think “I don't know that I'll make it up”. We did that ‘Farmbench’ for AHDB and they wanted all these figures and split down into youngstock and cows and arable and how much diesel we used for this and that. And by the time we had finished we guessed the majority of it because the more they do that and the more they ask, the more inaccurate it becomes. So, in a lot of ways it’s a waste of time. But I do think monitoring is important, but it’s monitoring the right things’ (Farmer 12).

Advisors also expressed difficulties in encouraging farmers to keep regular health records and participate in benchmarking, as summarised by this mixed practice veterinarian:

> ‘Most farmers are only interested in being outside with their animals, they don't want to be inside filling in boxes, tables and lists’ (A12).

One farmer explained that ease of recording played a role in farmers keeping health records with the use of computer programmes largely helping, and the use of paper records appearing useless:

> ‘The problem is right, we haven’t got a computer programme at the moment. If you haven’t got a computer programme you can’t get any reports to see how many in the last six months or twelve months or whatever, without physically counting it, so it’s pretty pointless writing it down. We are putting a computer programme in, so hopefully we will be able to get stuff like that out of it. But at the minute we just have loads of pieces of paper everywhere, saying we have a cow with X Y and Z wrong with it. And then that piece of paper will just be in a folder, and then like, who’s going to open the folder and have a look at how many milk fevers we've had last month?’ (Farmer 1).

In the current study, 6/22 farmers monitored body condition score, of which 5 were on a supermarket aligned contract and were required to do so to maintain their contract. The remaining farmers monitored cows body condition by eye, but did not body condition score, because they did not feel this would be useful. The following excerpts summarise this:

‘I just do it by eye’ (Farmer 13).

‘We have never had to report anything on body condition score. But I'm monitoring them every day, aren't I? I see them. No, I don't write it down’ (Farmer 9).

‘Do I put a number on it? No. Yeah plenty of people have asked me, "what score are they?" and I just know if they are too fat or too thin. My problem with putting a number on them is, my score 2 is different to your score, you know what I mean?’ (Farmer 6).

This is in contrast to mobility scoring, where 15/22 farmers carried out regular mobility scoring, so a list of lame cows could be passed on to the foot trimmer for regular prevention of hoof problems, of which 3 farmers were not required to do so by their milk buyer, and did so by choice:

‘I don't [body condition score], I don't think that I would get any more information out body condition scoring the cows then what I get from my nutritionist walking the shed and myself walking the shed on a three weekly/monthly basis. Mobility scoring is something that we have to do for [my milk buyer] on a quarterly basis for the milk contract. But I actually do it monthly because then any freshly lame cows can go onto the foot trimming list’ (Farmer 4).

Some farmers expressed interest in carrying out more regular body condition and mobility scoring, but could not justify the additional cost of paying for this service, as summarised in the following quotes below:

‘Yeah. It is done sometimes by the nutritionist if she’s got time. But it is definitely something I'd like to do more of. But again, I don't want to pay for it’ (Farmer 1).

‘I just find that I can pick them out as much as anyone can pick them out so why are we paying someone to do it, because we're not on a supermarket contract, we're on a very basic contract and we were paying for the vet techs time to do it. But just at the minute I just don't think it’s probably worth paying them £200 to come and stand there and look at them’ (Farmer 8).

Reasons why farmers did not value recording health issues and body condition scores regularly was also due to the data being historic, and therefore not appearing useful:

> ‘We had [anon mineral company] monitoring transition performance for a bit, but it was just a waste of time. She'd come, do the scoring and stuff then come in say, November for example, and say: "You had a problem in June, but you've got out of it" Well there’s not really any point in telling us that is there! Everything in farming is old information, but this was...really old information’ (Farmer 10).

> ‘I mean you look at a cow and think it’s fat well it’s too late, I can’t do anything about it. You can only do something about it during lactation. By the time they get to the transition period, it is too late’ (Farmer 17).

Four advisors perceived that farmers avoided taking regular health records and scoring their cattle because they may not want to know the truth or come to terms with the suboptimal records that require intervention. The quotes from two advisors below highlight this:

> ‘Some of them are scared of what might be revealed. If they find out the numbers they could be really upset so maybe they'd rather not know’ (A5 - feed sales representative).

> ER: ‘Do you think that farmers monitor transition cow health enough?’

> A1 (feed sales representative): ‘Oh [swears] no they do not! Because they don't want to see the truth. Some do a lot don't.’

The mean herd size for farmers that kept regular health records was 417 and was 313 for those that did not. This was partly due to farmers from smaller herds feeling like they did not need to keep health records, because they could keep track of the health and performance of their herd without writing it down, as highlighted the quote below:

> ‘Take milk fevers for example, I know how many we've had anyway. And plus, it’s such a low number, as in one last month, that I don't need to write that down’ (Farmer 1- herd size 200).

One veterinarian also explained that a smaller herd size meant that statistically it was not reasonable or worthwhile to take regular health records:

> ‘On smaller herds you don't have the numbers, so it’s difficult to monitor. It’s statistically nonsensical to monitor too frequently on small herds which is a shame because then you never really know what’s going on, but the problem on small herds when you’re monitoring frequently is you only ever see the noise in the data rather than the underlying trends. And you risk making very big decisions and changing everything, messing things up potentially based on just noise because you're monitoring things too frequently. So, it’s a real difficult problem and I don't think anyone’s solved it yet. But people feel like monitoring transition cow health more frequently is the right thing to do. Yeah. Anyway’ (A14 – dairy specialist veterinarian).

4.4 Prevention of the problem

4.4.1 Health monitoring

Farmer awareness of metabolic disorders and associated risk factors may be influenced by the practice of recording and monitoring the health and performance of their transition dairy cows such as calving difficulties and postpartum disorders (not to be confused with medicine records which are a legal obligation). Some milk processors require farmers to keep regular health records to maintain their milk contract and/or receive premium payments (industry and milk purchaser obligation but not a legislative requirement). It was suggested by some advisors that farmers who benchmark regularly against other farmers were aware of their performance, and were more proactive in making improvements to transition cow management, as summarised in the following quotes:

> ‘Farmers that actually benchmark and review their own performance data will for the majority of the time be running a quality system with strong animal health figures. So, I would say benchmarking and knowledge of costs and returns is the trend that would be consistent’ (A16 – feed sales representative).

> ‘What I think we've seen is certain farms who have adopted a lot of recommendations and importantly have adopted a lot of fresh cow monitoring protocols, we see them almost moving further away from the pack, because I don’t think the whole of the industry is shifting forward at the same rate’ (A2 – dairy specialist veterinarian).

Farmers from larger herds could see trends in the data, and attribute health issues with management issues:

> ‘We record everything into the computer. Then we go over it with our consultants and often we can see trends, when we had a lot of problems is usually down to when we overstocked or had fewer staff, so we were moving calving cows too early’ (Farmer 11 - herd size 1500).

> ‘The bigger herds tend to record more because they're better set up for it. If they don't take health records, it doesn't mean they're a bad farmer. I know lots of good farmers who are having problems that we can't get to the bottom of’ (A7 – feed sales representative).

In some cases, farmers stated that they took health records, but did not use the information to make transition-related decisions or improvements. Interpreting the data collected was perceived to be important if figures from health records are to be utilised to make future management decisions, yet farmers were unwilling or unable to do so. The following excerpts summarise this:

> ER: ‘When they give you the report, how do you use it?’

> ‘Yes, I look at it. Do I use it? [Pause] No, is probably the honest answer, I look at them and think: “why are those figures so rubbish”, and then...I've not come up with the answers as to why they are so bad yet’ (Farmer 12).

> ‘Not really, no. That’s the first time I've looked at the milk fever records probably for 3 or 4 months. If you hadn't come today, I wouldn't have looked at it’ (Farmer 16).

> ‘We write a lot down... It’s helpful to know all that, it’s just taking all the stuff on board and actually doing something with the information if you know what I mean? …It’s definitely useful to know it, but if you're paying for the service, you really have to take it on board, haven't you?’ (Farmer 14).

> ‘And I know you get a piece of paper at the end of it to say how many lame cows and that, but I don't find it that useful. I just don't use the information. The only time

we ever use it is to show the farm assurance. So that's probably quite bad!' (Farmer 8).

'It's all very well writing it down in the diary as we do every day but its collating that into meaningful numbers isn't it? Which we have to do for our milk buyer' (Farmer 16).

Some advisors also perceived health records to be unimportant due to the historic nature of the data, and a lot of the time, the data was not used in a meaningful or functional way to improve transition cow health. One dairy specialist veterinarian and feed sales representative summarised this below:

'Maybe, maybe but what do you do with it? I've got the biggest graphs and the nicest data sets, but it's all historic' (A2 – dairy specialist veterinarian).

'If you're going to spend money doing an investigation of any sort, then it's what you do with the result that really matters. The piece of paper isn't worth anything is it? The piece of litmus paper is worth nothing to a dairy cow. It's getting the farmers to understand what it means and how we can make it better' (A5 – feed sales representative).

4.4.2 Influence of Supermarket milk contracts

The milk contract played an important role in whether or not farmers kept regular health records and benchmarked their performance against other dairy herds. Direct contracts with supermarkets generally require dairy farmers to take regular health records, such as metabolic disease incidence, mobility and body condition scoring. Farmers on these contracts are usually paid a premium milk price, which is usually higher than that offered on a direct contract. The requirements and financial premiums offered by supermarket milk buyers appeared to motivate farmers in the current study to learn new information and maintain good practice across all aspects of dairy cow management, as highlighted in the following quotes:

'I'd probably do it, but it wouldn't be a conscious thing, it wouldn't be done that accurately if I didn't have to do it. Because we have to do it twice a year for our milk buyer, I make a point of doing it and doing it properly' (Farmer 3).

‘With the supermarket contracts, if you don't attend the meetings, you get knocked down. You have to attend, or you get penalised. I will go across country for a meeting. I have driven to Wrexham, Derbyshire, I will drive miles for a meeting, and it works because you're always learning something’ (Farmer 16).

In some cases, depending on the milk purchaser, farmers scored points for optimal health and welfare. This acted as an incentive for farmers which led to a sense of competition between farmers on the leader-board of some supermarket milk buyers:

‘We're always looking at your own cost of production to think where you are on a league table to people doing the same amount of milk’ (Farmer 7).

Farmer 16: “I understand the reasons why we do everything, and I intend to be over 90 points. We are at 88 now but I will be over 90 points!”

ER: ‘Is there a sense of competition on the leader-board?’

Farmer 16: ‘Indeed yes! Definitely. That’s why we joined the healthy heifer group with our vets. There was a dozen of us that were all benchmarked against each-other, and we’re all trying to be the best.…After a couple of meetings you didn’t mind what you said, because everyone was assigned a letter A B and C so on. But we were open and said we are B. I didn’t mind people knowing.’

While this sense of competition and motivation was not specific to transition cow management, it did influence farmers to make changes and improve transition management strategies where needed:

‘The supermarkets want to know everything, from milk fevers to DAs, the lot. So, it does spur you on to do the best and it makes us more proactive because for starters you don’t want to get kicked off your contract if you run into problems…and you want to be seen to be doing a good job anyway. When the transition cows are right, it’s peace of mind isn’t it?’ (Farmer 20)

‘Because we are on a supermarket contract, they want to say that their farmers are doing it better than everyone else, and I understand that. It can get a bit much

> because they want us to record everything, but sometimes you need that encouragement, or it doesn't get done. And because everyone else is moving forward, we have to improve too, or we could get left behind. That's why I need to improve dry cow housing ASAP!' (Farmer 22).

Advisors also expressed differences in farmer motivation and transition management between those that were on a direct-supply contract or an aligned supermarket contract, because farmers on an aligned supermarket contract were required to do more to maintain their contract and premium prices:

> 'My heart would say farmers on an aligned contract are a bit more aware of health issues and keep better health records for the supermarkets. They're often inspected by an independent vet as well, because they do a health check on those, so they have to have a lot more data to show. I would generally say those farmers on an aligned contract have got more money and more information' (A3 – independent nutritionist).

4.5 Discussion

4.5.1 Farmer awareness

One possible factor contributing to the sustained problem of transition cow health disorders in dairy herds is that farmers underestimate the prevalence of transition-related disease in their herds, and therefore do not perceive a need to take further action to control it. Although not a metabolic disease, lameness was used as an example of this by several participants in the current study. Studies by Leach et al. (2010) and Atkinson (2020) have evaluated farmer perception of lameness, with Leach et al. (2010) establishing that a reduction in lameness was restricted by the farmer perception of lameness. Bennet et al (2014) also found whole herd lameness assessments by trained researchers were substantially higher than that estimated by farmers. It is possible that as a result of farmers underestimating the prevalence of transition cow health disorders, or the inability to 'see' the problem, farmers may not consider it a large enough problem to warrant much attention, particularly as there are many other demands during a normal working day. This issue is made more complex because many transition-related diseases can be subclinical and difficult to see, lacking tangibility, meaning that farmers may struggle to make the connection between a management practice 3-weeks before calving and the subsequent effect that has on dairy cow health and performance weeks later in early lactation. Additionally, low milk prices on some herds may have reduced financial margins, and increases in herd size may have created more pressure on staff time, resulting in farmers prioritising more simple and less costly (of both financial and time) methods of transition management. Health issues that are immediately obvious, such as mastitis have a direct impact on milk returns due to the amount of saleable milk (Ashraf and Imran, 2020), with the consequence that health events such as these may attract more attention and become a farmer priority at the expense of other transition health issues.

Farmers and advisors in the current study reported an acceptance of metabolic disorders on farm, which was suggested to be partly due to farmers feeling out of control of transition cow disorders occurring, and that some metabolic disorders do not usually require veterinary intervention and are straightforward for farmers to treat themselves. This meant that reactive strategies and treating the problem was in some cases the preferred method, rather than taking time to implement a new strategy or diet which may require more time and thought. These findings are similar to those found by Vaarst and Sorensen (2009) when investigating calf mortality, where producers with high calf mortality had a basic belief that calf mortality is a permanent crisis and is to be expected on a dairy farm. Farmers and advisors reported difficulties in managing transition cow health disorders, particularly during busy periods on the farm, with the day-to-day workload contributing to some feeling a loss of control. Farmers and advisors in the current study mentioned a shortage of labour greatly affected farmer's ability to organise themselves and plan to implement more preventative measures rather than focus on purely reactive strategies. This was also reported by Alarcon et al. (2014) when investigating the attitudes of pig farmers towards disease control, where the control measures and the amount of extra labour required were mentioned as key factors for farmers to agree or disagree with recommendations set out by the government and their advisors. Additionally, Vaarst and Sorensen (2009) reported that farmers categorised with high calf mortality described situations in which they had spent a relatively large amount of time on crisis or reactive management strategies and 'running behind' and had difficulties in getting an overview of the situation. Farmers in this study typically spent too much time on unpredictable activities, and routines felt like a burden. These farmers also reported becoming accustomed to health problems, describing a permanent health 'crisis' as unavoidable, a constant challenge, or a condition of life. The study by Vaarst and Sorensen (2009) indicates that structure in the farmer or calf managers day-to-day routine was lacking in herds with high calf mortality. Furthermore, a lack of belief that a health problem can be solved may hinder the farmer in starting to structure the day-to-day work plan. This was also found by Alarcon et al. (2014) where in some cases, farmers who could not identify the cause of a health problem or the issue of dealing with complex disease situations lead to a feeling of uncertainty of how to address the health problem.

Advisors in the current study perceived that some farmers had few aspirations to improve dairy cow health and welfare which was due to either farmers not being aware of what optimal transition cow management looks like (lack of awareness), or farmers accepting their limitations and not being willing or able to change (acceptance). Interestingly, this was also reported by Mills et al. (2020), where veterinarians stated that farmers accepted the limitations to best practice for transition cows, which was usually considered due to the attitude that not all farmers can adopt best practice because of extrinsic factors and farm layout. Additionally, Garforth et al. (2013) established that much of the non-compliance for disease management in pig and poultry management was explained by farmers seeing practices as irrelevant to them, impractical, or not necessary. Furthermore, Sorge et al. (2010) found that the main reasons for non-compliance with Johne's control practices were farmers not believing that a change of practice was necessary, and that farm space did not allow for the change. This further highlights the requirement for advisors to co-create tailored and context specific approaches to achieving best practice for transition dairy cows (Bard et al. 2019), by acknowledging the farm-specific barriers and infrastructure. Additionally, efforts could be made to draw attention to the importance of best practice for transition cows, which may be difficult for farmers to see because as mentioned, many of the financial and production losses created by sub optimal transition management are 'hidden'. Farmers in the current study reported a difficulty to see metabolic diseases, particularly as they were often 'hidden' from plain sight, and that they often relied on their advisors to tell them when management strategies needed changing. This highlights the reliance of many farmers on farm advisors, and the importance of advisors being honest with farmers, without damaging the relationship by offending their clients.

It is possible that some farmers are unaware of best practice, particularly those who do not benchmark or compare their own performance with others. Dairy farming can be an isolated profession and if farmers do not see the benefits in participating in farm walks and discussion groups, they may miss out on learning new knowledge and the perception of their own herd performance and health status can change. Alarcon et al. (2014) established a feeling of isolation with some pig farming participants, and those that did not participate in active benchmarking or pig health discussion groups felt that no real system of disease alert was in place. This could further contribute to farmers feeling a loss of control if a disease outbreak was to occur.

Advisors in the current study perceived it to be impossible to change farmer perception and behaviour when they became normalised to seeing poor performance or health disorders, with one nutritionist reporting difficulties in bringing the farmers attention to this for fear of offending the farming client. While the farmer-veterinarian relationship has been explored in depth (Derks et al. 2013; Hambleton et al. 2017; Golding et al. 2019), there is a dearth of research explicitly focussed on the barriers for veterinary and non-veterinary advisors to provide advice, or how veterinarians are receiving and coping with challenges (Ruston et al. 2016). The farmer-advisor relationship is complex, and power relations, partiality and tensions can influence the degree of trust within the relationship (Sutherland et al. 2013). Additionally, the risk of losing credibility with farmers also governs the actions of other farm advisors, as seen with agronomists (Ingram 2008), and the need to retain their clients may influence advisor willingness to be forthcoming with honest responses about farm performance. Furthermore, the need for all industry stakeholders to work together is paramount, as discussed by Pyatt et al. (2017), where the importance of clients, veterinarians and paraprofessionals working as a team was highlighted to enhance service quality and co-create value. Meeting client expectations and developing strong relationships has been shown to improve treatment compliance and outcomes in human health care (Bell et al. 2002), however in animal health care the paraprofessional is not so well utilised (Pyatt et al. 2017). Integrated care and the use of multi-disciplinary teams may enhance farmer uptake of practice, as discussed in the Lowe Report (Lowe, 2009).

4.5.2 Reasons for the problem

Day-to-day workload and busy periods on the farm contributed to farmer difficulties in seeing transition cow health disorders and risk factors, and acting on them appropriately, as found by Leach et al. (2010) when investigating barriers to lameness control. This feeling of becoming ‘blind’ to some transition-related health issues further contributed to farmers feeling a loss of control, which was exacerbated during busier calving periods or with fewer staff. In some cases, farmers reported relying on their advisors to be honest and tell them when there was a problem, because they struggled seeing it. Similar findings have been reported by Brennan et al. (2016), where farmers reported feeling that other tasks and responsibilities got in the way of taking appropriate biosecurity measures, and they could only do “so much”. Vaarst and Sorensen (2009) reported farmers feeling a loss of control when investigating calf mortality and suggested that help from an advisor to proactively plan ahead may encourage farmers to feel more in control. Feeling in control can lead to a more positive attitude, and self-efficacy (Bard et al. 2019). The term ‘human sustainability’ was brought up in the interviews by a feed representative, who discussed the importance of efforts of farmers, and how this can act as a ‘reservoir’. This advisor explained the significance of farmers having enough time, motivation and recuperation, as a way to feel in control and replenish their efforts, which is required if they are to carry out more than just the essential day-to-day tasks of running the farm. This ‘effort reservoir’ has been illustrated in Figure 4.5.1. The farmer-specific priorities are variable depending on the type of farm, and the farmer's individual requirements and goals, but the basic principles apply where the essential day-to-day factors of running a farm (in this case, feeding and milking on a dairy farm) will be prioritised because they are crucial in maintaining the business and the health of cattle. The other secondary tasks (which are non-essential priorities to running the business), such as 'strategic planning' can also vary depending on the farmer and the type of farm, they are interchangeable and can change in order of importance, but they will not be carried out if farmer motivation and efforts are not replenished and sustained.

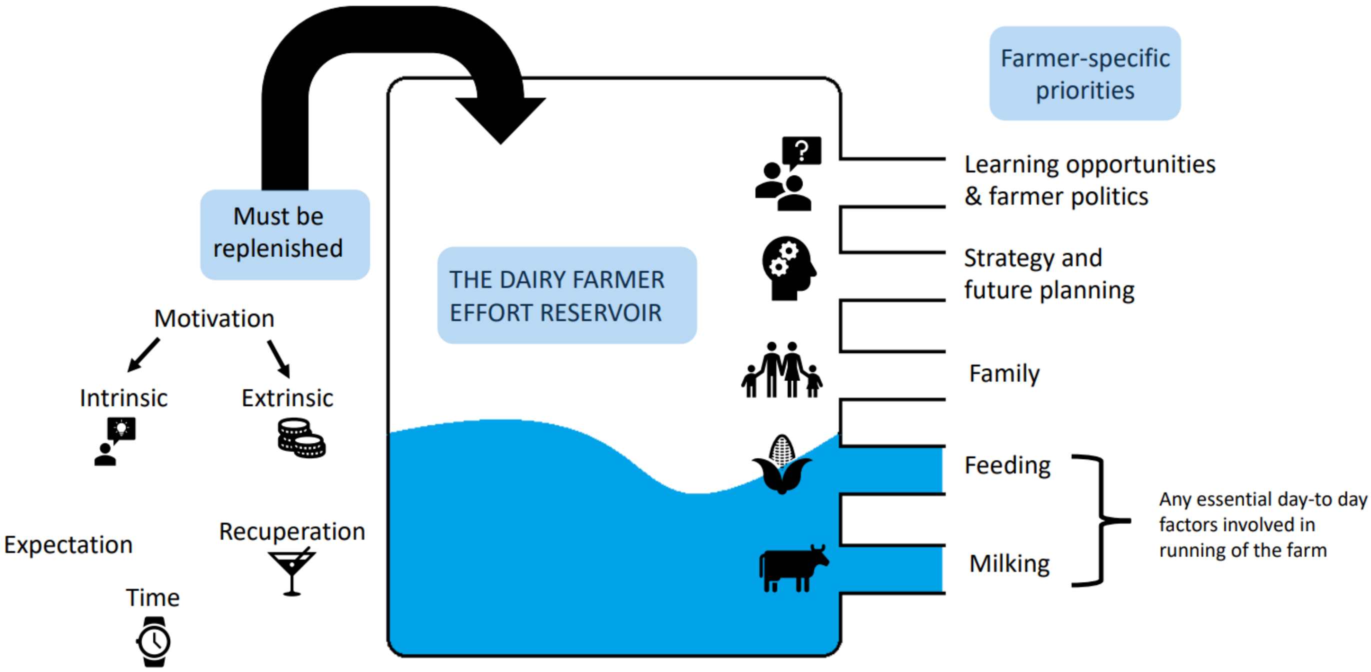


Figure 4.5.1: The dairy farmer 'effort reservoir'.

Some advisors in the current study reported noticing a transfer of attitudes of cattle health from one generation to the next, explaining that some farmers did certain things because they had always done it that way, or because that's how they had been taught by their parents. This was also found by Mills et al. (2020) where veterinarian participants commented on the benefits of some young farmers working abroad or away from home rather than learning the majority of their farming skills and information from their parents. The participants in the study by Mills et al (2020) viewed farmer education predominantly reflective of the traditional knowledge of the farm. Farmers and advisors in the current study suggested that some metabolic disorders could be treated without veterinary intervention, which made them easier to manage and may have contributed to farmers raising the threshold of intervention, acting later than perhaps necessary. New entrants to farming may have different attitudes towards transition cow health and management because they may not inherit generational attitudes from family members. There is a lack of literature surrounding new entrants in farming, however McDonald et al. (2015) investigated the motivations of new entrant farmers towards technology adoption and found that technology decisions of new entrant farmers are primarily motivated by financial considerations. Personal characteristics of new entrant farmers have previously been covered by McDonald et al. (2012), showing that the average new entrant farmer is a "young and highly educated male" with an agricultural education and is financially motivated. However, the study also reported also that the influence of family is a key driver behind decisions to enter dairying, along with their decision-making processes drawing largely from conventional wisdom shared with other members of the farming community.

Over-conditioned cows are at a higher risk of metabolic diseases, such as ketosis (LeBlanc 2010), fatty liver (Bobe et al. 2004) and milk fever (Houe et al. 2001). There is extensive scientific literature available which has focussed largely on the influence of body condition on metabolic disease incidence. In the current study, over-conditioned cows were accepted by some farmers as an inevitable problem that occurred, despite them fully acknowledging that their over conditioned cows were at higher risk of transition disorders. These farmers were unwilling to go to efforts to alter the high BCS. Additionally, the influence of the nutritionist was not discussed, rather BCS was considered an inevitable factor that may or may not cause transition issues, and if it did, farmers were armed with suitable reactive methods of solving the problem (such as monensin boluses, calcium boluses and mono-propylene glycol). This could mean that farmers don't 'see' the extent of the influence of body condition on metabolic disorders, because they have developed ways to manage the problem without veterinary intervention. As farmer 1 explained, sometimes farmers prefer a simple reactive solution to a more complex proactive one. This farmer went on to explain that when farmers experience a clinical case of metabolic disease, that one problem clinical cow is often seen in isolation, and the sub-clinical disease that may or may not be present in the background (that is 'hidden' and difficult to see) is not considered and is therefore not prioritised to be a problem that requires intervention. Farmers and advisors reported a general reluctance to make management changes unless absolutely necessary, with the notion that some farmers will adopt and continue with the most simplistic method of managing transition cows if they can "get away with it". This was due to farmers being busy and wanting to keep farm processes simple and less time consuming, rather than not caring for their stock. Additionally, farmers may not want to make management changes following past poor experiences with previous advisors, which may shape the desire to stay as they are and not search for 'hidden' metabolic issues that may require intervention. As Vaarst and Sorensen (2009) explained, when farmers feel a loss of control or a loss of faith and belief in their own ability to solve a problem, they lack motivation and strength to take action. Farmers in the current study adopted the values identified by Te Velde et al. (2002) by providing food drink and shelter, and a hygienic and comfortable environment. Researchers have explored the concept of the 'good farmer' (Burton 2004; McGuire et al. 2013; Naylor et al. 2018) in the light of understanding their conservation and production identities. Burton (2004) suggested that farmers can be reluctant to take on new practices that may be considered side-lines of productive farming, such as responding to government schemes that encourage farmers to into forestry management, which may undermine their primary identity as producers of the nation's food; essentially establishing that *farmers want to farm*. Sorensen et al. (2001) also suggested that because farmers must consider so many factors that shape their values, some factors are likely to conflict with others. For example, farmers may consider high welfare as a priority and want to provide more space for cattle, but this may conflict with the pressure to milk as many cows as possible to maximise milk sales. Farmers may prioritise their day-to-day workload and feel a sense of pride in reacting to and clinical transition disorders they face and feel reluctant to get involved in the complex nutrient and management requirements of the transition cow because it gets in the way of the 'hands on' farming. Farmers in the current study trusted their advisors to tell them when changes needed to be made, e.g. 'I leave all of that to my nutritionist', so if farm advisors are not proactive in making suggestions for improvement, identifying over-conditioned cows, and supporting farmers in making management changes, then practices may not remain at optimal standards. For example, when discussing cows looking underweight, one farmer stated, 'You never notice what's in your face all the time… it takes someone fresh to see it, who isn't afraid to say it.' Farmer awareness of risk factors for metabolic diseases may benefit from more objective measuring from independent outsiders such as the veterinarian, the nutritionist or paraprofessionals. Farmers who were not on an aligned supermarket contract and did not have to provide their milk buyers with BCS scores did not see the value in paying for an outsider to record BCS. More research is required to help farmers identify the importance of monitoring BCS so that it can be discussed with the nutritionist, veterinarian or consultant and addressed appropriately.

Farmers in the current study reported relying on simple and reactive strategies to manage the health of their transition cows, e.g., administering calcium at the point of calving for every cow, rather than employing a specific pre-calving diet to reduce hypocalcaemia risks, because administering calcium and monensin boluses was perceived to be simple, effective and timesaving. An over-reliance on existing strategies that may not be best practice could incur additional costs to farmers and have environmental implications (Wilson et al. 2009). This may be easily overlooked by farmers, those involved in their manufacture and sale and those recommending their use. Because of farmers' affinity for controlling metabolic diseases in a simple manner, farmers are unlikely to perceive direct risks to their farm brought about by the use of monensin and calcium boluses and may continue to use these as a reactive yet costly strategy. Wilson et al. (2009) investigated farmer adoption of integrated weed management (IWM) approaches that incorporate many tactics of prevention, avoidance, monitoring and suppression of weeds, rather than relying on herbicide control alone. It was speculated that farmer perception of the costs required to implement IWM exceeded the benefit derived from their use, and that farmers exhibit preferences to spend money on controlling weed communities with immediate benefits rather than investing in prevention strategies that may not be effective. It is possible that farmers are willing to invest in new practices, machinery and buildings when they can see an immediate benefit, and it may be difficult to see immediate benefits for transition cow investments during the pre-calving period because there is no immediate milk shipment to monitor, and perception of success during that time may not be as obvious and immediate to see. Rogers (2010) also explains that if practices don't adequately address short-term benefits, they are unlikely to be adopted.

When considering farmer usage of monensin boluses, it should be noted that they are a prescription only medicine prescribed by veterinarians for selective and targeted use on high-risk cows only (such as cows that are lame and excessively over or underweight) (Atkinson 2017). Monensin administered to cattle is excreted, and while it is biodegradable in manure and soil (Donoho 1984) it can pose environmental threats to aquatic ecosystems, and potential threats to human health (Perez et al. 2021). Despite the requirements for selective use, some dairy farmers in the study ignored this and administered monensin boluses to a large proportion or most of the herd, effectively 'blanket treating'.

4.5.3 Prevention of the problem

Record keeping and evaluation on farm are considered essential for monitoring herd performance and making effective adjustments to herd management (Barragan et al. 2016; Michels et al. 2019). Recording and benchmarking health disorders has been shown to encourage farmers to make changes in herd management by identifying areas needing attention and promoting discussion about best practices, such as calf management (Sumner et al. 2018). In the current study transition-related health disorders were recorded by 68% of farmers, of which 80% of those did so to meet the requirements of an aligned supermarket milk contract. This is considerably higher than that reported by Heuwieser (2010) in German herds where 39% of dairy farmers surveyed documented transition-related health disorders. Participants in the current study were however purposively sampled to represent an even split of dairy farmers on an aligned supermarket and non-aligned direct-supply contract, which may have influenced the number who monitored post-partum disorders. Of the farmers in the current study, 27% recorded BCS, which was 9% lower than that reported by Heuwieser (2010). None of the farmers in the current study documented the body temperature of freshly calved cows, which is in contrast to that reported by Heuwieser (2010) where a third of farmers did so. On 22% of farms in the current study the veterinarian visited the herd only if needed (no routine fertility visit), which is 51% lower than that reported by Heuwieser (2010). Of the farmers that were not required to take health records by their milk buyers, 59% chose not to monitor or document post-partum disorders because they did not have the time, or they did not think it was valuable to document. This is in keeping with the findings discussed by Burton (2004) who stated that farmers want to farm and do not want to be detracted from their main goals and priorities. Farmers are therefore less likely to take part in practices that demand more observation and attention to detail than conventional practices (Ingram, 2008), and can find processes such as form-filling off putting when it demands significant time and attention to detail (Edwards-Jones 2006). Additionally, Garforth et al. (2013) reported that some sheep farmers who had constructed flock health plans had only done so because it was required by the assurance scheme they were accredited to. Farmers in the current study felt that documenting health records was not a valuable use of their time due to the historic nature of the data, and that the action of recording the data was pointless unless it was to be used in a constructive way which would involve implementing a change in management or new protocols. Farmers can be reluctant to change (Blackstock et al. 2010), and advisors in the current study also reported this to be an off-putting factor when encouraging farmers to record health disorders, because often the data were not used in a constructive way, and as a consequence the process of health recording was deemed a time-wasting exercise. Conversely, farmers who took part (or were required to take part) in regular benchmarking were not put off by implementing changes in management found benchmarking to be useful. This heterogeneity of findings in the current study is similar to that found by Mills et al (2020), where benchmarking was generally seen as a motivating and helpful by some farming participants and not others. Mills et al. (2020) also reported that benchmarking could be seen as a barrier, with veterinarians reporting not showing the results to farming clients because they were unsure how they could use the data in a constructive way and suggest realistic changes to improve herd health without upsetting their clients. Sumner et al. (2018) found that farmers generally perceived benchmarking to be useful and motivating by peer comparison. Benchmarking is objective, and advisors can give their farming clients autonomy by allowing them to make choices in management based on the information they receive, meaning it can be co-constructed based on what the farmer perceives they can realistically change and achieve considering the farm-specific layout and barriers (Sumner et al. 2020). Advisors in the current study generally reported on the usefulness of objective reporting, as it helps to generate awareness of herd performance, with no emotion attached. Herd size influenced whether or not farmers took regular health records in the current study, also reported by Heuwieser (2010), with smaller herds choosing not to record as regularly. Farmers with smaller herds felt they did not need to document health records, with one explaining 'Take milk fevers for example, I know how many we've had anyway. And plus, it's such a low number, as in one last month, that I don't need to write that down' (Farmer 1). Similar findings were reported by Garforth et al (2013), where sheep farmers who didn't have a flock health plan chose not to because they felt it wasn't necessary 'because we know every sheep'. The current study found that in larger herds, data were more likely to be used to track herd disease statistics which were discussed with the nutritionist and veterinarian during herd health visits, as reported by Mills et al. (2020). Additionally, farmers with supermarket milk contracts kept regular health records and were more likely to interpret the data making use of those health records when compared with those who were on a direct supply contract. Supermarket milk contracts influenced farmer behaviour through incentivisation and creating a sense of competition between groups, suggesting that they have an overall positive effect on transition cow management.

4.6 Conclusion

The themes explored in this chapter from AYR farmers and their advisors have demonstrated how some farmers have become accustomed to seeing transition-related disorders occur, which in turn has influenced their perception of transition disorders, and the ability to notice when a change in behaviour or management is required. Results from this study also show that some farmers accept that their transition cows have become over-conditioned, despite acknowledging that this predisposes their cattle to metabolic disorders at and around the time of calving. The acceptance of over-conditioned cows was mainly due to a perceived inability to change dairy cow BCS easily and exacerbated by the aid of easy-to-use non-veterinary interventions and reactive strategies to treat health disorders that did occur. Farmer perception of transition cow dietary strategies and of space allowance were shown to be different to the actual findings on several farms. Possible ways to overcome this include farmers and advisors making special efforts to measure housing and space allocations and discussing how many cows can suitably fit in a building if they are to have minimal risk factors for transition-related disease. Most farmers that participated in benchmarking and health records did so because it was required by their milk buyer, but not all farmers that participated in this used the data appropriately or found it useful. Knowledge exchange efforts must be made in attempt to educate farmers and advisors in the importance of body condition and its influence on metabolic disease, so that reactive strategies can be minimised, and the risks of over-feeding cows and excessive weight gain can be reduced. More research could be conducted in this area to determine the root causes behind why so many pre-calving cows are outside the target ideal BCS range, and whether it stems from nutritional strategies, management styles, or both. Objective benchmarking is a useful non-emotive tool that can motivate farmers to change practices and create autonomy without damaging trust in the farmer-advisor relationship. Advisors are required to proactively discuss where improvements can be made, and the use of benchmarking may facilitate this by enhancing farmer awareness of metabolic disease and facilitating peer comparisons. This may help to provide solutions that are co-created acknowledge the farm-specific constraints, infrastructure and the farmers long-term priorities and goals.

5. Chapter 5: The farmer-advisor relationship

5.1 Introduction

The farmer behaviour and attitudes discovered in Chapter 4 could, in part, be due to interactions with advisors and their recommendations. In order to enact behavioural change, advisors must understand farmer-specific reasons why some recommendations may not be implemented successfully, and develop a tailored approach to farm issues, creating farmer-centred solutions that are co-constructed based on farmers' motivations. This requires advisors to be collaborative, engaged and sympathetic to their clients' needs (Bard et al. 2019). Furthermore, this approach must build on the tacit knowledge that is often used intuitively and subconsciously by farmers, thereby acknowledging local beliefs and practices and tailored towards the individual farm (Eastwood et al. 2012). In some cases, advisors can provide advice, yet farmer trust (or lack of) can impede behavioural change, and power relations, partiality and tensions can influence the degree of trust built with farmers (Sutherland et al., 2013). Additionally, advisors do not have automatic credibility and legitimacy - these have to be earned based on expertise and reputation (Cooper and Croyle, 1984; Vanclay, 2004), which further complicates the dynamic relationship between the farmer and the advisor. There is therefore a need to understand what influences the key actors who are engaged in managing metabolic diseases, as discussed in Chapter 1. Although one interview-based study has been conducted in Canada investigating farmer and veterinarians' opinions and barriers to transition cow management (Mills et al., 2020), to the authors' knowledge there have been no similar qualitative studies conducted in Europe, nor any involving non-veterinarian advisors on this topic. Indeed, Mills et al. (2020), while not including non-veterinary advisors in their study, emphasised a need to investigate the perspectives of nutritionists, feed representatives and business consultants. Key themes emerging from the qualitative data represent some of the complexities of managing the transition period from the perspectives of veterinary and non-veterinary advisors, and these themes include attitudes and experiences reflective of the sample diversity in this study. The main themes presented here contribute to a perceived lack of focussed transition management advice provided by advisors, and these related to advisors' commercial interests, a nervousness for advisors to get involved and advise on transition cow management, advisors not feeling valued, communication difficulties, and the perceived varying competencies of nutritionists, coupled with the lack of nutritionist training and regulation, as depicted in Figure 5.1.1.

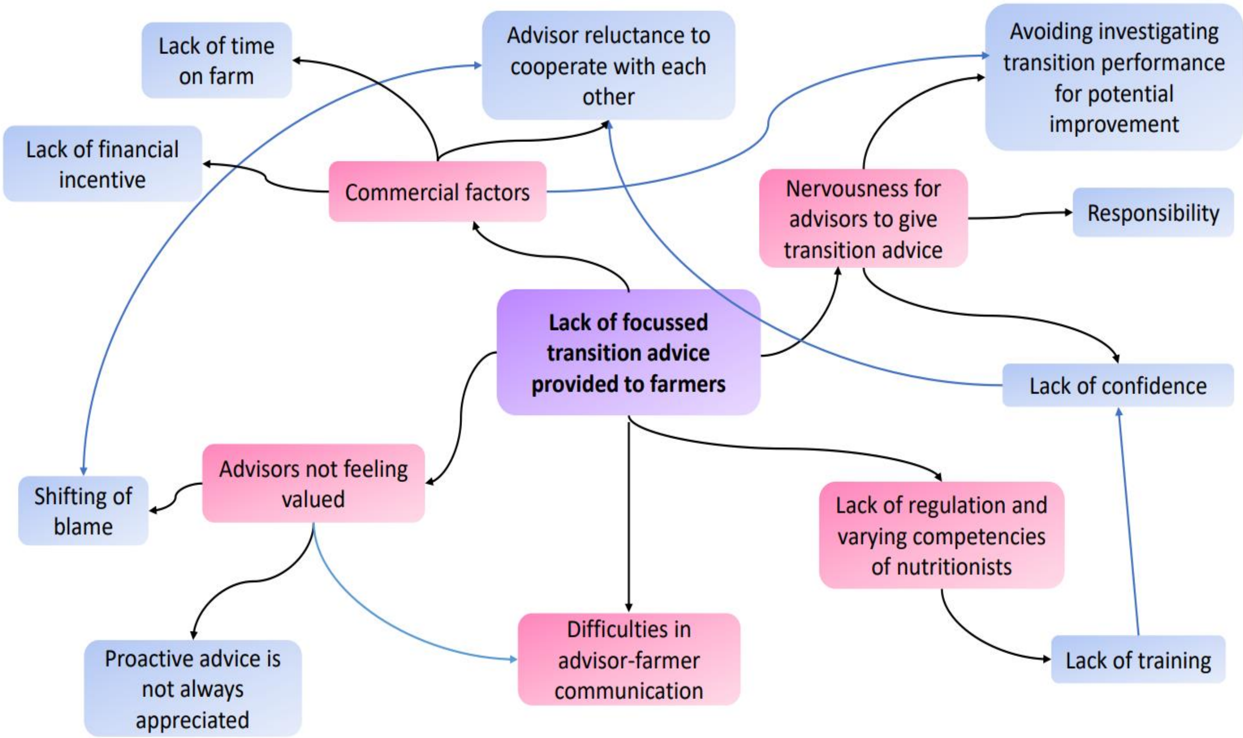


Figure 5.1.1: Thematic map depicting main themes from advisor interviews. Perceived barriers by advisors for providing focussed transition cow management advice to farmers, presenting the key themes (pink), and the sub themes (blue) that emerged from the interviews.

5.2 Advisor demographic information

All advisors came from different companies. The advisors were grouped on years of experience in their respective roles (Table 5.2.1); (1) < 5 years, n = 4; (2) 5-10 years, n = 6; (3) 11-15 years, n = 5; (4) 16-20 years, n = 4 and (5) >20 years, n = 5. The 22 veterinary and non-veterinary advisor participants were equally balanced by gender (male n = 6, female n = 6), and advised on both AYR and block calving herds.

Table 5.2.1 Demographic summary of participating advisors (n = 24) from England.

Advisor	Veterinarians	Type of advisor	Years of experience	Location	Method of interview
2	Veterinarian	Dairy specialist	15	Cheshire	Face-to-face
6	Veterinarian	Dairy specialist	15	Shropshire	Face-to-face
9	Veterinarian	Dairy specialist	8	Cambridgeshire	Telephone
10	Veterinarian	Dairy specialist	16	Cheshire	Telephone
11	Veterinarian	Mixed practice	5	Oxfordshire	Telephone
12	Veterinarian	Mixed practice	10	Herefordshire	Telephone
13	Veterinarian	Mixed practice	5	Cheshire	Telephone
14	Veterinarian	Mixed practice	13	Buckinghamshire	Telephone
21	Veterinarian	Dairy specialist	18	Staffordshire	Telephone
22	Veterinarian	Dairy specialist	2	Herefordshire	Telephone
23	Veterinarian	Mixed practice	17	Nottinghamshire	Telephone
24	Veterinarian	Mixed practice	22	Yorkshire	Telephone
1	Nutritionist	Feed supply	42	Shropshire	Face-to-face
3	Nutritionist	Independent	42	Cheshire	Face-to-face
4	Nutritionist	Feed supply	8	Staffordshire	Face-to-face
5	Nutritionist	Feed supply	3	Cheshire	Face-to-face
7	Nutritionist	Feed supply	15	Cheshire	Face-to-face
8	Nutritionist	Independent	20	Lancashire	Face-to-face
15	Nutritionist	Feed supply	1	Kent	Telephone
16	Nutritionist	Feed supply	10	Gloucestershire	Telephone
17	Nutritionist	Independent	25	Shropshire	Telephone
18	Nutritionist	Feed supply	2	Leicestershire	Telephone
19	Nutritionist	Mineral supply	5	Cheshire	Telephone
20	Nutritionist	Mineral supply	12	Derbyshire	Telephone

5.3 Commercial factors

5.3.1 Advisors under time pressure

Transition cow management was perceived to be a confusing area of dairy cow management by all advisors which, according to nutritionists, required more time spent on farm and time spent training. Advisors spoke of being under time pressure, particularly feed-sales representatives and nutritionists who were under pressure to meet targets and visit as many farms as possible:

> ‘When you’re selling feed, you’ve got to get around as many farms as possible. And meet targets. And sometimes, if you don’t meet those targets, you don’t keep your job. So, you can’t blame reps [feed company representatives] for not wanting to stand around chatting about transition when its complicated, and the commission is small’ (A4, feed company representative).

> ‘I’ve operated independently for 22 years… I’m not answerable to anyone else other than the client, I don’t have a sales manager over me asking me why my sales are down this month. [Feed company representatives] are not there to stand around talking about transition cows, they’re expected to go on farms selling them a tonne of milk powder or get the dairy cake [concentrate] order’ (A17, independent nutritionist).

5.3.2 Financial disincentives for nutritionists and feed company representatives

The financial rewards for feed company representatives to gain commission on dry cow feed is minimal in comparison to that gained when feeding the milking herd. For this reason, advisors speculated that feed company representatives were less eager to advise farmers on transition cow management in order to seek financial gain from the sale of a product:

> ‘From a commercial point of view…it is minimal tonnage really, isn’t it? Most people will focus on the milking herd to get the tonnage. I think the consultants and the other people that aren’t paid per tonne probably look at dry cow management more, but I know full well that the guys I work with will go after the dairy [concentrate] long before going near the dry cows.’ (A20 - mineral supplement representative).

> ‘I think a lot of advisors on farm are nervous about tampering with the dry cow system and I think commercially as well, when we look at commercial businesses, they do tend to focus on the lactating dairy business because of the volume of

food to consume and miss out a lot on the dry cow element. So, I think there is a commercial element to it which I don't like to say but we've got to be realistic and honest about it and I think that is the case. I'm not saying it's right, but I think that it does occur.' (A16 - feed company representative).

'Transition is a really complicated topic, it's a very short time where an awful lot happens, and so much has the potential to go wrong. And I can understand from a sales perspective it's not really where the tonnes are is it? To be really frank about it.' (A16 - mineral supplement representative).

5.3.3 Lack of advisor cooperation

Although farmers appreciated their veterinary and non-veterinary advisors co-operating to discuss transition cow health, all advisors claimed that advisor collaboration did not occur enough due to a lack of mutual respect, and a defensive attitude between veterinarians and nutritionists for commercial reasons:

'There is a lot of animosity between vets and nutritionists. A massive, massive amount!' (A3- independent nutritionist)

'We end up fighting and blaming each other, and some will always blame the feed supplier.... they say you're not feeding enough energy, that's a favourite, or the [parlour concentrates are] rubbish. No, it's not, it's usually the management is wrong!... Some vets would immediately fight you off or undermine you… we should be trying pull the rope the same way, that's the big cliché. We're in a tug of war on the farm, and my role is to pull it the same way [the farmer] is pulling it' (A1- feed company representative).

Defensive behaviour was perceived by veterinarians to be more common with feed company representatives rather than independent nutritionists. This could be because independent nutritionists may be more qualified or experienced, and therefore more comfortable in holding a conversation with a veterinarian, as mentioned in the following excerpt:

'The more sort of technical nutritionists that I've worked with I don't get that [defensive] vibe from if I'm going to be opinionated. I get the defensive attitudes more from the salesmen type of people [feed representatives], than the [independent] nutritionists. Like the guy who is making sure the orders are coming in and the protein levels are being tweaked when they turn out, that level of nutrition work. Not necessarily the independent guys and girls who have done degrees in agriculture and nutrition and PhDs and what not, you know, that level don't seem to feel threatened' (A10- dairy specialist veterinarian).

It was suggested that the lack of collaboration between veterinarians and nutritionists was partly due to a lack of veterinarians training in nutrition, and therefore a lack of understanding the role:

> 'The vet and nutritionist should be working together symbiotically, because how is the nutritionist going to know there is a problem, or vice versa if there is no communication? There are plenty of farms where I have never met the nutritionist and I've been doing the routine there every week. And that's just how some of them function, it's a very different approach. I think that's one area that's important, having a joined-up approach. And vets having a bit more training in it as well, because I definitely feel that I lack some vital knowledge about having a discussion in depth about a nutrition problem.' (A11- mixed practice veterinarian).

> 'Some of my younger colleagues who are maybe a bit less confident don't feel ready to ring up the nutritionist because they would feel intimidated about having that conversation. And they wouldn't be so ready to challenge a nutritionist in a constructive way, they would just agree with what they said. They probably wouldn't suggest trying something new, so it works both ways, the nutritionists who are less technically able are less likely to ring up the vet and have a chat' (A14- dairy specialist veterinarian).

5.4 Nervousness of advisors to give advice on transition cow management

5.4.1 Carrying responsibility

Providing transition advice was perceived to be high-risk, with a fear of receiving blame if the advice provided did not result in a positive outcome. This was perceived to be more of a problem for nutritionists and feed company representatives than veterinarians, as highlighted by the following quotes:

> 'I thought I was under pressure as a vet, but in a way, it is much more pressure as a nutritionist I think' (A5 - feed company representative who previously practiced as a veterinarian)

'The minute you take on some responsibility for dry cow feeding your head is on the block, isn't it? Sometimes it's safer to just not enter that arena. The more prescriptive you get, the more responsibility you carry. And the more the problem lands with you if it doesn't work' (A1 - feed company representative).

'When things are going well, nutritionists get no credit, then if things go badly everyone is pointing fingers at you, so I can see it's a terribly difficult job and... you don't want to bring up a problem do you? If you're in that situation... Whereas with vets, it's a bit easier because it doesn't necessarily reflect directly on us' (A14 - dairy specialist veterinarian)

'This is where the commercial side comes in, if the nutritionist is on a farm and he thinks the farmer is not listening, he should really tell the farmer and go. Because if they aren't listening and they get inspected by a vet, who's going to get the finger pointed at them? So, it is a difficult one. There are commercial pressures on a lot of people.' (A3 – independent nutritionist)

This nervousness about getting more deeply involved in transition cow nutrition was due to the perceived high risk of farmers suffering losses to metabolic diseases:

'I think quite a few people know how to ration a dairy cow, but dry cows can really freak people out. I think if you get dry cows wrong you can have quite big impact on subsequent lactations, fertility, and all sorts of things. I think people shy away from it.' (A20 - mineral supplement representative).

5.4.2 Lack of self-confidence

Veterinarians spoke of experiencing a lack of self-confidence and assertiveness when advising dairy farmers on transition cow management particularly when they were younger and less experienced in practice. Eleven out of the 12 nutritionists in this study spoke of having a lack of confidence in this area, however this was due to conflicting management strategies, and the issue that one nutritional strategy could work on one farm but not another as there were often other external and confounding farm factors affecting transition success:

'I do think there is a lot of conflicting advice from a nutrition point of view definitely. There are no hard and fast rules at the moment, because there's not a huge amount of evidence… so many people have different systems and different things suit different systems. Farmer A could do something that if Farmer B tried could be a complete disaster, even though Farmer A had no problems. I'm a big advocate for controlled energy and I very much stay away from steaming up [feeding higher levels of concentrates during late pregnancy to increase body energy reserves] wherever I can, it might get the milk post-calving, but then you've got an increase in negative energy balance and a longer return to positive energy balance. But a lot of nutritionists like to steam up dry cows, and the methods are totally conflicting.' (A20 - mineral supplement representative).

'It takes a lot of trust, its nerve wracking. I still get that funny feeling when you make a big ration change, and they say they will try it and you think oh [*swears*]! And you know in your own head on paper it will work, but this is the problem with everything on farm, there are so many components, with management and health.' (A19 - mineral supplement representative).

A lack of self-confidence to bring up transition cow management in conversation with their farming clients was mentioned by one feed company representative to be due to a lack of technical training, and training in the products that they were selling:

[Speaking of working previously at a firm specialising in transition management] 'I didn't feel like I had enough training in the [transition] feeds they were selling, I didn't feel confident advising farmers which dry cow feed to go on that much because I didn't know them well enough.' (A15 - feed company representative)

While there was lack of individual self-confidence and assertiveness reported by advisors, this also linked to a lack of confidence in published scientific findings, which did not always result in a successful outcome. This lack of confidence was exacerbated further by the high number of environmental and management factors influencing the effectiveness of transition management strategies, which were beyond the advisors' control:

'There's a confidence issue too because it is a very complicated matter, it is complex. A simple dairy cow ration is straightforward but with transition every dairy farmer has different limitations, environment, stocking rate, climate, cow history- they've all got huge parts to play. You can have a transition programme on one farm that works like a dream, you could replicate it on another, but it won't work because there are other variables in the background that are just screwing it up. So, I do think it's a confidence issue' (A18 - feed company representative).

> ‘The metabolic issues are coming from not managing them properly, whether its heat and space, or overstocking and high cell counts. They build these massive new sheds for their milkers and increase their milking cow numbers and not realise that in 9 months’ time there will be an extra 20 cows calving down into a shed that is the same size!’ (A15 - feed company representative).

Despite advisors understanding the external factors that influence transition success, both veterinarians and nutritionists reported feeling blamed for when it went wrong, despite their best efforts, and even when the fault was due to the farmer not implementing the management strategy properly, or the farmer making changes to the ration without notifying their advisors. This exacerbated the lack of confidence advisors were experiencing, because even when farmers did not follow instructions, the advisors felt they would be held accountable for an unsuccessful transition:

> ‘I feel like farmers are setting me up for a failure sometimes. They have a problem; they ask my advice, but they just don’t do it. Or they do it totally differently, or feed something else. Then they get frustrated with me, which is exhausting. But actually, they’re frustrated at a problem they have created. I just feel like saying: ‘don’t blame me for this, you didn’t follow my instructions!’ (A3 - independent nutritionist).

5.4.3 Avoiding investigation of transition management and performance

Advisors were reluctant to ask questions or advise on the current performance of transition cows, fearing that it would highlight the need to make changes or recommendations, which may not result in a positive outcome for their business:

> ‘Why would you risk your commercial involvement with the farm for trying to take on one last bit of area of management that isn't going to work? You know he's going to have cows that calve within a week of being dried off, you know he's going to have cows that never calve, so he could see what you have done as perhaps...failing. That’s why you would keep away from being proactive, and just getting involved where there is a problem, but otherwise just keeping away.’ (A1 - feed company representative)

> ‘If you’re supplying product in there, you’re not inclined to go looking for trouble. If the farmer hasn’t mentioned it, they’re not going to go and open a can of worms by saying actually something could be better, when they are feeding their fancy dry

cow roll [concentrate feed] … with a customer I think human nature means that nutritionists don't want to ask certain things' (A17 - independent nutritionist).

5.5 Advisors not feeling valued

Both veterinarians and nutritionists were discouraged from giving proactive transition advice to farmers when they did not feel valued or listened to by their farming clients. In particular, feed advisor representatives felt disinclined to provide advice to farmers when they thought there was a possibility of losing that customer to another firm, based on price per tonne of feed. Feed company representatives perceived that the farmer did not value feed representatives who provided advice alongside selling a product, therefore the farmer was considered undeserving of that advice. This was often backed up by an anecdote with a negative experience of losing a farm client, despite the nutritional input and advice from the sales representative:

> 'You can lose a customer to £3 per tonne, so you think: 'why should I break my neck investing a lot of time and giving them a lot of free transition advice when they go and leave you?' If you don't feel valued, you don't want to stick your neck out for them all the time.' (A4 - feed company representative).
>
> 'I think farmers give people a try and when they feel like they've learnt something from them, they shift. They're not very loyal sometimes' (A13, mixed practice veterinarian).
>
> 'So, I gave the farmer a free bit of advice based on sensible observation of his cubicles, that worked. That will have earned him lots of money for the rest of his farming career. And a delivery goes wrong *[snaps fingers],* and like that I am sacked. And that's another reason why sometimes you can understand the cynical salesperson who just sells' (A1 - feed company representative).

One feed sales representative suggested that the attitude of farmers accepting mediocrity, along with the risk of offending the farmer and affecting the farmer-advisor relationship influenced advisor likelihood to offer advice to change:

ER: ‘How often do you make a special effort to discuss transition cow health on farm visits?’

A1: ‘As required. In some cases, this might sound defeatist, but some people accept mediocrity and medium results and there’s no point discussing any change, so you just let it roll. And only when it gets desperate do you perhaps tell the guy. If he's happy with poor results, some cases you must be happy with them as well. Otherwise, you'd just drive yourself insane. You also risk really offending the guy by telling him he’s actually doing a really rubbish job’.

Veterinarians, however, felt discouraged to give proactive transition advice for different reasons. Rather than commercial competition affecting this, veterinarians felt frustrated when they were unable to make a positive difference on their clients’ farms because some farmers did not adopt the advice provided, even after a longstanding relationship between the farmer and veterinarian:

‘I can think of a farmer I went to on Tuesday, 1000 cows and I've worked with him for 12 years, and I can't think of ANYTHING I have managed to change there, from a transition cow perspective, that’s stuck. We have done specific transition visits, loads of reports, data analysis. So that’s quite depressing. You think: ‘why do I bother?’’ (A2 - dairy specialist veterinarian).

‘When I was younger, I would be going in investigating all these problems and saying, “Let’s do a transition review” and all the rest of it, and now with those farms I am just aware that its literally like banging your head against a wall! Because you put all that effort in, they don't do anything that you've suggested and three months later they say to you, do you know why we might be getting a few milk fevers? And you literally stare at them with your jaw on the floor and that’s so frustrating because you just feel like everyone’s laughing at you, because you go above and beyond putting a lot of effort in and it’s just thrown back in your face. And you've not charged for it appropriately either.’ (A11- dairy specialist veterinarian).

Advisors also perceived farmers to value transition cow ‘fire-brigade’ services more than preventative services, because they were seen to be solving a problem. It was thought that farmers couldn’t always attribute transition success to the advisor’s proactive planning as this was more difficult to see. This was made more complicated by the farmers being busy and may not want, or be able to, make the time to discuss transition issues:

'If you do a bad job and end up fire brigading all the time, they often think more of you because you've had a problem and you've been in and sorted it.' (A3- independent nutritionist).

5.6 Difficulties in communication

Farm advisors expressed frustrations with the difficulties in getting farmers to adopt advice, and advisors perceived nutritionists to have better communication skills than veterinarians, and an ability to 'get the message across' to farmers. This was found to be frustrating by some veterinarians:

> 'It's quite frustrating sometimes, because the farmers do often take what the nutritionist says more than what the vet says' (A11- farm veterinarian).

> 'Sometimes I think vets are so knowledgeable that they almost bore farmers, whereas the likes of you and me are on their level a bit more. We can speak to [farmers] as they speak to each other.' (A18 - feed company representative).

Interestingly, the view that an advisor's sales-motive hindered the farmer's trust was not limited to feed company representatives, as veterinarians were also seen to have a sales-motive, and this was also perceived to be a communication barrier between veterinarians and their farming clients:

> 'I kind of get the feeling that a nutritionist who is good at talking to people actually gets through to farmers a lot better than the vet does. I've had a couple of farmers who absolutely rave about the service they have from [feed firm], and they say that they come in and do this whole holistic approach, it's amazing, we've had less [left displaced abomasum] and better yields, and I think they're only doing the things that we have been telling them to do for years as vets! But they haven't listened because they just see us trying to sell them stuff' (A12- mixed practice veterinarian).

Communication skills were highlighted by advisors as important factors in getting farmers 'on their side', ultimately in order to either adopt their advice or to buy the product the advisor was selling, or both. Communication skills were also perceived by advisors to be influential in whether veterinarians (and other advisors) were considered good or bad:

‘It’s all to do with communication, and some of the best vets can be considered not good vets by farmers, because they haven’t got the right chat. And similarly, unfortunately some vets that aren’t really very good as vets can be considered really good vets by the farmer because they can read the farmers and say the right things at the right time’ (A21- dairy specialist veterinarian).

5.7 Regulation and competency of nutritionists

Advisors expressed their concern for the perceived lack of regulation of nutritionists in England, and how this impacted the health and nutrition of transition cows, due to the varying abilities and competencies of nutritionists and feed company representatives. The Feed Advisor Register (FAR) was established by Agricultural Industries Confederation (AIC) for farm nutritionists (www.agindustries.org.uk/feed-adviser-register.html), in response to industry and government demands to reduce emissions from farmed livestock. Nutritionists explained how becoming FAR registered involves participating in online modules and a multiple-choice questionnaire. The nutritionists’ opinions of the FAR in the current study were mostly negative, suggesting that the examining questions were not challenging enough, as highlighted in the following excerpts:

‘When does a feed rep turn into a nutritionist? When does a nutritionist just become a feed rep? The word ‘nutritionist’ is a dangerous word! Does it exist? Is there a qualification for it?’ (A1- feed company representative).

‘I think [FAR] lacks substance to be brutally honest. I think it was done as an industry initiative to really think about how to combat greenhouse gases, that’s ultimately why it was there to try and link environmental stuff with nutrition, which is important obviously, but it lacks teeth. The training and the assessments are in reality so easy... The FAR, it’s not enough. The average farmer doesn’t even know it exists’ (A17- independent nutritionist).

‘You couldn't call it [FAR] a force for good yet but it’s a step in the right direction’ (A5- feed company representative)

Other methods of accrediting nutritionists include postgraduate university degrees, becoming a BSAS Certified Animal Technologist (https://bsas.org.uk/assets/uploads/docs/entries/2020.12.12_BSAS_Accreditation_Application_Guidelines_Technologist_.pdf), and applying to be on the UK Voluntary Register of

Nutritionists (UKVRN) (https://www.associationfornutrition.org/register).The majority of veterinarians and independent nutritionists felt that more was needed to regulate nutritionists due to the potential financial loss a farmer could incur if the wrong nutritional advice were provided:

> ‘I think it should be regulated, wholeheartedly. The attitude that someone is 'just' a nutritionist is silly. The nutrition on a dairy farm is absolutely a lynch pin of pretty much everything. So, they are in a spectacularly responsible and powerful position. And I think if you've got people out there who are not up to scratch and up to speed, they can cause an immense amount of damage and financial loss. Particularly with transition cows’ (A12-mixed practice veterinarian).

> ‘Well, there are definitely different levels of competency when it comes to nutritionist. Yes, I think it should be regulated, people need to be safe and do no harm. If you're selling feed minerals that are essential, and you're not calculating how much magnesium the transition cows are getting and they all die, who gets sued?’ (A13- mixed practice veterinarian).

Nutritional competency and qualifications were deemed particularly important when concerning nutritional strategies relating to the dietary cation and anion balance (DCAB) of pre-calver diets. Diets with DCAB strategies were perceived to be complicated and high risk to successfully implement, and this risk was exacerbated by the lack of regulation and formal qualifications required to be a practicing nutritionist:

> ‘Nutritionists just aren't touching [DCAB]. We can't even get people to do the DCAB diet properly. They don't want to know, they aren’t trained in it, they don't understand it, they don't want to talk about DCAB with their farmers’ (A3-independent nutritionist).

> ‘There’s a lot of conflict about DCAB now, for example. Not many people understand it, number one. Number two, it’s not easy to achieve’ (A5- feed company representative)

> ‘I get nervous of a DCAB ration. You'd be surprised, there are many people doing DCAB and a lot of un-qualified people who aren’t doing it properly, or looking at urinary pH’ (A7- feed company representative)

5.8 Discussion

It is important to understand the context within which farmers and their advisors operate (Palczynski et al. 2020; Robinson 2020). The themes explored in this study, many of which are interconnected, demonstrate a diverse group of feed and veterinary advisors whose individual experiences, perspectives, and contexts impact their advice on transition cows, their farmer-advisor relationships, and the advisor's willingness to provide focussed transition-advice.

5.8.1 Commercial factors

A lack of time during farm visits was a major factor that impacted the amount of focussed transition management advice provided by feed company representatives. This was due to commercial pressures to visit as many farms as possible, in order to increase their chances of selling more products and feed, and meeting sales targets. As transition cow management was perceived to be a complicated area with multiple farm-specific limitations, it was also considered to be an area of farm management that required considerable time and discussion. Time pressure has similarly been shown to influence veterinary behaviour in companion animal care, with veterinary surgeons feeling that they had to rush and keep discussions minimal to ensure that consultations were within their allocated time (Belshaw et al., 2018), and in farm animal practice where veterinarians felt that time constraints impacted their ability to collect and analyse herd-fertility data (Mee 2007).

The current study outlined that most nutritionists and feed company representatives are paid a commission when they sell a compound feed or product. For this reason, nutritionists and feed representatives who were paid per tonne prioritised the feed sold to the main milking herd. The commission gained from advising farmers and selling a dry cow or transition product was perceived to be far less of a financial incentive. To the authors' knowledge, no research has been conducted to specifically investigate the commercial incentives influencing veterinary and non-veterinary farm advisor behaviour. However, Mee (2007) suggested that veterinarians may not be 'hungry enough' to provide fertility management services when there is less of a financial incentive, and because the opportunity cost of their time is high, they see less of a competitive return on investment when upskilling and providing additional services. In a similar vein, Charlton and Robinson (2019) suggested a lack of financial incentive for veterinarians to provide advice on anthelmintic use when the products were often being purchased elsewhere by their farm clients.

Within human health care the patient's outcome depends not only on medical skill, but also on 'people factors', such as communication between other roles, teamwork, and collaborative care (Firth-Cozens, 2001). Similarly, in companion animal practice, both veterinarian surgeons and veterinarian nurses are required for optimal patient care (Kinnison et al. 2014). Considering the significance of the role of nutrition in dairy cow health, and the importance of the veterinarian for emergency procedures and routine care, one can speculate that when the veterinarian and nutritionist work together to combine skills and experiences and maintain an open communication, they can have positive impacts on dairy cow health and farmer satisfaction. Both veterinary and non-veterinary advisors expressed difficulties in collaborating with one-another from different areas of professional practice. This was mostly attributed to a lack of mutual respect which influenced the advice offered on farm due to the 'animosity' between advisors and a shifting of 'blame', which resulted in the lack of farm advisors working collectively to solve farm challenges. Similar findings were reported by Ruston et al. (2016), who outlined that veterinarians felt threatened by non-veterinary advisors also offering preventative herd health measures. May et al. (2017) suggested that veterinarians and nutritionists can work together when 'blame' is removed. Challenges in collaboration of inter-professional practice can be seen in parallel in other areas of veterinary practice including small animal practice (Kinnison et al. 2014), working with farriers (Moyer et al., 2012) and with equine physiotherapists (Bergenstrahle and Nielsen, 2016). These difficulties centre on power, status, the appreciation of professional roles, and lack of (or poor) communication (Kinnison et al., (2014). Conflicts among professionals often stem from misconceptions about each profession's role (Englar et al., 2018). The advisors in the current study reported that there is no regulation of the use of the description 'nutritionist', so "nutritionists" can carry no qualifications and have a limited professional experience. This lack of regulation could contribute to the lack of mutual respect and appreciation of professional roles between veterinarians and nutritionists, and between other nutritionists themselves. Advisors did speak of the importance of culturing relationships for the farmer's benefit, but they understood it could be difficult, particularly when advisors feel less confident, experienced, or less knowledgeable on a topic. The conflicting theories and strategies relating to transition cow management are unlikely to help this, particularly when different advisors suggest different practices. One method to combat this reluctance to cooperate in veterinary practice is inter-professional education, a method used previously to encourage veterinary practitioners to learn with, from and about each other to improve collaboration and quality of care (Kinnison et al. 2011). Englar et al., (2018) conducted inter-professional education courses for human-health care and veterinary students and found that their unfamiliarity with their professions hindered their ability to collaborate. Additional research is required to address the gaps in knowledge and mutual respect for farm-advisory roles by correcting common misconceptions and recognising the contributions made by all parties on farm.

5.8.2 Nervousness for advisors to get involved in transition cow management

Advisors reported that when the dialogue on farm moved specifically towards transition cow management, they were more likely to 'shy away' from providing focussed transition advice due to a lack of confidence. This lack of confidence was due to the perceived high risk of the outcome being unfavourable - a risk partly attributed to farmers not properly implementing the management strategy, or external factors beyond the control of the advisor. Often, when problems are not solved, despite following the advice perfectly, the farmer will blame the failure on the quality of the advice (Derks et al. 2012). Both veterinarians and nutritionists reported feeling blamed for a lack of transition success, even when the fault was due to the farmer, which could further increase the 'high-risk' perception of advising in this area of dairy cow health. Mills et al. (2020) investigated farmer perception and barriers to transition cow management and presented similar findings, suggesting that farmers felt that their nutritionists were largely responsible for the success or failure of their transition cows, and that they would be "held accountable" for the outcome. The lack of confidence from advisors was partially attributed to the complexities of managing transition cows with farm-specific limitations, and the conflicting strategies that are published in the scientific literature. For example, some dietary strategies have been put forward which include feeding higher amounts of concentrates pre-calving in the close-to-calving groups (Gerloff, 2000), also known as high-energy conditioning diets (Grummer, 2004), to better prime the rumen for the post calving diet and reduce body fat mobilisation (Friggens et al., 2004). Cardoso et al. (2020) suggested a controlled energy diet, high in low-energy density fibre which reduces the level of insulin resistance post calving. Feeding controlled energy diets resulted in positive health impacts, such as lowered plasma non-esterified fatty acids, and a reduction in liver triglyceride concentration, but also a reduction in milk yield and milk fat when compared to high-energy dry cow diets (Silva-del-Rio 2010; Janovick et al., 2011). Mills et al. (2020) also illustrated disagreement in the application of scientific research, with some farm advisors finding scientific research difficult to apply at farm level, due to conflicting results from different studies. Nutritionists and feed representatives stated that they cannot afford to risk untested practices in such a competitive industry. The risk of losing credibility with farmers also governs the actions of other farm advisors, as seen with agronomists (Ingram 2008).

As there is generally less focus on transition cow management due to commercial factors and financial incentives, advisors may not prioritise learning more or refreshing their knowledge relating to this area of dairy cow management, and this may contribute to lower confidence levels. Roberts and Murray (2013) investigated perceptions of equine veterinarians and established that they were less confident advising on areas that they had received less professional training on and were less confident when their role covered multiple species rather than being equine-specific. Repeated and frequent use of transition cow knowledge may increase advisor confidence. Heath (2004) reported that mixed practice veterinarians who had limited equine clientele were concerned about staying current on equine-related information, reducing their confidence in providing equine-health advice. Lower advisor confidence levels in the current study may be due to relatively little education and training on transition management during professional training, or perhaps these participants had encountered fewer transition related cases in their practices. Similarly, advisors covering other species in general practice (mixed practice veterinarians, or nutritionists that cover beef and sheep nutrition) may be less confident and knowledgeable providing transition information compared to dairy-specific advisors, as demonstrated by Roberts and Murray (2013) for equine nutrition advice. Additionally, because nutritionists are not regulated, some nutritionists and feed representatives may have had no formal training. Veterinarians have shown to be more confident in topics where their clients are more knowledgeable, as seen in equine practice (Parker et al. 2018).

Regarding setting targets and goals tailored to the farm, advisors in the current study spoke of actively avoiding asking questions about transition cow health on farm to avoid the need to make new changes and recommendations, particularly if the farmer was using a transition product or feed from that advisor. Previous literature shows a reluctance for veterinarians to establish farmer goals because they felt they could be judged unfavourably if those goals were not met (Derks et al., (2013). The evaluation of veterinary communication skills during herd health visits showed that often no goals are set or evaluated (Jansen et al., 2010). Factors associated with transition cow health include nutrition, body condition and stocking rate (Atkinson 2016), and Mills et al. (2020) explained that when farmers perceived an inability to change these factors they may prioritise other farm goals that may not be deemed as important by their advisors. Derks et al. (2013) also established that veterinarians did not actively seek to identify farmer goals or problems, and that this should actively be sought by veterinarians as most farmers do not readily volunteer this information. Similarly, Bard et al. (2017) reported that veterinarians assumed the drivers behind farmer motivation, and it was not explicitly asked of them. The current study highlighted a disconnect between advisors and their farming clients, and that advisors are not actively seeking and discussing the true priorities of their farming clients relating to transition management. It appears that there is a requirement for advisors to establish the main priorities of their farming clients, and for more effective training on transition cow management for advisors that do not feel confident enough to try to meet the determined goals.

5.8.3 Advisors not feeling valued

The agricultural feed industry is competitive, and in cases where nutritionists and feed company representatives were paid commission on the tonnes of concentrate they had sold, some did not feel their advice was valued, and farmers were considered undeserving of focussed transition advice based on the lack of farmer loyalty to their nutritionists and feed representatives. This contrasts with the farmer-veterinarian relationship, where Ruston et al. (2016) explained that although trust must be earned, farmers tend to be very loyal to their veterinarians. Farmer loyalty appears to be influenced by the trust in their advisor, and advisors in the current study perceived farmers to be reluctant to trust feed company representatives due to their primary sales motive. Farmer loyalty and respect has been shown to influence the farmer-advisor relationship in the field of agronomy, with farmers shifting their loyalty to "more switched on" agronomists if they lost confidence in their current advisors (Ingram 2008). Veterinarians in the current study were frustrated when they were unable to instigate a behaviour change, or when farmers would not adopt advice, particularly when they had a long-standing relationship with their client. Behavioural changes are often difficult to initiate and sustain, and reasons for this differ from person to person (Speksnijder and Wagenaar, 2018). While behavioural changes are often facilitated by trusted advisors such as the veterinarian (Rose 2018), the intention to change and the transition into action is usually governed by the intrinsic motivation of the farmer (Bopp et al., 2019).

The advisors in the current study had complex relationships with their farming clients, and perceived that farmers thought highly of independent nutritional advisors, and negatively of feed company representatives. Mills et al. (2020) reported that Canadian nutritionists had "limited" relationships with dairy farmers, but it is unknown if these nutritionists were independent, or if they were feed company representatives. Interestingly, while the nutritionists stated that farmers held them accountable for their transition cow success or failure, advisors spoke of proactive veterinary advice not always being valued highly. Richens et al. (2015) established that the identification of the veterinarian as a 'fire-fighter' was linked to a sense of pride that some farmers rarely had to call their veterinarian, and how often the farmer called their veterinarian was used as a gauge of their herd's health. However, in a study examining veterinarians' opinions and drivers to proactive flock health, Bellet et al. (2015) reported that veterinarians perceived a problem with delivering predominantly reactive services only when problems occurred. While veterinarians are aware of their requirement to be proactive, they often struggle to maintain this in daily practice (Mee, 2007). The extent of this was highlighted by Ruston et al. (2016) where veterinarians reported difficulties in influencing farmer behaviour change, and despite coming under pressure to shift their role to a more preventative herd-health advisor, veterinarians were not promoting disease prevention services effectively to farmers. A reason for this could be because veterinarians perceive that farmers do not value their preventative services, and therefore they only offer what they think the farming client wants (e.g., “fire-brigade” approach) in order to avoid upsetting the farmer-veterinarian relationship. Veterinarians in the current study reported difficulties in taking a proactive approach to transition cow management, particularly when the veterinarians perceive certain problems or issues to be more important than issues perceived by their farmer clients. It is possible that due to the hidden nature of subclinical metabolic diseases, farmer perception of metabolic problems is minimal, compared to veterinarians' perceptions. Farmer perception of bovine health issues has been investigated by Leach et al. (2010) and Tunstall et al., (2019) who established that farmers underestimated lameness in their herds. The current study demonstrates potential differences in how veterinarians and farmers prioritise herd health issues, with veterinarians expressing their frustration trying to get their farming clients to implement new practices, adopt their advice, and focus on areas of farm management that they deemed to be more important.

5.8.4 Difficulties in communication

Veterinarians in the current study were keen to engage and educate their farming clients on managing their transition cows effectively, similar to the findings of Robinson (2020) when investigating farmer and veterinarian opinions on managing Johne's Disease in dairy cattle. However, in the current study veterinarians reported challenges in evoking change and persuading farmers to take on new or improved practices that would improve the health and welfare of transition cows, despite having a long-term trusting relationship with the farming client. Veterinarians highlighted communication as their main limiting factor towards getting farmers to adopt advice, which corresponds with findings from Jansen et al. (2010) who outlined that veterinarians are poor at active listening. Farmer education can also influence advisor behaviour. Ritter et al. (2019) established that veterinary communication altered with farmers that had post-secondary qualifications, and veterinarians became more nervous and used more counselling methods when communicating with those clients. Jansen and Lam (2012) suggested that veterinarians appear to be persistent in their remedial-centred and reactive expert role that occurs in veterinarian–farmer dialogue, and instead of being mere technical experts, veterinarians should take on the role of coach and facilitator, to empower farmers to make their own decisions, as also discussed by Bard et al. (2019). Interestingly, Hall and Wapenaar (2012) found that veterinarians favoured the approach of being a ‘friend of the farmer’ whereas the farming participants preferred a ‘proactive person that could give good technical advice’. Farmer adoption of advice was examined in depth by Ritter et al. (2019) who determined that farmer preparedness to adopt veterinary advice was negatively associated with the dominance of the veterinarian during the farm visit, and positively associated with farmer satisfaction.

5.8.5 Regulation and competency of nutritionists

The regulation of animal feed advisors was raised as a topic of concern by the interviewees. Aside from the Feed Advisor Register (FAR), there are other voluntary registers for nutritionists to join, but this is not controlled by legislation. The Association for Nutrition governs the UK Voluntary Register of Nutritionists (UKVRN) to distinguish qualified human and animal nutrition professionals who meet rigorously-applied training, competence and professional practice criteria (Cade et al., 2012). Parallel discussions and concerns have been raised in other areas of animal and veterinary regulation and professionalisation (e.g., The British Veterinary Association Congress 2008). It is not clear if ruminant nutritionists would be included in this process of regulation. Reader (2012) highlighted the importance of regulating para-professionals in large animal practice, as part of the veterinary-led team, in particular ‘veterinary technicians’ who often practice as foot trimmers, but could also be fertility technicians, parlour technicians or parlour hygiene specialists. Dairy nutritionists may not be viewed as paraprofessionals but may rather see themselves as professionals in their own right, but their influence is repeatedly overlooked in dairy research, which is surprising given the potential influence that nutritionists have on dairy cow health and farmer behaviour. As Lowe (2009) explained, some non-veterinary advisors may have a better working relationship or impact on changing farmer behaviour than the veterinarian, which was also expressed by advisors in the current study.

5.9 Conclusion

The current study found that there are specific barriers to providing focussed transition advice to farmers, such as commercial competition, challenges in communication and collaboration, the complexity of the subject and a nervousness for advisors to get involved in discussing transition cow management. Additional research is required to address the perceived lack of time and financial rewards for feed company representatives, in order to incentivise these advisors to provide focussed advice on this area of dairy cow health and management, as these were major factors influencing how likely they were to provide focussed transition management advice. Additional focussed training around transition cow management for all types of nutritionists is required to address the confidence issue when making recommendations and investigating areas for potential improvement. Approaches such as inter-professional education both at under- and postgraduate levels may be beneficial for veterinarians and nutritionists to appreciate their differing roles, and to improve the communication and collaboration between the advisors which is required. The opinions of non-veterinary advisors such as feed company representatives and nutritionists rarely feature in dairy cow health and welfare literature. Including nutritionists in this study has provided a wealth of perspectives ascertaining to the confusion and frustration that many farmers may feel towards transition cow health, management and the (lack of) advice provided by their advisors.

6. Chapter 6: Environmental barriers preventing optimal transition cow management

6.1 Introduction

Chapter 5 explored the stakeholder attitudes to transition management and found social barriers within veterinary and non-veterinary advisors that affected their perceived likelihood and ability to provide farmers with focussed advice on transition management. One of the reasons for this was the lack of confidence in published scientific findings working on farm, when there are a multitude of farm-specific barriers and confounding extrinsic variables which affect both the farmer adoption of transition practices, and effectiveness of those practices when they are adopted. One approach to solving the problem of transition cow health disorders is to identify the physical barriers to preventing improvement. The approach of identifying general barriers to improvement has been used in the medical field (see Kruse et al., 2016), soil health practices (Carlisle et al. 2016), managing Johne's Disease in cattle (Roche et al. 2019) and more recently when investigating transition cow management in Canada (Mills et al. 2020). So far, the barriers to optimal transition cow management explored in this thesis have largely been intrinsic barriers, relating to farmers awareness of metabolic disease, and the advisor attitudes that influence knowledge transfer on farm. Chapter 6 explores the farm-specific environmental factors connected to farm accommodation, set-up and economies of scale around feeding, that create impracticalities, prevent change and stop progress, even when farmers are aware of what they should do. These background farm-factors were also brought up by advisors in the interviews, of which they had no control of, yet influenced the success of the nutritional and management strategies (such as not providing enough feed space, or not having suitable facilities).

6.2 Feeding challenges

6.2.1 Economies of feeding

The ability to make a specific TMR for pre-calving cows was influenced by farmers who had the appropriate machinery, equipment and facilities. It was perceived that not all farmers would be able to afford or justify the cost of a mixer wagon to make a TMR, along with the machinery required to fill it and tow it. Additionally, not all farm infrastructure allowed for a mixer wagon to be used, because farmers may not have the appropriate feed barrier or access for a mixer wagon. Not using a mixer wagon was perceived to limit feeding methods on some farms to feeding pre-calving cows in ring feeders, meaning that anionic DCAB salts could not be mixed with the forage, and any additional concentrate or minerals had to be supplemented as a PMR. One farmer also explained that this contributed to why some farmers relied on more reactive strategies such as administering every calving cow with a bottle of calcium at the point of calving to minimise hypocalcaemia risks because they were unable to effectively implement proactive strategies to reduce these risks, as summarised in the quote below:

> ‘It’s difficult for farmers who don’t have a mixer wagon, because it’s not cost effective for everyone to buy one for £30000 and a tractor to run it, for the number of cows and his system. That would be £80000 for a tractor and a mixer wagon for maybe 100 to 200 cows, then I’ve got to sit on it for about 2 hours a day, you need a load-all [telehandler] to fill it up, that’s another £40000 then you’ve got to run it repair it service it and insure it! So, for those young starters or anyone who can’t milk more than 150 cows because of space or finances, or farm size, then it’s hard for them to justify the cost of that feeding system. So, for them, their transition diet is going be in ring feeders, just a simple system. They can’t feed mag[nesium] chloride or minerals in the silage, they are really limited. They have to make the most suitable bale silage for dry cows with not much fertiliser on, and maybe offer some adlib lick minerals, or dry cow nuts. Maybe they feed mag[nesium] chloride in the water. That’s pretty much what they rely on, it’s not perfect, but you can understand why those guys will be happy to use a [monensin bolus] or a bottle of calcium, because they haven’t got the facilities to avoid that. Smaller farmers are never going to be able to do it properly.’ (Farmer 1).

Farmers explained that additional methods of feeding pre-calving cows were available, by supplementing specifically formulated mineralised concentrates for pre-calving cows alongside a TMR or as part of a PMR with grass silage, baled silage or hay/haylage that can be fed down a barrier or in a ring feeder. Farmers referred to these as ‘dry cow nuts’, of which some contained additional calcium binders and anionic DCAB salts, and were perceived to be very expensive, as summarised in the following excerpts:

> ‘[The pre-calvers] get dry cow nuts. It’s all in there isn’t it so I don’t have to worry. Bloody dear though’ (Farmer 3)

> ‘They’re on the dry cow nuts with the [anionic DCAB] salts in. I like the idea of everything being in one bag. They get that with some hay or… whatever we have to feed them at the time really’ (Farmer 19).

In some cases, farmers perceived some types of ‘dry cow nuts’ to be more costly both from a financial and time perspective, than reactive strategies such as administering bottles of calcium at the point of calving to minimise hypocalcaemia risks. ‘Dry cow nuts’ with additional calcium binders were perceived to be an expensive feeding option, as highlighted in the quotes below:

> ER: ‘What about calcium binders, could you use those?’
>
> Farmer 1: ‘Have you seen the cost of them? They are really expensive, it’s ridiculous. Nearly a thousand pound a tonne. It’s cheaper and easier to just bottle a cow. And they don't always work, I've heard of people using them and they bind other minerals and drop intakes which is something I don't want.’

Of the farmers in the study that had a mixer wagon and were able to deliver a TMR to their pre-calving cows, some farmers reported that their herd size and the small group sizes of their pre-calving cows influenced their willingness to make a specific TMR for them. Making separate additional TMR mixes resulted in a perceived high amount of fuel consumption and wear and tear on the machinery used, so it was perceived that this would not be cost effective on small group numbers of pre-calving cows, as highlighted in the following excerpts:

> ‘When it comes to making mixes for dry cows, I don't make a TMR for them because the group is too small, and it just doesn't make sense using all the diesel and the wear and tear on machinery to make a mix for 5 dry cows. So, I can completely understand why most farmers don't do it on herds that aren't really big.’ (Farmer 1)
>
> ‘Dry cows are fed a predominantly straw based diet, and there is no difference in feed between the far-offs and close-ats [pre-calvers] at the moment. The groups are too small at the moment to justify making two separate mixes.’ (Farmer 14)
>
> ‘We don't have a big enough group of close-at cows to justify making a fresh mix for them’ (Farmer 13)

This resulted in 10/22 of the farmers in the study to feed their pre-calving cows every 2 or 3 days, with the aim to achieve a lower cost and to save time, as summarised in the quotes below:

> 'We found when we were chopping [straw] with our vertical tub mixer, it was talking forever to chop it. And obviously we were burning a lot of fuel it was taking ages so we just wanted something that's quick and easy that we can do every day, or every other day actually, we do a two-day mix. And anyway, like I say they seem to be doing alright.' (Farmer 8)

> 'I have dries [pre-calvers] on every other day, to keep it simple.' (Farmer 5)

> 'Who wants to make an extra mix for a small group of cows every day, if you can get away without doing it? No one, that's who.' (Farmer 3)

Some farmers reported trying to make a pre-calving TMR using part of the milkers' TMR, to also save costs and time. One farmer explained that this created problems with aerobic spoilage, by noticing that it was heating up throughout the day, as highlighted below:

> 'I was trying to make a ration using the milking cow ration to save time last summer, then adding dry cow minerals. But it wasn't working because I couldn't make it keep long enough. This time of year [August], it was heating up. I feed the dry cows every 2 or 3 days and it was struggling to last a day. I still feed them every 3 days now and…yeah it does still heat up a bit but not as bad as it did' (Farmer 3)

6.2.2 Feed storage

Storage (or lack of) also played a role in whether some farmers fed chopped straw to pre-calving cows. Feeding chopped straw in the pre-calving diet reduces the energy density of the ration, supplies additional bulk fibre and aids rumen-fill (Drackley 2010). However for farmers to do this, they must use or hire in a specific machine to chop it and store it in a dry location for later use. The quote below summarises this issue:

> 'We tried chopping straw with one of those [branded straw choppers] but we just haven't got anywhere to store it' (Farmer 8)

Lack of silage clamp storage influenced farmer ability to make specific silage for pre-calving cows, e.g., with minimal slurry and fertiliser input to reduce forage potassium concentration. To overcome this, some farmers made bale silage with minimal slurry and fertiliser as an alternative method of reducing hypocalcaemia risks arising from feeding forages high in potassium. Again, small group sizes influenced farmer attitudes to invest in a separate clamp for specific dry-cow silage, as it was perceived that the face of the silage clamp could suffer aerobic spoilage if only small amounts of silage were taken:

> ‘We haven't got the clamp space. I would love to, to be honest with you we have some bales that are low DCAB that we are going to start using. At the minute we are on second cut grass silage from the clamp and so we try and make low DCAB bale silage that’s not had any fertiliser or anything, so then we can make a mix with that… In the future I would love to make a clamp where we just clamp silage for the dry cows. But we probably don't calve enough for that. The clamp face would spoil’ (Farmer 8)

6.3 Housing challenges

6.3.1 Farm infrastructure and buildings

Overall farm space and facilities also influenced the way farmers kept their early lactation cows. Not all farmers had facilities to group early lactation cows separately for 21 DIM, though many farmers had a small straw pen for sick or recently calved cows to remain for several days before entering the main milking herd:

> ‘[After calving] she'll get milked straight away or fairly soon and go into that straw pen at the top of the cubicles for four or five days, just to make sure they're right and get them going. We haven't got the facilities to actually run a fresh straw group. I've tried to, if we're not tied for space, keep some of the older cows in there maybe for a little bit longer, just to make sure they're right… But if we were bigger numbers, we probably could justify keeping them in a bit longer’ (Farmer 5).

Existing farm buildings and layout was also a deciding factor on some farms as to whether they could improve or expand transition cow housing and have a dedicated calving pen. Not all farms had a dedicated calving pen, and some farms had no choice but to allow cows to calve within the pre-calving group.

‘No, we don't have a calving pen, they calve in the pen with the twelve [pre-calvers] in there. And we clean that out every three weeks, yeah, we don't have a calving pen. We just…to be honest we haven't got any space.’ (Farmer 8)

‘Our issue is that because of where the pre-calving shed is, we can’t expand that and make a calving pen on the end. The layout of the farm doesn’t allow for it. Unless we were to move everyone to the other side and build another shed, but that would cost a lot and we aren’t ready for that’ (Farmer 5)

6.3.2 Stocking rate

Pressure to milk as many cows as possible to maintain a profitable business influenced farmers’ willingness to over-stock transition cows above 100%. Additionally, busy calving periods on the farm, AYR calving patterns with a slight seasonal bias, and set days of the week where transition cows were moved in and out of their pens resulted in changeable group sizes, which subsequently influenced stocking rate and sometimes meant that transition cows were stocked over 100%.

‘[Stocking rate] runs pretty high on the whole farm. There's roughly 40 in the [close-to-calving group] probably, and I'd like it to be around 30 maximum… we are just a bit tight for space.’ (Farmer 14)

‘Fresh shed [stocking rate] is pretty good, the dry cow yard is probably pretty bad. It depends on what stage of the week you look at it, we will put 10 or 12 in on the Thursday because that’s the day we move the dry cows, so Friday, Saturday could be really full, but we normally have a lot calve over the weekend, so then by Monday, Tuesday it looks alright!’ (Farmer 10).

‘It’s difficult because we do a once a week move, you can move twenty cows in one go. I was doing twice a week but it’s almost too much of a social change in one week for them. So, we moved it back to once a week. We calve between 80 and 100 a month so moving 20 cows in one go, it’s not ideal.’ (Farmer 11)

‘We do try to spread out calvings as best as possible for bedding up purposes, feeding and general management. You can see when there’s too many in there, but it’s just when there isn't space for them elsewhere, you just end up piling them

> up… there are times where you think they are too full to be comfortable, especially during a busy spell. We write on the back of the wall in spray paint the max cow numbers for each shed, then it's easy to see and for everyone else who works here. Our vet gave us that idea.' (Farmer 15)

> 'In the winter I haven't got that luxury and the shed gets full. You've got to live with what you've got. It's never going to be absolutely perfect, is it?' (Farmer 4)

Bovine Tuberculosis (bTB) was also reported to be a major factor affecting whole herd stocking rate, because herds under bTB restrictions are unable to sell cattle (apart from youngstock on a specific bTB market), move cattle between holdings or buy in new cattle, which lead to some farmers holding on to cattle that they would have otherwise sold. This was reported to subsequently influence the stocking rate of transition cows.

> 'In winter until March, the dries will be one cow to one cubicle, and the early lactation cows and milkers will be stocked at 120%. I've got TB. In summer they will be stocked about 80% because we have a lot more space.' (Farmer 13).

> 'We got shut with TB in April, they stopped us buying in for three months which for a flying herd is quite detrimental, so we were down 100 cows probably over three months. We also held on to anything that we would have normally got rid of because we needed numbers, so the sheds were as full as they can be' (Farmer 11).

Some farmers reported having enough space to house transition cows separately for 2 weeks prior or 2 weeks post calving, but not 3 weeks prior or post calving:

> 'Dry cows … that's one I struggle with because I do like to give them three weeks pre-calving in there but there's only really space for them to have 2 weeks…But for dry cows I like to give them three weeks, and so it will be a little bit overstocked occasionally.' (Farmer 11)

Bedding costs were also reported by farmers to influence the time transition cows may spend in a pen, with one farmer limiting the amount of time his pre-calving cows spent on a loose straw yard due to the financial costs of straw, as highlighted below:

> ‘To calve everything on straw yards for three weeks... I don't think it can justify itself. I only move them on to the straw yard when I absolutely have to. I hate paying for straw’ (Farmer 4).

Many farmers had an affinity for sand bedding over other bedding options such as sawdust and straw with cubicles, due to the perceived reduction in risks for mastitis and the level of comfort it offered, however farm facilities and infrastructure prevented the use of deep sand cubicle beds on some farms. Not all slurry handling systems could manage the abrasive nature of sand, such as automatic scrapers, and sand could not be used where slurry was stored in towers rather than lagoons as it could cause blockages and not be dug out frequently. The quotes below summarise this:

> ‘We used to get toxic mastitis when we calved on [loose-housed] straw but we don't calve on straw anymore we calve on sand [loose sand in a pen] and that’s eliminated the toxic problems.’ (Farmer 16)

> ‘Our dream would be to bed on sand and have a really, really comfy system for the cows. But we are on the best mattress you can buy we think, or we got advised that anyway when we bought them. But the cows are still not...it’s not like them being on sand.’ (Farmer 8)

> ‘Sand is the only way, isn’t it? Can’t beat it. If everyone could deal with it, I bet every farmer would bed on sand. But if you’ve got auto[matic] scrapers or [slurry] towers it’s a no go!’ (Farmer 2)

6.4 Labour challenges

A shortage of skilled labour was expressed as a concern for many farmers in the study, which interfered with transition cow management and the day-to-day workload on the farm. Some farmers expressed practical difficulties with moving cows at the right time pre-calving to minimise stress and calving difficulties, and post-calving to get the cow milked as soon as possible and provide the calf with colostrum quickly after birth. Difficulties with moving cows at the optimal time were associated with a staffing shortage, a demanding day-to-day workload, and a lack of desire to move cows late at night, as highlighted in the following excerpts:

> ‘We used to try and move them as late as possible, but it’s just much easier to move them early and let them get on with it.’ (Farmer 4)
>
> ‘So, this is something I'm not really confident about, whether it’s right or wrong. We move them when they drop in their pins [relaxing of the pin bones] and I think practically that’s realistic with the number of staff we have. There’s only two of us here today and at most there is only three.’ (Farmer 13)
>
> ‘And as well we snatch calve too, so we try to get colostrum in calves as soon as we can. So, they're only in there for a couple of hours then we kick them straight into the milkers anyway. Unless they calve at 9 o’clock at night then they don’t get moved maybe until the next morning which is probably not ideal but it’s just how it works for us.’ (Farmer 8)
>
> ‘If she calves while I’m having my tea, I’m certainly not going out there to move her -she can wait until the morning’ (Farmer 9).

Most farmers reported trying to move cows in pairs and small groups where possible into the pre-calving group, but this was not always feasible with smaller AYR herds, where there may be fewer cows calving at any one time. The quote below was from a farmer who noticed the difference when moving cows in singles rather than in pairs or small groups:

> ‘Talking about moving them in singles, I did bring one heifer back a couple of weeks ago because we only had dribs and drabs calving, she was mooing for 3 or 4 days. Normally you bring a couple back, don't you? And you never see any signs. But it did make a noticeable difference just bringing one back, she was stressed.’ (Farmer 12)

Some farmers tried to maintain even numbers in the milking parlour for ease and better use of milking time, which influenced the way cows were moved in and out of the milking group. Farmer 16 prioritised having even numbers per side in the parlour over reducing stress by moving in pairs, because ease of management was deemed to be more important than drying off at the correct time:

> ‘We tend to move cows in singles rather than pairs. Literally there will be four moving this week, one a day, one a day. I'm not going to move two if I only need one. I need groups of 20 for the parlour, so if I've got 121 in there, I'm not going to move two.’ (F16)

6.5 Discussion

6.5.1 Feeding challenges

The current study found that practicalities on farm influence farmer ability and willingness to adopt certain practices, such as feeding daily, or not stocking above 100%, and farm-specific factors such as financial factors and availability of skilled labour can influence farmer willingness to invest in machinery and spend additional time making a TMR daily. Although farmers in the current study fed their milking cows either daily or twice per day, when providing a TMR to their pre-calving cows, 10 farmers employed time-saving exercises, such as feeding every 2 or 3 days. Making and delivering a TMR to pre-calving cows daily was perceived to be impractical by farmers with small group sizes, and impossible for some farmers without the necessary machinery or infrastructure to support it. Additionally, it was perceived to be cost-ineffective to make a fresh feed daily, due to the wear and tear on the machinery, the cost of the fuel involved, and the time it takes to mix and deliver feed each day. Published literature recommends removing old feed and providing a fresh feed daily to cows to stimulate dry matter intakes (DeVries and von Keyserlingk, 2005). Maximising DMI has been associated with reducing the risks of metabolic disease (Grummer, 2004; LeBlanc 2010), and should be prioritised during the transition period particularly as feed intake reduces up to 20% in the few days prior to calving and remains low during the first days of lactation (Fink-Gremmels 2008). Increasing feeding frequency has been associated with reduced sorting of the ration, and a low frequency of feeding may result in increased competition among cows (DeVries et al. 2005). Additionally, increased competition within groups may lead to some cows altering their feeding behaviour to avoid aggressive interactions (Miller and Wood-Gush, 1991). Furthermore, as feeding frequency increases, the distribution of feeding time and intake may be more evenly spread throughout the day, and a steady input of nutrients in the rumen throughout the day could have a stabilising effect on ruminal pH, reducing the risks of SARA (French and Kennelly, 1990). Farmers in the current study also explained how feeding every 2 or 3 days could result in the TMR or PMR heating-up, however it should be noted that this did not stop them from maintaining that practice, because practicality and time-saving efforts were often prioritised over potential issues and risk factors arising from not feeding daily. When silage heats up, this is usually a result of aerobic spoilage from mycotoxin spores and/or yeasts (Borreani et al. 2019). Mycotoxin spores are frequently present in silages, with incidence reported to be between 38-54% in silages and compounds (on 24 farms in the Netherlands) (Driehuis et al. 2008). When consumed in excess, mycotoxins can lead to health disorders in cattle (Fink-Gremmels, 2008). A common observation of contaminated feeds is the occurrence of a mouldy odour, produced by the spores metabolising and releasing volatile organic compounds, which is disliked by cattle and reduces feed intake (Fink-Gremmels 2008). Additionally, prolonged exposure of ensiled feeds to air during storage or at the feed barrier can lead to aerobic spoilage, usually initiated by yeasts that cause it to heat rapidly and spoil, leading to an additional loss of DM and nutrients (Kung, 2010). Problems associated with mycotoxins and yeasts can be minimised with tidy clamp management, reducing the exposure of air to silages, removing spoiled or waste feed daily from feed troughs and barriers, and feeding daily before aerobic spoilage occurs (Kung, 2010). It is possible that farmers in the study are unaware of or do not prioritise the potential health and performance issues relating to poor silage stability and the frequency of feeding their pre-calving cows. Fink-Gremmels (2008) explained that due to the pre-existing negative energy balance, cows in the transition period are particularly sensitive to the exposure of feeds contaminated with moulds, mycotoxins and fungal spores. Furthermore, like many subclinical metabolic disorders, clinical symptoms associated with excess mycotoxin intake can be 'hidden' from the naked eye, as they are generally non-specific, and include metabolic imbalances, and immunological and inflammatory reactions, such as impaired fertility and reduced rumen function (Fink-Gremmels, 2008).

Impracticality of new practices has been shown to contribute to minimal uptake of best practice on pig units (Peden et al. 2018), and infrastructure conditions have been identified as barriers to adoption of more sustainable agricultural practices (Rodriguez et al. 2008). Turner et al. (2017) explored 'boundaries to change' with beef and sheep farmers and established that a multitude of factors relating to infrastructure, land, labour and debt can influence behaviour change, but that it can 'constrain' change rather than acting as a barrier to any change taking place. Turner et al. (2017) explained that some boundaries may be 'firm' or 'flexible', and the degree to which boundaries are firm and flexible varied among individual farmers. Farmers' actions towards transition cow management were largely determined by their attitudes regarding the ease of management relating to specific farm factors such as financial pay-off, farm layout, lack of skilled labour and a lack of time. Dairy farmers must constantly evaluate the financial pay-off of each component in the production system if they are to maintain a profitable business (Kristensen and Jakobsen 2011). Because many of the losses attributed to suboptimal transition management are 'hidden' it could be difficult for farmers to see and understand the financial pay-off and return on investment, e.g., into additional machinery or fuel to provide a TMR to pre-calving cows daily. As Wilson et al. (2009) summarised, any communication efforts that attempt to educate farmers and influence behavioural change (assuming that farmer education is the barrier to practice) must highlight and emphasise the cost-effective nature of new and improved management practices if they are to be adopted. A common perception however is that barriers may stand in the way of farmers adopting new practices, and that if the barrier is identified and overcome (such as financial pay-off) adoption will follow. This may however be too simple a view of farmer rationale, particularly as farmers do not have a unified approach to farming (Turner et al. 2017).

The current study found that herd size influenced farmer willingness to feed pre-calving cows daily, with farmers from smaller herds being reluctant to feed daily due to impracticalities associated with small group sizes, and farm layout. Literature surrounding herd size and farmer adoption of practices mainly covers farmer adoption of technology-based software (El-Osta and Morehart 1999). For example, Gargiulo et al. (2018) and Tamirat et al. (2018) established that dairy farmers with larger herd sizes may adopt more precision and innovative dairy technologies, and Rose et al. (2018) explained that farmers with larger farms may generate a greater level of income, making it easier to adopt new innovations. This suggests that they may be more able to afford equipment such as mixer wagons and additional tractors to run feeding machinery, and as such may be the first adopters of new management practices arising from published scientific literature, such as employing specific dietary strategies to minimise metabolic disease risks. Furthermore, other research has found links between farmer adoption of practices and herd size, such as biosecurity (Campbell et al. 2011; Noremark et al. 2016). Veterinarians in Canada have also commented on challenges faced by farmers with small herds, noting that if a farm has a small group of pre-calving cows that it can be difficult to make a precise ration for them (Mills et al. 2020). Findings by Mills et al. (2020) are similar to those in the current study, suggesting that specific feeding challenges exist for farmers of smaller herds, and cows on smaller herds may be more susceptible to metabolic disease if factors arising from irregular or non-daily feeding influence their dry matter intake pre-calving (such as sorting, mycotoxin and yeast proliferation and an irregular supply of nutrients and minerals).

6.5.2 Housing challenges

Farm space and infrastructure also influenced farmer willingness and ability to house their transition cows for an adequate length of time, and to be able to store certain feeds for their pre-calving cows. This included a lack of storage space for chopped straw for inclusion into a TMR, and a lack of separate silage clamp storage preventing farmers from making specific ensiled forages with little fertiliser and slurry input to reduce forage potassium concentrations and subsequent hypocalcaemia risk in the pre-calving diet. Farm space and layout also prevented some farmers from having a specific calving pen, and the future ability to build one close to the shed that houses pre-calving cows. Furthermore, bedding choices were also influenced by farm infrastructure, along with the associated costs. The perceived high cost of straw influenced farmer willingness to house transition cows separately in a straw yard for a full 3 weeks prior and post calving, leading some to house pre-calving cows in a cubicle shed for longer than desired, and farm-specific factors such as having automatic scrapers, robotic milking machines and slurry towers was suggested to prevent farmers from installing deep sand beds to minimise mastitis risks and maximise cow comfort. Farm space and layout influences farmer behaviour and practices across other farming methods, such as influencing farmer willingness to switch to other alternative systems in pig and broiler units (Gocsik et al. 2015). Farm layout has also been reported to act as a barrier to lameness control, with layout either supporting effective and fast treatment of cows or acting as a hindrance (Horseman et al. 2014). Additionally, space to house transition cows influences stocking rate on farm, and not all farmers had the available sheds to group pre-calving cows for a full three weeks, or to house early lactation cows separately from the main milking herd for three weeks, if at all. Farmers in the current study were aware of the implications of stocking rate on feed and water availability, and space and comfort for their dairy cows, however some perceived an inability to avoid over-stocking due to pressures to milk as many cows as possible, implications of bTB and busy calving periods on the farm. Mills et al. (2020) suggested that when farmers perceive stocking rate to be unchangeable, they may prioritise other farm goals, such as milking more cows to increase milk sales. Methods to overcome barriers relating to farm space and infrastructure are difficult, as they usually require significant financial investment, and farmers may have other, more urgent priorities that require investment, particularly if they do not foresee their transition cow management to be sub-optimal. Additionally, Rose et al. (2018) outlined business factors such as cashflow, succession plans and profitability to be major influences on farmer behaviour. Instead, methods to counteract the infrastructural barriers to behaviour change could be recommended to farmers in discussion groups with farmers from similar backgrounds and similar herd sizes, who are likely to have similar barriers to change. For example, not all farmers have the clamp availability to make and store specific silage for pre-calving cows with minimal slurry input and may not have a mixer wagon to feed a TMR. However discussion could take place on alternative feeding methods such as making low-energy baled silage for pre-calving cows, or buying in alternative forages, with emphasis on the requirement to have the forage-mineral tested so hypocalcaemia risks can be managed. Additionally, where farmers insist on feeding pre-calving cows every 2 or 3 days, discussion could take place on the importance of DMI and monitoring rumen fill, mycotoxin awareness and the potential use of TMR heat stabilisers where preservatives can be mixed into a TMR and help prevent further aerobic spoilage (Kung, 2010). This would acknowledge context-specific barriers and take more of a local and situated approach to knowledge exchange, and may receive positive farmer engagement because it encompasses barriers and constraints that are specific to farmers in an area with similar characteristics (Kapoor, 2002). Decontextualized knowledge is difficult for local people to act on, and embrace into a behavioural change (Hamilton, 2018), and when the advice is tailor-made to a situation, it becomes more relevant (Ingram 2008).

6.5.3 Labour challenges

Shortage of time and skilled labour was reported by farmers to influence their decisions and practices around transition cow management. A lack of skilled labour contributed to a shortage of time and difficulties with managing day-to-day activities and certain transition cow management practices, e.g., offering ‘drinks’ and drenches to freshly calved cows. Additionally, a perceived lack of time and skilled labour, in association with the farmers daily workload influenced the way cows were moved between groups, with some farmers prioritising ease of management above potential social stress arising from moving cows alone rather than in pairs. Moving cows to and from different groups can develop social stress within cows in the pens (Cooke et al. 2010), and it has been suggested by Cook and Nordlund (2004) to move cows in pairs or small groups where possible to minimise bullying when establishing the social hierarchy. Farmers were also reluctant to move and milk freshly calved cows at night even when they felt it was necessary, because they were inside and resting, so cows had to wait until morning to be milked. As Rose et al. (2018) explained, having a higher number of farm staff may make it easier to implement certain management changes. The number of farm employees has shown to influence farmer uptake of biosecurity practices in Sweden (Noremark et al. 2016), and limited staff resources, both quantity and skill level, has shown to influence prompt treatment of lame cows (Horseman et al. 2014). Interestingly, when investigating barriers to successful transition management in Canada, lack of skilled labour was not identified as a main barrier (Mills et al. 2020). However the average herd size was 89 cows (DFC, 2019), which is smaller when compared to the UK (148 cows/herd; AHDB 2021), therefore the requirement for the number of skilled staff members may be lower in Canada than in the UK, due to the reduced herd size. As discussed in previous chapters, human sustainability can have an impact on day-to-day workload, and a shortage of skilled labour may influence the priorities of the farmer, e.g., just getting the bare essentials of day-to-day management done, rather than planning ahead to reduce potential metabolic disease incidence. As such, farmers may change their behaviour to save time, and cut corners. A time-saving exercise can be seen by farmers as a quick and relative advantage and become a long-term behaviour, which can then be difficult to change (Rose et al., 2018).

The current study demonstrates that challenges exist between farmers employing optimal health and nutritional practices for the benefit of their cattle, and pressures to save time and costs when managing their day-to-day workload. These challenges exist even when farmers are aware of the sub-optimal but time-saving practice negatively influencing the feed intake and health of their transition cows i.e., being aware that the feed is heating up but not making a change of behaviour by feeding daily. As discussed earlier, the scientific literature surrounding farmer behaviour change can sometimes assume that where knowledge transfer is effective, the associated behavioural change will take place, however this is not always the case. The current study has identified that farmers can be aware of how their sub-optimal practice influences the health and welfare of their transition cows (i.e., stocking cattle over 100%, not providing adequate feed space, accepting their cattle have an excess body condition score, not feeding daily), yet they can be unwilling or unable to change behaviour and adopt higher standards to prevent these from happening. When investigating farmer willingness to implement higher animal welfare standards, Gocsik et al. (2015) established that farmers may be willing to adopt standards if they fit the current farm infrastructure are reversible, and cover the additional costs. As farmers in the current study explained, their transition management practices were formed around their farm infrastructure and acknowledged their day-to-day workload. In some cases, farmers maintained a strategy they had adopted or inherited from an older generation, and that had become embedded in the norms of the day-to-day workload, such as feeding pre-calving cows every two days, and accepting that the calving pen became overstocked during winter or busy periods on the farm. These practices can become habitual, and people can have long-term habits that are resistant to behaviour change (Mankad 2016), particularly if there is no urgent requirement to change (Turner et al. 2017). Furthermore, the complexity of practices, and additional learning associated with new practices have proven to act as deterrents to adoption (Llewellyn et al. 2005), meaning that farmers may be unwilling to spend time adapting new methods to their existing farm infrastructure. Often there is a cost associated with a change, and direct financial incentives to adopt certain behaviours are frequently needed (Rose 2018).

Cost of change or products has shown to be considerably influential when investigating farmer behaviour in the current study, even when the health and welfare of cattle are concerned. This has also been reported in other studies. For example, Jones et al. (2015) found that dairy farmers would only use antibiotics, even when required, if they were affordable. Furthermore, profitability must follow a behaviour change if it is to be continually adopted (Leach et al. 2010) and previous research shows that if farmers cannot see the relative advantage in changing to a particular behaviour, then the change would be unlikely to occur (Rose et al. 2018). In the light of the current study, farmers may be unlikely to see immediate cost-benefits and relative advantages with feeding pre-calving cows daily, particularly if they do not monitor feed intake or BCS. Rewards and incentives have been shown to influence behaviour change (Vaarst and Sorensen, 2009), as have penalties when investigating farmer motivation to control mastitis (Valeeva et al. 2007). In this case, possible methods to incentivise or penalise could develop within the role of the milk buyer, as some milk buyers already set targets and requirements for certain management practices. Regulating transition management however could be considered difficult, as there is no way to prove how often farmers feed their cattle. Additionally, behaviour changes arising from incentives are not always sustained long-term, as seen in human health care (Kullgren et al. 2017).

6.6 Conclusion

The themes investigated in Chapter 6 demonstrate that environmental barriers exist which influence farmer adoption of optimal transition cow practices. Farmers can be aware of the transition-related disorders and risk-factors on their farms, yet they can be unwilling or unable to change behaviour and adopt higher standards to prevent these from happening. These barriers are farm-specific, and relate to cost effectiveness, herd-size, farm space and facilities, a shortage of skilled labour and time, a lack of feed storage space and a lack of machinery and equipment. Methods to further understand infrastructure barriers that farmers face could take place in the form of discussion groups lead by advisors, which may include farmers of a similar herd size and with similar farm layout, with tailor-made and targeted solutions that could be effectively presented to farmers that acknowledge local and specific issues. This may encourage farmers to move away from the costly use of strategies that are designed for selective and targeted use only, and instead encourage farmers to plan forward, work with their advisors and, for example, buy or produce baled specific forages for pre-calving cows, if they are unable to feed a TMR. There are alternative pre-calver feeding strategies which can be adopted to accompany farm-specific barriers that prevent farmers from feeding a TMR, such as feeding specific pre-calving concentrates with anionic DCAB salts to reduce the risk of milk fever. Of the farmers that fed pre-calving cows a TMR, 10/22 in the study chose not to feed daily because practicality and time-saving efforts were often prioritised over potential issues and risk factors associated with this. Feeding every 2 or 3 days could have negative effects on pre-calver DMI, due to aerobic spoilage, increased competition and aggressive interactions at the feed face, thus increasing the risks of metabolic disease. Making farmers aware of the cost benefits of more appropriate feeding strategies, and of feeding pre-calving cows daily may be necessary for them to see the value in health and welfare improvement, which may not be immediately obvious, as many of the losses associated with sub-optimal transition cow management are ‘hidden’. The importance of the role of the advisor has been explored in Chapter 5. It is likely to be difficult to change farmer behaviour without including trusted people during knowledge exchange approaches, such as involving key advisors in a given region that exert social pressure on farmers and may help to shift social norms and attitudes.

7. Chapter 7: Seasonal calving farmer attitudes to transition cow management

7.1 Introduction

Chapters 3 to 6 have largely addressed the attitudes and experiences of AYR calving farmers and their advisors on transition cow management, including intrinsic factors such as their awareness and perception of transition cow management on their own farms, and the extrinsic and environmental factors that contribute to the barriers to uptake of optimal practices. Chapter 7 explores the attitudes of block-calving farmers towards transition cow management, including those of advisors, to determine whether their differing calving patterns and cow type contribute to differences in transition management styles, opinions and experiences. Semi-structured interviews were conducted with 10 block calving farmers (3 spring calving herds, 3 autumn calving herds, and 4 combined spring and autumn calving herds) from the Northwest and Midlands of England, and 24 advisors (12 veterinary and non-veterinary advisors) across England. Full details on the methodology for block-calving interviews can be found in section 2.6.3, and for the advisor interviews in section 2.6.2. Block or seasonal calving systems account for approximately a fifth of dairy farms in the UK (AHDB, 2019). Their structure provides the opportunity to maximise the conversion of grazed grass to milk, alongside focused task management and seasonal farm labour requirements (Lindley and Willshire, 2020). Spring calving systems focus on maximising milk production from grazed grass and minimising the cost of milk production by keeping cows outdoor where possible and reducing variable costs of purchased feeds, and the cost of housing and machinery (Macmillan 2012). Spring calving systems may be susceptible to unpredictable climatic conditions during the early calving period around February (AHDB, 2019). Autumn herds typically calve between August and November, calving outside at grass, however cattle are kept indoors during winter (Lindley and Willshire, 2020). There is variation in the way autumn herds are managed, with some farms operating a low input self-feed system and some operating a more intensive TMR based system. The economic success of both seasonal calving patterns is underpinned by optimal reproductive management (Macmillan 2012). Fertility can be negatively impacted by body condition score and metabolic disease in early lactation (Leblanc, 2010). The average cost of production for block calving herds is typically 1.1ppl to 2.4ppl lower than that on AYR herds (AHDB 2016). AYR calving herds tend to have higher veterinary, feed and labour costs than seasonal calving herds. However, many milk buyers look for a flat milk production profile, and not all farmers have the appropriate land type to support seasonal calving (AHDB, 2016). The main themes arising from the interviews with seasonal calving herds have been depicted in Figure 7.1.1.

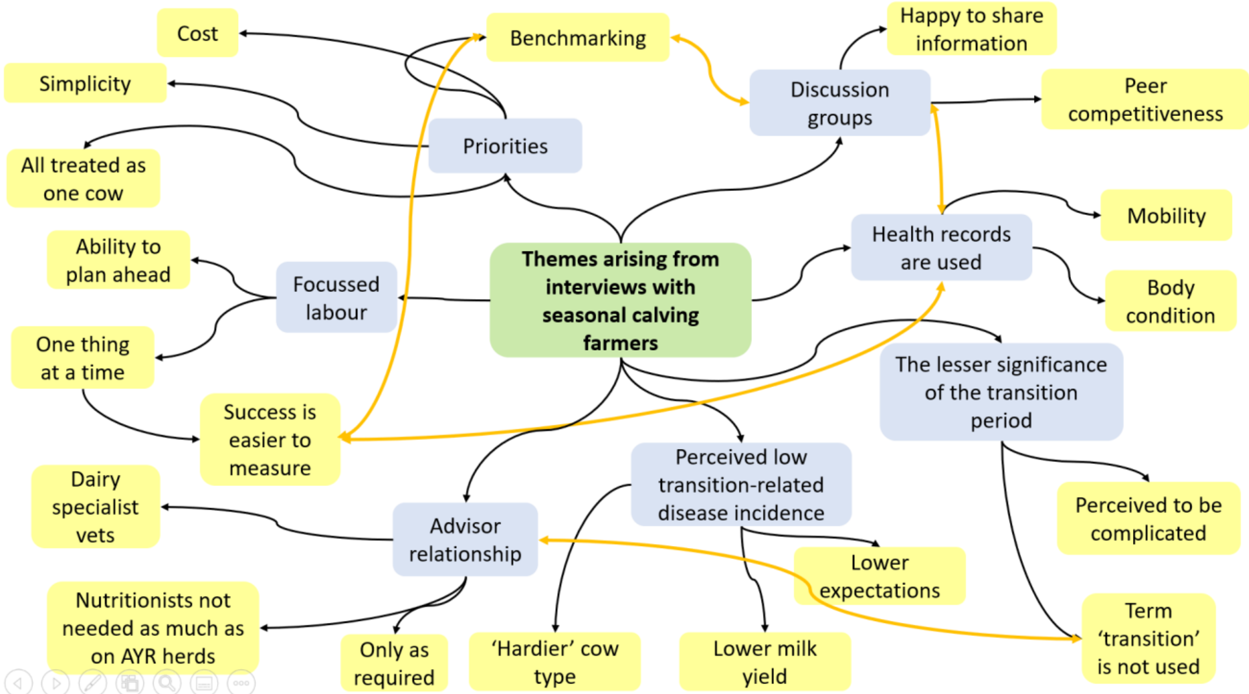


Figure 7.1.1: Thematic map depicting main themes from interviews with seasonal calving farmers, presenting the key themes (blue), and the sub themes (yellow) that emerged from the interviews.

7.2 Block calving farmer demographic information

All of the block calving farms in the study were from the North-West and Midlands of England (Table 7.2.1). The block calving herds had a mean of 468 cows (range 200-1200) and a mean farmer age of 46. Three out of the ten farmers that block calved had a supermarket contract, the remaining seven had direct-supply milk contracts. Seven farmers had post-secondary education qualifications. All farmers used different veterinarian practices, and 5/10 had a nominated nutritionist with the remaining 5 stating they did not. Farmers that used a nutritionist (n = 5) had different nutritionists, two of whom were independent with the remaining three working for different feed companies.

Table 7.2.1: Demographic summary of block calving farmers (n = 10) from the North-West and Midlands of England.

Farmer	Age (years)	Location	Milk contract SM= supermarket D= direct	Herd size (cows)	Calving pattern	Post - secondary education	Method of interview
23	50	Cheshire	SM	1200	Spring & autumn		Face-to-face
24	34	Staffordshire	D	200	Spring & autumn	✓	Face-to-face
25	60	Cheshire	SM	350	Spring & autumn	✓	Face-to-face
26	36	Cheshire	D	400	Spring & autumn	✓	Face-to-face
27	34	Staffordshire	D	450	Autumn	✓	Telephone
28	39	Shropshire	D	220	Autumn		Face-to-face
29	45	Shropshire	SM	250	Autumn	✓	Face-to-face
30	55	Cheshire	D	310	Spring		Face-to-face
31	43	Staffordshire	D	800	Spring	✓	Telephone
32	64	Staffordshire	D	500	Spring	✓	Telephone

7.3 Comparable themes to AYR farmers

7.3.1 Prioritising simplicity and cost

Simplistic transition management methods and ease of management in the day-to-day running of the farm was prioritised by block calving as well as AYR calving farmers. The importance of running a 'simple system' was regularly emphasised by block calving farmers to be an important ethos to their business. Complicated management strategies that hinder the day-to-day running of the farm were avoided where possible, as highlighted below:

> 'They calve and they go outside. And it's very simple…. Keep it simple! Don't overcomplicate it, that's the answer' (Farmer 23- spring and autumn calving herd).
>
> 'Vets are very clever people but [pause], the truth is it's all very well talking about doing something but if it complicates the system massively and makes life really hard work then no one is going to do it, so it's about keeping things dead simple…. it can't mess with your day, can't it? It's got to be simple. Because human nature is to cut corners. If you make something really hard it won't work' (Farmer 24- spring and autumn calving herd).
>
> 'I just think some of these big Holstein herds make things too damn complicated. I mean for us it is literally 150g of magnesium chloride and a cheap mineral. It isn't broke so why am I going to try and fix it? I'm telling my nutritionist all the time, it isn't broken, so I'm not going to spend another £1000 a tonne on minerals' (Farmer 29- autumn calving herd).
>
> 'No, I wouldn't know much about any of that... If I had to mollycoddle every cow I'd have to have a fleet of Romanians around. That's the truth! It's got to be simple!' (Farmer 31- spring calving herd).
>
> 'I'm trying to do the right things, but I wouldn't say there's much science because I'm doing it off the back of a fag packet. I'm trying to avoid problems but there is no science behind it' (Farmer 32- spring calving herd).

Cost of production was emphasised by all block calving farmers to be a priority, to maintain a profitable business. Block calving farmers spoke freely of their production costs and how they took steps to save money:

'It's all about cost of production. You have to know if its viable or not. How many AYR farmers don't know whether they are making money or not? It's shocking!' (Farmer 23- spring and autumn calving herd).

'What do I feed my dry cows? Whatever is cheap!' (Farmer 31- spring calving herd)

One farmer went on to explain how monitoring his cost of production meant emphasising the longevity of the cows in his herd:

'Because our cows are so worthless when we cull them, they've got to live a long time. If you buy a Holstein for £1200 but you can hang her up for £900 you've lost £150 a year depreciation on that cow. Whereas if it costs us £1000 and write her off in two years, you're only going to get £350 for that cow. So, the depreciation on her is huge, they've got to last a long time' (Farmer 24- spring and autumn calving herd).

7.3.2 Health records and scoring

Regarding monitoring transition-related disorders, there was heterogeneity in attitudes amongst block calving farmers towards the perceived usefulness of keeping health records. Four block calving farmers monitored transition-related disorders and three only did so because they were required to by their milk buyer:

'We don't use the records, really. It's a tick box exercise as much as anything else for [Anon supermarket milk buyer]' (Farmer 26- spring and autumn calving herd).

'We body condition twice a year because we have to, we don't tend to use the results though. We probably should write it down and use it more, but we are always looking ourselves' (Farmer 27- autumn calving herd).

'Body condition… [supermarket buyers] only want to know the very thin cows. Most of my cows are fat anyway, I don't have many thin cows… I don't think they actually give a monkeys what we are doing, it's all just a tick box exercise. I don't like to think that we were doing a bad job before we had a supermarket contract but just because we are measuring it now doesn't mean it's that much better. It's what you do with that information' (Farmer 29- autumn calving herd)

One block calving farmer however did see value in monitoring transition-related health disorders, and kept track of metabolic disorders by using a whiteboard in the staff room in order to promote discussion with farm staff (Figure 7.3.1):

> ‘We have a whiteboard behind you that we track every day. It’s pretty self-explanatory… any milk fevers or retained cleansings go down on the board too. It actually creates a topic of conversation. You soon see a chunk of milk fevers appear and it starts the conversation because its instant when you see it. And when we have the problems, we can usually relate it back to a member of staff on during that period who wasn’t feeding properly or putting magnesium out. And we work quite a funny rota, so generally we don’t follow on from each other so if you’ve been off for a few days, it’s a good way of communicating. It’s instant and thought provoking when you see that they’ve had 6 milk fevers on your two days off! And it’s getting people thinking about it more, we are getting the younger ones to fill the board in more every day, so if they write in that they’ve had retained cleansing, it makes them actually think about why they are getting the problems instead of seeing them in the field and forgetting about them once they’ve treated them’ (Farmer 28- autumn calving herd).

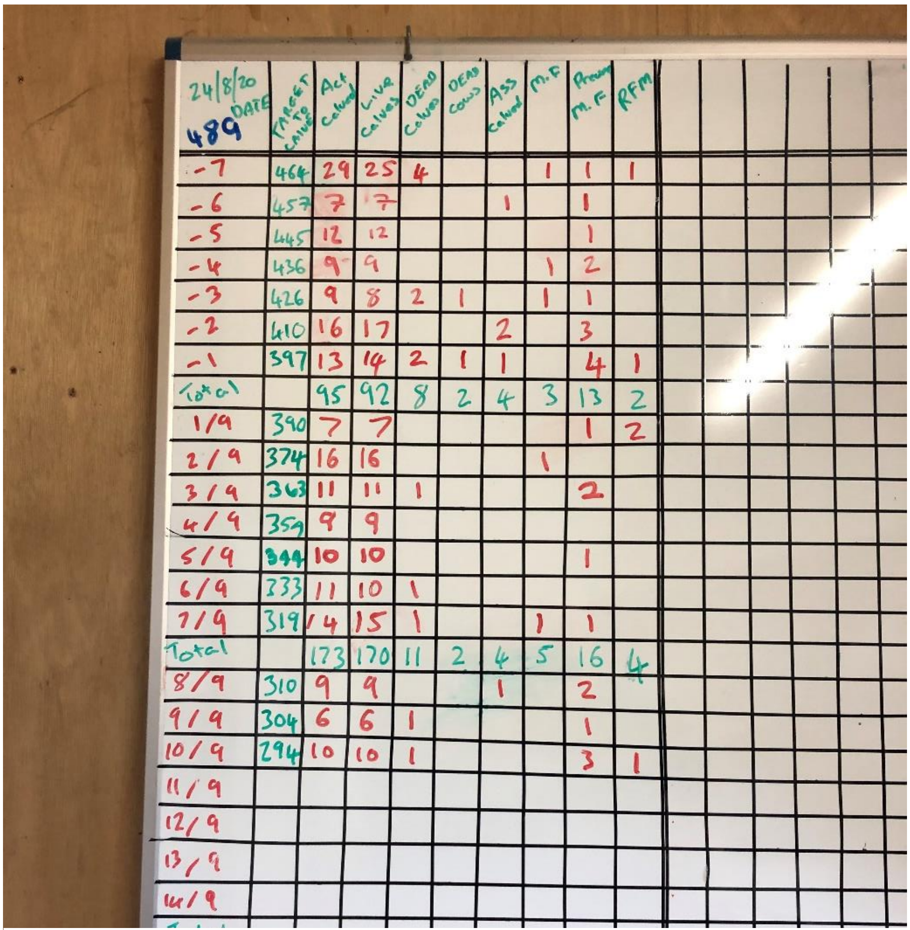


Figure 7.3.1: A whiteboard used to track metabolic disorders, situated in the staff break-room. (Farmer 28- autumn calving herd)

BCS scoring was seen as a valuable tool to group cows that were perceived to be under- or overweight, so that they could fed or housed accordingly. If cows were perceived to be underweight, farmers would dry them off earlier, and in some cases, group them and feed them a separate higher starch ration or bring them inside for winter where they would otherwise be outwintered if spring calving. Cows perceived to be overweight were fed a restricted diet during the dry period, and in some cases offered some lower energy forage such as hay:

> ‘We condition score the cows about a month before I dry them off and if there are any that are just under performing or are ribby they get dried off early. They go onto grass and bales, a bit more energy than what they need so they can pile the weight on before calving. Anything else that is looking ok gets dried off and goes in a straw yard and is fed hay, just maintenance only’ (Farmer 27- autumn calving herd).

‘We condition score all the cows in the Autumn on a kiwi score of 1-10, I was kiwi trained, so we are aiming for a calving score of 5. Anything over a 4, can go on crop, anything below goes into housing. So that’s what differentiates the cows on where they are going…we don’t allow them to get over fit. And if they did, we would group them up and manage them differently. We are body condition scoring all the time’ (Farmer 24- spring and autumn calving herd).

‘We score for mobility, abrasions and body condition. We mobility score once a month especially in the winter. And we trim cows on that basis. We condition score 100 days post calving, then look again around April time during dry off. We wouldn’t separate the thin cows, but we’d dry them off earlier’ (Farmer 28- autumn calving herd).

‘Normally, they’ll be dried off about 20th December and depending on condition score at drying off… last year they were a bit thin, but we will have to feed them with silage to keep condition on for 3 or 4 weeks, or if its good we will restrict silage and feed some hay’ (Farmer 25- spring and autumn calving herd)

Mobility scoring was perceived to be a useful tool for identifying lame cows. This was perceived to be particularly important for block calving farmers because they relied heavily on pasture, and their cows had to walk long distances to reach the grazing fields:

‘I mobility score every day, I have a zero tolerance to lameness. If I see a lame cow it gets done there and then on that day. I’m always looking out for lameness and we footbath every day. I have to keep our cows mobile because they walk such a long way, our cows walk over 2km, so if they have no feet to walk on that won’t happen. I body condition score before serving. For a group of skinnier cows, I have milked once a day before in the past, and they graze nearer the parlour’ (Farmer 27- autumn calving herd).

‘Our furthest field is over 1k away. That means my cows cover nearly 5 km in a day walking back and forth twice a day. That’s a fair distance isn’t it? Can’t be having lame cows on this farm if you expect them to walk that far’ (Farmer 26- spring and autumn calving herd).

Farmer 23 (spring and autumn calving herd): ‘They are condition and mobility scored quarterly by a vet tech.’

ER: ‘Do use the reports?’

Farmer 23: 'Yes especially on the locomotion. Body condition doesn't concern me too much.'

7.4 Contrasting themes to AYR farmers

7.4.1 The lesser significance of the transition period

When asked about their transition management styles, block calving farmers reported a general low priority or low significance of the transition period, because the diets fed before and after calving were perceived to be very similar. This was determined by the quotes that arose in the interviews, where 7 out of the 10 seasonal calvers made reference to the transition period being a term they either did not use, or a period of time that they did not spend time thinking about or planning for. The transition period was deemed 'not applicable' to some block calving farmers as it was a term not commonly referred to by them, and it was associated with AYR farming and the Holstein breed of cows, as highlighted in the following excerpts:

> 'The transition is not significant. It just drifts in. It's virtually the same, except we are putting concentrates into them, and we are giving them less straw' (Farmer 24- spring and autumn calving herd).
>
> 'So, we don't really refer to it as the transition period. That's Holstein talk! It's all a bit complicated and doesn't really apply to us' (Farmer 32- spring calving herd).
>
> 'My grazers, whilst they manage their business well, their understanding of transition management is just about non-existent…it's not in their vocabulary' (A6- dairy specialist veterinarian).
>
> 'For the spring lads I don't describe it as transition. Because they will look at me like I don't know what I'm talking about. I just don't describe it to them, I talk to them about how we are going to manage the dry cows, I just don't hang it on a term because they might even go away from me. Because they think I'm talking that Holstein rubbish and they don't need to worry about that' (A2- dairy specialist veterinarian).

Block calving farmers in the study emphasised how they did not treat their cows as individuals the way farmers on AYR systems did. Block calving herds were managed as 'one cow' or as a group in uniformity:

'We see it all as one cow' (Farmer 23- spring and autumn calving herd).

'We don't treat our cows as individuals, they are groups of cows. They have to be because of the way I'm farming' (Farmer 24- spring and autumn calving herd).

7.4.2 Focussed labour

Block calving farmers in the study emphasised how being able to focus on one area of dairy cow management at a time impacted transition cow management positively, and they perceived managing transition cows on block calving herds to be easier than on AYR calving herds:

'When you're calving cows, you're concentrating on calving cows. You're not [artificially inseminating] anything, you're not messing about doing other things, you're concentrating on your calving cows. Heifers hit the ground at the same time, then you focus on grazing, then you focus on drying cows off. It makes focusing on calving cows much easier' (Farmer 23- spring and autumn calving herd).

'I think it's just the beauty of block calving… you've got all year to plan it…there isn't a lot to go wrong. I think the trouble with the AYR boys is they are pushing for yield so much… but there's no process to how they do things sometimes. They just dry cows off because they think she's ready to dry off. Rather than thinking about it a good month before drying off and assessing her condition you know, they don't build themselves up to it, whereas they should really. How much do they really assess the cow before transitioning? You know yourself that the transition starts before drying off really' (Farmer 27- autumn calving herd).

Advisors also noted that block calving systems resulted in transition cows being managed well and perceived block calving farmers to have fewer transition-related problems than AYR farmers, because they could focus on one aspect of transition at a time, success was more measurable, and they were able to make decisions more easily:

'I think they manage things really well because they focus on one thing at a time, so all your problems come at once' (A4- feed representative).

‘There are so many advantages to block calving. Human nature is seasonable, you should have periods where you look forward to something, and then fulfilment comes. It may or may not be successful it doesn't really matter but there’s an end point. If you block calve than you have more end points in a short space of time, its stressful with lots of action but you have a start and a finish. If you calve all year round you never actually achieve those end points collectively in the same way. You're always looking to the same chore the next day, so one of the disincentives for transition is "well I would but I never have a big enough group to justify every-day feeding, or a defined enough time to do that". And a block calver can measure their success easily... block calvers also are ones who like numbers. They're more decisive, and in a way, that’s less wearing, isn't it?’ (A5 – feed representative).

7.4.3 Perceived low transition-related disease incidence

Block calving farmers in the current study reported having a perceived low incidence of transition-related health disorders, with 8 out of the 10 farmers interviewed reporting having minimal transition issues:

‘What we’ve done is what we’ve done for years now, and we accept the situation as it is. Do you want some data of what we’ve achieved this year? We don’t get metabolic problems. We had 4 retained cleansings and 4 milk fevers out of 196 calvings’ (Farmer 25- spring and autumn calving herd).

‘We don’t have many problems with the spring cows, maybe the odd milk fever if we haven’t got them on the diet quick enough. We don’t bother making them a mix if there are only a couple of cows left and we are bored of it all, then we wonder why we start getting problems!’ (Farmer 29- autumn calving herd)

‘We don’t really have metabolic problems. I think we toggled [operated on displaced abomasums] two cows last year. Milk fevers? I could count on one hand…’ (Farmer 24- spring and autumn calving herd)

Block calving farmers perceived the type of cow and milk yield to influence transition cow success or failure, suggesting that herds with high yielding cows were more likely to suffer from transition-related disorders. The type of cow on block calving farms was perceived to be ‘hardier’ than that found on AYR herds because they were smaller, usually cross-bred and produced less milk. Because they produced less milk they were perceived to be under less metabolic stress:

‘It’s the cow type though, we aren’t asking them to run a million miles an hour, it’s just a steady cruise along. They’re not under strain, we’re not asking them to pump ridiculous amounts of milk out, its straightforward. Those cows doing 11000 litres, if you do the slightest thing wrong, that comes crashing down’ (Farmer 23- spring and autumn calving herd).

‘The expectation that we put on a cow though is so much less… because of our transitional feed system, there is no encouragement to give milk, whereas people on an AYR TMR system tailor-make it so a cow can flick from being dry to milking and giving considerable amounts of milk within a week of calving. We would only expect a spring calving cow to give 15 litres…’ (Farmer 25- spring and autumn calving herd).

‘I’ve done it before where I just throw them out to grass, and some can cope with it. Fair play to the Jersey crosses because they are hardy, some cows you can literally be so ruthless transition and they just calve and go out and they just do it. But I don’t think it really does them any good, they end up losing a lot of weight pretty quick’ (Farmer 27- autumn calving herd).

Some advisors also perceived that smaller grazing-type cows giving less milk on block calving farms were more likely to succeed during the transition period and experience fewer transition related disorders than those found in AYR herds:

‘The guys who have moved from 11000 litre Holsteins to smaller cows are just seeing fewer problems by virtue of that, which...I think is a great thing’ (A12 – mixed practice veterinarian).

Furthermore, Holsteins were actively disliked by several block calving farmers in the study, because they were associated with having metabolic problems and being difficult to manage:

‘I do think our cows have got a bit too much Holstein about them as well. They need bringing down in size, so we are serving to more Friesian types now… I’m not a big fan of Holstein traits, obviously the milk is good, but they come with their problems. I like Jerseys really, I would have a herd of Jerseys if I could' (Farmer 26- spring and autumn calving herd).

'Not speaking out of turn, but the type of cow that they are [Holsteins], we just couldn't keep them alive. Purely from mismanagement, that's all it is. It's just an acceptance of lameness, an acceptance of how it is. But they're very difficult animals to manage… We've bred a thoroughbred racehorse and some people are treating them like cart horses!' (Farmer 25- spring and autumn calving herd).

One farmer went on to explain how important it was for the type of cow to be suitable for their system and housing. When cows refused to lie in cubicles, instead of training those cows to lie in cubicles they were dried off or sent elsewhere:

Farmer 24 (spring and autumn calving herd): 'Our biggest problem with winter milking and cubicles is our cows aren't trained on cubicles. So that is an issue for us, they just won't lie in.

ER: 'Do you get mastitis problems because of that?'

Farmer 24: 'No because if they don't lie in, they get dried off and that's the end of that [laughs]. We just don't bother trying to keep them in to milk them, we dry them off and they go on crop or loose housing. The cow has to fit the system'.

7.4.4 The advisor relationship

Block calving farmers generally reported not requiring a nutritionist, particularly if they were spring block calving as their model of milk production relied heavily on grazed grass:

ER: 'Do you have a nutritionist?'

Farmer 24 (spring and autumn calving herd): 'No, I do it all myself. I don't need a nutritionist'

Farmer 23 (spring and autumn calving herd): 'No. What do I need a nutritionist for? Well, that's wrong but, we do have a nutritionist for the Autumns. I feed a 14% protein cake when they're out at grass. Fairly straightforward with a mineral pack in it … I would say we do a bit of grass testing, but I don't have someone giving me a ration telling me to feed this or that, it doesn't happen. It's very straightforward.

It's simple. If I ask for it, they will give me their opinion, but generally you only ask for advice if you've got a problem. If you haven't got a problem, you aren't going to ask for advice. But my nutritionist…they don't tell me anything new. I find they only tell me things that I want to hear. There's no new information, but that doesn't matter for me.'

Farmer 27 (autumn calving herd): 'We don't have a nutritionist. You know, we are low input. As soon as the grass takes off it doesn't really matter what we do then because we are all grass focussed.'

One block calving farmer sought advice from an independent nutritionist, and a further two block calving farmers with autumn calving herds in the study sought advice from a feed sales representative because they often bought in additional feed to enhance milk production, rather than constantly relying on grazed grass:

'Yes… we roughly go through things with the autumns, but I close enough know what I'm doing myself really…. anyone can be a nutritionist really, our nutritionist used to be a foot trimmer… I'll make a diet, he will check it, but I know it will be right. I look at the energy but it's all fag packet. Everything is all fag packet here, but all cows eat a different amount one day to the next, and its dead easy for a nutritionist to sit down in front of a computer and give you lots of diets, and that's not how the job works I'm afraid. I'm always keeping an eye on what he's doing, if that makes sense?' (Farmer 26- spring and autumn calving herd).

'[Pause] Well we only use [Anon feed representative] for the autumns … my herdsman doesn't like him, and I don't like him he's a bit arrogant. He just likes the sound of his own voice quite a lot' (Farmer 25- spring and autumn calving herd).

Block calving farmers were confident about discussing their idea of transition management. Block calving farmers required less advisor input and generally formulated diets themselves. In some cases, they had those diets checked by advisors. They also discussed the difficulty in taking advice from multiple advisors, and from those with a sales motive:

'I never take what someone tells me as gospel, I'll ring someone else, and ring other nutritionists to ask them about grazing and other things. I always check what people say. I look at diets all the time. The diet I'm feeding is what I've made up it's not what someone else has told me to feed. And I'll send it to my nutritionist to check over. And we've made the dairy nut specifically to the job it needs to do. It's expensive! But they're all out to sell something. That's why I'll always check with someone else who is right with me, you might not get an honest answer off anyone, but you'll get an answer just by choosing from them all, you just have to find your own way through. But also, I'm not scared of trying stuff, you find out what works and what doesn't' (Farmer 26- spring and autumn calving herd).

'I've been there before though where you have the vet the nutritionist the feed rep and everyone's an expert, everyone knows best. Sometimes it can be too many cooks. I think sticking to your vet and nutritionist is fine. Somebody independent too is always good. People that work for corn companies try to be as independent as possible but they're always pushing their own feed' (Farmer 27- autumn calving herd).

Additionally, dairy specialist vets were perceived by block calving farmers to be better than veterinarians from mixed practices, due to their specialist and more focussed advice. Of the 10 block calving farmers in the study, 8 were with dairy specialist veterinarian practices:

'We moved vets 12 years ago which was a big move…changing nutritionists is easy, but it's a big thing to move vets. They weren't focused enough to work together to move our business forward. Like retained cleansings and all that sort of thing, they would come out and do, they wouldn't show you how to do it, they wouldn't teach us how to treat a cow with milk fever in the vein, they would insist on doing that. They were from a mixed practice though' (Farmer 26- spring and autumn calving herd).

'The practise we've moved to is more dairy specialist. The one we were with was a smaller mixed practice. The difference in them has been massive! Our old vets were much less focussed on dairy herds and dairy businesses. What did it, we had a vet at a talk once from our practice and he was talking about what they were doing as a practice and it just blew us out the water, they were so much further forward. They're so far in front. When you ring them up, they will talk you through things as well. They're far more helpful. If your vets aren't so willing and open it does make such a difference. It really does' (Farmer 32- spring calving herd).

'We used to be at a mixed practice, but our vet left, and we went with him…they were dairy, small animal and did horses too, so yeah. But no there wasn't a big problem there really, we don't have as much vet input though and we've stuck with the same vet. We moved with him because he was predominantly dairy' (Farmer 31- spring calving herd).

'We were with [anon] vets, who are …they're ok but they were too emphasised on the small animal as well as the large animal side of things whereas our current vets are fully dairy. I can ring them up for anything.' (Farmer 27- autumn calving herd)

Block calving farmers stated that they had a low veterinary input. Veterinarians were brought in to do a specific job only and proactive discussion about other aspects of herd health was avoided and deemed unnecessary:

'Our vet understands what I do, which is low-cost dairy farming. The input is like 0.7 pence per litre, that's vaccines the whole lot. He never comes, he hasn't been to an emergency job this year' (Farmer 24- spring and autumn calving herd).

'Farmers talk about vets discussing things that don't interest them. Well, I wouldn't allow that conversation to take place. Because we don't want it. And if a vet is called out to a job, he's come to do that job and that's it. Obviously, we have to do a herd health plan every 12 months but that's all' (Farmer 25- spring and autumn calving herd).

I try not to use them too much and I don't like using too many antibiotics' (Farmer 27- autumn calving herd).

One farmer explained how he 'parks' advisors up, only bringing them in to advise on the business during the transition period and fertility scanning:

'We use [anon] farm vets. We park them for a while once we get past breeding, we won't tend to see a lot of them. Then we get involved quite heavily now to mid-

November December, once a fortnight. We park them up after that and use them again next year. We have a very good relationship with them, they know our system and our targets and what we want to achieve. They are very dairy focused. With the fertility stuff, I have a good grasp of where we want to be, and we are guiding the vet a little bit more on that, where we are being led by the nutritionist. But we only bring the nutritionist in to prepare cows for calving and breeding, then we send him away' (Farmer 28- autumn calving herd).

7.4.5 The importance of discussion groups

Discussion groups were described by block calving farmers as valuable tools to share information and discuss pivotal issues across all aspects of dairy herd management, including transition:

'Discussion groups are a huge pivotal part of our business, the growth of my knowledge right from when I was in New Zealand, going on different farms I'd go to 2 a month. I was part of a lot of groups. It's a massive part of the whole business. You have to be an open book' (Farmer 24- spring and autumn calving herd)

Two block calving farmers perceived AYR farmers to generally be reluctant to share information with others:

'We go to discussion groups with like-minded grazing people, then we have a lot of groups that want to come to us to see the business. We are our own little group really. We went in an advisory capacity to go on one of our bosses other Autumn farms. AYR farmers don't tend to share information so much' (Farmer 28- autumn calving herd).

'I've always been in discussion groups, always. Since I was about 20, and I've always been prepared to talk to other people, but my own opinion which isn't going to sound very good is that a lot of people that are on all year round calving TMR, keeping cows inside, I almost feel that a lot of them feel that they've got the specialist system and they do not want to share that information with anyone else. Perhaps that's my perception' (Farmer 25- spring and autumn calving herd).

Block calving farmers emphasised the requirement for small group numbers of like-minded people in discussion groups, and how this helped ease stress related to transition health problems:

> 'You need a balance of people…so, if someone is getting 30% milk fevers, they need to be in with a group who are getting 20-30% milk fevers… and it's got to be on farm. You've got to get them all on a grounding where they can all can communicate about that's common to them all. It can make it difficult with a diverse group.' (Farmer 31- spring calving herd).
>
> 'I really, really get something out of discussion groups because I find it… for a mental thing really. If you've got an issue on farm, farms can be quite lonely places and very stressful and you can often think that you are doing a really crap job and I know this sounds bad but there is always someone around the corner doing a worse job than you are [laughs]. You can go to a discussion group and say that you are having a crap time and someone else will say "Oh yes we had that problem, and we did this…or I know how to rectify that. And a problem shared is a problem halved. There's always learning too with facilitators, you get a good topic, and you end up learning even if it's just basic stuff I think it's really useful. I don't understand why all year round calvers don't do it more really. I love that sort of stuff.' (Farmer 27- autumn calving herd)
>
> 'Yes, so the discussion groups, you can't have big groups, it doesn't work. You need a small group of farmers who trust each other. And their benchmarking could be margin over purchased feeds, or figures like that because they're quite interesting figures to look into' (Farmer 23- spring and autumn calving herd).

Advisors in the study also commented on how block calving farmers learn well from each other during discussion groups and meetings:

> 'The one thing about discussion groups which the grazers do better than anyone, you'll form a group, and you'll actually accept that someone's going to be quite offensive to you and will tell you if you're doing a rubbish job. What you can then do is tell them they are doing a rubbish job, but you buy into this...being aware that what you hear might be uncomfortable' (A1- feed representative).

> ‘The only people I know that function and learn really well from one another are the block calvers. Cause they form these formal groups. You almost sign when you enter the group that you will keep information within the group, and there’s a few of them around here and they do function and help each other, and they are quite brutal with each other at times but if they're brutal with you, you can be brutal with them’ (A12- mixed practice veterinarian).

> ‘I do think they are more likely to take on new technology. And go to meetings and exchange ideas and take ideas from each other much, much better. They've been very good at the discussion groups, they take things on board like body condition score, and they'll pick each other’s brains and follow good practice…My personal views of a grazer system are that they are parasites, the milk price...what are they doing to it, they don't produce milk for three months of the year, so they aren't producing for the market! There should be a 6p per litre deduction on spring calving herd milk, because they're killing the market!’ (A3- independent nutritionist).

7.5 Discussion

The themes explored in this chapter demonstrate both comparable and contrasting views, priorities and management practices towards transition cow management between block calving and AYR calving farmers. The farmers included in this study were intended to be representative of farmers in England, by nature of the purposive sampling strategy used to recruit seasonal calving farmers with spring and autumn calving patterns, differing herd sizes and milk contracts.

There were comparable themes between the two groups of farmers, such as perceiving the action of keeping health records as being irrelevant and not useful and prioritising simplistic management methods. Cost of production was also noted as an important factor of herd management with both block calving and AYR farmers that took part in regular benchmarking. Additionally, both groups of farmers had complex relationships with their veterinary and non-veterinary advisors, although the strength of the relationship between block calving farmers and their advisors could be considered tenuous, as they had a high perceived level of independence and only sought advice from their advisors as required. Furthermore, many block calving farmers chose not to use a nutritionist which is unlike the AYR farmers discussed in this thesis. Only one of the block calving farmers sought advice from an independent nutritionist, and a further 2 out of the 10 farmers sought occasional advice from their feed sales representative, of which all 3 had autumn calving herds. None of the block calving farmers with spring calving herds used a nutritionist. Other opposing themes between both groups of farmers include transition management not being seen as a significant period to warrant much thought or proactive planning. The term ‘transition’ was not referred to by block calving farmers, unless in response to a question asked by the researcher. Furthermore, all block calving farmers reported experiencing few transition-related disorders and 7 out of the 10 farmers perceived the use of BCS scoring to be a useful tool to prepare cows for the transition period and feed or manage them according to their body condition, which contrasts with that found with AYR farmers in the current study. Further themes emerged within the interviews with block calving farmers, which serve to act as positive factors influencing transition cow management, such as the active participation in discussion groups and the sharing of knowledge, having a ‘hardier’ lower yielding type of cow that experiences less metabolic stress and transition-related issues by virtue of genetic potential, and the ability to focus on one area of management at a time.

7.5.1 Prioritising simplicity and cost

The economic advantages of spring calving patterns and producing 80% of milk from spring grass have been outlined by Dillon (1997) and Finneran et al. (2010). Evidence shows that pasture-based farming can be more profitable than systems where herds are housed indoors and rely on stored forages (Dartt et al. 1999). Additionally, the success of this approach in New Zealand has led to further interest in seasonal and grass-based milk production in parts of Europe (Washburn 2002), particularly in Ireland (Geary et al. 2013). In this type of system, reproductive efficiency is essential to maintain a concentrated calving pattern (Morton, 2010), and emphasis is placed on minimising feed and culling costs in comparison to systems where cows are housed (White et al., 2002). Additionally, grass-based systems can result in lower capital costs for machinery, manure systems and other facilities (AHDB 2016). The requirement for housing, machinery and associated expenses is often minimised on seasonal grazing herds, by focussing their efforts largely on the pasture type, soil fertility and designing farm infrastructure around cow tracks and paddocks to assist pasture access (Roche et al. 2017). This was also found by Brownlie et al. (2011) when investigating seasonal calving farmer attitudes to the importance of various farm management practices, the importance of farm infrastructure, farm tracks, fences, pastures and water systems was rated highest and was the least variable. Furthermore, the study by Brownlie et al. (2011) found that seasonal calving farmers prioritised pasture management above animal health. What the current study and the literature outlined above show, is that spring calving farmers are intensely focussed on pasture management, and other factors that directly influence cows’ access and utilisation of pasture. Although autumn calving cows are often housed during winter months, the aim on many autumn calving herds is still to maximise milk production at grass during late summer and autumn months (Lindley and Willshire, 2020). All of the autumn calving herds in the current study aimed to maximise milk production from grass where possible. This may explain why all block calving farmers in the current study prioritised maintaining their dairy system under minimal cost and simplistic management methods, so that their time could be focussed on maximising the utilisation of pasture. Furthermore, block calving farmers go to further efforts to reduce the costs of rearing replacement heifers and housing adult cattle by out-wintering (Atkins et al., 2020).

7.5.2 Health records and scoring

As discussed in Chapter 1, BCS pre-calving has a huge influence on dairy cow health, particularly metabolic disease incidence and fertility in early lactation. As milk yield increases rapidly post-calving, cows will often enter a state of negative energy balance which cannot be matched by DMI, so adipose tissue is mobilised to meet the energy reserves (Le Blanc, 2010). Exacerbation of negative energy balance through excessive BCS loss and insulin insensitivity will have a considerable impact on conception and pregnancy rates (Roche et al., 2003). Buckley et al (2003) found that in Ireland, cows below BCS 2.75 at breeding had an 8% lower in-calf rate when compared to cows with a BCS between 2.75 and 3.0. Interestingly, block calving farmers understood the value of calving cows at optimal BCS and made further attempts to correct this when BCS was not ideal. Of the block calving farmers, 70% utilised BCS scoring as a useful tool to monitor BCS and understood the importance of optimal BCS at calving but the majority (60%) did not perceive keeping health records (such as monitoring calving difficulties and transition related diseases) to be important, unless it was required by their milk purchaser. A similar theme was also found with AYR calving farmers where although 68% of AYR farmers kept health records, 54% only did so to meet the demands of their supermarket milk contracts. The remaining AYR farmers that did not keep health records chose not to because they did not find it important or useful, and because the data was historic, and the process was too time consuming.

7.5.3 The lesser significance of the transition period

When investigating the significance of the transition period for block calving farmers, they did not perceive it to be a significant period of time to focus on specific feeding and management strategies, which was largely reflected in the vocabulary used between the groups of farmers, rather than the lack of action for cows during this period. Block calving farmers did not refer to pre-calving and early lactation cows as transition cows, because the herd was seen as one cow, which was managed carefully and according to body condition and stage in gestation and lactation. The terminology used by block calving farmers was different, where the term ‘transition’ was associated with ‘complicated’ farming, ‘AYR’ systems and ‘Holstein’ type cows. The interview study found that block calving farmers did not refer to the transition period as any other type of terminology, rather the cows just ‘drifted’ from being ‘dry’ in late pregnancy to ‘milking’ in early lactation without a specific label.

7.5.4 Focussed labour

The ability to focus on one task at a time was perceived to be a positive factor influencing block calving farmers ability to manage dairy cow health as a whole. Additionally, advisors in the study reported perceived benefits of farmers being less distracted, feeling more in control and being able to measure success more easily. Other studies have found that farmers opt for block calving systems to try to concentrate the workload (Westbrooke 2006) in order to increase the time available for non-physical farm management, family and leisure. Farmers also talked about being able to increase their focus on specific farm enterprises and management tasks, leading some to move from year-round calving to block calving and others to reduce the number of enterprises on their farm (Westbrooke 2006). Studies investigating labour input on block calving farming systems have found peaks of labour requirement during spring months and the lowest labour requirement in winter months (Deming et al., 2019). In 2015, dairy farmers were classified as having the longest working week, with an average of 50.4 hours per week compared with the national average workweek of 35.7 hours (Central Statistics Office, 2015). Seasonal grazing farmers are able to recognise the focussed demand for labour during the busy calving periods and focus on reducing labour demand through attempts to be as efficient as possible, such as employing contractors and outsourcing labour (Deming et al. 2019). Brownlie et al. (2011) investigated the attitudes and priorities of farmers of block calving herds in New Zealand, of which 90% of farmers operate a spring calving system and reported that farmers employed farm advisors to undertake regular BCS scoring. Likewise, the weighing of youngstock was outsourced to external contractors. Outsourcing labour may lead to more time to strategically plan ahead and may explain why block calving farmers in the study felt in control of their transition cow management, which contrasts with AYR farmers where 17 out of the 22 felt confused and out of control with how to deal with their transition-related disorders. Additionally, due to the nature of cows moving through their production stages in a short window, block calving farmers felt they had the ability to modify BCS if they felt a large proportion of the herd were over or under optimal BCS. This was mentioned by 7 of the block calving farmers during the interviews. This is difficult for AYR farmers, of whom 14 of the 22 perceived BCS to be very difficult to change. While the nature of the calving pattern of AYR herds prevents farmers from adopting the same strategies as seasonal calvers, more efforts could be made by AYR calving farmers to outsource some labour during busy periods on the farm to allow for more time to strategically plan and become as efficient as possible. However, this is particularly difficult to suggest due to the reported labour shortages. A survey conducted by the Royal Association of British Dairy Farmers reported that one third of UK dairy farmers have considered ceasing farming due to labour shortages, and 63% of farmers surveyed had struggled to recruit in the last five years despite attempts to make job opportunities appear more attractive by offering more holidays and weekends off (The Cattle Site, 2021).

7.5.5 Perceived low transition-related disease incidence

When compared to AYR farmers in the current study, the majority of block calving farmers reported a perceived low incidence of transition-related disorders (70%). This is in contrast to AYR farmers in the current study where 77% of farmers reported having at least one type of transition-related disorder that they couldn't solve. Similar findings have been reported in the scientific literature. Washburn et al. (2002) compared the reproduction, mastitis and body condition of cows in confinement on a TMR system and cows predominantly on pasture on a grazing system. Cows in confinement had 1.8 times more clinical mastitis and 8 times the rate of culling due to mastitis than cows at pasture. Body condition scores were however generally higher for cows in confinement than cows on pasture (Washburn et al. 2002). Other studies have also shown differences in mastitis incidence and SCC in favour of pasture systems, (Bela et al., 1995; Goldberg et al., 1992) although these studies now are approximately 30 years old. Conversely, other studies have shown no differences between the two systems with general herd health (Parker et al. 1993) and SCC (Rust et al. 1995). Olde Riekerink et al. (2007) determined that when comparing calving systems, incidence rate of clinical mastitis was caused by different environmental pathogens, with *Streptococcus uberis* being associated with pasture and E. coli being associated with fully housed systems.

Selection of cow type and genetic merit play an important role in grass-based farms with seasonal calving patterns (Olori et al. 2002), with reproduction being highly prioritised by block calving herds to maintain a tight calving interval of approximately 365 days (Lindley and Willshire 2020). Studies of grass-based production systems indicate that cows with a high genetic merit for milk production have a higher interval from calving to first service, poorer conception rate overall along with a higher number of services per conception compared to cows of medium genetic merit (Snijders et al. 2001). Some block calving farmers in the current study reported outcrossing the genetics of their herd to other breeds such as Jersey and Norwegian Red, due to their 'hardier' qualities, and enhanced fertility.

Additionally, some block calving farmers actively disliked Holsteins due to their perceived high maintenance nature. Jersey cows have been shown to have higher conception rates and higher percentages of cows pregnant by 75 DIM and have half as many clinical cases of mastitis per cow as Holsteins (Washburn 2002). Additionally, Auldist et al. (2007) compared the reproductive performance, milk yield, live weight and BCS loss of purebred Holsteins and Holstein x Jersey cows in early lactation on spring calving herds. The cross bred cows in the study had higher first-service conception rates and lower final not-in-calf rates, suggesting they are more suitable for use in block calving herds where fertility is prioritised (Auldist et al. 2007). They also had marginally higher BCS but produced on average 2.2kg less milk than the Holsteins. These studies suggest that cows on an AYR housed system that usually have a higher genetic merit than those found on seasonal calving herds may be more predisposed to transition related disorders, as they produce higher milk yields and are subsequently under more metabolic stress during the transition period than lower producing dairy cows found on block calving farms. This does not mean however that cows on block calving herds do not suffer from transition-related disorders. In contrast to the findings reported above, Ribeiro et al. (2013) characterised the prevalence of periparturient diseases in seasonal grazing farms, looking at a total of 957 cows across two herds. Overall, 37.5% of cows presented at least one clinical disease and 59% had at least one subclinical health problem. The most prominent diseases were subclinical hypocalcaemia (43.3%) and subclinical ketosis (35.4%). Additionally, both clinical and subclinical diseases had further negative effects on reproduction and increased the risks of pregnancy loss. As discussed previously, subclinical issues are 'hidden' from sight, so it is possible that block calving farmers may have a perceived low prevalence of metabolic or transition related issues, yet they still may be present, and contribute negatively to poorer performance or fertility. Based on the study by Ribeiro et al. (2013), it is possible that seasonal calvers are unaware of the less tangible and subclinical transition issues that may occur and attribute their 'success' with a live calf and no clinical milk fever cases. Regarding mastitis however, the study by Ribeiro et al. (2013) found that the prevalence was lower than that reported for cows in confinement (Dubuc et al. 2010).

7.5.6 Advisor relationships

Unlike the AYR calving farmers in the current research who mostly had strong relationships with their veterinarians and nutritionists, block calving farmers more selectively sought advice from veterinarians at only certain times of the year. AYR farmers typically have routine veterinarian fertility visits, whereas seasonal calvers often schedule pregnancy diagnosis on a single veterinary visit, at a time when pregnant cows are expected to be sufficiently advanced in gestation (Chambers et al., 2020). This limits the time block calving farmers spend with their veterinarian, and as such, they may not develop the same strength of relationship as AYR farmers do when seeing their veterinarian for a regular routine visit. All seasonal farmers in the current study however did speak highly of their veterinarians, and half had sought to change from mixed practices to dairy specialist veterinarians for more focussed advice. While they had relatively positive relationships with their veterinarians, these relationships were based on a requirement only basis, where farmers sought advice on areas that they wished to gain knowledge on, and no more. Block calving farmers were not open to additional discussion on other areas of dairy cow health, and the topic of conversation was to remain relevant to what the farmer wanted to discuss. Seasonal farmer opinions of and relationships with nutritionists were variable, with only 1 out of the 10 of block calving farmers not employing an independent nutritionist because they perceived themselves not to need one, and only a further 2 block calving farmers with autumn herds utilising occasional advice from feed sales representatives, only when required. Block calving farmers were confident with their system requirements, and what feeds they would have available or need to buy in, which contrasted with quotes found in AYR farmer interviews who were often unsure of their nutritional needs and relied on their nutritionist. This is likely because the same system and calving pattern is repeated every year and seasonal farmers know what to expect and learn how to be prepared to cope with negative health consequences arising from poor weather or limited pasture. Seasonal farmers reported a requirement to keep feeding methods simple, whilst still effectively targeting the right type of feed to the cows that required it (such as feeding starchier feeds to thinner cows).

7.5.7 Discussion groups

Seasonal farmers in the current study reported the use of discussion groups to be useful methods of learning from their peers and from local experts brought in to offer advice to the group. Discussion groups were used as methods of knowledge transfer and bench marking against farmers of similar systems and herd sizes, by being open with their financial accounts and holding farm walks. Discussion groups were spoken of positively, as a pivotal tool to discuss all matters of dairy cow health, welfare and farm profitability, and to exchange ideas. It was emphasised that small groups for local farmers were required to engage farmers within the group, and so they felt comfortable sharing private information. The benefits of farmer discussion groups have been widely reported as a beneficial way to facilitate peer learning (Rose et al., 2018; Bard et al., 2019; O'Conner et al., 2021). Knowledge exchange that takes place between peers which is tacit, farmer-led and encompasses farmer engagement is more likely to be taken on positively and be incorporated or adopted into a behavioural change (Bard et al. 2019), because the discussion topics are more likely to be popular and perceived to be relevant to their businesses, infrastructure and local conditions (O'Connor et al. 2021). Furthermore, while farmers cite other farmers as valued sources of information when making decisions, involving an independent facilitator such as a topic 'expert' can keep the discussion on target and manage conflict (Barret 2014). Aside from the need to exchange business ideas, block calving farmers also spoke of the benefits of social interaction that discussion groups provided, to ease loneliness and isolation that is often associated with farming because 'a problem shared is a problem halved'. Interestingly, AYR farmers were perceived by block calving farmers to be unwilling to share information with others, and it was suggested that they could benefit and learn from more discussion group participation. Considering the level of confusion and difficulties that AYR farmers reported when managing their transition cows, active participation in discussion groups may be beneficial, not only from a benchmarking perspective but also to aid mental health and socialisation that can be negatively impacted during busy or stressful periods on the farm. Barret (2014) discussed how some farmers can feel stressed and anxious when placed in some social settings and groups where they feel they need to share information that they would otherwise prefer to keep private, such as disease prevalence or financial information. Block calving farmers in the current study expressed their confusion and were unsure why AYR farmers do not participate in discussion groups as they did, by sharing all relevant information and being completely open with their financial accounts. It is possible that AYR farmers may be less likely to feel pride and more likely to feel shame in sharing information relating to their prevalence of transition-related disorders in a discussion group setting. Bronner et al. (2014) noted that guilt and shame has acted as a barrier to reporting disease in sheep and on poultry farms, and Elbers et al. (2010) reported 'guilt, shame and prejudice' as a limitation to reporting outbreaks of swine fever. Seasonal calving farmers may feel more content sharing information on their transition management and success/failure because they have a low perceived incidence of transition related disease. By facilitating benchmarking, discussion groups may have a motivating effect, as some farmers may feel a sense of pride and competition to perform the best in terms of animal health or performance, as found with AYR farmers on supermarket contracts in the current research, who took part in benchmarking as required by their milk purchaser.

7.6 Conclusion

When compared to the themes derived from the AYR farmer interviews, there was generally heterogeneity in the attitudes between the farmers of different calving systems, with only two themes being comparable, prioritising simplicity and cost, and not finding the keeping of health records useful. Generally, the themes derived from block calving farmers contrasted those from the AYR farmers, where the transition period was given less significance, and the majority of seasonal calving farmers stated that they had a low perceived incidence of transition-related disorders (70%). Block calving farmers were able to focus on one aspect of dairy cow management at a time, meaning that their transition cows had more focussed time and attention, and they were able to target their labour at times when it was most needed. The nature of perceiving the whole herd as one cow meant that managing BCS and the risks for metabolic disorders could be minimised more easily than by AYR calving farmers. Furthermore, novel findings include seasonal calvers having more distant relationships with their advisors compared to AYR farmers, as advisors were only consulted at busy periods of the year regarding specific topics that were farmer-led. The use of discussion groups was noted to be a valuable tool for information sharing, peer comparison and benchmarking, and it was suggested that AYR farmers could learn from seasonal calving farmers by adopting the same knowledge exchange approach. Novel findings derived from this interview research also include how seasonal calving farmers did not refer to the transition period as a specific time point or period, rather the cows just ‘drifted’ from being ‘dry’ in late pregnancy to ‘milking’ in early lactation without a specific label.

8. Chapter 8: The attitudes of dairy farmers in England towards transition cow management determined through a questionnaire

8.1 Introduction

Chapters 3 to 7 present and discuss findings from a qualitative and quantitative regional study investigating farmer and stakeholder attitudes to transition cow management. So far, barriers have been identified which influence farmer implementation of optimal practices, and advisor willingness to provide focussed transition advice, in farmers and advisors from the North-West and Midlands of England. The themes that were derived from these information-rich interviews have helped to form the basis of a questionnaire, used to determine if findings from the regional study were consistent across a wider range of dairy farms. The aim of the questionnaire was to understand how farmers across England manage their transition cows, particularly the challenges associated with this period of dairy cow health and the relationships they have with their veterinary and non-veterinary advisors.

8.2 Results

There were 100 respondents to the dairy farmers questionnaire. No respondents needed to be excluded from data analysis. Information on the distribution and inclusion criteria of the questionnaire, along with data analysis can be found in Chapter 2.9 (Materials and methods).

8.2.1 Background information

Farmers supplied the first 3 digits of their post code so the county within which they were located could be determined. The geographical distribution is shown in Figure 8.2.1.

Figure 8.2.1: A map of the England displaying the geographical distribution of the questionnaire participants

Farmers with more than one herd were asked to choose one of their herds and base the answers of the questionnaire on that herd. Of the questionnaire participants, 75% were male, the remaining 25% were female. Regarding farming systems, 5% stated that they were operating an organic system, while the remaining 95% were conventional.

The age of participants is provided in Table 8.2.1:

Table 8.2.1: The distribution of age of farmer questionnaire respondents.

How old are you?	Number of respondents	Percentage of respondents (%)
<25	10	10
25-35	37	37
36-45	19	19
46-55	13	13
56-65	16	16
>65	2	2
Prefer not to say	3	3

When asked their role on the dairy farm, the majority (71%) of respondents stated that they were farmer owner/operators, with 16% as herd managers, 9% describing themselves as farm workers, 3% as farm managers and 1% as an assistant. Regarding herd size, the majority (41%) of respondents were from herds containing 100-200 cows (Fig 8.2.2), with 35% between 201-400 cows. There was less representation from larger herds, with 10% of respondents from herds of 401-600 cows, 1% 601-800 cows, and 5% over 800 cows. Smaller herds of under 100 cows were represented by 8% of farmers.

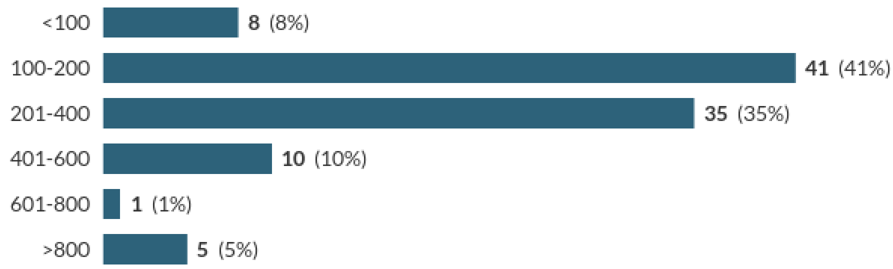


Figure 8.2.2: Herd size distribution among questionnaire respondents.

The majority of farmer respondents had an all-year-round calving pattern (76%), with nearly a quarter from block calving herds (Fig 8.2.3). Of the respondents from block calving herds, 7% were from spring block herds, 9% from autumn block herds and 8% from a combination of spring and autumn block calving herd.

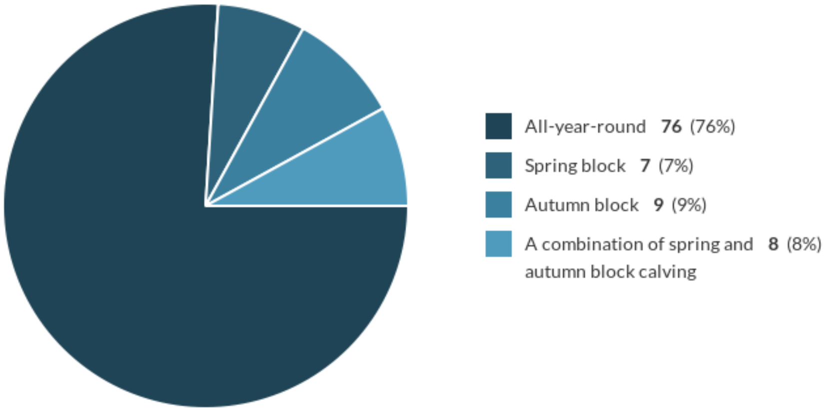


Figure 8.2.3: Participant's herd calving systems.

The majority (29%) of respondents stated that they had an average yield of 9501-11000L, followed by 28% with an average yield of 8001-9500L, and 21% with an average yield of 6501-8000L (Fig. 8.2.4). Lower average annual yield yields were represented by the block calving herds, with 2% of respondents having an average annual yield of below 5000L and 8% with a yield between 5000-6500L. Higher yields of over 11000L were reported by 12% of respondents.

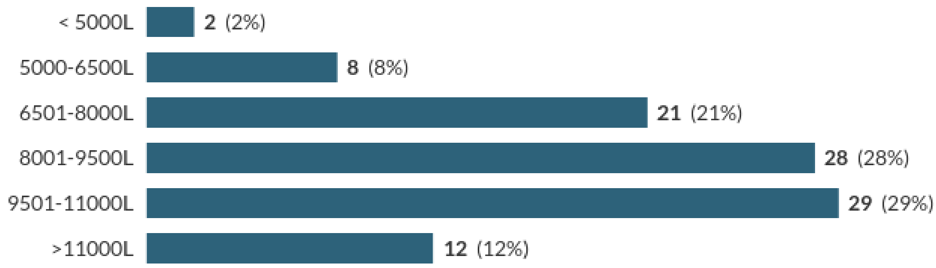


Figure 8.2.4: Participants' average herd milk yields

Over three quarters of the farmer respondents milked their cows twice per day (78%), with 11% of farmers milking three times per day, 10% milking their cows with robotic milking machines and 1% of farmers milking once per day (Fig 8.2.5).

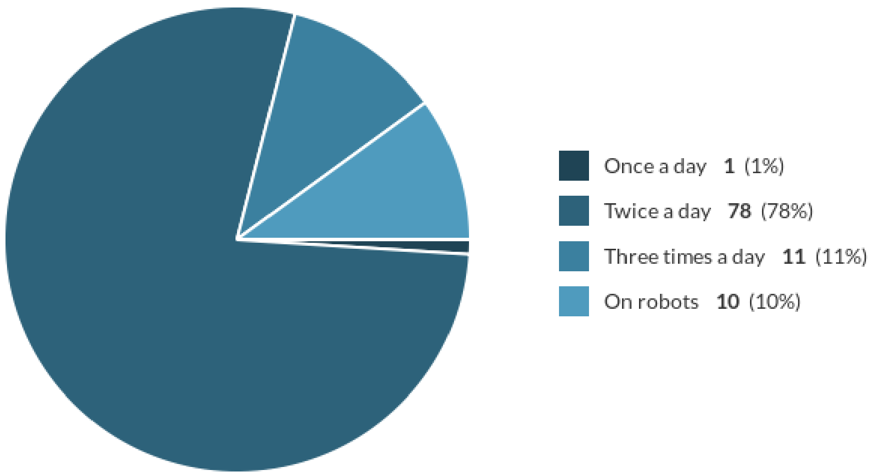


Figure 8.2.5: Participants' distribution of milking frequency.

8.2.2 Transition cow management

Farmers were asked if their pre-calving cows were grouped separately from the main milking herd 2-3 weeks prior to calving, to which 95% responded yes and 5% no. In comparison, only 28% of respondents grouped their freshly calved cows separately from the main milking herd 2-3 weeks post-calving, whereas the majority (72%) did not. Farmers were asked to characterise their current transition management on a ranking scale, 1 being very good and 5 being very poor (Fig. 8.2.6). The majority of farmers (32%) chose to rank their transition management as 2 (good), with 31% at 3 (neither good nor bad). Nearly a quarter of farmer respondents (24%) ranked their transition management as 4 (bad), with 4% choosing to rank it at 5 (very bad). Less than 10% of farmers chose to rank their transition management at 1 (very good). There was no significant relationship between the ages of respondents and the way they ranked their current transition cow management (Fisher's exact test: $p = 0.29$).

Figure 8.2.6: Distribution of farmer responses ranking their current transition cow management on a Likert scale (1 being very good and 5 being very poor).

Farmers were asked about their intentions to improve their transition management by choosing one statement that was most applicable to their situation. Just over half of respondents (52%) stated they were actively seeking advice to improve their transition management. Just over a quarter (26%) of farmers stated that they had intentions to improve transition management on their farms in the future but not immediately, and the remaining 22% reported they had no intention to improve transition management on their farms. There was no significant relationship between farmer age category and their intentions to improve transition cow management (Fisher's exact test: $p = 0.38$). Farmers were also asked how frequently metabolic diseases/conditions occurred in their herds, by ranking each disease/condition on a 1-5 scale, where 1 was never and 5 was very common. Table 8.2.2 displays the responses; percentages are for each metabolic disease where participants ranked them 1-5 in perceived prevalence. The most commonly reported metabolic disease with a perceived high prevalence was mastitis with the highest mean rank of 2.53 (Kruskal-Wallis: $p = 0.67$), with 4% of farmers ranking it at 5 (very common) and 10% ranking it at 4 (common).

Table 8.2.2: Farmer reported prevalence of metabolic diseases/conditions, ranked 1-5 on a Likert scale.

	Ranking								
	1	**2**	**3**	**4**	**5**	**Don't know**	**Mean rank**	**Median**	**Interquartile range**
Clinical milk fever	12%	65%	16%	7%	0%	0%	2.18	2	0
Retained cleansings	3%	65%	26%	4%	1%	0%	2.34	2	1
Metritis (dirty cows)	9%	56%	28%	6%	1%	0%	2.34	2	1
Mastitis	10%	45%	31%	10%	4%	0%	2.53	2	1
Displaced abomasum	38%	52%	6%	4%	0%	0%	1.76	2	1
Clinical ketosis	29%	58%	9%	1%	2%	1%	1.92	2	1

Retained cleansings and metritis had equal mean ranking of 2.34, followed by clinical milk fever with a mean ranking of 2.18 and clinical ketosis at 1.92. The condition most reported as 'never' was displaced abomasum with 38% of respondents ranking it at 1, resulting in the lowest mean rank of 1.76

Farmers were also asked to rank transition cow health problems compared with other herd health and welfare challenges (Table 8.2.3). Transition cow health problems were ranked as the most important problem amongst other herd health and welfare challenges with a mean rank of 2.11, followed by lameness (2.46), mastitis (2.87), reproductive failure (3.07) and respiratory disease (4.33). There were no differences (Kruskal -Wallis p = 0.79) in the way farmers ranked transition cow health problems compared to other herd health challenges.

Table 8.2.3: Farmer perceived ranking of transition cow health problems, compared to other health and welfare challenges in their herd (1 being the most important and 5 being the least important).

	Ranking							
	1	**2**	**3**	**4**	**5**	**Mean rank**	**Median**	**Interquartile range**
Transition cow health problems	48%	17%	13%	17%	4%	2.11	2	2
Lameness	40%	24%	17%	16%	1%	2.46	2	1
Mastitis	14%	17%	38%	19%	7%	2.87	3	2
Reproductive failure	13%	22%	18%	27%	14%	3.07	3	2
Respiratory disease	8%	2%	5%	18%	65%	4.33	5	1

Respondents were asked to provide the top two reasons why cows leave their herds in the first 60 days of lactation (Fig. 8.2.7). The most common answer was injury and illness (65%), followed by mastitis and udder issues (32%), transition cow health related problems (21%), and sudden death (20%). Other options were evenly represented, and included reproductive failure (8%), lameness (7%), other (8%), none of these (9%), and low milk production (3%).

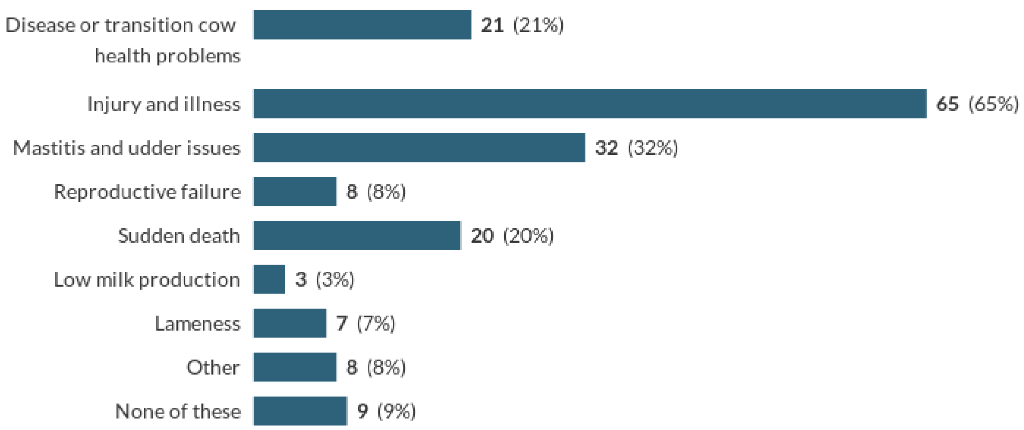


Figure 8.2.7: Participants' main reasons why cows left the herd within 60 days of lactation, on dairy farms (selling freshly calved dairy animals was not an option).

Participants were also asked what they considered their challenges were to a successful transition, and to rate the top 3 (1 being the most important, followed by 2 and 3) (Table 8.2.4). The majority of respondents felt they did not have challenges to transition success (mean rank 1.46), followed by 'housing is out of date/not spacious enough' (mean rank 1.61), and 'metabolic diseases that I can't control' (mean rank 1.73). There was no difference (Kruskal-Wallis p = 0.82) in the way farmers ranked their perceived challenges to transition cow management.

Table 8.2.4: Farmer perceived challenges to a successful transition, ranked by importance (1 being most important, followed by 2 and 3).

	Ranking					
	1	**2**	**3**	**Mean rank**	**Median**	**Interquartile range**
Metabolic diseases that I can't control	51.4%	24.3%	24.30%	1.73	1	1
Housing is out of date/not spacious enough	53.7%	31.7%	14.6%	1.61	1	1
Lack of feed or water space	13.3%	66.7%	20%	2.07	2	0
Lack of advice or information from my vet	0%	50%	50%	2.5	2.5	0.5
Lack of advice or information from my nutritionist	33.3%	33.3%	33.3%	2.0	2	1
Due to farm layout, I can't feed a total or partial mixed ration to my pre-calving cows	30.4%	52.2%	17.4%	1.87	2	1
Due to farm layout, I can't group or feed my dry cows separately	20%	20%	60%	2.4	3	1
Small group sizes make it a challenge to feed a fresh ration every day	41.9%	29%	29%	1.87	2	2
Lameness	19%	47.6%	33.3%	2.14	2	1
Conflicting advice from advisors	12.5%	50%	37.5%	2.25	2	1
Other herd health issues take priority	18.2%	27.3%	54.5%	2.36	3	1
I do not consider that I have challenges to transition success	69.2%	15.4%	15.4%	1.46	1	1
Other	50%	6.3%	43.8%	1.94	1.5	2

Farmers were also asked how often they looked proactively for signs of transition cow health problems to treat them before they worsen, by ranking 1-5 on a Likert Scale, 1 being very regularly and 5 being not at all. The majority of farmers (44%) ranked themselves as 1, to be proactive in looking for signs of ill health during the transition period, followed by a quarter ranking themselves as 2, 16% at 3, 7% at 4 and 2% at 5. A small percentage of respondents (6%) chose to answer ‘I don’t know’. Respondents were also asked if they used any transition health monitoring tools, and if so, to rate the top 3 in order of importance, 1 being most important, 3 being the least important (Table 8.2.5). Of the respondents using transition health monitoring tools, the most important was rumination monitoring systems (collars/bolus) (mean rank 1.26), followed by ‘none of these’ (mean rank 1.67), ‘fresh cow checks during a routine veterinary visit’ (mean rank 1.73) and ‘daily group walks’ (mean rank 1.84). There were however no differences (Kruskal-Wallis $p = 0.56$) in the way farmers ranked the importance of health monitoring tools.

Table 8.2.5: The use of and perceived importance (ranked 1-3, in order of importance, 1 being the most important, 3 being the least important) of transition health monitoring tools, by dairy farmers in England.

	Ranking					
	1	**2**	**3**	**Mean rank**	**Median**	**Interquartile range**
Rumination monitoring system (collars/bolus)	77.8%	18.5%	3.7%	1.26	1	0
Activity monitoring system (pedometers)	33.3%	44.4%	22.2%	1.89	2	0.75
Ketosis testing	30.8%	15.4%	53.8%	2.23	3	1.75
Feed intake calculations	22.7%	45.5%	31.8%	2.09	2	1
Fresh cow checks during routine vet visit	43.8%	39.6%	16.7%	1.73	2	1
Rectal temperatures (or bolus temperatures)	36.4%	36.4%	27.3%	1.91	2	2
Sudden drop in milk yield	22.6%	38.7%	38.7%	2.16	2	1
Daily group walks	39.5%	36.8%	23.7%	1.84	2	1
Rumen fill scoring	20.8%	37.5%	41.7%	2.21	2	1
Monitoring somatic cell count	26.1%	17.4%	56.5%	2.3	3	1.25
Administering mono-propylene glycol to cows with a low rumen fill.	6.5%	46.7%	46.7%	2.4	2.5	1
None of these	66.7%	0%	33.3%	1.67	1	1.5

The majority of participants reported that BCS was important for transition cow health, but that they didn't record it (49%), followed by 33% of farmers who thought it was very important and took steps to manage it and BCS score regularly (Figure 8.2.8).

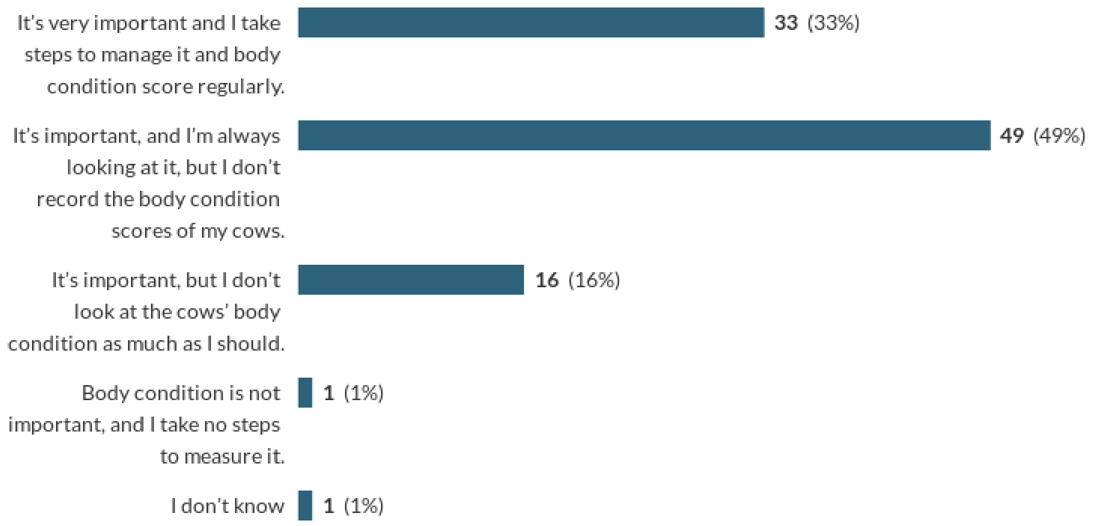


Figure 8.2.8: Farmer attitudes towards the importance of body condition for transition cow health when asked how important they considered body condition for transition cow health.

The majority of farmers stated that stocking rate was important in influencing transition cow health and avoided overstocking (58%) (Fig. 8.2.9). This was followed by 39% of farmers who thought it was important but still overstocked their transition cows for other reasons.

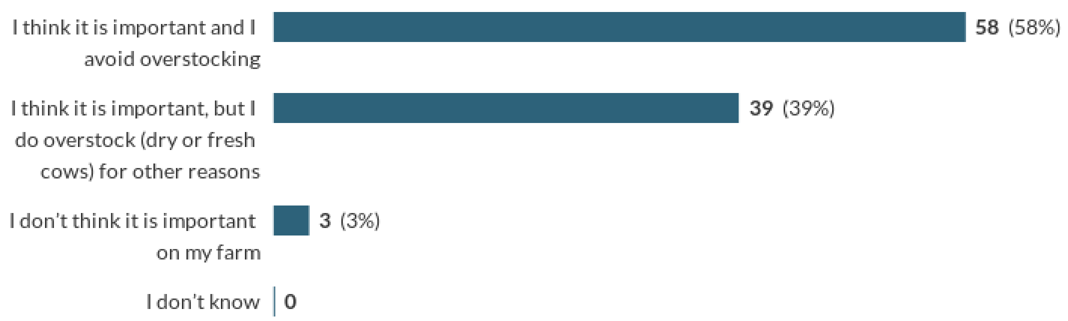


Figure 8.2.9: Farmer attitudes towards the importance of stocking rate on transition cow health in England when asked how important they considered stocking rate for transition cow health.

8.2.3 Feeding transition cows

When feeding their pre-calving cows, the majority (71.7%) of farmers stated that they fed once per day, followed by 20% that fed every other day (Fig. 8.2.10). Only 5.1% of farmers fed twice per day and 3% of participants fed every three days or more.

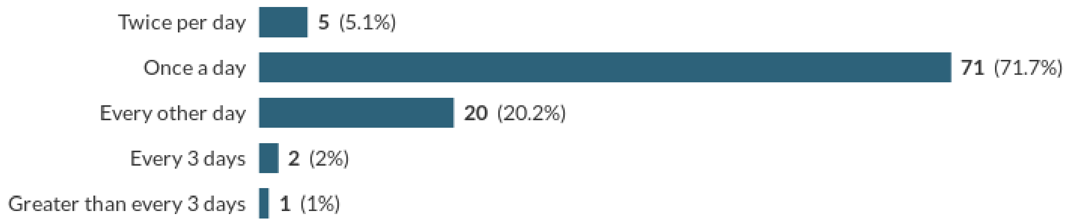


Figure 8.2.10: Frequency of feeding pre-calving cows on dairy farms in England when asked how often they made a fresh feed for pre-calving cows.

Farmers were asked how they maximised DMI for their transition cows (Fig. 8.2.11). The most popular responses were ‘cleaning out feed troughs before fresh feed is delivered’ (59%), followed by ‘pushing-up feed at the barrier 2-4 times per day’ (48%), and ‘providing at least 75 cm of feed space at all times’ (46%).

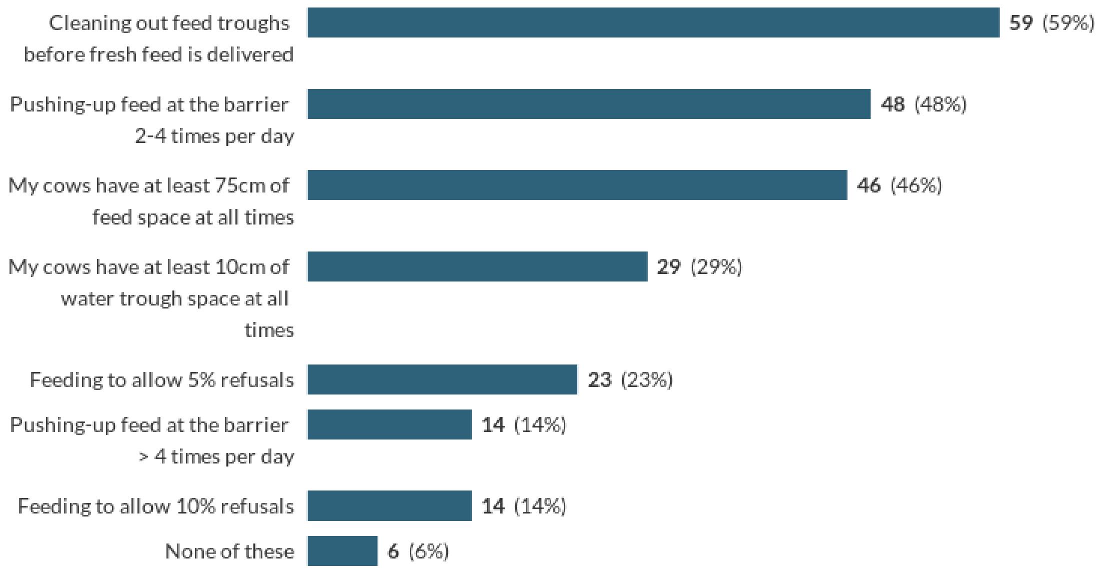


Figure 8.2.11: Participants’ methods of maximising DMI on dairy farms.

When asked how pre-calving cows were fed, the most popular response was to feed a ‘specific pre-calving cow TMR or PMR’ (51%), followed by ‘silage/hay, top-dressed with a nut or a blend’ (26%) (Fig. 8.2.12). Of the farmers that responded, 10% fed their pre-calving cows silage or hay but chose not to feed any additional concentrates, and 3% chose ‘other’ where they specified ‘hybrid brassicas with haylage bales’, ‘tight on grass and haylage to keep topped up’ and ‘grazed fodder beet and silage’.

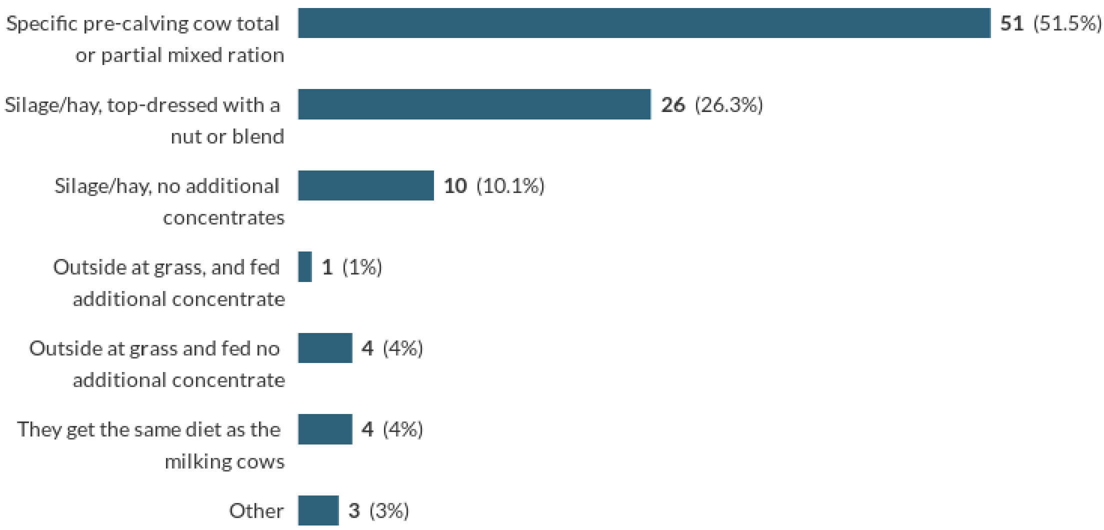


Figure 8.2.12: Methods of feeding pre-calving cows on dairy farms in England.

Regarding feeding vitamins and minerals to pre-calving cows, participants could select between 1 and 8 answers (Fig. 8.2.13). The most popular method of delivering pre-calver minerals was via a bagged mineral in a TMR (42.4%), followed by the use of mineral lick blocks (28.3%) and a mineralised concentrate (26.3%). Only 4% of farmers chose not to feed minerals to their pre-calving cows. The main reason for this was the perception that their pre-calving cows did not need additional minerals (75%, n=3) followed by ‘I have never been advised to’ (25%, n=1) and ‘I have used them before and they didn’t help/work as expected’ (25%, n=1). There were four respondents who indicated that they did not feed minerals to their pre-calving cows (one producer chose two responses), three were from AYR calving herds and 1 was from a spring calving herd.

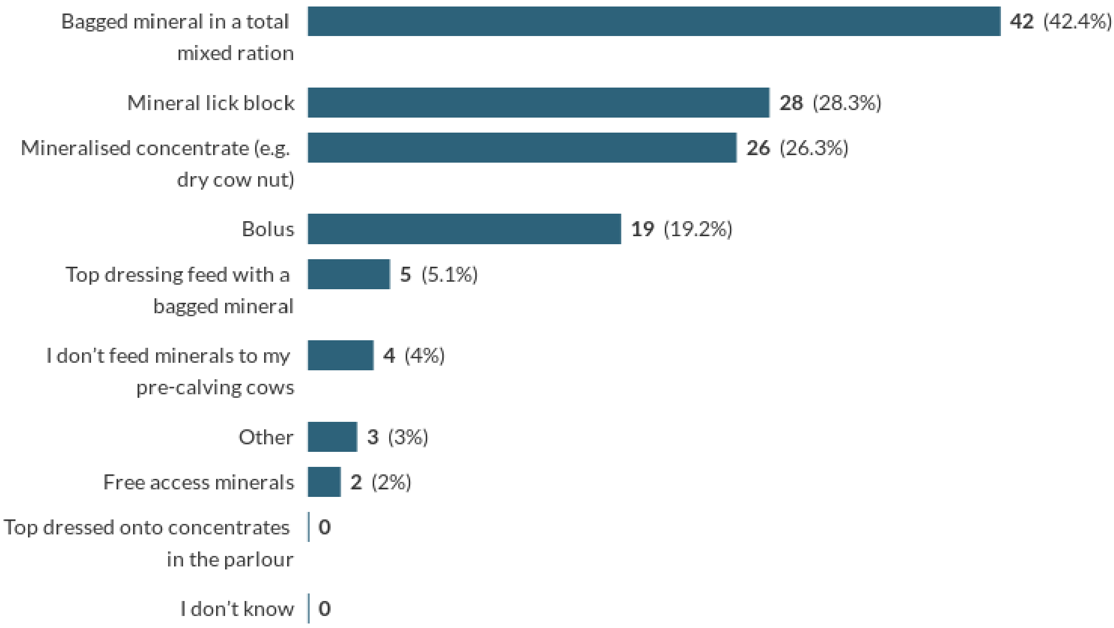


Figure 8.2.13: Participants' methods of feeding vitamins and minerals to pre-calving cows

Farmers were asked if they fed anionic salts to their pre-calving cows, and if so what their method of feeding was (Fig. 8.2.14). Of the respondents, 37.4% of farmers did not feed anionic salts for milk fever prevention. Of the farmers that did, the most popular method of delivery was within a TMR or PMR, followed by in a water trough. Of the 37% of farmers who did not feed anionic salts to their pre-calving cows, the most popular reasons for this were because they had never been advised to (52.8%, n=19), followed by farmers perceiving that their pre-calving cows did not need them (19.4%, n=7). Other reasons were 'I don't know' (16.7%, n=6), 'I have used them before and they didn't help/work as expected' (8.3%, n=3) and 'it's too costly' (2.8%, n=1).

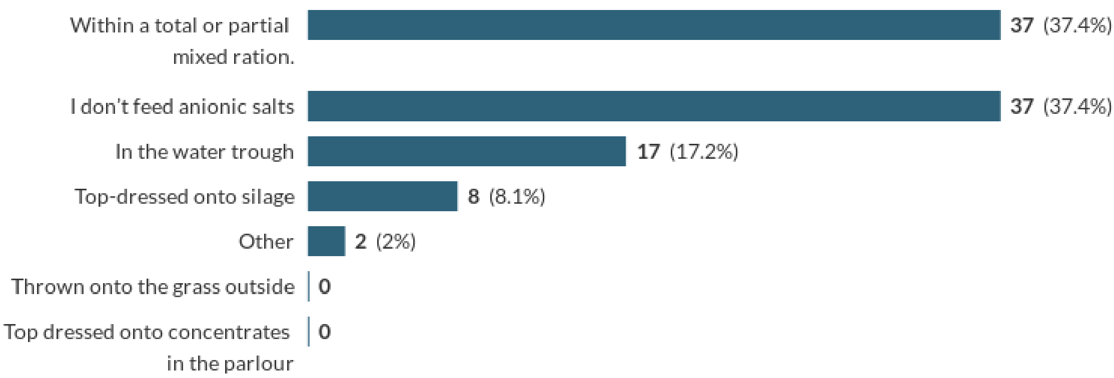


Figure 8.2.14: Participants' methods of feeding anionic salts to pre-calving cows on dairy farms.

Participants were asked if they fed or used additional supplements to their transition cows to help reduce metabolic disease (Fig. 8.2.15). The most common additional supplement was ‘fresh cow drinks or drenches’ (49.5%), followed by ‘calcium boluses’ (42.4%) and Kexxtone^{TM} (monensin) boluses (32.3%). Of the 24.2% of farmers that chose not to feed additional supplements to their transition cows, the most popular reasons were that their transition cows did not need additional supplements (45.8%, n=11), followed by never being advised to (16.7%, n=4) and ‘I don’t know’ (16.7%, n=4). Other responses included ‘it’s too costly’ (12.5%, n=3), ‘I have used them before and they didn’t help/work as expected’ (12.5%, n=3) and ‘I don’t have the time’ (8.3%, n=2).

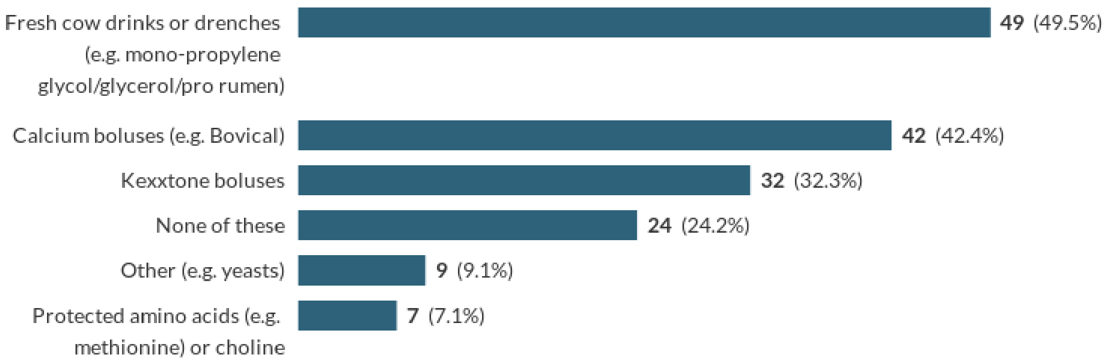


Figure 8.2.15: Additional supplements fed to transition cows on dairy farms in England when asked if they fed additional supplements (pre- or post-calving) to help reduce metabolic disease.

8.2.4 Relationships with advisors

Participants were asked about their relationships with their farm-advisors. Farmers were asked if their veterinarians were from a dairy specific or a mixed practice. Of the farmers that responded, 51% (n=51) reported their main veterinarian to be from a mixed practice of dairy, beef and sheep, with 29% (n=29) using a veterinarian from a dairy specific practice, and 20% (n=20) using a veterinarian from a mixed practice of small animal equine and farm. There was however no relationship between farming systems and whether their veterinarian was from a mixed or dairy specific practice (Fisher’s Exact test: $p = 0.37$). Farmers were also asked how they would describe the strength of their relationship with their veterinarian (Figure 8.2.16). The majority of respondents reported their relationship to be ‘very good’ (63%), with 31% suggesting it was ‘good’, 5% reporting it was ‘indifferent’ and only 1% reporting it to be ‘poor’.

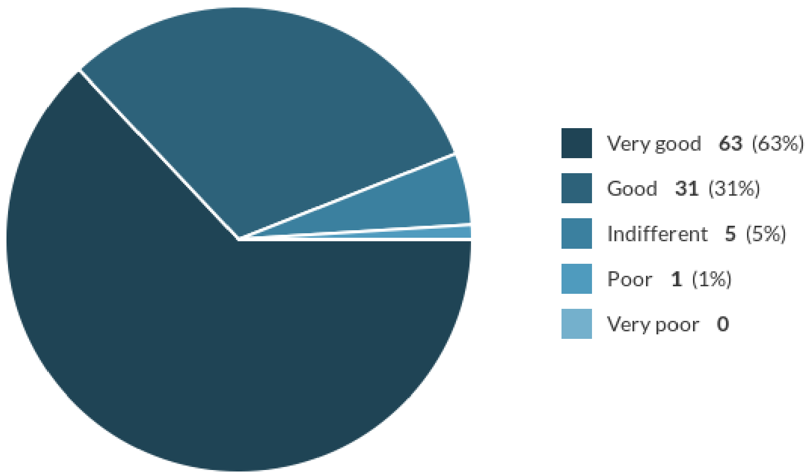


Figure 8.2.16: Dairy farmer attitudes towards the relationship with their veterinarian.

When asked how often farmers discuss transition management with their veterinarian, the majority (39%) of famers did so only when there was a problem, followed by ‘usually, on most visits’ (36%), and ‘not very often’ (12%) (Fig. 8.2.17). Only 7% of farmers discussed it ‘always’ on every veterinarian visit, with 6% never discussing transition cow management with their veterinarian.

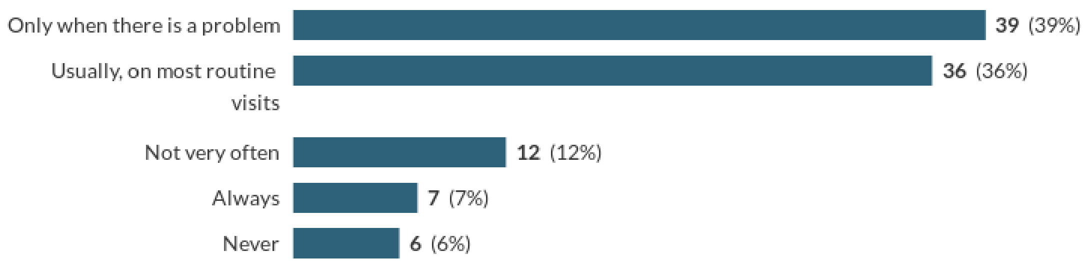


Figure 8.2.17: Dairy farmer perceived frequency of transition management discussion with their veterinarian.

Participants were asked if they would like more attention to be paid to transition management during visits with their veterinarian, to which 55% of respondents replied no, 23% replied ‘I would but I don’t want to pay additional vet time for it’ and 22% chose ‘yes, and I would be prepared to pay for the advice’. Of the farmers that chose ‘yes’, there was no trend in average annual milk yield (Fisher’s exact test p = 0.87), herd size (Fisher’s exact test p = 0.96), or age category (Fisher’s exact test p = 0.78). However, 17/22 of those farmers choosing ‘yes’ were from AYR farms, and the remaining 5 were from block calving herds.

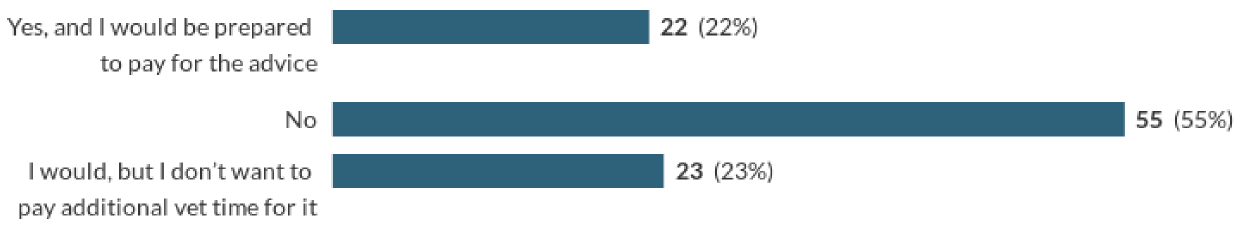


Figure 8.2.18: Farmer responses when asked if they would like more attention to be paid towards transition cow management during visits with their veterinarian.

Farmers were also asked to choose responses that may apply to them and their veterinarian, based on how proactive their veterinarian was and how often they discuss transition management (Fig. 8.2.19). The majority of respondents (46%) stated that their veterinarian was proactive and asked them about their transition management, while 42% indicated that while their veterinarian was helpful with transition cows, the farmers had to initiate the discussion about transition management. This was followed by 15% of respondents who said that other herd health issues were prioritised.

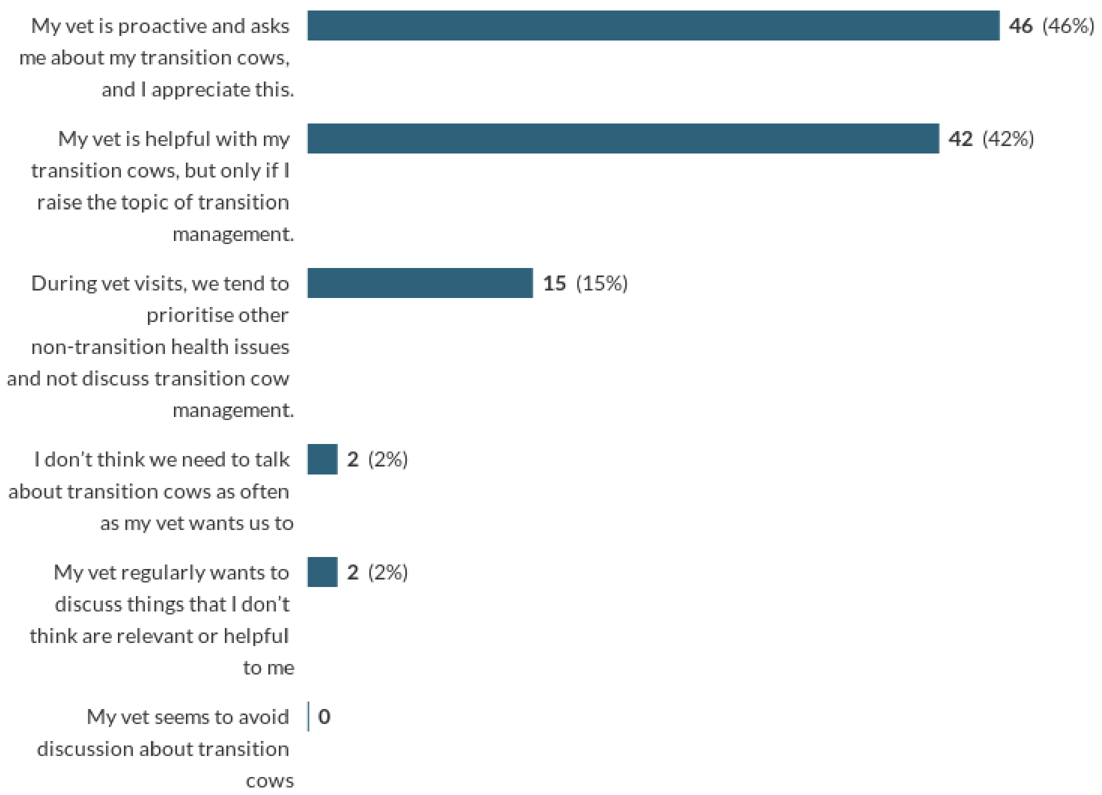


Figure 8.2.19: Dairy farmer responses towards the perceived proactiveness of their veterinarian concerning transition cow management and discussion.

When asked if they had any non-veterinary advisors (Fig. 8.2.20), 51% stated they sought advice from a nutritionist or feed representative, 49% stated that they had an independent nutritionist/consultant, 16% had a dairy business consultant, 8% had none of these, and 3% responded with ‘other’. Farmer responses on types of non-veterinary advisors were not statistically related to herd size or age, however of the farmers who sought advice from an independent nutritionist, the majority (43%) were from herds between 201-400 cows, with 33% being from herds between 100-200 cows. Respondents were also asked if their nutritionist covered other species, to which 25.6% (n=23) responded yes, 42.2% (n=38) responded no, and 32.2% (n=29) responded ‘I don’t know’.

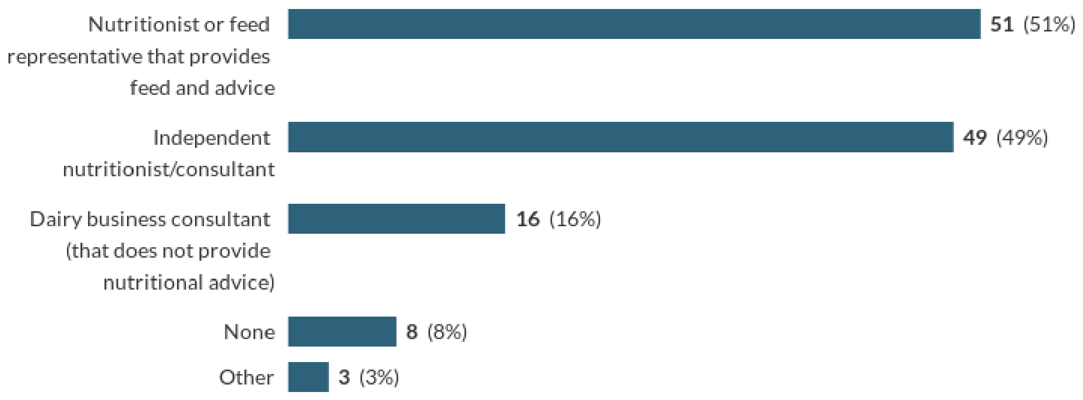


Figure 8.2.20: Participants’ use of non-veterinary advisors by dairy farmers.

Farmers were asked how they would describe the strength of their relationship with their nutritional advisors (Fig. 8.2.21). The majority responded with ‘very good’ (63.3%), followed by 28.9% saying it was ‘good’, 5.6% suggesting it was ‘indifferent’, and 2.2% saying it was poor. No respondents chose to answer ‘very poor’.

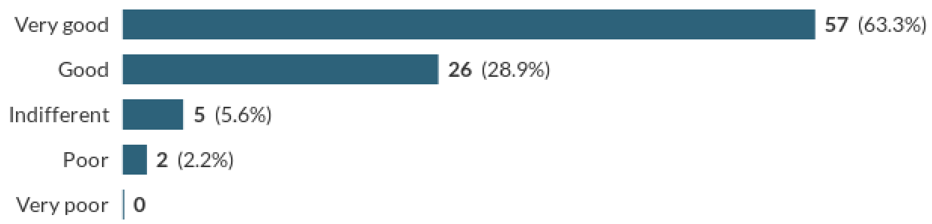


Figure 8.2.21: Dairy farmer attitudes towards the relationship with their nutritional advisors.

When asked how often farmers discussed transition cow nutrition with their non-veterinary nutritional advisors, 37.1% responded with ‘always’, and ‘usually, on most routine visits’, followed by 15.7% responding with ‘only when there is a problem’, 9% responding with ‘not very often’, and 1.1% responding with ‘never’ (see Fig. 8.2.22).

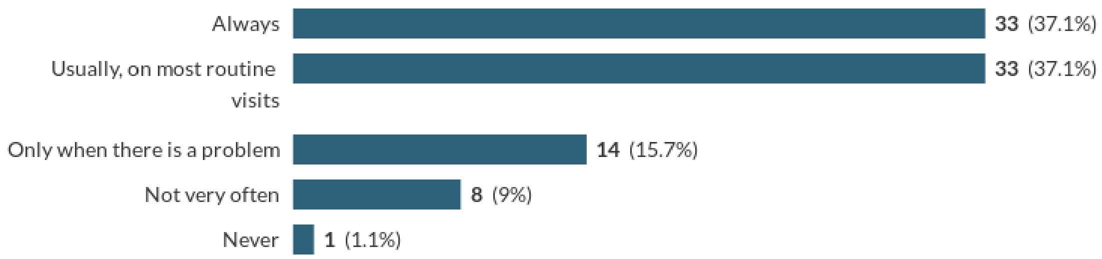


Figure 8.2.22: Dairy farmer perceived frequency of transition-nutritional discussion with their nutritional advisors.

Farmers were also asked to choose the response that most closely applied to their relationship with their nutritional advisors, based on how proactive their advisors were in bringing up the topic of transition cow management during visits, and how often they discussed nutritional management of their transition cows (Fig. 8.2.23). The majority of participants (65.5%) indicated that their nutritionist was proactive and brought up transition discussion, however 27.6% of producers reported that their nutritionist was helpful but only if the farmer raised the topic of transition. None of the respondents indicated that their nutritionist avoided discussion about transition cows, however 8% of producers suggested that the main milking herd was prioritised, so discussion of transition cows got missed.

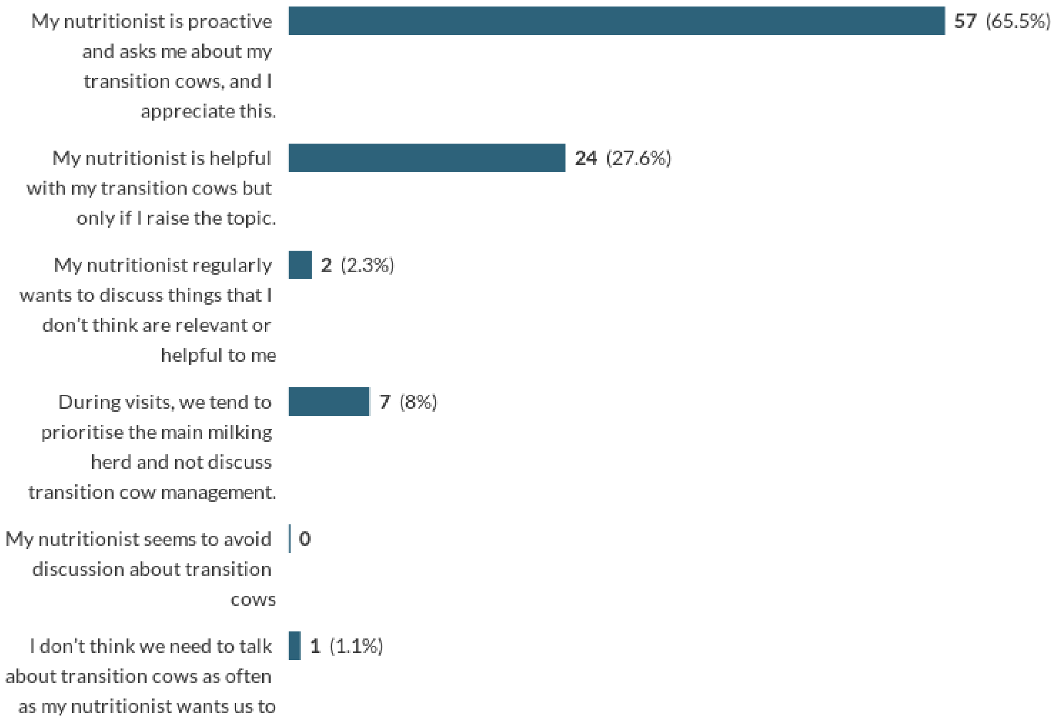


Figure 8.2.23: Dairy farmer responses towards the perceived proactiveness of their nutritional advisors concerning transition cow management and discussion.

Respondents were also asked if they would like more attention to be paid to the nutritional management of transition cows by their nutritional advisors (Fig 8.2.24), to which the majority (70.8%) responded 'no', whilst just under a third responded 'yes' (29.2%).

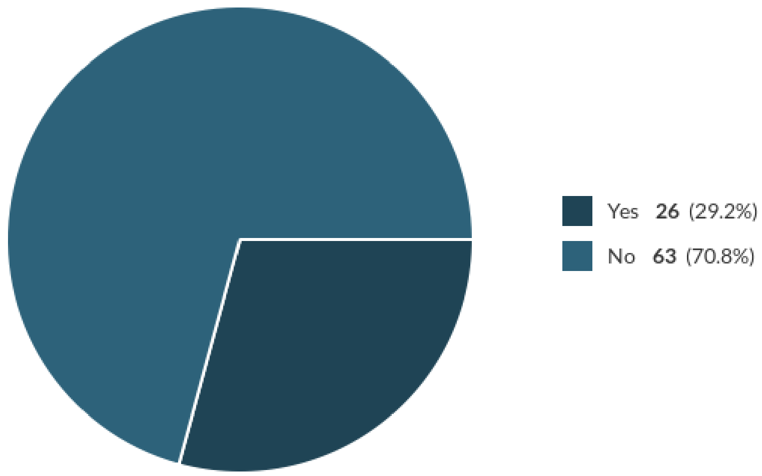


Figure 8.2.24: Dairy farmer responses when asked if they would like more attention to be paid to transition cow management by their nutritional advisors.

Respondents who did not have a nutritional advisor were asked the reason for this, and to choose a response that applied to their situation, to which 35.7% (n=5) chose to answer they did not need any nutritional advice, 35.7% (n=5) responded with 'I don't know', 21.4%

(n=3) answered ‘I have had poor experiences with nutritionists in the past’, 7.1% (n=1) that they were currently looking for a nutritionist and the remaining 7.1% (n=1) did not have a feed representative and did not want to pay the additional cost of an independent nutritional advisor. Of the respondents who stated that they did not have a nutritional advisor, eight were from AYR calving herds and four were from spring calving herds.

Farmers were asked if they had made any impactful changes to transition cow management or housing in the last three years, and if so, to rank the changes in terms of how impactful they perceived those changes to be towards transition cow health (Table 8.2.6). Respondents did not have to choose three answers but were limited to a maximum of three. The most impactful change ranked by farmers was ‘built new or improved existing transition housing, allowing more room per cow’ (mean rank, 1.32). This was followed by ‘none’ (mean rank, 1.38), and ‘introduced routine calcium bolusing to some freshly calved cows’ (mean rank 1.79).

Table 8.2.1: Dairy farmer responses to changes made towards transition cow management or housing, in England.

	Ranking					
	1	**2**	**3**	**Mean rank**	**Median**	**Interquartile range**
Built new or improved existing transition housing, allowing more room per cow	73%	21.6%	5.4%	1.32	1	1
Increased feed or water space, or reduced stocking rate	26.3%	50%	23.7%	1.97	2	0.75
Introduced a system to try to reduce stress and movements at calving (e.g., stress-free calving line/moving in pairs)	28.6%	37.1%	34.3%	2.06	2	2
Introduced routine calcium bolusing to some freshly calved cows	42.1%	36.8%	21.1%	1.79	2	1
Introduced routine drenching of mono-propylene glycol to some freshly calved cows	8.3%	66.7%	25%	2.17	2	0.25
Introduced a new transition health monitoring protocol of any kind (e.g., rumen fill scoring, rumination collars, ketone testing, fresh cow checks)	39.1%	30.4%	30.4%	1.91	2	2
Introduced a new diet or method of feeding	41.5%	34.1%	24.4%	1.83	2	1
None	81.3%	0%	18.8%	1.38	1	0
Other	33.3%	0%	66.7%	2.33	3	1

Farmers were also asked that if no recent changes had been made, what was the reason for this, to which 28.3% of farmers responded with 'I do not need to make any management or housing changes', followed by farm infrastructure not being suitable to make sufficient changes (13.2%), cost (11.3%), and lack of time/labour (11.3%) (Fig. 8.2.25). Additionally, 5.7% of farmers chose to respond with 'transition advice is confusing and difficult to follow', 3.8% lacked interest of motivation in the suggestion, 1.9% lacked confidence in making sufficient changes, and the remaining 1.9% chose to respond with 'other'.

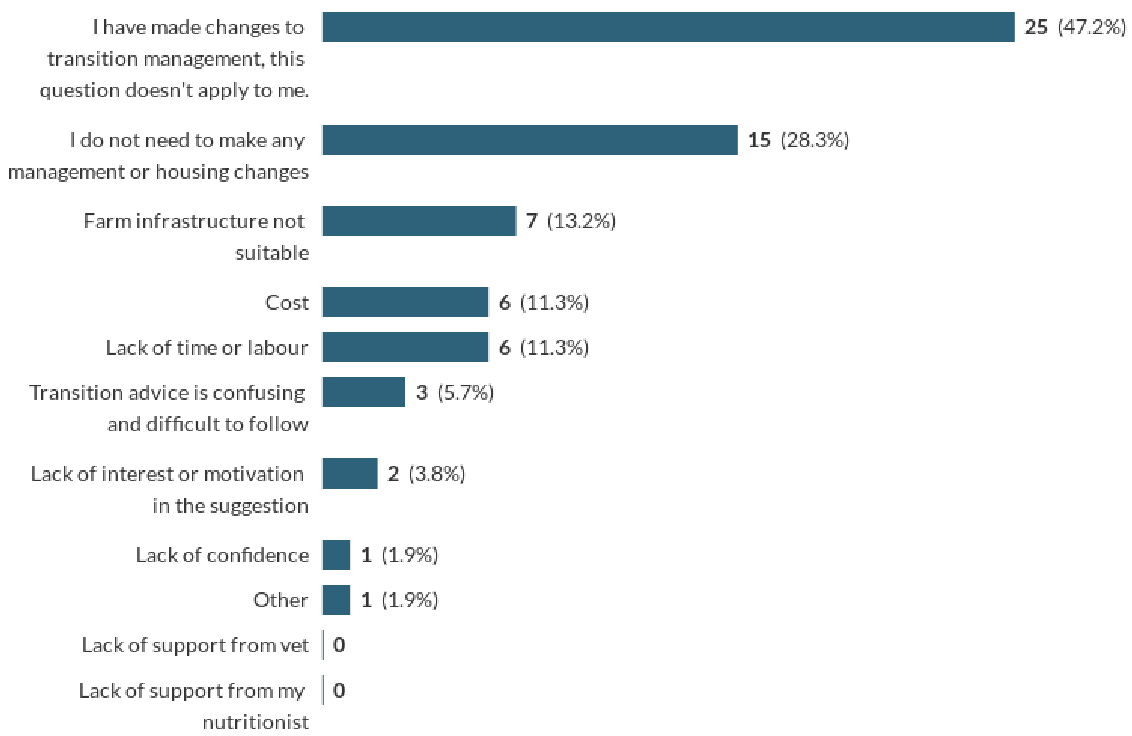


Figure 8.2.25: Dairy farmer responses towards reasons why no recent transition cow management changes had been made on their farms, in the last 3 years.

8.3 Discussion

8.3.1 Background information

The number of respondents is similar to that reported by Garnett (2017) when investigating farmer perceptions of milk fever prevention (108 respondents), but lower than that of Fujiwara (2018) (148 respondents), and higher than that reported by Bentley et al. (2016) (25 respondents), when conducting a transition cow risk management survey. The questionnaire required the respondents to be operating or working on an English dairy farm and resulted in no responses having to be excluded from the data analysis. The questionnaire was distributed via social media, national dairy farmer magazines and publications, so the participants would represent a large demographic. The questionnaire featured in national dairy farmer publications (Farmers Weekly, Farmers Guardian and British Dairying) which may have improved the range of the demographic, but there is no way of determining how many people viewed the questionnaire and did not fill it out, or which responses came from which source. In April 2021, there were 8040 dairy farmers in England (AHDB 2021), so the 100 respondents who completed the survey represent only 1.24% of dairy farmers in England. The majority of dairy farmers completing the survey were from herds of 100-200 cows (41%) and 201-400 cows (35%), which is similar to the mean size of an English dairy herd in 2021 which was reported to be 155 cows/herd (AHDB 2021). The majority of respondents were from AYR calving herds (76%), with 7% from a spring block herd, 9% from an autumn block herd and 8% from a herd with a combination of spring and autumn block calving cows. This is representative of British dairy farms, where AHDB (2016) reported current calving patterns to be 81% AYR, 4% spring calving, 8% autumn calving and 7% being a combination of spring and autumn. The majority of respondents came from farms with a mean annual yield of between 9501-11000L. This is higher than the UK annual yield reported by AHDB (2021) of 8004L. Interestingly, the most common age range for participants in the current study was 25-35, which is a relatively young demographic compared to that reported by Fujiwara (2018), where the most common age range for a questionnaire investigating UK dry cow management strategies was between 45-64. Regarding frequency of milking, the majority of respondents milked their cows twice per day (78%), with 11% milking three times per day, 10% milking on robots and 1% milking once per day. This contrasts with Bentley et al. (2016) where 4% of producers had robotic herds, and 36% of producers milked three times per day. However, it should be noted that the study by Bentley et al. (2016) was undertaken in Iowa, United States, and the majority of respondents were from herds with an annual yield of between 10886-12700 L. This higher average annual yield is more likely to be associated with milking three times per day (Soberon et al. 2011).

8.3.2 Transition cow management

Respondents were asked how their transition cows were grouped, with 95% indicating that pre-calving cows were grouped separately from the main milking herd for 3 weeks prior to calving, whereas only 28% of respondents grouped their early lactation cows 2-3 weeks post calving separately from the main milking herd. These findings are similar to that found by Heuwieser et al. (2010) where 21.6% of respondents had a designated ‘fresh cow pen’, and that by Fujiwara et al. (2014) and Bentley (2016) where 72% of producers fed their pre-calving cows a separate ration, and the majority of farmers grouped their pre-calvers 3 weeks prior to calving.

Similar to that reported by Bentley et al. (2016), challenges associated with transition cow success could be categorised into three main groups, nutrition, metabolic disease, and farm infrastructure/facilities, with the additional category created in the current study of farm advisors. The current study found that when farmers were asked to rank their transition cow management on a Likert scale of 1-5 (1 being very good and 5 being very poor), only 9% considered their management to be ‘very good’, whilst the majority (32%) chose ‘good’ and 31% chose to rank themselves ‘neither good nor bad’. These findings conflict with that found by Bentley et al. (2016) in Iowa, US, who although having a relatively low number of respondents, found that 42% of producers characterised their transition cow program as ‘excellent’. The semi-structured interviews reported in Chapter 4 found that AYR farmers generally considered their transition management strategies to be acceptable or in some cases sub optimal, with very few farmers stating that it was excellent or without its challenges.

Farmers were asked about their intentions to improve transition cow management, with over half of the respondents (52%) stating that they were actively seeking advice or working towards improving it. Over a quarter (26%) of respondents stated they had intention to improve transition management in the future but not immediately and the remaining 22% stated they had no intention to improve transition management on their farms. Farmer intentions to improve their transition management systems may relate to their awareness (or lack of) towards risk factors affecting metabolic disease. Santmann Berends (2014) distinguished three different phases of awareness concerning calf mortality: (1) farmers who were only partly or not at all aware of high mortality; (2) farmers who felt powerless because of their inability to find a solution to their problems; and (3) farmers who knew they can be inaccurate when feeding calves but were reluctant to change this. This highlights the different levels of awareness, and therefore subsequent intentions to improve farm practices. The categories created by Santmann Berends (2014) can easily be adapted to the interview participants, however the current study found that while there were farmers who were aware of their risk factors for metabolic disease and were proactive about reducing further risks, some farmers were successful and some were unsuccessful in their efforts, despite being motivated and engaged with improvements. The results from the questionnaire demonstrate similar findings to that reported from the interviews, in that there were groups of farmers who were motivated with intentions to improve transition management (proactive), alongside groups who intend to improve in the future but not immediately (and may have reactive strategic tendencies), and those who had no intentions of improvement (complacent), either because they did not perceive themselves to have a problem, were unaware of transition disorders on their farms, or lacked the confidence, interest, support or financial backing to make those changes. Furthermore, advisors in the interviews reported in Chapter 5 that some farmers did not aspire to improve transition cow management, because they have accepted their limitations and are not willing or able to change them. The level of ‘acceptance’ towards metabolic disorders was discussed in Chapter 4 and was likened to other areas of dairy cow health problems, such as lameness, and farm-specific issues that acted as barriers to the uptake of optimal practices were explored in Chapter 6.

Mastitis was the most reported transition-related health disorder in the questionnaire. Mastitis was also reported by Bentley et al. (2016) to be a common challenge to transition success, which agrees with Garnett (2016), where the three most popular answers for herd health issues were mastitis, locomotion and infertility. This was also found by Pothmann et al. (2014) when conducting a survey of Austrian dairy farmers, with mastitis and high cell counts being of the greatest concern. Furthermore, studies have found mastitis to be the issue of most concern for farmers in the USA (Caraviello et al. 2006), and the Netherlands (Boersema et al. 2003). Mastitis was found in the current study to be the second most common reason for cows leaving the herd in the first 60 days. It is possible however that farmers focus on the issues that are tangible and that they can see, as discussed earlier in the thesis, and may not form the same associations with other metabolic disorders such as ketosis, which are more difficult to identify. The current study found that retained cleansings and metritis were equally ranked as the second most prevalent disease on farm, followed by clinical milk fever. Interestingly, clinical milk fever was found to be the most frequently recorded metabolic disease in German herds by Heuwieser et al. (2010), followed by retained cleansings, whereas Garnett (2016) reported that veterinarians believed farmers under-report their incidence of milk fever. It is possible that farmers under-report metabolic disorders due to social desirability bias, or perhaps due to them not having an accurate and true perception of their milk fever incidence rate. This is possible, particularly as many farmers in the interview study (Chapter 4) did not record transition cow health disorders (as discussed earlier in the thesis). The ‘completeness’ of milk fever records was examined by Espevedt et al. (2010) on Nordic dairy farms, where under-reporting of metabolic disease was suggested. The metabolic disorder with the lowest prevalence in the current study was clinical ketosis, however this is less tangible and less obvious to see (Steen et al. 1997) and it does not require immediate attention when compared to a ‘downer cow’ with hypocalcaemia, or an udder infection, where the affected cows’ milk cannot enter the bulk tank (Valeeva et al. 2007). Furthermore, Heuwieser at al. (2010) reported recorded cases of ketosis to be lower than all other metabolic disorders indicated in a questionnaire investigating ‘fresh cow’ management practices on German herds. Regular examination of early lactation cows identifies more cows at risk of illness, and if farmers are not carrying out routine ‘fresh cow checks’ with their veterinarian, then it is possible that ketosis may occur at a considerable level but remains undetected.

The majority of farmers in the current study, whilst having a positive relationship with their veterinarian, discussed transition cow management 'only when there is a problem' (39%), indicating that a large proportion of the respondents did not carry out routine veterinary fresh cow checks. On the contrary, when asked how often respondents looked proactively for signs of transition cow health problems, ranked on a 1-5 scale, the majority of farmers (44%) rated themselves as 1 (very regularly). This contrasted with answers provided when farmers were asked about their use and perceived importance of transition health monitoring tools, where 'none' of these' was ranked 1 at a rate of 66.7%, with a mean ranking of 1.67.This suggests that there is a proportion of farmers that do not use any health monitoring tools or protocols, yet still consider themselves to be very proactive at looking for signs of transition cow health problems.

Transition cow health problems were ranked by producers in the current study as the most important problem amongst other herd health and welfare challenges, which is similar to that reported by Fujiwara et al. (2018), where the majority of respondents selected the transition period to be one of the three more important periods in dairy herd management. However, the results may have been over-represented due to transition cow management being in the forefront of participants minds whilst conducting the questionnaire. Respondents were asked to provide the top two reasons why cows leave the herd in the first 60 days of lactation, and over two thirds (65%) of farmers indicated that this was due to injury and illness, followed by 32% choosing 'mastitis and udder issues', and 21% indicating that the reasons were specific to transition cow health problems. Interestingly, this finding is in contrast with Bentley et al. (2016) where nearly half of the respondents (48%) lost cows to 'disease or fresh cow problems', which is interesting despite the majority of producers (42%) in that study characterising their transition cow management as 'excellent'. The reasons why cows left the herd in the first 60 days reported by Bentley et al. (2016) were however similar to that in the current study, with injury and illness (36%) and 'mastitis and udder' (36%) the next most popular choices.

The main farmer-perceived challenges to a successful transition in the current study were 'housing is out of date/not spacious enough, and 'metabolic diseases that I can't control'. This is similar to findings from the interviews in Chapter 6, where AYR farmers reported difficulties with infrastructure and dated housing negatively influencing transition success and reporting certain metabolic diseases to have a higher prevalence than they would like, but not knowing how to rectify the issue. Later in the questionnaire, farmers were asked if they had made any impactful changes to transition cow management, and if so, to rank those changes. The most impactful change was reported as 'built new or improved existing transition housing, allowing more room per cow', followed by 'none', and ‘introduced routine calcium bolusing to some freshly calved cows’. This is similar to that found by Bentley et al. (2016), where survey respondents indicated that their future plans included building new facilities for transition cows and provide more space. Additionally, respondents in the study by Bentley et al. (2016) indicated future plans to include improving herd management through implementing an activity monitoring system, hiring full-time employees to monitor transition cows, grouping heifers from mature cows, and having an early lactation cow group if they did not already have one. When asked about farmer-perceived challenges to transition success, it should not be ignored that the third most chosen response was ‘metabolic diseases that I can’t control’. This is similar to the findings reported previously in Chapter 4, where AYR farmers reported feeling a loss of control and did not know how to solve their transition health issues. Additionally, when asked about perceived challenges to transition success, the majority of respondents indicated that they did not have any challenges, which contrasts with the 9% of producers who characterised their transition cow management as ‘excellent’. This suggests that while many respondents do not perceive themselves to have challenges to transition cow success, there is still a proportion of farmers that do consider themselves to have challenges and a perceived high prevalence of metabolic disorders, and these challenges and metabolic disorders are reflective of those found in the interviews conducted in this study.

Farmers were asked if they used any transition health monitoring systems, and if so to rank them (1 being most important, 2 and 3), with the most important being rumination monitoring systems (collars//bolus). This contrasts with the findings by Bentley et al. (2016) where rumination monitoring systems were the least popular option, chosen by only 8% of respondents, and where daily pen walks were indicated to be the most used health monitoring tool by 88% of producers. The current study found ‘daily group walks’ to be the third most important, after ‘none of these’ which had the second lowest mean ranking. Unfortunately, the interviews in Chapter 4 did not specifically determine different transition health monitoring systems, unless brought up by the interviewee. Regarding body condition, nearly half of the respondents indicated that while they felt BCS was important, they didn’t record it. This is in-keeping with the results from the interviews, as discussed in Chapter 4. Furthermore, similar findings were reported by Heuwieser et al. (2010), where only a minority of farmers reported monitoring BCS in early lactation cows. When asked about stocking rate, the majority of farmers stated that it was important and avoided overstocking (58%), whilst 39% also thought it was important but still overstocked transition cows for other reasons. This is similar to the findings reported from the interviews in Chapter 6, where infrastructure and housing prevented some farmers from proving sufficient space for their transition cows. Additionally, pressures existed from bovine TB restrictions that affected stocking rate, along with busy calving periods, and seasonal biases in calving patterns. Only 3% of questionnaire participants indicated that they did not think stocking rate was important on their farms.

8.3.3 Nutritional management of transition cows

Participants were asked a range of questions relating to feeding their transition cows. The questionnaire found that the majority of farmers (71.7%) fed their pre-calving cows once per day (or provided fresh forage), with 20% feeding every other day, and 3% feeding every 3 days or more. Later in the questionnaire, farmers were asked how they fed their pre-calving cows and only 51.5% reported that they fed a total or partial mixed ration, with 26.3% feeding silage/hay top dressed with a nut or blend. During the farm audits in the interview study (Chapter 3), where farmers provided a silage/hay top dressed with a concentrate, the forage was never supplied fresh daily and a bale was fed to last 2-3 days. The farmers stated that the cows were fed this way due to the small group sizes, in order to save time, diesel and machinery wear and tear by not making a TMR. As highlighted in Chapter 4, challenges exist for farmers delivering a fresh feed daily to small groups of cows. The questionnaire findings however contrast with that reported from the interviews, where 10/22 farmers fed their cows every 2 or 3 days. As discussed in Chapter 6, herd size plays an influential role in feeding frequency due to small group sizes creating issues with economies of feeding. Interestingly, the mean herd size of interview participants was 376 cows, whilst the majority of interview participants (41%) had a herd size between 100-200 cows. It is also possible that social desirability bias may have influenced participant answer choices and led to more desirable but less truthful answers. Additionally, Bentley et al. (2016) reported nutritional challenges for farmers mixing the correct amount of feed for the size of group, and Mills et al. (2020) reported that farmers with small groups of pre-calving cows were reluctant to make a fresh feed daily. The delivery of fresh feed has been reported to reduce aggressive interactions at the feed face, variation in energy and NDF intake, and sorting behaviour (DeVries et al. 2005). Fujiwara et al. (2018) reported that feed for pre-calving cows on UK dairy farms was most often delivered daily (85%), with 8.4% feeding ever second day, and 4.7% feeding less than every second day. Bentley et al. (2016) also reported the majority of producers on farms in Iowa US fed pre-calving cows once per day, and 40% of respondents fed early lactation cows twice per day. However, it should be noted that the average herd size in the study by Bentley et al. (2016) was 395 milking cows, which is considerably higher than that found in the current study and may have influenced farmer willingness to feed daily due to group sizes.

When asked how respondents maximised DMI for their transition cows, the majority of farmers indicated that they cleaned out feed trough before fresh feed was delivered (59%) and they pushed up feed at the barrier 2-4 times per day (48%). Additionally, 14% of farmers pushed up feed more than four times per day. These findings are similar to that reported by Fujiwara (2018), where 29.2% of farmers pushed up feed for pre-calving cows three or more times per day, and 9.4% pushed up twice daily. Furthermore, 10.4% in the current study reported pushing up once daily, 3.8% did not push feed up at all, and 47.2% did not need to push up due to feed trough design. Methods of mineral feeding were in line with the proportion of respondents feeding a TMR, with 42.4% providing a bagged mineral in a TMR, 28.3% providing a mineral lick block and 26.3% feeding a mineralised concentrate. Methods of mineral delivery vary on farm, as discussed by Sinclair and Atkins (2015). Of the respondents, 19.2% fed a mineral bolus. Interestingly, 4% of farmers indicated that they did not feed minerals to pre-calving cows, with reasons being the perception that they did not to need additional minerals (n=3), along with 'I have never been advised to' (n=1) and 'they didn't help/work as expected' (n=1). This may be concerning, as the consequences of not meeting mineral requirements for pre-calving cows were outlined in Chapter 3 and if undersupplied, can influence metabolic disease incidence. Results also varied when farmers were asked about feeding anionic salts to pre-calving cows. There was even split between farmers providing anionic salts within a TMR/PMR, and not feeding anionic salts (37.4%). Furthermore, 17.2% of farmers fed anionic salts in a water trough, which can have negative consequences on water intake due to unpalatability, and an unmonitored irregular intake of salts (Melendez et al. 2002). Interestingly, when asked why farmers did not feed anionic salts, the most popular reason was that they had never been advised to (n=19) which similar to the findings reported in Chapter 5, where some nutritional advisors where reluctant to get involved in transition management and provide dietary and management advice. Furthermore, seven respondents perceived that their cows did not need anionic salts, which may be the case depending on the diet fed, and six respondents indicated they didn't know. This again supports the findings in Chapter 5, where on-farm discussion of transition feeding and management may not be carried out enough or instigated by advisors (or farmers), leading farmers either to not know or not perceive reasons why they may benefit from feeding anionic salts to reduce the risks of hypocalcaemia. Other methods of managing risks of hypocalcaemia exist, such as feeding calcium boluses prior to calving and low potassium forages, however feeding anionic salts are an increasingly popular measure of achieving a partial DCAB system that is achievable for most dairy farmers (AHDB 2012).

Regarding the use of additional supplements to reduce metabolic disease, 'fresh cow drinks or drenches' were the most popular option (49.5%), with 42.4% of farmers indicating the used calcium boluses for freshly calved cows. Bentley et al. (2016) also found that calcium boluses were a popular choice for farmers, with 86% of respondents using them routinely. Furthermore, Garnett (2016) reported the most popular answer for farmer choices for milk fever prevention was targeted supplementation around calving, and partial DCAB diets. The current study also indicated that over two thirds (63%) of farmers implemented a partial or full DCAB diet for milk fever prevention, through the use of anionic salts. Monensin or 'Kexxtone®' boluses were used by 32.3% of respondents, which supports that found in the farmer interviews, where monensin boluses were used by 17/22 farmers, and were occasionally used as a 'blanket treatment', even though only targeted use is permitted.

8.3.4 Farm advisor relationships

The use of farm advisors, both veterinary, nutritional and others has proved important and influential in farmer decision-making, as reported in Chapter 5 and in other literature (Farrell et al. 2021). Pothmann et al. (2014) found that with issues relating to feeding, nutritional consultants were the most common source of information used by farmers, followed by veterinarians, and that from a survey of 1018 Austrian dairy farmers, those with high yielding herds were more likely to involve nutritional consultants than those with lower yielding herds. The current study found that the majority of participants using an independent nutritional advisor were from herds with an average annual yield of 9501-11000 (39%), however the majority of questionnaire respondents came from farms with a mean annual yield of between 9501-11000L and so had a higher representation. Following this, 20% of these were from herds with an average annual yield of >11000L and 18% had a yield of 8001-9500L. There was no statistical significance between the relationship of annual yield and the use of an independent nutritionist in the current study. Interestingly, while the interview study found that block calving farmers generally used veterinarians from dairy specific practices, there was no significant relationship between farming system and whether the veterinarian was from a dairy specific or mixed practice in the current study. Regarding the strength of the relationship with their veterinarian, the majority of respondents indicated it to be 'very good' and 'good' which is similar to that found in the interviews in Chapter 4 and that in studies by Derks et al. (2013) and Garforth et al. (2013). However, the majority of producers (39%) in the current study stated that they only discussed transition cow management with their veterinarian when there was a problem, with 36% indicating they discuss it on most routine veterinary visits. This finding is similar to the previous responses where the majority (44%) of producers ranked themselves on a (1-5) scale as 1 to be very proactive in looking for signs of ill health during the transition period, and proactive in discussing how transition cow management may play a role in the prevention of metabolic problems. Interestingly, Heuwieser et al. (2010) reported that the veterinarian only visited the herd when needed on most German farms (73%) and found significant differences between small and medium farms compared with larger herds. Interestingly, the current study found no statistical relationships between how often producers discussed transition cow management and herd size (Fishers exact test: $p = 0.86$). Just over half (55%) of the respondents in the questionnaire study indicated that they did not require any more attention to be paid to transition during veterinary visits, with 23% suggesting that they would but didn't want to pay additional vet time for it. Some 22% of producers indicated that they would like more attention paid to transition during veterinary visits and they would be willing to pay for it. This suggests that veterinarians are not meeting the needs of some farmers, which has been discussed by Derks et al. (2013) where veterinarians were not fully aware of the goals and priorities of their farming clients, and Bellet et al. (2015) where veterinarians were reluctant to provide proactive preventative services regarding flock health, because they perceived sheep farmers were not prepared to pay for these services. Interestingly, when asked about the perceived proactiveness of their veterinarian, 42% of farmers in the current study indicated that they had to raise the topic of transition cow management in order to discuss it with their veterinarian. This is in line with the interview findings in Chapter 5 where some advisors were reluctant to instigate discussion in this area of dairy cow health. The farmer responses regarding the proactiveness of their veterinarian varied to that found when asked about their nutritional advisors. Approximately half of the respondents had at least one nutritional advisor, either a feed representative (51%), and/or an independent nutritional consultant (49%), and producers indicated that the relationships with these advisors were largely positive. However, the questionnaire findings revealed that nutritional advisors were perceived by farmers to be more proactive than their veterinarians when discussing transition cow health, with 37.1% of respondents indicating that they discuss transition 'always', and the same percentage reporting it to be 'usually on most routine visits'. This is considerably more than 7% of respondents indicating that they discuss transition management with their veterinarian as 'always'. Additionally, 65.5% of farmers chose to answer with 'my nutritionist is proactive and asks me about my transition cows, and I appreciate this'. These findings contrast with that found in the interviews in Chapter 5 where feed representatives were generally reluctant to advise on transition cow management, due to a lack of confidence, training, a lack of feed-sales commission, and the perceived high responsibility of getting it wrong. However, the current questionnaire indicated that nearly half (49%) of farmers used an independent nutritional advisor. Independent nutritionists were found in the interviews to be much more open and willing to discuss transition cow nutrition and management when compared to feed representatives and this may explain why questionnaire respondents felt that their nutritional advisors were proactive in this area of dairy cow health. It does however highlight that in comparison, veterinarians were less proactive than their non-veterinary advisors, and that for over a fifth of the respondents, the veterinarians were not meeting the needs and goals of farmers, with a lack of proactive transition advice.

It should be noted that social desirability bias may have influenced responses, where participants chose responses that they believed to be more socially acceptable and desirable than their true thoughts and beliefs (Grimm, 2010). This can lead to the under-reporting of less socially desirable but accurate responses that are more reflective of the respondent's true feelings. Despite the risks of this bias, the questionnaire was conducted online in an anonymous manner, (with anonymity stated at the beginning of the questionnaire) and this should have reduced the likelihood of this occurring (Grimm, 2010).

8.4 Conclusion

Challenges relating to housing were identified that were considered to relate to out-of-date or not spacious enough for the group sizes, and farmers reported experiencing metabolic diseases that they couldn't control, as a challenge to transition success. Additionally, stocking rate and BCS were regarded as important by producers, but additional factors led to some overstocking their transition cows, and farmers did not record body condition scores of their cows, as found in the qualitative interviews. Recording of BCS was not statistically correlated with herd size or average annual yield. There were both similarities and contrasting views to be drawn from the questionnaire and interview findings. Contrasting findings included the perceived proactiveness of nutritionists as indicated by questionnaire respondents, which was perceived to be high, and higher than that of veterinarians. While there were feeding challenges indicated by some questionnaire respondents relating to frequency of feeding pre-calving cows, the majority of producers (71.7%) reported feeding their pre-calving cows daily, which is unlike that found in the interview study, where 10/22 farmers chose to feed their pre-calving cows every 2 or 3 days due to small group sizes.

9. Chapter 9: General discussion and potential solutions to improve transition cow management

9.1 Introduction

Chapter 9 discusses the potential solutions to the farmer and advisor barriers to optimal transition cow management that have been reported in Chapters 3 to 8. Some of these solutions have been suggested by the participants in the interview studies, whilst others have been derived from evaluation of the empirical data collected by the researcher and the current literature. The chapter then acknowledges the limitations of the studies, with recommendations for future work and final conclusions.

9.2 Farmer engagement

9.2.1 Benchmarking and discussion groups

In Chapter 4, AYR farmers reported experiencing multiple metabolic disorders and that they treated many of these themselves, perceiving a need to become more independent, such as treating ketosis and hypocalcaemia themselves. This may indicate that some farmers consider their need for veterinarians to be less important in the role of managing transition cow health. Fewer meetings with veterinarians and other advisors could result in farmers becoming further accustomed to experiencing transition cow health disorders, with this forming a norm, particularly if they are not aware of the prevalence and impact of the transition disorders on farm, or how they compare to their peers.

Adjusting the commonly accepted levels of transition-related disorders is important if farmers are to continue treating these disorders themselves with minimal veterinarian involvement. This is not just required in AYR herds, but for seasonal calvers too, as although seasonal calving farmers reported having minimal transition issues in Chapter 7, their advisor involvement was also minimal. Adjusting the social norms of all metabolic diseases may be helped by simple and objective benchmarking tools during annual herd health reports, through veterinarians anonymously comparing the performance of their farming clients. For example, this was reported by Farmer 1 to be an effective motivator by his dairy specialist practice, and an example can be seen in Figure 9.2.1, as provided by that farmer, where his veterinarian costs were compared with other farms, and illustrated in the following quote:

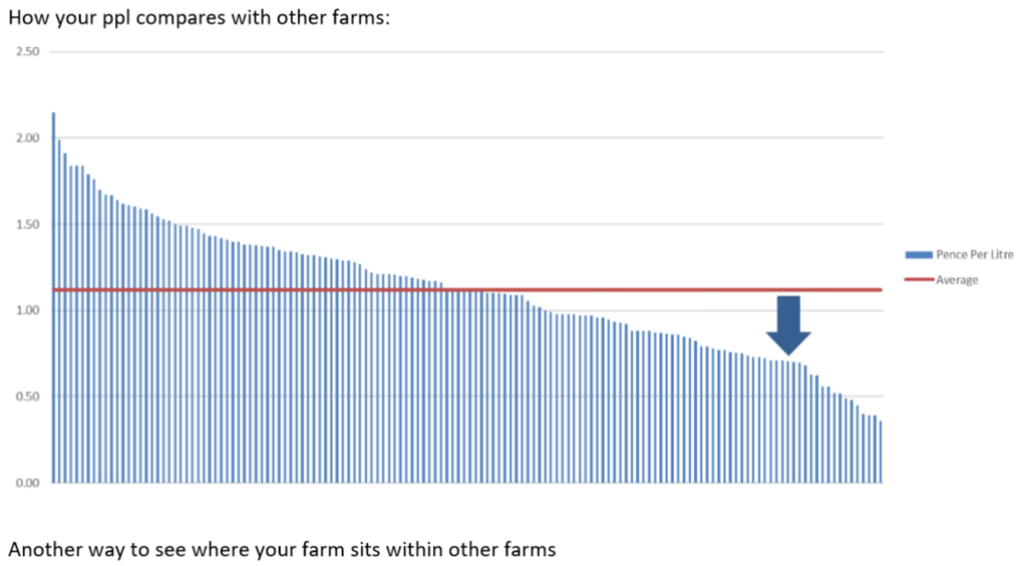


Figure 9.2.1: An example demonstrating one farmer's veterinary costs on a pence per litre basis (ppl) in a veterinary benchmarking report provided during the farmer interviews (red line is the average).

> 'It's good to see where you are compared to other farmers. When the vets give us the report at the end of the year, it's comparing us to the other [Anon farmer clients]. If you want to improve you've got to see where you are first. Most of our vet cost is preventative vaccines so that's good' (Farmer 1).

The literature supports this attitude to benchmarking, with Sumner et al. (2018) reporting that farmers viewed benchmarking reports and peer comparisons favourably. This encouraged them to make management changes by identifying areas needing attention and promoted discussion about optimal practices. Based on this evidence, efforts could be made to develop a simple and user-friendly phone/computer-based system to monitor transition diseases, which if linked to a nationwide database, could permit farmers to compare themselves with similar farms anonymously to identify areas of focus and new targets. Benchmarking can take the form of discussion groups, where annual accounts and costings are compared with farmers on similar systems, as reported in Chapter 7. Leach et al. (2010) also reported that farmer suggestions encouraged others to take more action to reduce cattle lameness, which included the participation of discussion groups, and gaining more information on the costs of lameness. The majority of seasonal calving farmers discussed in Chapter 7 participated in discussion groups and spoke positively of them, suggesting they were motivating and informative. It has been outlined by Rose et al. (2018) and Bard et al. (2019) that effective discussion groups often require the inclusion of an expert or facilitator, but discussion groups also rely heavily on the engagement of the farmer, with a desire to share their information and improve their performance (Barret 2014).

Due to the nature of seasonal calving, herd performance figures from these farms can be more easily compared, relative to figures on AYR calving farms. It was suggested by farmers with seasonal calving herds, and some advisors, that AYR farmers should participate more in discussion groups to facilitate knowledge transfer and share ideas, choosing a small number of targets that were simple and easy to monitor, and benchmarking those. Findings in Chapter 4 showed that when farmers were required to participate in lengthy and complicated record keeping it was less likely to be carried out accurately, if at all. If AYR farmers were to focus record keeping on to their main transition issues, such as the number of retained placentas every month, or pre-calver blood BHBAs (both measures that if suboptimal can lead to multiple health disorders during the transition period (LeBlanc 2010)), this may result in record keeping being more likely to be carried out and bring problem areas to light. This, in turn, could create additional social pressure and competitiveness between groups of farmers and encourage them to examine reasons why their results may be suboptimal (Barret 2014). Furthermore, this may help to address the issue of a lack of awareness of transition health disorders, particularly when it is discussed between like-minded farmers with similar herd sizes and systems. However, engaging farmers to participate in these benchmarking efforts can be challenging. According to Barret (2014), Rose et al. (2018) and Bard et al. (2019) farmer engagement in discussion groups is more likely to take place when the groups are farmer-led, small, local, with farming peers, that cover topics of their choice, and include collaborating advisors who understand the goals of the group.

9.2.2 Farm staff engagement and ‘fresh cow checks’.

Optimal transition cow management not only relies on the engagement of the farmer, but also that of the wider farm staff team if they are involved in the management of the transition period. In a study by Burton et al. (2012) the daily interactions between staff and their cattle, as well as how the staff felt that day, were shown to affect staff behaviour, leading the authors to conclude that more appreciation should be given to the environment in which staff work when attempting to change behaviour. Chapter 4 reported the opinions of some veterinarians, who also suggested that some staff were intervening at a lower rate and went on to discuss the importance of staff engagement during the transition period.

> 'I have problems engaging with clients, engaging the staff on farm with transition cows particularly when things are going wrong. If you've got a larger herd, you can get more staff in the fresh pen doing active fresh checks in the first week after calving. But if you're not careful it can become quite a burden on those guys doing the fresh checks, and when things go wrong, they're the guys working harder and harder to solve the problem. It's very easy for them to learn strategies where they do less work, or… even if rumination has crashed and this cow needs pumping because she has an empty rumen, it's very easy even without knowing it to say that rumen score is actually ok, or she seems to be doing alright.' (A14- dairy specialist veterinarian).

One veterinarian also discussed the importance of recognising when things are going well rather than just having meetings during a crisis, to build a positive work ethic and motivate staff:

> 'And also, with people factors, the other thing is it can feel very destructive to only talk about transition when they are having problems, because it really puts people off, especially when guys are managing the transition cows. If you are talking about having meetings with nutritionists and vets, they should really be more frequent, when we don't have problems to try and point out when things are going really well, to show the effect of what happens when we do things right and congratulate them when it goes right. If we only ever meet when we have a load of [displaced abomasums], then it's depressing and it's hard to learn from things that are always negative, people need rewards as well. We are all guilty of it because everyone is so busy, the farmer the vet, but we need to make more of an effort if we want to get people engaged in these things, we have to reflect on things going well, why they are going well, rather than just when things are going badly (A22- dairy specialist veterinarian).

Although these are advisor opinions suggesting potential solutions, they require farmer engagement and incur additional veterinary costs if they are to be implemented. Some veterinarians reported the usefulness of 'fresh cow checks' during routine fertility visits. This promoted discussion on farm and highlighted the prevalence of transition-related disorders to farmers and staff, and may aid in improving the problem of the lack of farmer awareness towards transition disorders:

> ‘But if I could get all farmers doing one thing it would be getting them to do their post calving fresh cow checks, routinely for 7-10 days, to do temperature, rumen fill, intake and yield, smell, and then putting them on a treatment protocol if they failed. If I could just get them doing that, it’s still a little bit downstream but as a start, it would be brilliant’ (A2- dairy specialist veterinarian).

> ‘I prefer to have a member of staff on farm doing the sampling because it gets them involved in the fresh cows, doing fresh cow checks, if we can get them blood sampling because it gets them involved and gets them seeing the outcome of their management. So, we try to get them to do that sort of thing weekly and we try to review that information every few weeks’ (A14- dairy specialist veterinarian).

Additionally, Chapter 4 reported differences between farmer perception of transition cow risk factors and diets, and the actual measurement on farm. On three farms, pre-calving cows were receiving 2 to 3 times the recommended requirement of the minerals that the farmer or manager thought they were receiving. This suggests that staff engagement and training may be necessary to ensure that the correct diets are being fed. While the balance of responsibility for transition cow health is weighted heavily towards the farmer and the staff with day-to-day managerial responsibilities, industry stakeholders such as veterinarians and non-veterinary advisors have interests and influences in the decisions that are made, and thus influence how advisors engage with advice and new behaviours (Whay et al. 2012). Farmer-staff engagement can be facilitated and promoted by engagement from their advisors, through monitoring and intervention support. Whay et al. (2012) established that when farmers were aided by a facilitator to control lameness, they generated substantial numbers of lameness control action points. While farm decision-making is primarily down to dairy farmers and their staff, farmers need support in initiating and sustaining behavioural changes. Farmers can often have multiple ideas of how to manage specific areas of dairy cow health, as reported in Chapters 3 to 7, and a guided approach may focus their ideas and increase engagement with behavioural changes (Bard et al. 2019), as discussed in the next section.

9.3 Advisor engagement

9.3.1 Transition nutrition specialists

The findings in chapters 4, 5 and 7 have demonstrated that as well as paying more attention to dairy farmers themselves, more advice is required if transition cow health and welfare are to be improved on UK dairy farms. The findings in Chapter 5 demonstrated a lack of focussed transition management advice provided to farmers, however findings from the questionnaire study (Chapter 8) conflicted with this; when farmers were asked if they required more transition-related advice the majority of questionnaire respondents indicated that they did not require further attention to be paid to transition management during veterinary and nutritional visits. Furthermore, the questionnaire (Chapter 8) found that nutritionists were perceived to be more proactive than veterinarians when raising the topic of transition cow management with farming clients, with 65.5 % of respondents stating their nutritionist was proactive, compared to 46% of respondents indicating their veterinarian was proactive. This conflicted with the interview findings, where nutritional advisors reported feeling unprepared and lacking confidence to raise the topic of transition cow management on farm, leading one mineral supplement representative to suggest that transition nutrition specialists may aid with the problem of the lack of focussed transition advice provided on farm (Chapter 5), The quote below from a mineral supplement representative who had previous experience as a feed sales representative is highlighted below:

> 'You look at all the feed companies now that have calf and heifer specialists, but no one has dry cow specialists, do they? …. And I think it's scary, and I think most of the people giving advice on farm are paid on tonnes, aren't they? …and I think it's got to be knowledge transfer, and we've got to do something differently or nothing is going to change. It's who you go to isn't it? When you get into the nitty gritty, you can't be a master of all trades can you? Dry cow specialists, you see? That's what we need!... And that's the problem I think, there is a real lack of understanding. Some of these reps are selling fertiliser, seed, silage additive, beef and sheep feed, dairy cake, they're selling everything aren't they?' (A20- mineral supplement representative).

Transition nutrition specialists could be employed by feed firms and be utilised by farms as required with other nutritionists and feed sales representatives to help with specifically focussed decision-making and nutritional management. They may or may not gain commission from the sales of transition-related feeds, and if they did not have a direct commercial interest and were just paid for their advice with a fixed salary rather than on sales commissions, they may have a more independent status in the eyes of dairy farmers. This could mean that dairy farmers were more likely to adopt their advice, as Chapter 4 reported that farmers thought highly of their independent nutritionists and had more issues with the commercial priorities of feed sales representatives. Outsourcing transition advice to specialists, or employing people solely as transition specialists, may help to address the issue of confidence and responsibility, if nutritionists are able to bring in a transition specialist when they were unsure how to deal with problems. Additionally, it protects the advisor-farmer relationship by outsourcing transition advice to specialists, as some advisors reported a fear of being completely truthful with their farming clients, in case they upset or offended them and lost the commercial relationship. Specialist transition advice related to subclinical disease or BCS may also be better coming from someone who is less likely to be perceived to be trying to sell them something. Specialisation has been developed in recent veterinary practice, with dairy veterinarians focussing more narrowly on mastitis, reproduction or nutrition (Statham et al. 2015; Moya et al. 2021).

Receiving advice from a specialist may influence the way that advice is interpreted and received by the farmer. As Beaver (2010) explained, there are multiple disciplines for veterinarians to formally specialise in. Indeed, nutritionists and other non-regulated non-veterinary advisors may gravitate towards specific areas of farm animal nutrition and management, such as dairy, beef or sheep. As discussed in Chapter 5, this may influence advisor confidence towards providing advice and specific up-to-date knowledge of a certain field. When investigating sheep farmer opinions on the role of veterinarians in flock health, Kaler and Green (2013) reported that farmers do not consider veterinarians able to make improvements in flock health and productivity because there are not many sheep specialist veterinarians, and therefore they did not use their veterinarians proactively. Additionally, Sumner et al. (2020) when investigating farmer opinions of calf management and benchmarking, reported that although veterinary expertise was considered more reliable than other sources (e.g., nutritionists and other farmers), some farmers did not view their veterinarian as having expertise on calves or being a specialist in youngstock, thus undermining the usefulness of the overall advice. Furthermore, Chapter 7 of the current thesis reported block calving farmers were moving away from mixed practice veterinarians and employing dairy-specific veterinarians because they appreciated more focussed and specialist advice. Dairy specialist veterinarians were considered more reliable than mixed practice veterinarians by seasonal calving and AYR farmers. The literature appears to demonstrate that farmers appreciate specialist advice (Kaler and Green, 2013; Sumner et al. 2020), and it is possible that transition cow nutrition specialists may provide advice that is appreciated and considered more reliable by farmers than what they receive from advisors in multi-discipline roles. This may help with the problem of a lack of farmer awareness of transition disorders and assist in enacting behavioural changes.

9.3.2 Inter-professional education to address advisor collaboration

The findings from the advisor interviews established that veterinary and non-veterinary advisors often appeared reluctant to collaborate with one another. As suggested in Chapter 5, inter-professional education (IPE) may be a possible solution to addressing the lack of collaboration between the overlapping disciplines. Inter-professional education programmes combine students from different professions (usually healthcare orientated) in a classroom or clinical setting to learn about the scope of practice of the different professions (Hall and Weaver, 2001). The goals of IPE are to rely on teamwork, communication, mutual planning, collective decision-making and shared responsibilities, and is an important component in health profession training (Estrada et al. 2016). Inter-professional education may also help to develop a mutual respect for different roles (Kinnison et al. 2014), potentially addressing the issue of 'blame' that was reported by advisors in the current study. Challenges related to IPE in healthcare have been described by Garman et al. (2006), and centre on power relations, professional hierarchy, and decision-making responsibility (Whitehead 2007). IPE could be taught at under- and post-graduate level in the veterinary, agricultural and animal science university curricula, which may help to address the communication barrier between veterinary and non-veterinary advisors, at least amongst Higher Education graduates. For advisors who are non-university educated, employers of nutritional advisors could arrange IPE in-house, with local veterinary practices who are willing to cooperate, so that both veterinary and nutritional advisors can learn from each other and understand their differing roles, and the advantages of collaboration.

9.3.3 Adapting strategies to the farmer-perceived environmental barriers

Based on the scientific literature and the interviews with farmers and advisors, it is apparent that strategies for optimal transition management exist for all types of dairy farming systems, despite their perceived barriers. The questionnaire study (Chapter 8) established farmer-perceived challenges that related to housing that was out-of-date or not spacious enough, and challenges relating to delivering fresh feed daily to small groups of transition cows. Advisors therefore need to engage with the farm-specific barriers and adapt their advice to the farm layout and infrastructure because bespoke tailor-made knowledge is more likely to be adopted (Bard et al. 2019). For example, making or buying low-potassium forages may considerably reduce the risks of milk fever, as discussed in Chapter 3 (Roche et al. 2003).

The interview study (Chapter 6) reported differences in the way farmers managed their transition cows in small and large herds. Farmers with smaller herds considered they had more feeding challenges relating to small group sizes and methods of feeding. Where farmers don’t have a mixer wagon, specific dry cow concentrates can be bought and top-dressed by hand down a feed barrier or in a ring feeder with specific mineral supplementation, protein and starches, developed for the pre-calving period to prevent nutritional deficiencies. Furthermore, where anionic DCAB salts cannot be mixed in with the forages, there are specific dry cow concentrates available that contain ammonium chloride, providing a negative DCAB charge and reducing the risks of hypocalcaemia, depending on the mineral analysis of the forages fed (https://advancesourcing.co.uk/product/advanced-healthycalver/). Anionic salts are one method of controlling milk fever but are not the only method. Calcium binders (concentrates that absorb calcium in the rumen to achieve a low calcium pre-calving diet) and calcium boluses are also accepted methods of milk fever prevention (Goff 2008; Garnett 2016).

Regardless of herd size or system, all farmers could feed daily (depending on the skilled labour and time available), as it is a perceived challenge or a flexible boundary rather than an impossibility or a firm boundary, as discussed by Turner et al. (2017). The importance of feeding daily could be emphasised by all advisors to reduce the risks of forage spoilage, DM losses, reduced feed intake, and the subsequent risks of metabolic disease. Other management practices as outlined in Figure 9.3.1, can be achieved by all dairy farmers on every system where pre-calving cows are grouped separately, regardless of the infrastructure barriers present on farm. The extent of change that farmers are willing to make is influenced by the flexibility of their boundaries, and flexibility is influenced by farmer motivation and their desire to seek new knowledge (Turner et al. 2017).

Maximising dry matter intake

- Regular feed push ups
- Cleaning out troughs
- Fresh feed daily

Controlling stocking density

Monitoring transition cow health

- Daily group walks
- 'Fresh cow' checks on routine vet visit
- Health scoring- Rumen fill/ body condition/lameness

Providing pre calving cows with a specific diet or forage with additional concentrate

Feeding pre calving minerals

- Within the pre-calving concentrate
- Top dressed or mixed into the forage or TMR

Feeding anionic DCAB salts to pre calving cows

- DCAB salts within a pre calver concentrate
- Top dressed or mixed into the forage or TMR

Using additional supplements that help reduce metabolic disease

- Boluses (rumensin or calcium)
- Protected amino acids or choline
- Fresh cow 'drinks' or drenches

Figure 9.3.1: Management practices to reduce transition-related disease, which can be implemented on all UK dairy farms.

9.3.4 Motivational interviewing

Some farmers in the current studies reported feeling frustrated when their veterinarians' discussed parts of herd management that they did not feel was important to them, particularly when they had to pay for that advice and veterinary time (Chapter 5). The importance of recognising farmer goals and priorities has been well covered in the literature (Jansen et al. 2010; Derks et al. 2013; Ritter et al. 2017), and there is a potential need to emphasise this to UK dairy advisors, to ensure that their professional discussion is farmer-led and identifies farmer goals so that advice is more likely to be acknowledged and enacted into a behavioural change (if required). This may also result in professional advice becoming more tailor-made to the individual system and infrastructure. Mis-understanding how farmers prioritise animal welfare improvements from a goal-setting perspective creates a barrier to improvements (Sumner et al. 2018). For example, when investigating antimicrobial resistance, Golding et al. (2019) concluded that when veterinarians and farmers share a common goal it drives cooperation, however veterinarians are not always aware of farmer goals (Derks et al. 2013). Some farmers may focus largely on milk production, whereas others may prioritise a healthy herd with fewer problems (Kristensen and Enevoldsen, 2008). Efforts must be made by both veterinary and non-veterinary advisors to invest time in understanding the personality of the farmer and his or her goals and priorities.

The issue of suboptimal transition cow management must therefore be targeted effectively in a bespoke manner, so that a positive outcome is more likely to align with the targets set by the farmer, whether that be a reduced cost in veterinarian services, a higher milk yield, or a reduction in metabolic disorders. Furthermore, it is essential to recognise that farmers themselves have a wealth of expertise and 'know how' about their farms (Curry and Kirwan, 2014; Sumane et al. 2018), which is important to identify and value when influencing farmer behaviour changes. The farmer should be at the forefront of any development (Rose et al. 2018), and adopting innovative approaches used across other disciplines such as psychology and healthcare, such as 'motivational interviewing' (Miller and Rollnick, 2013) may be an effective technique farm advisors can use during discussion with their farming clients. Motivational interviewing evolved from human healthcare, more specifically treating alcoholism and addiction problems, and is now applied to other psychiatric disorders (Blaxter et al. 2017). Motivational interviewing works on the principle of empowering people (or farmers) to make their own decisions (Bard et al. 2018) by bringing farmer knowledge and experience together with the expertise of the advisor, to empower farmers and make long-lasting changes. As Svensson et al. (2020) explained, veterinarians often provide advice in a persuasive style which can result in farmer-resistance to behavioural change. Motivational interviewing aims to facilitate farmers' internal motivation to change, and farming clients of veterinarians who were trained in motivational interviewing expressed more 'change talk' when compared to farmers with veterinarians who were not trained (Svennson et al. 2020). Training veterinarians in motivational interviewing was perceived to be useful, relevant, and successfully improved the communication skills of veterinarians, meaning that it could also be taught to other non-veterinary advisors such as nutritionists, consultants and feed sales representatives. Figure 9.3.2 summarises how empowering farmers to co-create their own strategic plans, with collaborative non-dominant advisors may influence farmer adoption of advice.

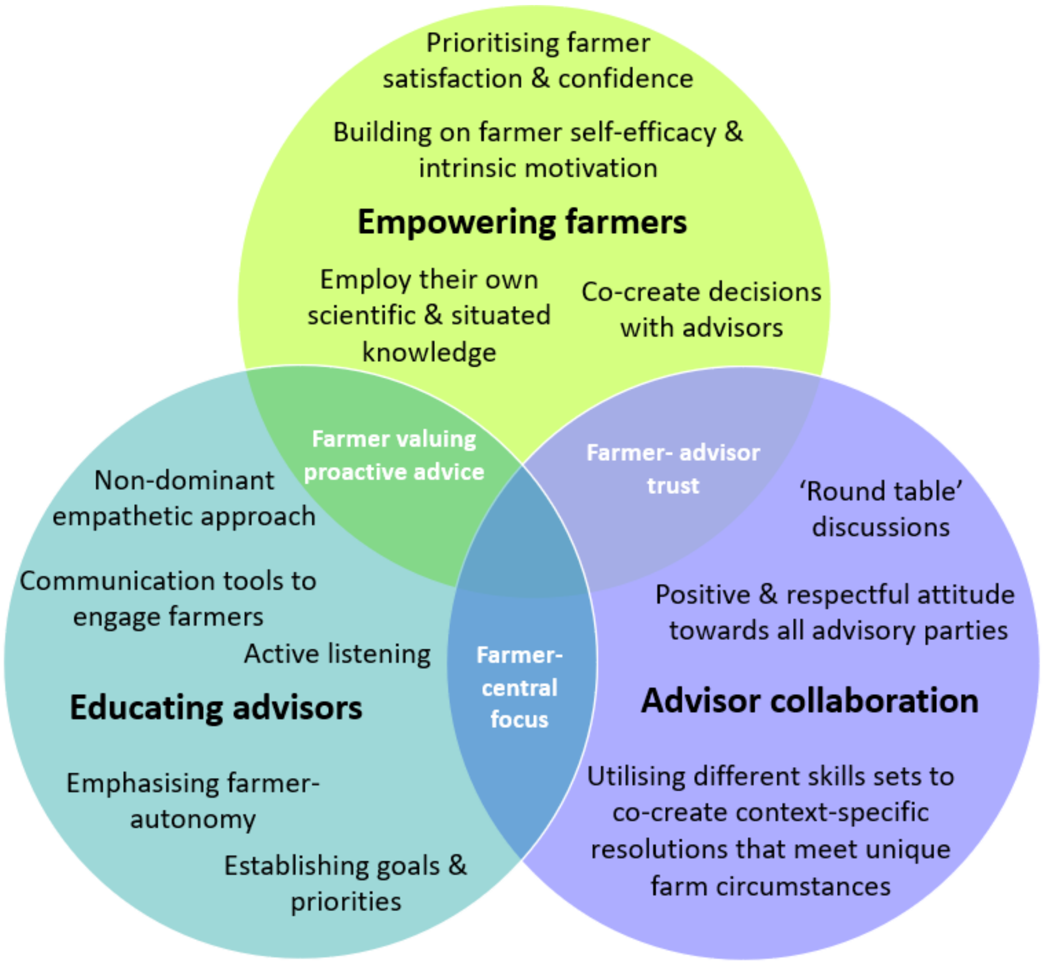


Figure 9.3.2: Farmer empowerment, advisor education and collaboration and how this may lead to a more farmer-centric trusting relationships with all involved advisory parties and may influence farmer adoption of advice.

9.4 Industry engagement

9.4.1 Motivational effects of supermarket contracts and milk prices

The findings reported in Chapter 4 demonstrated that farmers on supermarket contracts who received penalties and premiums depending on performance and health targets of their herd were more motivated to maintain optimal transition cow health, make management changes where required, and invest in newer and improved housing. Economic penalties and premiums have been established to be influential in enhancing farmer motivation to reduce mastitis incidence (Valeeva et al. 2007), and farmers have suggested that an increase in milk price and economic penalties could encourage them to take more action to reduce cattle lameness (Leach et al. 2010). Additionally, some farmers and advisors suggested implementing more effective audits as a way to motivate them to implement and maintain optimal transition practices. Currently, the Red Tractor Assurance farm audits assess health plans for 'metabolic disease' but do not assess the prevalence of these disorders (Red Tractor, 2020). The challenges here involve farmers providing assessors from assurance schemes or milk buyers with factual information, when they are often reluctant to keep health records (Burton 2004) and develop health plans (Garforth et al. 2013). Findings from Chapter 4 demonstrated that farmers reported fabricating health records and other data when form-filling, particularly when it was complicated and time-consuming.

Findings in Chapter 4 also demonstrated that penalties, premiums and inspections enforced by supermarket milk buyers are an effective motivator, and these methods could be implemented by other direct-supply milk buyers, if they were willing to pay premium prices. Further challenges arise here however, as this depends on milk buyers' willingness to pay a premium price to the farmer. This may be possible if milk buyers were to advertise their milk as a premium product based on the additional health checks and requirements that their suppliers have to meet to retain a supply contract. Currently, on direct-supply milk contracts, the price paid for milk depends on-the-spot market price based on consumer demands and the world market, which can be extremely volatile (Banks and Marsden, 1997; Farmers Weekly, 2021). Ultimately, the interview study and current literature shows that farmers respond to penalties and premiums, such as those offered and enforced by supermarket contracts. If other direct non-supermarket milk buyers could replicate this model and pay higher premium prices to dairy farmers based on their transition cow health and management as supermarket milk buyers do (monitoring health records, metabolic diseases and regular BCS and mobility scoring for example), farmers on direct supply contracts may be more motivated to ensure optimal transition cow management on their farms.

9.4.2 Regulation of nutritionists

Regarding the regulation of non-veterinary advisors, further industry engagement could include a requirement for dairy nutritionists to have a formal qualification. As discussed in Chapter 5, the FAR is in place to address environmental efforts towards managing nitrogen and carbon in livestock feeding, however it is voluntary and there is no legal requirement for a formal nutritional qualification. Furthermore, farm advisors commented on how FAR was not sufficiently challenging, and in their opinion did not do enough to formally educate nutritionists and prevent improper advice being given on farm. Improper nutritional advice could result in poor farm animal health and increased disease incidence. Regulating nutritionists could also be a route for more focussed training, meaning that fewer nutritionists would feel reluctant to advise on the transition period. Specific ruminant nutritionist courses are available and are being adopted more frequently by veterinarians and feed sales representatives. Additionally, other voluntary schemes and registers for nutritionists to join are available, as discussed in Chapter 5. This however does not address the number of farm advisors who are without the appropriate knowledge or credentials and may provide incorrect advice in order to gain sales commission on the products sold. As found by Palczynski et al. (2020) when investigating calf health and feeding, farmers respect the advice given by feed company representatives, who may or may not have qualifications in ruminant nutrition.

Challenges exist here regarding the financial implications, and where the responsibility lies. In response to the lack of veterinarians available for TB testing, DEFRA developed an Animal Health Paraprofessional OCQ (AHP) qualification for non-veterinarian technicians to become approved TB testers (APHA, no date) (http://apha.defra.gov.uk/ahp/index.htm). Additionally, the RCVS are exploring the potential for a veterinary paraprofessional qualification for those working in a supportive role within a veterinary practice, such as veterinary technicians (RCVS 2019). Furthermore, BASIS developed courses to train and certify those working in the pesticide and fertiliser sectors (https://www.basis-reg.co.uk/training). However, to date, no arrangements have been made to regulate nutritionists, despite the considerable influence they have on farm animal health, welfare, performance, and on farmer behaviour, as outlined in chapters 4, 5 and 7.

9.5 Limitations

The main limitations of the study include the regional aspect of the participants, as most were centred in the Midlands of England. Additionally, the researcher personally knew a small number of farmer and advisor participants that were interviewed, which may have introduced a bias to the sample. Purposive and 'snowball' sampling may have led to participants who were particularly interested in transition cow management but given the active effort to engage farmers of different herd types, sizes, contracts and systems, along with anonymity and greater geographical spread of the questionnaire in Chapter 8, mean that the findings are likely to be indicative of the wider population of dairy farmers in England.

A potential limitation in the quantitative farm data collection could be that when comparing farmer perception of transition health disorders and risk factors, actual cases of health disorders on the farms in the study were not recorded, so the true prevalence of metabolic disease could not be quantified and compared. This however was due to many farmers in the current study not recording transition cow health disorders and when they were recorded, farmer error, perception or dishonesty in the number of disorders reported may have impacted their reliability. Additionally, there are limitations in the farm data collection with the timings of samples, where the transition cows were measured for rumen fill and hock condition at one time point during the day and these factors could change regularly during the day. Similar limitations apply to water trough cleanliness, where this could vary during different times of the day depending on whether a cow had recently had a drink or not. It was however not considered feasible to collate quantitative farm data across multiple time points, as this would have required additional visits which may have discouraged farmers from study participation and would have necessitated a smaller sample size. The timing of feed sampling was deliberately conducted immediately after feed delivery, so no sorting should have occurred that may have influenced the nutritional analysis. The farm audit took place post-interview, and the timing of the quantitative analysis was different on different farms and depended on the length of the interview. This may have influenced the reported rumen-fill score of transition cows, and other farm audit measurements. The researcher aimed to overcome confounding limitations such as this by always conducting quantitative analysis in the same logical order on each farm.

There are also possible limitations regarding subjectivity with some of the quantitative analysis. Despite the researcher being a RoMs-registered mobility scorer (https://roms.org.uk/) and participating in training courses and calibration assessments in body condition scoring, human subjectivity may still occur when taking transition cow health measurements (e.g., BCS) and scoring the cleanliness of water troughs. The researcher aimed to overcome these issues to the best of their ability by always carrying the scoring assessment sheets, so when there was difficulty scoring cattle or housing, the researcher could refer back to these to make the assessment as objective as possible.

The farmer questionnaire was sent out digitally to aid with data interpretation and was distributed as widely as possible without monitoring of the response rates. The sample group for the questionnaire has the issue of potential bias, as it may be that farmers with particular transition cow health issues on farm or had a particular interest in transition cow management may have felt more inclined to respond. The questionnaire may have received more responses if there had been a financial incentive to participate, for example, if participating had automatically enrolled the farmers into a prize draw.

9.6 Recommendations for future work

Mineral concentrations of transition diets could be explored in more depth, and from a nationwide perspective, as this was a regional study and acknowledged water sources and forages which may have different geographical variations due to soil type and water source. The measurement of BCS was outlined to be a considerable factor influencing transition cow health, yet farms in the study generally had cows that exceeded the optimal score, with a higher than recommended proportion of groups outside the target BCS, and AYR farmers did not value BCS scorings as a useful and practical tool in managing transition cow management. For these reasons, further research could be conducted in this area to determine at which point cows are gaining the excess in BCS. Additionally, attempts to address and change farmer perception of BCS scoring may benefit the health of transition dairy cows in the UK, by encouraging farmers to work with their nutritional advisors to manage BCS and value its importance more.

Further work to investigate the attitudes of non-veterinary advisors may be worthy of investigation, as this is the first study of its kind to determine the attitudes of nutritional advisors involved in adult dairy cow health and has demonstrated some informative and illuminating reasons that contribute to the problem. There is a dearth of qualitative research that acknowledges the opinions and experiences of these non-veterinary advisors who are highly influential with regards to farmer behaviour and decision-making. Similar and successful attempts have been made investigating nutritional advisor opinions towards calf health and rearing (Palczynski et a. 2020a), and these methods are repeatable across all aspects of farm animal health where nutritional advisors have an involvement. Additionally, further research could be undertaken to determine if the regional findings regarding advisor opinions and experiences are applicable to other parts of the UK, and indeed, worldwide.

9.7 Final conclusions

The main findings of this thesis were:

- Farmer perception of transition cow health, management, and risk factors for health disorders differed from that found by the researcher during quantitative analysis.
- Nutritional analysis of transition cow diets demonstrated that mineral concentrations of pre-calver diets were suboptimal, presenting high risks for hypocalcaemia incidence, and mineral concentrations that were unnecessarily excess in early lactation diets.
- There was a lack of farmer awareness of transition-health disorders in the Northwest and Midlands of England.
- Some farm advisors were reluctant to provide focussed transition management advice to farmers in the Northwest and Midlands of England
- There were multiple farmer-perceived environmental challenges (feeding, housing and labour) which made farmers feel unwilling or unable to adopt higher standards to prevent transition related health disorders.
- There was generally heterogeneity in the attitudes towards transition cow management and farmer perceived prevalence of health disorders between seasonal and AYR calving farmers.

The nationwide questionnaire conducted demonstrated that many of the themes derived from the interviews can be applied to other dairy farmers in England. The most notable differences where that a relatively small proportion of questionnaire respondents (23%) indicated they fed pre-calving cows every 2 or 3 days, which contrasted with interview findings where nearly half of interview participants (10/22) fed every 2 or 3 days. Also, interview participants indicated that their nutritional advisors were proactive at transition cow discussion and nutritionists were considered more proactive than veterinarians. This contrasted with interview findings (Chapter 5) where nutritionists themselves reported feeling reluctant to provide focussed transition advice.

To address the suboptimal standard of transition cow management on UK dairy farms, the engagement of the farmer, advisor and the dairy farming industry are required, collaboratively. Efforts to encourage farmers (particularly those with AYR herds) to participate in benchmarking may enhance farmer awareness of transition-related health disorders, along with regular veterinary 'fresh cow checks' at routine fertility visits. The use of transition specialists may also help to address the lack of focussed transition advice provided on farm, but it is important that all advisors, both veterinary and non-veterinary, participate in IPE to address the lack of advisor collaboration. Collaborative advisors that are less likely to blame each other and instead show mutual respect for one another can guide farmers through behavioural changes effectively, through the use of tailored advice, combining their differing skills across different disciplines and employing strategies from behavioural and psychological models and MI. This approach is more likely to empower farmers to make long-lasting behavioural changes based on their intrinsic motivations. Industry efforts could also be made to address the lack of regulation for nutritionists. Chapter 4 reported that farmers were motivated to improve or maintain optimal transition cow practices when they were paid premiums or received financial penalties through their milk buyers. A milk pricing schedule that would specifically motivate and reward improvements in transition cow management may, however, be difficult to implement.

The studies conducted and described within this thesis have identified reasons that contribute to the high levels of metabolic diseases on UK dairy farms, despite the increasing volumes of scientific research, through the use of mixed methodological approaches. These reasons related to the general farmer awareness and perception of metabolic disease, attitudes of and complex relationships between farmers and their advisors, as well as the environmental boundaries that influence farmer decision making. The thesis outlines novel findings and has attempted to advance the scientific literature by providing realistic solutions which may contribute to the reduction of metabolic disease on farms in the UK and elsewhere.

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11. Appendices

11.1 Project information sheet

Research Project Information Sheet: A qualitative study into the social factors that influence health and welfare in the transition period of cows, in dairy herds across the Midlands.

Emma Hutcheon

PhD. researcher in Animal Production, Health and Welfare, Harper Adams University

Through interviews with dairy farmers, cattle vets and nutritionists in the midlands this research project aims to:

1. Gain an understanding of farmers' opinions of the importance of the transition period, along with different management practices that may be in place to try and manage diseases and problems associated with the transition period.

2. Test farmers' perceptions of success and failure in this area in their own herds, and see if this is supported by what is actually happening at farm level.

3. Gain an insight into how vets and nutritionists advise farmers in the management of the transition cow.

The research findings will be included as part of a PhD thesis, and may also be published in academic journals and other relevant publications; presented orally or in posters at scientific conferences; and used for teaching purposes within the university or to other interested audiences as invited.

The research is being funded by the Barham Benevolent Foundation, a registered UK charity with the objectives of promoting education and research in the dairy industry.

This study will produce measurements and data such as forage and feed analysis which the farmer is entitled to see when available. It is not within the intentions of the study for this information to be conflicting, to any advisors, vets, or nutritionists that you may consult.
If you would like to discuss any aspect of the study, or the details of this form, please contact me by email: ehutcheon@harper-adams.ac.uk.

11.2 Interview consent form

<u>A qualitative study into the social factors that influence health and welfare in the transition period of cows, in dairy herds across the Midlands in the UK.</u>

<u>Participant consent form</u>

Harper Adams University attaches a high priority to the ethical conduct of research. I therefore ask you to consider the following points before signing this form. Your signature confirms that you are willing to participate in this study.

• You are contributing to my research into the social factors that influence the health and welfare of transition cows on UK dairy farms. Our discussions will be digitally audio-recorded and then transcribed into a written record of the interview. Notes may also be taken in the course of the interview. The recordings will be stored securely. The transcriptions, together with any notes taken in the course of the interview, will be analysed as part of the study.

• The research findings will be included as part of the final PhD thesis, and may be published in academic journals and other relevant publications; presented orally or in posters at scientific conferences; and used for teaching purposes within the university or to other interested audiences as invited.

• Presentation of the research findings will include direct quotations from the interviews, but individuals will never be named, although regional location may be used, and whether the interviewee was a farmer, a vet or a nutritionist.

This study will produce measurements and data such as forage and feed analysis. It is not within the intentions of the study for this information to be conflicting, to any advisors, vets, or nutritionists that you may consult.

• Your contribution to the research is very valuable. Nevertheless, should you wish to withdraw from the project, I will fully respect your decision.

<u>Confirmation</u>

I confirm that I have freely agreed to participate in this research project. I have been briefed on what this involves and I agree to the use of the research findings as described above. I understand that the material is protected by a code of professional ethics. I hereby assign copyright in my contribution (the interview transcript) to Harper Adams University.

Participant Signature: ________________ Print name: ________________ Date: _____

Researcher Signature: ________________ Print name: ________________ Date: ____

11.3 All-year-round farmer interview guide

Tell me about your farm

Transition cow housing
Please describe your dry cow housing
Please describe your fresh cow (or milking cow) housing
Do you house your fresh cows separately?
Perception of stocking density
Perception of feed space
Do you have a separate calving pen? How often is it cleaned?
At what stage do you move cows to the calving pen?

Feeding
What do you feed your dry and your fresh cows?
How do you formulate this diet?
Do you consult anyone to make sure it is right? If so, who?
Do you ever make silage specifically for your dry cows?
How do you feed them? Mixer wagon/ring feeders/trough/barrier
How often do you push feed up?
How often do you make a fresh feed for your dry and fresh cows?
Do you feed minerals to you dry cows? If so, in what form? (Boluses/mineral buckets/bespoke free access/dry cow rolls)
Do you feed any other supplements to your transition cows?
What do you think about your water provision?
How often do you clean out the water troughs?
Please can you talk me through what you feed your dry cows, and where you keep them in the summer months?

Health and Routine
Drying off policy
Dry period- does it have a specific length
Do you have a calving policy/routine? If so, can you talk me through it?
How do you introduce cows to the main milking herd after calving?
What steps do you take to minimise the incidence of metabolic diseases?

Health records and monitoring
What transition-related health conditions do your cows suffer from most?
Are your cows routinely body condition scored?
Are your cows routinely mobility scored?
Do you keep health records? – Milk buyer influence

Advisors/vets/Consultants
How would you describe your relationship with your vet?
Do you have a consultant?
Do you have a nutritionist?
Who do you listen to most?

Do your vet and nutritionist ever collaborate with each-other?

Future planning & personal perception
Do you have any future plans for your transition cow housing?
What do you think are the most important things to get right in managing dry cows and fresh cows?
How well do you think you manage your transition cows?
Do you consider yourself to be short of farm labour?

Information and learning
Where do you get most of your information from regarding transition cow management?

Is there anything I have missed out that you would like to add?

11.4 Block calving interview guide

Tell me about your farm

Are you spring block/autumn block/mixed?

Please describe the transition period for your cows

What is the main metabolic problem?

Transition cow housing
Please describe the dry cow housing
Please describe your fresh cow (or milking cow) housing
Perception of stocking density
Perception of feed space
Do you have a separate calving pen? How often is it cleaned?
At what stage do you move cows to the calving pen?

Feeding
What do you feed your dry and your fresh cows?
How do you formulate this diet?
Do you consult anyone to make sure it is right? If so, who?
Do you ever make silage specifically for your dry cows?
How do you feed them? Mixer wagon/ring feeders/trough/barrier
If feeding indoors, how often do you make a fresh feed for transition cows?
Do you feed minerals to your transition cows? If so, in what form?
What do you think about your water provision?
Do you feed any additional supplements?

Health and Routine
Do you have a calving policy/routine? If so, can you talk me through it?
What steps do you take to minimise the incidence of metabolic diseases?

Health records and monitoring
What transition-related health conditions do your cows suffer from most?
Are your cows routinely body condition scored?
Are your cows routinely mobility scored?
Do you keep health records? – Milk buyer influence

Advisors/vets/Consultants
How would you describe your relationship with your vet?
Is your vet dairy specific/mixed practice…
Do you have a consultant?
Do you have a nutritionist?
Who do you listen to most?
Do your vet and nutritionist ever collaborate with each-other?

Future planning & personal perception
Do you have any future plans for your transition cow housing?

What do you think are the most important things to get right in managing transition cows?
How well do you think you manage your transition cows?
Do you consider yourself to be short of farm labour?

Information and learning
Where do you get most of your information from regarding transition cow management?
What are your thoughts on discussion/grazing groups?

Is there anything I have missed out that you would like to add?

11.5 Veterinarian interview guide

Tell me about your role

How long have you been in this role for? Qualifications/experience.

Dairy specific/Farm specific/Mixed practice

In the time that you have been in your role, do you think transition cow management as a whole has improved, got worse or stayed the same?

Why do you think that is?

What are your thoughts on this statement?: In a 2019 study involving 1748 UK Dairy herds the overall prevalence of subclinical ketosis in the first 20 days of lactation was found to be 28.5%.

Incidence of disease

What transition cow health problem do you see most on farm?

Why do you think that is?

What is your opinion on external circumstances such as milk price/aligned/non-aligned milk contracts and the influences of these (if any) on transition cow health and management?

Have you noticed any trends between farms with a high prevalence of transition cow diseases and farms with a low prevalence?

Advice on farm

How often do you make a special effort to discuss transition cow health during farm visits?

Would you consider yourself to have more of a preventative herd-health role, of a fire-fighter/immediate treatment type of approach?

Why do you think that is?

In your opinion, between vet, farmer, feed rep, consultant, who's responsibility is it to deliver information and educate farmers on transition cow health and management?

Do you provide feed advice?

Do you collaborate or work together with any nutritionists or feed representatives?

Expand- why/why not.

Currently, there is no requirement for a formal qualification to be a farm 'nutritionist'. What are your thoughts on this?

Health monitoring

What is your opinion on health monitoring, to reduce transition disease incidence?

Expand if needed- BCS/mobility/milk contracts

Farmer engagement

Some farmers can be hard to reach with information on transition cow health. Why do you think that is?

Use of discussion groups/talks- what are your thoughts?

Based on the questions I have asked, on reflection, is there anything you would like to add, or anything that you would like to change about your views on transition cow management?

11.6 Nutritionist interview guide

Tell me about your role

How long have you been in this role for?

Do you have a formal nutritional qualification?

In the time that you have been in your role, do you think transition cow management as a whole has improved, got worse or stayed the same?

Why do you think that is?

What are your thoughts on this statement?: In a 2019 study involving 1748 UK Dairy herds the overall prevalence of subclinical ketosis in the first 20 days of lactation was found to be 28.5%.

Incidence of disease

What transition cow health problem do you see most on farm?

Why do you think that is?

What is your opinion on external circumstances such as milk price/aligned/non-aligned milk contracts and the influences of these (if any) on transition cow health and management?

Have you noticed any trends between farms with a high prevalence of transition cow diseases and farms with a low prevalence?

Advice on farm

How often do you make a special effort to discuss transition cow health during farm visits?

Would you consider yourself to have more of a preventative herd-health role, of a fire-fighter/immediate treatment type of approach?

Why do you think that is?

In your opinion, between vet, farmer, feed rep, consultant, who's responsibility is it to deliver information and educate farmers on transition cow health and management?

Do you collaborate or work together with any vets with mutual clients?

Expand- why/why not.

Currently, there is no requirement for a formal qualification to be a farm 'nutritionist'. What are your thoughts on this?

What is your opinion on the feed advisor register?

Health monitoring

What is your opinion on health monitoring, to reduce transition disease incidence?

Expand if needed- BCS/mobility/milk contracts

Farmer engagement

Some farmers can be hard to reach with information on transition cow health. Why do you think that is?

Use of discussion groups/talks- what are your thoughts?

Based on the questions I have asked, on reflection, is there anything you would like to add, or anything that you would like to change about your views on transition cow management?

11.7 Farm audit data collection forms

Farmer	
Farm name	
Date	
Whole herd size	
Number in milk	
Precalver cows recorded	
Early lactation cows recorded	
Average annual milk yield	
Length of dry period	
Take feed samples	
Precalver diet	
Early lactation diet	

Precalver cow housing	
Number of cows in pen	
Visible neck sores present	Yes/no
Dispersion/crowded areas/bottle necks	
Straw yard/cubicles	
Shed length	
Shed width	
Pen space per cow if straw yard	
Feed space	
Feed space per cow	
Neck rail height	
Neck rail position	
No. of water troughs	
Water trough dimensions	
Water space per cow	
Water trough cleanliness	1 2 3 4
No. of cubicles	
Stocking density	
Cubicle length	
Cubicle width	
Lunging space	
Kerb height	
Cubicle style	
Bedding type	

Early lactation/main milking group housing	
Number of cows in pen	
Visible neck sores present	Yes/no
Dispersion/crowded areas/bottle necks	
Straw yard/cubicles	
Shed length	
Shed width	
Pen space per cow if straw yard	
Feed space	
Feed space per cow	
Neck rail height	
Neck rail position	
No. of water troughs	
Water trough dimensions	
Water space per cow	
Water trough cleanliness	1 2 3 4
No. of cubicles	
Stocking density	
Cubicle length	
Cubicle width	
Lunging space	
Kerb height	
Cubicle style	
Bedding type	

Cow ID	BCS	Hock hygiene	Hock condition	Rumen fill	Mobility

11.8 Farmer questionnaire

Harper Adams University

Farmer opinions and practices on transition cow management

Page 1: About this questionnaire

Farmer opinions and practices concerning transition cow management

Page 1: About this questionnaire

Participant information statement

Firstly, thank you for participating in this questionnaire. This questionnaire is only for farmers working with dairy cows in the England.

This questionnaire forms part of a PhD study being conducted at Harper Adams University which investigates factors that influence dairy cow health and welfare during the transition period.

We want to understand how you manage your transition cows, in particular, the challenges of managing transition cows and the advisory relationships you have with your veterinary and non-veterinary advisors.

Please answer all questions accurately and to the best of your knowledge. We are seeking meaningful and representative data that will provide an insight into the opinions and experiences of dairy farmers caring for their transition cows across England.

Data protection: All responses are anonymous. Data will be used for the purposes of research as explained above and will be presented in my PhD thesis and associated papers and oral presentations which may arise from that work. Only the student researcher (Emma Redfern) and other authorised academics on my supervision team at Harper Adams University will have access to your responses. The findings will be published anonymously and stored securely on a database for a maximum of 6 years by Harper Adams University, before being destroyed. By participating in and completing this questionnaire, you are consenting to the collection of the data in the form of your responses to the questions, but you have the right to withdraw from this study at any time. For further information please contact Emma Redfern at eredfern@harper-adams.ac.uk.

This questionnaire should take less than 15 minutes to complete. So grab a coffee and let's begin!

1. Are you a dairy farmer or farm worker in England?

- ○ Yes
- ○ No

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Page 2: You and your herd

2. Are you:

- ◯ Male
- ◯ Female
- ◯ Prefer not to say

3. How old are you?

- ◯ <25
- ◯ 25-35
- ◯ 36-45
- ◯ 56-65
- ◯ >65
- ◯ Prefer not to say

4. To understand whether responses vary by region, what are the first four digits of your postcode?

5. What is your role on the dairy farm?

- ◯ Farmer owner/operator
- ◯ Farm manager
- ◯ Herd manager

- Farm worker
- Assistant
- Other

6. If you have more than one farm, please select one farm and base your following answers on this selected farm only. What is the current herd size?

- <100
- 100-200
- 201-400
- 401-600
- 601-800
- >800

7. What farming system do you operate?

- All-year-round
- Spring block
- Autumn block
- A combination of spring and autumn block calving

8. What is the average annual yield?

- < 5000L
- 5000-6500L
- 6501-8000L
- 8001-9500L

- 9501-11000L
- >11000L

9. Which farming system is most applicable in classifying your herd?

- Non-organic
- Organic

10. During peak production, how many times are the cows milked?

- Once a day
- Twice a day
- Three times a day
- On robots

Page 3: Onto your transition cows

11. Are your pre-calving cows grouped seperately from the main milking herd 2-3 weeks prior to calving?

- Yes
- No

12. Are your freshly calved cows grouped seperately from the main milking herd 2-3 weeks post-calving?

- Yes
- No

13. How would you characterise your transition cow management currently? (1 being very good, and 5 being very poor)

- 1
- 2
- 3
- 4
- 5

14. Which of these statements is most applicable to your situation?

- I am actively seeking advice or working to improve my transition management
- I intend to improve transition management in the future, but not immediately
- I currently have no intentions to change my transition management

15. How frequently are the diseases/conditions listed below occurring in your herd? Please rank them 1-5 (where 1 is never and 5 is very common)

Please don't select more than 1 answer(s) per row.

	1	2	3	4	5	I don't know
Clinical milk fever	☐	☐	☐	☐	☐	☐
Retained cleansings	☐	☐	☐	☐	☐	☐
Metritis (dirty cows)	☐	☐	☐	☐	☐	☐
Mastitis	☐	☐	☐	☐	☐	☐
Displaced abomasum	☐	☐	☐	☐	☐	☐
Clinical ketosis	☐	☐	☐	☐	☐	☐

16. How do you rank the importance of transition cow health problems compared with other herd health and welfare challenges in your herd? (1 being the most important and 5 being the least important)

Please don't select more than 1 answer(s) per row.

Please don't select more than 1 answer(s) in any single column.

	1	2	3	4	5
Transition cow health problems	☐	☐	☐	☐	☐
Lameness	☐	☐	☐	☐	☐
Mastitis	☐	☐	☐	☐	☐

Reproductive failure	☐	☐	☐	☐	☐
Respiratory disease	☐	☐	☐	☐	☐

17. What are the top 2 reasons why cows leave your herd in the first 60 days of lactation? Please tick two. (selling freshly calved dairy animals is not an option)

Please select between 1 and 2 answers.

- ☐ Disease or transition cow health problems
- ☐ Injury and illness
- ☐ Mastitis and udder issues
- ☐ Reproductive failure
- ☐ Sudden death
- ☐ Low milk production
- ☐ Lameness
- ☐ Other
- ☐ None of these

18. What do you consider are your challenges to a successful transition? Please rate the top 3. (1 being most important, followed by 2 and 3.)

Please don't select more than 1 answer(s) per row.

Please select between 1 and 3 answers.

Please don't select more than 1 answer(s) in any single column.

	1	2	3
Metabolic diseases that I can't control	☐	☐	☐
Housing is out of date/not spacious enough	☐	☐	☐
Lack of feed or water space	☐	☐	☐

Lack of advice or information from my vet	☐	☐	☐
Lack of advice or information from my nutritionist	☐	☐	☐
Due to farm layout, I can't feed a total or partial mixed ration to my pre-calving cows	☐	☐	☐
Due to farm layout I can't group or feed my dry cows separately	☐	☐	☐
Small group sizes make it a challenge to feed a fresh ration every day	☐	☐	☐
Lameness	☐	☐	☐
Conflicting advice from advisors	☐	☐	☐
Other herd health issues take priority	☐	☐	☐
I do not consider that I have challenges to transition success	☐	☐	☐
Other	☐	☐	☐

19. How often do you look proactively for signs of transition cow health problems during the transition period to treat them before they worsen? (1 being very regularly, and 5 being not at all).

- ○ 1
- ○ 2
- ○ 3
- ○ 4
- ○ 5
- ○ I don't know

20. Which transition health monitoring tools do you use? Please rate the top 3 (1 being most important, followed by 2 and 3)

Please don't select more than 1 answer(s) per row.

Please select between 1 and 3 answers.

Please don't select more than 1 answer(s) in any single column.

	1	2	3
Rumination monitoring system (collars/bolus)	☐	☐	☐
Activity monitoring system (pedometers)	☐	☐	☐
Ketosis testing	☐	☐	☐
Feed intake calculations	☐	☐	☐
Fresh cow checks during routine vet visit	☐	☐	☐
Rectal temperatures (or bolus temperatures)	☐	☐	☐
Sudden drop in milk yield	☐	☐	☐
Daily group walks	☐	☐	☐
Rumen fill scoring	☐	☐	☐
Monitoring somatic cell count	☐	☐	☐
Administering mono-propylene glycol to cows with a low rumen fill.	☐	☐	☐
None of these	☐	☐	☐

21. How important do you think body condition is for transition cow health? Please select one.

- ○ It's very important and I take steps to manage it and body condition score regularly.
- ○ It's important, and I'm always looking at it, but I don't record the body condition scores of my cows.
- ○ It's important, but I don't look at the cows' body condition as much as I should.
- ○ Body condition is not important, and I take no steps to measure it.
- ○ I don't know

22. How important do you think stocking density is for transition cow health? Please choose one:

- I think it is important and I avoid overstocking
- I think it is important, but I do overstock (dry or fresh cows) for other reasons
- I don't think it is important on my farm
- I don't know

Page 4: Feeding your transition cows

23. How often do you make a fresh feed for your pre-calving cows? (Or provide fresh forage)

- Twice per day
- Once a day
- Every other day
- Every 3 days
- Greater than every 3 days

24. What do you do to maximise dry matter intake for your transition cows? Choose all that apply.

- Pushing-up feed at the barrier 2-4 times per day
- Pushing-up feed at the barrier > 4 times per day
- Cleaning out feed troughs before fresh feed is delivered
- My cows have at least 75cm of feed space at all times
- My cows have at least 10cm of water trough space at all times
- Feeding to allow 5% refusals
- Feeding to allow 10% refusals
- None of these

25. How do you feed your pre-calving cows? (Please choose only one answer)

- Specific pre-calving cow total or partial mixed ration
- Silage/hay, top-dressed with a nut or blend
- Silage/hay, no additional concentrates
- Outside at grass, and fed additional concentrate

- Outside at grass and fed no additional concentrate
- They get the same diet as the milking cows
- Other

25.a. If you selected Other, please specify:

26. Do you feed vitamins and minerals to your dry cows? If so, what is your method of feeding these?

Please select between 1 and 9 answers.

- [ ] Bagged mineral in a total mixed ration
- [ ] Mineralised concentrate (e.g. dry cow nut)
- [ ] Top dressing feed with a bagged mineral
- [ ] Bolus
- [ ] Mineral lick block
- [ ] Free access minerals
- [ ] Top dressed onto concentrates in the parlour
- [ ] Other
- [ ] I don't feed minerals to my pre-calving cows
- [ ] I don't know

26.a. If you don't feed minerals to your pre-calving cows, what is the reason?

- [ ] It's too costly
- [ ] I don't have the time
- [ ] My dry cows don't need additional minerals
- [ ] I have never been advised to
- [ ] I don't know

- [ ] I have used them before and they didn't help/work as expected

27. Do you feed anionic salts to your dry cows? (e.g. magnesium chloride/calcium chloride for dietary cation and anion balance) If so, what is your method of feeding them?

- [ ] Within a total or partial mixed ration.
- [ ] Top-dressed onto silage
- [ ] In the water trough
- [ ] Thrown onto the grass outside
- [ ] Top dressed onto concentrates in the parlour
- [ ] Other
- [ ] I don't feed anionic salts

27.a. If you don't feed anionic DCAB salts to your pre-calving cows, what is the reason?

Please select between 1 and 5 answers.

- [ ] It's too costly
- [ ] I don't have the time
- [ ] My dry cows don't need anionic salts
- [ ] I have never been advised to
- [ ] I don't know
- [ ] I have used them before and they didn't help/work as expected

28. Which of these additional supplements do you feed or use for your transition cows (pre-calving or post- calving) to help reduce metabolic disease?

- [ ] Kexxtone boluses
- [ ] Calcium boluses (e.g. Bovical)

- [ ] Fresh cow drinks or drenches (e.g. mono-propylene glycol/glycerol/pro rumen)
- [ ] Protected amino acids (e.g. methionine) or choline
- [ ] Other (e.g. yeasts)
- [ ] None of these

28.a. If you don't use any additional supplements, what is the reason?

- [ ] It's too costly
- [ ] I don't have the time
- [ ] My dry cows don't need additional supplements
- [ ] I have never been advised to
- [ ] I have used them before and they didn't help/work as expected
- [ ] I don't know

Page 5: Your advisors

29. Is your vet from a dairy specific practice or a mixed practice?

- ◯ Dairy specific
- ◯ Mixed farm practice (dairy, beef and sheep)
- ◯ Mixed practice (small animal, equine and farm)
- ◯ I don't know

30. How would you describe the strength of your relationship with your vet?

- ◯ Very good
- ◯ Good
- ◯ Indifferent
- ◯ Poor
- ◯ Very poor

31. How often do you discuss transition management with your vet? Please choose the most appropriate response:

- ◯ Always
- ◯ Usually, on most routine visits
- ◯ Only when there is a problem
- ◯ Not very often
- ◯ Never

32. Would you like more attention to be paid to transition management during vet

visits?

- Yes, and I would be prepared to pay for the advice
- No
- I would, but I don't want to pay additional vet time for it

33. Please choose any of the responses that you think may apply to you and your vet:

- [ ] My vet is proactive and asks me about my transition cows, and I appreciate this.
- [ ] My vet is helpful with my transition cows, but only if I raise the topic of transition management.
- [ ] I don't think we need to talk about transition cows as often as my vet wants us to
- [ ] During vet visits, we tend to prioritise other non-transition health issues and not discuss transition cow management.
- [ ] My vet regularly wants to discuss things that I don't think are relevant or helpful to me
- [ ] My vet seems to avoid discussion about transition cows

34. Which of these non-vet advisors do you have? Tick all that apply.

- [ ] Independent nutritionist/consultant
- [ ] Nutritionist or feed representative that provides feed and advice
- [ ] Dairy business consultant (that does not provide nutritional advice)
- [ ] None
- [ ] Other

34.a. Does your nutritionist cover other species? (e.g. beef and sheep)

- Yes

- No
- I don't know

34.b. How would you describe the strength of your relationship with your nutritionist/feed representative?

- Very good
- Good
- Indifferent
- Poor
- Very poor

34.c. How often do you discuss transition cow nutrition with your nutritionist/feed representative?

- Always
- Usually, on most routine visits
- Only when there is a problem
- Not very often
- Never

34.d. Please choose any of the responses that you think apply with your nutritionist/feed representative:

- [ ] My nutritionist is proactive and asks me about my transition cows, and I appreciate this.
- [ ] My nutritionist is helpful with my transition cows but only if I raise the topic.
- [ ] My nutritionist regularly wants to discuss things that I don't think are relevant or helpful to me
- [ ] During visits, we tend to prioritise the main milking herd and not discuss transition cow management.
- [ ] My nutritionist seems to avoid discussion about transition cows
- [ ] I don't think we need to talk about transition cows as often as my nutritionist wants

us to

34.e. Would you like more attention to be paid to transition management during visits by your nutritionist?

- Yes
- No

34.f. If you don't have a nutritional advisor, why is this? Please choose any that apply:

- I do not need nutritional advice
- I am currently looking for a nutritionist
- I have had poor experiences with nutritionists in the past
- I do not have a feed representative and I don't want to pay the additional cost for an independent nutritional advisor
- I don't know

35. Do you feel you have made any impactful changes have you made to your transition housing or transition management, in the last 3 years? Please rank the top 3 changes (1 being the most impactful)

Please don't select more than 1 answer(s) per row.

Please select between 1 and 3 answers.

Please don't select more than 1 answer(s) in any single column.

	1	2	3
Built new or improved existing transition housing, allowing more room per cow			
Increased feed or water space, or reduced stocking density			

Introduced a system to try to reduce stress and movements at calving (e.g. stress-free calving line/moving in pairs)	☐	☐	☐
Introduced routine calcium bolusing to some freshly calved cows	☐	☐	☐
Introduced routine drenching of mono-propylene glycol to some freshly calved cows	☐	☐	☐
Introduced a new transition health monitoring protocol of any kind (e.g. rumen fill scoring, rumination collars, ketone testing, fresh cow checks)	☐	☐	☐
Introduced a new diet or method of feeding	☐	☐	☐
None	☐	☐	☐
Other	☐	☐	☐

35.a. If no recent changes have been made, what was the reason? Please tick all that apply.

- ☐ I do not need to make any management or housing changes
- ☐ Cost
- ☐ Lack of time or labour
- ☐ Farm infrastructure not suitable
- ☐ Lack of interest or motivation in the suggestion
- ☐ Lack of confidence
- ☐ Transition advice is confusing and difficult to follow
- ☐ Lack of support from vet
- ☐ Lack of support from my nutritionist
- ☐ Other
- ☐ I have made changes to transition management, this question doesn't apply to me.

Page 6: Final page

You have reached the end of this questionnaire! Thank you for participating, you have contributed to important research which will aim to improve the heath and welfare of transition dairy cows!