UNDERSTANDING FARMER DECISION-MAKING AND THE ROLE OF ADVISORS

TO IMPROVE DAIRY CATTLE WELFARE

by

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the degree of	Doctor of Philosophy	
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Abstract

Canadian dairy farms are becoming increasingly complex businesses with many farms growing in size which requires increased labor. These changes have resulted in new challenges for farmers, including having to balance the human resource management needs of their farm with traditional duties of animal care. To improve animal welfare on farms, it is important to understand the views of the farmers responsible for the day-to-day care of the animals, as well as their advisors such as veterinarians. The overall objective of this thesis was to improve understanding of dairy farmer decision-making on animal care practices and how advisors influence these decisions, focusing on the perspectives of stakeholders in the lower Fraser Valley region of British Columbia, Canada. Chapter 1 introduces the concept of animal welfare and the context for this research. Chapter 2 reviews the available literature on five human resource management concepts on dairy farms: 1) professional accreditation and professional development, 2) extension activities, 3) the role of the advisor, 4) standard operating procedures and, 5) employee training. Chapter 3 describes an interview study with farmers and veterinarians that set out to understand the barriers to improved care of cows around the time of calving, a time period when cows are at increased risk of disease. Chapter 4 describes a participatory study that involved working with farmers to develop standard operating procedures for newborn calf care, including understanding the role of the advisor in this process. Using secondary analysis of the datasets arising from Chapters 3 and 4, Chapter 5 describes a study aimed at understanding who farmers consult across management practices.

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Lastly, Chapter 6 presents a general discussion, including a description of the contributions arising from this thesis and suggestions for future research including: 1) understanding the extension needs of farmers in Canada, 2) integrating participatory methods in policy, training program and extension curriculum development, and 3) understanding how farmers make animal care decisions with the aid of technology and data on farms. This thesis adds to the growing discussion regarding farmer decision-making and how advisors, including researchers, can work with farmers to improve the lives of the animals under their care.

Lay Summary

The overall objective of this thesis was to improve understanding of dairy farmer decisionmaking on animal care practices and how advisors influence these decisions, focusing on the perspectives of stakeholders in the lower Fraser Valley region of British Columbia, Canada. Using interviews and participatory methods, this thesis explores the topics of barriers to improved care of cows around the time of calving (Chapter 3), the development and use of standard operating procedures for newborn calf care (Chapter 4) and understanding who farmers consult across these management practices (Chapter 5). Lastly, Chapter 6 presents a general discussion, including a description of the novel contributions arising from this thesis and suggestions for future research including: 1) understanding the extension needs of farmers in Canada, 2) integrating participatory methods in policy, training program and extension curriculum development, and 3) understanding how farmers make animal care decisions with the aid of technology and data on farms. This thesis adds to the growing discussion regarding farmer decision-making and how advisors, including researchers, can work with farmers to improve the lives of the animals under their care.

Preface

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Prologue

An important aspect of conducting social science research is recognizing your own positionality: the values, experiences and biases that you bring to your research. I grew up in a small town in British Columbia and have always been an animal person. I have worked with animals in veterinary clinics, wildlife rehabilitation centers and animal shelters; I have shared my home with animals and I have consumed animals. All of these experiences have shaped my perspective on human-animal relationships and are an important component of why I started graduate school 4 years ago.

Animal welfare is a societally driven science; I am here because I care about animals, because my values and experiences have led me to this discipline. The strength of animal welfare science is the diverse, fascinating, creative methods that are used to understand real world problems. We cannot separate the human world from that of the animals that are under our care. By building relationships and understanding the humans within these systems, we have the opportunity to create animal systems that respect the needs of all involved: human and animal.

When I first started my PhD training, I believed that distancing myself from my participants was the only way to 'objectively' collect data; I was the research implement and could therefore not show who I was as a person. Participants would ask me questions and I would avoid revealing too much of my own biases in an effort to be a 'good' researcher. However, these conversations would be stilted; why would someone share their experiences

with me if I would not share with them? Why would they trust me if they were unable to see me as a person? Over time I came to realize that I can be a good researcher and build relationships with those I work with. Now when I am asked what I do, as is often the case in our lab lunch time meetings, I say that I work *with* veterinarians and farmers to understand decision-making in the dairy industry. I am inextricably linked to the stories that I present from my participants in this dissertation; we cannot divorce the two and I think we should question why we want to.

I am so grateful for the people and animals that I have met in the 4 years since I started my PhD training. All of the experiences have collectively shaped the person I am today and the values that I hold; they have shifted my positionality. Instead of avoiding our biases in an effort to be objective, what if we embraced these experiences and recognized the strength that diversity adds to our collective research goals? I believe that we have a moral obligation to care and provide for animals. It is this that has guided me, and will continue to guide my research. However, by listening to others that hold different values, we can challenge, strengthen or adapt our thinking. Meaningful change happens collectively. I look forward to continuing to challenge my own positionality in the years to come.

Chapter 1: Introduction

1.1 Conceptual background

1.1.1 Defining animal welfare

Animal welfare first gained societal relevance with the release of Ruth Harrison's Animal Machines (1964) in which she explored the conditions of farm animals housed in the United Kingdom in confinement agriculture. The resulting societal pressure led to the emergence of the diverse field of animal welfare science; a societally-driven discipline with the aim of improving the lives of animals under human care (Fraser et al. 1997). The Brambell report (1965), commissioned by the British government in response to Ruth Harrison's book provided one of the first conceptions of animal welfare, conveyed as 'five freedoms' for animals: 1) freedom from hunger and thirst, 2) freedom from discomfort, 3) freedom from pain, injury or disease, 4) freedom to express normal behavior, and 5) freedom from fear and distress. Though still used today, animal welfare is conceived in a variety of ways (Weary & Robbins, 2019) dependent on many social, ethical and cultural factors (Rollin, 2007). For example, Rollin (1993) argues that respect for animals requires that we allow them to express their natural *telos* (i.e. "the pigness of the pig, the cowness of the cow"). Broom (1991) defines animal welfare based on the subjective experiences of the animal (i.e. their ability to cope within their environment) as evidenced by physiological measurements. Similarly, Duncan (2005) describes animal welfare based on the feelings of the animal while other researchers have focused on an animals' ability

to express normal behaviors (Dawkins, 1988). This thesis uses the animal welfare framework developed by Fraser et al. (1997) that consists of three components: natural living (the animal's ability to perform natural behaviors), affective states (the emotional state of the animal) and biological functioning (the animal's health). Under this framework, an animal will achieve optimal welfare when all three concepts are satisfied.

Animal welfare research has increased greatly over the years (Freire & Nicol, 2019), partly in response to growing public concerns about the quality of life led by animals (Weary & von Keyserlingk, 2017). This is perhaps especially true for farm animals (Appleby, 2004), evidenced by the growing demand for non-animal alternatives such as plant-based milk (McCarthy et al., 2017) and cultured meat (Bryant & Barnett, 2018). Animal welfare science takes a multidisciplinary approach, incorporating ethics, economics and sociology, as well as the biological sciences to understand stakeholder perspectives (Appleby, 2004) leading to practices that resonate broadly with societal values.

1.1.2 The dairy industry

Dairy farms in North America are increasing in size and becoming more dependent on external labor (Barkema et al., 2015). This expansion is also associated with technological advancements and improved efficiency (Hagevoort et al., 2013). In the United States (US), the total number of dairy farms has decreased by 74% over the last four decades, but the number of cows has increased 325% (Chase et al., 2006). Similarly, in Canada between 2006 and 2016 the number of farms decreased by 23% yet the average production per farm increased by 39%

(Canadian Dairy Commission, n.d.) with an average farm size of 89 cows in 2019 (Dairy Farmers of Canada, 2019). With farms increasing in size, in both animals and human labor, a farmer's role now includes human resource responsibilities (Hagevoort et al., 2013) in addition to the traditional role of animal care.

The typical succession of the family farm from one generation to the next is complex and can have economic impacts on those involved (Leonard et al., 2017). Moreover, while tradition often dictated that children of older generations felt obligated to follow in the steps of their parents, this is no longer the norm for younger generations; partly explained by the greater emphasis placed on work-life balance (Villa, 1999). However, there is some evidence that younger generations that do continue farming take a more business-like approach than previous generations (Villa, 1999). This change in farmer demographics, coupled with the lack of skilled employees entering the workforce (Bitsch et al., 2006; Schewe, 2015), has resulted in a new set of management problems for dairy farmers of today.

One factor that sets the Canadian dairy industry apart from countries around the world is the supply management system. Introduced in 1983, supply management limits the amount of milk produced and ensures that farmers are paid a stable price (Barichello, 1999). In comparison, milk price in most other countries is dependent on supply and demand; when supply is high milk prices fall, increasing volatility in milk markets (Barkema et al., 2015). Other countries around the world have forgone supply management systems in the dairy industry (e.g. European Union in 2015, Läpple & Sirr (2019); New Zealand in 1984, Agropur Dairy Cooperative (n.d.)), and the supply management system in Canada has come under criticism,

particularly from international trade partners (Carter & Merel, 2016). Many economists, consumer advocates and other stakeholders have recommended the dismantling of Canada's supply management system for reasons of both domestic and international trade (Findlay, 2012). If farmers want to maintain a system that has been largely abandoned around the world, they must work to create an industry that aligns with societal values (i.e. social license; Gehman & Lefsrud, 2017; Raman & Mohr, 2014).

In the dairy industry, public perspectives have been explored in many countries around the world, such as Germany (Busch et al., 2017), Brazil (Cardoso et al., 2017), the United Kingdom (Ellis et al., 2009) and the United States (Robbins et al., 2019). If we focus on the Canadian context, studies have sought to understand public views on contentious practices such as pasture access (Schuppli et al., 2014) and cow calf-separation (Ventura et al., 2013). The few studies available to date suggest that Canadians prioritize systems that provide outdoor access and allow calves to remain with their mothers (Schuppli et al., 2014; Ventura et al., 2016). In addition, there are other dairy management practices of which the public is largely unaware but likely to perceive negatively (e.g. tie-stall housing; Robbins et al., 2019). While understanding societal values is an important place to start when looking to improve animal welfare practices, the perspectives of the farmers who directly care for these animals must also be considered.

1.1.3 Dairy farmer decision-making and animal welfare

Dairy farmers have the ability to directly improve the lives of animals under their care. Farmers that handle their animals more frequently, such as during milking, have a strong sense of attachment to their animals (Balzani & Hanlon, 2020) and use empathetic language when describing painful conditions in their animals (e.g. lameness; Horseman et al., 2014). However, the interpretation of 'animal welfare' by farmers and other industry stakeholders is not consistent; for instance, farmers frequently place greater importance on health than on affective states or natural behavior (see review by Balzani & Hanlon, 2020). A focus group study with dairy farmers in Ontario, Canada found that farmers could identify, and agreed, on what they considered the key welfare issues faced by their industry, citing for example cattle handling, transition cow disease, and calf care (Croyle et al., 2019). Another survey focusing on Canadian dairy stakeholders, reported that producers along with veterinarians, researchers, government personnel and other industry stakeholders rated animal welfare as the top management issue facing the industry (Bauman et al., 2016). While animal welfare is recognized as a concern, farmers vary in their willingness to participate in animal welfare programs (i.e. Germany; Heise & Theuvsen, 2018), although farmers were more willing to accept farm animal welfare programs if it meant improving public trust in the industry (Germany; Schreiner & Hess, 2017).

There are many factors that go into farmers decision-making around animal care and welfare including farmer personality, characteristics of their households and other variables (Edwards-Jones, 2006). To protect their business and provide for themselves and their families,

farmers describe constraints to providing optimal welfare for their animals (e.g. calf welfare; Vetouli et al., 2012). Similarly, Brazilian dairy farmers recognized dehorning as an animal welfare concern and painful for the animal but also stated that there were economic tradeoffs that affected their willingness to provide pain management to calves (Cardoso et al., 2016). Other work has shown that farmer decision-making is affected by factors such as production (Haine et al., 2017), economics (Rodriguez et al., 2008), and peer comparison (Sumner et al., 2018; see review by Ritter et al., 2017). There is a respect for tradition among some farmers (i.e. *"that's the way we've always done it!"*; Bassi et al., 2019) that may slow the adoption of changes to farm practice. Working with farmers allows an understanding of these constraints, and of how advisors, such as veterinarians and researchers, can work with farmers to find solutions that benefit all parties concerned.

1.2 Methodology and theoretical framing

This thesis is approached from with the conception of animal welfare developed by Fraser et al. (1997). As discussed above, animal welfare science began with a focus on the animal (e.g. how they feel, how they behave, etc.), but researchers increasingly understand that the human dimension must also be considered given that it is the stockpersons who have the greatest impact on an animal's quality of life (Hemsworth, 2003; Lund et al., 2006). While in some cases traditional methodological approaches to qualitative inquiry (i.e. phenomenology, ethnography, case study, etc.) are appropriate to answer the questions raised in animal welfare research, the features in these approaches make their applicability limited (Cooper & Endacott,

2007). In this thesis I use a generic qualitative approach that draws on the strengths of these other methodologies to more directly answer my research questions (Bellamy et al., 2016). Percy et al. (2015) discuss this problem in the context of psychology, explaining how generic qualitative inquiry prioritizes using qualitative and mixed methods to understand the experiences of individuals without following the traditional methodological approaches. Sometimes described as descriptive qualitative research (Sandelowski, 2000), generic qualitative inquiry focuses on understanding external and real-world experiences of an individual and not internal or psychological experiencing (Percy et al., 2015). As Sandelowski (2000) explains, qualitative descriptive studies provide comprehensive summaries of an event in everyday terms. This approach uses structured or semi-structured interviews, surveys or activity-specific participant observations¹ to ask targeted questions, often guided through the researchers pre-understanding of the topic (Percy et al., 2015).

¹ The specific methods used in this thesis are described in each empirical chapter (i.e. Chapter 3-5).

Generic qualitative inquiry is an approach that has been used in many different contexts, including studies seeking to understand dementia patient professional and familial caregivers' experiences of stigma (Werner et al., 2020), pharmacists' views of professional and personal well-being (Schommer et al., 2020), and teachers' experiences working with students with autism spectrum disorder (Josilowski & Morris, 2019). Researchers in nursing (Sandelowski, 2000), emergency medicine (Cooper & Endacott, 2007) and psychology (Percy et al., 2015) have all argued for the acceptance of this approach to answer questions outside of the traditional approaches to qualitative research. This approach allows for participants' external experiences, attitudes and beliefs of their outer world to be considered (Percy et al., 2015).

The Animal Welfare Program at the University of British Columbia (UBC) aims to improve the lives of animals under human care. Given that applied perspective, the research presented in this thesis aims to answer real-world problems in the Canadian dairy industry in an effort to improve the lives of the humans and animals in these systems. While generic qualitative inquiry does not have prescribed ontological (i.e. the reality that researchers investigate) and epistemological (i.e. the relationship between the researcher and the reality) (Healy and Perry, 2000) underpinnings like that of other methodologies (Kahlke, 2014), this thesis works under the paradigm of realism. Realism assumes that there is a real world to discover (ontology) but that it can only be imperfectly discovered (epistemology; Healy and Perry, 2000). As described by Healy and Perry (2000), realism researchers acknowledge that they are neither value-laden nor value-free but instead 'value-aware'. Given the implicit

underpinnings of animal welfare science as a discipline driven by societal values and the research questions I had, this was the most appropriate paradigm for this thesis.

1.3 Context for this research

The context for my thesis research is the dairy industry in the lower Fraser Valley region of British Columbia, Canada. The lower Fraser Valley is home to a high proportion of the approximately 450 dairy farms and 82,500 milking cows in British Columbia (Canadian Dairy Information Centre, 2020), producing 73% of the provinces' milk (BC Ministry of Agriculture, 2014). Additionally, The UBC Dairy Education and Research Centre is located in the region. This working dairy farm also produces research with a focus on animal welfare and reproduction. Given the proximity of the UBC farm to the local dairy industry, farmers, veterinarians and other industry stakeholders in the region often have had some exposure to research. The history of the UBC farm in this region likely helps establish a relationship of trust among researchers and dairy industry stakeholders.

1.4 Thesis aims

The overall objective of this thesis is to better understand farmer's management decisions and how advisors influence these decisions from the perspective of stakeholders in the lower Fraser Valley region of British Columbia, Canada. Given that dairy farms are growing in size and farmers are increasingly required to hire external labor, the first aim of this thesis was to understand the status of the available literature regarding human resource management of dairy farms. Secondly, given the gap between evidence-based best management practices

and dairy cow welfare issues on individual farms, the second aim of this thesis was to better understand barriers to improved animal care management practices from the perspectives of veterinarians and farmers. Additionally, while advisors are important to the dairy industry, little is known about their role in protocol development, something that is increasingly required for welfare assurance programs. Therefore, the third aim was to better understand the role of the advisor (i.e. veterinarian, researchers) in management practices; specifically, in the use and development of standard operating procedures. Lastly, the fourth aim was to better understand who farmers consult across animal care management practices in an effort to better understand social referents to dairy farmers.

Chapter 2: Challenges and opportunities for successful human resource management on dairy farms

2.1 Introduction

As dairy farms increase in size they become more complex (Sischo et al., 2019). Many dairy farms are structured as a business, with the farm manager taking on the role of human resource manager (Hagevoort et al., 2013) in addition to dealing with the day-to-day tasks of working with their animals. While there is variation in farmer management ability (Bewley et al., 2001), the nature of 'running the farm' now requires a set of skills beyond traditional knowledge of animal care.

Given the demanding nature of the occupation, farming can be associated with stress and anxiety (Jones-Bitton et al., 2020) and has one of the highest risks of suicide in any industry (for reviews see Fraser et al., 2005; Kolstrup et al., 2013). Farmers experiencing stress rarely seek mental health support (Cole & Bondy, 2019), and instead often search for practical advice for how to better manage their farms (Stanley-Clarke, 2019). The stress felt by farmers has been shown to be associated with the welfare of the animals in these systems; for example, for farmers in Norway there was a correlation between those who had higher levels of occupational well-being and lower stress, and animals that were experiencing better welfare (Hansen & Østerås, 2019). Farmers in the UK and Ireland viewed the needs of animals as greater than the needs of people in circumstances of farmer stress and fatigue (Tone & Irwin, 2019). Additionally, farmers in Finland stated that improvements in animal welfare were

directly linked to their own well-being, but did recognize that this was difficult to implement (Kauppinen et al., 2013). By understanding the unique subculture of farmers (Cole & Bondy, 2019) and viewing intensification of the dairy industry as a multi-dimensional problem, there is the potential to improve multiple aspects of the industry including animal welfare (Clay et al., 2019; Fraser, 2014).

Dairy industry organizations have an opportunity to assist farmers in a way that benefits farmers and their animals. Human resource management practices are used to ensure quality employee performance (Hagevoort et al., 2013) and training in this area of management has the potential to decrease employee turnover, increase profitability and lower production costs (Schuler & MacMillan, 1984), improving the livelihood of farmers and productivity of their businesses. Initiatives to accomplish these goals have emerged as the dairy industry has seen the need. For example, in Canada and the US online human resource guides have been developed for farmers (e.g. British Columbia (BC) Dairy Producers Human Resource Tool Kit, BC Dairy Association, n.d.; Farm Workforce Development manual, The National Dairy FARM program, 2019). While these manuals exist, it is not known whether these are an effective way to disseminate information to producers. Research into best practices and programs in the area of human resource management has increased in recent years; this research will be the focus of this review.

2.2 Objective of this review

Although there are numerous conceptions of animal welfare (Weary & Robbins, 2019), this review will use the framework developed by Fraser et al. (1997) that consists of three components: natural living (the animal's ability to perform natural behaviors), affective states (the emotional state of the animal) and biological functioning (the animal's health). Under this framework, an animal will achieve optimal welfare when all three of these components are maximized. While the discipline of animal welfare began with an animal-centric focus, understanding the complexity of animal management requires an understanding of the people who care for them (Fraser, 2014). Therefore, this field of study continues to incorporate other disciplines, including behavior, ethics, economics and sociology (Appleby, 2004), with the goal of understanding these complex animal systems. As described above, improving animal welfare is a multi-dimensional problem and one that can benefit from understanding and improving management practices on farm and farmer well-being.

The objective of this narrative review is to present the current literature in 5 areas of human resource management of a dairy farm: 1) professional accreditation and professional development, 2) extension activities, 3) the role of the advisor, 4) standard operating procedures and, 5) employee training. The topics of interest were chosen after reviewing the available literature on human resource management on dairy farms. Articles were included in this review if they addressed one of these 5 aspects and used quantitative or qualitative research methods.

2.3 The role of professional accreditation in the dairy industry

There are those who question whether farming is a profession (Brassley, 2005). According to Fraser (2014), a profession must include three main components: 1) provision of a service or product, 2) competence in a certain knowledge or skill and, 3) creation of public trust through respecting public interest and upholding societal expectation. As Fraser (2014) argued, a feasible model is needed that fosters skills and knowledge transfer for farmers and their workers, and that facilitates the transition of animal production into a profession. Farmers are not a uniform group and the degree of professionalism varies (Brassley, 2005). In the next section I discuss the model of professional accreditation and professional development in the dairy industry and other potential avenues of professionalization.

2.3.1 Professional accreditation and assurance programs

Professional accreditation is a mechanism for ensuring accountability, promotion of professional responsibility and quality assurance (de Paor, 2016). An increase in public awareness of animal agriculture has resulted in an increase in industry programs and guidelines (Lundmark et al., 2014; Mench, 2008). Accreditation systems are important to build public trust (e.g. charitable organizations; Bekkers, 2003), perhaps especially given the public's reaction to uncover investigations illustrating poor practices on some farms (Tiplady et al., 2013). The Dairy Farmers of Canada's ProAction initiative ("ProAction") is a required program for all Canadian dairy farms and was developed for consumer assurance with the vision of demonstrating *"responsible stewardship of their animals and the environment, sustainably producing high*

quality, safe and nutritious food for consumers" (Dairy Farmers of Canada, n.d.). Fraser (2006) divides animal welfare assurance programs into 5 types: 1) non-mandatory welfare codes and guidelines (e.g. Canada's National Farm Animal Care Council (NFACC)), 2) regulations (e.g. United Kingdom (UK)), 3) inter-governmental agreements (e.g. European Union (EU) Council Directives), 4) assurance programs of corporate customers and their associations (proAction), and 5) product differentiation and labelling programs. These programs can be resource-based (e.g. bedding type, stocking density), outcome-based (e.g. health, behavior parameters) or based on continual improvement (Main et al., 2014). The success of these programs is dependent upon stakeholder support, ease of implementation, enforceability and comprehensiveness of the standards (Fraser 2006).

There is no standardization in animal welfare accreditation programs (Main et al., 2014) and the resulting variation in standards is likely to cause confusion. However, evidence indicates that voluntary standards (i.e. ones that individuals or companies can choose to participate in) have higher rates of compliance than legislative standards (Clark et al., 2016) and can provide outcomes beyond legislative requirements for animal welfare (Lundmark et al., 2018). Additionally, when comparing 3 animal welfare assessment programs in California (Dairy Quality Assurance Center, Humane Farm Animal Care, University of California-Davis), Stull et al. (2005) found that while the rankings of farms participating in these programs varied, the 3 programs agreed regarding the bottom farms in the sample. This finding suggests that accreditation systems may be most effective in identifying farms that fail to provide adequate care for their animals. Although implementation of such standards may result in improved

animal welfare, Fraser (2014) argues that this is best accomplished if it is prompted by farmers rather than by outside stakeholders. For example, in the UK, 60% of dairy farmers participating in a producer-led program aimed at reducing antimicrobial use on farm reported that they were willing to change practices on their farms (van Dijk et al., 2017). However, another study reported that UK farmers perceived compulsory regulations and government oversight as necessary to enforce the adoption of such agreements (Heffernan et al., 2008). These examples demonstrate the nuanced views between stakeholders regarding farmer-led and governmentled initiatives.

Some form of audit is needed to demonstrate compliance. Stull et al. (2005) argued that third party audits were needed to avoid variation in individual assessments, but for these to be credible (to farmers) the farmers must trust the expertise of the auditors. One study found that organic dairy farmers in the northeastern United States were concerned about the knowledge and skill level of local organic certifiers (Pereira et al., 2013). Similarly, Croyle et al. (2019) found that farmers in Ontario, Canada doubted that assessors had adequate knowledge given their perceived lack of training. There is little research into the perspectives of farmers on this topic and understanding their views on accreditation programs could be important for compliance.

2.3.2 Professional development and education

Knowledge transfer from one generation to another is an important method of learning in agriculture (Wójcik et al., 2019), but more formalized educational programs are gaining traction (Chase et al., 2006). Higher education in agriculture is a way for farmers to be taken

more seriously and gain more responsibility within their own farm (Deming et al., 2019). In a study of Irish farmers, 68% of participants had received some form of formal agricultural training (Dillon et al., 2016). In a survey of Australian dairy farmers, Beggs et al. (2015) found that dairy farms with a larger herd size were more likely to have employees with formal education or industry training than smaller farms. Deming et al. (2019) reported that participation in a dairy farm management program increased managerial skills in financial and personnel resources, leadership, communication and decision-making on farm. In a sample of US calf-care personnel, 70% of owners reported that they had attended college, compared to only 37% of calf managers (Sischo et al., 2019). Only 13% of dairy farm employees (n=1,432) from 4 US states reported having some form of higher education (Rodriguez et al. 2018). Therefore, while training within the agricultural sector is increasing for those in managerial positions, variation remains across job titles on the farm. There is evidence that farmers are now actively seeking additional training (e.g. Johne's disease; Sorge et al., 2010). On-going education can be accomplished via extension activities, a topic that will be discussed further in the next section.

2.4 Extension activities in the dairy industry

Assessments of extension activities in the dairy industry have been conducted in many countries including Bangladesh (Uddin et al., 2017), Tasmania (Hall et al., 2019), and Ireland (Lapple & Hennessy, 2015). Extension activities are one of the main missions of US land-grant universities and are valued by some farmers (Chase et al., 2006). For instance, in Kentucky, 25%

of participant farmers indicated that they attended off-farm extension activities at least once per year (Russell & Bewley, 2011). Canada does not have a similar model of university-based extension, and has instead adopted more of a privatized extension model (Milburn et al., 2010).

Some dairy extension activities are known to be valuable to farmers (Hall et al., 2019). Activities such as participatory discussion groups were associated with decreased somatic cell count (SCC) at the herd level (Dillon et al., 2016) and receiving information from an extension officer was associated with lower bulk tank SCC (Delong et al., 2017). Similarly, discussions in Danish "stable schools" allowed for farmers to work collectively on a problem while identifying their own farm specific goals (Vaarst et al., 2007b). Discussion groups can improve farm efficiency (Lapple & Hennessy, 2015) and farmers' confidence in managing their business (Hall et al., 2019). Vaarst et al. (2007a) contacted participants of a Ugandan farmer training program 2 years after the study ended and found that groups still met at least once a month.

There appears to be some merit in providing opportunities for discussion on matters relating to farm management. Discussions incorporated at the farm level with weekly employee meetings or meetings with farm advisors may provide benefits, but to our knowledge this has not been studied.

The trend toward greater use of online communication has changed how farmers access information (Garforth 2015), but farmers do not always perceive online information as helpful. In Canada, Ritter et al. (2015) found that emails, along with local industry meetings, were least used by farmers when seeking information on Johne's disease prevention. Similarly, Russell and Bewley (2011) reported that, for Kentucky dairy farmers, printed forms of communication (i.e.

newsletters, magazines) were a more effective information delivery method than electronic sources (i.e. websites, webinars, podcasts). Chapman et al. (2009) found that print media, equipment dealers, public events and farm consultants were all important sources of information for disseminating farm safety practices. North American producers also appear to rely on industry news sources such as Hoard's Dairyman and Progressive Dairyman (both available in print and online) for information on management topics such as stockmanship, farm safety and employee training (Wilmes & Swenson, 2019). However, provision of information is only one aspect of extension efforts. Workshops consisting of in-class presentations, hands-on demonstrations and group discussions have been shown to be beneficial for transferring skills related to calving management (Schuenemann et al., 2013). Even though technology can be an important way of disseminating information, it appears that dairy farmers vary in their ability to access this information. Russell and Bewley (2011) found that time of year was an important factor for educational meetings or seminar attendance, with the best times being those that avoided crop related conflicts (e.g. November to March in Kentucky). To conclude, both format and timing are both important factors when designing extension activities for farmers.

Extension activities have limitations, particularly since they do not appear to reach all farmers. Lapple and Hennessy (2015) found that early participators in an extension program were younger, had larger herds and were more educated than non-participants. Hall et al. (2019) found that 20% of participant dairy farmers from Tasmania believed that extension activities were developed for new or inexperienced farmers and were repetitive over time.

Additionally, some work indicates that caution is warranted when developing activities; for example, Hall et al. (2019) found that farmers were less likely to return to subsequent activities if previous ones were thought to be irrelevant. Given that farmers have varying needs, a participatory approach to extension may be beneficial in allowing for topics to be identified by farmers, increasing the likelihood that they consider the programs relevant.

2.5 The role of the advisor

Advisors are an important aspect of any business. Farmer-advisor dialogue is needed to foster shared understanding and build new knowledge (Duval et al., 2018). Advisors in the dairy industry may need training in communication (Bard et al., 2017a), specifically in how to discuss farm management practices with farmers. For example, in Australia, a human resource management diploma program created for farm advisors and graduates changed the way they viewed their role in the industry (Nettle et al., 2018). The traditional family dairy farm adds an additional complexity compared to other industries. In this section, I outline what is known about veterinarians and other advisors to dairy farmers and how advising differs in the context of the family farm.

2.5.1 The veterinarian as an advisor

Veterinarians are trusted advisors for dairy farmers (Stanley-Clarke 2019; Sumner et al., 2019) and farmers respect their veterinarians (Golding et al., 2019). A trusted advisor has an explicit and implicit level of trust from the decision maker (Strike, 2013) and these individuals

are believed to provide the highest quality information (Neu et al., 2011). In the dairy industry, the length of the relationship between farmers and their advisors appears to be an important factor (Stanley-Clarke, 2019). Additionally, the existence of an established relationship increased the credibility of the advisor in the eyes of the farmer. For instance, Croyle et al. (2019) found that farmers in Ontario were more likely to take advice regarding animal welfare from someone they trusted, such as their veterinarian, compared to a government official or dairy researcher. Svensson et al. (2019) found that adherence to veterinary advice was dependent on trust, feasibility and priorities of the farmer. Further research should explore the factors that influence advisor relationships in an effort to create solid advisee-advisor partnerships.

Veterinarians have a prominent role on many farms, providing advice on animal health (Swinkels et al., 2015), reproduction (Garforth et al., 2006), developing treatment protocols (Raymond et al., 2006), animal welfare (Croyle et al., 2019), and antimicrobial stewardship (van Dijk et al., 2017), although individual farmers vary in their intention to contact their veterinarian for advice (e.g. regarding mastitis; Espetvedt et al., 2013). Farmers expect that veterinarians will point out animal welfare issues to which they have become "barn blind" (i.e. *"they do not always see something as abnormal because they become accustomed to seeing it every day"*; Croyle et al. 2019, p. 7390). However, the veterinary-client model can be paternalistic (Bard et al., 2017a), and there may be important gaps between what veterinarians perceive as important to farmers and what is actually important to them. For example, when trying to understand farmer values around herd health management programs, Kristensen &
Enevoldsen (2008) found that veterinarians believed farmers valued production and financial performance above others aspects of management, a position that was not consistent with their actual values.

Farmers and veterinarians perceive the role of the veterinarian differently. For example, veterinarians view their role in management of their client's farm (i.e. optimizing milk production, decreasing economic costs) as more prominent than perceived by the farmers (Hall and Wapenaar 2012). Additionally, while farmers appear to trust their veterinarians, they do not feel that their veterinarian has a role in management decisions (e.g. antimicrobial stewardship; Golding et al., 2019), disease prevention practices (Svensson et al., 2018) or they are unwilling to pay for certain services (Duval et al., 2018; Friedman et al., 2007; Svensson et al., 2018). While a sample of Alberta farmers appeared to be satisfied with veterinary services, they were less satisfied with how veterinarians discussed costs related to procedures (Ritter et al. 2019). Santman-Berends et al. (2014) found that some Dutch farmers did not talk to their veterinarian about calf mortality because it did not occur to them to do so. Furthermore, farmers in Denmark believed that veterinarians lacked general knowledge in farm management (Kristensen & Enevoldsen, 2008) and showed poor ability to work well with other advisors and farm staff (Svensson et al., 2018). These examples speak to the limitations of the veterinarians' role in different areas of farm management.

2.5.2 Other advisors in the dairy industry

There is little research on the role of advisors other than veterinarians. Bruijnis et al. (2013) found that in addition to veterinarians, hoof trimmers and feed advisors have a role in delivering information and motivating farmers regarding foot health management. Similarly, Swinkels et al. (2015) found that nutritionists, other dairy farmers, and other food animalproducing farmers were positive social referents for dairy farmers; in contrast, government bodies were considered negative referents in regards to antibiotic use. Moreover, pharmaceutical representatives were not trusted as sources of information regarding antibiotic use (Friedman et al., 2007). In addition to veterinarians, other farmers and milk cooperatives are also viewed as important sources of information regarding mastitis treatment (Kayitsinga et al., 2017). Similarly, Santman-Berends et al. (2014) reported that farmers believed that they had a good relationship with their feed supplier. In the Netherlands over half of the participants in a study undertaken by Derks et al. (2012) discussed nutrition related matters with only the veterinarian or not at all, suggesting that veterinarians may be trusted over other advisors (e.g. nutritionists) that may have more relevant training. There is some evidence that dairy farmers believe that farm consultants do not work well together (Croyle et al., 2019). Finally, Garforth (2011) found that other farmers had little impact on participants with respect to disease risk management. Future research is needed to identify the positive social referents to dairy farmers, and how these vary depending on the issue at hand.

2.5.3 Advising in the context of a family business

Dairy farms have been, and largely continue to be, family run operations passed down to family members from one generation to the next (Deming et al., 2019; Villa, 1999); as Brassley (2005) describes, "*most farmers... appear to be selected by accident of birth*" (p. 245). This system creates challenges specific to working with family. For example, family farms do not offer the traditional home and work-life boundaries that exist with other jobs (Deming et al., 2019). Power struggles can exist, making business decisions complex, particularly in the case of intergenerational conflicts (e.g. parent and child) or gender influenced conflicts (Glover, 2014). Additionally, conflict can arise among siblings, particularly in the context of succession and transfer of the family farm (Taylor & Norris, 2000), including resentment from siblings who will not become successors (Cassidy & Mcgrath, 2014). Deming et al. (2019) found that even when family members worked full-time on the farm they were not viewed as employees and job titles or responsibilities were not always clear. Role ambiguity is a potential source of conflict on family farms (Ballard-Reisch & Weigel, 1991).

The unique dynamics of family dairy farm advising has not been explored to our knowledge. In other contexts, it is clear that there are complexities advisors must navigate regarding family businesses and their individual members (see review by Strike et al., 2018). For example, trusted advisors must create an environment that allows individual family members to learn and work together (Neu et al., 2011).

2.6 Standard operating procedures

Protocol development is a necessary component of running a business, as these records act as safeguards from an internal and regulatory perspective (Gough & Hamrell, 2009). Standard operating procedures (SOP) are a set of steps that show how a company operates (Gough & Hamrell, 2009). When followed, SOPs allow for uniformity across personnel in any given task (Amare, 2012), reduce errors, and can be used as training tools (Barbe et al., 2016). SOPs should be specific enough that they are clear and understandable to employees yet allow for the flexibility that is needed in day-to-day operations (Gough & Hamrell, 2009). SOPs are increasingly required for animal welfare assurance programs in the dairy industry (see Dairy Farmers of Canada's proAction initiative (Dairy Farmers of Canada, n.d.) and The National Dairy Farm Program in the United States (The National Dairy FARM program, 2019)); however, while research has shown that many farmers believe that assurance is an important goal of SOPs (Bell et al., 2006), little is known about how SOPs are used or whether they are effective at achieving the desired outcome.

While written protocols are viewed as important for specific topics (e.g. antibiotic use; Friedman et al. 2007, Kayitsinga et al. 2017) farm record keeping is sometimes poor (Ellingsen et al., 2012). Additionally, research has found that protocols for commonly performed procedures (i.e. dehorning, hoof trimming, euthanasia) are often not written down (Stull et al., 2005). Hesse et al. (2017) completed a survey of 248 German dairy farms to assess use and development of SOPs. While 82% of participants indicated they had SOPs, only 54% stated that these were available in writing. Lack of time and difficulty in creating SOPs were important

factors in whether these were present on farms (Hesse et al., 2017). Raymond et al. (2006) found that while the majority of Washington State dairy producers believed that written protocols would decrease errors and production losses, only 1/3 of participants had protocols for common medical conditions. Additionally, Bell et al. (2006) found that while 29% of farmers believed that protocols for lameness and mastitis were useful for new staff, many of these farmers disliked the additional paperwork. Research regarding SOPs on dairy farms is limited and there does not seem to be consensus on their use. However, given that SOPs are an important tool for assurance programs (Manghani, 2011), further research should explore what makes SOPs work in the context of a dairy farm.

SOPs can be developed in many ways with different stakeholders involved in this process. Boersema et al. (2013) found that pre-set protocols regarding young stock rearing were provided to farmers by 10% of a sample of veterinarians in the Netherlands. While there is relatively little in the dairy science specific literature in regards to who is involved in SOP development, literature from other contexts speaks to the importance of involving multiple stakeholders. For example, SOPs should be reviewed by someone outside of the writing process and audited periodically to ensure that the procedure is performed as written (Barbe et al., 2016). Additionally, SOPs should act as living documents and updated when practices change (Ashbrook, 2014), ensuring that they reflect current practice (Gough & Hamrell, 2009). Unfortunately, Stull et al. (2005) found that 8 out 10 participating dairies in California did not complete annual reviews of their protocols with on-farm personnel. Further research is

warranted on who is involved in writing SOPs and how this influences the effectiveness of these documents.

2.7 Training of personnel and development of training materials

Employees are an important part of a dairy farm, especially as farm size grows (Durst et al., 2018). Employees can be hired for specialized tasks (e.g. milking) or diverse tasks (Duarte Malanski et al., 2017) and hiring generalist employees can allow for cross-training (Schuler & MacMillan, 1984). However, farmers often lack the time or skill to recruit and select employees which can lead to hiring employees with an inadequate skillset (Bitsch et al., 2006).

Farming has high rates of fatal and non-fatal injuries (Douphrate et al., 2009), and underreporting of injuries is common (Douphrate et al., 2013). Farmers are concerned with worker safety and training, and viewed safe handling techniques as a priority, but this training is not always delivered (Wilmes & Swenson, 2019); in Colorado and Wisconsin, 31% (Menger-Ogle et al., 2019) and 67% (Juárez-Carrillo et al., 2017) of participating dairy farm workers, respectively, did not receive health or safety training at their current place of employment. In one study, 11% of employees (in Michigan, New York, Pennsylvania, Connecticut; Durst et al. 2018) and 19% of employees in another (in Colorado; Román-Muñiz et al. 2006) did not receive training when first hired on farm. Erskine et al. (2015) found that 49% of employees on 12 farms in Michigan had not received education regarding mastitis control practices. Lack of training may be a barrier to improving practices on farm (e.g. implementing recommended

milking protocols; Belage et al. 2019). Part of this challenge may be a result of farmers lacking training in how to train new employees (Hagevoort et al., 2013; Wilmes & Swenson, 2019).

To train employees, employers need to be able to clearly communicate farm goals and associated tasks, something that is not always done effectively (Durst et al., 2018). The inability to retain quality employees could result in the need to revert to family labor, particularly on small farms, slowing farm expansion (Schewe, 2015). While training is sometimes neglected by farmers due to lack of time (Bitsch et al., 2006) this can have consequences for the farmer down the line; for example, low stress handling can improve animal health, welfare and productivity (Hemsworth, 2003).

2.7.1 Training dairy employees

Employees appreciate understanding the importance of why they do their tasks in addition to how to do them (Erskine et al., 2015). Information needs to be simple and accessible to employees with varying levels of education (Friedman et al., 2007). The format of the educational material also appears to matter; laminated posters, flowcharts hung in the barn, videos and educational seminars were all viewed as good tools for information regarding antibiotic use (Friedman et al., 2007). Current methods of training vary, though a common model is shadowing experienced workers (Bitsch et al., 2006; Wilmes & Swenson, 2019). This method can also result in the transmission of 'bad habits' (Wilmes & Swenson, 2019; Bitsch et al., 2006).

Different techniques can aid in the acquisition of new skills, including the use of technology. For example, (Rodriguez et al. 2018) developed safety training videos that were shown on tablets to dairy farm employees; 90% of employees found the device easy to use and 95% of these participants liked this mode of learning. Most importantly, knowledge of farm safety practices improved when comparing test scores before and after the use of these videos, and 98% of participants reported that they took steps to reduce safety risks in the workplace for both themselves and their coworkers (Rodriguez et al. 2018). When training dairy producers to administer a nerve block for disbudding of calves, Winder et al. (2018) found that there was no difference in success for online training modules, hands-on training or a combination of the two. That said, participants in the hands-on treatment had higher confidence in their ability to perform the procedure compared to online training. Vasseur et al. (2013) found that training using a combination of photographs, live observations and discussion resulted in increased agreement between assessors of body condition scores in dairy cows. Arthur et al. (1997) reported that dyadic training protocols (training in pairs) was more successful in skill acquisition than training employees individually.

Employee turnover continues to be a challenge in the dairy industry with one study finding annual turnover from 4 US states ranging from 8 to 144% (Durst et al., 2018). Unlike retail or manufacturing sectors, dairy farms cannot temporarily downsize operations in response to employee shortages and employee turnover is expensive and disrupts routine of the farm (Billikopf & González, 2012). Long shifts in the milking parlor can lead to low job satisfaction and increased risk of turnover (Bitsch et al., 2006). Additionally, (Billikopf &

González, 2012) found that concerns about compensation and inadequacies of benefits were the top reasons for California dairy employees leaving their positions. From the broader literature there are examples of companies that provide incentives for employees to stay; for example, a compensation system tied to company profits resulted in a turnover rate of less than 1% (Schuler & MacMillan, 1984). In the dairy industry, incentive programs could include increased pay for calf weight gain or lower calf mortality or morbidity. Further research should explore creative solutions and their influence on employee turnover.

2.7.2 Training and language

With increased migrant labor, language barriers for farm workers are important to understand and accommodate (Wilmes & Swenson, 2019). The US dairy industry is highly dependent on foreign labor (Jenkins et al., 2009) with many workers having little dairy experience (Hagevoort et al., 2013). In a survey of calf care personnel in the US, Sischo et al. (2019) found that as the number of calves reared increased, the proportion of calf care employees that were comfortable speaking English decreased. Dual language training resources have been cited as important for farm practices such as antibiotic use (Friedman et al., 2007). Language barriers are also a known source of stress for dairy employees (Griffin et al., 2019).

Diverse cultural and language backgrounds of employees need not be a problem; a survey by Delong et al. (2017) found that bulk tank somatic cell counts (BTSCC) were lower when dairy farm employees spoke a different language to that of the farms' primary decision maker. Additionally, training programs that are tailored to employees with different language

requirements can aid in employee retention. For example, hands-on technical workshops (Chase et al., 2006) and dual language "pocket dictionaries" (Raymond et al., 2006) have been shown to be beneficial for Spanish speaking workers in the US dairy industry. Rovai et al. (2016) found that structured topic-based weekly lessons in Spanish improved worker confidence in completing their jobs, working relationships, and workplace attitude. Veterinarians (Erskine et al., 2015) and farm managers (Bitsch et al., 2006) recognize the importance of learning more about the cultural needs of their employees to improve workplace relationships. In conclusion, there can be value in strengthening language and culturally specific training programs in regions reliant on migrant labor.

2.8 Conclusion

I provided a narrative review of the literature in five topics, identifying areas that warrant further investigation. My goal was not to generalize the findings presented, but instead to summarize and contextualize the available literature. While there has been increasing interest in the human resource management of dairy farms in recent years, there are numerous topics that require further investigation. From the topics discussed in this review, some potential areas of focus are 1) offering professional development or extension programs that better fit current management needs of a specific region, 2) creating opportunities for open dialogue with farm advisors and strengthening existing advisor-advisee relationships, 3) assisting in the development of protocols and training programs that are tailored to specific

farms. Research in this field will add to the human resource literature from a new disciplinary lens and assist dairy farmers in improving the management of their farms.

While a few papers included in this review made use of participatory methods (e.g. Vaarst et al., 2007a; van Dijk et al., 2017), the majority did not and I find considerable merit in the broader use of these methods in future research to increase the possibility of translating research into practice (Macaulay et al., 2011). Participatory research methods ask targeted questions, thereby leading to higher quality data and improvements in dissemination (Flicker, 2008). Ultimately, the research should be to help improve the lives of farmers and the animals under their care: outcomes for the participants should be just as valued as outcomes for the researchers.

By supporting farmers, there is the potential for increased farm success, employee retention and improved quality of life for the people who live on these farms. Additionally, there is some evidence of a link between farmer satisfaction and animal welfare; by improving the lives of farmers, there is the likelihood of improved quality of life for their animals as well. Moreover, industry stakeholders, including researchers and government, need to understand their role in realizing this goal. Keeping in mind that the implementation of these programs will always be more successful if they are producer-led or done with the help of a trusted advisor (i.e. veterinarian).

Chapter 3: Identifying barriers to successful dairy cow transition management

3.1 Introduction

The transition period is generally defined in the academic and veterinary literature as three weeks before to three weeks after a cow gives birth to a calf (Drackley, 1999; Grummer, 1995; Mulligan & Doherty, 2008). During this period the cow experiences numerous environmental changes, including diet changes and regroupings, and physiological changes associated with parturition and the onset of lactation (Cook & Nordlund, 2004; Grummer, 1995). Unfortunately, many cows become sick in the month after calving (Leblanc, 2010). Researchers working in nutrition, immunology, physiology, and veterinary medicine have done the majority of the research targeted at reducing illness (Mulligan et al., 2006; Overton & Waldron, 2004). Recently studies have focused on the behavior of these animals and how it changes in response to illness (Itle et al., 2015; Proudfoot et al., 2009). Similarly, there has been an increase in literature targeted at practitioners on how best to improve transition period management practices (Atkinson, 2016).

Some work has surveyed management practices associated with the transition period. For example, Heuwieser et al. (2010) surveyed 429 dairy farms in Germany to better understand management practices for transition cows, including how often cows were monitored and whether they had a designated fresh pen. Robichaud et al. (2016) looked at calving management practices on Canadian farms and found that group calving was most common in freestall barns and that cows spent on average 14.5 days in the calving area. This

previous survey data provides an understanding of what farmers do, but not why they do it. Qualitative methods such as interviews can be used to understand values, attitudes or motivations of participants (Berkwits & Inui, 1998). To our knowledge, no stakeholder research has focused on the transition period from a qualitative perspective.

Understanding this problem from a new perspective may help to close the gap between research and practice; a problem not unique to transition cow management or indeed agriculture. Researchers working in public health (see review by Glasgow & Emmons 2007) and social work (Pettus-Davis et al. 2011) have developed tools and strategies to help practitioners' close the gap between research and practice. Focusing on agriculture, Peden et al. (2018) reviewed the literature on pig aggression and evidence of uptake of best practices in the industry (as measured by industry magazines and other gray literature); they attributed the minimal uptake of these practices to 1) the problem being viewed as low priority, 2) the perceived impracticality of new practices, 3) ineffective communication to the farming community, and 4) economic factors. It is unclear what is causing this research-to-practice gap in transition period management.

One approach to the problem is to identify barriers preventing improvement. This approach has been used in other industries to understand barriers to adoption (for an example from the medical field see review by Kruse et al., 2016). In agriculture, barriers to adoption of more sustainable practices have been identified as information dissemination, economics, social factors, farmers' characteristics and infrastructure conditions (Rodriguez et al., 2008). This approach also has been used to help understand barriers to implementing environmentally

friendly practices in the dairy supply chain (Ghadge et al., 2017) and at the farm level to understand barriers to reducing lameness on dairy farms (Leach et al., 2013); both studies employed surveys as the primary method of data collection. Turner et al. (2017) put forward a similar concept of 'boundaries to change' in a study that explored beef and sheep farmers approach to change. This concept "*describe[s] the way management, infrastructure, land, enterprises, labor and debt factors can constrain change rather than acting as an obstacle or barrier to any change taking place*"". These authors go on to explain that some of these boundaries may be firm, making it unlikely for change to occur, whereas other boundaries are more flexible. The degree to which boundaries are firm or flexible also varied among individual farmers. From the existing literature, it is unknown what barriers or boundaries to improvement exist in transition period management.

This study sought to describe barriers to improved transition period management from the perspective of farmers and veterinarians in the lower Fraser Valley region, using individual and group interviews paired with photo elicitation. Photo elicitation was used to add depth to interviews and to facilitate collaboration between the interviewer and participant as they discussed the meaning of the photo (Harper, 2002).

3.2 Material and Methods

This research was approved by the University of British Columbia's Behavioural Research Ethics Board (H17-00182).

3.2.1 Participants

This qualitative study used interviews with photo elicitation to understand the views of farmers (n=11; 10 men and 1 woman) and veterinarians (n=8; 6 men and 2 women). Purposive sampling (Given, 2008) was used to contact the four veterinary clinics in the region, with three clinics agreeing to participate. To recruit farmers, each veterinary clinic forwarded study information to their clients (i.e. chain-referral sampling; Penrod et al. 2003). In addition, farmers known to the authors through the dairy farm community were contacted. Farmers that participated in the study were owners and/or herd managers within the lower Fraser Valley region of British Columbia. All farmer participants had freestall facilities and milked on average 250 cows (range 80 - 500). Participants were recruited until saturation (i.e. the point at which new ideas were no longer heard; Guest et al., 2006) was reached in relation to the study objectives.

3.2.2 Interviews

A semi-structured interview guide (see Appendix A) was created and pilot tested with a separate group of veterinarians and farmers; these interviews were not included in the analyzed data as they were not practicing in the region of interest. A semi-structured interview guide was chosen to allow for the participants' responses to guide the direction of the conversation. The spirit of these question was adhered to, but wording was altered depending on context. Participants were contacted over the phone and/or email and were told the goals of the study. On the day of the interview, all participants signed a consent form before

interviews began and were offered a copy of the consent form to keep for their records. Interviews were conducted between April and October 2017 and averaged 25 min in length (13-50 min range), not including warm up questions (e.g. about their farm, business and other small-talk to make the participants comfortable with the interviewer, often provided during an impromptu farm tour). Warm up questions were included to ensure that participants felt comfortable with the researcher. Veterinary interviews (8 individual interviews) all took place in the veterinarians' office. Due to veterinarian's unpredictable schedules, scheduled interviews were sometimes cut short due to emergency calls or client needs. While I used the time allotted to the best of my ability, this could be considered a limitation. Farmer interviews (6 individual interviews, 2 group interviews with 2 and 3 participants at their request and only when there was more than one decision maker on the farm) took place in the participant's home or barn. The location of the interview was the choice of the participant to ensure that they were in an environment where they were comfortable. Active listening techniques such as paraphrasing participants' words and reflecting back, revisiting earlier comments from participants for clarity and revisiting inconsistencies in their stories or discussion were all used to help clarify participant perspectives throughout the interviews.

3.2.3 Photo elicitation

Farmers and veterinarians were asked to take a photo of something on their own or a clients' farm that they perceived as positive for transition cow welfare or something they were proud of in their transition program. The conversation surrounding the photo and the photos

themselves were included for analysis. In some cases, farmers gave a tour of the farm and I took the photo of the area that the farmer indicated they were proud of (see Appendix B for examples of photos taken).

3.2.4 Analysis

All interviews were transcribed by a professional transcription service and compared to the audio recording for accuracy. Transcripts were provided to participants to ensure that their thoughts were expressed accurately. Transcripts and photos were coded using NVivo (QSR International; Burlington, MA) qualitative data analysis software using open coding in which inductive codes were created from the dataset (Marshall & Rossman, 2016). A codebook was then developed that grouped codes into larger themes (Macqueen et al., 1998). Using this codebook, myself and another trained researcher coded a subset of the interviews, any disagreements were discussed and the codebook was changed. New transcripts were coded by both researchers and this process repeated in an iterative way until agreement was reached and both researchers were satisfied with the final codebook. Once no further changes were made to the codebook, I recoded all of the transcripts. Data were not analyzed separately by stakeholder group (i.e. farmers, veterinarians), but the quotes provided below are identified as from veterinarian or farmer participants (e.g. V1 and F1, respectively). Quotes are provided as examples from the data and were modified for length and clarity when needed.

3.3 Results

The results of this study present the complexities of managing the transition period from the perspective of veterinarians and farmers in this study. Participants generally felt that transition management was going well and that the health of dairy cows was gradually improving in the region. However, there were aspects of farm management that emerged as barriers to improving transition management. Four themes emerged (see Figure 3.1): 1) definition of transition period and sources of information that aid in improvement, 2) farmer attitude toward health and welfare of transition cows, 3) identified limiting factors influencing transition management, and 4) veterinarian involvement in the transition period. Figure 3.1 Thematic map of barriers to improved transition management with themes presented in blue, subsequent sub-themes presented in green.



3.3.1 Theme 1: Definition of transition period and sources of information that aid in improvement

3.3.1.1 Defining the transition period

There was variation in how 'transition period' was defined by participants. Veterinarians consistently perceived this time to be three weeks before to three weeks after calving. However, as one veterinarian explained, this definition has changed over time: "*it used to be we'd talk about transition as being calving day, and then it got expanded to 21 days before calving...then 21 days post-calving...now, I would think of it even as the far offs or the 45 to 60 days pre-calving through the fresh group calving, then 21 days following*" (V1). For farmers, there was more variation in how the 'transition period' was defined, and in many instances, participants defined it based on their management. For example, one participant defined transition as *"two to three weeks pre-calving when they go into my closeup pen. I would do longer, but I'm a little tight on space. And they leave the fresh pen at four days fresh"* (F1). One participant defined this as any transition to a new group stating that *"it's all the group changes in-between. Moving them into the dry cows they usually fight for a few days. Then moving them onto the pack, they usually ride around"* (F11).

3.3.1.2 Sources of information

Sources of information such as conferences, websites and data from programs such as Dairy Comp were viewed as motivating management tools on farm. For example, farmers

reported using milk production data to track production abnormalities (i.e. drop in milk) that could serve as an alert to monitor the cow more closely. Data were also used to track herd disease statistics over time which were then discussed with the veterinarian during herd health visits.

Benchmarking, that helps farmers compare their performance with that of their peers, was generally seen as motivating, although some participants felt that could also be a barrier. For example, when discussing benchmarks performed by the veterinary clinic for clients one veterinarian explained: "there have been a couple of clients that I don't even show them their results, because I can't figure out how I'm going to use this in a positive way. So, I just don't show them" (V3).

Another important source of information identified was scientific research, and this was viewed as both a barrier and a motivator. Some participants incorporated research findings when making management or facility design decisions. However, other participants felt that inconsistencies between studies made these difficult to interpret. When describing an expansion to their facility one farmer stated: *"we're trying to do it according to all these studies, but then we do it all, then another study comes out saying that was all wrong."* (F2).

3.3.2 Theme 2: Farmer attitude toward health and welfare of transition cows

Participants discussed the importance of attitude toward transition cow management. For example, one veterinarian explained: *"I think it's just the ones that do well are the ones that have that drive to excel and to do well. There's some farmers that always think, "Well, that's*

good enough," and that's probably doesn't make a good farmer" (V3). Underlying these attitudes towards management was a sense of pride in taking care of their farm as "there's pride in the work. I have clients that they don't want to see a sick cow. Even if it costs them money or if it's less profitable, they're going to treat the herd better because they take pride in how the cow looks" (V1). Along with pride, the transfer of attitudes from one generation to the next was noticed by participants. For example, one veterinarian explained:

"There is this group of young farmers that still have been—I shouldn't say brainwashed—but they learned it all from their fathers, but [others] have gone away, worked off the farm, a few of our young farmers have gone to New Zealand or Australia to work for a period of time so that gives them a chance to see and... that gets them a chance to talk to other young farmers and ... put a different twist on what the previous generation did" (V8).

According to participants, transition period success or failure was largely dependent on style of management. Management styles that emerged from this study were proactive, complacent, and reactive and were dependent on the farmers' individual attitudes and personal characteristics.

The proactive management style included an element of long-term thinking as farmers were planning for the future or voicing what they hoped to achieve. For example, one participant explained: "we always try and keep on the cutting edge of things in terms of how to monitor our animals, and be more preventative as opposed to treating problems as they come" (F4). This theme was also echoed by a veterinarian: "farms that are taken over by younger,

more progressive generation, [are] thinking more and more to how do we prevent disease, not just fix problem stuff" (V4).

Complacent management reflected a degree of contentment with the current status of their transition cows and these farmers typically did not plan to make changes. In the words of one veterinarian: *"there are some farmers that always think, "Well, that's good enough"* (V3). There was also the feeling of *"it's not broke, don't fix it"* (V6).

The reactive management style was one in which changes or decisions were made only once problems arose. For example, when describing monitoring of disease incidence, one farmer stated: *"if there's a bunch of something all of a sudden, then we'll look at it. But, for the most part we don't actually look at it too much"* (F11).

Underlying these management styles were the reasons that farmers have for making changes in their transition cow program. Veterinarians felt that understanding these reasons helped them communicate with their clients. For example, one respondent suggested that economic impact was the key factor to discuss with one of their clients: "putting an economic spin on that, we can say to them, when we do this, this is the value we receive from it" (V7).

3.3.3 Theme 3: Factors influencing transition management

3.3.3.1 Stocking density

Farmer and veterinarian participants viewed stocking density during the transition period as a key aspect of transition cow management and this was often discussed in relation to

the limitations of the facilities. Some participants refused to overstock their transition pen as they noticed detrimental effects on the cows. For example, one farm was proud of the fact that they housed all fresh cows at a stocking density of 70% for at least 2 weeks before moving them into the main milking herd. The following interaction between two farmers illustrates how they viewed the value of understocking for the purpose of monitoring fresh cows:

F3: Most people don't [understock] because [they see this as] a waste of space. How many milk cows could you put—[into the pen]?

F2: You could put 100 in there.

F3: Yeah, you're supposed to put 100 cows. Where we would put a maximum of 70 because we are understocking this part of the barn. Other guys [might say] "oh, it's a waste of space…" Look, I don't know how these guys do it because you see this cow, she calves, three to four days later she taken to the herd. How you are you going to look for her? How are you going to find her again?

In contrast, some farmers favored overstocking as they viewed this as a way to milk more cows. This was specifically related to increased quota allotments with two farmers stating the number of cows they have in a 75 cow pen:

"F7: Eighty's too much, but I mean, with the quota and stuff, we've managed to --

F8: We're pretty crowded right now.

F7: It's crowded, but we-yeah, we-yeah, we-

F8: Well, I wouldn't say crowded. We're full. (Laughs). Yeah, they've given us allotments of quota this year. Like, 15 percent so far this year."

When discussing this extrinsic barrier, one veterinarian described perceived risks associated with this approach: *"if a barn is full and now we want to make more milk, the poorly managed farms will try to do that by jamming a few more cows in there. Now they're crowded. You could argue you'll make a little bit more milk for short term, but then you're going to have really poor efficiency, because now ... the bottle neck will become cow comfort"* (V1).

There was also some disagreement among farmers on what was considered overstocked, particularly when looking at availability of different resources such as the feeding space or lying stalls per cow. For example, farmers from one farm viewed their pen as full, but not overstocked, despite providing insufficient feeding spaces for all cows to feed at once.

3.3.3.2 Nutrition management

Nutrition management was viewed as one of the most important aspects of managing the transition period and a crucial preventative measure for avoiding transition period diseases such as ketosis. For example, one veterinarian stated: *"if you've got your nutrition right—you still need to manage them properly- it's huge, because LDAs [left -displaced abomasum] and ketosis are really nutritional diseases"* (V3). Similarly, participants attributed changes in health of transition cows to dietary problems and often sought the advice of their nutritionist or veterinarian to help solve this sort of problem.

Nutrition management was also viewed as a challenge for some farmers, including mixing specific rations for different periods. For example, as one veterinarian explained "to make a ration right—let's say you're a small farm and you've got five close-up cows. Well, there

is an ideal ration...But if you have five cows, how can you make a ration that's just right just for those five cows? It might mean that you need some specific inventory, but what if you run out of that hay because of what the weather was doing last summer? It can be a real challenge on a small farm." (V1). This challenge was thought to result in some cows getting a diet that was deemed "too good for them" (F8; when discussing dry cows) or not good enough. Participants also felt that it was important both to create the correct ration and to ensure that the cows consumed this ration; the latter was thought to be affected by management practices and aspects of the cow's physical environment. For example, "if you are feeding a low energy high straw ration and you don't have enough water space, then the cows will drop in intake, because they're thirsty. They need that water to get that straw and everything digested. So, if you don't have that, then you're going to affect your intakes. And if your intakes are low, your transition cow issues go up" (V5).

Nutritionists were viewed as important stakeholders in transition management by both veterinarians and farmers. Farmers mentioned the value of contacting the nutritionist when problems arose. Participants felt that nutritionists were largely responsible for the success or failure of their transition cows. For example, *"I'm not the kind of farmer who's going to have a nutritionist come, and sit down, and write me up a ration and then not follow it. I pay him to write me a ration, so I'm going to follow it, and then I'll hold him accountable for whatever is going to happen"* (F4).

3.3.4 Theme 4: Veterinarian involvement in the transition period

3.3.4.1 Veterinarian involvement

Veterinarians were viewed as important advisors in transition management. Some participants discussed how the veterinarian was involved in changes made on farm. For example, *"I lean on… my vet for pretty much everything that we do policy change wise. I don't go out and do anything without kind of conferring with [my veterinarian]. I just think it's important. If you're going to go ahead on your own, doing your own thing, then, you know, if it goes sideways you don't have anyone to back you up"* (F5). The frequency of herd health visits varied among farms (ranging from every week to every 4 weeks), but all participants reported that these visits were regularly scheduled. Herd health visits were the main time farmers discussed their transition cows with the veterinarian. Veterinarian involvement with transition cows included traditional veterinary services such as disease treatment, as well as advice on management and barn design. Some veterinarians in this study also described their shift in focus to preventative medicine and encouraged their clients to do the same.

3.3.4.2 Knowledge

Participants expressed normative claims about what 'should' be done or what is considered best practice for transition cows; however, various limitations prevented farmers from providing optimal conditions for their transition cows. For example, one veterinarian (V4) stated that *"I think for the most part, the farms do a really good job, or at least they know what*

they need to do to reduce these transition issues... I think not everyone can [adopt] best practices. I think the ones that aren't doing best practices are aware of [this] and just accept their limitations".

Farmers valued their veterinarians' knowledge. For example, one farmer said "they're educated, right? So, they have the opinion that's supposed to be a good opinion" (F2). In contrast, veterinarian participants often viewed farmer education as largely reflective of traditional knowledge of the farm. For example, one veterinarian felt that farmers "do things that their dad did. They do things that their neighbor did. Yeah, it's a lot of tradition" (V1).

3.4 Discussion

The results of this study show the complexities of managing the transition period from the perspective of veterinarians and farmers with many of the themes being interconnected. For example, farmer attitude towards transition management may influence veterinarian and nutritionist involvement. This underscores the complexity of this period and the importance of discussion between all parties involved. Additionally, how stakeholders discuss the transition period is important; farmer and veterinarian participants in this study defined the transition period differently, which could be a barrier to improvement. Ventura et al. (2016) identified ambiguity around the definition of 'animal welfare' as a challenge for dairy and beef cattle veterinarians, possibly leading to inconsistent messaging to farmers. Confusion around definitions was also found in a study assessing Brazilian dairy stakeholder understanding of lameness (Olmos et al., 2018). Recognizing the difference in terminology used may provide an

opportunity for veterinarians and farmers to engage on the issue, and thus better identify shared goals.

There were sources of information identified by both farmers and veterinarians that were perceived to facilitate improvement in transition management, but in some cases, these could also act as barriers. For example, benchmarking was perceived as helpful by some participants but not others. Benchmarking has been done on several different aspects of dairy farming including efficiency of nutrient use (Mu et al., 2017) and health status of lactating dairy cows (Parker Gaddis et al., 2016). Sumner et al. (2018) found that farmers generally perceived benchmarking calf welfare as beneficial, as it allowed them to understand how well their animals were managed through peer comparison. By showing clients a benchmark report, veterinarians give autonomy to their client to make changes based on the information they receive.

The current study illustrated some disagreement about the application of scientific research. Some participants found research motivating, but others found it difficult to apply given conflicting results from different studies. Gunnar Hansen & Greve (2015) found that human capital, defined in their study as years and level of farmer education, had a direct effect on farm performance as measured through productivity for Norwegian dairy farmers. Additionally, Vanclay (2004) explained that uptake of scientific knowledge is often done when it aligns with farmers' own knowledge and values (i.e. *"science does not automatically have credibility and legitimacy"*). Previous research has noted difficulties in communicating scientific research to non-scientists, and in helping them make informed decisions (Treise & Weigold,

2002); lack of scientific literacy can be a barrier to science communication and training stakeholders in how to communicate scientific results more effectively is needed. Through knowledge mobilization activities (i.e. "*all the activities and products created that help your research be useful and used*"; Rowell, 2017), transition cow research that has taken place for decades may help farmers with "real life" problems. Trusted advisors, such as the veterinarian, can help in communicating these scientific results to farmers.

Participants in this study discussed the importance of farmer attitude towards transition cow management. Understanding attitude towards management (e.g. as influenced by the type of farmer; Richens et al. 2016) can be important. Ritter et al. (2017) conducted a review on farmer adoption of management practices to prevent or control disease and found that understanding the farmer's mindset was important when attempting to motivate change. There are many factors that influence a farmer's decision-making, including personality, goals for the farm, and previous experience (Caroline Ritter et al., 2017). In the current study, veterinarians sometimes provided economic arguments when discussing changes with their clients. On the topic of biosecurity, Shortall et al. (2018) found that the capital investment (see Bourdieu, 1986) required to increase herd size increased the likelihood that farmers would listen to veterinary advice. However, other studies have found that economics may not be the primary consideration for farmers (Magalhães-sant'Ana et al., 2017). Derks et al. (2013) found that veterinarians could not identify a farmer's goal after a herd health visit and were reluctant to ask farmers what their goals were. Similarly, Bard et al. (2017) found that farmers' motivation was assumed by veterinarians but not explicitly asked of them. While there are additional

factors that will influence farmer decision-making, farmer-veterinarian communication may be a key factor to overcoming barriers to transition management and other issues on farm.

Factors thought to be associated with transition cow health included stocking density and nutrition. This is not surprising; many biological studies on transition cow management have focused on stocking density (Lobeck-Luchterhand et al., 2015) and nutrition (Loor et al., 2007). However, instances where participant farmers perceived an inability to change these factors may reflect them prioritizing other farm goals. For example, some farmers may place greater priority on increased milk shipments, and view having more animals in the pen as a way to achieve this goal. Identifying differences in priorities represents another opportunity for improved communication among stakeholders. In some cases, veterinarians and other advisors may also play a positive role in discussing longer-term risks associated with practices like overstocking. This is just one example of expanding the role of the veterinarian (van der Leek, 2015), with a focus on preventative medicine (Atkinson, 2016; Ruston et al., 2016), a point echoed by participants in this study.

There was the sense among participants, both veterinarian and farmer, that veterinary involvement in the transition period could be improved. Veterinarians were involved with farms primarily through scheduled herd health visits that are known to be beneficial for cow health (Derks et al., 2014; Speksnijder et al., 2015). Duval et al. (2017) found that French farmers believed veterinarians would always have a role on dairy farms, particularly for acute health cases that the farmers are unable to address. However, Kristensen & Jakobsen (2011) argued that veterinarians should work towards a more collaborative approach with their clients based

upon open dialogue and a shared understanding of the goals of the farm. Veterinarians are a trusted source of information (Alarcon et al., 2014) and so by working collaboratively with clients (as opposed to a more paternalistic approach sometimes used; Bard et al. 2017), it may be possible to find more effective management strategies. For example, van Dijk et al. (2017) conducted a study using participatory policy-making with farmers in the UK. This producer-led initiative included dairy farmers and veterinarians conducting workshops to draft new policy on antimicrobial stewardship. Not only did these workshops provide tangible outcomes that could be applied on farm, participants also benefitted from the dialogue among stakeholders (van Dijk et al., 2017). This model could be applied at the farm level, allowing farm staff, owners, and advisors such as nutritionists and veterinarians to collaboratively develop on farm policy and practices.

Nutritionists, despite being considered an important stakeholder in successful transition management, appeared to have a limited relationship with the farmers from the perspective of participants in this study. This limited involvement is also reflected in the literature as, to my knowledge, no research has specifically assessed nutritionist perspectives on dairy cow transition management, or issues related to dairy farm management. I encourage new work on the nutritionist's perspective, given their importance in transition management and perhaps other challenges on dairy farms.

This study is, to my knowledge, the first to assess stakeholder views on the transition period, but it has several limitations. One of these is that I am neither a dairy farmer nor veterinarian, and thus was likely viewed as an outsider. This could also be viewed as an

advantage, as participants may be more willing to explain things in detail to someone they view as an outsider. Additionally, the results need to be understood within the context of the specific region where the study was conducted. Results may differ for other farms and other regions. In particular, given the proximity of the UBC farm, participants likely had some experience with research. An advantage of this relationship was that it provided a platform of trust that allowed us to engage with participants and for them to voice opinions on the sometimes contentious issues described. Finally, farmers were recruited through their veterinarian and directly by the authors; I recognize the possibility of recruitment bias.

3.5 Conclusion

A clear and consistent definition of the transition period may help farmers and veterinarians make transition related decisions. Increasing veterinarian and farmer communication and collaboration in making decisions may help achieve improvements in transition period management. Barriers vary by farm, so an individualized approach is required. Chapter 4: Dairy farmer advising in relation to the development of standard operating procedures

4.1 Introduction

Standard operating procedures (SOPs) are a set of steps that show how a process should be performed (Gough & Hamrell, 2009). When implemented, SOPs have the ability to harmonize practices among workers and can be used to train new or existing employees (Barbe et al., 2016; Sischo et al., 2019). With increases in farm size and the use of non-family labor (Barkema et al., 2015), and a move towards increased use of technology (Hagevoort et al., 2013), SOPs are likely to be increasingly important on dairy farms. SOPs are now required by some welfare assurance programs, such as Dairy Farmers of Canada's proAction Initiative (Dairy Farmers of Canada, n.d.) and the National Dairy FARM Program in the United States (The National Dairy FARM program, 2019). Despite SOPs being required by many animal welfare assurance programs, it is unclear whether they are consistently used and if they actually improve animal care practices on farm.

While some studies have developed SOPs for management practices on dairy farms (e.g. predicting calving; Streyl et al., 2011), there is little in the peer-reviewed literature on farmers use of SOPs on dairy farms. Hesse et al. (2017) surveyed 248 German dairy farmers and found that only 54% had a written SOP. While some protocols, such as those relating to antibiotic use, are viewed as important to farmers (Friedman et al., 2007; Kayitsinga et al., 2017), common procedures are often not written down (Stull et al., 2005) with farmers' citing reasons such as

their dislike of additional paperwork (Bell et al., 2006). Additionally, articles in industry-oriented conference proceedings provide farmers helpful advice on how best to implement practices and employee training (Wenz, 2007).

Involving employees in the development of SOPs can help improve employee buy-in (Amare, 2012). Also, having individuals outside of the writing process review an SOP can help improve clarity (Barbe et al., 2016). To date, no work has investigated who is involved in the process of creating SOPs for individual dairy farms. Both knowledge (see Neu et al., 2011) and trustworthiness (see Strike, 2013) of external advisors may be significant in this development process; for instance, farmers may reject advice from 'experts' who are not viewed as trustworthy (Garforth, 2015). In the dairy industry, veterinarians are viewed as trusted advisors by many dairy farmers (Sumner et al., 2019) and are frequently involved in developing health treatment protocols (Raymond et al., 2006). Boersema et al. (2013) found that 10% of veterinarians sampled in the Netherlands provided pre-set treatment protocols to their clients. To our knowledge there has been no research regarding the involvement of veterinarians in the development of individualized SOPs on dairy farms.

Farm management advising is complex and how communication occurs between veterinarians and farmers has implications on management decisions. For example, veterinarians who use a mutualistic style of communication, compared to more traditional paternalistic communication, appear to see greater advice adherence (Bard et al., 2017; 2019). Svensson et al. (2019) found that on 169 dairy farms in Sweden adherence to advice was related to: 1) trust in the veterinarian, the advice given and the advisory process, 2) feasibility

of the suggested measures and, 3) severity of the problem and perceived need to implement the suggestions. Bard et al. (2019) found that for advice to be enacted by farmers it must be seen as meaningful and compatible with their worldview. The realities on traditional family farms can create additional challenges when it comes to advising (for family business advising see review by Strike et al., 2018) due to power struggles within the family (Glover, 2014; Taylor & Norris, 2000) or ambiguities in job titles or roles on the farm (Ballard-Reisch & Weigel, 1991; Deming et al., 2019). To our knowledge, advice adherence has not been explored in the context of SOPs on the family dairy farm.

The aims of this study were to better understand what types of advice from different advisors (researchers, veterinarians) are incorporated when developing a new SOP and what factors influenced advice adherence.

4.2 Materials and methods

This research was approved by the University of British Columbia's Behavioural Research Ethics Board (H18-00409). Data collection took place April - December 2018.

There are several SOPs required by proAction for animal care on dairy farms in Canada, including for colostrum management and calf feeding, animal health practices, down cow management and euthanasia. While colostrum management was the initial focus of our study, we soon realized that farmers had SOPs that reflected the first period of a calf's life, including colostrum management, navel dipping, ear tagging and other procedures they viewed as being associated with the first few days of life. Given the breadth of procedures we termed this SOP
"newborn calf care" so that participant farmers could include tasks they deemed important. The focus of this paper is not the SOP content, but rather the use of the SOP on farm and how advisors (i.e. veterinarian, researchers) influenced the development process.

4.2.1 Recruitment

We recruited a convenience sample (Miles et al., 2014) of working dairy farmers in the lower Fraser Valley region of British Columbia through industry social media platforms and through information delivered directly to farmers (e.g. veterinary clinics, data management companies). Recruitment advertisements included a study overview and contact information for the study team. Farmers who reached out to researchers by phone or email were then provided further details about the study. Recruitment proved difficult through the methods stated above, so we also recruited additional participants via a local veterinary clinic and by word of mouth. After the initial contact, individuals that wished to participate were sent an email with a consent form and letter of introduction.

4.2.2 Study design

This study was part of a larger research project examining SOP use and development on dairy farms in the region, with a total of 11 farms participating. This study was comprised of an initial meeting, a development meeting, and a follow up meeting which resulted in each farm being visited 3 times. Repeat visits aided the researchers in establishing a deeper relationship

with participants; a process that has been shown to result in richer discussions (Polkinghorne, 2007).

4.2.2.1 Initial meeting

When farmers (owners and/or farm managers) indicated an interest in developing or modifying their colostrum management SOP a meeting was scheduled. At this meeting the participants signed the previously emailed consent form and were offered one of these for their own records. Participants were then asked a series of structured questions regarding the farm (i.e. number of animals, number of employees, etc.), their perceptions of SOPs, and how (or if) they currently used an SOP for newborn calf care (for full list of questions see Appendix C). If they already had a newborn calf care SOP a photograph was taken. All farms (n=11) were then asked who they would like to have at the subsequent meetings (i.e. farm staff, veterinarians, nutritionists, etc.). Participants that indicated that they would like to have their veterinarian present (n=6) were included in the current analysis. Though given the option, farmers did not ask that other advisors (e.g. nutritionist) be invited to participate.

4.2.2.2 Development meeting

The development meeting was scheduled with the purpose of creating a new SOP or modifying the existing SOP for newborn calf care. The meeting started with the farm owner/manager describing what was currently done on their farm in regards to newborn calf care. Researchers (myself and another PhD student) acted as participant observers during this

process and provided examples of SOPs in a variety of formats (e.g. flow charts, text based, photo based, video, etc.) that depicted SOP's designed for other procedures on dairy farms. At the end of this meeting, researchers offered to provide technical help in developing the new SOP (e.g. formatting and layout) due to farmers' self-described technological limitations; participants were responsible for the content of the final SOP. Once the researchers received the final SOP from participants, farmers were asked to use the new SOP for 3 months after which the follow-up meeting was scheduled.

4.2.2.3 Follow-up meeting

Participants were asked semi-structured interview questions regarding the use of the new SOP, including what worked for them and what did not (see Appendix D). Finally, a photo was taken of the new SOP.

4.2.3 Analysis

All meetings were audio recorded to ensure accuracy in the thoughts expressed. In addition to the SOP documents, participant observation, structured and semi-structured interviews, researchers also kept field notes of the meetings that were used to help explain the results of this study. All interviews were audio recorded and recordings were transcribed by a professional transcription company and checked for accuracy. After transcription of the audio recordings was complete the transcripts were provided to participants to ensure that their thoughts were expressed accurately. Participants did not request any changes. All data sources

(SOP documents, participant observation notes, structured and semi-structured interviews) were included in the thematic analysis. This type of analysis involves the data being coded inductively to identify emergent themes that answered the study aims. An initial codebook (see Macqueen et al. 1998) was developed after coding all data. Subsequently, I met to discuss the initial codes and themes with another trained researcher, after which each coded a subset of the data before meeting again to discuss any discrepancies. I then recoded the data, iteratively updating the codebook, before a final codebook that accurately reflected the data and participants' experiences was decided upon between myself and the other researcher. All of the data was then re-coded using the final codebook. Quotes provided below were chosen to best exemplify the data; in some cases, quotes were modified with ellipses representing omitted text, or square brackets representing replaced or added text, for ease of reading.

4.2.4 The research team

The research team for this study all conduct research in the Animal Welfare Program, Faculty of Land and Foods Systems at The University of British Columbia. In addition to myself, data was collected with a fellow PhD student. We both have training and experience in conducting interviews and focus groups and were present for all interviews but at each meeting one researcher acted as a facilitator and the other as a participant-observer and note taker. This method of including multiple researchers has been shown to improve the reliability of the data collected (Berkwits & Inui, 1998). Given that while collecting the data for this study we offered advice on the development of the SOP, and acted as participant observers in this

process, we also included ourselves in the role of advisor during analysis. This role of observersas-participants, as defined by (Gold, 1958), acknowledges that participants are aware of the researchers' goal of data collection and participation in developing the SOP. Participant observers are intertwined in the process and accompany their participants in activities (Berkwits & Inui, 1998). This allows participants to build rapport with researchers and for researchers to better understand context (see review by Kawulich 2005).

4.3 Results

Six farms out of the 11 farms visited requested that their veterinarian be part of their SOP development. These 9 individuals (5 men and 4 women) and their herd veterinarian (3 men and 2 women; some farms had the same herd veterinarian) were included in the analysis. Herd size varied from 30 - 500 cows (average 209), number of employees (defined in this study as family members who worked on the farm as well as part-time and full-time externally hired labor) ranged from 4-10 (average 5.5) (see Table 4.1).

Table 4.1 The participant identifiers used to label the different types of participants (F for farmer and A for advisor) associated with each of the farms visited, the number of milking cows on each of these farms and the number of employees, including family members, on each farm.

	Participant Identifier	Number of milking cows	Number of employees
Farm A		30	4
Farme	r F1		
Adviso	r A3		
Farm B		250	8
Fame	r F2		
Adviso	r A4		
Farm C		140	3
Farme	r F3		
Adviso	r A5		
Farm D		125	4
Farme	r F4		
Farme	r F5		
Adviso	r A6		
Farm E		500	10
Farme	r F6		
Farme	r F7		
Adviso	r A4		
Adviso	r A7		
Farm F		210	4
Farme	r F8		
Farme	r F9		
Adviso	r A4		

The results are structured to show the themes that emerged that answer each of the two study aims: 1) what types of advice from different advisors (researchers, veterinarians) available to farmers are incorporated when developing a new SOP and 2) what factors influence advice adherence.

4.3.1 Part 1: Advice offered to farmers

Advice offered to farmers was centered around 3 main themes: 1) the purpose of the SOP, 2) developing an SOP and 3) accountability and tracking of procedures.

4.3.1.1 Theme 1: The purpose of the SOP

One theme that emerged from discussions with participants was the desire to know what the purpose of an SOP is, who an SOP is for and why it is important. When it came to understanding the purpose of the SOP, some participants discussed the difference between a farm specific SOP and one that reflects industry-wide standards. During one meeting, when a farmer was struggling with the distinction between farm specific versus industry wide, their veterinarian suggested "we have our industry recommendations that we ideally are making our protocol around, but we don't want to have a standard operating procedure on your farm that is not able to occur. Say you don't have any powdered colostrum on your farm, so it's not a backup source. There's no point to us having that written in your protocol" (A3). Some farmers saw the purpose of SOP as a safeguard when the manager or owner was away and someone else needed to complete farm tasks. However, some viewed SOPs as "pointless" (F9) or commented that they only make SOPs to satisfy proAction requirements, arguing that no one was going to read them. For example, one farmer said that "you can write the SOPs...you can have everything written down, and you're going to have 15 pages that nobody else is going to read" (F5).

Determining *who* the SOP is for was an important factor for participants. For example, as one participant stated *"it totally depends on who your audience is… Is it for the farmer or the farm manager who is ultimately responsible for the care? Is it for the individual who, in the moment, may or may not be there? Each individual is so different in how they learn and what they follow"* (F1).

Finally, understanding the *why* of the SOP was also viewed as important, as one veterinarian explained: "*Because if [employees] understand that it matters to you and it's important... the colostrum management gets done, and it gets done well... It's giving people the reason why it's important, because a lot of people don't necessarily see that. They just think it's one extra step"* (A3).

4.3.1.2 Theme 2: Factors to consider when developing the SOP

All farms had an existing SOP or multiple SOPs when we began this study. In some cases, the SOP that farmers had on file was a general template provided by assurance programs. In other cases, the veterinary clinic provided the existing SOP to clients; in many instances these were not farm specific. In one case, the farmer did not know they had a farm specific SOP developed by their veterinary clinic:

F3: This is just a generic one from [veterinary clinic]
A5: He has a better one.
A1: You have a better one?
F3: It's in my head.
A5: No, it's on your... computer.
F3: Oh, really?
A5: Yeah, you have an account.
F3: Oh, on the vet thing.

A5: Yeah. On the portal thing. F3: I don't know my account number so— A5: I figured.

When it came to creating a customized SOP for the farm, numerous factors were considered, including the balance between how simple or complicated to make the SOP. For example, one farmer stated that "*I think we needed to update our protocols. But I think—you start adding so many things, right? If I want to add something… it's going to keep getting longer*" (F2). There was variation across farms in the level of detail that was considered ideal with many farmers stressing that "*simpler is always better…It has to be simplified*" (F1). When describing their procedure for cleaning colostrum equipment, one farmer was frustrated with the amount of detail in some SOP and stated that "*we have a pretty simple process. In my opinion, if you can't wash a [colostrum] bag, you shouldn't be working here. (Laughs) I don't know. It's harsh, but can you not wash dishes? Just do it."* (F9). While the level of detail was varied, there was agreement across participating farms that SOPs should be tailored to reflect current practice on the individual farm, despite this not being the case at the outset of this study.

Much of the discussion during the development of the SOP centered on the format it should take. All the SOPs in this study began as text, but having been made aware of alternative options many farmers elected to utilize different formats. Farmers valued different formats for different reasons. For example, including pictures in an SOP allowed for specific equipment to be highlighted; a point viewed to be beneficial for workers who spoke English as a second language or were not comfortable reading English. Additionally, photos were thought to help

with providing guidance for practices such as ear tagging calves, as explained in this exchange between a veterinarian and 2 farmers.

F5: Yeah, that's something that I was trying to work on for tagging calves, pictures. So, it's like — A6: Where do you put the tag. That's a good spot. A picture's a good place to use there. F4: It's worth a thousand words.

Other formats such as decision trees and videos were viewed as beneficial by some participants, but for different reasons. Decision trees were thought to be effective in relaying important information in a concise way. For example, when discussing the difference between decision trees and a text-based SOP, one veterinarian said that they "always liked the flow diagrams because I do think they're easy...I'm a skimmer. And so, I see something like that [gesturing to text-based SOP] and that's three or four lines long, I skim it, so I'm not really reading it" (A4). This format also allowed for it to be posted, for example on the wall of the calf barn, for ease of access. Videos were viewed by some as beneficial for training of new employees. Interestingly, many farmers stated that multiple formats on the farm would be helpful. For example, one farmer felt that these would provide "different resources to suit the learning style of the person that you have hired" (F1).

4.3.1.3 Theme 3: Accountability and tracking of procedures

One of the most important aspects of the SOP described by participants was how best to ensure compliance. Employee accountability was discussed in relation to what tools could be used and the many factors that could affect employee accountability. For example, education level and language of employees was frequently raised as an important factor. As one farmer

explained, one of their employees has "worked here about four years. He can't read or write. I can't leave him any written instructions. I pretty much have to be here on the days [he's here]" (F1). Similarly, the experience of the employee was important. While some farmers were finding that new employees did not have agricultural experience, the opposite sometimes proved to be more problematic when it came to SOP compliance. For example, when discussing the changes to their new SOP one farmer remarked "I'll have to show everybody.... Of course, it's going to be the easiest for the newest employees" (F2). In situations like this, where habits have been formed with long-term employees, veterinarians stressed the importance of employee meetings or ongoing training. For example, when F2 was discussing their struggle with incorporating new steps into their SOP, their veterinarian stated that "something that might help with that is once you have the protocol is for us all to sit down with it. And sometimes having one of us explain why you've made the decisions [to your staff], then it makes it easier for them... because it's not just you telling them new rules" (A4).

Tools for tracking employee compliance with SOPs included video cameras in the barns, checklists and calf cards. For example, one farmer spoke about installing cameras in their barns so that even if *"there's no boss around… you are being watched. Just always remember that"* (F6). Checklists (see Appendix E for example) and calf cards were viewed as a way to turn an SOP into an active protocol and ensure that the steps were being followed. As one veterinarian explained:

"I do find the checklists are extremely helpful, especially for larger farms where there's more employees. So, having the time the calf is born, when they got the first feeding, and that

employee that feeds them has to initial that they fed them that much. Time at second feeding, and how much they got, whether they got vaccinated, and it's all initialed by employees. And it does make sure that each calf gets done. And if you are doing any total proteins on calves, then you can relate back, "Oh, this calf didn't get fed for 12 hours. That's why it failed" (A3).

Similarly, calf cards were viewed as helpful in providing information on individual calf hutches or pens. Both checklists and calf cards were incorporated as single use or laminated for reuse.

4.3.2 Part 2: Factors influencing adherence to SOP advice

Five themes emerged relating to the adherence to the advice offered: 1) feasibility of the advice, 2) resources required, 3) priority of the advice, 4) other actors involved, and 5) the importance of data.

4.3.2.1 Theme 1: Feasibility of the advice

Some farmers found that the advice given for their new SOP was not feasible given their farm or management routine. For example, when discussing the location of calf cards, one farmer realized that while they liked the idea of placing the cards on the calf pens, the calves made this a challenge:

"Well, we had little cards that was working good. We could laminate them and stuff, but the calves eat them. So, we can't really—we stopped using them, because the cards are [bigger

than the stand] and so, the babies, they see them, and they lick them, and we've lost a bunch of them" (F7).

Additionally, when it came to developing new or revised SOPs, some aspects were deemed to be successful but others were not. To start, while participants liked the idea of using decision trees in their procedures, some stated that these proved to be difficult to implement. For example, when one farmer sat down to write out the decision tree they found that the resulting tree was becoming too complicated to be useful: *"That would have been—well, we could have put it in there, but I don't know how big that decision tree would have got"* (F2). The length of the SOP or level of detail required meant that some formats did not work for farmers, despite these formats seeming attractive in earlier discussions.

In some cases, the new SOP and the associated advice was simply not effective. For example, while initially some farmers used powdered colostrum as a backup source for their calves, several changed to using frozen colostrum once they learned that powdered colostrum was associated with lower success as assessed through blood tests. These participants changed their SOP to use frozen colostrum and only used powdered colostrum as a last resort.

4.3.2.2 Theme 2: Resources required

Adherence to a new SOP was also influenced by the additional resources required. For example, in all cases the development of the new SOP required the use of some form of technology (e.g. creating documents using a computer). This proved difficult for some farmers. One farmer described why a decision tree SOP was not completed: *"I would love to do it on the*

computer. I just don't know how to make the bubbles and the arrows" (F4). In many cases farmers did not have the needed software on their computer. Additional resources identified as barriers included the time needed to develop the SOP and economic constraints. Along with the extra time required to complete the task, some identified the challenge of including the extra steps in the new SOP in their day-to-day routine, something that farmers did not always remember to do. For example, when describing the inclusion of a checklist in their calf management one farmer explained: *"I'm sure once you've been doing it for every calf, or once you get going, then it's easy. It's just getting into that rhythm of doing it"* (F3). Similarly, some participants stated that there was some training or 'convincing' required for older employees who did not see the value in the change: *"my dad, I'm trying to convince him of another step. Have to kind of buy in their support that if they calve a cow to test the colostrum"* (F1).

4.3.2.3 Theme 3: Priority of the advice

When it came to making a new SOP, one theme that emerged was the priority that this took in the lives of the farmers. Other priorities (such as harvest) and constraints (such as lack of employees) affected the priority accorded to developing, maintaining and using the SOP. In some cases, farmers did not complete their new SOPs because "nothing was broken, right? It's not like, 'Oh, we were screwing up here all the time.' We seem to have most of the bases covered" (F4). However, these farmers did acknowledge that there were some things that they still wanted to change or include in their SOPs, as their current SOP did not reflect their true management practices, or were outdated.

Some farmers were determined to improve their newborn calf management and viewed updating their SOP as a way to assist in this process. For example, one farm had a goal of feeding colostrum to their calves within 3 hours of birth. While this was not always achieved, they were making progress towards their goal as the farmer discussed: "probably the biggest change was the three hour [goal]...it's worked on some and others it hasn't. It's getting in there... starting this whole thing, we've been able to get that window down" (F2). Additionally, data acquired through changes made during this study, such as tracking colostrum quality or passive transfer success, resulted in farmers using this data to plan for further changes in management.

4.3.2.4 Theme 4: Other actors involved

When making the new SOPs farmers described benefits and detriments in including external advisors such as their veterinarian. Veterinarian involvement was often viewed as important for management changes to occur and in some instances, farmers remarked that changes only happened due to veterinarian involvement.

Some farmers remarked that the changed SOP also benefited the veterinarian in terms of advising for their herd. For example, when describing the utility of the checklist for calf management, one farmer remarked that "[A4]'s going to find it the most useful. Because she's got her data, too, so she can put it up against this" (F2). However, some farmers felt that after the development meeting with the veterinarian they did not discuss this further and the veterinarian was not involved in implementing the new SOP. For example, when asked if their

veterinarian was involved after the meeting, one farmer stated: "not really, no. (Laughs) He's a smart guy, he knows his stuff. But—yeah, he's just so busy with everything else" (F3). In some cases, the veterinarian never followed up about the suggested changes.

Employee considerations were also a factor that affected adherence. For example, some farmers felt that they were asking too much of employees to incorporate additional steps into their SOP while others lacked manpower to make the desired changes. The need for additional training was also discussed as explained by one farmer: "*Our two newest calf feeders are not dealing with testing or trying to get the colostrum in the calves. I haven't gotten them to that point. Usually we have enough people around that somebody who's been here for a while just does it*" (F2). Finally, differences in opinion and lack of communication with employees was thought to affect SOP adherence. For example, during the development meeting on Farm D, the farmer and herd manager showed us two completely different sets of SOPs for the same farm.

4.3.2.5 Theme 5: The importance of data

When farmers began tracking information (e.g. calf cards, checklists, colostrum quality or passive transfer success), they remarked on the value of this data. Some felt that collecting data was reassuring, particularly when good results were seen and others felt that recording information was important regardless of outcome. Others felt that this was good information to have but they did not do much with it. For example, one farmer expressed that due to his small herd size (30 cows), tracking information would not be important: "... *if I had a really large 2000 cow dairy... you could actually use that data*" (F1). Others did not continue tracking certain data

that they viewed as unnecessary. However, several felt that tracking information over time gave them the ability to see trends and make management decisions based on those trends. For example, on one farm over the course of a single month the rate of passive transfer success went from 40% to 90%. As the farmer described:

"We thought about that for a long time. Because that's significant.... [we think it is because of] no hired help... Our last guy finished, and we had no hired help after the end of August. So, our protocol's always been, at birth, first feeding of colostrum right away..... So, we assumed that was happening, the protocol was in place, but we think it probably wasn't." (F8)

4.4 Discussion

To our knowledge, this is the first study to explore the development of SOPs on dairy farms. A recent systematic review of farmer participatory extension argued that these types of interventions were growing in popularity, however only 15% took place in developed countries (Knook et al., 2018). Dairy farmer discussions, such as the ones we facilitated during this study, have been shown to decrease somatic cell count (SCC) at the herd level (Dillon et al., 2016), improve farm efficiency (Lapple & Hennessy, 2015) and allow for collective work on a shared goal (Vaarst, et al., 2007b). From the results of this study, we would recommend more work on the value of regularly scheduled meetings between farm personnel and advisors.

Advice offered to farmers regarding the development of the SOP focused on the purpose of the SOP, the format that would best fit the farm, and employee accountability. Farmers said that they were required to have SOPs to be compliant with the assurance

program; in many cases SOPs were created only as a requirement for proAction, but these were not farm specific and were rarely used. This may speak to the limited understanding of the purpose of SOPs or the limited perceived necessity from the perspective of the farmers. Additionally, we recommend that future research explore the link between SOP compliance and animal welfare indicators (i.e. benchmarking or reports given to farmers). We also recommend that the purpose of SOPs in welfare assurance programs be explored further, specifically from the perspective of those that develop these programs.

Another important aspect of the SOP identified by the participant farmers was how to ensure employee accountability. Farmers who were concerned about this, and incorporated some form of accountability or tracking, viewed this as a beneficial step. Accountability, whether in the form of a checklist or calf card, was then used to predict trends or understand their management in a new way. The collection of data in this manner by some farmers was evident in the follow up meetings when they showed us their checklists and discussed how they were using that information. We recommend that further research investigate how tracking of data on the farm effects management decisions.

This study adds to the growing body of literature that aims to understand farmer decision-making and advice adherence. In the present study, many factors affected adherence to advice such as feasibility of the advice, resources required and priority of the advice. Svensson et al. (2019) found that adherence to veterinary advice was dependent on trust in the veterinarian and the advice, feasibility and priorities for Swedish dairy farmers. Kauppinen et al. (2013) found that perceived ease of implementation and importance were both factors that

influenced management decisions on Finnish dairy farms. Lack of time and limited finances were identified as barriers to following procedures targeting antibiotic use for farmers in South Carolina (Friedman et al., 2007). Factors that affect adherence will vary depending on context, though we can see some similarities between our results and the findings from the above studies. Advice adherence is largely contextual and differences in farmer attitudes towards a certain practice will influence adherence. Future research should determine what practices are of priority to farmers in an effort to find research opportunities that would best allow for increased adherence and farmer buy-in. Lapple & Hennessy (2015) found that financial incentives encouraged participation in agricultural extension activities in Ireland; similar strategies could be employed in this context as well.

An important consideration affecting advice adherence was the involvement of other stakeholders in this process. This study included the farm owners/managers, researchers and veterinarians. Participating in this study required that both farm managers and veterinarians set aside time to have a conversation around newborn calf care practices on their farm, something that was not done on a regular basis outside of the context of this study. Sumner et al. (2019) found that having farmers sit down with their veterinarian led to conversations around calf management for the first time. Additionally, in many cases suggested changes to the SOP required veterinarian involvement (e.g. collecting blood samples). The veterinarian's involvement greatly influenced advice adherence as evidenced by veterinarians following through on collecting blood samples or not. Similarly, Svensson et al. (2019) found that if farmers felt that veterinarians did not fulfill a promise (e.g. supply needed information) then

adherence to advice was poor. The lack of initiative to make changes to the SOP by some of our participants could speak to the priority of the practice to not only the farmer, but the veterinarian as well. Given this finding, we recommend that further research seek to understand the veterinarians' perceptions of SOPs as this is not something that was explicitly sought in this study. In addition to the veterinarian, some farm staff were expected to complete the new procedures on the farm, but were not actively involved in the SOP development process. Involving employees in the development of SOPs can increase buy-in (Amare, 2012) and this is considered a best practice (Barbe et al., 2016). While this option was given to participants in this study at the outset it was only done once (by a farm owner who invited their herd manager to participate); we suggest that future research include employees in the SOP development process to assess buy-in and SOP compliance.

Finally, we included ourselves as advisors in this process. We view this as a strength of this study as researchers are an important component of the dairy system and building relationships with industry stakeholders is an important step to creating change.

In some cases, farmers elected to make no changes to the SOP. This may be a reflection of the advice offered; farmers may have found the advice not meaningful for their farm (Bard et al., 2019). This also may reflect the lack of importance of SOPs or specifically the SOP that we chose to focus on for this study. Past research has shown that record keeping for calf health on some farms is poor (Norway; Ellingsen et al. 2012). Newborn calf care was chosen as it is required by proAction, but it appears that many farmers did not rank calf care as a high priority. Other SOPs (such as one focused on udder health) may have engendered more interest.

There were several limitations to this study. The sample for this study was small; recruitment was hampered due to pragmatic constraints (i.e. length of time to recruit, small population of farmers to sample from, and the exhaustion of all recruitment methods). We cannot generalize our results to all dairy farmers, or even all farms within the same region. As with any study that employs qualitative methods, context is important. For this study we focused on farmers in the lower Fraser Valley region of British Columbia, Canada. Farmers in this region are familiar with the UBC Dairy Education and Research Centre, perhaps making them more open to research and outreach opportunities. Additionally, we can conclude from this study what advice was incorporated into the SOP for the farm, but this may not directly translate into day-to-day operations. We suggest that further research explores how SOP use on farm translates into measurable animal welfare outcomes.

4.5 Conclusion

SOPs are becoming common on dairy farms due to increased farm size and oversight from assurance programs. To our knowledge, this study is the first to try to understand the role of the advisor in the development of a farm specific SOP and the factors that influence adherence to advice in this context. This article adds to the literature on farmer decisionmaking and advice adherence, and to the limited literature on SOP use and development on farms. The findings of this study suggest that a farm-specific SOP that actively tracks procedures is most beneficial, and that advice adherence is context dependent.

Chapter 5: Social referents for dairy farmers: who farmers consult when making management decisions.

5.1 Introduction

Many factors influence decision making by farmers, including external drivers (e.g. financial rewards or penalties; de Lauwere, 2020) and internal drivers (individual values and beliefs; Ritter et al., 2017). Social referents (i.e. influential people in one's life) can also influence decisions, in part because behaviors, attitudes and beliefs are learned from those around us (Burkhardt, 1994). In the dairy industry, social referents provide information to farmers and influence decision-making (see Kristensen & Jakobsen, 2011; Ritter et al., 2017). This is particularly of interest when looking to improve management practices on dairy farms and the welfare of the animals on farm.

Different social network theories address the role of social referents (see Kadushin, 2012), with some distinguishing between cohesive (i.e. friends or those with close interpersonal ties) and structural equivalents (i.e. referents that occupy the same position in a social network) (Shah, 1998). Farmers are often an influential source of information for their peers (Skaalsveen et al., 2020). This is unsurprising as individuals with similar characteristics or attributes are more likely to be drawn together (i.e. homophily; Kadushin, 2012) and structural equivalents (or peers) are used as social comparison referents (Shah, 1998). Eastwood et al. (2012) discuss the role of farmers as 'translators' (i.e. individuals that bridge the gap between two

communities) when looking at uptake of dairy farming technology and how having a subject matter expert (e.g. familiar with running a dairy farm) is valuable.

Veterinarians are another valuable social referent to dairy farmers and are considered trusted sources for information (Ellis-Iversen et al., 2010; Garforth, 2015; Stanley-Clarke, 2019). Moya et al. (2020) found that in relation to implementation of biosecurity measures, veterinarians and other farmers were the most relevant sources. Other studies have addressed the positive role of other social referents to dairy farmers, such as hoof trimmers and feed sales advisors (e.g. on the topic of foot health; Bruijnis et al., 2013), nutritionists and other farmers (e.g. on the topic of antibiotic use; Swinkels et al., 2015), and other farmers and milk cooperatives (e.g. on the topic of mastitis; Kayitsinga et al., 2017). However, these studies only focus on social referents to farmers in relation to one management practice; while context is important, to my knowledge no research has addressed social referents for dairy farmers across management practices.

This study took place in the lower Fraser Valley region of British Columbia (BC), Canada. The lower Fraser Valley is one of the most productive regions in the province with 73% of the milk produced in this region (BC Ministry of Agriculture, 2014). The University of British Columbia's (UBC) Dairy Education and Research Centre is located in this region, providing the opportunity for researchers to make connections with individuals in the local dairy industry and facilitating collaboration between researchers and industry stakeholders. The aim of this study was to understand: 1) who farmers consult when making management decisions, across two different animal care practices, and 2) what characteristics of social referents influence farmer

decision-making. To do this we have conducted a secondary analysis of two datasets that employed non-naturalistic methods (i.e. interviews and participatory discussion groups).

5.1.1 Reflexivity statement

The University of British Columbia's Animal Welfare Program aims to improve the lives of the animals under human care; understanding the attitudes and behaviors of the people who care for animals is key to this effort. Under this paradigm we developed a study to explore the barriers to improved transition management (see Mills et al., 2020a). This study identified the importance of advisors, specifically veterinarians and nutritionists, in farmer decision-making and practice. These results motivated a second study aimed at understanding the development and use of standard operating procedures for newborn calf care management on dairy farms with the involvement of advisors (see Mills et al., 2020b). In this study we found that some farmers opted to involve their veterinarian in the development of these procedures, and others chose not to involve their external advisors at all; no farmers in our sample chose to involve their nutritionist in this process. These results suggested that both veterinarians and nutritionists were valued by the farmer in one context (transition period management), but appeared to be less valued in another (newborn calf care management). The goal of the current manuscript is to explore the reasons for this difference. Using secondary analysis, we explored the aforementioned datasets, this time specifically focusing on social referents to dairy farmers across contexts.

5.2 Materials and methods

This research was approved by The University of British Columbia's Behavioural Research Ethics Board (H17-00182; H18-00409).

5.2.1 Data Handling and Secondary Analysis

This study employed a secondary analysis of existing data sets. While secondary analysis of quantitative data is popular and methodologies have been developed for this use, there is less of a tradition of reusing qualitative datasets (Heaton, 2004) and the validity of this use has been debated (Mason, 2007; Moore, 2007). Following Silva (2007), reanalysis of past datasets allows for the exploration of themes that were not apparent under our earlier analytical framework. Heaton (2004) defines three types of secondary data analysis: 1) formal data sharing (data officially made available for sharing; i.e. online databases), 2) informal data sharing (data made available by request) and 3) personal or inside secondary analysis. This study undertakes the third type in that analysis is being conducted by the same researchers that collected data. Transcripts were coded using NVivo (QSR International; Burlington, MA) qualitative data analysis software. Thematic analysis was used to inductively create codes from the dataset. A codebook was then developed by using these codes to identify larger themes (Macqueen et al., 1998). However, given the nature of the first aim of the study, this descriptive theme was not coded inductively as specific mention of social referents by dairy farmers were sought in the data. The codebook was discussed with another trained researcher followed by both of us coding a sub-section of the transcripts. After reflecting and revising the codebook, I

recoded all of the data using the final codebook. Below the two datasets used in this secondary analysis are described:

5.2.1.1 Dataset 1: Transition period management

The aim of this study was to understand barriers preventing the adoption of improved transition period management practices. This study employed interviews and photo elicitation to understand the perspectives of a convenience sample (Miles et al., 2014) of farmers and veterinarians in the lower Fraser Valley region. Only the interviews with farmers (n=11) were included in the current analysis. To recruit farmers, veterinary clinics in the region forwarded study information to their clients (i.e. chain-referral sampling; Penrod et al., 2003). In addition, farmers known to the authors through the dairy farm community were contacted. Data collection took place April - October 2017.

5.2.1.2 Dataset 2: Development of standard operating procedures for newborn calf care

The aim of this study was to understand the use and development of standard operating procedures (SOPs) for colostrum management and newborn calf care for farmers and their advisors. We again recruited a convenience sample of working dairy farmers (n=17) in the Fraser Valley region of British Columbia, this time through industry social media platforms and through information delivered to farmers (e.g. veterinary clinics, data management companies). This study employed participatory methods to develop a new SOP, in addition to interviews and document analysis. Data collection took place April - December 2018.

5.3 Results

Our results are based upon interviews with 26 farmers from 17 dairy farms. Two farmers participated in both primary studies. Farm size ranged from 30 to 500 (mean: 222) lactating cows. Our analysis resulted in 3 themes that related to the objectives: 1) who farmers consult when making management decisions across practices and the role of these social referents, and 2) the personal and professional characteristics of social referents and 3) the strength of the relationship between social referent and farmer.

5.3.1 Theme 1: Who farmers consult when making management decisions across practices and the role of the referent

Farmers consulted many different social referents when making changes to farm practices. Below we describe similarities and differences in how these 'social referents' were engaged in providing advice regarding changes to farm practices related to transition period management and newborn calf care. Referents are presented as 1) individuals external to the farm that are hired by the farmer and 2) other referents that farmers sought advice from.

5.3.1.1 External hired advisor

This category of referents included people external to the farm who farmers paid (e.g. veterinarians, nutritionists and/or feed suppliers, equipment dealers, financial advisors and genetics companies), although not necessarily paid for the specific advice given relative to the

management changes considered here. Veterinarians were the most important social referent; they were often consulted on aspects of farm management, sometimes even on topics that are outside of their primary training in animal health, such as barn design and nutrition. In transition period management, veterinarians were most involved in herd health management; for example: *"He's here every two weeks for herd health. And then like he'll come do [pregnancy] checks and stuff. And then, every once in a while we communicate back and forth."* (F18). In developing protocols for newborn calf care, veterinarians provided resources (such as protocol templates) and services (such as testing for passive transfer success); for example, when discussing the extensive involvement of their veterinarian in calf management one farmer described that *"they're great resources to have a vet clinic like that"* (F1).

Nutritionists also provided advice on issues related to transition management, but the farmers we interviewed did not consider nutritionists as important social referents in developing protocols for managing newborn calves. For example, when discussing transition period management one farmer stated: *"If we started having issues we go to the nutritionist before we go to the vet. Because that's where we'll see it first. The vet doesn't see the cow until 30 days"* (F18). In contrast, when discussing who they wanted to involve in developing a new calf care protocol, farmers typically pointed to their veterinarian rather than the nutritionist. As explained by one participant, the *"[nutritionist]'s not too involved in the calves"* (F4).

Equipment dealers, financial advisors and genetics companies were occasionally cited as social referents by the dairy farmers across both animal care practices. Participants felt that these individuals were good sources of information and resources, and that it was important to

include them when considering major changes in farm management. For example, when discussing who would be involved in the planning of a new facility, including a new calf barn, one farmer said: "My vet [and] my nutritionist are the biggest two. Banker, obviously, for the financing side. And then equipment dealers for "Oh, this is what we did at this guy's place. This is what we did at this guy's place."" (F4).

5.3.1.2 **Other referents**

Other referents discussed were people in the farmers' social or professional networks that they consulted when making management decisions but were not external advisors hired by the farmer. These referents included researchers working with UBC, other farmers and farm staff, including family members. While there were distinct differences in the role of external hired referents in the context of transition cow health versus the context of developing protocols for calf care, roles were more consistent when farmers discussed other referents.

UBC was a social referent to farmers. Participants discussed studies that they had read from the institution, events they had attended at the university run dairy farm and participation in research studies that resulted in them changing certain management practices. For example, when talking about future changes to their calf barn one farmer remarked: *"I even want to make a step forward. These calves all share one big pen together. If we ever built a calving pen or a bigger box stall, I'd actually put comfy suites. Like they have at UBC."* (F17). Similarly, the researchers that conducted these studies were sometimes viewed as social referents, for example, when participants asked questions of the interviewers, most commonly: *"What are*

other people doing?" (F15). Additionally, farmers said that participating in research studies allowed them to spend time reflecting on management practices. When discussing the development of their new calf care protocol one farmer described what it was like to have someone walk them through the process:

"it was such a help, because I didn't even know where to start, you know? And then you sent [SOP templates] and it's like, "Well, try this and try that." You two are awesome at really helping with SOPs and how to create them and stuff.... [on the first day] I'm just like—I don't know. Because I really don't want to do this and this is bullshit. (laughs)" (F10).

Other farmers were also viewed as important sources of information or resources for participants. This varied from borrowing supplies to discussing ideas for new barn designs and what they would do differently if given the choice. As two farmers explained:

F24: "That's one good thing about our business is that you have—we have access to all kinds of help, information, neighbors".

F25: "We're not in a big competition... people [are] willing to share what they're doing"

Farm employees, including family members that worked on the farm, were important social referents. Employees sometimes helped when updating protocols or reminding farmers of the benefit of this: *"I find in the summertime [the parlor] gets dirtier... so I said before milking... just spray the parlor down with a hose, make it all wet, and it stays clean. He said write that down on the SOP so he would remember."* (F11). Family members, including those who did not work day-to-day on the farm, were important as they often had different skill sets and areas of expertise. For example, when discussing how to make their new SOP, one farmer

described: "I would love to do it on the computer. I just don't know how to make the bubbles and the arrows. That's the part I don't—no idea. So, I need help with that. My sister is fairly decent with that kind of stuff, so maybe I need to coerce her into it" (F4).

5.3.1.3 **Diversity of opinions**

As evidenced by the variety of referents discussed above, participants discussed the importance of consulting with many different individuals to gather diverse opinions before making a management decision. One farmer even consulted with several different veterinarians:

"Most people have one vet or vet clinic they use, and it's just like, "We're dedicated to them," and that's that. But I look for the best of the best... I have [veterinarian #1] and [veterinarian #2], they're the main two, but there's one or two others. It's like, "Well, you're beneficial with reproduction, and you're beneficial with this. I just need your opinion on something."" (F10)

Participants discussed the importance of remaining open to learning from others: "I know I don't know everything... I'm always open to hearing things that are happening, because as long as you keep an open mind and then listen to people... there's a lot of good advice out there." (F20). Farmers felt that by soliciting advice from many different social referents, they would find the advice that works for their farm: "I think sometimes you can get bombarded by too much information, but knowledge is a good thing, too... Don't take me wrong, I don't know everything. (Laughs) But I kind of pick through, and I'm like, "Yep, this make sense," or "This doesn't," or "Yeah, you know what, I think this'll work for us and this won't."" (F10).

However, differences in opinions between referents and farmers were not always beneficial and sometimes led to disagreements. When discussing how they disagreed with advice from their veterinarian in how to manage fresh cows, two farmers who worked together had the following exchange:

F19: So, we started [treating cows with glycol early] too, and it's like, oh, that's pretty interesting. And the vet said too, "well technically they're not ketotic". Well, that's what we're doing.

F18: I don't care [what the veterinarian says]. This is way cheaper than giving a bottle of dextrose and way easier for us and it'll save milk.

Some farmers discussed that while they solicited information from different social referents, some of these social referents were also trying to sell something. This was believed to result in biased opinions in the resulting advice. For example, when discussing their nutritionist one participant stated that: *"So, obviously, they have biased opinions... they work for the grain company, but it's a service.... they're paid on commission, so they're good [at] sales."* (F1).

5.3.2 Theme 2: Personal and professional characteristics of social referents

5.3.2.1 Personal characteristics

When discussing their social referents, participants discussed personal characteristics of the individual. Key aspects were whether the person was considered knowledgeable, willing to

share information or resources, and helpful. All of these qualities were considered to be important to farmers and resulted in a social referent that was valued by the farmer. Availability was also a factor for farmers; social referents, particularly referents hired for a specific area of expertise, had to be available to farmers when needed. For example, one farmer described that their veterinarian was likely too busy to help in the development of a new SOP: *"First thing he would probably say is that we are wasting his time. "I'm too busy, I've got to go here""* (F11).

5.3.2.2 Actions of social referents

When discussing who they consulted to make management decisions, participants focused on the actions of the social referent. Farmers found it preferable if information was given in a way that did not force the farmer to make a change but instead offered alternatives to current management practices. When talking about their veterinarian one farmer said *"she's not going to force it or anything. But if we wanted to add something, then she'll give her two bits into that."* (F2). In some cases, when suggested changes were provided through opendialogue with a social referent, we were able to document changes in farmer attitude and subsequent behavior over time. The example in Table 5.1 shows the changes in one farmer's attitude towards milk allowance for their calves after a conversation with their herd veterinarian.

Table 5.1 Quotes illustrating a change in attitude of a farmer (F1) towards milk allowance for their calves after a discussion with their herd veterinarian (A3)

Meeting 1

F1: Growing up, my dad was strictly no more than four litres a day. So, I've increased that but... there's certain research that shows a calf can drink eight to ten litres a day. But experience doing that and talking with other farmers, not necessarily researchers, but there's a lot of other side effect issues. The calf might physically drink that much, but when you—they don't want to eat grain as much, because they just get all their dietary intake in milk. And then when you wean them, it can be significant weight loss or there's no gain because it's such a, how do you transition from—it's kind of like you're feeding this dairy calf as a veal calf.

Meeting 2

A3: The other thing with the feeding is at the point where we're considering, ethically, are we starving this calf, right? Or are we underfeeding and malnourishing that calf? And so, the ethics does not make you more money, but it is an ethics question. This is how much volume we should be feeding them for them to meet adequate nutrition.

F1: Why was a standard, let's say, for so long to feed-

A3: Two litres twice a day? We thought it was good enough.

F1: Where does eight—in a non-manipulated environment, how much would the calf suck from the dam the first day?

A3: A ton. And we actually do have one dairy farm that they have four litre bottles, and they feed them four litres three times a day to their calves. So, we do have farmers that are doing that. Because we do recommend the 10 litres, typically, and then all of a sudden, one farm takes it a little bit further and they're like, "Yeah, I don't have any issues. Calves are happy, they're growing, we're happy." So, it is —they will drink. Not every calf will drink that much, but it's offering them the volume.

F1: And does that increase chance of diarrhea, scours, other... digestive consequences?

A3: Not anything where they're really getting sick from. If anything, it should make them more vigorous. They may have more of the milky manure that they tend to get when they're on higher volumes.

F1: Yeah.

Meeting 3

F1: [explaining why they had increased their milk allowance] I tried higher milk a couple years ago, but there's still the mindset from some farmers, "Well, that's why the calves get the runs, because they're getting too much milk." But most science doesn't really show that calves have diarrhea because they get too much milk. The calf has the ability to actually drink a lot.

In contrast, changes that were perceived to be 'forced' upon the farmer; for example, as a result of industry regulations and other external pressures, were viewed as frustrating. When discussing their frustration with forced changes one farmer stated: *"I mean, I know they say, when you're in the mind frame that you're never going to change that's bad, too. (Laughs) But if it's not broken, why fix it? (Laughs) And I'm not trying to be stubborn."* (F10).

Participants discussed that social referents provided resources that helped in making management decisions, including supplies, equipment, templates for standard operating procedures, and pre-made protocols. For example, when discussing how they developed their current standard operating procedures, many farmers said that they were provided this by their veterinarian or by an industry group. While this was viewed as helpful, farmers also valued and used protocols that were tailored to the individual needs of their farm: *"[the veterinarian and I] sort of do it together. What was on the wall [of the barn] was sort of a customized to your farm sort of thing"* (F16).

Participants discussed how social referents provided their recommendations. The participant farmers explained that they sometimes deferred to advisors in cases where they trusted them as experts. However, in the case of referents hired by farmers, some participants explained that it was important that recommendations would lead to concrete results. For example, *"I think [our success with the transition period is due to] our feed rep. I think that's 100 percent our feed rep. Even when he came and wanted to work with us, he said, "Even if you want to give me one pen, the only pen I want is your far-off pen. That's the one I want to prove myself with, and then we can move forward. But if you're only allowing me to have one pen," he*

said, "I can set the cows up from that pen for their lactation… And I think he's, at least in his feed company, he's the top in my eyes. He's a knowledgeable guy. So, that's why we chose him." (F17).

Participants discussed how their social referents collect and interpret data and the value of this when making management decisions. For example, one farmer implemented a checklist to track colostrum management on their farm and believed that their herd veterinarian would be able to better advise them as she was also collecting other information on the farm: *"Probably [the veterinarian]is going to find it the most useful. Because she's got her data, too, so she can put it up against this."* (F2).

Participants discussed the benefit of social referents giving advice from their own personal experience with farming. For example, *"well, one good thing about our vet…his brother has a dairy farm, as well… He's hands-on on feeding and everything. So, that's the good thing.... You know, if we have a question, we can always ask him...what do you guys do?"* (F24). Similarly, social referents use their experience with other farmers when offering advice to participants. For example, *"the guy... that we buy the feed from... he's a nice guy. He doesn't come across as being abrasive, but I mean, he will [say], "Okay, it doesn't have to be that way. Other people aren't doing it like that. You shouldn't be doing it like that.""* (F16). In contrast, farmers sometimes felt that social referents did not have enough experience to consult on certain practices. For example, *"Realistically, the vet has a lot of information, but they don't really ever milk a cow and feed a calf. (Laughs)"* (F14). In such cases, participants felt that sometimes social referents provided advice outside of their expertise or training.
Participants also discussed cost when soliciting advice. For example, some participants were hesitant to ask for their veterinarian's advice if they thought that this would require paying the 'call out' fee for the visit to the farm. Conversely, some farmers felt that ignoring the advice of hired referents was a waste of money, suggesting that farmers may be more likely to follow advice that they paid for.

5.3.3 Theme 3: The strength of the relationship between social referent and farmer

The third theme focused on the strength of the relationship between the farmer and their social referent. One factor that contributed to the strength of the relationship was its length; this was particularly noticeable when farmers talked about their veterinarians and nutritionists. When farmers had long standing relationships with these social referents, they often described these as such: *"Since I started [as] the herdsman, so 2002. The day I graduated until now... he's been a big influence on the way I manage this farm.... it'd be very hard to pull him from my hands, or vice versa. We're on the same page."* (F17). Conversely, participants often described relationships with new social referents as more difficult and requiring that the farmer learned to work with the new person:

F4: "it's kind of getting that working relationship. It's coming. We're just learning each other's tweaks a little bit... It completely threw me off the first couple of herd healths, because it was, he did it this way and I did it this way. We're working together to make it seamless."

Some participants found that they did not have a strong relationship with their social referent. For example, this was evident in cases when a referent would commit to providing

resources but then would not follow through with this. However, some farmers felt that, in the case of referents hired by the farmer, it was the responsibility of the farmer to follow up and that these referents should only be as involved as the individual farmer wanted them to be. For example, when discussing the involvement of their herd veterinarian one farmer stated: *"I think as much as you want them to have"* (F21).

Some social referents had such a strong relationship with the farmer that they were included in developing farm goals and farm policy. For example, one farmer commented: *"from what I'm understanding from my other boss [gestures to veterinarian], I should be getting five litres a day [of colostrum] into these calves, so I just try it. Just do it."* (F6). This farmer also commented that: *"[their veterinarian] pretty much runs the place with [F6's daughter]. They tell me what's happening."* (F6).

Participants talked about the importance of having different social referents work together to discuss problems on the farm. This was believed to ensure that everyone was 'on the same page'. For example, when discussing the benefit of developing a new SOP with different advisors one farmer described that *"[herd veterinarians] do a lot. They're involved a lot with the stuff we do here. [After the last meeting], then everyone's on the same page. There's no, well this person said this, and now it's telling this person something different. So, I think that meeting was very helpful, because then everyone agrees, and everyone knows what's going on" (F7).*

There were some instances when farmers tried to sit down with multiple advisors but some of these social referents were opposed to the idea. On farmer commented: *"That's, yeah*

one of the complaints with [nutrition company] and the vet[erinarian]. They don't like to communicate too much. I remember them saying before, so. It's always better that they would communicate together, I think" (F22). In some instances, participants said that this was the reason that they switched advisors. When talking about their nutrition company one participant said *"we just couldn't get the guys to come out and talk to us. We wanted to have the vet here and those guys, and that just didn't work, and then we said that's it."* (F14).

When it came to the frequency of communication there was considerable variation among social referents. For veterinarians, scheduled herd health visits that ranged from every week to every 6 weeks guaranteed that farmers would have regular contact. However, other social referents varied in their frequency of contact with some being sporadic and unscheduled. For example, when talking about his nutritionist, one participant stated: *"he'll show up if he hasn't been around for a while, just see how things are going. You know, probably if he hasn't stopped in for three weeks he'll just stop by"* (F21).

5.4 Discussion

The results of this study show some differences across the two different animal care practices (transition period management, newborn calf care management), particularly in terms of the role of veterinarians and nutritionists. We also found similarities in characteristics that farmers looked for in a social referent. Individuals who are open to certain ideas are more likely to expose themselves to these ideas (Kadushin, 2012), so the referents selected may share similar viewpoints to begin with. Similarly, Kahan (2010) describes this as 'cultural cognition' or

the influence of group views on risk perceptions and beliefs. However, the range of referents consulted by farmers suggest that at least some were open to a diversity of perspectives when making management decisions.

Veterinarians were involved in both management practices, not surprisingly given that veterinarians are commonly viewed as trusted advisors to farmers (Sumner et al., 2019), even when this meant they were advising on topics that might be considered to be outside of their training. In a survey of 254 dairy farmers in the Netherlands, Derks (2012) found that over half of their participants either discussed nutrition with their veterinarian only or did not consult any external advisor. As Kleen et al. (2011) describes, veterinary medicine is moving towards an integrated herd advising approach, resulting in a more comprehensive role for veterinarians on the farm. The variety of matters that veterinarians were consulted on suggests that they would benefit from additional training in some areas than what is currently provided in veterinary schools.

Nutritionists were another important social referent to farmers, especially for transition period management, but not in newborn calf care. This could speak to the difference between advising or economic investment for the lactating herd compared to newborn calves, as nutrition for these animals was discussed in both contexts but nutritionists were not consulted in relation to calves. To our knowledge no previous research has documented the way farmers involve nutritionists as resources on topics related to farm management; we suggest future research explore how nutritionists view their role in the context of the dairy system.

The interviewers were sometimes also seen as a source of information by the participants. For example, farmers sometimes asked "what are other people doing?" when discussing their own practices. Canada does not have a model of agricultural extension like that of the United States (see review by Bernard, 2019) and instead has adopted what is largely a privatized model (Milburn et al., 2010). Therefore, researchers that visit individual farms to conduct interviews may be the only source that farmers are able to ask about the latest research information. This direct contact may also be especially important for farmers that do not find electronic methods of communication effective (Russell & Bewley, 2011) or those that are disconnected from their peers within the local dairy community. We recommend that future research aims to better understand the extensions needs of Canadian dairy farmers and the role of university researchers.

Farmers discussed how social referents influenced their decisions through forced or unforced change. As Kadushin (2012) describes, the process of personal influence can take place through 3 mechanisms: 1) the recipient solicits influencers advice, 2) the influencer actively attempts to persuade the recipient, and 3) the influencer serves as a model. Those that influence farmers through a mechanism of partnership as opposed to persuasion (Bard et al., 2017b) may be more successful in building relationships and changing practices.

One factor that influenced farmers' perspectives on individual social referents was the length of the relationship. Stanley-Clarke (2019) found that long-term relationships between New Zealand dairy professionals and their clients was a valuable attribute. The frequency, proximity and intensity of interactions between cohesive agents (i.e. those with close

interpersonal ties) influence perceptions of the workplace (Shah, 1998), such that individuals come to share beliefs and attitudes over time (Kadushin, 2012). An additional important characteristic of a 'good' referent to farmers included the frequency of communication; in combination, these results suggest that individuals hired by farmers may be in a better position to become a trusted referent. For example, compare a veterinarian, performing herd health visits at regular intervals (frequency of communication) over many years (length of relationship), versus a peer farmer whose advice is sought on a sporadic basis. We recommend intervention studies with social referents to determine if this relationship can be strengthened by evaluating these factors.

There are several limitations to this study. Secondary analysis of qualitative data has been criticized (Moore, 2007); however, as the results of the current study show, asking a new research question can generate new insights into existing data sets (Silva, 2007). Additionally, farmers were not directly asked who they considered social referents. Instead this information emerged through the conversations had during data collection. It is unclear if farmers would give the same answer if they were asked this directly. As with all qualitative work, a limitation of our study is that we are not able to generalize our findings; the results of the current work should be considered within the context of the specific issues considered (transition cow health and calf care) as well as within the context of the culture of this region. That said, we suggest that our results do provide valuable insights into who and what dairy farmers look for in seeking advice on farm practice; important considerations when designing future studies in this area.

5.5 Conclusion

The results of this study show the attributes and actions that can make social referents valuable to farmers as well as differences in referent roles across two animal care practices. While the personal and professional characteristics that farmers look for in their referents vary, there are behaviors that referents can perform that are likely to strengthen their relationships with farmers, such as scheduling regular meetings and providing feasible recommendations and resources that facilitate decision-making. We recommend intervention studies to better understand the role that different social referents play in farmer decision making, including new work on the role of nutritionists and dairy researchers.

Chapter 6: General discussion and future research

6.1 Overview

The overall objective of this thesis was to better understand farmer's management decisions and how advisors influence these decisions. Using qualitative and participatory methods to engage farmers and their advisors in the lower Fraser Valley region of BC, I took an in-depth look at farmer decision-making across animal care practices. This thesis illustrates the diversity of participant experiences and highlights ways that researchers and other social referents in the dairy industry can better support farmers in improving to animal care practices.

Chapter 2 reviewed the literature in 5 areas of human resource management of dairy farms: 1) professional accreditation and professional development, 2) extension activities, 3) the role of the advisor, 4) standard operating procedures (SOP), and 5) employee training. This chapter identified numerous areas in need of research, including understanding the relationships between farmers, advisors and employees, and the role of SOPs on dairy farms, particularly in the context of animal care and employee training. I also concluded that future studies in dairy farm human resource management could benefit from increased use of participatory research methods.

Chapter 3 described a study with the aim of understanding barriers preventing the adoption of more successful management practices around the time of calving when cows are transitioning into lactation. Participants (both farmers and veterinarians) viewed management during this transition period as difficult. The lack of a single conception of the 'transition period'

emerged as one barrier hindering improvement; agreeing on a clear and consistent definition for the transition period may be an important first step to improved practices on dairy farms. Participants also identified other barriers hindering improvement during this time, including variation in farmer attitudes towards transition cow management, veterinarian involvement, stocking density of cows, and nutrition management. Barriers to improved practices varied by farm suggesting that a tailored farm-specific approach is required to make meaningful change. Advisor involvement, both nutritionist and veterinarian, emerged as an important component of successful transition period management. This result was integral to the designing of the study presented in Chapter 4.

Chapter 4 describes a study that aimed to understand the role of advisors in developing an SOP and exploring the factors that may affect advice adherence. We took a participatory approach to protocol development in an effort to increase engagement with the research process and to create a product (i.e. a new SOP) that would be more beneficial to farmers. When developing the SOP, farmers sought advice around 3 main themes: 1) the purpose of the SOP, 2) developing an SOP and, 3) accountability and tracking of procedures. Farmer adherence to this advice was focused around 5 main factors: 1) feasibility of the advice, 2) resources required, 3) priority of the advice, 4) other actors involved and, 5) the importance of data. The findings of this study suggest that a farm-specific SOP that actively tracks procedures is most beneficial, and that advice adherence is context dependent.

Chapter 5 describes a study that used secondary analysis to understand social referents to dairy farmers across different animal care practices. While veterinarians and nutritionists

were valued by farmers in one context (Chapter 3 - transition period management), this was not the case in the other context (Chapter 4 - newborn calf care management). The goal of this chapter was to explore reasons for this discrepancy. Findings from this study focused around 3 main themes: 1) who farmers consult when making management decisions across animal care practices and the role of the referent, 2) personal and professional characteristics of social referents and 3) the strength of the relationship between social referent and farmer. We noted similarities across practices regarding the dairy farmers' views on what characteristics make up a good social referent, but the role of these referents varied across animal care practices. We recommended future research on how to strengthen the relationship between farmers and their social referents and to explore the role of lesser known social referents, including university researchers.

The research presented in my thesis has explored farmers' management decisionmaking and the role of their advisors that are important to this process. The following sections discuss the strengths and limitations of this thesis as well as potential areas for future research.

6.2 Strengths and limitations of this thesis

In the following section I will discuss how the research presented contributes to the field of dairy welfare research; specifically, I will focus on the strength of integrating human resource management and animal welfare, the centering of farmers' experiences, including understanding those in their social networks, and the integration of participatory methods. This will be followed by a discussion of the limitations of this thesis.

6.2.1 Bringing together human resource management and animal welfare

"What I think make[s] a good cow person is a certain level of empathy towards the animals. They're not choosing to be here. I'm their caretaker. Take care of them. And I think you find workers that share that same level of empathy." (P17)

The research described in this thesis brought together the two previously disparate fields of human resource management and animal welfare, using the conception of animal welfare developed by Fraser et al. (1997). To improve animal welfare on dairy farms it is first important to understand the management challenges that dairy farmers are facing. As described in Chapter 3 and Chapter 4, transition period management and newborn calf care on dairy farms are both farm management practices that are associated with animal welfare problems such as illness (e.g. transition period; Mulligan & Doherty, 2008) and inadequate colostrum feeding (e.g. key component of calf management; Palczynski et al., 2020). My work focused on understanding farmer management decisions around these two practices and is a novel contribution to the broader literature. Conceptually, my findings move forward efforts to understand barriers to adoption of improved animal welfare practices, an ever increasing challenge as farms continue to grow in size and complexity. While many researchers have aimed to understand human resource management on dairy farms (i.e. Durst et al., 2018; Rodriguez et al., 2018), the work described in my thesis was the first attempt to look at these issues through an animal welfare lens. As argued in Chapter 2, given the complex system of a

dairy farm, topics such as development and implementation of standard operating procedures, employee training and extension activities will be key to future success. Improving the wellbeing of humans on dairy farms has the potential to improve the welfare of the animals.

SOP are increasingly being required by animal welfare assurance programs, such as Dairy Farmers of Canada's proAction initiative (Dairy Farmers of Canada, n.d.). To my knowledge, this thesis presents the first study that aims to understand how these SOPs are perceived, developed, and used on dairy farms. While other industries have examined the benefits of SOPs for standardizing practices (Barbe et al., 2016), this has not been explored in the context of dairy farms. While there is still more work to be done to see if SOPs do achieve the intended goal of standardizing practices, this aspect of my Ph.D. research is a unique contribution to this field.

6.2.2 A focus on farmer's perspectives

One of the strengths of this thesis is the focus on the farmers' perspective. Farmers make daily decisions around animal care and thus are key to improving animal welfare. Fraser (2014) argues that initiatives are best adopted if they are producer-led. When discussing animal welfare issues, farmers have been described as making tradeoffs between welfare issues and other factors, such as production needs (Cardoso et al., 2016) and economic constraints (Rodriguez et al., 2008). By focusing on the views and perspectives of farmers the findings of this thesis have the potential to play a key role in improving farm animal welfare.

While farmers' perspectives were the focus of my thesis, their decisions around dairy cow management do not take place in a vacuum. There are many social referents involved in farmer decisions. As Cardoso et al. (2016) argued, changing the views of farmers depends also on changing the views of those who advise them. An established relationship is an important indicator of farmer acceptance of advice (Croyle et al., 2019). By working with farmers to identify these key social referents on different animal care issues, we can better address animal welfare concerns on farms. Given the work showing that veterinarians are important advisors to farmers (Alarcon et al., 2014; Stanley-Clarke, 2019), it is not surprising that they also played a key role in this thesis. However, my results also suggest that there are other important social referents for farmers, and understanding their perspectives is also important if we are to better understand dairy farmer decision-making.

6.2.3 Integration of participatory methods in dairy stakeholder research

The research presented in this thesis made use of participatory methods such as photo elicitation (Chapter 3) and participatory protocol development (Chapter 4) to help understand farmer decision-making. Participatory research is defined as the co-construction of research between researchers and those affected by the research (Jagosh et al., 2012). This method of research allows for the involvement of affected stakeholders in many stages, such as design, data collection and analysis (i.e. ladder of participation; Arnstein, 2019). Participatory methods allow participants to find creative solutions to problems in their communities (Kingery et al., 2016) and allow for outcomes that are valued by participants as well as researchers (Macaulay

et al., 2011). Additionally, integrating knowledge from different stakeholders improves research quality (Ernst et al., 2018) and builds relationships between researchers and industry (Jagosh et al., 2012). To date, participatory methods have been rarely used in dairy research, with some notable exceptions on extension practices (Vaarst et al., 2007a) and participatory policy-making (van Dijk et al., 2017). The described work in this thesis is thus a contribution to this developing area of research.

As researchers that work with stakeholders, we must also consider that by participating in our work, stakeholders may incur personal costs of their own. Participants provided their time, and may also have experienced some frustration with the research process (Flicker, 2008). We need to be cognizant of these costs to participants and attempt to compensate them accordingly such as by paying participants for their time with gift cards (Killawi et al., 2014), or incentives such as industry services (Newton et al., 2020). Although I used participatory methods in the work outlined in this thesis, the lack of compensation given to my participants in the study (i.e. Chapters 3 and 4) is a shortcoming of this work. Future research suggestions that integrate participatory methods and participant compensation are discussed below.

6.2.4 Limitations of this work

This thesis approached farmer decision-making related to practices affecting animal welfare, using the theoretical approach of generic qualitative inquiry (Percy et al., 2015). Some may view this as a limitation as it diverges from the traditional methodologies that dominate sociological research (i.e. grounded theory, ethnography, phenomenology, etc.). As Percy et al.

(2015) describes, generic qualitative inquiry focuses on the outer experiences of participants and not the inner lived experiences (i.e. phenomenology). Given my research questions, this approach appeared to be the most appropriate. Generic qualitative inquiry, much like other approaches to qualitative research, requires reflexivity, robust description of methods, and approaches to enhance rigor, such as member checking and triangulation (Cooper & Endacott, 2007). The research presented in this thesis made every attempt to incorporate these practices to increase the trustworthiness of the research presented.

The sample sizes of the studies presented in this thesis are small. However, my goal was not to present generalizations to all dairy farmer populations, but instead to describe and present the stories and experiences of farmers within the chosen context, the lower Fraser Valley region of British Columbia. I hope that these findings can provide some insight for future research that can perhaps be transferable (Smith, 2018) to other groups or contexts.

The sampling methods described in this thesis may also be viewed as a limitation. Purposive and convenience samples were used based in large part by the availability of individuals meeting our inclusion criteria but also pragmatic constraints (Groger et al., 1999). Additionally, I acknowledge that the farmers that chose to participate in these studies were likely already interested in improving practices or were more progressive than others that declined our invitation to participate. Future work should aim to engage farmers that are harder to reach or those that hold values different from our own.

With the exception of veterinarians, I did not interview other social referents. This could be argued to be a limitation. However, given that my goal was to center farmer perspectives,

they were given the choice of who to include (Chapter 4), and they chose not to include other social referents. This lack of engagement may speak to the limited role that other advisors have from the perspective of dairy farmers, but could also be reflective of the management practice that we chose (e.g. newborn calf care). I encourage more work on developing opportunities to involve advisors in the conversation around decision-making on dairy farms, employing other methods and practices to achieve this goal.

6.3 Future research

While conducting the research described in this thesis, I identified many potential avenues for future research. As discussed in Chapter 2, farmers are not trained to be human resource managers, but this is becoming part of their job as farm size increases and more employees are hired on farm. Research is needed to assist farmers with changing human resource needs as farms grow in size and change. Specifically, farmers need help in developing training programs, in how to recruit and retain employees and in how to develop effective protocols. While not explicitly an animal welfare issue, it is an area that indirectly affects animal welfare. Undercover animal cruelty investigations that depict mistreatment of animals are a concern for the public (Tiplady et al., 2013) and highlight the need for improvements on many farms, including animal handling. By assisting farmers in developing the skills and programs to train and retain skilled workers there is greater potential to ensure proper treatment of animals on farms.

Further research should aim to integrate diverse and participatory methods to understand stakeholder perspectives in the dairy industry. While most dairy cattle welfare research is motivated by researchers' ideas based on identified gaps in the literature, going forward research must take the time to understand the wants and needs of those working within the industry, considering what aspects of their business farmers believe need further inquiry. This should not replace the creative and innovative ideas of researchers, but farmer input may reduce the otherwise considerable gap between research and practice (Peden et al., 2018). By employing participatory methods that engage stakeholders throughout the research process, including in the design, the development of research questions and in data collection, we may create more meaningful research outcomes that help facilitate change. Participatory areas of research that focus on the needs of dairy farmers may be particularly effective in areas such as policy development, training program development and extension curriculum design.

Social referents are influential when discussing stakeholder decision-making (Kadushin, 2012) and in the context of dairy farmers, social support can reduce stress (Furey et al., 2016). The influence of social networks on farmer decision-making has been explored in other contexts such as no-till farming practices (Skaalsveen et al., 2020) and implementation of precision farming technology (Eastwood et al., 2012). This previous body of literature suggests that advisors (such as veterinarians) and other farmers are important nodes (i.e. connections in a social network; Kadushin, 2012) for farmers, given their close relationships. However, to my knowledge this area of research has not been explored in the context of animal welfare. While we were able to gain some insight into the type of individual that is considered to be a social

referent to dairy farmers (see Chapter 5), I recommend that future research applies social network analysis to better understand animal welfare referents to dairy farmers.

Another unexplored area of farmer decision-making is use of technology on dairy farms. Technology is increasing in the dairy industry (Khanal et al., 2010), and the use of 'big data' is gaining traction in agriculture (Lioutas et al., 2019; Newton et al., 2020). Studies have shown that there can be benefits to integrating technologies such as automated milking systems (see review by Jacobs & Siegford, 2012), use of activity and rumination monitors to predict calving (Borchers et al., 2017) and precision livestock monitoring tools that can allow for real-time monitoring and care of animals (Norton & Berckmans, 2017). Newton et al. (2020) conducted a case study of Australian dairy farms to understand farmer engagement with big data through Australia's dairy herd milk recording scheme. These authors reported that farmers felt that collecting data on their farm allowed for better decision-making, such as knowing when to end a cow's lactation, remove her from the herd, and to identify sick cows. However, to my knowledge there is no literature that focuses on the use of data or technology for farmer decision-making in the context of animal welfare. Future research should explore how farmers are making animal care decisions with the aid of technology, and what they see as barriers and opportunities associated with further technology use.

6.4 Conclusion

Using the conception of animal welfare and a generic qualitative inquiry approach, the aim of this thesis was to better understand dairy farmer decision-making in relation to animal

care practices. I was able to explore farmer decision-making in relation to management of the cow around calving ('transition') and newborn calf care, explore social referents to farmers across practices and review what is known about human resource management practices in the context of the dairy farm. This research adds to the growing conversation around the connection between farmer welfare and animal welfare as well as farmer decision-making and the role of advisors to improve the lives of the animals under their care.

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Appendices

Appendix A Interview guide for Chapter 3 study

Theme		Question
Photo elicitation	Question	Can you describe the picture to me?
Injury/disease	Question	What do you think (you/your clients) are doing well in
and management		transition cow management?
	Prompt	What are some of the biggest concerns or problems?
Veterinarian	Question	What do you think the role of the veterinarian is in
Involvement		addressing these issues?
	Prompt	What are (they/you) doing on your farm?
	Prompt	What would (you/they) like (them/you) to be doing?
Motivating	Question	What do you think are some motivating factors to improve
factors		transition cow management?
	Prompt	What are the motivating factors for farmers?
	Prompt	What are motivating factors for vets?
General Prompts	Prompt	Could you tell me more about that?
	Prompt	Could you walk me through that?
	Prompt	What do you think was going on there?
	Prompt	Would you mind explaining that again so that I can
		understand?
	Question	What are other challenges that have not been mentioned?
	Question	Of all the things we discussed what do you believe is the
		most important?

Appendix B Three photographs provided by three different participants for the photo

elicitation element of Chapter 3.

Panel A) illustrates the 'Transition Pen' at the farm of participants F2 and F3 which is stocked at 70% and is viewed as an important factor to a successful transition period as this allows them to better individually monitor postpartum cows for 3 weeks. Panel B) The participation in previous research studies resulted in changes to stall bedding for one participant (F4) in the hopes of reducing hock abrasions. They further discuss potential future changes (waterbeds) and the limitations of their facility (e.g. slatted floors resulting in deep bedded packs perceived to not be possible). Panel C) Participant F5 describes the move from their farms hospital pen (pictured above) at 3 days fresh into a 'Transition Group'. This participant describes how heifers are typically moved directly into the transition group (due to their perceived ease of calving and lack of space), which can sometimes cause problems with monitoring that animal post-calving.



Appendix C Interview guide for Chapter 4 study - meeting 1

What is your role on the farm?	
Number of milking cows	
How many people (including part time	
employees) work on this farm?	
What are their roles?	
Who is your veterinarian?	
How often are they here?	
who is your nutritionist?	
How often are they here?	
Do you have SOPs?	
How would you define SOP?	
What does your COD for coloctry to look	
like? (take a picture)	
Are the other SOP's written down?	
Are they created together with other	
employees?	
Are the employees trained on them?	
Do you ever make modifications to	
existing SOPs? and why?	
Who helped you create your SOP?	
Is there variation in how employees	
complete processes?	
Why?	
what do you think of SOPs in general?	

Appendix D Interview guide for Chapter 4 study - meeting 3

Theme		Question				
Implementation	Question	What steps were taken to implement this SOP?				
	Prompt	What did not go well?				
	Prompt	What went well?				
Use of SOP	Question	Has the new SOP changed your colostrum management?				
	Prompt	In what way?				
	Question	Have you changed anything in the SOP since it was developed?				
	Prompt	Do you plan on changing anything in the SOP?				
	Question	Did you follow the SOP every time?				
	Prompt	Why or why not?				
	Prompt	What was different? What did you do differently?				
	Question	What was your outcome or goal?				
	Question	Do you think this outcome was achieved?				
	Question	What do you think about SOPs after this				
		process?				
Stakeholder	Question	Did you involve additional stakeholders in				
Involvement		the SOP development?				
	Question	If yes, would you use this stakeholder				
		Involvement again in SOP development?				
	Questien	If no, why not? Do you wish that you had?				
	Question	this process?				
General	Probe	Could you tell me more about that?				
	Probe	Could you walk me through that?				
	Probe	What do you think was going on there?				
	Probe	Would you mind explaining that again so that I can understand?				
	Question	What are other challenges that have not been mentioned?				
	Question	Of all the things we discussed what do you				
		believe is the most important?				
	Question	Do you have any questions for me?				
	Final question	Do you have anything else to add?				

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