

BURLEIGH DODDS SERIES IN AGRICULTURAL SCIENCE

Improving dairy herd health

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Introduction

Increasing concern about over-reliance on antibiotics (resulting in antimicrobial resistance), as well as broader concerns about animal welfare, have put greater emphasis on preventative measures in maintaining the health of farm animals. Herd health management programmes take a population approach based on quantitative epidemiology which makes it possible to assess disease risk and, as a result, prevent and manage diseases more effectively. This volume reviews key challenges in dairy herd health management.

Part 1 covers the principles of dairy herd health management, such as the key issues in herd health management and challenges in disease surveillance of dairy cattle as well as the advances in techniques for health monitoring and disease detection in dairy herds. Part 2 focuses on the prerequisites of dairy herd health management, specifically the advances in understanding immune response and the relationship between dairy cattle welfare and health. Chapters in Part 3 cover herd health at different stages of the life cycle. Discussions on optimising reproduction and transition cow management to maximise dairy herd health are included. Chapters also examine managing calves and managing replacement and culling to optimise dairy herd health. The final part of the book examines various ways to optimise dairy herd health, covering areas such as optimising udder health, hoof health, preventing bacterial diseases and the ways data-driven decision support tools can be used in dairy herd health.

Part 1 Principles

Chapter 1 reviews key issues in dairy herd health management. Dairy herd health management is assessing, monitoring and improving the health of dairy cows at a population level. Good herd health management takes a holistic approach and is ongoing and cyclical. All members of the dairy farm team and their advisors are involved, decisions are informed by data generated by the herd. These data may come from numerous sources. The data are processed and analysed to monitor cow health, target investigations and evaluate progress. To make lasting change on farms, advisors must communicate appropriately with farm managers to understand behaviour and motivate change. This chapter reviews these aspects of dairy herd health management, giving practical suggestions on how to get started, how to incorporate herd health management into business models and how to maintain momentum.

The next chapter provides an overview of the different aspects concerning disease surveillance programs. Chapter 2 describes a specific and conceptual framework related to disease surveillance of production diseases within the individual herd, including both animals and farmers. Regarding farmers, this

chapter focus on the justification and purposes for doing disease surveillance as well as the possible decisions and actions they can take to enhance the efficiency of the disease surveillance programs. It also discusses some of the most novel biomarkers that can be potentially used to identify pre-clinical disease states, which will have the potential to minimize the negative effects of production diseases. Finally, the chapter looks into the future perspectives and possible challenges that future automated disease surveillance systems will need to face in order to keep an optimal animal health, performance and welfare within the individual herd.

The subject of Chapter 3 is advances in techniques for health monitoring and disease detection in dairy cattle. It starts by reviewing how the focus in the veterinary profession has shifted from the treatment of acutely diseased animals to more proactive management, which includes the use of epidemiological tools to identify risk factors for animal health, welfare and production. The chapter then reviews information management systems and the different on-farm diagnostic tests that can be performed to provide the necessary data on dairy herd health. A section discussing the use of electronic devices and precision livestock farming techniques is also provided. The chapter also provides a case study which describes how subclinical ketosis was detected in dairy cows.

The final chapter of Part 1 examines the use of data-driven support tools in dairy herd health. Chapter 4 begins by describing the development process of data-driven decision support tools for dairy herd management with an emphasis on real-time continuous data integration and its applications on dairy herd health. It includes concepts on big data analysis, expert systems, and artificial intelligence towards more sustainable dairy farm production systems.

Part 2 Prerequisites

Part 2 opens with a chapter that reviews advances in understanding immune response in dairy cattle. Chapter 5 begins by analysing the genetics for dairy health, specifically focusing on the importance of identifying the most appropriate measure of disease resistance to ensure the desired dairy health outcome. The chapter also discusses epigenetics and how epigenetic mechanisms are integral to improving dairy immune responses. A section on environmental stresses that dairy cattle encounter is also provided, specifically heat stress and climate. Crossbreeding and immunity in dairy cattle is also discussed. The chapter also examines the importance of colostrum in calf health and emphasises the importance of ensuring early colostrum ingestion for calf survival. The chapter concludes by stressing how cattle have played a key role in immunology and why it is critical for dairy producers to identify cattle with a high immune response.

Chapter 6 discusses the intimate partnership between dairy cattle welfare and health. It begins by examining the welfare implications of common dairy cow diseases such as lameness, mastitis, metritis, acidosis, ketosis and other production-related diseases. It also addresses the impact of subclinical diseases as well. Stress and immune function is also discussed, followed by a review of how mental health can impact the welfare of dairy cattle. A case study on the health and welfare of cows in Indian shelters is also included.

Part Health at different stages in the life cycle

Chapter 7 reviews optimising reproductive management to maximise dairy herd health and production. Reproduction is central to the operation of a dairy herd through initiating lactation and providing replacement animals and offspring for sale. This chapter outlines the steps required to detect reproductive problems and limitations in cows and herds. It then elaborates some strategies to overcome limits to reproductive health and production concentrating on detecting cows requiring attention through record monitoring, analysing herd records to monitor reproduction and identify areas that limit performance and providing strategies to deal with these limits. The main limits addressed are anoestrus and inadequate oestrus detection that are addressed through education of farm workers, aids to oestrus detection and the use of planned breeding programs to induce and control oestrus and breeding. Nutritional causes of limited reproductive performance are also considered as well as strategies to limit abortion.

The next chapter assesses managing dry cow udder health. The dry period lays a foundation for a successful next lactation, especially from the udder health perspective. It is a high-risk period for acquiring new intramammary infections (IMI), but it also provides an excellent opportunity for eliminating existing subclinical infections. The way cows are dried off and milking is halted at the end of lactation impacts the involution process, mammary health and cow comfort. Chapter 8 reviews the current knowledge about the impact of milk cessation methods (abrupt vs. gradual dry-off) on mammary involution, udder health and cow comfort. The importance of dry cow therapy is discussed, especially in the light of current global concerns related to antibiotic resistance.

Chapter 9 focuses on managing calves to optimise dairy herd health. The chapter demonstrates how calve management can play a critical role in optimising herd health. It starts by discussing the costs of heifer rearing and how good early life management can reduce the costs of heifer rearing. The chapter also discusses the importance of setting targets for heifer rearing, focusing specifically on data management, data recording and benchmarking. It then goes on to discuss managing dairy cattle at the start of the herd lifecycle and how this can have significant effects on calf health. Sections on the impact

of calthood diseases and nutritional management on dairy herd health are also provided. The chapter also addresses the role of vets in communicating best practice in calve management, then concludes by highlighting the impact of better calf management on overall herd health.

The subject of Chapter 10 is managing replacement and culling in dairy herds. Approximately one third of dairy cows are replaced every year. Replacement of dairy cattle is an important part of the cost of dairy production and an environmental sustainability concern. Primary culling reasons are reduced health and fertility. Reduced welfare often precedes culling. The chapter focuses on factors that affect replacement and culling in dairy herds with a focus on cows. The act of culling is simple, but the risk factors and economic considerations are complex. The chapter first presents some data on culling risks and reasons, explores more in depth the effects of poor health on culling, and presents aspects of economic decision-making regarding culling and replacement decisions.

Part 4 Particular health issues

The first chapter of Part 4 covers optimising udder health in dairy cattle. Chapter 11 begins by reviewing mastitis, inflammation of the mammary gland, which is generally caused by bacterial infections, is one of the most important and most studied diseases in dairy cattle. Diagnostic approaches are discussed with specific attention for the bacteriological causes of the disease. Subsequently immunological aspects of intramammary infections will be reviewed. Because treatment of mastitis is unavoidable at some point in time in most dairy herds, attention is given to treatment of mastitis with an emphasis on different types of antibiotics and antibiotic resistance. The most important part of udder health management, however, is the preventive management. From that perspective, breeding, housing and nutrition are shortly discussed, as are the milking machine and milking procedures. Finally, attention is given to problem solving once mastitis has led to a herd level problem and some future trends are discussed.

Chapter 12 examines optimising foot health in dairy cattle. The chapter begins by reviewing the importance of lameness then goes on to discuss claw horn disruption. It also reviews aetiopathogenesis of white line bruising and lesions, which is then followed by a section on aetiopathogenesis and control of digital dermatitis. A case study on an 800 cow Holstein herd with a sudden rise in sole ulcers and white line lesions is also included. The chapter concludes with an overview of the emerging diseases in dairy cattle.

The final chapter of the book discusses preventing bacterial diseases in dairy cattle. Chapter 13 begins by examining state of the art disease prevention in dairy cattle, focusing specifically on bovine respiratory disease (BRD). The

chapter uses the disease triangle as a basis for discussion, emphasising how disrupting certain parts of the triangle can prevent diseases. It first focuses on bacterial and viral pathogens associated with BRD and the role of the host and the role of the environment in bacterial infection. The chapter then goes on to discuss the importance of disease detection and how various tools can be used to help prevent diseases such as BRD. A discussion on risk assessment tools is also provided. The chapter concludes by highlighting the importance of considering all factors of the disease triangle when looking at ways to prevent diseases.

Chapter 1

Key issues in dairy herd health management

John Remnant, James Breen, Peter Down, Chris Hudson and Martin Green, University of Nottingham, UK

- 1 Introduction
- 2 Key features of herd health management
- 3 Concepts in measuring disease and performance
- 4 Using data in herd health management
- 5 Herd health management in practice: initiating change
- 6 Herd health management in practice: implementing change
- 7 Summary
- 8 Where to look for further information
- 9 References

1 Introduction

Dairy herd health management involves assessing, monitoring and improving the health of dairy cows at a population level. This is an approach advocated internationally in areas with an industrialized dairy production (Alawneh et al., 2018; Ansari-Lari et al., 2010; Barkema et al., 2015; Cannas da Silva et al., 2006; Galon et al., 2010; Noordhuizen and Wentink, 2001). Since the benefits of maintaining a healthy, efficient productive dairy herd are so wide-ranging, it is difficult to understand why the concept of 'herd health' hasn't been more firmly embedded in dairy industries throughout the world. This chapter outlines some of the key beneficiaries and outcomes of adopting a successful herd health program.

1.1 The farmer

The economic benefits of maintaining a healthy herd are clear. Substantial financial losses in dairy production are often associated with key endemic diseases such as mastitis, lameness and infectious conditions as well as suboptimal nutrition and reproduction (Geary et al., 2012; Kossaibati and

Esslemont, 1997; Liang et al., 2017; Mahnani et al., 2015). For dairies to be a sustainable business, farms must be profitable and good cow health is one major element of the financial equation (Edwards-Jones, 2006). However, the benefits of herd health to the farmer extend beyond just monetary considerations. Other reasons farmers may wish to have healthy livestock include: pride in a well-run business, the core belief that animal well-being is important, a dislike of wastage, increased ease of management through not having to deal with sick or under-performing stock and altruism – the knowledge that disease from their animals will not be passed to other animals on the farm or to other farms.

1.2 The environment

With concerns about climate change and its potential devastating impacts on much of the world, looking after our environment has become increasingly prominent. The global dairy sector is considered to be responsible for around 4% of total anthropogenic greenhouse gas (GHG) emissions although large variations are recognized between farms and regions (FAO, 2019). In many cases, improvements to herd health are acknowledged as one of several mitigation strategies to reduce emissions alongside fertilizer/slurry and soil management, optimal use of feeds and nutrition, improving the efficiency of energy and water consumption and genetics (Green et al., 2011). Health and productivity are known to vary considerably between herds, which suggests that there is often scope for improvement. Increasingly, the environmental impact attributed to individual farms is being measured and benchmarked and, although tools for such analyses have scope for substantial improvement, this trend is likely to continue. Indeed, it is likely in the relatively near future that benchmarking of environmental impact will play a major role in the auditing of dairy farms and the sales of dairy products, for example, the 'proAction' initiative by the Dairy Farmers of Canada (<https://www.dairyfarmers.ca/proaction>).

1.3 The cow

Beyond the importance of herd health in terms of farm economics and the environment, the most compelling reason to improve herd health is probably cow welfare. Dairy cows are sentient beings, and it is right that we should care for them throughout their lives by looking after their health and welfare. It is clear that good health plays a pivotal role in good welfare whilst poor health is often a reason for compromised welfare of dairy cattle. Most diseases and conditions have an important impact on cow welfare, but we draw particular attention to lameness, mastitis, periparturient disease, dystocia and delayed treatment as being potentially substantial welfare issues. Good welfare, however, extends beyond good health. There is increasing awareness that

welfare should not only include minimizing negative experiences but also incorporate enhancement of positive aspects of the lives of cows. As an example, a 'quality of life framework' has been proposed by the UK Farm Animal Welfare Council (FAWC, 2009) identifying five opportunities for positive welfare in farmed animals: comfort, pleasure, confidence, interest and a healthy life. Although research into positive aspects of the welfare of dairy cattle is still limited, it is likely to become of increasing importance in the future. A modern dairy herd health program should include every aspect that influences the welfare of cows.

1.4 The citizen

The consumer and wider society have a legitimate interest in how food is produced, both from the perspective of whether the products they consume are produced in a manner they find acceptable as well as the extent to which farming itself affects the natural environment (Boogaard et al., 2008; Cardoso et al., 2017; Jackson et al., 2020). The fact that it involves care and management of live animals adds complexity to ethical assessments of livestock farming. Important issues that must be considered include food security, affordability and choice, animal welfare, impacts on local and wider landscapes and environments as well as the problem of antimicrobial resistance. The relative importance of these different factors depends on regional, economic and cultural differences. However, animal welfare should be an essential element underpinning any herd health program. Even though citizens in many parts of the world are separated from farming in terms of their own experience and understanding, it is still essential to take full account of wider social attitudes about how animals are farmed. An active, successful herd health program should help address these attitudes and provide a clear route in demonstrating high levels of health, welfare and husbandry on dairy farms. Improving health, welfare and husbandry are likely to improve other areas important to the citizen. As well as the environmental benefits from reduced emissions and antimicrobial use should be reduced by herd health management. Preventing, and therefore reducing, diseases is likely to reduce antimicrobial use on farms, thereby reducing the selection pressure for antimicrobial resistance (Hyde et al., 2017, 2019).

2 Key features of herd health management

In this section, we outline some key aspects of herd health management that are consistent between farms, countries and advisors. These features provide the foundation of herd health management. We also assess the particular role of veterinary practitioner within the herd health management team.

2.1 Population level focus

Herd health management is essentially applied epidemiology. The health and welfare of a herd are monitored at a population level, with interventions made to prevent disease and improve the health and welfare of the whole herd. This contrasts with considering health at an individual cow level by making a diagnosis and treatment plan for a sick animal. Both approaches are important. However, it is the population-level approach that distinguishes herd health management. This may not be immediately obvious to many veterinary practitioners whose training is traditionally weighted heavily toward the former rather than the latter. The population-level nature of herd health management tends to result in more preventive approaches compared to individual cow medicine although the two are linked. Individual animal diagnoses should commonly lead to considerations of disease issues at the herd level.

2.2 A holistic approach

In addition to being at a population level, herd health management considers the goals and motivations of farmers and the dairy business. A deep understanding of the owner's or manager's aspirations for the herd and farm as well as an understanding of the system in use are essential to ensure that recommendations are relevant to the dairy business being advised.

2.3 Data driven

Herd health management is informed by the regular and systematic collection and analysis of data from the farm. These data may consist of farmer records of management or treatments, external records such as those collated by milk quality laboratories from Dairy Herd Improvement (DHI) testing or data from cow and environmental sensors. These data are used to inform on-farm investigations and observations to identify and then manage risk factors. Effective herd health management relies on these data to facilitate on farm investigations and to drive high-quality decision-making.

2.4 Ongoing and cyclical

Effective herd health management is not a one-off intervention. Herd health management is a cyclical and iterative process. This distinguishes herd health management from both one-off problem-solving visits and occasional visits to audit compliance with standards and/or protocols for quality assurance. These alternative approaches have their merits and may be integrated into a wider herd health management program, but its continuous and iterative nature is what distinguishes herd health management. Herd health management relies

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