"Moneyball": A new approach to practice; building the perfect team and prioritizing problems in dairy herds

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Abstract

It is well known that transition cow diseases negatively affect reproductive performance; thus, profitability and welfare of dairy herds. Prevention of diseases at the herd level requires a constant effort and effective coordination of the total system (animals, environment, nutrition, and personnel). Substantial knowledge exists to prevent many diseases or conditions; however, it must be translated into on-farm applications or practices to have a meaningful effect at the herd level. Reproductive data of dairy herds throughout the United States showed that more than 73% of the variation in pregnancy risk (between bottom 10% and top 10% of herds) was due to management practices and/or environment. Fully trained and competent workers know what to do and how to do it, and have the skills and abilities to do the work. However, competent workers will often fail to perform when conflict or lack of satisfaction, motivation, and/or communication occur, resulting in lower work performance which affects the overall herd productivity. Frequent assessment of performance, educational needs, and training of dairy personnel should be top priorities for dairy operations to achieve a consistent and efficient herd performance over time. Practicing veterinarians regularly visit their clients and are ideally placed to identify at-risk dairy herds likely to benefit from personnel training (e.g., calving management), conflict management, and development of preventive standard operating procedures.

Key words: dairy, management, transition cow, disease prevention

Résumé

Il est bien établi que les maladies des vaches en transition ont un impact négatif sur la performance de reproduction et par conséquent sur la rentabilité et le bien-être des troupeaux laitiers. La prévention des maladies au niveau du troupeau demande un effort constant et une coordination adéquate de toutes les composantes du système (animaux, environnement, nutrition et personnel). Une vaste connaissance existe afin de prévenir plusieurs maladies ou conditions. Toutefois, elle doit se traduire dans des applications et des pratiques à la ferme pour se concrétiser au niveau du troupeau. Des données de reproduction dans des fermes laitières américaines ont montré que 73% de la variation dans le risque de gestation (dans la fourchette excluant les troupeaux dans le premier et le dernier décile) découlait de la régie des troupeaux et/ou de l'environnement. Des travailleurs compétents et dûment formés savent ce qu'il faut faire et comment le faire et possèdent les compétences et les aptitudes pour faire le travail. Toutefois, des travailleurs compétents vont souvent manquer à la tâche lorsque prennent place des conflits ou s'il y a un manque de satisfaction, de motivation ou de communication, entraînant un rendement inférieur qui influence la productivité du troupeau dans son ensemble. Une évaluation fréquente de la performance et des besoins de formation et d'éducation du personnel laitier devrait être hautement prioritaire dans les élevages laitiers afin de maintenir une performance constante et de haut niveau au fil du temps. Les vétérinaires en pratique visitent régulièrement leurs clients et sont donc idéalement à même d'identifier les fermes laitières à risque qui bénéficieraient de la formation du personnel (e.g. la régie du vêlage), de la gestion des conflits et du développement de procédures préventives d'opération normalisées.

Introduction

It is well known that transition cow diseases negatively affect reproductive performance; thus, profitability and welfare of dairy herds. The risk factors affecting dairy herd performance are multi-factorial and managerial in nature.[11,30] Inadequate nutrition,[16] cow comfort,[25] udder health,[1,32] heat stress, reproductive strategies,[7,20,22,38] and AI technique[2,10] negatively impact reproductive performance in dairy operations. Furthermore, calving-related losses such as stillbirth and uterine diseases (e.g., metritis) have been associated with management practices prior to and at calving,[24,36,37] and reduced reproductive performance.[12,28,33,43] Poorly designed facilities (e.g., stalls, flooring) and high stocking density (>100%) affect resting time and ruminating;[15,19] consequently, cows are at increased risk of developing hoof lesions and the subsequent suppression of estrous behavior[17] and reduced reproductive efficiency.[18,42]

Prevention of diseases at the herd level requires a constant effort and effective coordination of the total

system (animals, environment, and personnel [Figure 1]). Substantial knowledge exists to prevent many diseases or conditions; however, it must be translated into on-farm applications or practices to have a meaningful effect at the herd level. Transition-related losses (e.g., stillbirth, reproductive performance, milk yield) and welfare practices have become known challenges for the dairy industry worldwide, and management practices within-herd prior to and after calving have been associated with these problems.

Considering the complexity of a dairy production system, the objectives of the present article were: 1) to identify approaches for best work-team performance; 2) to identify strategies to improve dairy personnel performance (knowledge, skills, and attitude); and 3) to identify and rank within-herd risk factors to prevent calving-related losses while improving herd productivity and welfare. Case-based examples were provided to highlight the importance of management practices delivered by dairy personnel on the overall herd performance.

What Makes a Good Team?

In addition to regular full-time managers, many dairy operations are using advisory teams (veterinarians, nutritionists, consultants [Figure 2]) as a critical management tool to improve personnel performance, communicate strategies, resolve problems and conflicts, review or implement new protocols, and enhance decision-making (financial, feed inventory, herd health

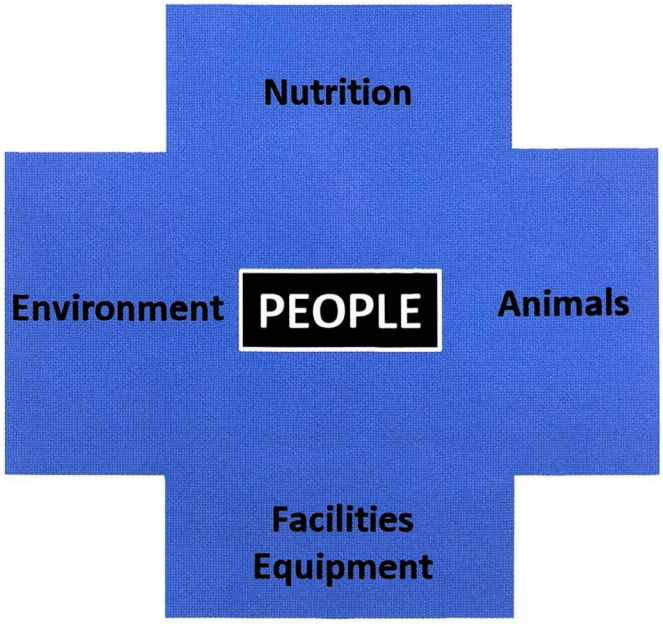

Figure 1. Interaction of dairy personnel with components of an integrated production system (animals, facilities/equipment, environment, and nutrition).

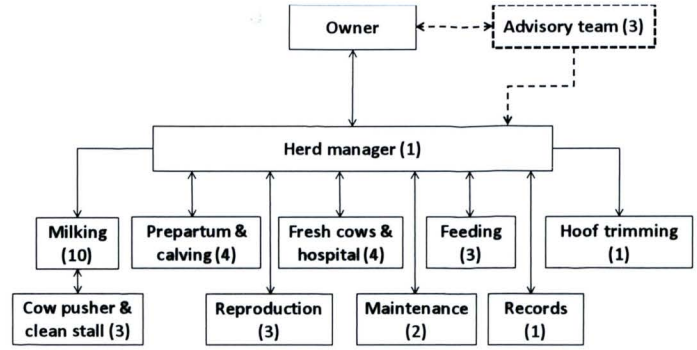

Figure 2. Organizational scheme of dairy herd with an estimated 5000 cows. The scheme shows the work teams assigned to manage milk and dry cows on a day-to-day basis. Additional work teams for crops-pastures (planting, harvesting) and replacement heifers are not shown.

performance). For effective teamwork and optimum herd performance, concepts about team building and development were discussed.

Clutterbuck[14] defined "team" as a small number of people with complementary skills who are committed to a common purpose, performing goals, and approaches, for which they hold themselves mutually accountable. A work team was defined as small groups of interdependent individuals who share responsibility for outcomes of their organization.[41] All people associated with a dairy farm can be considered as part of a team (i.e., owners, managers, workers, veterinarians, nutritionists, and consultants); however, the dairy farm is made up of 1 or several work teams, depending on the size of the operation (Figure 2). The focus for effectiveness should be placed on the work team because those in separate work teams within the operation, while committed to a common purpose or goal, do not necessarily share responsibility for outcomes. For example, a work team of those responsible for making hay or planting and harvesting crops has different outcomes than the work team in the milking parlor, caring for pariparturient cows, or those feeding lactating cows.

The following example illustrates the work teams, tasks, and interconnections (Figure 2): a large, family-owned dairy operation is managed by 1 herd manager, which oversees 31 dairy personnel distributed in 9 areas of the production system. Each of the 9 areas is led by 1 section manager. An external advisory team formed of 3 professionals (herd veterinarian, nutritionist, and accountant) is responsible for overall financial information (e.g., cost of production, feed-cow inventory, and replacements); herd health and nutrition recommendations, monitoring and interpretation of data; and training of personnel. The cow-labor ratio is approximately 143:1. In this example, all people associated with the farm are

considered part of the overall team, but as seen in Figure 2, there are actually 7 functional work teams within the farm (milking, cow pusher and clean stall, prepartum and calving, fresh cows and hospital, reproduction, feeding, and maintenance) and 2 individual tasks (hoof trimming and record-keeping). It is important for owners, managers, and/or advisory teams to recognize these distinctions and manage task assignments, communication, and training accordingly.

How to Build Effective Teams

Building effective teams requires: 1) top-level commitment and specific, clear, and agreed-upon goals; 2) trust and involvement between manager and employee; 3) willingness to take risks and share information; and 4) time, resources, and commitment to training.[27,40] It is critical that herd managers or owners spend quality time finding the right task for the right worker and matching responsibilities with appropriate work teams. Tests of knowledge and observation through hands-on demonstrations serve as valuable instruments to help identify those participants that are skilled and able to follow on-farm standard operating procedures (SOP).[40] When building a work team for calving management, managers should focus on selecting competent and meticulous personnel that share similarities (able to closely follow SOPs, practice good record-keeping, pay attention to details) to maximize the potential for team work and performance.[21,26] Additionally, building on employees' strengths and managing their weaknesses allow managers to achieve high personnel performance (Tables 1 and 2).[9,13] In dairy farms, owners and/or managers have greater authority and power in making decisions; therefore, they should assemble the work teams based on individual strengths and weaknesses by grouping personnel with complementary knowledge and skills.

Table 1. Effect of on-farm problems/issues at the time of training on dairy personnel knowledge, skills, and performance.

Parameter assessed	On-farm problem/ issue[§]		
	Yes	No	P
Knowledge[†], %	19	21	>0.05
Skills[‡], %	32	35	>0.05
Performance[*], %	4	23	<0.05

[†]Percentage points increase in knowledge gain by dairy personnel between pre- and post-test scores during a calving management workshop.
[‡]Percentage points increase in dairy personnel skills after calving management or milking routine training.
[*]Percentage points increase in dairy personnel performance after calving management or milking routine training.
[§]On-farm problem/issue was defined as self-reported conflict, lack of communication, disrespect, etc. with herd manager or co-worker by dairy personnel.

What Makes a Team Effective?

The following 6 characteristics of effective teams are critical to achieve high dairy personnel performance (adapted from Hackman[23] and Levi[29]): 1) clear directions (established SOPs) and objectives used to focus the team's efforts; 2) open communication practices and routinely monitor/discuss personnel performance; 3) skillful herd managers that facilitate team interactions and assist individuals when problems or conflicts occur; 4) skillful managers that can execute day-to-day tasks; 5) appropriate resources and equipment/facilities to perform the tasks; and 6) create a trusted and respectful working environment to allow team members to implement decisions. The use of established SOPs and hands-on training for work team members will likely improve personnel performance and ensures all workers understand the tasks, thereby achieving consistent herd performance and outcomes over time. Managers need to make sure that workers correctly understand the task and properly implement SOPs by practicing open communication and allowing workers to ask questions for further clarification (Table 2). Those who do not fully understand the task or are fearful of questioning will return to work, but fail to properly implement the SOPs (Table 2). Therefore, herd performance will likely suffer because of poor implementation of SOPs.

Do Workers Know and Understand the Purpose of the Team?

Dairy personnel should be familiar with the purpose of the team: 1) why it exists, 2) how it relates to the overall farm strategy, 3) to whom it is responsible, and 4) how it will benefit the farm. Under field conditions, an effective team worker shares the following qualities (adapted from Brounstein[8]): 1) demonstrates reliability, 2) communicates constructively, 3) listens actively, 4) functions as an active participant, 5) shares information openly and willingly, 6) shows commitment to the team, 7) works as a problem-solver, and 8) treats others in a respectful and supportive manner. In practice, dairy personnel should know and understand their role and purpose and why it is important.

How Do We Identify the Right People for the Right Job?

Finding well-qualified workers is a challenging task for dairy farmers, and it is very painful to lose them. Identifying cows in need of calving assistance, following the proper milking routine procedure, and consistent delivery of total mixed ration (TMR), among others,

Table 2. Effect of two dairy herd manager styles on the effectiveness of communication, implementation of task following SOP, and turn over of personnel.

Manager styles‡	Manager	Dairy Personnel	
	Communication of task	Implementation of task following SOP	Turnover
Tolerates wide range of personality styles, accepts and manages errors, calm but firm on decisions, and always rewards/acknowledges success†	Yes	More likely	Less likely
Does not tolerate wide range of personality styles or accept errors without consequences, often overreacts on decisions, and seldom rewards/acknowledges success*	Yes	Depends on interpretation of the task at the time of communication	More likely

‡The manager styles illustrate two different management approaches to execute on a day-to-day basis standard operating procedures (SOP) at the herd level.
†This description represents a herd manager that focuses on active listening, interact with workers on a daily basis, and anticipate and/or solve personnel issues.
*This description represents a herd manager that uses a "no questions" or "do what I say" approach, focuses on task execution, interact with workers on a daily basis, and prefer new workers as opposed to manage personnel issues.

are critical tasks (Figure 2) that require well-trained workers and established SOPs for optimal outcomes. Practicing veterinarians regularly visit their clients and are ideally placed to identify at-risk dairy herds likely to benefit from personnel training (e.g., calving management) and development of SOPs.

Personnel Knowledge, Skills, and Attitude

It is critical that herd managers or owners spend quality time finding the right task for the right worker. This is perhaps the most important task when building effective work teams within dairy operations for consistent outcomes over time. For calving management personnel, characteristics such as attention to details (able to follow the established SOP), knowledge level, and skills were significantly associated with stillbirth.[35,37,39,40] However, the assessment of attention to details requires close observation and monitoring of personnel by the herd manager or trainer. Training schools for dairy personnel are a critical management tool, and the use of tests of knowledge (pre- and post-tests) and supervised hands-on training provide a metric to assess personnel's level of knowledge, skills, and meticulousness.[40] It is important to note that calving personnel need sufficient time to practice and gain confidence (learning-by-doing approach) to successfully apply the newly learned skills within their context or systems. Fully trained and competent workers know what to do and how to do it, and have the skills and abilities to do the work; however, competent workers will often fail to perform if they have poor attitude due to conflict, lack of satisfaction, motivation, or communication (Table 1). Poor attitude results in lower work performance, affecting overall herd performance.

Although on-farm SOPs are essential management tools for modern dairy operations that summarize critical information or steps involved in a particular task or procedure (e.g., management of dystocic births, TMR, milking routine), they should not be used as the only source of information for dairy personnel. Learning from a set of descriptive bullets, as in most SOPs, carries a real risk for mistakes because calving personnel might not understand the whole process. For instance, dairy personnel attending a calving training workshop shared examples of unclear recommendations such as "wait 2 hours and assist cows experiencing difficult births" or "if there is no calving progress call for help".[40] The SOP for calving management must provide clear reference landmarks for time zero (when to start counting) and signs of the normal progression of calving; otherwise, most calving personnel would not be able to correctly follow the above recommendations.

Tracking Personnel Performance and Turnover

Frequent assessment of performance, educational needs, and training of dairy personnel should be top priorities for dairy operations to achieve a consistent and efficient herd performance. It is common to observe large within-herd variation in milking personnel performance (MPP) and turnover (TO) over time. Assessing team performance, resolution of conflicts, and comprehensive training of dairy personnel are critical management tasks to achieve consistent performance in dairy herds (Table 2). One of the positive aspects about turnover is that it provides opportunities for remaining team members to increase or change responsibilities. Some herds keep a multi skilled person(s) who serves as the trainer and is readily available, not allocated to any specific

mandatory daily role on the farm, which can be used to plug the gaps caused by absentees to help maintain productivity levels. This person could assist training new employees, has flexibility in everyday responsibilities to fill in for absentees, and keeps busy when fully staffed by helping wherever needed to increase overall productivity.

Recently, the effect of MPP (95% vs 85%) and TO of personnel (5% vs 30%) on milk losses of dairy herds were assessed.[34] For the simulation, the performance of each worker (compliance with milking routine protocol) was set to 85% or 95%. Milk losses were set at 1 kg/cow/day due to lack of udder stimulation (cows at risk).[31] An adjustment period of 14 days with a 66.5% performance was estimated for each new worker. The overall risk performance (%; RP) was estimated taking into account the team milking performance and TO. The number of cows at risk (cows/day) was estimated based on the RP (10 workers) and herd size (2000 cows). Milk price was set at $0.41/kg. Costs for herd audit were set at $1000 and training program at $1000 (for 4 sessions per year). Milk losses ($/year/cow) and return on investment (ROI) were estimated. For this analysis, losses associated with the time and resources spent in recruitment, selection, and hiring as well as the orientation and initial training of new personnel were not included.[5,6]

For a 2000-cow herd, the overall effect of TO (5% vs 30%) on milk losses was $6744 while the overall effect of RP (85% vs 95%) on milk losses was $27920. Cows at risk and milk losses were higher ($14 per cow/year) for RP 85% with 30% TO (342 cows/day) compared with RP 95% with 5% TO (110 cows/day). The ROI for high performance teams (RP 95% and 5% TO) was $18 for every $1 invested (herd audit and training). The estimated ROI assumes that equipment/facilities are adequate, participants are willing to learn and apply the newly learned concepts, and the herd audit correctly identifies the needs. These findings suggest that both TO and RP affect the bottom line of dairy herds.

How Can We Help Farmers Prioritize Challenges on the Farm?

The use of defined events (e.g., stillbirth, metritis, retained fetal membranes, lameness) should be perhaps the first step to prevent transition cow problems under field conditions. It is very difficult to manage what cannot be measured and incorrect or missing data often leads to erroneous conclusions or management decisions. Many factors influence the reproductive and productive performance of dairy herds; thus, profitability. For instance, it is common to observe large between herd variation in pregnancy risk (PR) of lactating dairy cows. Reproductive data from 8,211 dairy herds obtained from the Dairy Records and Management Systems in 2010 across the United States were used to estimate the mean 21-day PR and weighted averages (considering the number of herds and PR) for the bottom 10% and top 10% of herds. It was estimated an 8% PR for the bottom 10% of herds and 26% PR for the top 10% of herds with a mean PR of 16%. Furthermore, using a subset of 50 dairy herds, it was estimated that >73% of the variation in PR was due to management practices and/or environment. Successful identification of factors affecting reproductive performance at herd level can be challenging due to their multi-factorial nature. A herd assessment tool was developed to assess the overall herd performance taking into account personnel performance and their management practices.[3,4] The instrument ranks risk factors affecting herd performance such as stillbirth, retained fetal membranes, metritis, mastitis, lameness, body condition score, estrus detection, conception risk, cow-labor ratio, stocking density among others. This tool uses as inputs the actual herd data (from records or walk-through observation) and as outputs the ranking of risk factors affecting performance (e.g., PR, stillbirth, personnel).

Veterinarians often trouble-shoot poor reproductive performance in dairy herds, but this process requires constant monitoring and comprehensive assessment of several events. Because the herd management varies greatly from farm-to-farm, ranking of within-herd risk factors with greater contribution weights (e.g., stocking density, training) on PR is critical to implement corrective, step-by-step management strategies. Using data from one dairy herd previously assisted to improve PR (from 19% to 23%), the effectiveness of a herd assessment tool to aid in decision making about reproductive performance of dairy cows was assessed.[3,4] Risk factors [stillbirth, retained fetal membranes (RFM), metritis, mastitis, lameness, body condition score (BCS), estrus detection (ED), conception risk (CR), cow-labor ratio, and stocking density] were assessed according to their contribution weights on PR. Additionally, risk factors (one year before and after intervention) were compared with desired reference values to obtain the ranking of risk factors. According to the herd assessment tool, stocking density; metritis; lameness; and stillbirth were the top four risk factors explaining PR before intervention. Recommendations were close-up pen for dry cows; 85% stocking density for close-up and fresh cows; comprehensive training (calving management and hoof trimming) to dairy personnel; and no changes were made on nutrition and reproductive management. After intervention, the relative difference (change of risk factor values) was improved for stillbirth (45%), lameness (46%), metritis (33%), stocking density (13%), and mastitis (13%). No changes were observed for RFM (0%), BCS (0%), and cow-labor ratio (0%) while the relative differences for ED (3%) and CR (6%) were decreased after intervention.[4]

Conclusion

Decision support tools that combine sound biological knowledge of cows with the assessment of several factors at the same time affecting directly or indirectly a specific area of the production system and management strategies will likely allow herd managers and veterinarians to identify and rank the risk factors in a priority order. Every dairy farm is an integrated system and decisions made on one area of the farm will have an impact on other areas of the farm. Frequent assessment of performance, educational needs, and training of dairy personnel should be top priorities for dairy operations to achieve a consistent and efficient herd performance over time. The herd assessment tool could assist decision makers in focusing on real within-herd risk factors accounting for the effect of management and work team performance.

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References

1. Ahmadzadeh A, Frago F, Shafii B, Dalton JC, Price WJ, McGuire MA. Effect of clinical mastitis and other diseases on reproductive performance of Holstein cows. *Anim Reprod Sci* 112:273-282, 2009.
2. Bas S, Hoet A, Rajala-Schultz P, Sanders D, Schuenemann GM. The use of plastic cover sheaths at the time of artificial insemination improved fertility of lactating dairy cows. *J Dairy Sci* 94:793-799, 2011.
3. Bas S, Federico P, Schuenemann GM. I. Interactive index to identify and rank risk factors affecting reproductive performance of lactating dairy cows under field conditions. *J Dairy Sci* 95:656, 2012a.
4. Bas S, Nebel RL, Schuenemann GM. II. Identifying within-herd risk factors affecting reproductive performance of lactating dairy cows under field conditions. *J Dairy Sci* 95:177, 2012b.
5. Bliss B. The Advisor - Cost of Employee Turnover. www.isquare.com/turnover.cfm, accessed May 27, 2013.
6. Billikopf G, González G. Turnover rates are decreasing in California dairies. *California Agriculture* 66:153-157, 2012.
7. Britt JH. Enhanced reproduction and its economic implications. *J Dairy Sci* 68:1585-1592, 1985.
8. Brounstein M. Managing teams for dummies. Wiley Publishing Inc., Indianapolis, Indiana, 2009.
9. Buckingham M, Clifton DO. Now, discover your strengths. New York, NY: Free Press, 2001.
10. Caraviello DZ, Weigel KA, Craven M, Gianola D, Cook NB, Nordlund KV, Fricke PM, Wiltbank MC. Analysis of reproductive performance of lactating cows on large dairy farms using machine learning algorithms. *J Dairy Sci* 89:4703-4722, 2006a.
11. Caraviello DZ, Weigel KA, Fricke PM, Wiltbank MC, Florent MJ, Cook NB, Nordlund KV, Zwald NR, Rawson CL. Survey of management practices on reproductive performance of dairy cattle on large US commercial farms. *J Dairy Sci* 89:4723-4735, 2006b..
12. Chebel RC, Santos JEP, Reynolds JP, Cerri RLA, Juchem SO, Overton M. Factors affecting conception rate after artificial insemination and pregnancy loss in lactating dairy cows. *Anim Reprod Sci* 84:239-255, 2004.
13. Clifton DO, Nelson P. Soar with your strengths. New York, NY: Delacorte, 1992.
14. Clutterbuck D. Coaching the team at work. Boston, MA: Nicholas Brealey International, 2007.
15. Cooper MD, Arney DR, Phillips CJC. Two- or four-hour lying deprivation on the behavior of lactating dairy cows. *J Dairy Sci* 90:1149-1158, 2007.
16. Curtis CR, Erb HN, Sniffen CJ, Smith RD, Kronfeld DS. Path analysis of dry period nutrition, postpartum metabolic and reproductive disorders, and mastitis in Holstein cows. *J Dairy Sci* 68:2347-2360, 1985.
17. Diskin MG, Sreenan JM. Expression and detection of oestrus in cattle. *Reprod Nutr Dev* 40:481-491, 2000.
18. Faull WB, Hughes JW, Clarkson MJ, Downham DY, Manson FJ, Merritt JB, Murray RD, Russell WB, Sutherst JE, Ward WR. Epidemiology of lameness in dairy cattle: the influence of cubicles and indoor and outdoor walking surfaces. *Vet Rec* 139:130-136, 1996.
19. Fregonesi JA, Tucker CB, Weary DM. Overstocking reduces lying time in dairy cows. *J Dairy Sci* 90:3349-3354, 2007.
20. Galvão KN, Federico P, De Vries A, Schuenemann GM. Economic comparison of reproductive programs for dairy herds using estrus detection, timed AI, or a combination of both. *J Dairy Sci* 96:2681-2693, 2013.
21. Gibson JL, Ivancevich JM, Donnelly JH, Konopaske R. Organizations: Behavior, structure, process (13th ed.). New York, NY: McGraw-Hill, 2009.
22. Giordano JO, Fricke PM, Wiltbank MC, Cabrera VE. An economic decision-making support system for selection of reproductive management programs on dairy farms. *J Dairy Sci* 94:6216-6232, 2011.
23. Hackman JR. Leading teams: Setting the stage for great performances. Boston, MA: Harvard Business School Press, 2002.
24. Hunter A, Maquivar MG, Bas S, Workman JD, Schuenemann GM. Assessment of work shift transition of calving personnel on stillbirth in Holstein dairy cows. *J Dairy Sci* (Abst, accepted), 2013.
25. Huzzey JM, DeVries TJ, Valois P, von Keyserlingk MAG. Stocking density and feed barrier design affect the feeding and social behavior of dairy cattle. *J Dairy Sci* 89:126-133, 2006.
26. Janis IL, Mann L. Decision making: A psychological analysis of conflict, choice, and commitment. New York: Free Press, 1977.
27. Klein C, Diaz Granados D, Salas E, Le H, Burke CS, Lyons R, Goodwin GF. Does team building work? *Small Group Research* 40:181-222, 2009.
28. LeBlanc SJ, Duffield TF, Leslie KE, Bateman KG, Keefe GP, Walton JS, Johnson WH. Defining and diagnosing postpartum clinical endometritis and its impact on reproductive performance in dairy cows. *J Dairy Sci* 85:2223-2236, 2002.
29. Levi D. Group dynamic for teams. Thousand Oaks, CA: Sage, 2007.
30. Lucy MC. Reproductive loss in high-producing dairy cattle: where will it end? *J Dairy Sci* 84:1277-1293, 2001.
31. Rasmussen MD, Frimer ES, Harvath Z, Jensen NE. Comparison of a standardized and variable milking routine. *J Dairy Sci* 73:3472-3480, 1990.
32. Santos JEP, Cerri RLA, Ballou MA, Higginbotham GE, Kirk JH. Effect of timing of first clinical mastitis occurrence on lactational and reproductive performance of Holstein dairy cows. *Anim Reprod Sci* 80:31-45, 2004.
33. Sheldon IM, Lewis GS, LeBlanc S, Gilbert RO. Defining postpartum uterine disease in cattle. *Theriogenology* 65:1516-1530, 2006.
34. Schuenemann GM, Maquivar MG, Bas S, Workman JD. Effect of milking personnel performance and turnover on milk losses in dairy herds. *J Dairy Sci* (Abst, accepted), 2013.
35. Schuenemann GM, Nieto I, Bas S, Galvao KN, Workman J. I. Dairy calving management: Dystocia and timing for intervention. *J Dairy Sci* 94:744, 2011.

36. Schuenemann GM, Nieto I, Bas S, Galvao KN, Workman J. II. Dairy calving management: Effect of perineal hygiene scores on metritis. *J Dairy Sci* 94:744, 2011.
37. Schuenemann GM, Bas S, Gordon E, Workman J. III. Dairy calving management: Assessment of a comprehensive program for dairy personnel. J Dairy Sci 94:483, 2011.
38. Schuenemann GM, Federico P, De Vries A, Galvão KN. Timing to reach the new level of pregnancy and milk yield after an improvement in reproductive management in dairy herds. *J Dairy Sci* 94:257, 2011.
39. Schuenemann GM, Nieto I, Bas S, Galvão KN, Workman J. Assessment of calving progress and reference times for obstetric intervention during dystocia in Holstein dairy cows. *J Dairy Sci* 94:5494-5501, 2011.
40. Schuenemann GM, Bas S, Gordon E, Workman JD. Dairy calving management: description and assessment of a training program for dairy personnel. *J Dairy Sci* 96:2671-2680, 2013.
41. Sundstrom E, De Meuse KP, Futrell D. Work teams: Applications and effectiveness. *American Psychologist* 45:120-133, 1990.
42. Vanegas J, Overton M, Berry SL, Sischo WM. Effect of rubber flooring on claw health in lactating dairy cows housed in free-stall barns. *J Dairy Sci* 89:4251-4258, 2006.
43. Walsh RB, Kelton DF, Duffield TF, Leslie KE, Walton JS, LeBlanc SJ. Prevalence and risk factors for postpartum anovulatory condition in dairy cows. *J Dairy Sci* 90:315-324, 2007.
44. Wolfenson D, Roth Z, Meidan R. Impaired reproduction in heat-stressed cattle: basic and applied aspects. *Anim Reprod Sci* 60–61:535-547, 2000.