Cost-Effective Reproductive Programs for Lactating Dairy Cows: Economic Comparison of all Estrus Detection, all Timed-AI, or a Combination of Both

Published on: 5/19/2014

Author/s : Gustavo M. Schuenemann (The Ohio State University) and Klibs N.A. Galvão (University of Florida)

INTRODUCTION

The three largest expenses of the dairy business are: 1) feeding lactating dairy cows, 2) raising replacement heifers, and 3) labor. Reproductive performance of lactating dairy cows directly influences the annual frequency of calving (which affects the number of replacement heifers available) and milk yield (due to extended low productivity lactation and dry period).

Many factors such as feed management (Batch et al., 2008), cow comfort (Huzzey et al., 2005; 2006), uterine diseases (Sheldon et al., 2006; Brick et al., 2012), pregnancy loss (Santos et al., 2009), semen handling (Dalton et al., 2004) among other affect the conception risk (CR) and 21-day pregnancy rate (PR) of lactating dairy cows. Therefore, best transition cow management practices (during the weeks before and after calving) are key determinant for optimum reproductive performance of cows, economic success, and sustainability of dairy operations. Suboptimal reproductive performance leads to extended days open, increased culling due to reproductive failure, and decreased milk yield (Meadows et al., 2005; De Vries et al., 2010).

Choosing the most cost-effective reproductive protocol for the specific dairy herd is a critical managerial decision. 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. There are many reproductive tools available, from synchronization of ovulation to estrus detection programs (visual observation or measuring cow activity); but regardless of the tool a farmer may use, proactive management practices at the farm level matter when it comes to reproduction. Therefore, two key aspects of reproductive management were assessed to illustrate: (1) the economic outcome of reproductive programs using estrous detection (ED) and (2) the impact of improving 10 percentage points (from 85% to 95%) in both compliance and accuracy of ED on herd profitability. Additionally, it is common to observe large among-herd variation in culling risk within 60 DIM. Therefore, the effect of two culling risk strategies within 60 DIM (6% vs 12%) and two cow sale prices ($1.85 vs $1.37 per kg live weight) were compared using the same reproductive program and performance on the economic outcomes of dairy herds.

PARAMETERS AND ASSUMPTIONS

The following factors that are known to affect the economic benefits of three reproductive programs were assessed: (1) accuracy of ED (85% vs 95%) and (2) compliance with each injection of the synchronization protocol (85% vs 95%). Milk price was set at 0.33 or 0.44 $/kg and ED rate was set at 60%. The combinations of reproductive programs are provided in Table 1. The economic analyses were estimated using an individual-based model of a dairy herd (Galvão et al., 2013).

For the simulation, pregnancy to first AI was 33.9% and then decreased by 2.6% for every subsequent insemination and ED was set to 60%. Accuracy of ED (85% or 95%), and compliance with each injection (85% or 95%) of the AI protocol were evaluated. Inaccurate ED resulted in 0% CR. Missing a Presynch injection resulted in loss of 50% of the benefit, and missing an Ovsynch injection resulted in decrease in CR by 70%. Pregnancy diagnosis was performed at 32 days after AI and open cows were managed according to each reproductive program.

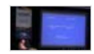
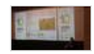
Cows were not AI after 366 days in milk (DIM) and open cows were culled after 450 DIM. Culled cows were immediately replaced with a nulliparous heifer 280 days pregnant to maintain the herd at 1000 cows (lactating and dry). Death losses were set at 6% and abortion at 11.3%. The dry period was set at 60 days. Net daily value was calculated by subtracting the costs with replacement heifers ($1,600/heifer), feeding costs as dry matter ($0.25/kg of lactating cow diet; $0.15/kg of dry cow diet), breeding costs [$0.10/cow/day for ED; $2.65/dose of prostaglandin F2alpha; $2.40/dose gonadotrophin releasing hormone (GnRH); $0.25/injection administration; $3.0 per pregnancy diagnosis], and other costs ($2.5/day to account for labor, veterinarian, and fixed costs) from the daily income with milk sales ($0.44/kg milk), cow sales ($1.65/kg live weight), and calf sales ($140/calf).

There is no single parameter that can fully describe and monitor the success of a transition cow management program. Typically, dairy herds with excellent transition cow health had less than 6% of culled cows within 60 DIM (Nordlund and Cook, 2004). Therefore, the same reproductive program as described above (TAI-ED-60-95; milk price was set at $0.44 per kg) and two culling risk strategies within 60 DIM (6% vs 12%) were used to estimate the economics of transition cow management (Schuenemann and Galvão, 2014). A sensitivity analysis was also performed using culled cow prices at $1.85 or $1.37/kg live weight to assess the effect of beef market variation on herd profitability (Schuenemann and Galvão, 2014).

RESULTS AND IMPLICATIONS

The distribution of CR, 21-day PR, DO, and PP at 366 DIM by breeding program is provided in table 1. The combination of TAI with ED, regardless of ED accuracy or TAI compliance, resulted in higher 21-day PR and reduced DO compared to ED or TAI programs (Table 1).

Table 1. Reproductive parameters for three programs that used 60% estrus detection only (ED; 85% or 95% accuracy), timed-AI only (TAI) with compliance (85 or 95%) with each injection of the TAI program, and combination of both.

DO, d	129	120	156	114	117	113
PP at 366 DIM	92.3	94.3	81.2	89.4	95.5	97.3

Click here to enlarge the image

Three reproductive programs that used 60% estrus detection only (ED; 85% or 95% accuracy), timed-AI only (TAI) with compliance (85 or 95%) with each injection of the TAI program, and combination of both were compared:

ED-60-85: 60% estrus detection only with 85% accuracy of ED.

ED-60-95: 60% estrus detection only with 95% accuracy of ED.

TAI-85: timed-AI only with 85% compliance with each injection of the TAI program.

TAI-95: timed-AI only with 95% compliance with each injection of the TAI program.

TAI-ED-60-85: timed-AI with 85% compliance with each injection of TAI program combined with 60% ED with 85% accuracy of ED.

TAI-ED-60-95: timed-AI with 95% compliance with each injection of TAI program combined with 60% ED with 95% accuracy of ED.

SR = service rate; CR = average conception risk; 21-d PR = 21-day pregnancy rate; DO = mean days open; and PP at 366 DIM = proportion of pregnant cows at 366 days in milk.

†Adapted from Galvão et al., 2013.

The proportion of cows culled, replacement costs, and breeding costs determined the annual profit. Combination of TAI with ED, with good compliance (95%) and accuracy (95%), will provide the best return on investment. Furthermore, ED program is better than TAI with similar accuracy and compliance, but TAI with good compliance is better than ED with poor accuracy (Table 2). Assuming that the herd size remains constant, combination of TAI with ED (95% compliance and accuracy of ED; TAI-ED-60-95) resulted in the greatest profit ($1,616), followed by ED ($1,585.5 and $1,567.9) and TAI only ($1,483.4 and $1,559.5; Table 2). Although milk prices ($0.33 vs $0.44) significantly affected profitability, most of the economical benefits between TAI-ED-60-95 and TIA-85 programs are due to increased culling risk (11 percentage points) because of reproductive failure and replacement costs (Table 2).

Table 2. Distribution of cows and economical ($/cow/year) outcomes for three programs that used 60% estrus detection only (ED; 85% or 95% accuracy), timed-AI only (TAI) with compliance (85% or 95%) with each injection of the TAI program, and combination of both.

		Economics of Breeding Programs†					
Parameters		**ED-60-85**	**ED-60-95**	**TAI-85**	**TAI-95**	**TAI-ED-60-85**	**TAI-ED-60-95**
Lactating, %		87.4	86.9	88.6	87	86.3	85.6
Culling risk, %		34.5	33.4	38.9	33.1	29.6	27.8
Milk, kg/cow/d		33.7	33.9	33.2	33.6	34	34.2
Replacement costs, $		552.6	534	622.7	529	473.4	444.5
Breeding costs, $		100	96.6	104.8	92	135.5	126.3
Profit, $	at $0.33	324.6	348.3	237.2	315.5	333.5	375.2
	at $0.44	1,567.9	1,585.5	1,483.4	1559.5	1,582.8	1,616.0

Click here to enlarge the image

For comparison purposes, the price of milk was set at $0.33 or $0.44 per kg.

†Adapted from Galvão et al., 2013.

Culling risk within 60 DIM (fresh cows) is referring to the number of sold lactating cows removed from the herd (due to health/injury events or performance) and expressed as a percentage of the number animals that calved. According to the model (same herd size, synchronization program, reproductive performance, and feeding costs), the annual profit for a 1000-cow herd was $55,480 higher for herds with 6% compared to 12% culling risk within 60 DIM when culled cow sale price was $1.85 (Table 3; Schuenemann and Galvão, 2014). When the culled cow sale price was $1.37/kg and replacement costs remain the same, the annual profit was $80,300 higher for herds with 6% compared to 12% culling risk within 60 DIM (Table 3; Schuenemann and Galvão, 2014). Early removal of lactating cows from the milking herd due to poor transition cow management significantly affects the annual profit of dairy operations.

Table 3. Economics of transition cow management program in dairy herds.

	Cull Price ($/kg live weight)	
Variables	**$1.85**	**$1.37**
Profit, culling risk 6%[1]	$1,877,195	$1,801,275
Profit, culling risk 12%[1]	$1,821,715	$1,720,975
Difference in profit (6% - 12% culling risk)[1]	$55,480	$80,300

[1]Calculated for 1000-cow herd. Milk price was set at $0.44 per kg.

Click here to enlarge the image

[1]Calculated for 1000-cow herd. Milk price was set at $0.44 per kg.

TAKE HOME MESSAGE

after AI) and resynchronization of non-pregnant cows, will improve PR, reduce days open, and increase the overall profit of the herd. Designing and implementing a proactive transition cow management program (from cow comfort to personnel training) will significantly reduce calving-related losses, optimize reproductive performance of lactating cows, and increase profitability of the herd regardless of the reproductive program used.

References

Bach, A., N. Valls, A. Solans, T. Torrent. 2008. Associations between nondietary factors and dairy herd performance. J Dairy Sci. 91:3259-3267.

Brick T.A., G.M. Schuenemann, S. Bas, J.B. Daniels, C.R. Pinto, D.M. Rings, and P.J. Rajala-Schultz. 2012. Effect of intrauterine dextrose or antibiotic therapy on reproductive performance of lactating dairy cows diagnosed with clinical endometritis. J. Dairy Sci. 95:1894-1905.

Dalton, J.C., A. Ahmadzadeh, B. Shafii, W.J. Price, and J.M. DeJarnette. 2004. Effect of simultaneous thawing of multiple 0.5-ml straws of semen and sequence of insemination on conception rate in dairy cattle. J. Dairy Sci 87:972-975.

Dubuc, J., T.F. Duffield, K.E. Leslie, J.S. Walton, and S.J. LeBlanc. 2011. Effects of postpartum uterine diseases on milk production and culling in dairy cows. J. Dairy Sci. 94:1339-1346.

De Vries A., J.D., Olson, and P.J., Pinedo. 2010. Reproductive risk factors for culling and productive life in large dairy herds in the eastern United States between 2001 and 2006. J. Dairy Sci. 93:613-623.

Galvão K.N., P. Federico, A. De Vries, and G.M. Schuenemann. 2013. Economic comparison of reproductive programs for dairy herds using estrus detection (ED), Ovsynch, or a combination of both. J. Dairy Sci. 94:257.

Huzzey, J.M., M.A.G. von Keyserlingk, and D.M. Weary. 2005. Changes in feeding, drinking, and standing behavior of dairy cows during the transition period. J. Dairy Sci. 88:2454-2461.

Huzzey, J.M., T.J. DeVries, P. Valois, and M.A.G. von Keyserlingk. 2006. Stocking density and feed barrier design affect the feeding and social behavior of dairy cattle. J. Dairy Sci. 89:126-133.

Meadows, C., P.J. Rajala-Schultz, and G.S. Frazer. 2005. A spreadsheet-based model demonstrating the nonuniform economic effects of varying reproductive performance in Ohio dairy herds. J Dairy Sci, 88:1244-1254.

Nordlund, K.V., and N.B. Cook. 2004. Using herd records to monitor transition cow survival, productivity, and health. Vet. Clin. Food Anim. 20:627-649.

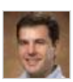
Santos, J.E.P., H.M. Rutigliano, and M.F.S. Filho. 2009. Risk factors for resumption of postpartum estrous cycles and embryonic survival in lactating dairy cows. Anim. Reprod. Sci. 110:207-221.

Sheldon, I.M., G.S. Lewis, S. LeBlanc, and R. Gilbert. 2006. Defining postpartum uterine disease in cattle. Theriogenology 65:1516-1530.

Schuenemann G.M., P. Federico, A. De Vries, and K.N. Galvão. 2011. 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.

Schuenemann G.M., and K.N. Galvão. 2014. Economics of transition cow management of dairy herds. J. Dairy Sci. (abstract accepted).

Author/s



Gustavo M. Schuenemann
DVM, MS, PhD, Assistant Professor Co-Project Director, Extention Component Leader at the Ohio State University.