DAIRY RESEARCH

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Does testing and treating cows with propylene glycol pay?

The Impact of Subclinical Ketosis in Large

Prevalence of subclinical ketosis (SCK) on well-managed TMR fed freestall herds in the Northeast and upper Midwest is high and costly. Current research shows that treating SCK cows with propylene glycol is cost-effective in almost all scenarios until preventive management strategies are implemented.

Although all cows visit a state of negative energy balance as they transition from late gestation to early lactation, some cows do this less smoothly, resulting in milk loss, disease, poorer reproduction, and even death or culling. Similarly, certain herds face more challenges when managing the transition period.

To combat this negative energy balance cows supplement food eaten with fuel from body stores. And they break down fat to produce non-esterified fatty acids (NEFA), some of which are converted to ketones (e.g., B-hydroxybutyrate; BHB) when the liver is overwhelmed with NEFA. At the herd level, management and nutrition should be optimized to meet the cow's energy needs, minimize the length and depth of negative energy balance, and maintain a desired level of milk production.

Some amount of both NEFA and BHB are normal in early lactation ruminants, however, excessive amounts of either can lead to increased risk of disease, decreased reproductive performance and decreased milk production. Ketone monitoring and evaluation can be less expensive and more practical than NEFA monitoring, although NEFA concentrations are a bit more predictive. Additionally, some cow-side ketone tests also offer a high degree of accuracy. The most common fluids used for ketone tests, presented in order of increasing accuracy, are: urine (e.g. Ketostix®), milk (e.g. KetoTest™), and blood (e.g. Precision Xtra™ Meter). The blood meter, a hand-held device originally designed for use in humans with diabetes, costs about $30 and the test strips cost around $1.50 per sample when purchased through your veterinarian. This test is very accurate (>96% sensitivity and 99% specificity) and gives a cow-side answer in about 10 seconds.

To establish an objective BHB threshold which could be used to monitor both individual cows and herds for subclinical ketosis (SCK), a Cornell University study evaluated a sample of 100 TMR-fed, free-stall herds located in the northeast, with good computer records. Subclinical ketosis is defined as having an excessive BHB concentration that is associated with increased risk of disease, but is below clinical ketosis (CK) levels. In this study, the cut-point for SCK was identified as ≥ 1.2 mmol/L for cows 3 to14 days in milk (DIM). Cows in this range were 10 times more likely to develop a displaced abomasum (DA), and/or CK, and/or metritis when compared to cows with BHB concentration less than 1.2 mmol/L. These SCK positive cows were also twice as likely to leave the herd and produced less milk (~1000 lbs/cow/lactation) than their healthy counterparts.

Based on information from 60 herds in the study, when more than 15% (3 out of 15) of animals sampled from 3 to 14 DIM had BHB concentrations > 1.2 mmol/L, these herds had a 1.8% increased incidence in DA and CK in the first 30 DIM and a 1% lower 21-d pregnancy risk compared to herds with less than 15%. If more than 15% of cows had BHB concentrations above 1.2 mmol/L, the herd ME 305 milk average was considerably less; approximately

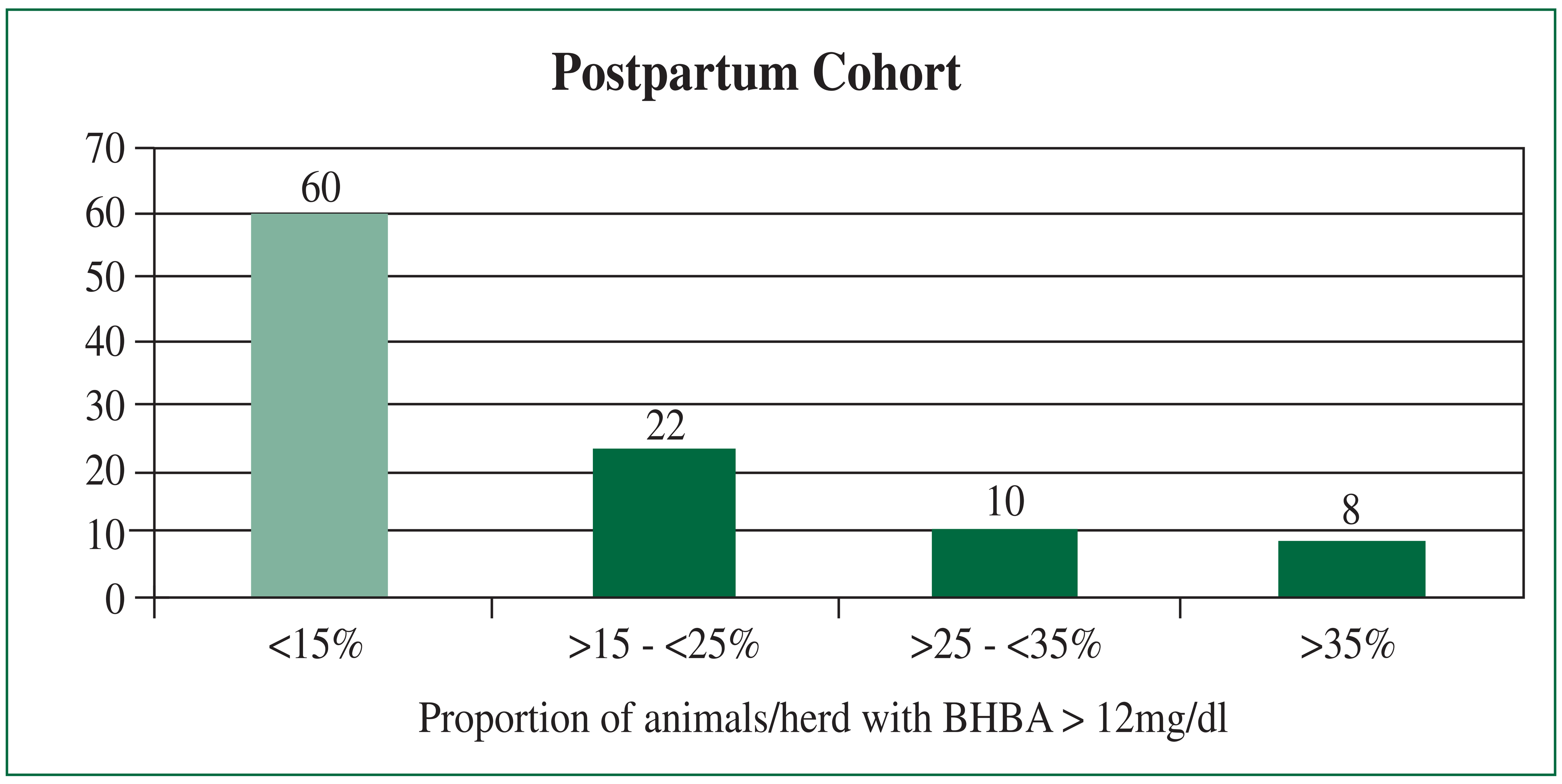

Figure 1. Prevalence of herds showing the percent of sampled animals within herd above BHB > 1.2 mmol/L (~12mg/dl). 40% of herds were above the herd alarm level of 15% of sampled animals.

FYI

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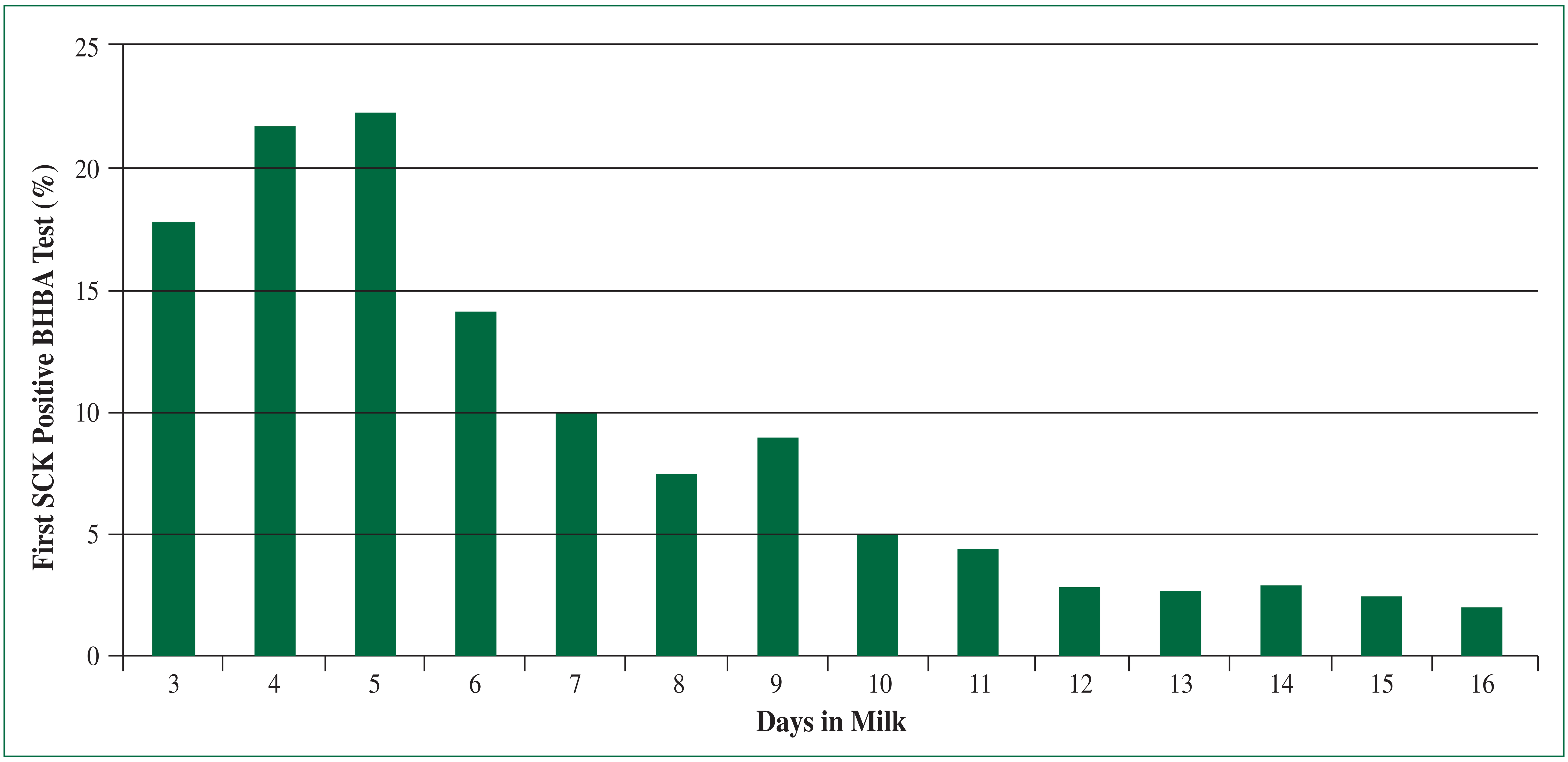

Figure 2. Incidence of subclinical ketosis (B-hydroxybutyrate > 1.2 mmol/L) by days in milk of test.

1,100 pounds less per cow.

It is important to note that these herds were not chosen to participate in the study due to any issues with metabolic disease. Within herds only cows that appeared healthy were sampled. To be included in the study, a cow could not have already developed a DA, CK or metritis. Despite these selection criteria, the prevalence of herds above the herd alarm level was 40%. Being above the herd alarm level means that more than 15% of sampled animals had BHB concentrations > 1.2 mmol/L.

In the study prevalence, an estimate of existing cases of disease, was used to evaluate the effect of SCK on herd performance. Estimating herd prevalence can be done very quickly, and it is recommended to sample at least 15 to 20 healthy animals between 3 to 14 DIM and record how many of the animals sampled have BHB concentrations > 1.2 mmol/L. For example, if 20 animals are sampled and 4 have a BHB concentration ≥ 1.2 mmol/L, then the prevalence is 20% (4/20) and the herd is considered at increased risk for negative downstream outcomes.

Although prevalence is a very useful measurement, the incidence of a condition sometimes gives different information. Incidence is defined as the number of cows that develop a new case of SCK, divided by all the animals at risk. If, for example, 15 cows within a group of 50 sampled cows develops a new case of SCK sometime from 3 to 16 DIM, the incidence is 30% (15/50). The incidence of SCK is approximately twice the prevalence.

A more recent study by researchers at Cornell and the University of Wisconsin followed 1,717 cows from 3 to 16 DIM in 4 free-stall, TMR-fed herds. Using the Precision Xtra meter, all cows that calved within the study period were monitored for SCK, defined as a BHB concentration of 1.2 – 2.9 mmol/L. Cows were tested on Mondays, Wednesdays and Fridays. Each cow was sampled six times, beginning at 3, 4 or 5 DIM and ending on 14, 15 or 16 DIM. The highest incidence of SCK occurred at 5 DIM, with 75% of cows that developed SCK testing positive for the first time from 3 to 7 DIM. Cows that tested SCK positive from 3 to 7 DIM were over 6 times more likely to develop a DA, 4.5 times more likely to be removed from the herd, 0.7 times as likely to conceive to first service, and made almost 5 pounds less milk per cow per day for the first 30 DIM than cows first testing SCK positive between 8 and 16 DIM. Thus it is important to identify these SCK cows early in lactation to reduce the risk of negative downstream events.

The above study also looked at risk factors in dry cows to help predict which cows developed ketosis between 3 and 5 DIM, as most cows first develop SCK during this time, and are at a higher risk for negative events than cows that first develop SCK later in lactation. Cows with pre-calving NEFA ≥ 0.30 mEq/L were almost two times more likely to develop ketosis than cows with NEFA < 0.30 mEq/L. Similarly, cows birthing male calves were 1.8 times more likely to develop ketosis than cows birthing female calves. In addition, cows with a calving ease ≥ 3 on a scale of 1 to 5 were 2.6 times more likely to develop ketosis than cows with a calving ease < 3, cows that gave birth to a dead calf were 2.2 times more likely to develop ketosis than cows that gave birth to a live calf, and parity ≥ 3 cows were 3 times more likely to develop ketosis than their younger herdsmates. Thus for herd managers and owners who choose to focus their ketosis testing, rather than to test all fresh cows, should pay special attention to cows with high pre-calving NEFA, older cows and cows that have had difficulty birthing.

The same study evaluated the benefits of daily oral drenching of propylene glycol in cows diagnosed with SCK. The first time a cow tested positive for SCK she was randomized to either the treatment group where she received 300 mL (10 oz) of propylene glycol by oral drench once daily until she tested < 1.2 mmol/L or the control group where she was not given propylene glycol. Most cows were treated for 5 days. The SCK positive cows treated with propylene glycol were almost half as likely to develop a DA, half as likely to be removed from the herd, and on some farms made more milk (3 pounds per cow per day) in early lactation than SCK cows not given propylene glycol. In addition, SCK cows treated with propylene glycol were more likely to conceive at first service. Based on this study and the expected duration of SCK, treatment of SCK positive cows with a 5 day course of daily propylene glycol drenching is suggested.

A partial budget was developed to assess the benefit:cost ratio of different SCK testing scenarios and treatment with propylene glycol. On a herd level, the most cost-effective method depends on the herd SCK incidence. This analysis evaluated four different testing and treatment strategies at varying herd SCK incidences. Results indicate that at herd SCK incidences above 50%, blanket treatment of all fresh cows with 5 days of oral propylene glycol starting at 5 DIM is the most cost-effective strategy. At incidences between 15 and 50%, testing cows that are 3 through 9 DIM two days per week (e.g. Mondays and Thursdays) and treating SCK positive cows with 5 days of oral propylene glycol is the most cost-effective strategy; although testing all cows that are 3 through 16 DIM one day per week (e.g. Mondays) will also provide a positive return on investment. For a herd with a 40% incidence of SCK that freshens 1,000 cows per year, choosing to test cows two days per week and treat the positives will benefit $10,000 to $25,000 per year.

It may be easier to first conduct a SCK prevalence test (sample 15 to 20 cows) on a herd to approximate the herd incidence and determine the best test and treatment plan. For those herds with an estimated incidence greater than 50%, where blanket treatment with PG is initiated, repeated prevalence testing may be necessary after management changes to determine if treating all fresh cows remains the best option. For herds with an incidence from 15 to 50%, either the one day per week or two day per week testing strategies will allow for repeated monitoring of herd incidence. It is important to remember that herds where cows are tested from 3 to 9 DIM should assume that only 80% of the cows that will develop SCK between 3 and 16 DIM are identified. Repeated incidence or prevalence testing is recommended to evaluate changes in transition cow management and to allow appropriate adjustment of farm SCK testing and treatment protocols. Remember the goal is to not treat many, if any, cows with propylene glycol, but rather have transition cow management strategies in place to lower the prevalence of SCK to less than 15%.

SCK is a condition not recognized clinically until it predisposes cows and herds to higher incidences of transition cow diseases, lower milk production, and lower milk production. Thus it is costly. Work with your management team to develop a testing strategy to assess your level.

Feed Lower-Starch Diets to Fresh Cows?
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weight and body condition, and concentrations of serum nonesterified fatty acids (NEFA) and hydroxybutyrate (BHBA). Serum NEFA tended to be higher for cows fed MH than cows fed LL or HH.

This study demonstrated that lower-starch (23%) diets can support lactational performance following a high-fiber, controlled-energy dry diet. Some keys to making lower-starch lactation diets work include use of high quality forages and nonforage fiber sources and increasing the sugar content. The step-up diet approach (MH) may be preferred over the 1-group lactation diet approach (LL and HH) because of improvements in nutrient use (i.e. milk nitrogen efficiency). However, the 1-group lactation diet approach (LL) may be preferred when energy from corn starch is expensive relative to energy from nonforage fiber sources or when a facility does not have the ability to have 2 groups in early lactation.

	Dietary Treatment			
Item	**LL**	**MH**	**HH**	**P - value**
DMI, lb/d	55.4^{x}	54.8^{xy}	52.1^{y}	0.06
Starch intake, lb/d	11.7^{b}	13.9^{a}	13.4^{a}	<0.01
Rumen fermentable starch, lb/d	9.7^{b}	11.4^{a}	11.0^{a}	<0.01
Neutral detergent fiber intake, lb/d	19.8^{a}	17.8^{b}	16.7^{b}	<0.01
Milk, lb/d	105.4a^{b}	109.8^{a}	97.2^{b}	0.04
3.5% Fat-corrected milk, lb/d	114.2	114.8	104.3	0.09
Solids-corrected milk, lb/d	104.3	105.4	95.7	0.09
Fat, %	3.88^{x}	3.64^{y}	3.79^{xy}	0.08
True protein, %	2.90	2.92	2.97	0.52
Milk urea nitrogen, mg/dL	15.2^{a}	12.7^{b}	11.9^{b}	<0.01
Milk/DMI, lb/lb	1.92	2.02	1.87	0.18
Milk nitrogen efficiency, %	34.2^{b}	37.6^{a}	35.6^{ab}	0.005
Serum NEFA, µEq/L (1-21 DIM)	452^{aby}	577^{ax}	431^{by}	0.03
Serum BHBA, mg/dL (1-21 DIM)	9.3	8.8	7.8	0.15

^{ab} *Least squares means within a row without a common superscript differ (P 0.05).*
^{xy} *Least squares means within a row without a common superscript differ (P 0.10).*