The Seven Habits of Highly Successful Milking Routines

Pamela L. Ruegg

Dept. of Dairy Science,1675 Observatory Dr.,Madison WI 53706
Email: plruegg@wisc.edu

Take Home Messages

- The consistent implementation of standardized milking practices such as forestripping, predipping, the use of single towels to dry teats and well-defined milking routines are essential aspects of quality milk production.
- All farms should utilize a milking routine that includes the following steps: Predipping – with a minimum contact time of 30 seconds; Forestripping – the only method to detect mild-moderate clinical mastitis; Adequate drying of teats; Attachment of the milking unit within 1- 2 minutes; Prompt removal of the milking unit when milking is completed; effective post-milking teat disinfection
- Implementation of these practices is dependent on the ability to clearly communicate the value of these practices and to motivate milking personnel to consistently apply them.
- The managerial tasks of running a dairy farm must include the development of written milking procedures and must value continual training for milking personnel.

Introduction

The efficient production and harvest of high quality milk is the goal of most dairy farmers. High quality milk is visually appealing, free of adulteration and meets specific quality standards for somatic cell count (SCC), and bacteria. The highest quality milk usually has a SCC of less than 200,000/ml. Producers of high quality milk know that a consistent method of premilking udder hygiene and the uniform attachment of properly functioning milking machines are important. The objective of milking management is to ensure that teatcups are applied to visibly clean, well stimulated teats, milk is rapidly and efficiently harvested and milking units are removed when milking is completed. A number of milking routines are used on dairy farms but no

WCDS Advances in Dairy Technology (2006) Volume 18:317-326

single milking practice will independently result in improved milk quality in the face of overwhelming exposure to mastitis pathogens. Good milking practices that are consistently applied to clean, well-handled cows will result in the production of high quality milk. Management practices used to improve milk quality are interdependent and the secret of producing high quality milk is to consistently use well-defined milking practices that reduce exposure to mastitis pathogens. The "one size fits all" approach doesn't apply to milking routines, but there are seven principles of highly successful milking routines that contribute to the production of high quality milk.

■ HABIT 1. Cows are Calm and Clean before Milking.

Cow cleanliness is a major determinant of both milking efficiency and the rate of intramammary infection. Several studies have identified relationships between cow cleanliness and measures of milk quality. Udder hygiene scores (UHS) can be easily and efficiently obtained during milking using a visual scoring system (Schreiner and Ruegg, 2003). This system was used to repeatedly score 1250 dairy cows housed in freestalls on 8 Wisconsin dairy farms (Schreiner and Ruegg, 2003). Cows were categorized as "clean" (UHS of 1 or 2) or "dirty" (UHS of 3 or 4). Somatic cell counts and subclinical mastitis infections were higher for animals categorized as "dirty." Significantly more environmental and contagious mastitis pathogens were recovered from milk samples obtained from cows with dirty udders as compared to cows with clean udders. Hygiene scores of udders should be routinely performed as a quality control measure just as body condition scores are performed to monitor nutritional management.

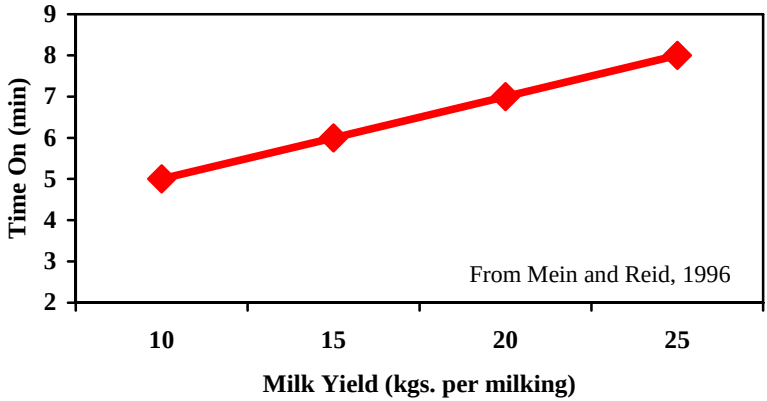
Cow handling is an important determinant of milking time efficiency. The release of adrenaline within 30 minutes of milking can interfere with milk letdown and prolong unit on-time. Cattle have varying abilities to recognize and respond to animal caretakers. Some cows have large responses to behavior of handlers and others have small responses. Typical responses include avoidance of handlers (flight distance) stepping and kicking during milking and increased amounts of residual milk. Calm cows enter the milking parlor readily and do not generally defecate in the milking parlor. If a number of cows are refusing to enter the parlor or are defecating frequently in the milking parlor, operator and parlor performance should be examined.

■ HABIT 2. Cows are Grouped

There are at least 2 non-nutritional reasons to group cows. Minimizing exposure to cows known to be infected with subclinical mastitis is necessary to control the new infections rate. In herds that have not fully controlled

contagious mastitis pathogens, there are generally 3 classes of cows: 1) non-infected, 2) infected, and 3) unknown infection status. Individual cow SCC values and cow culture results can be used to determine which cows are infected. It is safe to assume that cows with several linear scores of ≥4 (SCC>250,000) are chronically infected. Most cows that consistently have linear scores <4 are uninfected. Cows that have a single elevated score, or fluctuating scores fall into the unknown category. Fresh heifers are generally put in the uninfected group until their first SCC is obtained. Fresh mature cows should be classified based upon their previous SCC status or cultures obtained at calving. In freestall-parlor operations, uninfected cows should be grouped together and milked first. Cows of unknown infection status are milked next and the infected cows are milked last. In stall-barns, infection status can be used to order the cows within the barn so that infected cows are always milked last. Alternatively, one or more milking units can be identified and always used on infected cows. For example, if 6 units are used and 30% of the herd is known to be infected, 2 units could be reserved for use in infected cows and 4 units used for uninfected cows. Sometimes it is necessary to manually sanitize units between cows. To achieve adequate pathogen reduction, units should be rinsed, exposed to 25-50ppm iodine for at least 30 seconds, rinsed and then allowed to dry.

Figure 1. Effect of Yield on Milking Time



In parlor operations, cow grouping is an important element of parlor performance. Milk yield has a major influence on the length of milking (Figure 1; Mein and Reid, 1996). Gains in parlor performance have been documented by various grouping strategies. Sorting cows into low (≤27kgs/cow/day) and high (>27 kgs/cow/day) milk production or fast (<10

min/cow) and slow (>10 min/cow) milking times can have a large influence on parlor throughput (Table 1; Thomas).

Table 1: Gains in parallel parlor performance from no grouping compared to grouping strategies (from Thomas 1995)

Grouping	1 Cows per hour	Double 8 Milk per Hour	2 Cows per hour	Double 16 Milk per Hour
None	------	------	------	------
Group by Milk yield	+1.1	+29 kg/hour	+3.7	+60 kg/hour
Group by Milking Time	+4.0	+31 kg/hour	+5.6	+100 kg/hour

■ HABIT 3. A Consistent Premilking Cow Prep is Used

Cows love routine and will reward operators that provide it. Research has documented a 5.5% increase in lactational milk yield when a standardized milking routine was used compared to a variable milking routine (Rasmussen et al., 1992). The implementation of standardized milking processes can be difficult because most farms use several milking technicians and the technicians often have limited training. Clear communication of expectations of employees needs to be supported with training and resources to help the employees meet those expectations. Efforts to standardize the milking routine and train employees to consistently meet farm expectations can result in improved milk quality, better job performance and enhanced employee retention.

Statistics from Wisconsin farms that use freestalls (n = 101) and participated in a milk quality program indicate that management of the milking parlor is often neglected (Rodrigues et al., 2005). In this group of herds, the reported use of recommended milking practices was generally high. Of the farms, 89% always wore gloves when milking, 97% applied postmilking teat dips, 98% used predips, and 89% reported that milkers forestripped cows before attaching milking units. On participating farms (average herd size of 377 milking cows), there were approximately 6 different people milking cows each month, with a range of 2 to 16 separate individuals working in the parlor throughout the month. Training of milking technicians occurred relatively infrequently. Only 22% of the farms indicated that they held frequent training sessions for their milkers, 49% indicated that they trained milkers only at hiring and 29% indicated that milkers were never trained. Less than half (41%) of the farms reported that they had a written milking routine.

Many milking parlors on large dairy farms are used continuously and farmers often focus on increasing parlor throughput. Data from Wisconsin freestall operations (n = 101) indicate that the largest influences on cows per hour per operator (cows/hr/operator) are training frequency and the presence of a written milking routine (Table 2; Rodrigues et al, 2005). Frequent training of milking technicians resulted in the fastest milking speeds and the lowest monthly rate of clinical mastitis (Table 2). The use of a complete milking routine (includes forestripping, predipping and drying before unit attachment) also resulted in faster parlor performance. The combination of a complete milking routine and frequent training resulted in the most efficient parlor throughput. Cows were milked at a rate of 52 cows per hour per operator when a complete milking routine and frequent training was used in contrast to 38 and 35 cows per hour per operator for herds that used an incomplete milking routine and frequent training or incomplete routine without training, respectively.

Table 2. Influence of Milking Routine on Performance for Wisconsin Freestall Farms (n = 101) (from Rodrigues, et al. 2005)

Variable		Cows per Hour per Operator	Monthly Rate of Clinical Mastitis
Written Milking Routine	Yes	46.9[b]	5.0%
	No	35.6	7.1%
Training Frequency	Never	33.6[b]	9.6%[b]
	At Hiring	41.6	4.8%
	Frequently	49.4	5.8%
Complete milking routine[a]	Yes	40.8	5.5%[b]
	No	35.3	10.3%
Forestrip	Yes	40.9[c]	5.8%[c]
	No	32.9	9.4%

[a]routine includes forestripping, predipping, drying before unit attachment;[b] $P < 0.05$; [c]$P < 0.10$

Methods of premilking teat preparation have been extensively studied. There is no question that the most effective method to disinfect teats is to predip using an approved disinfectant. The use of pre-dipping using iodine has been demonstrated to reduce standard plate counts and coliform counts in raw milk by 5 and 6 fold, respectively as compared to other methods of premilking udder preparation (Galton et al., 1986). It is important to recognize that sufficient time and contact of the disinfectant with the teat is necessary for effective reduction in bacterial numbers. Teat dips need to be properly

formulated, completely applied to debris free teats, and allowed sufficient time (30 seconds) for action before removal.

The examination of milk before attaching milking units is necessary to ensure that all abnormal milk is diverted from the human food chain and should be a standard practice on ALL farms. Teat cistern milk contains the highest concentration of bacteria of any fraction of milk. Forestripping is adequately performed when 2-3 streams of milk are expressed and is the most effective means to ensure adequate milk letdown. When both predipping and forestripping are practiced, there is no data that indicates that the order that the steps are performed will affect milk quality. In a subset of our data from Wisconsin freestall operations, milking performance was equal for herds regardless of which premilking procedure was performed first (Table 3). On a practical basis, when teats are clean, it may be best to forestrip before teat end disinfection to reduce the opportunity to re-contaminate teat skin. In milking parlors, cows can be forestripped onto the floor but the appearance of the milk should be noted to identify cows with mild cases of clinical mastitis. In stall barns, milk should never be forestripped onto cow beds. The use of gloves by milking staff is recommended to reduce the potential spread of mastitis pathogens by contaminated hands.

Table 3: Reported milking efficiency in stall-barn operations in Wisconsin

	Number of Herds	Average CPHPO[a]	95% Confidence Interval
Use ATO	29	28.7	24.8 – 32.6
No ATO	175	20.9	19.3 – 22.5

[a]cows per hour per operator (from Ruegg et al., 2000)

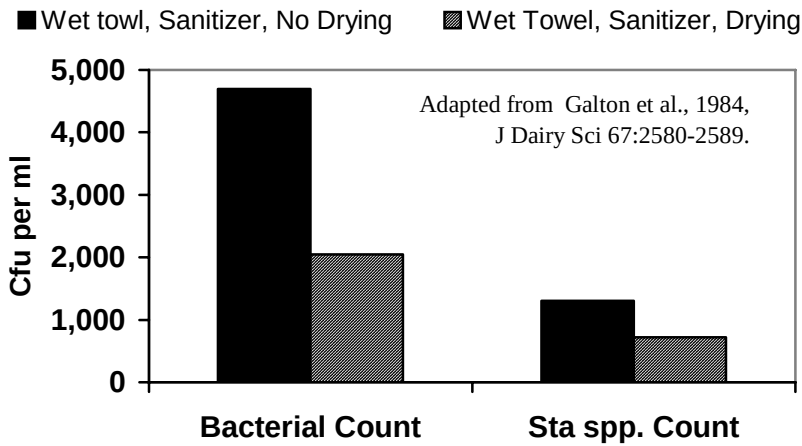
■ HABIT 4. Teats are Dry

Effective drying of teats is probably the most important step in hygienic premilking preparation. A study reported that herds that dried teats had bulk tank SCC values 44,000 cell/ml lower than herds that did not utilize this practice (Moxley et al., 1978). In another study, drying reduced bacterial counts of teat ends from 35,000 – 40,000 cfu/ml for teats that were cleaned but not dried to 11,000-14,000 cfu for teats that were dried using a variety of paper towels (Galton et al., 1986). In Wisconsin freestall operations, 65% reported the use of 1 cloth towel per cow, 27% used 1 disposable paper towel per cow and 8% used 1 paper or cloth towel to dry udders on 2 cows. The use of a single towel to dry udders on more than 1 cow was reported by 18% of stallbarn operators and was associated with a higher monthly rate of clinical mastitis (7.8% for herds that used 1 towel/cow versus 12.3% for herds that used towels on >1 cow (Rodrigues et al., 2005). There are a wide variety

of paper and cloth towels that are used to dry teats and recently the use of wet towels to dry teats has become popular. Moisture is an important growth requirement for bacteria and wet towels do not adequately remove moisture (Figure 2). Cloth towels have the advantage of being more absorbent than paper towels but should be disinfected by washing with bleach or very hot water and drying at high temperature in an automatic dryer (Fox, 1997). Cloth towels should be of adequate size, monitored for wear and replaced when worn. The buildup of chemical residues on some towels made of synthetic fibers can reduce the absorbency and effectiveness of the towel.

The use of latex or nitrile gloves by milkers can help reduce pathogen transfer. Gloves both protect milkers' skin and reduce the contamination of teats from milkers' skin. Gloves can be easily changed between groups, further reducing the likelihood of pathogen transfer. In Wisconsin, a larger percentage of operators with parlors (88%) have adopted the use of gloves as compared to stall barn operators (33%). To check the effectiveness of teat disinfection and drying, a clean swab can be rubbed across the end of the teat prior to unit attachment. A swab from a properly prepared teat will remain clean. A dirty swab indicates that teat preparation methods should be improved.

Figure 2. Effect of Drying on Bacterial Counts of Milk



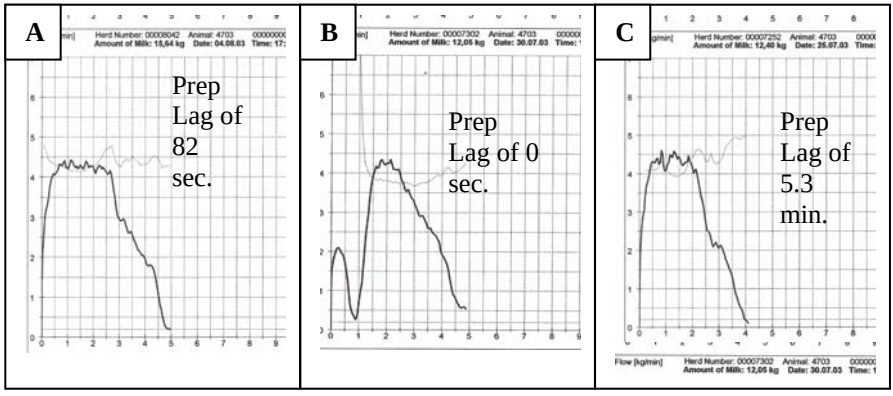
■ HABIT 5. Units are Properly Attached

The time period between stimulation of the cow and unit attachment is often referred to as the "prep-lag" time. One objective of the milking routine is to attach the milking unit to well-stimulated cows that have achieved milk

letdown, thus maximizing milk flow (Figure 4A). A prep-lag time of 45-90 seconds is generally recommended, but negative consequences (reduced milk yield) have not been reported until lag times have exceeded 3 minutes (Rasmussen et al., 1992). The absence of adequate milk letdown will often result in bi-modal milk flow (Figure 4B) and the application of the milking unit without stimulation or immediately after stimulation should be discouraged. It appears that prep-lag times longer than 90 seconds will not be uniformly detrimental (Maroney et al., 2004). The use of 3-4 cow territorial work routines in parlors will generally result in adequate prep-lag times.

A primary decision in premilking routine is deciding how many cows each operator will prep prior to unit attachment. Several common routines have been developed that utilize groups of 3-4 cows to ensure that prep-lag times and pre-dip contact time are optimized. A standardized process of unit attachment should be followed. To minimize air admission, the short milk tubes should be bent back over the claw ferrules. During the process of individual teatcup attachment, the teatcups are raised toward the teat, straightening the liner and minimizing air admission. Units should be adjusted and aligned so that cluster weight is evenly distributed. Units should be aligned so that the claw outlet is pointed at the head of the cow (conventional parlors) or directly between the legs in parallel parlors. Proper unit adjustment results in fewer liner slips. A goal of <5-10 slips per 100 cow milkings has been suggested as a thumb-rule. A wide range of variation in unit reattachment rate was reported in the survey of Wisconsin dairy operators. While many operators reported a 0% reattachment rate, the maximum reported reattachment rate was 25%. As expected, milking efficiency on that dairy was exceedingly poor.

Figure 3. Milk flow curves of 1 cow milked using 3 prep-lag times (0 sec., 82 sec, 5.3 min.)



■ HABIT 6. Units are Properly Removed

Milking is completed when the available milk is fully harvested. Undermilking occurs when all the milk is not removed ("not milked out") and overmilking occurs when teatcups are attached to teats but milk is not flowing. The biggest danger of undermilking is financial. The biggest danger of overmilking is damage to teat ends resulting in mastitis. Most stall barn operators are dependent upon visual observation and experience to determine when milking is completed. Only 14% of surveyed farmers with stall barn operations reported using automatic take off units (ATO). Stall barn operators that utilized ATO's were considerably more efficient than stall barn operators that did not have ATO's (Table 3). Ninety-one percent of most parlor operators surveyed reported that they utilized ATO's. Adjustments in the ATO settings can improve milking time and teat end condition. A Danish experiment demonstrated that when the threshold setting on the ATO was raised from .20 to .40 kg/minutes the average unit on-time was reduced by 0.5 minutes and teat condition improved (Rasmussen et al., 1990). Additional time savings can be gained by changing the detacher delay time after the threshold is reached from 20-30 sec to 10 seconds. To avoid milk yield loss, changes in detacher delays should be made gradually in 3 second intervals. High threshold settings and short detacher delays will apply to 3X herds with a good cow prep, resulting in improved teat condition and milking speed.

Manual cluster removal should mimic the ATO process. Vacuum should be shut off and the 4 teatcups removed together. The completeness of milk-out can be estimated by occasionally checking the amount of milk that can be hand stripped from a cow after milking is completed. Left-over milk that can be expressed by hand milking is termed strip-yield. Cows can be considered to be fully "milked out" if <300 ml of milk can be hand stripped post-milking. Hand stripping should not be practiced routinely.

■ Habit 7. Cows are Managed Post-Milking

Post-milking teat antisepsis was initially developed to reduce the transmission of contagious mastitis pathogens and has been widely accepted. Ninety-five percent of surveyed WI farms reported using either teat dipping (80%) or spraying (20%). Teat spraying is more common in parlor operations. Spray applicators are preferred by some operators because of convenience and to keep teat dip from becoming tainted with contaminated milk. While it is theoretically possible to adequately cover the teat using a spray applicator, in reality it is difficult to accomplish. To evaluate the adequacy of teat spraying, a paper towel can be wrapped around the teat after dipping. A properly dipped teat will have teat dip completely around the towel. Many producers temporarily discontinue teat dipping in subzero weather. An alternative

strategy is to post-dip teats, allow at least 30 seconds contact time and then dry the teats off prior to releasing the animals. Finally, the last step in an effective milking routine is to ensure that the cows remain standing for at least 30 minutes after milking is completed. Most producers provide fresh feed to encourage this behavior.

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