It’s All in the Milk Flow

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Notes:

PowerPoint Slides on next page

It's All in the Milk Flow

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Outline of Talk

- Discussion of influences on the front end of the milk flow curve
- Discussion of consequences of getting it wrong
- Outlining ideas for how we monitor this
- Brief overview of influences on the back end of the milk flow curve

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The Milk Flow Curve of an Individual Cow

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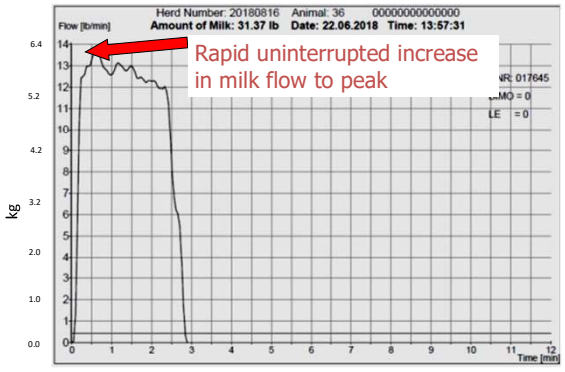
High Flow Rates



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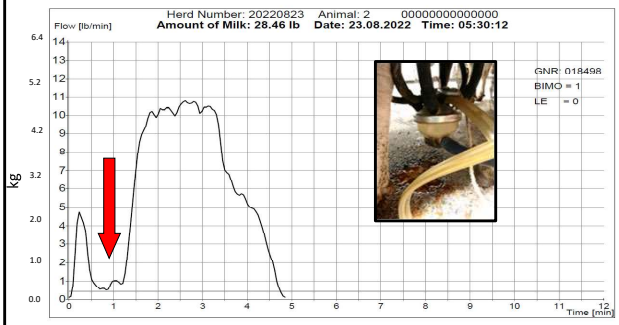
Bimodal Milk Flow or Delayed Milk Ejection



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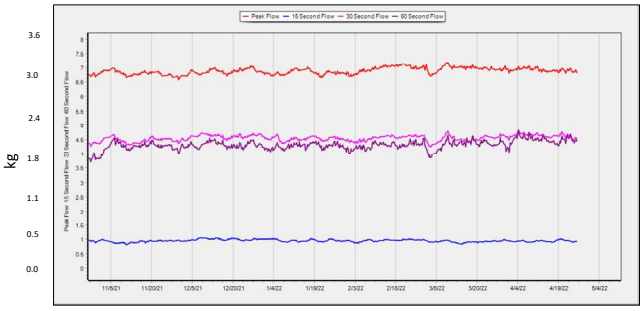
Bimodal Milk Flow or Delayed Milk Ejection



6 months of data

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Milk Letdown Physiology

- "Milk ejection is an inborn reflex, an involuntary act not under the conscious control of the cow."

  from Milking Machines and Lactation

- Teat stimulation of dairy cows caused oxytocin release and milk ejection at all times during the day.

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Milk Letdown Physiology

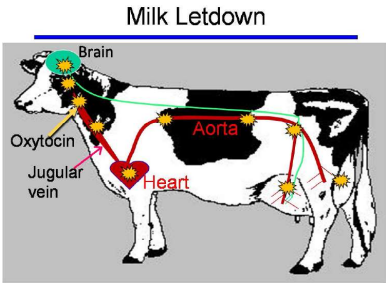

Diagram from www.qualitymilkalliance.com used with permission from Dr. Ron Erskine

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Milk Letdown Physiology

- Milk is present in two primary areas in the udder just prior to milking
  - Cisternal fraction
    - ~20% of milk yield, removed by opening teat canal
  - Alveolar fraction
    - ~80% of milk yield, **need oxytocin**

Bruckmaier and Blum, 1998

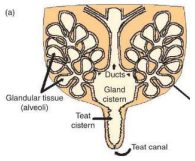

Diagram Adapted from Nickerson SC and Akers RM (2011) Mammary Gland | Anatomy. In: Fuquay JW, Fox PF and McSweeney PLH (eds.), Encyclopedia of Dairy Sciences, Second Edition, vol. 3, pp. 328–337. San Diego: Academic Press.

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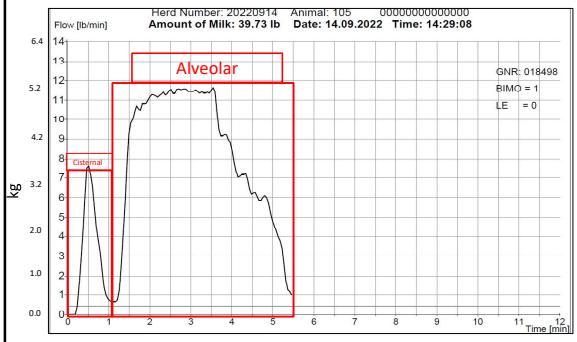
Bimodal Milk Flow



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Bimodal Milk Flow or Delayed Milk Ejection

- Why should we care about bimodal milk flow?
  - Influence on unit on time
  - Kickoffs
  - Reattaches
  - Liner slips
  - Cows leaving the parlor not milked out
  - Loss of milk production!
- These influence parlor efficiency, mastitis risk, and ultimately the bottom line.

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Milk Letdown Physiology

- What causes a failure of milk letdown?
  - Failure to achieve adequate oxytocin levels from stimulation
  - Release of epinephrine (adrenalin)
    - Blocks oxytocin receptors
    - Causes contraction of the teat and cisternal area
  - Milking in unfamiliar surroundings
    - Oxytocin release is blocked and so only cisternal milk is removed

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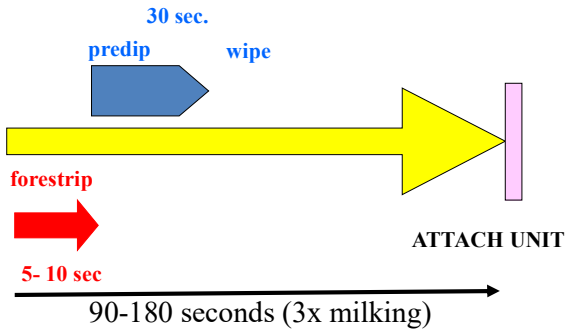
Udder Preparation & milk let-down



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Milking Routine Timing

- Pre-dip Contact Time (>30 seconds)
- Initial Stimulation Time (5-10 seconds or more)
- Lag Time (time from start of stimulation to unit attachment) (90-180 seconds)

Are there issues with the timing if it is performed correctly?

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Milking Routine Timing

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What if we get it wrong?

- Negative influences on:
  - Cow (pain, mastitis)
  - Teat (increased risk of damage)
  - Parlor (increased unit on time, less efficient)
  - Milker (more kick-offs, reattaches, dirtier units)
  - Herd Manager (more mastitis)
  - Owner (less milk, more mastitis)

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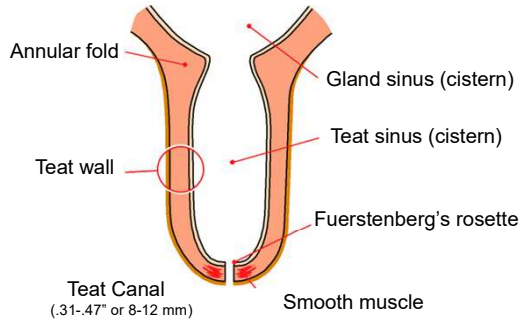
Teat Anatomy



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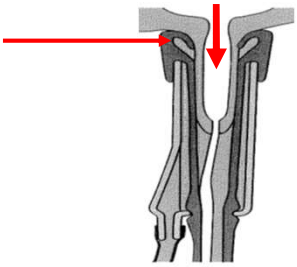
Forces on fluids within the teat during pulsation cycles

b phase (open phase)



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Liner Movement

Start of milking

End of milking

Notice the movement of the liner toward the teat base as the cow milks

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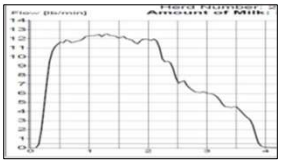
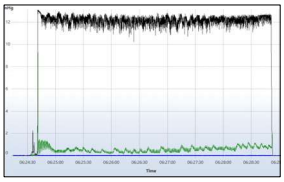
Good Letdown



Milk Flow



Claw vacuum (black)

Mouthpiece chamber vacuum (green)

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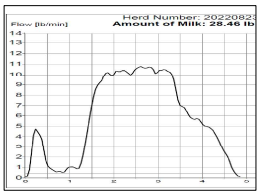
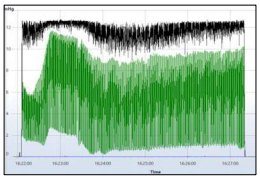
Poor Letdown



Milk Flow



Claw vacuum (black)

Mouthpiece chamber vacuum (green)

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Influence on Teat Ends

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Short and Medium-term Effects

- Why do they matter?
  - Prolonged closure of teat canal after milking
    - Traditional thought = 30-60 minutes
    - Work from Europe (Neijenhuis, F., 2001) shows it is much longer under certain conditions
    - Our work (Wieland, M., 2018) also showed this for 3x milked cows
- What does this mean for entry of environmental mastitis causing organisms?

Neijenhuis, F., G. H. Klungel, and H. Hogeveen. 2001. Recovery of cow teats after milking as determined by ultrasonographic scanning. Journal of Dairy Science 84(12):2599-2606. NMC. 1999. Laboratory Handbook on Bovine Mastitis. Rev. ed. National Mastitis Council, Madison, WI.
Wieland, M., Virkler, P.D., Borkowski, A.H., Ålveby, N., Wood, P, Nydam, D.V.: 2019. An observational study investigating the association of ultrasonographically assessed machine milking induced changes in teat condition and teat-end shape in dairy cows. Animal 13(2):341-348. DOI: 10.1017/S1751731118001246.

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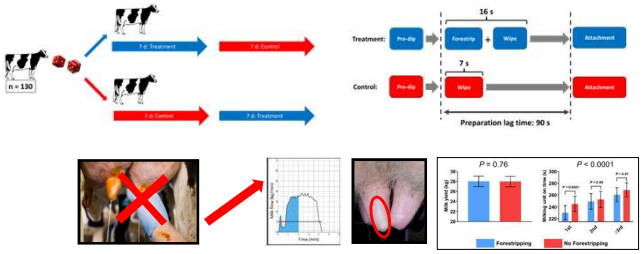
Delayed milk ejection – Risk factors



Wieland, M., Virkler, P.D., Weld, A., Melvin, J.M., Wettstein, M.R., Oswald, M.F., Geary, C.M., Watters, R.D., Lynch, R. and Nydam, D.V.: 2020. The effect of 2 different premilking stimulation regimens, with and without manual forestripping, on teat tissue condition and milking performance in Holstein dairy cows milked 3 times daily. J Dairy Sci. 103(10):9548-9560. DOI: 10.3168/jds.2020-18551.

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Milk Production

Minute Delay =

7 Lbs Tossed Away

Dr. Ron Erskine at recent NMC Regional Meeting Short Course based on their published research about how delayed milk ejection influences milk production.

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Milking Routine Timing

- **Your Action Item**:
  - Go home and time your routine in the 3 critical areas that I outlined
- If it is not correct, then work on ways to correct it
- Without a good routine, you will have a challenge to milk cows quickly, gently, and completely.

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Monitoring The Front End of the Curve on Your Farm

- If you have parlor data use:
  - Pounds of milk in the first two minutes (2 min milk)
  - Goal is >15 lbs (6.8 kgs) for 3x milking
  - Goal is >18 lbs (8.2 kgs) for 2x milking
- If you do not have parlor data then:
  - Recheck the timing of your routine in the 3 critical areas on a regular basis and at unannounced times for all milkers

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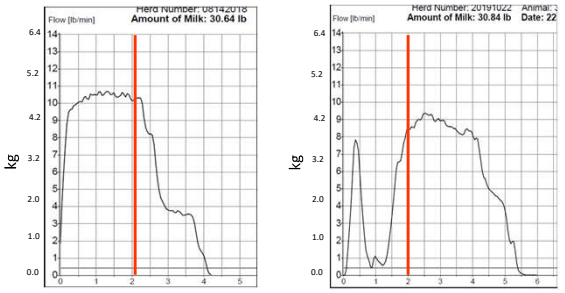
Milk in First Two Minutes



Milk in first two minutes = 18 lbs (8.2 kgs)

Milk in first two minutes = 7.3 lbs (3.3 kgs)

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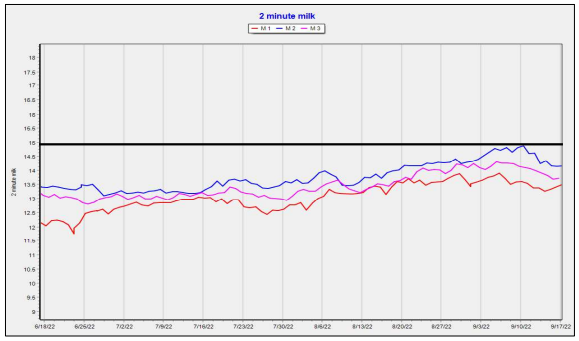
Milk in First Two Minutes



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Other Influences on the Front End of the Curve

- Vacuum levels
- Pulsation settings

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Inappropriate Claw Vacuum Settings

- Has the average claw vacuum at peak flow for a 5 to 20 second interval been accurately measured on at least 10 cows?
- Is it appropriate for your herd?
  - Goals of your dairy
  - Liners
  - Risk of over milking (milking routine, ATO settings, unit alignment, etc)

48 kPa vs 42.5 kPa

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Inappropriate Claw Vacuum Settings

- 1000 cow herd with a double 20 parallel parlor
- Increasing clinical mastitis and bulk tank somatic cell count (SCC)
- Hardness at teat end = 50% abnormal
- Average claw vacuum was 13.3”Hg (45.1 kPa)
- Liner manufacturer wants 11.5”Hg (39.0 kPa)

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Inappropriate Pulsation Settings

- Have the pulsation parameters been accurately measured?
- Are they appropriate for your herd?

	Previous set-up	New claws, shells, and liners	After adjustments
Claw vacuum ("Hg(kPa))	12.2 (41.4)	12.1 (41)	11.8 (40)
Pulsator rate	60	60	60
Pulsator ratio	60:40	65:35	60:40
b phase (ms)	450	496	442
d phase (ms)	235	186	226

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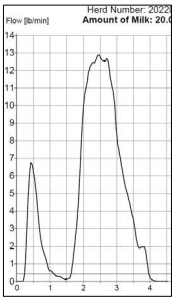
Summary of the Major Influences on the Front End of the Milk Flow Curve

- **Milking Routine**
  - **Stimulation**
  - **Lag Time from Stimulation to Unit Attachment**
- Also think about:
  - Claw vacuum levels
  - Pulsation settings



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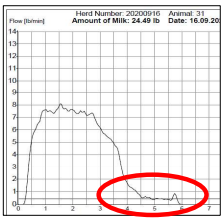
Major Influences on the Back End of the Milk Flow Curve

- You can have a great front end of the curve but a poor back end. Think about:
  - Unit alignment
  - Automatic take-off settings
  - Use of manual mode



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Poor Unit Alignment

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Unit Alignment Scoring

- Poor unit alignment
  - Increases the risk for liner slips
  - Influences milking speed of individual quarters
  - Increases the risk of teat damage and abnormal cow behavior
  - Can add confusion to appropriate Automatic Take-Off settings
  - Decreases parlor efficiency
    - Prolonged unit on time
    - More chance of reattach

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Why Adjust ATO settings?

- Reduce the risk of teat damage
- Improve animal welfare
- Reduce unit on time
- Increase parlor efficiency

What happens to milk production?

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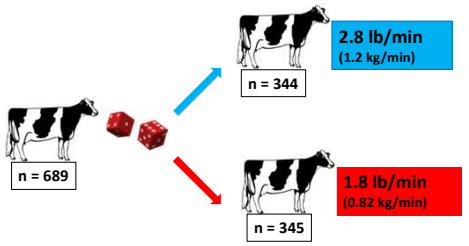
A randomized trial to study the effect of automatic cluster remover settings on milking performance, udder health, and teat condition



Wieland, M., Nydam, D.V., Heuwieser, W., Morrill, K.M., Ferlito, L., Watters, R.D., and Virkler, P.D.: 2020. A randomized trial to study the effect of automatic cluster remover settings on milking performance, teat condition, and udder health. J Dairy Sci. 103(4):3668-3682. DOI:10.3168/jds.2019-17342.

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Summary

2.8 lb/min | 1.8 lb/min

- No difference in milk
- 27 seconds less unit on time with 2.8 lb/min
- No difference in components
- Short term teat scores better with 2.8 lb/min
- No difference in mastitis

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Automatic Take-Off Settings

- Need to take into account complete picture of milking routine, teat scoring, goals of dairy, milking equipment, strip yields, etc

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Monitoring the Back End of the Milk Flow Curve

- If you have parlor data then use:
  - Unit on time
  - Time in low flow
- If you do not have parlor data then:
  - Time the unit on time and observe the claw and cow behavior at the end of milking

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Putting it All Together

Pounds (kgs) of milk/stall/hour

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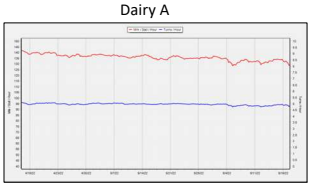
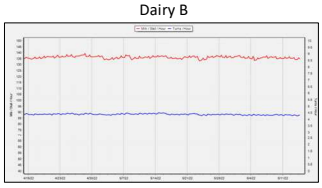
Putting it All Together

Dairy A



Dairy B



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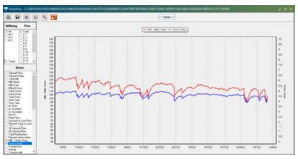
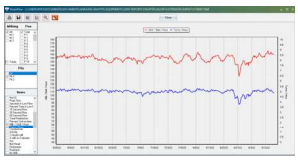
Putting it All Together

Dairy A



Dairy B



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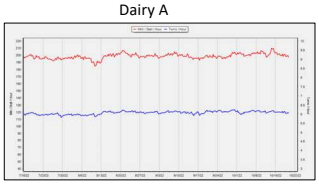
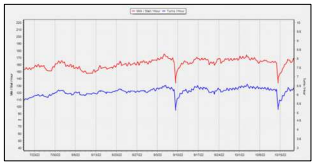
Putting it All Together-Rotary

Dairy A



Dairy D



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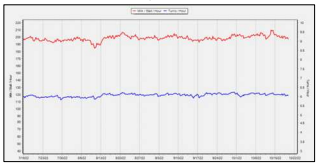
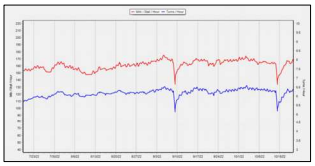
Putting it All Together-Rotary

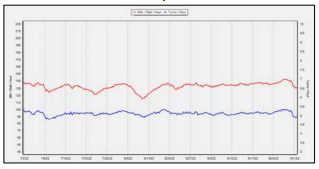
Dairy A



Dairy D



Dairy C



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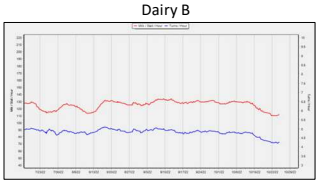

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Summary of Front End

- **<u>Time your milk routine</u>**
- Monitor with 2 minute milk or timings
- Check claw vacuum levels
- Check pulsation

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Summary of Back End

- Look at unit alignment in your parlor
- Check what your automatic take-offs are currently set at:
  - Adjust if complete picture warrants this
- Monitor with:
  - unit on time
  - time in low flow
  - observing claws at end of milking

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Questions?

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