



**Calving Management Practices for Dairy Herds**

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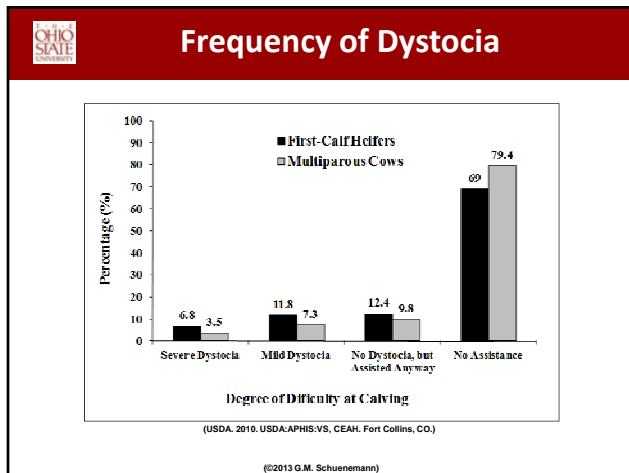
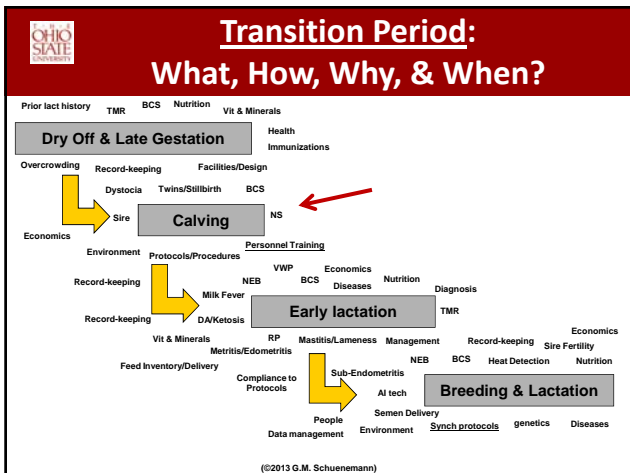
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**Objectives**

- Recognize the imminent signs of birth and calving progress
- Provide guidelines for calving management practices to reduce the prevalence of stillbirth and metritis under field conditions
- Be able to determine when first-calf heifers or cows need assistance at calving
- Be able to record calving-related events

Please note that the information provided herein may or may not apply to all situations. Consult with your herd veterinarian for more information.

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**Maternity Pen or Area**

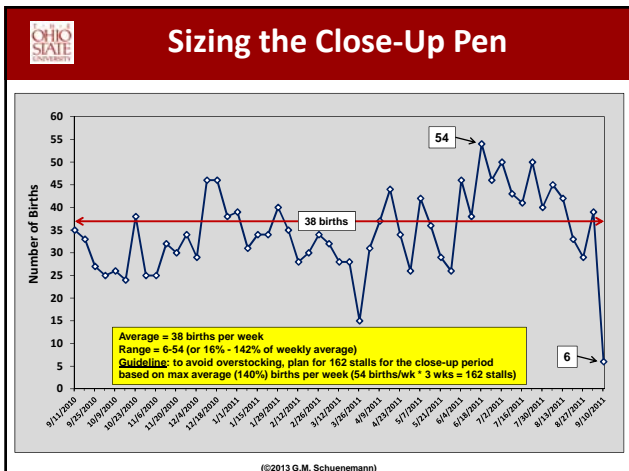
- **Guidelines:**
  - At least 175 ft<sup>2</sup> (16 m<sup>2</sup>) per cow
  - **Flooring:** sand, dirt, or clay
  - **Bedding:** straw (6-10 in deep), change frequently to keep it dry and clean
  - Well-ventilated
  - Adequate lighting

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**Sizing the Close-Up Pen**

- **Example: 2000-cow herd**
- Determine the time period (3 wks) and size of close-up pen (# of stalls)
  - 2000/365 = average 5.5 births per day
- How many calving per week?
  - 5.5 births/d \* 7 d = ~38 births per week
- How long is the close-up period?
  - 38 births \* 3 wks = ~115 births for the 3-wk close-up period

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**Management of Close-Up Cows**

- Although “average” births per week is a valuable metric, most producers are faced with calving “ranges”
- All these calculations assume cow grouping at dry-off and “calving date” is known
- Add additional challenges for no-calving dates (bull bred first-calf heifers or cow, missing records, or unknown pregnancy status)

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**Parturition**

- Parturition is a process initiated by a cascade of hormonal and physical changes at the end of gestation (~280 days in cattle)
- Three stages:**
  - Stage I (dilation of birth canal)
  - Stage II (labor or calf expulsion)
  - Stage III (passing fetal membranes)
- It progresses gradually from one stage to the next!

(Noakes et al., 2001; Schuenemann et al., 2013)

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**Stage I**

- Stage I** consists of the dilation of the birth canal (soft tissues and ligaments)
- Restless behavior:** Walk, transition from laying to standing positions, kick the belly, vocalization, tail raised, urinate, ...
- Physical changes:** Udder is full, dilation of vulvar ring, ...
- It ends with a fully dilated cervix and the appearance of the amniotic sac (AS) or “water bag” outside the vulva

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**Stage II**

- Stage II** begins with a fully dilated cervix, the appearance of the “water bag”, and abdominal contractions are evident


**Straining**

**Delivery**

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**Stage III**

- **Stage III** is the expulsion of the fetal membranes, which occurs around 8-12 hours post calving. If >24 hours, it is considered retained fetal membranes (Ketton et al., 1996)



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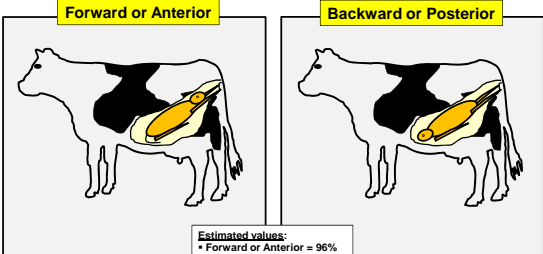
**Calf Delivery**

- **Presentation:** It refers to whether the calf is coming forward (anterior), backward (posterior), or transverse
- **Position:** It refers to the calf's position in relation to the cow
- **Posture:** It refers to how the calf's head and limbs are in relation with its body

(Noakes et al., 2001; Schuenemann et al., 2013)

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**Normal Calf Delivery**



**Estimated values:**

- Forward or Anterior = 96%
- Backward or Posterior = 4%
- Multiple Births = 5%
- Breech = 1%

(Hunter et al., 2013)

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**Eutocic or Dystocic Births**

- **Eutocic Birth:** Normal delivery of single or multiple calves
- **Dystocic Birth:** It is defined as a difficult birth resulting in prolonged calving or severe assisted extraction of the calf at birth

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### Early Signs of Calving

Cow with enlarged vulva & mucus plug

Cow with dilated vulva & enlarged udder




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### Imminent Signs of Calving

Walking, pacing, sniffing, & tail-raised

Lying down & showing feet of the calf outside the vulva




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### Imminent Signs of Birth

Envelops outside the vulva & tail-raised

Showing feet/nose of the calf outside the vulva



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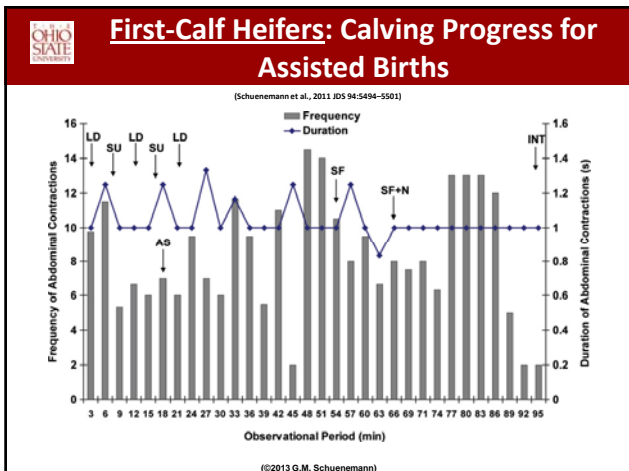
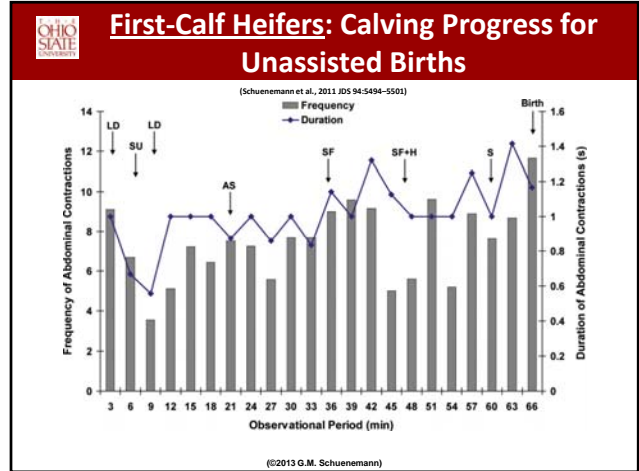
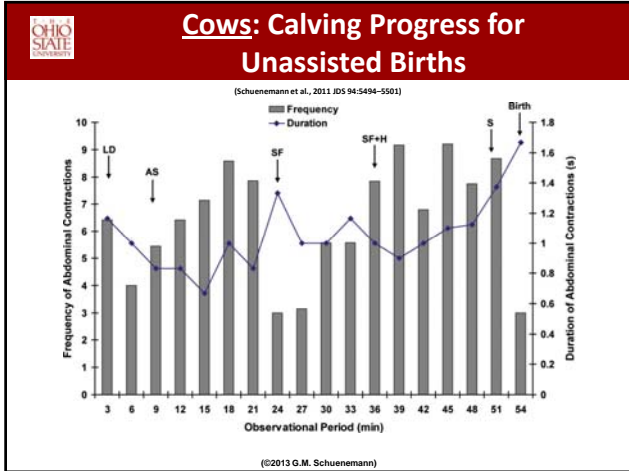
### Normal Delivery

The rear legs of the calf are still in the vulva of the cow, but birth is completed

Cow recovers from labor, stand-up, & lick the calf



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### Reference Signs and Values for Holstein Cattle


| Signs of Normal Births  | Description                 | References  |
|---|-----------------------------|---|
| Appearance of the AS or feet of the calf outside the vulva                        | Landmark references         | Noakes et al., 2001<br>Schuenemann et al., 2011a    |
| Signs of calving progress   | Evident every 15-20 minutes | Schuenemann et al., 2011a                           |
| Mean time since the appearance of the AS outside the vulva to birth               | 70 minutes(*)               | Noakes et al., 2001<br>Schuenemann et al., 2011a    |
| Mean time since the appearance of the feet of the calf outside the vulva to birth | 65 minutes(*)               | Schuenemann et al., 2011a                           |
| Time that a cow or first-calf heifer is in labor (abdominal contractions)         | ≤2 hours                    | Gundelach et al., 2009<br>Schuenemann et al., 2011a |
| Frequency of observation  | At least every 1 hour       | Schuenemann et al., 2011a                           |

(\*) The mean times were estimated using the mean + 2 SD (standard deviation)  
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**Cow Move into Maternity Pen**

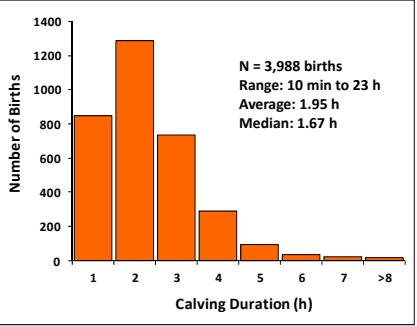
- **Limited research studies** on cow move around parturition vs stillbirth
- For herds that group cows according to expected calving date, periparturient cows should be moved from close-up to maternity pen prior to or at the onset of labor (appearance of AS outside the vulva)
- Frequency of observation and personnel skills

Cow showing "water bag" outside the vulva (Stage II or onset of labor)



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**Length of Time in Maternity Pen**




N = 3,988 births  
Range: 10 min to 23 h  
Average: 1.95 h  
Median: 1.67 h

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**Landmarks of Imminent Birth**


Appearance of the "water bag" outside the vulva

Appearance of the feet of the calf outside the vulva



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**Is the Calf Coming Backward?**



- Both rear legs or front legs?
- Will the calf fit into the birth canal?
- Monitor progress!
- ...

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### Monitor Calving Progress

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### Guidelines for Assisted Births

OBSERVATION

Parturition Begins
Normal Birth

No Calving Progress

INTERVENTION

Normal presentation, position, and posture

Abnormal presentation, position, and posture

Correction

Guidelines for Assisted Extraction

Extraction Possible

Extraction Not Possible

DECISIONS

Calf Alive/Dead

Assisted Extraction

No Progress within 30 min

Call Your Veterinarian

(Adapted from Schuijt and Ball, 1980) ©2013 G.M. Schuenemann

### Guidelines for Obstetrics

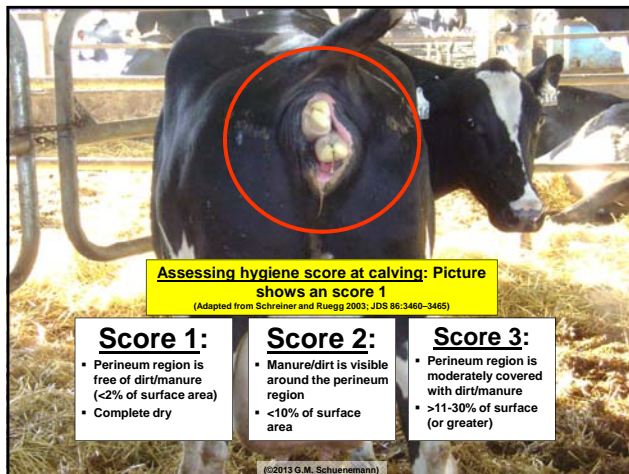
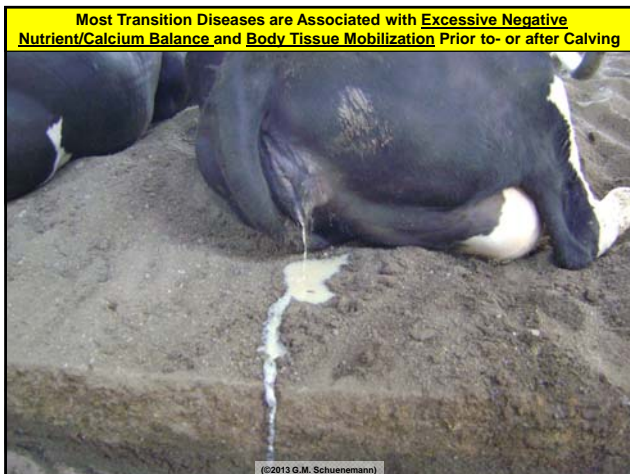
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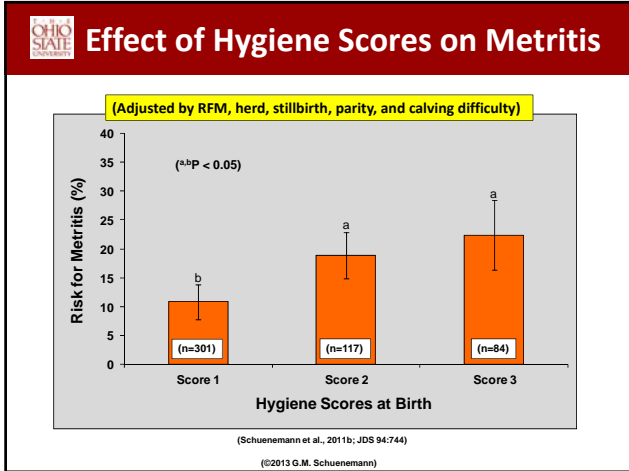
### Hygiene Practices

- Use clean, disposable, long sleeve gloves
- Wash the perineum with clean water and soap-disinfectant, repeat if cow defecates!
- Sanitize obstetric chains before and after each intervention or use

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- ### When Should I Call for Help?
- Establish guidelines in your SOP
  - Normal progression occurs every 15-20 minutes
  - If no progress within 1 hour after the appearance of the water bag, intervention is required!
  - When abnormal posture is evident (e.g., appearance of one foot outside the vulva) immediately after “water bag” appearance, or for uterine torsions (where the water bag or feet do not appear outside the vulva), obstetric intervention is rendered
  - If there is no progress within 30 minutes of intervention, call for help!
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- ### Assist the Newborn
- Make sure the calf is breathing
  - Check cow for any additional calf (twins)
  - Feed colostrum to the calf within 3 hours of birth
  - When the cow is able to stand and walk, move her to the fresh pen
- Cow sniffing the newborn calf immediately after birth
- 
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## Proper Sanitation

- Remove placenta from the maternity pen
- For assisted births, wash and sanitize obstetric chains and bucket before and after each use
- See link to CFSPH below for selected desinfectants

Link to the Center for Food Security & Public Health at Iowa State University:  
[http://www.cfsp.h.iastate.edu/Infection\\_Control/disinfectant-resources-for-veterinarians.php](http://www.cfsp.h.iastate.edu/Infection_Control/disinfectant-resources-for-veterinarians.php)

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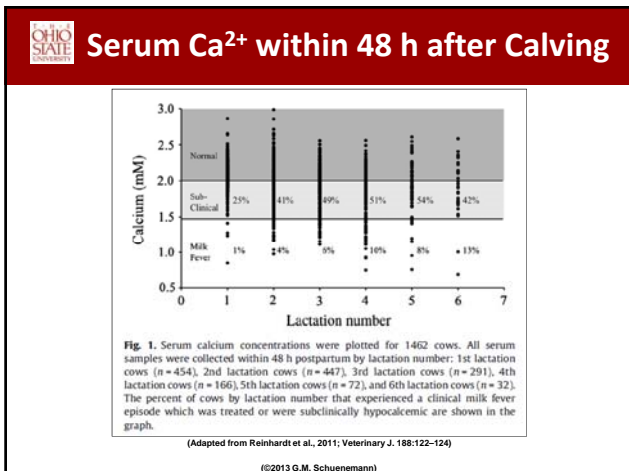
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| Characteristics of Selected Disinfectants |  |  |   |  |  |  |
|---|--|--|---|--|--|--|
| Disinfectant Category                     | Alcohols                                     | Aldehydes  | Biguanides  | Halogens: Hypochlorites  | Halogens: Iodine Compounds   | Quaternary Ammonium Compounds (QAC)                        |
| Example: Table Sanitizers                 | Alcohol: 70% ethanol, 40% isopropanol        | Formaldehyde: 0.5% formalin                            | Chlorhexidine: 0.05% solution   | Bleach: 1% available chlorine  | Bleach: 1% available chlorine  | Quaternary Ammonium Compounds (QAC): 0.1% solution         |
| Mechanism of Action                       | Disrupts protein synthesis, denatures lipids | Aldehyde: protein cross-linking, membrane permeability | Disrupts protein synthesis, membrane permeability                                 | Oxidation: protein denaturation, membrane damage   | Oxidation: protein denaturation, membrane damage   | Oxidation: protein denaturation, membrane damage           |
| Advantages                                | Fast acting, leaves no residue               | Broad spectrum   | Broad spectrum  | Stable in storage, relatively safe   | Stable in storage, relatively safe   | Good efficacy with organic material, non-corrosive         |
| Disadvantages                             | Alcohol: evaporation, flammable              | Aldehyde: irritant, corrosive, and tissue fixation     | Chlorhexidine: irritant, not for large animals, not for use in food contact areas | Unstable in sunlight, irritant, corrosive, oxidizes metals, affects membranes and tissue structure | Unstable in sunlight, irritant, corrosive, oxidizes metals, affects membranes and tissue structure | Changing to some metals, can cause skin and eye irritation |
| Compatibility                             | Phenolics                                    | Quaternary   | None  | None   | None   | None   |
| Legislation                               | Effective                                    | Effective  | Effective   | Effective  | Effective  | Effective  |
| Myxomatosis                               | Effective                                    | Effective  | Variable  | Effective  | Effective  | Effective  |
| Unintended Effects                        | Effective                                    | Effective  | Effective   | Effective  | Effective  | Effective  |
| Non-enveloped viruses                     | Variable                                     | Effective  | Limited   | Effective  | Effective  | Variable   |
| Spores                                    | Not Effective                                | Effective  | Not Effective   | Effective  | Effective  | Not Effective  |
| Fungi                                     | Effective                                    | Effective  | Limited   | Effective  | Effective  | Variable   |
| Efficacy with Organic Matter              | Reduced                                      | Reduced  | ?   | Rapidly reduced  | Rapidly reduced  | Variable   |
| Efficacy with Hard Surfaces               | ?  | Reduced  | ?   | Effective  | ?  | Effective  |
| Efficacy with Metals                      | ?  | Reduced  | Inactivated   | Inactivated  | ?  | Effective  |

? Information not found  
 Disclaimer: The use of trade names does not in any way signify endorsement of a particular product.  
 For additional product names, please consult the most recent Compendium of Veterinary Products.  
 Reference: Linton, L., page 488, Russell AD. Disinfection in Veterinary and Farm Practice. 1987. Blackwell Scientific Publications, Oxford, England.  
 Gault, P., Mahony, S. Disinfection and Disease Prevention in Veterinary Medicine. In: Stock, B., ed. Disinfection, Sterilization and Preservation. 5th edition. 2011. Lippincott, Williams and Wilkins: Philadelphia.

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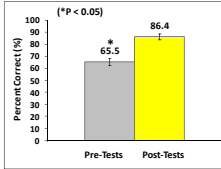
## Prevention of Stillbirth

- At national level:**
  - Selection program for sires with calving ease genetics
- At herd level:**
  - Training of calving personnel & establish SOPs
  - Facilities & prevent hypocalcemia prepartum
  - Close monitoring of first-calf heifers
  - Calves born in backward presentations
  - Communication at the time of shift change of personnel
  - Length of time in dry pen
  - Use of sires with calving ease genetics
  - ...

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## Effect of Calving Training to Dairy Personnel on Stillbirth?




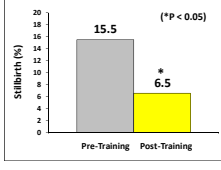


Percent Correct (%)

Pre-Tests: 65.5  
Post-Tests: 86.4

(Schuenemann et al., 2013)





Stillbirth (%)

Pre-Training: 15.5  
Post-Training: 6.5

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## Additional Considerations

- Early intervention has the potential to prevent stillbirth, but also has the potential for dam injury due to lack of soft tissue dilation
- For backward presentations, help finish birth!
- For first-calf heifers, once the nose/feet of the calf are outside the vulva, help finish the birth!
- Calving protocols/data should be reviewed and adjusted (if necessary) at least twice a year
- Make sure your calving personnel know what to look for/monitor before and during calving and why it is important

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## Personnel Feedback on Calving Management Practices

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http://dx.doi.org/10.3168/jds.2012-5976  
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### Dairy calving management: Description and assessment of a training program for dairy personnel

G. M. Schuenemann,<sup>1</sup> S. Bas, E. Gordon, and J. D. Workman  
Department of Veterinary Preventive Medicine, The Ohio State University, Columbus 43210

ABSTRACT      Key words: dairy personnel, calving management.

▪ Importance of open communication within the farm team (e.g., between workers at the time of work shift and when to call for help)

▪ Need for new or additional obstetric chains to assist difficult births

▪ Need for additional help to be able to assist severe or multiple cows experiencing dystocia at the same time

▪ Importance of having established and written calving protocols (e.g., hygiene practices, what to look for, why it is important, and when it is appropriate to intervene)

▪ Animals with unknown anticipated calving dates (e.g., missing records or bull bred first-calf heifers)

▪ Use of defined events for record-keeping (e.g., scale used for ease of calving, stillbirth, retained fetal membranes)

▪ Proper maintenance of calving or maternity pen (e.g., broken water hose or gate)

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## Record-Keeping

| Dairy: MATERNITY - CALVING |     |           |      |              |            |            |     |            |       |            |         |          |
|----------------------------|-----|-----------|------|--------------|------------|------------|-----|------------|-------|------------|---------|----------|
| COW ID                     | FIN | DATE      | BCS  | TIME STARTED | TIME BIRTH | ALIVE/DEAD | SEX | DIFFICULTY | PHS   | STILLBIRTH | CALF ID | INITIALS |
| 4421                       | 10  | 6/22/2013 | 3.75 | 2:00 pm      | 3:25 pm    | A          | M   | 1 2 3 4    | 1 2 3 | NO         | 1000    | GMS      |
| 1987                       | 10  | 6/25/2013 | 3    | 6:15 am      | 9:00 am    | D          | M   | 1 2 3 4    | 1 2 3 | YES        |         | TWIN     |
| 1987                       | 10  | 6/25/2013 | 3    | 6:15 am      | 9:00 am    | A          | M   | 1 2 3 4    | 1 2 3 | NO         | 1001    | TWIN     |
|                            |     |           |      |              |            |            |     | 1 2 3 4    | 1 2 3 |            |         |          |
|                            |     |           |      |              |            |            |     | 1 2 3 4    | 1 2 3 |            |         |          |
|                            |     |           |      |              |            |            |     | 1 2 3 4    | 1 2 3 |            |         |          |
|                            |     |           |      |              |            |            |     | 1 2 3 4    | 1 2 3 |            |         |          |
|                            |     |           |      |              |            |            |     | 1 2 3 4    | 1 2 3 |            |         |          |
|                            |     |           |      |              |            |            |     | 1 2 3 4    | 1 2 3 |            |         |          |
|                            |     |           |      |              |            |            |     | 1 2 3 4    | 1 2 3 |            |         |          |
|                            |     |           |      |              |            |            |     | 1 2 3 4    | 1 2 3 |            |         |          |
|                            |     |           |      |              |            |            |     | 1 2 3 4    | 1 2 3 |            |         |          |
|                            |     |           |      |              |            |            |     | 1 2 3 4    | 1 2 3 |            |         |          |
|                            |     |           |      |              |            |            |     | 1 2 3 4    | 1 2 3 |            |         |          |
|                            |     |           |      |              |            |            |     | 1 2 3 4    | 1 2 3 |            |         |          |
|                            |     |           |      |              |            |            |     | 1 2 3 4    | 1 2 3 |            |         |          |

(PHS = Perineum hygiene score (1-3 scale) at calving; BCS = Body condition scored immediately after calving; A = Alive; D = Dead; F = Female; M = Male)

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## Degree of Assistance at Calving

| Scale               | Description of Dystocia <sup>(*)</sup>  | References   |
|---------------------|---|--|
| 1 to 3 scale        | 1 = no assistance<br>2 = slight assistance<br>3 = needed assistance   | Meyer et al., 2001   |
| 1 to 5 scale        | 1 = no assistance<br>2 = assistance by one person without the use of mechanical traction<br>3 = assistance by 2 or more people<br>4 = assistance with mechanical traction<br>5 = surgical procedure | Dematawewa and Berger, 1997<br>Lombard et al., 2007<br>Schuenemann et al., 2011a |
| Combination of both | Description is based on calving difficulty  | Mangurkar et al., 1984<br>Schuenemann et al., 2011a                              |

(\*)Description of scales used to determine the degree of dystocia according to the degree of assistance provided during parturition in Holstein herds.

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## References

1. Barrier, A.C., M.J. Haskell, A.J. Macrae, and C.M. Dwyer. 2012. Parturition progress and behavior in dairy cows with calving difficulty. *Appl. Anim. Behav. Sci.* 139:209-217.
2. Boyle, A.R., C.P. Ferris, and R.E. O'Connell. 2013. Does housing multiparous dairy cows with multiparous animals prior to calving influence welfare- and production-related parameters after calving? *Appl. Anim. Behav. Sci.* 143:1-8.
3. Duchamps, P., B. Nicks, B. Canart, M. Gielen, and I. Istasse. 1988. A note on resting behaviour of cows before and after calving in two different housing systems. *Appl. Anim. Behav. Sci.* 22:99-105.
4. Dematawewa, C.B.M., and P.J. Berger. 1997. Effect of dystocia on yield, fertility, and cow losses and an economic evaluation of dystocia scores for Holsteins. *J. Dairy Sci.* 80:754-761.
5. Gearhart, M.A., C.R. Curtis, H.N. Erb, R.D. Smith, C.J. Siffen, L.E. Chase, and M.D. Cooper. 1990. Relationship of changes in condition score to cow health in Holsteins. *J. Dairy Sci.* 73:3132-3140.
6. Gundelach, Y., K. Essemeyer, M.K. Totscher, and M. Hoedemaker. 2009. Risk factors for perinatal mortality in dairy cattle: Cow and foetal factors, calving process. *Theriogenology* 71:903-909.
7. Hunter, A., M.G. Maguivar, S. Bai, J.D. Workman, and G.M. Schuenemann. 2013. Assessment of work shift transition of calving personnel on stillbirth in Holstein dairy cows. *J. Dairy Sci.* (Abstract).
8. Jensen M.B. 2011. The early behaviour of cow and calf in an individual calving pen. *Appl. Anim. Behav. Sci.* 134:92-99.
9. Jensen M.B. 2012. Behaviour around the time of calving in dairy cows. *Appl. Anim. Behav. Sci.* 139:195-202.
10. Johanson, J.M., and P.J. Berger. 2003. Birth weight as a predictor of calving ease and perinatal mortality in Holstein cattle. *J. Dairy Sci.* 86:3745-3755.
11. Killion, D.F., F.D. Livemore, and R.E. Martin. 1998. Recommendations for recording and calculating the incidence of selected clinical diseases of dairy cattle. *J. Dairy Sci.* 81:2502-2509.
12. LeBlanc, S.J. 2008. Postpartum uterine disease and dairy herd reproductive performance: A review. *Vet. J.* 176:102-114.
13. Lombard, J.E., F.B. Curry, S.M. Tomlinson, and L.P. Garber. 2007. Impacts of dystocia on health and survival of dairy calves. *J. Dairy Sci.* 90:1751-1760.
14. Mangurkar, B.R., J.F. Hayes, and J.E. Moxley. 1984. Effects of calving ease-calf survival on production and reproduction in Holsteins. *J. Dairy Sci.* 67:1496-1509.
15. Meo, J.F. 2004. Managing the dairy cow at calving time. *Vet. Clin. North Am. Food Anim. Pract.* 20:521-546.
16. Meo, J.F. 2008. Prevalence and risk factors for dystocia in dairy cattle: A review. *Vet. J.* 176:93-101.
17. Meijering, A. 1984. Dystocia and stillbirths in cattle: A review of causes, relations and implications. *Livest. Prod. Sci.* 11:143.
18. Miedema, H.M., M.S. Cockram, C.M. Dwyer, and A.J. Macrae. 2011. Behavioural predictors of the start of normal and dystocic calving in dairy cows and heifers. *Appl. Anim. Behav. Sci.* 132:14-19.
19. Miedema, H.M., M.S. Cockram, C.M. Dwyer, and A.J. Macrae. 2011. Changes in the behaviour of dairy cows during the 24 h before normal calving compared with behaviour during late pregnancy. *Appl. Anim. Behav. Sci.* 131:8-14.
20. Meyer, C.L., P.J. Berger, K.J. Koehler, J.R. Thompson, and C.G. Sattler. 2001. Phenotypic trends in incidence of stillbirth for Holsteins in the United States. *J. Dairy Sci.* 84:515-523.
21. Noakes, D.E., T.J. Parkinson, and G.C.W. England. 2001. Dystocia and other disorders associated with parturition, 8th ed. *Arthur's Veterinary Reproduction and Obstetrics*, Saunders.
22. Prouffrock, L.L., M.B. Jensen, P.M.H. Heegaard, and M.A.G. von Keyserlingk. 2013. Effect of moving dairy cows at different stages of labor on behavior during parturition. *J. Dairy Sci.* 96:1639-1646.

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## References

1. Reinhardt, T. A., J. D. Lippold, B. J. McCluskey, J. 589, P. Goff, and R. L. Horst. 2011. Prevalence of subclinical hypocalcemia in dairy herds. *Vet. J.* 188:122-124.
2. Sheldon, I.M., J. Cronin, L. Goetze, G. Donofrio, and H.J. Schuberth. 2009. Defining postpartum uterine disease and the mechanisms of infection and immunity in the female reproductive tract in cattle. *Biol. Reprod.* 81:1025-1032.
3. Schuenemann, G.M., S. Bas, J. E. Gordon, and J. D. Workman. 2013. Dairy calving management: Description and assessment of a training program for dairy personnel. *J. Dairy Sci.* 96:2673-2680.
4. Schuenemann, G.M., I. Nieto, S. Bas, K.N. Galvko, and J. Workman. 2011a. Assessment of calving progress and reference times for obstetric intervention during dystocia in Holstein dairy cows. *J. Dairy Sci.* 94:5494-5501.
5. Schuenemann, G.M., I. Nieto, S. Bas, K.N. Galvko, and J. Workman. 2011b. II. Dairy calving management: Effect of perineal hygiene scores on metritis. *J. Dairy Sci.* Vol. 94:744 (E-Suppl. 3).
6. Schullj G and Ball L. 1980. Delivery by forced extraction and other aspects of bovine obstetrics. In: *Current Therapy in Theriogenology*. 1st Ed. D.A. Morrow (Ed). W.B. Saunders Co. Philadelphia, p 251.
7. Steeneke, M., C. Bahr, D. Berckmans, I. Halaachwi, A. Antler, and E. Maltz. 2012. Lying patterns of high producing healthy dairy cows after calving in commercial herds as affected by age, environmental conditions and production. *Appl. Anim. Behav. Sci.* 136:88-95.
8. USDA. 2010. Dairy 2007: Herd, Calf Health and Management Practices on U.S. Dairy Operations, 2007. USDA-APHIS-VS, CIAM, Fort Collins, CO.
9. The Center for Food Security and Public Health at Iowa State University. Link: [http://www.cfsph.iastate.edu/Infection\\_Control/diagnostics/resources\\_for\\_veterinarians.php](http://www.cfsph.iastate.edu/Infection_Control/diagnostics/resources_for_veterinarians.php)

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