OHIO DAIRY VETERINARIANS MEETING

2017 PROCEEDINGS

“Calf and Heifer Replacement Management and Economics”

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Ohio Dairy Veterinarians Meeting

January 5, 6, & 7, 2017 in Columbus, Ohio

"Calf and Heifer Replacement Management and Economics"

Hotel Reservation Deadline Tuesday, December 6, 2016

Conference Registration Deadline Friday, December 16, 2016

PLATINUM

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Animal Profiling International (API)
Multimin
Tech Mix
Agri-Sales/YTEX
DHIA
AfiMilk

Dairy replacement management is critical to the profitability of the dairy. Maximizing the next generation of dairy animals means more milk. Having the right amount of healthy heifers is the focus of this year's meeting.

Dr. Mark Thomas will focus on management of replacement heifers on Thursday. The program on Friday and Saturday will focus on replacement economics and disease recording with Dr. Mike Overton.

On Friday night, Dr. Dave Erf of Zoetis, our platinum sponsor, will discuss genetic selection to improve the health of dairy cattle. Dr. Erf will be back Saturday morning to discuss managing heifer inventories and evaluating the genetic potential of the herd.

Meeting Locations

Hilton Garden Inn (Thursday and Saturday)
3232 Olentangy River Road, Columbus OH
Hotel must be reserved by **12/6** by calling 614-263-7200.
Be sure to mention your affiliation with the
Ohio Dairy Veterinarians to reserve the room rate of $119.

Fawcett Center (Friday)
2400 Olentangy River Road, Columbus OH

The cost is $249. Veterinary students admitted free.

Mail your registration and payment by 12/16 to secure your enrollment, handouts, and all of your meals.

Speakers

CE = 10 hours

David Erf, Ph.D. is a member of the Zoetis Dairy Technical Services team as a dairy geneticist. In this role, he assists with the CLARIFIDE dairy genomic testing program. He helps customers realize the full potential of genomic testing. Dr. Erf has over 20 years experience in the Artificial Insemination industry and has served on numerous boards and committees dealing with genetics in the dairy industry. He was born and raised on a dairy in North Central Ohio and now resides with his family in the Twin Cities area of Minnesota.

Dr. Michael W. Overton is the Associate Advisor - Dairy Technical Consultant at Elanco Knowledge Solutions . He received his B.S. and D.V.M. from North Carolina State University and practiced veterinary medicine for 8 years in North Carolina. He then completed a Dairy Production Medicine Residency and his Masters of Preventive Veterinary Medicine degree at UC Davis and worked as a Dairy Production Medicine Specialist at UC Davis-VMTRC in Tulare, CA for 6 years. Afterwards, he joined the University of Georgia – College of Veterinary Medicine where he served as Professor of Dairy Production Medicine and chief of service and graduate coordinator for the food animal program for about 7 years. In May 2012, he joined the Elanco Knowledge Solutions team. In this role, Dr. Overton is responsible for developing economic models and tools for both internal and external customers, for providing consultative services to dairies and their consultants, and for building analytical capabilities for the global Elanco team. Throughout his professional career, Dr. Overton has worked extensively in the areas of reproductive management, transition management, analysis of on-farm records, and economic decision-making. He has authored or co-authored over 100 peer-reviewed, proceedings or industry publications on various topics regarding dairy production medicine and travels frequently to speak and consult in the U.S. and internationally. Dr. Overton lives in Athens, Georgia with his wife Carol.

Dr. Mark Thomas is a consulting veterinarian with Dairy Health & Management Services & Countryside Veterinary Clinic in Lowville, New York. He earned a Bachelor's of Science in Animal Science at Cornell University and continued his education at the College of Veterinary Medicine where he earned a Doctor of Veterinary Medicine (DVM) degree in 1997. In 2001 he completed the Penn State Dairy Production Medicine Certificate Program. He is a diplomate of the American Board of Veterinary Practitioners (ABVP) certified in dairy practice.

Following graduation Dr. Thomas entered clinical practice at Countryside Veterinary Clinic, LLP in northern New York. He is currently a partner in the practice which has 18 veterinarians serving large and small animal clients. In early 2012 he joined other colleagues and founded Dairy Health & Management Services (DHMS) to provide decision-based consulting research to dairy clients within the USA and internationally.

Within practice Dr. Thomas' main focus is production and preventative medicine. In addition to routine veterinary care, Dr. Thomas provides consulting services in the areas of nutrition, reproduction, milk quality (certified milking equipment technician), facility design and replacement rearing both within the USA and internationally. He speaks Spanish and provides bilingual training programs. Outside of practice, Dr. Thomas enjoys lecturing at meetings and is also active in teaching through the Cornell Pro Dairy program and the Summer Dairy Institute at Cornell.

He has served as an active member of the AABP membership committee and has co-chaired the student program at the AABP national convention. He was the AABP District I director for 7 years and is currently in the position of president.

In 2011 he received the AABP Merial Excellence in Preventive Medicine- Dairy Award.

Ohio Dairy Veterinarians Meeting

THURSDAY, January 5, 2017 Hilton Garden Inn

1:00	WELCOME	
1:30	Group Housed Feeding Systems	Dr. Mark Thomas
2:30	Replacement Rearing Beyond Milk	Dr. Mark Thomas
3:45	Break	
4:30	Data-based Decision Making	Dr. Mark Thomas
6:00	Dinner	
7:00	HAACP Committee Update	Dr. Dick Wiley

FRIDAY, January 6, 2017 Fawcett Center

6:30	OSU Breakfast	Proudfoot
7:15	State of OSU CVM	Dean Moore
7:45	OSU Research Reports	Proudfoot
9:00	Sponsor Displays/Intro	
9:30	Making Better Culling Decisions	Mike Overton
10:30	Break/Sponsor Displays	
11:00	Economic Considerations	Mike Overton
12:00	Lunch	Speakers: Fred Gingrich AABP Sue SKorupski USDA Tony Forshey ODA Jenny Hubble ODPA Elizabeth Harsh OCS
2:00	Heifer Data and Culling Decisions	Mike Overton
3:00	Break/Sponsor Displays	
3:30	First Calving Age & Future Lactation	Mike Overton
5:00	Break	
5:30	Social Time with Students	Gordon
6:00	Dinner	
6:30	Platinum Presentation- Genetic Selection	Dave Erf
7:00	Practice Presentations	Gordon
7:30	Summer Extern Presentations	Gordon

Saturday, January 7, 2017 Hilton Garden Inn

6:30	BREAKFAST (hotel)	
7:30	Transistion Disease Recording	Mike Overton
8:30	Genetic Audits	Dave Erf
9:30	Break	
9:45	Managing Replacement Inventories	Dave Erf
11:00	Annual Business Meeting	
12:00	Adjourn	

The Ohio Dairy Veterinarians is not affiliated with The Ohoi State University, although the OSU Department of Veterinary Preventive Medicine has graciously accepted the responsibility for the program registration.

Please feel free to copy/forward any of this information and pass it on to colleagues.

REGISTRATION DEADLINE FRIDAY, DECEMBER 16, 2016

REGISTRATION FORM

Ohio Dairy Veterinarians Meeting

January 5 – 7, 2017

Hilton Garden Inn – 3232 Olentangy River Road
Columbus OH 43232
Phone: 614-263-7200 • Room Rate $119.00
Fawcett Center – 2400 Olentangy River Road
Phone: 614-292-1342

FEE: $249.00 • Veterinary Students FREE

Everyone including students MUST register so we have a meal count.

NAME ______________________________

PRACTICE NAME ______________________________

ADDRESS ______________________________

CITY ______________________________

STATE ______________ ZIP CODE ______________

PHONE ______________________________

FAX ______________________________

EMAIL______________________________

*We need your email address to provide you with our most current information.

ODV Registration @ $249.00 = ________

Saturday Registration ONLY @ $50.00 = ________

SUBTOTAL ________

Scholarship Contribution = ________

TOTAL ENCLOSED $ ________

Be sure to make your hotel reservation by **December 6, 2016** to get room rate of $119.

Please mail your registration and payment.

Send form and remittance to (check payable to OSU):
Ohio State University Dept of Veterinary Preventive Medicine
Attn: Jeffrey D Workman
A100P Sisson Hall
1920 Coffey Road
Columbus, OH 43210

Questions: Ohiodairyvets@gmail.com

THE OHIO DAIRY VETERINARIANS

PRESENTS THIS

CERTIFICATE OF CONTINUING EDUCATION

TO

For participation in the 2017 Annual Meeting entitled
“Calf and Heifer Replacement Management and Economics”

Columbus, Ohio
January 5-7, 2017

Em Mowrer, DVM & Gabe Middleton, DVM
Presidents, Ohio Dairy Veterinarians

This program provides 11 hours of continuing education credit on an “hour per hour” basis.

Thanks to our Sponsors…

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- *Milk Specialties Global*
- *COBA/Select Sires Inc.*
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- *Ohio Veterinary Medical Association (OVMA)*

Silver –

- *Animal Health International*
- *Arm & Hammer*
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THE DRIVE TO DO BETTER IS IN OUR DNA.

American dairy producers have an inherent desire to do better. This "do better" drive is why they are moving away from only using parent average to gauge an animal's transmitting ability to a more trusted measure—Genomic Predicted Transmitting Ability (GPTA) values[1] from CLARIFIDE.®

Why are GPTAs better? Parent average is a simple average of each parent—and is built on the assumption that an offspring inherits a balanced complement of their respective parents' genetic merit for all traits. The reality is that sometimes they receive a more favorable or less favorable set. It also assumes that you have the right parents—but in commercial dairies, the wrong sire is recorded about 14.4 percent of the time.[2] **Parent average reliability ranges between 20 and 30 percent**[3] depending on how much is known about the sire and dam.

On the other hand, GPTA values from CLARIFIDE are based on an animal's actual genetic makeup—like using a GPS instead of a compass to get from one point to another. That's why **GPTA values from CLARIFIDE average some 40 points higher—in the 60 to 70 percent reliability range.**[2]

How does that benefit your herd? You have the power to proactively make more effective animal management decisions, even when the animal is very young. You won't need to wish you had more heifers out of that great five-year-old cow, or freshen a two-year-old that doesn't pull her weight. With CLARIFIDE, you can more confidently build the herd you want to milk in the future.

BETTER RELIABILITY WITH CLARIFIDE

Using CLARIFIDE we really have sound science behind our decisions. That significantly impacts our management decisions. We have seen a significant increase in milk production.

Brian Fiscalini,
Fiscalini Farms in Modesto, Calif.

OR

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WHAT ARE YOU WAITING FOR? DO BETTER.

Visit www.clarifide.com or www.youtube.com/zoetisgenetics.

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[1] GPTA values are derived from the USDA-CDCB dairy genetic evaluation system using CLARIFIDE data.

[2] Zoetis data on file. Results from analysis of cumulative 3K and 6K results reported from USDA-CDCB dairy genetic evaluation as of September 2012 and associated submission data.

[3] Source: USDA-CDCB evaluation for CLARIFIDE-tested Holstein females ≤ 12 months of age as of April 2014. Median value for NM$ in this data set = 22%.

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CONFIDENCE IS KNOWING THAT YOU GOT IT RIGHT.

When you run a stocker operation, the sun doesn't tell you when the work is done. So, when you do get some downtime, it's because you know things are on the right track. That's why you choose the confidence of treatment with Zuprevo® *(tildipirosin)* when you see signs of BRD.

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IMPORTANT SAFETY INFORMATION

FOR USE IN ANIMALS ONLY. NOT FOR HUMAN USE. KEEP OUT OF REACH OF CHILDREN. TO AVOID ACCIDENTAL INJECTION, DO NOT USE IN AUTOMATICALLY POWERED SYRINGES WHICH HAVE NO ADDITIONAL PROTECTION SYSTEM. IN CASE OF HUMAN INJECTION, SEEK MEDICAL ADVICE IMMEDIATELY AND SHOW THE PACKAGE INSERT OR LABEL TO THE PHYSICIAN. DO NOT USE Zuprevo® 18% IN SWINE. Fatal adverse events have been reported following the use of tildipirosin in swine. NOT FOR USE IN CHICKENS OR TURKEYS. Cattle intended for human consumption must not be slaughtered within 21 days of the last treatment. Do not use in female dairy cattle 20 months of age or older. Use of this drug product in these cattle may cause milk residues. A withdrawal period has not been established in pre-ruminating calves. Do not use in calves to be processed for veal. The effects of Zuprevo® 18% on bovine reproductive performance, pregnancy and lactation have not been determined. Swelling and inflammation, which may be severe, may be seen at the injection site after administration. Subcutaneous injection may result in local tissue reactions which persist beyond slaughter withdrawal period. This may result in trim loss of edible tissue at slaughter. Brief summary available on adjacent page.

048539 R10

PRODUCT INFORMATION
NADA 141-334, Approved by FDA.

ZUPREVO® 18%
(tildipirosin)

Injectable Solution for Cattle

ANTIMICROBIAL DRUG
180 mg of tildipirosin/mL For subcutaneous injection in beef and non-lactating dairy cattle only.

Not for use in female dairy cattle 20 months of age or older or in calves to be processed for veal.

CAUTION: Federal (USA) law restricts this drug to use by or on the order of a licensed veterinarian.

BRIEF SUMMARY: for full prescribing information use package insert.

INDICATIONS: Zuprevo® 18% is indicated for the treatment of bovine respiratory disease (BRD) associated with *Mannheimia haemolytica*, *Pasteurella multocida*, and *Histophilus somni* in beef and non-lactating dairy cattle, and for the control of respiratory disease in beef and non-lactating dairy cattle at high risk of developing BRD associated with *M. haemolytica*, *P. multocida*, and *H. somni*.

WARNINGS: FOR USE IN ANIMALS ONLY. NOT FOR HUMAN USE. KEEP OUT OF REACH OF CHILDREN. TO AVOID ACCIDENTAL INJECTION, DO NOT USE IN AUTOMATICALLY POWERED SYRINGES WHICH HAVE NO ADDITIONAL PROTECTION SYSTEM. IN CASE OF HUMAN INJECTION, SEEK MEDICAL ADVICE IMMEDIATELY AND SHOW THE PACKAGE INSERT OR LABEL TO THE PHYSICIAN.

Avoid direct contact with skin and eyes. If accidental eye exposure occurs, rinse eyes with clean water. If accidental skin exposure occurs, wash the skin immediately with soap and water. Tildipirosin may cause sensitization by skin contact.

For technical assistance or to report a suspected adverse reaction, call: 1-800-219-9286.

For customer service or to request a Material Safety Data Sheet (MSDS), call: 1-800-211-3573. For additional Zuprevo 18% information go to www.zuprevo.com.

For a complete listing of adverse reactions for Zuprevo 18% reported to CVM see: http://www.fda.gov/AnimalVeterinary/SafetyHealth.

DO NOT USE ZUPREVO 18% IN SWINE. Fatal adverse events have been reported following the use of tildipirosin in swine. NOT FOR USE IN CHICKENS OR TURKEYS.

RESIDUE WARNING: Cattle intended for human consumption must not be slaughtered within 21 days of the last treatment. Do not use in female dairy cattle 20 months of age or older. Use of this drug product in these cattle may cause milk residues. A withdrawal period has not been established in pre-ruminating calves. Do not use in calves to be processed for veal.

PRECAUTIONS: The effects of Zuprevo 18% on bovine reproductive performance, pregnancy and lactation have not been determined. Swelling and inflammation, which may be severe, may be seen at the injection site after administration. Subcutaneous injection may result in local tissue reactions which persist beyond the slaughter withdrawal period. This may result in trim loss of edible tissue at slaughter.

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MERCK
Animal Health

Introducing Imrestor™ (pegbovigrastim injection)—the first-of-its-kind immune restorative for periparturient dairy cows and heifers, available only by veterinary prescription.

During the critical time around calving when a dairy cow's immune system is suppressed, Imrestor helps restore the integrity of a cow's innate immune system to reduce the incidence of clinical mastitis by 28% in the first 30 days of lactation in periparturient dairy cows and periparturient replacement dairy heifers, helping protect her potential and the well-being of the entire dairy.

It's just the helping hand a dairy producer needs.

To help protect the whole herd with Imrestor as part of an ongoing herd health management program, contact your veterinarian or Elanco representative.

Visit www.HelpProtectYourDairyHerd.com to learn more.

Important Safety Information: No withdrawal period or milk discard time is required. In case of accidental self-injection, wash the site of injection thoroughly with clean running water. Foreign proteins such as pegbovigrastim have the potential to cause anaphylactic-type reactions. Do not use Imrestor to treat cows with clinical mastitis because effectiveness has not been demonstrated for this use. Some cases of hypersensitivity-type reactions have been observed in studies. Abomasal ulcerations/erosions were observed in safety studies; it was concluded that these findings were not clinically relevant. Please see Brief Summary of full Prescribing Information for additional information.

DEDICATED *to the* DEDICATED

Elanco
Imrestor™
(pegbovigrastim injection)

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Elanco™ AH0955

Imrestor™ *pegbovigrastim injection*

15 mg pegbovigrastim per 2.7 mL single dose syringe
For subcutaneous injection in periparturient dairy cows and periparturient replacement dairy heifers.

CAUTION: Federal (USA) law restricts this drug to use by or on the order of a licensed veterinarian.

Before using this product, please consult the product insert, a summary of which follows:

DESCRIPTION: Imrestor is a sterile injectable formulation of pegbovigrastim (an immunomodulator, bovine granulocyte stimulating factor) in single-dose syringes. Each syringe of Imrestor contains pegbovigrastim (15 mg), L-arginine hydrochloride (94 mg), L-arginine (40 mg), and citric acid monohydrate (17 mg).

INDICATIONS FOR USE: For the reduction in the incidence of clinical mastitis in the first 30 days of lactation in periparturient dairy cows and periparturient replacement dairy heifers.

DOSAGE AND ADMINISTRATION: This is a two-dose regimen. The same dose is used regardless of cow/heifer body weight. Remove surface dirt from the injection site area before injecting. Inject the entire contents of the syringe subcutaneously. Do not reuse the syringe.

Administer the first dose (syringe) 7 days prior to the cow's or heifer's anticipated calving date. If necessary, the first dose may be administered within a range of 4 to 10 days prior to the anticipated calving date to accommodate management schedules. Administer the second dose (syringe) within 24 hours after calving.

Animals that calve either less than or more than 7 days after the first dose should receive the second dose within 24 hours after calving.

Prior to administration, Imrestor should be visually inspected for particulate matter and discoloration. Imrestor is a clear, colorless solution and may contain a few small, translucent or white particles. Imrestor should not be used if it is discolored or cloudy, or if other particulate matter is present.

Do not shake or tap the syringe prior to use.

WARNINGS:

▶ **RESIDUE WARNING:** No withdrawal period or milk discard time is required when used according to the labeling. ◀

HUMAN WARNINGS: Not for use in humans. Keep out of reach of children.

USER SAFETY WARNINGS: In case of accidental self-injection, wash the site of injection thoroughly with clean running water. Foreign proteins such as pegbovigrastim have the potential to cause anaphylactic-type reactions. If you experience swelling or redness at the site of exposure, or more severe reactions such as shortness of breath, seek medical attention immediately and take the package insert with you. Report the event to Elanco Animal Health at 1-800-428-4441. To obtain a Safety Data Sheet, contact Elanco Animal Health at 1-800-428-4441.

PRECAUTIONS: Do not use Imrestor to treat cows with clinical mastitis because effectiveness has not been demonstrated for this use.

ADVERSE REACTIONS: Some cases of hypersensitivity-type reactions have been observed in studies outside the United States within five minutes to two hours, occurring most often after the first administration of Imrestor. Clinical signs may include elevated respiratory rate, dyspnea, urticaria, sweating, dependent edema, swollen mucous membranes, and/or hypersalivation, and, rarely death. These reactions resolve within hours of onset with or without therapeutic intervention and have not been shown to reoccur with subsequent injections of Imrestor. Abomasal ulcerations/erosions were observed in the Margin of Safety studies. (See Target Animal Safety section).

To report a suspected adverse drug event, contact Elanco Animal Health at 1-800-428-4441. For additional information about adverse drug experience reporting for animal drugs, contact FDA at 1-888-FDA-VETS or http://www.fda.gov/AnimalVeterinary/SafetyHealth.

EFFECTIVENESS: The effectiveness of Imrestor for the reduction in the incidence of clinical mastitis was demonstrated in a multi-site natural infection field study conducted at four sites in the U.S. and one site in France. A total of 801 healthy periparturient commercial dairy heifers and cows were enrolled and treated with Imrestor or saline by subcutaneous injection in the neck when they were identified as being approximately 7 days before their anticipated calving date (Day -7), and again within 24 hours after calving (Day 0). Each quarter of each enrolled animal was evaluated at each milking from Days 3 to 30 to monitor the development of clinical mastitis. Animals developing clinical mastitis (using quarter health, milk quality, and California Mastitis Test [CMT] evaluations) through Day 30 were classified as treatment failures. Administration of Imrestor resulted in a statistically significant difference (p = 0.025) in the incidence of clinical mastitis (treatment failure rate) across all five sites with a difference in favor of the Imrestor-treated group (failure rate: 60/331 = 18.13%) compared to the saline-treated group (failure rate: 85/338 = 25.15%).

STORAGE INFORMATION: Store under refrigeration (2° to 8°C; 36° to 46°F). DO NOT FREEZE. Avoid prolonged exposure to sunlight. Excursions of up to 24 hours at room temperature (15° to 30°C; 59° to 86°F) are allowed after receipt.

DISPOSAL: Dispose of used syringes in a leak-resistant, puncture-resistant container in accordance with applicable Federal, state and local regulations.

HOW SUPPLIED: 10, 50 or 100 single-dose syringe packages with each syringe containing 15 mg of pegbovigrastim.

NADA 141-392. Approved by FDA.

Manufactured for Elanco Animal Health,
a Division of Eli Lilly and Company, Indianapolis, IN 46285.

For technical assistance or to report suspected adverse drug events, contact Elanco Animal Health at 1-800-428-4441.

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AH0955 MAR 2016 PA088964AMX_Mkt4

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1

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More calcium in multiple forms for delivery when she needs it.

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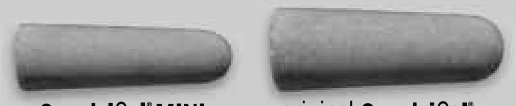
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3

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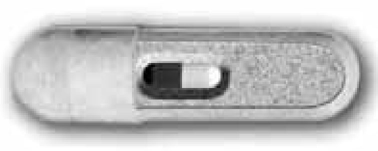
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440-212-1632 | Hans.Maybach@bio-vet.net

300 Ernie Drive | Barneveld, WI 53507

800-246-8381 | www.bio-vet.com

ZACTRAN®
(gamithromycin)

150 mg/mL ANTIMICROBIAL
NADA 141-328, Approved by FDA
For subcutaneous injection in beef and non-lactating dairy cattle only. Not for use in female dairy cattle 20 months of age or older or in calves to be processed for veal.

Caution: Federal (USA) law restricts this drug to use by or on the order of a licensed veterinarian.
READ ENTIRE BROCHURE CAREFULLY BEFORE USING THIS PRODUCT.

INDICATIONS
ZACTRAN is indicated for the treatment of bovine respiratory disease (BRD) associated with *Mannheimia haemolytica*, *Pasteurella multocida*, *Histophilus somni* and *Mycoplasma bovis* in beef and non-lactating dairy cattle. ZACTRAN is also indicated for the control of respiratory disease in beef and non-lactating dairy cattle at high risk of developing BRD associated with *Mannheimia haemolytica* and *Pasteurella multocida*.

CONTRAINDICATIONS
As with all drugs, the use of ZACTRAN is contraindicated in animals previously found to be hypersensitive to this drug.

WARNING: FOR USE IN CATTLE ONLY. NOT FOR USE IN HUMANS. KEEP THIS AND ALL DRUGS OUT OF REACH OF CHILDREN. NOT FOR USE IN CHICKENS OR TURKEYS.
The material safety data sheet (MSDS) contains more detailed occupational safety information. To report adverse effects, obtain an MSDS or for assistance, contact Merial at 1-888-637-4251.

RESIDUE WARNINGS: Do not treat cattle within 35 days of slaughter. Because a discard time in milk has not been established, do not use in female dairy cattle 20 months of age or older. A withdrawal period has not been established for this product in pre-ruminating calves. Do not use in calves to be processed for veal.

PRECAUTIONS
The effects of ZACTRAN on bovine reproductive performance, pregnancy, and lactation have not been determined. Subcutaneous injection of ZACTRAN may cause a transient local tissue reaction in some cattle that may result in trim loss of edible tissues at slaughter.

ADVERSE REACTIONS
Transient animal discomfort and mild to moderate injection site swelling may be seen in cattle treated with ZACTRAN.

EFFECTIVENESS
The effectiveness of ZACTRAN for the treatment of BRD associated with *Mannheimia haemolytica*, *Pasteurella multocida* and *Histophilus somni* was demonstrated in a field study conducted at four geographic locations in the United States. A total of 497 cattle exhibiting clinical signs of BRD were enrolled in the study. Cattle were administered ZACTRAN (6 mg/kg BW) or an equivalent volume of sterile saline as a subcutaneous injection once on Day 0. Cattle were observed daily for clinical signs of BRD and were evaluated for clinical success on Day 10. The percentage of successes in cattle treated with ZACTRAN (58%) was statistically significantly higher (p≤0.05) than the percentage of successes in the cattle treated with saline (19%).
The effectiveness of ZACTRAN for the treatment of BRD associated with *M. bovis* was demonstrated independently at two U.S. study sites. A total of 502 cattle exhibiting clinical signs of BRD were enrolled in the studies. Cattle were administered ZACTRAN (6 mg/kg BW) or an equivalent volume of sterile saline as a subcutaneous injection once on Day 0. At each site, the percentage of successes in cattle treated with ZACTRAN on Day 10 was statistically significantly higher than the percentage of successes in the cattle treated with saline (74.4% vs. 24% [p <0.001], and 67.4% vs. 46.2% [p = 0.002]). In addition, in the group of calves treated with gamithromycin that were confirmed positive for *M. bovis* (pre-treatment nasopharyngeal swabs), there were more calves at each site (45 of 57 calves, and 5 of 6 calves) classified as successes than as failures.
The effectiveness of ZACTRAN for the control of respiratory disease in cattle at high risk of developing BRD associated with *Mannheimia haemolytica* and *Pasteurella multocida* was demonstrated in two independent studies conducted in the United States. A total of 467 crossbred beef cattle at high risk of developing BRD were enrolled in the study. ZACTRAN (6 mg/kg BW) or an equivalent volume of sterile saline was administered as a single subcutaneous injection within one day after arrival. Cattle were observed daily for clinical signs of BRD and were evaluated for clinical success on Day 10 post-treatment. In each of the two studies, the percentage of successes in the cattle treated with ZACTRAN (86% and 78%) was statistically significantly higher (p = 0.0019 and p = 0.0016) than the percentage of successes in the cattle treated with saline (36% and 58%).

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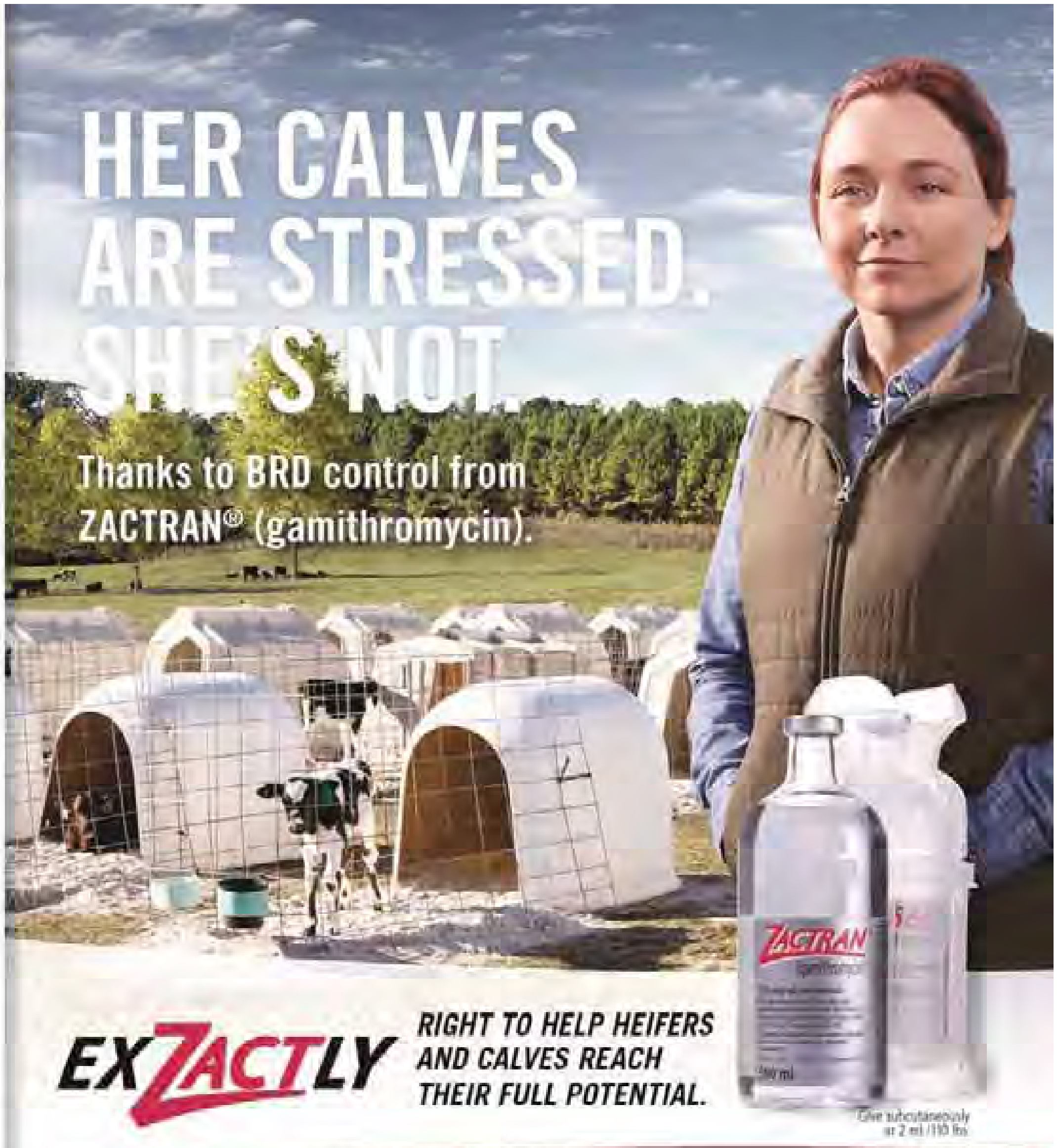
RUMIOTD1349 (12/13)



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IMPORTANT SAFETY INFORMATION: *For use in cattle only. Do not treat cattle within 35 days of slaughter. Because a discard time in milk has not been established, do not use in female dairy cattle 20 months of age or older, or in calves to be processed for veal. The effects of ZACTRAN on bovine reproductive performance, pregnancy and lactation have not been determined.*

[†] Based on Manufacturers' Suggested Retail Price.
[1] Sifferman RL, Wolff WA, Holste JE, et al. Field efficacy evaluation of gamithromycin for treatment of bovine respiratory disease in cattle at feedlots. *Intern J Appl Res Vet Med.* 2011;9(2):171-180.
[2] ZACTRAN product label.
[3] van Der Fels-Klerx HJ, Martin SW, Nielen M, Huirne RBM. Effects on productivity and risk factors of Bovine Respiratory Disease in dairy heifers; a review for the Netherlands. *Netherlands Journal of Agricultural Science.* 2002;50:27-45.
[4] Lechtenberg K, Daniels CS, Royer GC, et al. Field efficacy study of gamithromycin for the control of bovine respiratory disease in cattle at high risk of developing the disease. *Intern J Appl Res Vet Med.* 2011;9(2):189-197.
[5] DRAXXIN product label.

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Sponsored by the Ohio Veterinary Medical Association

For students studying veterinary medicine, the best way to learn is by firsthand experience. In an effort to encourage students who want to take their education to the next level, the **Ohio Veterinary Medical Association** will provide a total of $8,000 in matching grant funds to veterinarians willing to introduce students to food animal medicine.

PURPOSE OF THE PROGRAM

This externship opportunity has been established to facilitate the exploration of food animal medicine as a viable career path among veterinary medicine students. The program also encourages and supports OVMA food animal practitioners in developing mentorship opportunities and, potentially, future associate veterinarians.

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- Food animal medicine (bovine, swine, ovine, poultry or aquaculture) makes up at least 25 percent of your practice's activity.
- At least half of the practicing veterinarians are OVMA members.
- Practice is located in Ohio.
- Agree to engage students in food animal medicine for the majority of the externship, as well as match OVMA externship funds dollar for dollar.

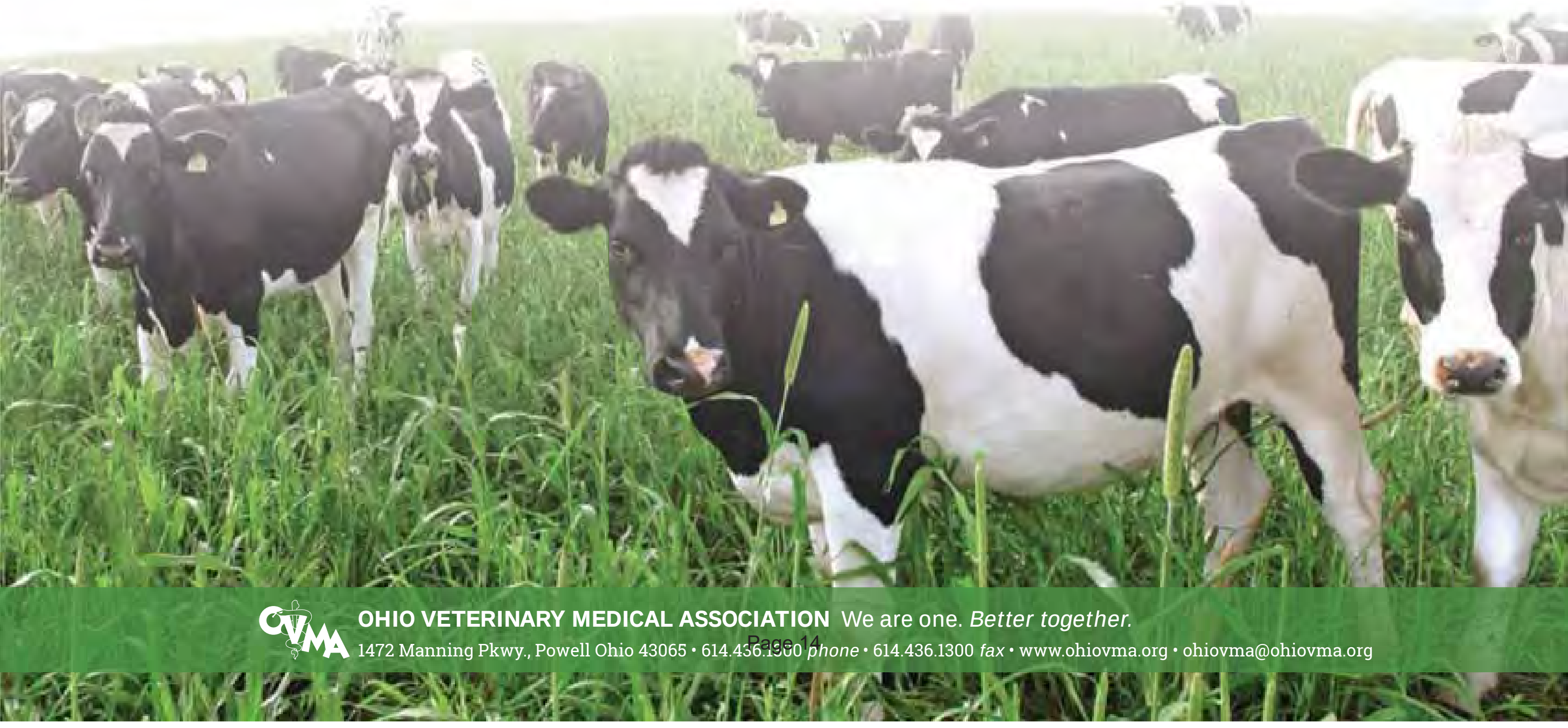
If your practice meets these criteria, you may be awarded up to $1,500 for the 2017 program.

HOW TO APPLY

For full program details and to apply, please visit www.ohiovma.org/externship. Applications must be received by no later than Feb. 15, 2017.

QUESTIONS?

Contact Michelle Holdgreve at 800.662.6862 or mrh@ohiovma.org.



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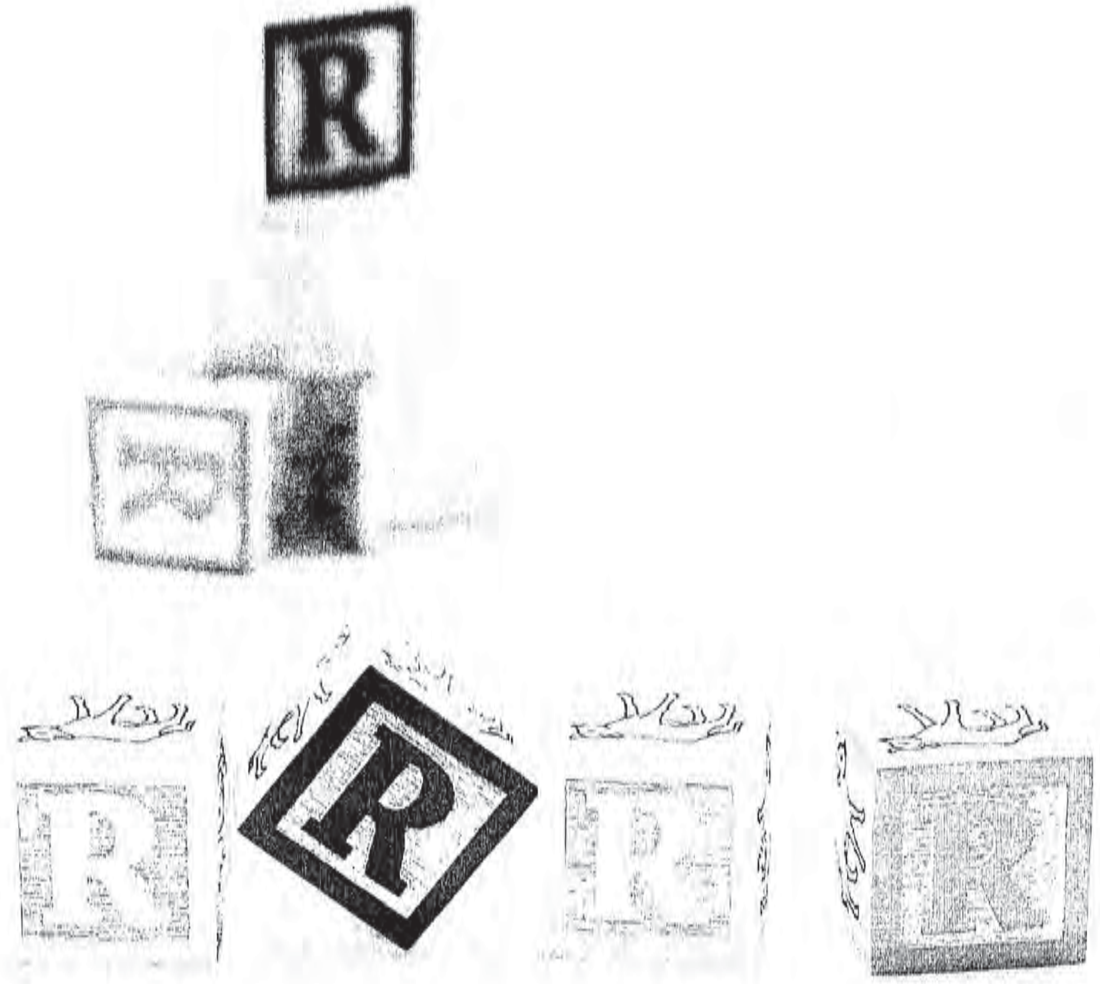

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BOVICARE-CP MAKES ALL SYSTEMS GO

Research

Cryptosporidium parvum infects calves at two to eight days of age and often re-infects at eight to 12 days. Infected calves frequently exhibit diarrhea and shed organisms known as oocysts. Oocysts ability to survive in the herd environment can create cycles of infection and poor performance.

TRIAL DESIGN	1.	2.	3.	4.	5.
	44 calves; 22 controls, 22 treatments (clean caught, colostrum deprived)	BoviCare-cp administered days 1 to 7 of life	BoviCare-cp dosed at 2 mL/calf for a.m. and p.m. feedings for seven days through the milk replacer	Calves challenged with C. parvum at 10 days of life	Observed 14 days post-challenge

TRIAL RESULTS

Oocyst shedding

Duration: Days of shedding	Controls: Treated:	107 days total (22 calves) 62 days total (22 calves)
Oocyst shedding: Measured in logs of organisms shed (p=0.05)	Controls: Treated:	2.4×10^8/gram of feces 1.6×10^6/gram of feces (> 2 log reduction or > 99% reduction)

Diarrhea: Incidence and Severity

Days Post-Challenge	Percent Incidence of Disease		Percent Reduction in Disease
	Controls	BoviCare-cp	
4-DPC	64%	27%	58% reduction
5-DPC	55%	18%	67% reduction
6-DPC	48%	14%	71% reduction
7-DPC	25%	5%	80% reduction
8-DPC	30%	9%	70% reduction
9-DPC	25%	9%	64% reduction
10-DPC	25%	9%	64% reduction

Weight gain

Total gain: 14 days post-challenge; 24 days of age	Controls: Treated:	17 pound total gain (19 surviving calves) 67 pound total gain (22 calves)
Average daily gain: 14 days post-challenge; 24 days of age	Controls: Treated:	0.063 lb./calf/day 0.217 lb./calf/day

Mortality

Severe challenge:	Controls: Treated:	3/22 calves 0/22 calves

CONCLUSION Administration of BoviCare-cp exhibited a statistically significant reduction in shedding and morbidity, as well as a statistically significant increase in weight gain at a p-value of 0.05.

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Benefits to You:

- Kills pathogens that:
  - -- Cause scours
  - -- Affect rate of gain
  - -- Impact death loss rates
- Quick kill times
  - -- 3 minute disinfection for controlling bacterial contamination
  - -- 5 minute disinfection for controlling viral contamination
- Environmentally friendly
  - -- Breaks down into table salt and organic acids
  - -- Safe for employee handling

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- Ropy milk issues
- Milking parlor mats, floors, & decks
- Parlor/milk room walls
- Drains
- Anywhere bacterial slime is present
- Freshening pens
- Water troughs, bowls, pails, & buckets

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You can use Polyflex® (*ampicillin*) with total confidence. Polyflex goes beyond conventional penicillin therapy. It offers broad-spectrum activity and reliable meat withdrawal and milk withholding times. Use Polyflex instead.

For more information on Polyflex, contact your local veterinarian or a Boehringer Ingelheim Vetmedica, Inc. representative.

Residue Warnings: Do not treat cattle for more than 7 days. Milk from treated cows must not be used for food during treatment, and for 48 hours (4 milkings) after the last treatment. Cattle must not be slaughtered for food during treatment, and for 144 hours (6 days) after the last treatment.

Polyflex®

Contact your local Boehringer Ingelheim Vetmedica, Inc. representative for a demonstration of the Polyflex calculator. Learn the true cost of treatment.

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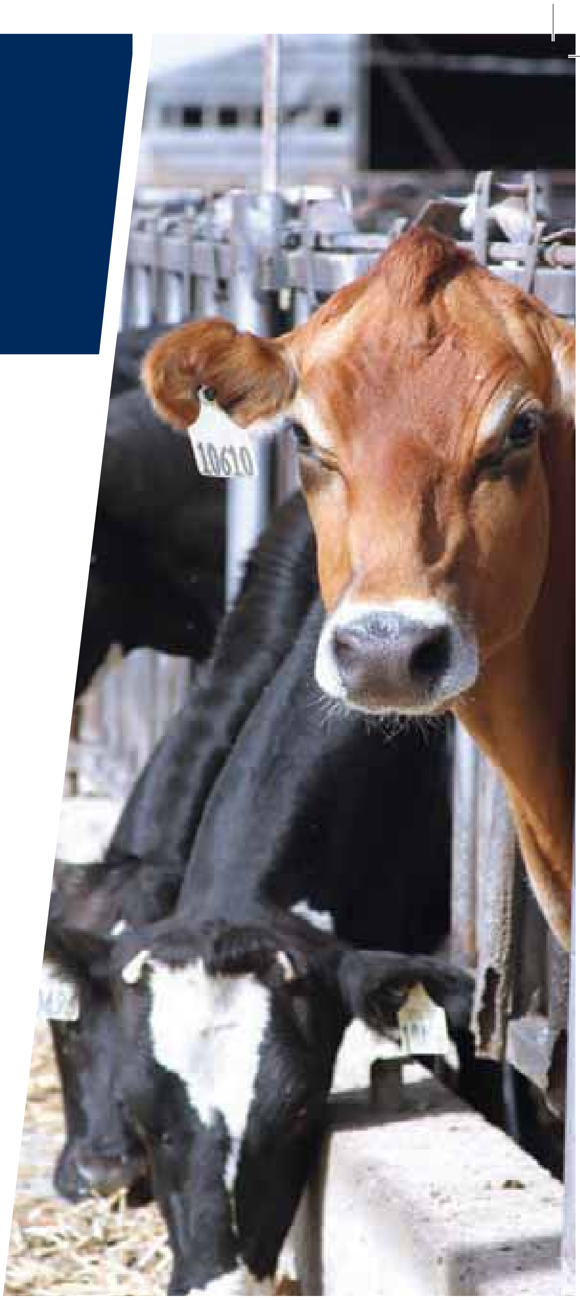

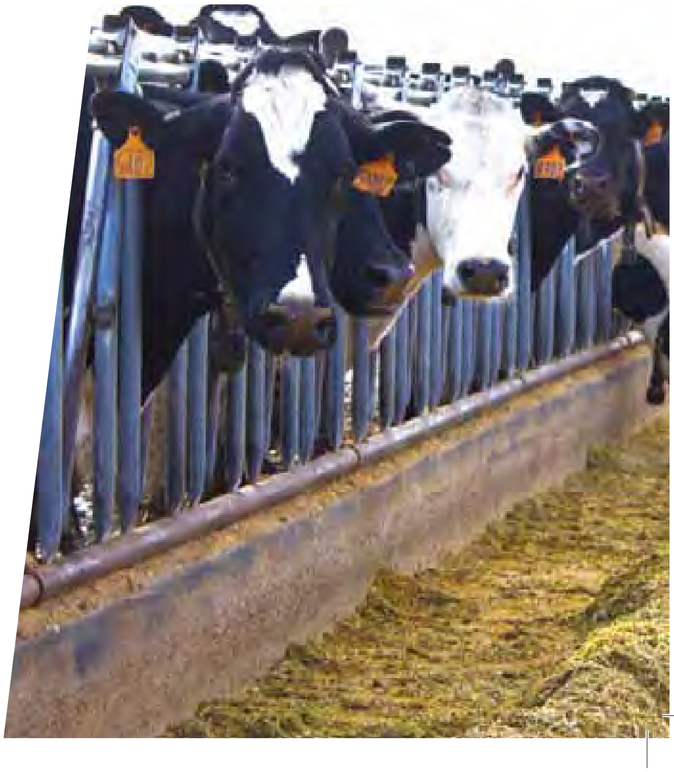

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REVIEW of SERVICES

Animal Profiling International, Inc. is an American company dedicated to the improvement of animal health management through risk-assessment technologies and advanced animal identification systems. API has tested over 2 million head of cattle for Bovine Viral Diarrhea (BVD) and currently services clients in over 40 U.S. states.

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The unique design of the Trusti Tuber and Flexi Tuber ensure your calf does not suffer. The flexible tube, specially designed safety tip and mouthpiece ensure that stress, discomfort and injury is avoided. A comfortable calf and smoother process make the Antahi tubers much easier to use and learn than rigid feeders. Both the Trusti Tuber and the Flexi Tuber can be held in place with one hand and the Flexi Tuber also offers a strap-on function for a more hands free option. The Antahi feeding range also includes a quality Peach Teat Cap for efficient bottle feeding and easy transition to and from the tubers.

Beneficial Features

- **Large 1 gallon bottle capacity** — *less refilling*
- **Calf size markers** — *to guide optimal tube placement*
- **Wide base and cap** — *sturdy and easy to fill*
- **Reliable valve** — *fast flow even with thick colostrum*

Struggle-Free Calf Tube Feeding

Kinder

The flexible tube prevents painful pressure points and injury and allows the calf to breathe easily throughout the procedure. Behavioral sign of stress and an increase in heart rate are both reduced by 88% when compared to a rigid feeder.

Easier

The tube swallows easily and the calf does not struggle making the tubers very easy to use and learn. Further design features improve all around usability.

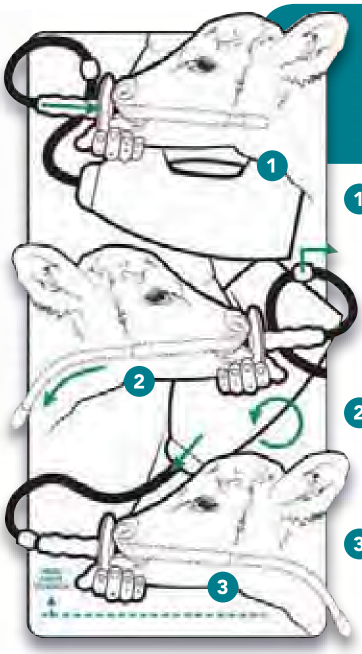
Safer

A specially designed safety tip combined with the flexible tube enables the calf to swallow easily and the tube to gently pass into the esophagus, even with heavy hands, safely bypassing the airway. Bruising and scratching of tissue is prevented due to the protective mouthpiece, flexible tube, and the safety tip design.

Faster

A smoother process and reliable fluid flow makes for faster feeding. Shown in trials to almost halve procedure time per feed.

HOW TO USE:



1. *Place the mouthpiece so the circular guard connects comfortably with the calf's muzzle. With one hand, hold both the mouthpiece handle and under the calf's chin for easy control and guidance.*
2. *Advance the flexible tube through the mouthpiece up to the appropriate size mark so the tube enters the esophagus.*
3. *Raise the bottle to allow fluid to flow. Ensure the head of the calf does not drop below stomach level.*

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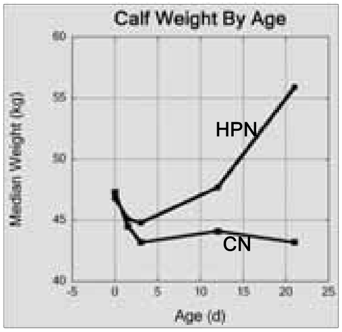
OUTLINE

- Benefits of optimal nutrition & growth
- Acidified, ad-lib feeding systems
- Research summaries
- Economics
- Practical aspects of feeding acidified milk
- Summary

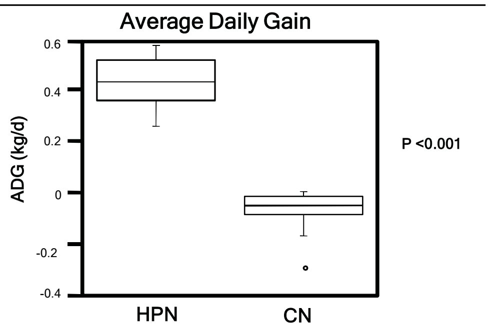
HEALTH & GROWTH BENEFITS OF OPTIMAL NUTRITION

- Immune responses of Holstein and Jersey calves during the pre-weaning and immediate post-weaned periods when fed varying planes of milk replacer (Ballou, 2012).
- Effects of source of trace minerals and plane of nutrition on growth and health of transported neonatal dairy calves (Osorio, 2011)
- Effect of nutritional plane on health and performance in dairy calves after experimental infection with Cryptosporidium parvum (Ollivet, 2012)

HIGH (HPN) VS. CONVENTIONAL (CN) PLANE OF NUTRITION



Ollivett, Nydam, et al, 2011



CONCLUSIONS & CLINICAL RELEVANCE

- After a pathogen challenge, calves maintained hydration, had faster resolution of diarrhea, grew faster and converted feed with greater efficiency when fed a higher plane of nutrition.

WHAT ABOUT FUTURE MILK PRODUCTION?

- Miner Institute, Chazy, NY
- .57 v. 1 kg of MR powder per day
- Cows which were fed 1 kg/d as calves produced +700 kg 1st lactation
  - JDS, 2005

CORNELL T&R HERD- MIKE VANAMBURGH

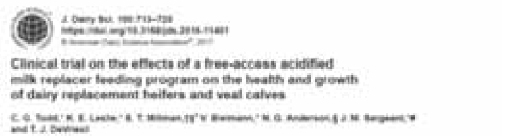
- 1998, started feeding for .9 kg ADG
- >1,000 weaning weights
- >725 1st lactations
- Any relationship between calf performance and 1st lactation performance?

CORNELL T&R HERD- MIKE VANAMBURGH

- Range in ADG to weaning: 0.24 to 1.2 kg/d
- Milk yield increased by 409 kg (1st lactation) for every .45 kg gain above 0.22 kg/d
- ~700 kg additional 1st lactation milk for expected pre-weaning growth of 1 kg/day.

SUMMARY OF DATA: DOUBLING BIRTH WEIGHT W/ LIQUID FEED BY WEANING

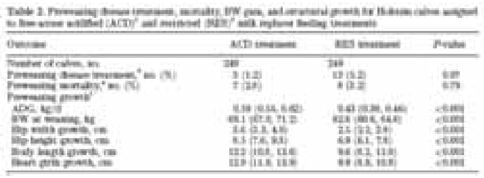
Study	Response (kg)
Bar-Peled et al., ’98	+452
Foldager and Krohn, ’94	1,403
Foldager et al., ’97	519
Miner Inst., ’05	700
MSU ’06	500
Drackley et al., ’07	836
U. Minn ’08	998
Cornell U., ’09	792
Average Response	+840



J. Dairy Sci. 100:713–725

Clinical trial on the effects of a free-access acidified milk replacer feeding program on the health and growth of dairy replacement heifers and veal calves

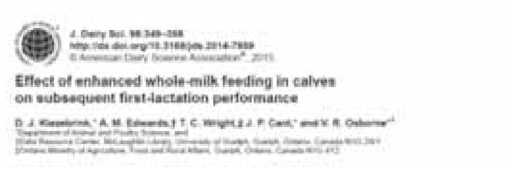
- Increased ADG
- Decreased odds of pre-weaning treatment
- No difference in pre-weaning mortality and post-weaning morbidity/mortality
- Effects did not persist post-weaning



SUMMARY OF EARLY NUTRITION EFFECTS

- Nutrient intake early in life impacts lactation performance
- All data is positive or neutral – no negative effects
- Mechanisms are not completely understood
- Bottom Line: **There is future milk in early life colostrum and nutritional management!**

DO WE NEED TO INVESTIGATE FURTHER?



J. Dairy Sci. 98:349–358
http://dx.doi.org/10.3168/jds.2014-7959
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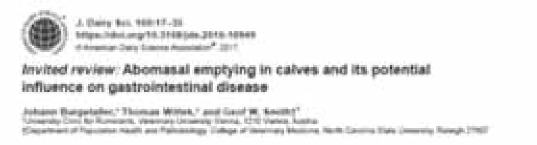
Effect of enhanced whole-milk feeding in calves on subsequent first-lactation performance

D. J. Kiezebrink,* A. M. Edwards,† T. C. Wright,‡ J. P. Cant,* and V. R. Osborne*1

- 4 vs. 8 L whole milk/day divided in 2 bucket feedings
- Increased pre-weaning ADG and height
- Decreased treaments
- No persistent post-weaning effects on weight or stature
- No difference in first lactation performance

IS FEEDING METHOD IMPORTANT TO OUTCOME?



J. Dairy Sci. 100:17–35
https://doi.org/10.3168/jds.2016-10949
© American Dairy Science Association®, 2017.

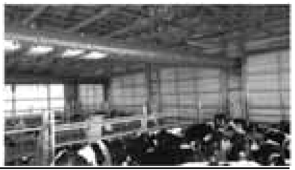
***Invited review:* Abomasal emptying in calves and its potential influence on gastrointestinal disease**

Johann Burgstaller,* Thomas Wittek,* and Geof W. Smith†

- Number of feedings/day and amount fed.
- More research needed

GROUP HOUSING CHALLENGES

- Ventilation
- Surface/Bedding
- Space availability
  - Calves in pens of 12-18 had more respiratory disease than calves in pens of 6-9 (Svensson, 2006)
- Feeding systems



WELL-DESIGNED VENTILATION PLAN

GROUP HOUSING & FEEDING
HOW DO WE DELIVER MILK?

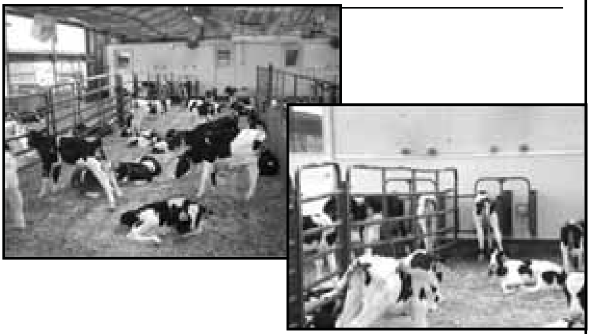
- Gang feeders
- Automated feeders
- Ad-lib acidified

GANG FEEDERS

- Inexpensive
- Hygiene issues
- Not ad-lib

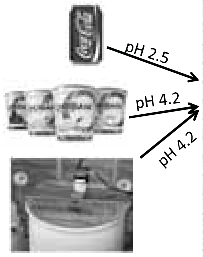
AUTOMATIC FEEDERS

- Computerized-data
- Greater investment
- Maintenance
- Not always ad-lib



ACIDIFIED AD-LIB SYSTEMS

- Basic or sophisticated.
- Milk replacer (pre-acidified)
- Whole milk
  - Pasteurized (or not)
  - Chemical pasteurization? (acid)



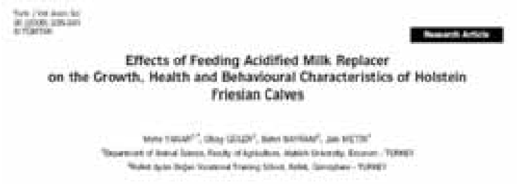
Citric Formic

Courtesy of Neil Anderson

Table 1. The pH Scale: Some Examples

pH Value	H^+ Concentration Relative to Pure Water	Example
0	10 000 000	battery acid
1	1 000 000	sulfuric acid
2	100 000	lemon juice, vinegar
3	10 000	orange juice, soda
4	1 000	tomato juice, acid rain
5	100	black coffee, bananas
6	10	urine, milk
7	1	pure water
8	0.1	sea water, eggs
9	0.01	baking soda
10	0.001	Great Salt Lake, milk of magnesia
11	0.000 1	ammonia solution
12	0.000 01	soapy water
13	0.000 001	bleach, oven cleaner
14	0.000 000 1	liquid drain cleaner

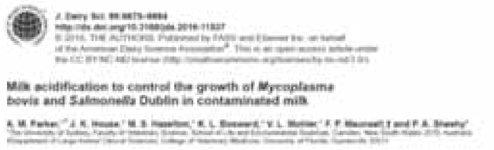
ACIDIFICATION & HEALTH



Research Article

Effects of Feeding Acidified Milk Replacer on the Growth, Health and Behavioural Characteristics of Holstein Friesian Calves

- Increased feed efficiency
- Reduced scours incidence



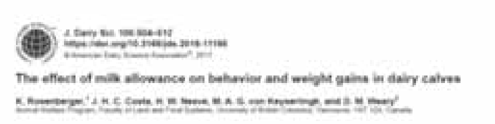
J. Dairy Sci. 99:9875–9884
http://dx.doi.org/10.3168/jds.2016-11537

Milk acidification to control the growth of *Mycoplasma bovis* and *Salmonella* Dublin in contaminated milk

No detected *M. bovis* nor *Salmonella* Dublin at 1 and 2 hours post-acidification (pH 4.0), respectively.

SOCIAL ASPECTS?

MILK ALLOWANCE AND BEHAVIOR


J. Dairy Sci. 100:504–512
https://doi.org/10.3168/jds.2016-11195
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The effect of milk allowance on behavior and weight gains in dairy calves

K. Rosenberger,[1] J. H. C. Costa, H. W. Neave, M. A. G. von Keyserlingk, and D. M. Weary[1]

- 6,8,10 or 12 L/day whole milk offered via automated feeder
- Increased ADG with increased milk feeding
- More unrewarded visits to feeder with lower feeding rates concluding calves were hungry

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J. Dairy Sci. 97:6450–6462
http://dx.doi.org/10.3168/jds.2014-8065
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Competition during the milk-feeding stage influences the development of feeding behavior of pair-housed dairy calves

E. K. Miller-Cushon, R. Bergeron, K. E. Leslie, G. J. Mason, and T. J. DeVries

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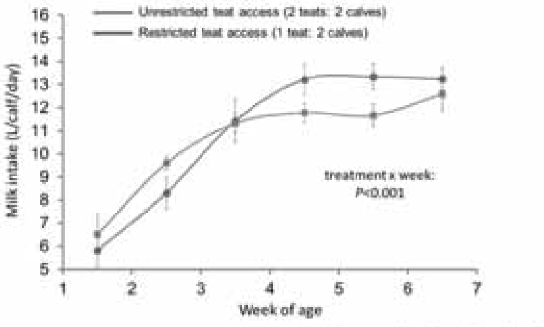
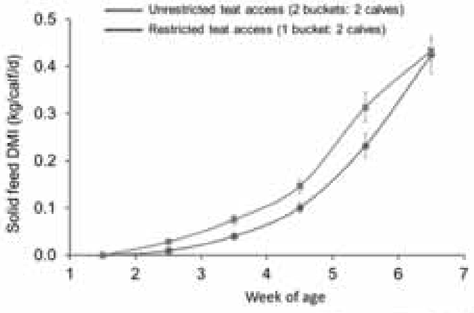
Effect of competition on milk intake



Courtesy of Trevor DeVries

Miller-Cushon et al 2014 J Dairy Sci 97:6450-6462

Effect of competition on solid feed intake



Courtesy of Trevor DeVries

Miller-Cushon et al 2014 J Dairy Sci 97:6450-6462

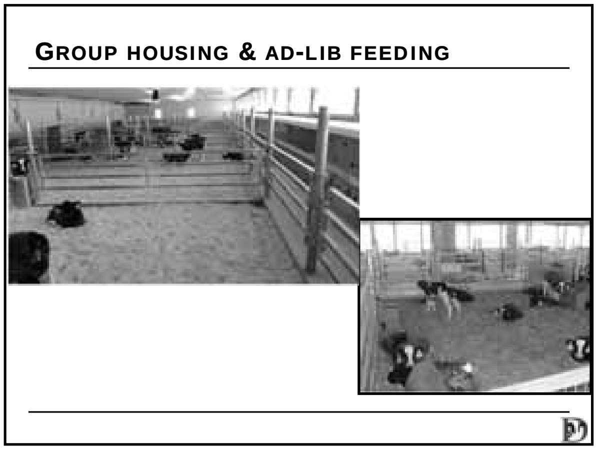
GROUP HOUSING & FEEDING

Source: N. Anderson

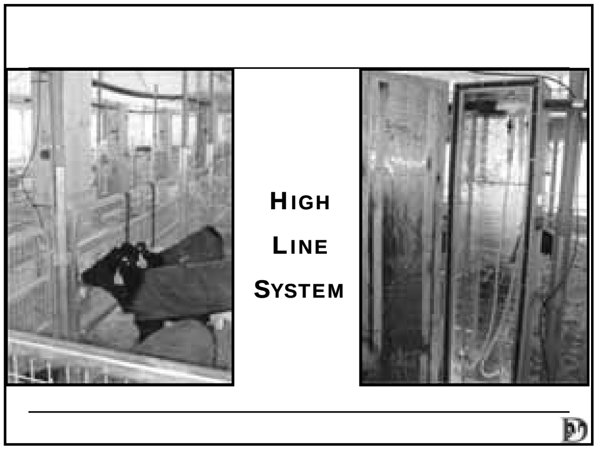
GROUP HOUSING & AD-LIB FEEDING

GROUP HOUSING & AD-LIB FEEDING

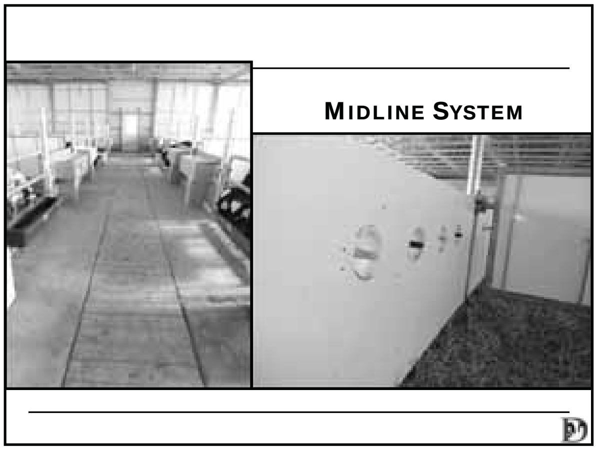
A seasonal set-up for acidified whole milk



GROUP HOUSING & AD-LIB FEEDING



HIGH LINE SYSTEM



MIDLINE SYSTEM

WEANING SYSTEM

AD-LIB & GROUP HOUSING RESEARCH SUMMARIES

Mark J. Thomas, DVM, DABVP-Dairy
Frans Vokey, MS, PAS
Dairy Health & Management Services, LLC

Daryl V. Nydam, DVM, PhD
Cornell University College of Veterinary Medicine

OVERVIEW

- Late spring/summer 2011
- Three collaborating dairy farms
  (Northern New York)
- Objectives:
  1. Group vs. individual housing with ad-lib feeding.
  2. Citric vs. formic acid as a preservative for milk replacer.

GROUP VS. INDIVIDUAL

- Pasteurized/formic acid acidified whole milk
- Ad-lib feeding
- Group housing (8 calves/pen, 3 nipples/pen)
- Individual housing
  (clusters of 8- 4x8 pens with solid sides, 1 nipple/calf)
- Alternating group and individual pen clusters within same barn.

GROUP VS. INDIVIDUAL PENS

	Group (n=40)	Individual (n=32)	p-value
ADG (lbs.) @ 50 days	1.51^a	1.32^b	0.01
Serum Total Protein	5.9^a	5.8^a	0.61
Birth weight (lbs.)	88.3^a	89.4^a	0.66

DISEASE EVENTS

Event	Group (n=40)	Individual (n=32)
Scours	0	0
Pneumonia	1	0
Other	0	0
Total disease events	1	0

CONCLUSIONS

- No apparent detrimental effects of group housing as compared to individual pens given similar nutrition.
- Disease events (scours, pneumonia) were negligible throughout study (1 case of pneumonia).

CITRIC VS. FORMIC ACID

- 24/17 Citric acid acidified (commercial) milk replacer vs. 24/17 milk replacer acidified (on-farm) with formic acid.
- pH of 4.2 (Some issues with product pH for ~2 weeks)
- Two facilities.
- Identical feeding management within each farm.

PH IS IMPORTANT!

- A two week period of high milk pH (~5) had significant effects on disease incidence and weight gain.
- Important to consider this issue in regards to data analysis and conclusions.

CITRIC VS. FORMIC ACID

	Citric acid (n=38)	Formic acid (n=35)	p-value
ADG (lbs.) @ 40 days	0.92^{a}	1.14^{b}	0.03
Serum Total Protein	5.54^{a}	5.39^{a}	0.29
Birth weight (lbs.)	88^{a}	95^{b}	0.01

DISEASE EVENTS

Event	Citric acid (n=43)	Formic acid (n=36)
Scours	3 (7%)	0 (0%)
Pneumonia	7 (16.6%)	4 (11%)
Other	4 (9.5%)	0 (0%)
Death	5 (11.6%)	0 (0%)
Total disease/death events	19 (39.6%)	5 (13.8%)

CONCLUSIONS

- Statistically higher ADG in formic vs. citric groups.
- Subjectively, no apparent negative effects of citric vs. formic acid for the acidification of milk replacer. (Currently in wide use)
- **Two week period of high pH and following disease make data analysis difficult for citric group**.

Cornell University

Cornell University Cooperative Extension Lewis County

ECONOMICS

The Effects of Feeding Strategy and Housing Management on Intake and Growth Performance of Holstein Calves from Birth through Weaning

H. M. Gauthier, S. E. Williams, D. M. Shenk, C. S. Ballard, K. M. Morrill, and H. M. Dann
William H. Miner Agricultural Research Institute, Chazy, NY
Cornell University, Ithaca, NY

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Pre Weaning Performance birth to day 53

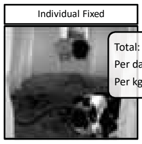
	Treatment				P-value	
Variables	FI	AI	AG	SE	FI vs. AI	AI vs. AG
Milk replacer intake, kg DM	40.6	59.7	54.8	3.4	<0.01	0.35
Starter intake, kg DM	11.2	4.5	2.2	1.8	0.04	0.41
Total intake, kg DM	51.7	64.2	57.0	3.5	0.05	0.20
Body weight gain, kg	28.0	39.3	40.3	3.4	0.06	0.84
Average daily gain, kg	0.56	0.75	0.81	0.05	0.04	0.43
Gain:feed	0.54	0.61	0.70	0.02	0.04	0.01

- Mean daily intake before weaning was about 7L for FI, 12L for AI and 11L for GA

Courtesy of H. M. Gauthier

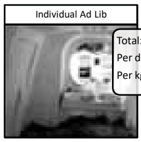
Feed & Labor Cost to Weaning

Individual Fixed



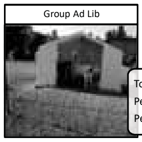
Total: $232.00
Per day: $4.38
Per kg of gain:$**7.82**

Individual Ad Lib



Total: $282.13
Per day: $5.32
Per kg of gain:$**7.10**

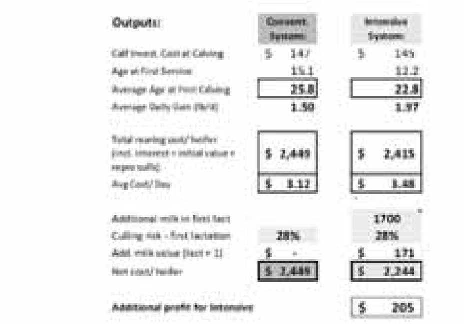
Group Ad Lib



Total: $226.95
Per day: $4.28
Per kg of gain:$**5.29**

Courtesy of H. M. Gauthier

ECONOMICS



Outputs:	Current System	Intensive System
Calf Invest. Cost at Calving	$ 147	$ 145
Age at First Service	15.1	12.2
Average Age at First Calving	25.8	22.8
Average Daily Gain (lb/d)	1.50	1.97
Total rearing cost/ heifer (incl. interest + initial value + repro suffs)	$ 2,449	$ 2,415
Avg Cost/ Day	$ 3.12	$ 3.48
Additional milk in first lact		1700
Culling risk - first lactation	28%	28%
Add. milk value (lact + 1)	$ -	$ 171
Net cost/ heifer	$ 2,449	$ 2,244
Additional profit for Intensive		$ 205

Overton, 2013

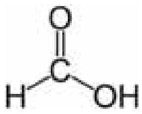
ADVANTAGES OF AD-LIB

- Access to feed- easier (& safer?) to deliver a high plane of nutrition
- Labor efficiency
- Socialization
- Potential for increased growth rates
- Potential for improved lifetime productivity

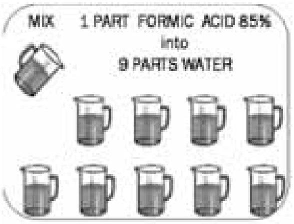
DISADVANTAGES

- Disease transmission
- Change in management style
- Disease recognition

HOW TO ACIDIFY? FORMIC VS. CITRIC (OTHERS?)



FORMIC ACID 85%
MUST BE DILUTED BEFORE USE
NOT APPROVED IN THE USA. OK IN CANADA.



...dilute the acid

- safe handling
- ease of mixing

1 L into 9 L = 10 L dilute acid

Dr. Neil Anderson, OMAFRA December, 2011

...add dilute formic acid to milk

~30 ml (1 oz) of dilute acid to 1L

whole milk or milk replacer

Important Points:

1. Aggressive agitation
2. Temperature (<75°F)
3. Rate of acid addition to milk (slow!)

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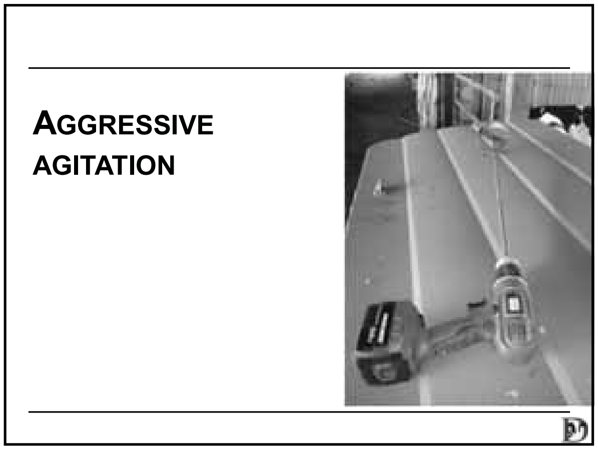
pH GOAL= 4.0-4.2



AGGRESSIVE AGITATION

FEEDING TEMPERATURE IS VERY IMPORTANT!

- At least 75 degrees F
- Preference of 90+ degrees
- How do we keep it warm?

WHAT ABOUT INTERSUCKLING?

KEYS TO SUCCESS

1. Stocking density- at least 3 m^2 lying area per calf. Dry, dry bedding.
2. Excellent ventilation using positive pressure ventilation tubes or neutral systems. Most barns just don't have it right! Be aggressive. Remember air exchanges/hour.
3. True ad-lib (don't limit intakes)
4. Age range- try and fill a pen in 7-10 days.
5. Cold milk (<75F) really discourages intakes. Cold milk (<75F) really discourages intakes. Offer milk at 85-90+ degrees F.

KEYS TO SUCCESS

6. Proper pH is very important. Ideal range=4.0-4.2. Too low discourages intakes, too high allows for bacterial growth.
7. Maintain consistent total solids. Monitor with Brix refractometer.
8. Acidify cool milk (<75 degrees) to prevent curdling. Add diluted acid slowly while agitating.
9. Concentrated acid is dangerous! Be careful.

QUESTIONS/COMMENTS?

Replacement Rearing
Beyond Milk

Mark J. Thomas, DVM, DABVP-Dairy

What is the goal?

- 85% of mature size post-calving (Van Amburgh, 2005)
  - 1275 lbs. (~580 kg) Holstein
  - 960 lbs. (~440 kg) Jersey
- 20-22 months of age (Chebel, 2010)
- Live, vigorous calf
- Calving ease
- Adequate quantity of quality colostrum
- Uneventful transition to lactation (disease)
- High milk production
- Subsequent pregnancy

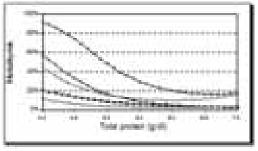
How do we achieve this?

- Adequate passive transfer (colostrum)
- Low incidence of BRD & enteric disease
- Optimal growth rates (further research needed)
- Effective weaning transition
- Optimal post-weaning growth
- Efficient reproductive management (pregnant by 11-13 months of age, 55% of mature size)

(M. Duplessis, 2014)

Adequate Passive Transfer

- Improved growth rates
  (Faber et al., 2005; Nocek et al., 1984; Faber. 2005; Drackley, 2010)
- Reduced treatment and mortality rates
  (NAHMS, 1996)
- Decreased age at first calving
  (Faber et al. 2005)
- Increase 1st & 2nd lactation milk production
  (Denise, 1989; Faber, 2005)



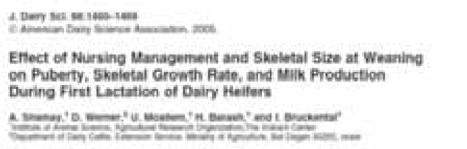
Low Disease Risk

- Heifers treated for pneumonia during the first 3 months of life are 2.5 times more likely to die after 90 days of age.
- Heifers treated for scours are 3 times more likely to freshen at >30 months of age.

Radostits, 2001

Optimal Growth
Doubling birth weight by weaning

Study	**Response (kg)**
Bar-Peled et al., '98	+452
Foldager and Krohn, '94	1,403
Foldager et al., '97	519
Miner Inst., '05	700
MSU '06	500
Drackley et al., '07	836
U. Minn '08	998
Cornell U., '09	792
Average Response	+840

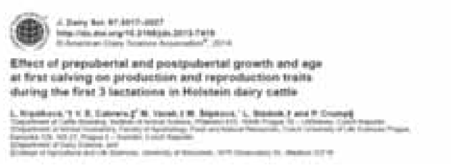


J. Dairy Sci. 88:1460–1469
© American Dairy Science Association, 2005.

Effect of Nursing Management and Skeletal Size at Weaning on Puberty, Skeletal Growth Rate, and Milk Production During First Lactation of Dairy Heifers

A. Shamay,[1] D. Werner,[2] U. Moallem,[1] H. Barash,[1] and I. Bruckental[1]

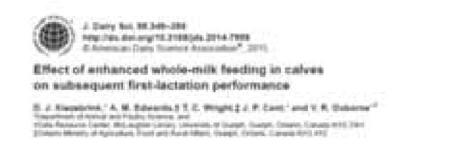
- Increased body weight
- Decreased age at puberty
- Increased milk production



J. Dairy Sci. 97:3017–3027

Effect of prepubertal and postpubertal growth and age at first calving on production and reproduction traits during the first 3 lactations in Holstein dairy cattle

- Low age at first calving (<22 months of age) did not have a negative effect on production nor reproductive performance.



Effect of enhanced whole-milk feeding in calves
on subsequent first-lactation performance

- 4 vs 8 liters whole milk/day
- Increased ADG to 28 DOF
- No difference in BW at 3 & 11 months
- No lactational performance difference
- ADG to weaning of 775g/day (>1000g/day common in many systems)
- Was the gain difference significant enough to effect future performance?

Summary of Early Nutrition Effects

- Nutrient intake early in life impacts lactation performance
- All data is positive or neutral – no negative effects
- Mechanisms are not completely understood
- Bottom Line: **There is future milk in early life colostrum and nutritional management!**

- **Further research to evaluate the economics.**

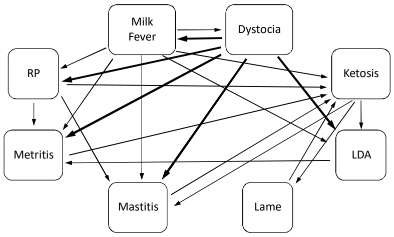
Optimal post-weaning nutrition & Growth

- 1.8-2.0 #/day ADG to reach benchmarks
- Importance of efficient (lean tissue) growth
- Rations balanced for MP & ME
  - Excess fat deposition can effect future milk production (Sejrsen, 2000)
  - Negative correlation between body weight & dystocia.
    - Younger/smaller
    - Older/over conditioned

(Thompson, 1983; Erb, 1985)

  - Dystocia & transition disease

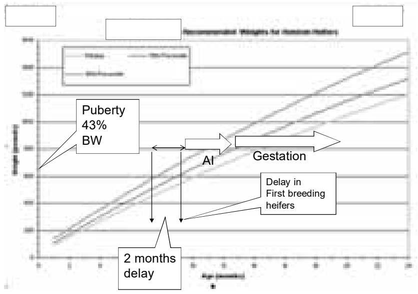
Interrelationships of Disease



Reproductive Management

- What is the optimal voluntary waiting period (VWP)?
- What is the optimal frame/weight at calving?

INDUSTRY BENCHMARKS



Industry Benchmarks

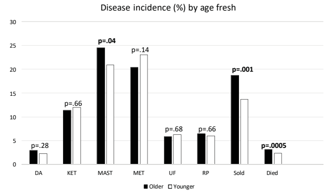
- Voluntary Wait Period or Voluntary *Weight* Period?
- Breed at 55% of mature weight (puberty at 43% of mature weight) (NRC, 2001)
- What is the variation in mature weight within a herd?
- What if mature weight is reached at <11 months of age?
  - Age of first calving of 18-19 months

DHMS Data

- Compared age at first calving from 18-26 months of age
- Disease (retained placenta, displaced abomasum, BRD, ketosis, metritis, mastitis, sold, died)
- Total milk, ME305, lactation length
- Conception rate
- Age at first calving <21 months n=1066
- Age at first calving >21 months n=1209

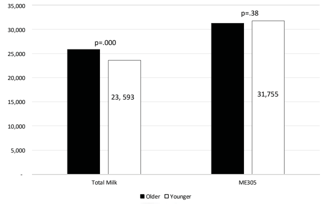
Reduced Age at First Calving

- No difference in health or reproductive performance
- 4% increased mastitis incidence >21 mos.
- Reduction in sold/died for < 21 mos.

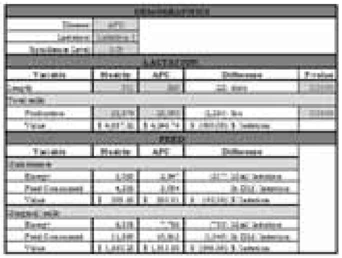


Reduced Age at First Calving

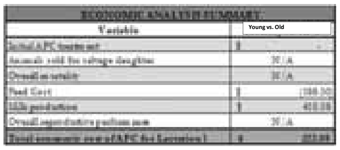
- 2,281 lbs. less total milk <21 mos.
- Decreased lactation length < 21 mos. (289 vs. 311 days)
- No difference in ME305



Economics of reduced production

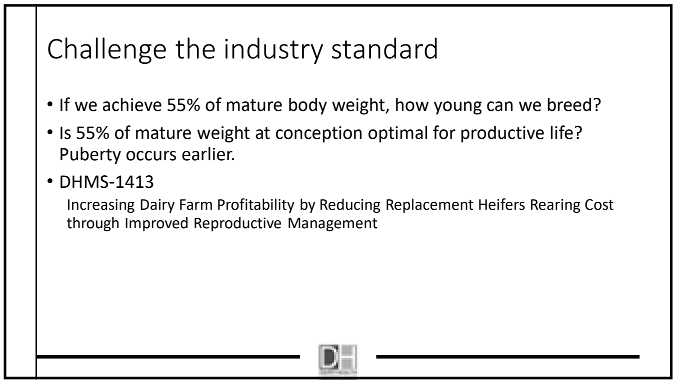


Economics of reduced production



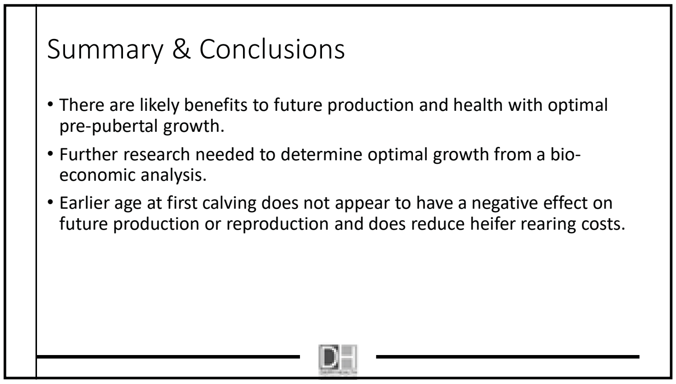
Does not consider the benefits of reduced rearing costs and increased number of future lactations.

http://dyson.cornell.edu/outreach/extensionpdf/2014/Cornell-Dyson-eb1402.pdf



Challenge the industry standard

- If we achieve 55% of mature body weight, how young can we breed?
- Is 55% of mature weight at conception optimal for productive life? Puberty occurs earlier.
- DHMS-1413
  - Increasing Dairy Farm Profitability by Reducing Replacement Heifers Rearing Cost through Improved Reproductive Management



Summary & Conclusions

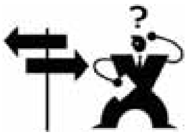
- There are likely benefits to future production and health with optimal pre-pubertal growth.
- Further research needed to determine optimal growth from a bio-economic analysis.
- Earlier age at first calving does not appear to have a negative effect on future production or reproduction and does reduce heifer rearing costs.

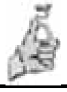
Data-Based Decision Making

Mark J. Thomas, DVM, DABVP

Ohio Dairy Vets- 2017

Paper vs. Rock vs. Scissors





Introduction

• Method I	Casual Observation
• Method II	First Principles
• Method III	Decision Tree Analysis
• Method IV	Benchmarking
• Method V	Evidence-Based
• Method VI	Based on Results of Commercial Field Trials

Method I - Casual Observation

- Anecdotal evidence
- “Year to year” comparisons
- “Farm to farm” comparisons
- Extremely large differences are required for this method to be successful!

Method II – First Principles

- Making decisions using basic, foundational propositions or assumptions from specific disciplines
- Usually involves generation of a theory, hypothesis, and course of action with direct application and not much consideration for validation

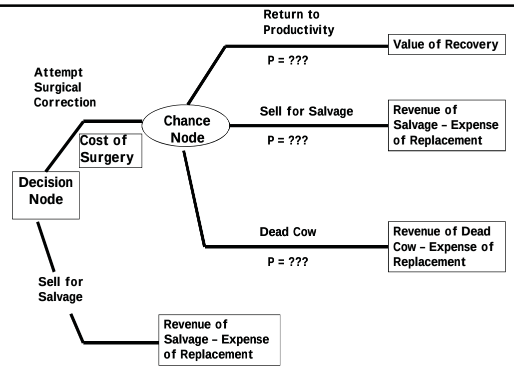
Method III – Decision Tree Analysis

- Decision tree analysis can be used to model decisions on a cash basis

Method III – Decision Tree Analysis

- Unsuccessful toggle-pin fixation of a left displaced abomasum - what to do next?
- For the average commercial dairy cow:
  - Attempt surgical correction

    or
  - Sell for salvage



Decision Node

Attempt Surgical Correction

Cost of Surgery

Chance Node

Return to Productivity

P = ???

Value of Recovery

Sell for Salvage

P = ???

Revenue of Salvage – Expense of Replacement

Dead Cow

P = ???

Revenue of Dead Cow – Expense of Replacement

Sell for Salvage

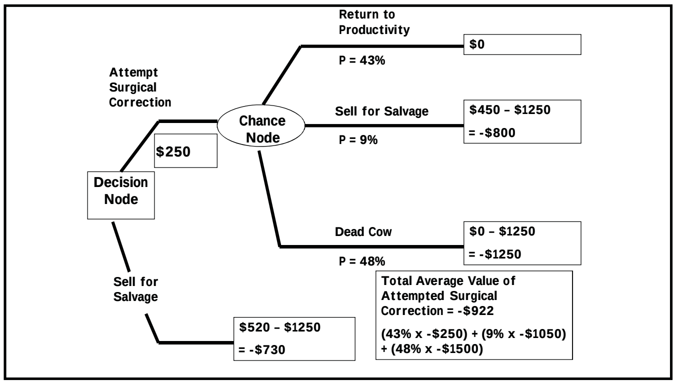
Revenue of Salvage – Expense of Replacement

Method III – Decision Tree Analysis

- Values for costs, probabilities, and expenses
  - Cost of surgery determined using historical records +/- adjustment for current prices
  - Probability of surgical outcomes derived from retrospective analysis of historical records
    (n = 53)
  - Probability of revenues determined using data from a suitable source - NY Ag Statistics Service

Method III – Decision Tree Analysis

- Assumptions used in decision tree model
  - Dairy is operated with all "slots" full
  - Replacements enter herd and begin milking immediately
  - Cow with productive outcome is worth as much as "typical" replacement
  - Salvaged cow looses or gains no revenue before culling



Decision Node

Attempt Surgical Correction

$250

Chance Node

Return to Productivity

P = 43%

$0

Sell for Salvage

P = 9%

$450 – $1250

= -$800

Dead Cow

P = 48%

$0 – $1250

= -$1250

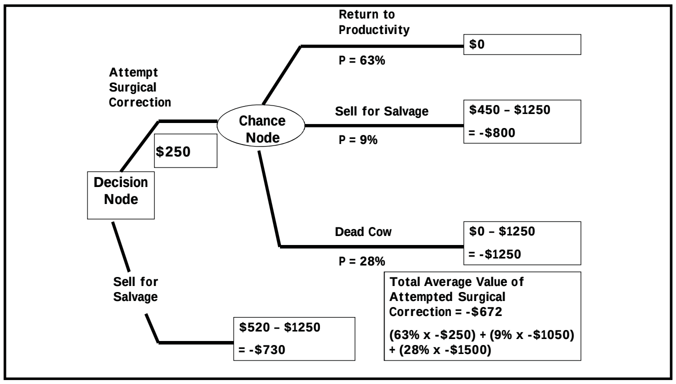
Sell for Salvage

$520 – $1250

= -$730

Total Average Value of Attempted Surgical Correction = -$922

(43% x -$250) + (9% x -$1050) + (48% x -$1500)



Decision Node

Attempt Surgical Correction

$250

Chance Node

Return to Productivity

P = 63%

$0

Sell for Salvage

P = 9%

$450 – $1250

= -$800

Dead Cow

P = 28%

$0 – $1250

= -$1250

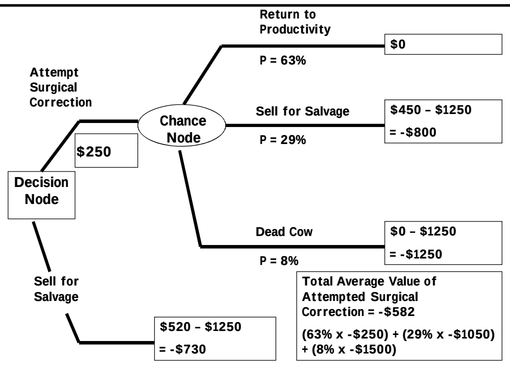
Sell for Salvage

$520 – $1250

= -$730

Total Average Value of Attempted Surgical Correction = -$672

(63% x -$250) + (9% x -$1050) + (28% x -$1500)



Return to Productivity

$0

P = 63%

Attempt Surgical Correction

Chance Node

Sell for Salvage

$450 – $1250
= -$800

P = 29%

$250

Decision Node

Dead Cow

$0 – $1250
= -$1250

P = 8%

Sell for Salvage

Total Average Value of Attempted Surgical Correction = -$582

(63% x -$250) + (29% x -$1050) + (8% x -$1500)

$520 – $1250
= -$730

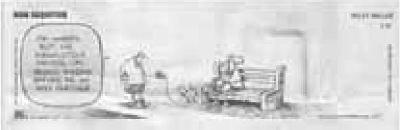
Method III – Decision Tree Analysis

- Simple or complex decision trees can easily be constructed
- The major limitation of decision tree analysis is that the actual probabilities associated with each chance node in the decision tree are usually unknown

---

Method IV - Benchmarking

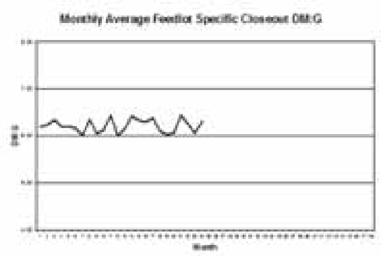
- Benchmarking is the process of comparing a population of interest to a standard or reference population
- The method of comparison can be simple and straightforward or complex and formalized, such as Statistical Processing Control



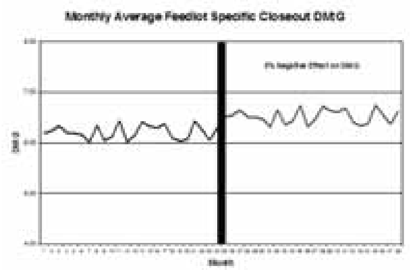
Method IV - Benchmarking

- Objectives of benchmarking
  - monitoring
  - forecasting or modeling
  - decision making??

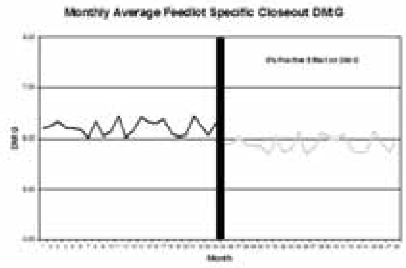
Method IV - Benchmarking



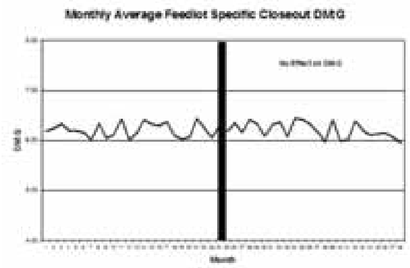
Method IV - Benchmarking

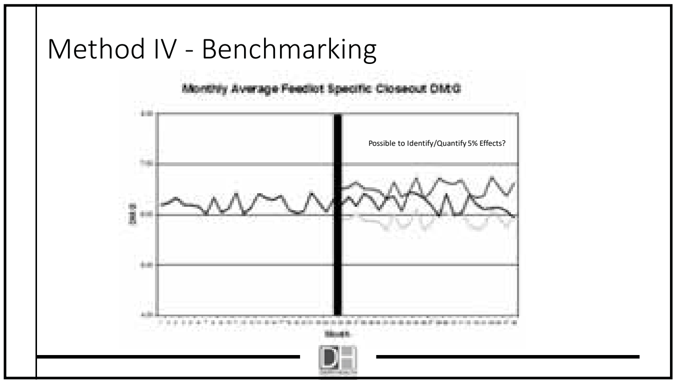


Method IV - Benchmarking



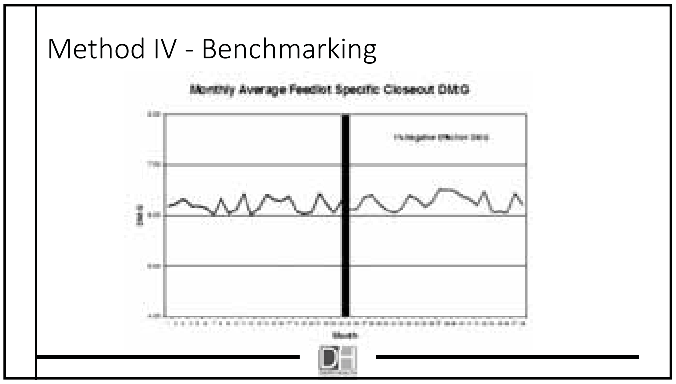
Method IV - Benchmarking





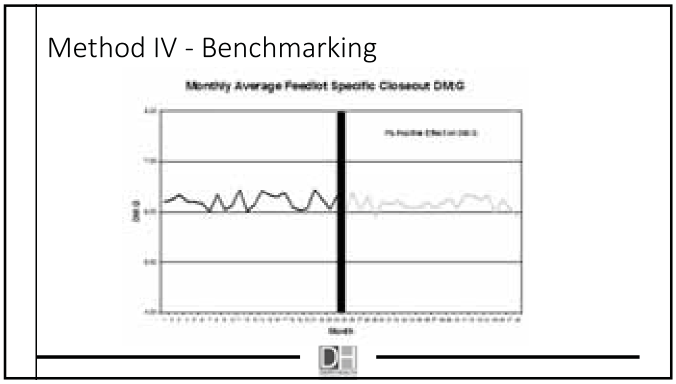
Method IV - Benchmarking

Possible to Identify/Quantify 5% Effects?



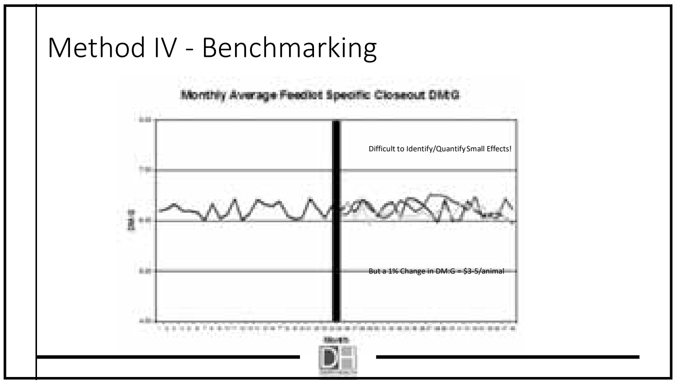
Method IV - Benchmarking

1% Negative Effect on DM:G



Method IV - Benchmarking

1% Positive Effect on DM:G



Method IV - Benchmarking

Difficult to Identify/Quantify Small Effects!

But a 1% Change in DM:G = $3-5/animal

Method IV - Benchmarking

- Benchmarking as a decision making tool:
  - Very applicable in well-defined, non-biologic processing or manufacturing systems
  - May be applicable in animal agriculture systems where natural variability due to genetic and environmental factors has been controlled or eliminated
  - Not very applicable in situations where there is a lot of natural variability and the processing or manufacturing system is not well-defined

Method IV - Benchmarking

- Benchmarking is a more appropriate decision making tool in some biologic systems than in others:

• Poultry	+++
• Swine	++
• Aquaculture	++
• Dairy	+/-
• Feedlot	--
• Cow-calf	---

Method IV - Benchmarking

- Summary of benchmarking use in cattle production systems:
  - a useful tool for monitoring and forecasting
  - limited usefulness for decision making

Method V - Evidence Based Approach

- “Evidence-based medicine is the conscientious, explicit and judicious use of current best evidence in making decisions about the care of individual patients.” (Sackett 1996)
- Aims to apply evidence gained from the scientific method to certain parts of medical practice

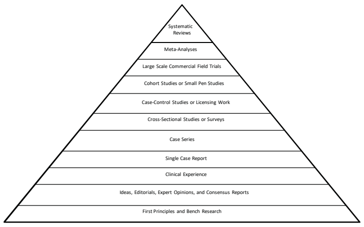
Method V - Evidence Based Approach

- Seeks to assess the quality of evidence relevant to the risks and benefits of treatments/interventions
- Systems to stratify evidence by quality have been developed

Method V - Evidence Based Approach

- United States Preventive Services Task Force for ranking quality of evidence about treatments/interventions:
  - Level I: Evidence obtained from at least one properly designed randomized controlled trial.
  - Level II-1: Evidence obtained from well-designed controlled trials without randomization.
  - Level II-2: Evidence obtained from well-designed cohort or case-control analytic studies, preferably from more than one center or research group.
  - Level II-3: Evidence obtained from multiple time series with or without the intervention. Dramatic results in uncontrolled trials might also be regarded as this type of evidence.
  - Level III: Opinions of respected authorities, based on clinical experience, descriptive studies, or reports of expert committees.

Method V - Evidence Based Approach



Adapted from Figure 4 – Relative strengths of evidence provided by different methods used in clinical research illustrated diagrammatically in the so-called pyramid of evidence. Strength of association increases from the base to the peak of the pyramid.

JAVMA, Vol 235, No. 9, November 1, 2009

Method V - Evidence Based Approach

- An originally focused idea that gets very easily diluted with very low quality evidence when high quality evidence is not readily available
- <u>The critical issue is knowing what quality of evidence is being used to make each decision</u>

Method VI - Based on Results of Commercial Field Trials

- Making decisions based on relevant data generated from commercial field trials

Method VI - Based on Results of Commercial Field Trials…continued

- Data-based decision making requires relevant data describing important dairy production variables
  - Morbidity
  - Mortality
  - Production efficiency (Milk:Feed)
  - Reproduction

Method VI - Based on Results of Commercial Field Trials…continued

- Economic models that accurately simulate all aspects of dairy production are used as part of the data-based decision making process to ascribe economic values to the important dairy production variables

Method VI - Based on Results of Commercial Field Trials…continued

- Field trials conducted in small-pen facilities or research settings provide the basis for commercial field trials
- Field trials conducted under commercial production conditions provide the most relevant data

Method VI - Based on Results of Commercial Field Trials...continued

- Parasite Control Programs for Feedlot Calves *(J Am Vet Med Assoc 2000; 216: 1965-1969)*
  - Published data demonstrate the cost-effectiveness of using avermectins, which control internal and external parasites, versus organophosphates, which control only external parasites, due to improvements in feedlot performance with the avermectins

---

Method VI - Based on Results of Commercial Field Trials...continued

- Parasite Control Programs for Feedlot Calves
  - In theory, parasite control programs using a combination of products to control internal and external parasites will provide similar effects on feedlot performance at a lower cost
  - No data available to support or refute this suggestion

Method VI - Based on Results of Commercial Field Trials...continued

Parasite Control Programs for Feedlot Calves

Performance data summary based on carcass weight

	Experimental Group		
Performance Variable	Ivomec Pour-On	Safeguard/Expar/ Spotton	Standard Error
Initial Weight (lb.)	628.8	629.5	± 0.7
Final Weight Carcass (.lb)	1205.5^{a}	1190.8^{b}	± 1.3
Weight Gain Carcass (lb.)	559.3^{a}	541.1^{b}	± 2.2
DOF	183.5	182.7	± 0.6
DDMI (lb./day)	18.40	18.37	± 0.04
ADG Carcass (lb./day)	3.05^{a}	2.96^{b}	± 0.01
DM:G	6.04^{a}	6.21^{b}	± 0.02

1. Means in the same row with different superscripts are significantly *(P < 0.05)* different.

Method VI - Based on Results of Commercial Field Trials...continued

Parasite Control Programs for Feedlot Calves

Carcass grading data summary

	Experimental Group		
Carcass Grading Variable	Ivomec Pour-On	Safeguard/Expar/ Spotton	Standard Error
Yield Grading			
1	24.60^{a}	31.51^{b}	± 1.46
2	54.06	53.47	± 0.94
3	20.73^{a}	14.71^{b}	± 1.21
4	0.61	0.30	± 0.13
Quality Grade			
Choice	48.87^{a}	39.61^{b}	± 1.09
Select	46.98^{a}	53.55^{b}	± 1.10
Standard	4.15^{a}	6.84^{b}	± 0.81

1. Means in the same row with different superscripts are significantly *(P < 0.05)* different.

Method VI - Based on Results of Commercial Field Trials…continued

- Parasite Control Programs for Feedlot Calves
  - Economic evaluation of the observed differences demonstrate an economic advantage of $13.93 advantage per animal in the Ivomec Pour-On group

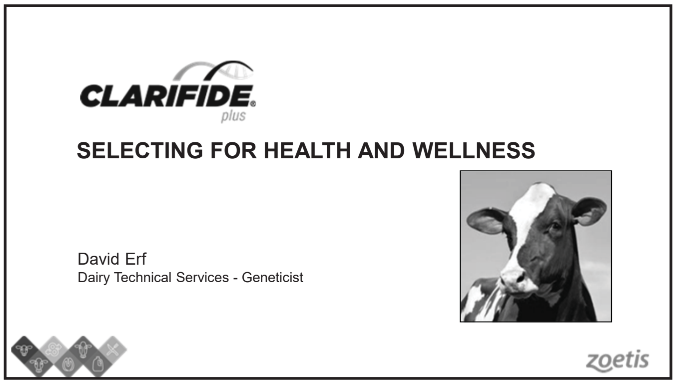
• Higher Program Cost	($ 0.80)
• Higher ADG	$ 1.77
• Improved DM:G	$ 8.69
• Higher Percent Choice	$ 5.01
• Lower Percent Yield Grade 1	($ 0.74)

Method VI - Based on Results of Commercial Field Trials…continued

- The emphasis of the decision making process is switched from a theoretical and/or “least-cost” approach to a “maximum net benefit” approach
- The interpretation of existing data and/or the ability to generate original data are required

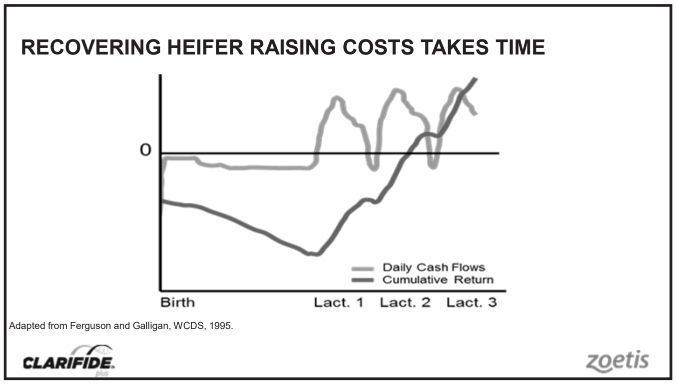
Summary

- Establishing a decision making process is an important component of each cattle production enterprise
- Various decision making methods are available for use in cattle production



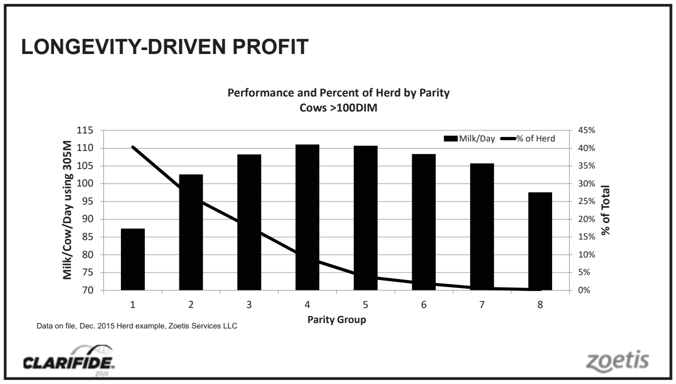
SELECTING FOR HEALTH AND WELLNESS

David Erf
Dairy Technical Services - Geneticist



RECOVERING HEIFER RAISING COSTS TAKES TIME

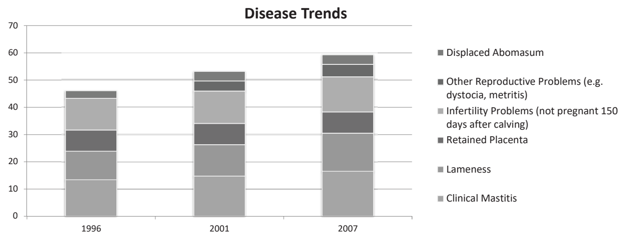
Adapted from Ferguson and Galligan, WCDS, 1995.



LONGEVITY-DRIVEN PROFIT

Data on file, Dec. 2015 Herd example, Zoetis Services LLC

DAIRY COW MORBIDITY TRENDS



USDA. 2008. Dairy 2007, Part II: Changes in the U.S. Dairy Cattle Industry, 1991–2007 USDA-APHIS-VS, CEAH. Fort Collins, CO #N481.0311.

IMPACT OF MORBIDITY IS SIGNIFICANT IN DAIRY COWS

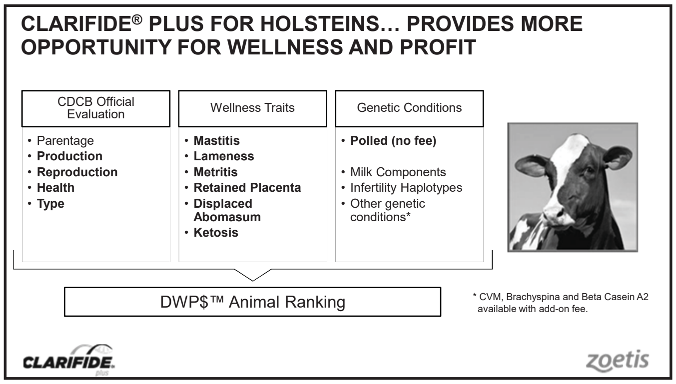
	Incidence per Lactation Range	Cost ($) per Case	Culling Risk[1] (%)
Displaced Abomasum	3-5% [1,2,3,4,13]	$494 [4]	26.9
Ketosis	5-14% [1,3,4,13]	$117-289 [4,5]	32.5
Lameness	10-48% [2,4,6,13]	$177-469 [4,7]	16 [2]
Mastitis	12-40% [1,2,3,4,8,13]	$155-224 [4,8,9]	32.7
Metritis	2-37% [1,3,10,11,13]	$300-358 [10,11]	17.1
Retained Placenta	5-15% [1,2,3,4,11,12]	$206-315 [4,12]	31.7

[1] Grohn, Y. et al. 1998. Effect of Diseases on the Culling of Holstein Dairy Cows in New York State. J. of Dairy Sci, 81(4):966-978.
[2] USDA. 2008. Dairy 2007, Part II: Changes in the U.S. Dairy Cattle Industry, 1991–2007 USDA-APHIS-VS, CEAH. Fort Collins, CO #N481.0311.
[3] Bar, D., et al. 2007. Effect of repeated episodes of generic clinical mastitis on milk yield in dairy cows. Journal of dairy science 90(10):4643-4653.
[4] Guard, C. 2009. The costs of common diseases of dairy cattle. Central Veterinary Conference Proceedings. Kansas City, MO..
[5] McArt, J.A. et al, 2015. Hyperketonemia in early lactation dairy cattle: a deterministic estimate of component and total cost per case. J. of Dairy Sci. 98(3):2043-2054.
[6] Bicalho, R.C. Lameness in Dairy Cattle: A debilitating disease or a Disease of Debilitated Cattle? Western Dairy Management Conference, 2011. Pg 73-83.
[7] Cha, E. et al. 2010. The cost of different types of lameness in dairy cows calculated by dynamic programming. Preventive veterinary medicine 97(1):1-8.
[8] Cha, E, et al. 2014. Optimal insemination and replacement decisions to minimize the cost of pathogen-specific clinical mastitis in dairy cows. Journal of dairy science 97(4):2101-2117.
[9] Cha, E, et al. 2011. The cost and management of different types of clinical mastitis in dairy cows estimated by dynamic programming. Journal of dairy science 94(9):4476-4487.
[10] Overton, M. and J. Fetrow. 2008. Economics of postpartum uterine health. Proc Dairy Cattle Reproduction Council:39-44.
[11] "The Value of Uterine Health: the diseases, the causes, and the financial implications." Dairy Cattle Reproduction Council article.
[12] Guard, C., 1999. Retained Placenta: Causes and Treatments. Advances in Dairy Technology (1999) Vol. 11, page 81.
[13] Zwald, N.R., K.A. Weigel, Y.M. Chang, R.D. Welper and J.S. Clay. 2004. Genetic selection of Health Traits using Producer-Recorded Data. I. Incidence Rates, Heritability Estimates and Sire Breeding Values. J. of Dairy Sci., 87:4287-4294.

A FEW POINTS TO CLARIFY

- Genetics – the study of heredity, or how the characteristics of living things are transmitted from one generation to the next

- Genomics – branch of biotechnology concerned with applying the techniques of genetics and molecular biology to the genetic mapping and DNA sequencing of sets of genes, with organizing the results in databases, and with applying the data

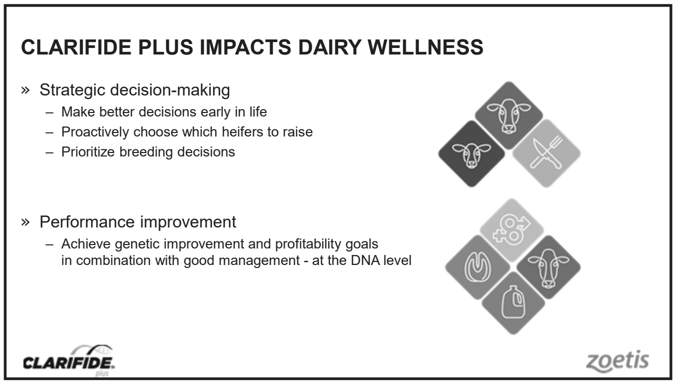


CLARIFIDE® PLUS FOR HOLSTEINS… PROVIDES MORE OPPORTUNITY FOR WELLNESS AND PROFIT

CDCB Official Evaluation	Wellness Traits	Genetic Conditions
• Parentage • **Production** • **Reproduction** • **Health** • **Type**	• **Mastitis** • **Lameness** • **Metritis** • **Retained Placenta** • **Displaced Abomasum** • **Ketosis**	• **Polled (no fee)** • Milk Components • Infertility Haplotypes • Other genetic conditions*

DWP$™ Animal Ranking

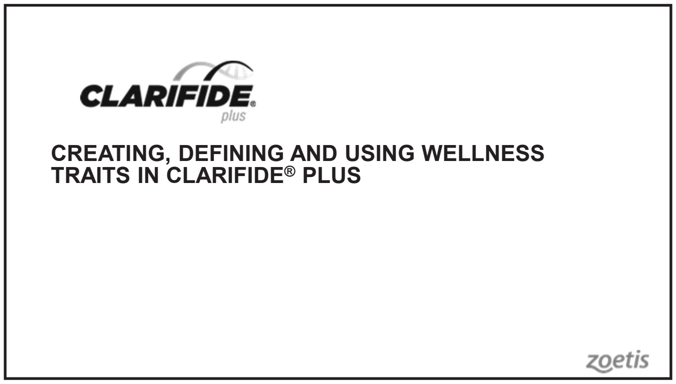
* CVM, Brachyspina and Beta Casein A2 available with add-on fee.



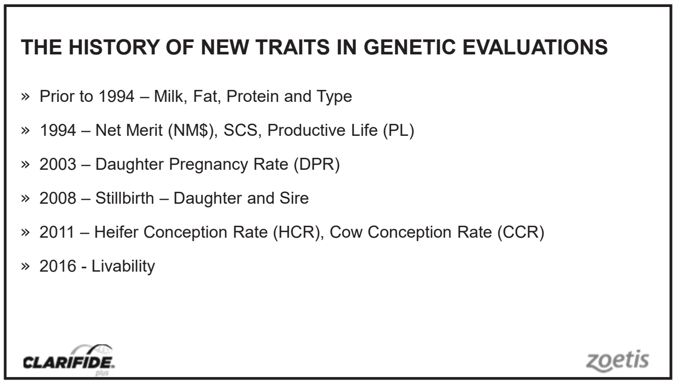
CLARIFIDE PLUS IMPACTS DAIRY WELLNESS

» Strategic decision-making
  - Make better decisions early in life
  - Proactively choose which heifers to raise
  - Prioritize breeding decisions

» Performance improvement
  - Achieve genetic improvement and profitability goals in combination with good management - at the DNA level

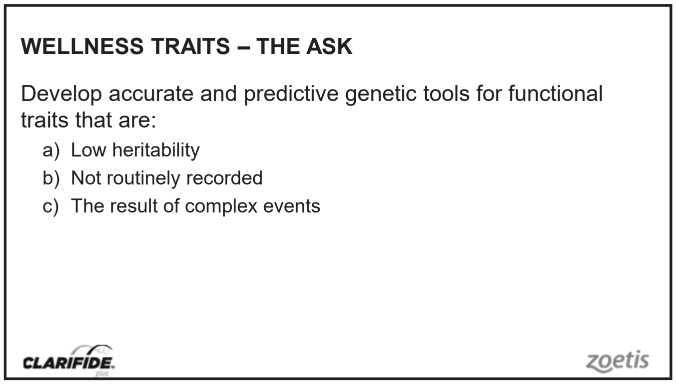


CREATING, DEFINING AND USING WELLNESS TRAITS IN CLARIFIDE® PLUS



THE HISTORY OF NEW TRAITS IN GENETIC EVALUATIONS

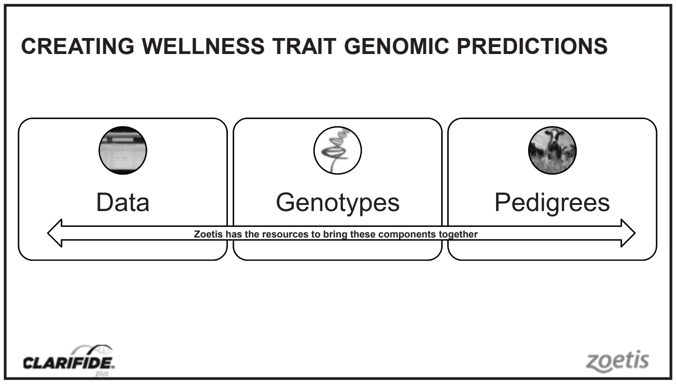
- Prior to 1994 – Milk, Fat, Protein and Type
- 1994 – Net Merit (NM$), SCS, Productive Life (PL)
- 2003 – Daughter Pregnancy Rate (DPR)
- 2008 – Stillbirth – Daughter and Sire
- 2011 – Heifer Conception Rate (HCR), Cow Conception Rate (CCR)
- 2016 - Livability



WELLNESS TRAITS – THE ASK

Develop accurate and predictive genetic tools for functional traits that are:

a) Low heritability
b) Not routinely recorded
c) The result of complex events



CREATING WELLNESS TRAIT GENOMIC PREDICTIONS

Data

Genotypes

Pedigrees

Zoetis has the resources to bring these components together

POWER OF THE DATA IN CLARIFIDE® PLUS

Trait	No. records in GE
Mastitis (MAST)	4,267,826
Lameness (LAME)	3,744,435
Metritis (METR)	3,078,504
Retained Placenta (RETP)	3,479,000
Displaced Abomasum (DA)	3,131,012
Ketosis (KET)	1,995,574
Pedigree	15,616,182
Genotypes	105,152

Number of records available after cleaning and editing in August 2015
Over 10M lactations

Source: Data on file, Zoetis internal data, August 2015, Zoetis Services LLC

PHENOTYPIC MEANS AND HERITABILITIES IN THE ANALYSES

Trait	Unit	Mean	h^2
Mastitis	Case per animal/lactation	0.23	0.069
Lameness	Case per animal/lactation	0.20	0.063
Metritis	Case per animal/lactation	0.10	0.059
Retained placenta	Case per animal/lactation	0.05	0.073
Displaced abomasum	Case per animal/lactation	0.02	0.081
Ketosis	Case per animal/lactation	0.05	0.059

- Each trait was defined as a Holstein female recorded with the presence or absence of a disease/disorder in a given lactation
- Every cow was assigned with 0 (no incidence) or 1 (recorded one or more incidences) per lactation

Source: Data on file, Zoetis internal data, August 2015, Zoetis Services LLC

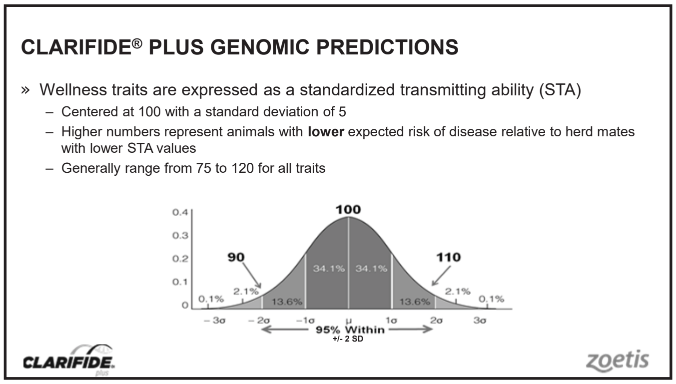
MILLIONS OF RECORDS AND CUTTING EDGE METHODOLOGY CONTRIBUTES TO AVERAGE RELIABILITIES OF 49 OR HIGHER

Trait	GPTA Reliabilities (%) of young genotyped and pedigreed females
MAST	**51**
LAME	**50**
METR	**49**
RETP	**50**
DA	**49**
KET	**50**

29,901 heifer observations (<2 years old)

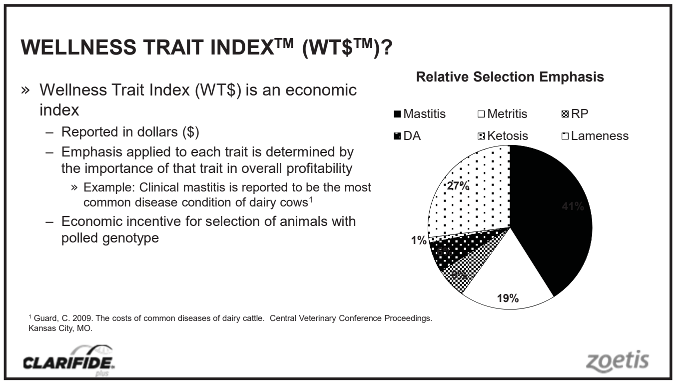
Reliabilities are similar or better than Reliability of some core CDCB traits (i.e. HCR & DSB)

Source: Data on file, Zoetis internal data, August 2015, Zoetis Services LLC



CLARIFIDE® PLUS GENOMIC PREDICTIONS

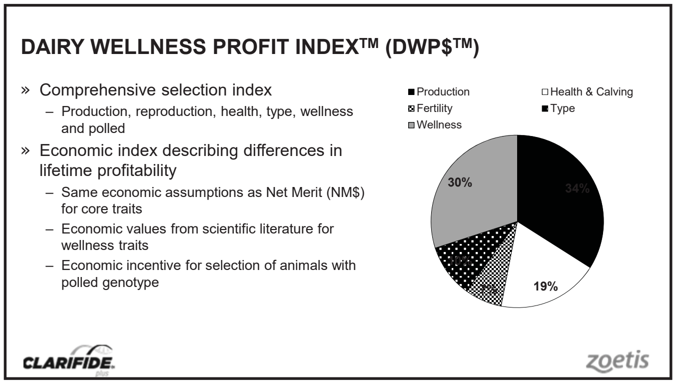
- Wellness traits are expressed as a standardized transmitting ability (STA)
  - Centered at 100 with a standard deviation of 5
  - Higher numbers represent animals with **lower** expected risk of disease relative to herd mates with lower STA values
  - Generally range from 75 to 120 for all traits



WELLNESS TRAIT INDEX$^{\text{TM}}$ (WT\$$^{\text{TM}}$)?

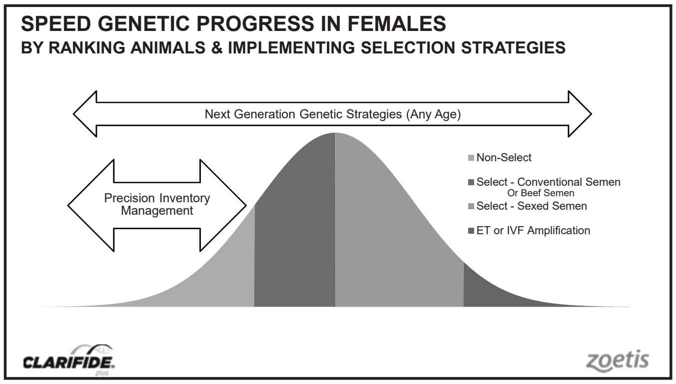
- Wellness Trait Index (WT$) is an economic index
  - Reported in dollars ($)
  - Emphasis applied to each trait is determined by the importance of that trait in overall profitability
    - Example: Clinical mastitis is reported to be the most common disease condition of dairy cows[1]
  - Economic incentive for selection of animals with polled genotype

[1] Guard, C. 2009. The costs of common diseases of dairy cattle. Central Veterinary Conference Proceedings. Kansas City, MO.



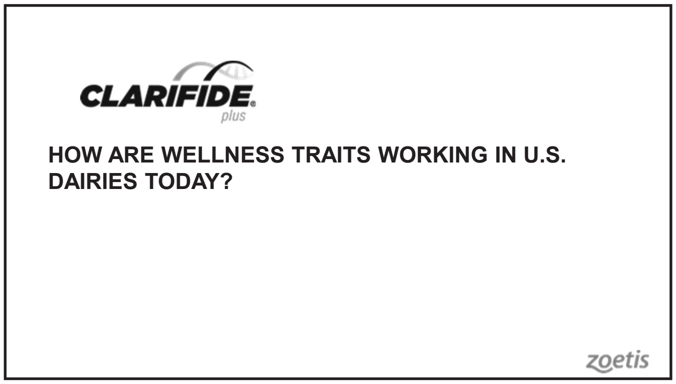
DAIRY WELLNESS PROFIT INDEX$^{\text{TM}}$ (DWP\$$^{\text{TM}}$)

- Comprehensive selection index
  - Production, reproduction, health, type, wellness and polled
- Economic index describing differences in lifetime profitability
  - Same economic assumptions as Net Merit (NM$) for core traits
  - Economic values from scientific literature for wellness traits
  - Economic incentive for selection of animals with polled genotype



SPEED GENETIC PROGRESS IN FEMALES

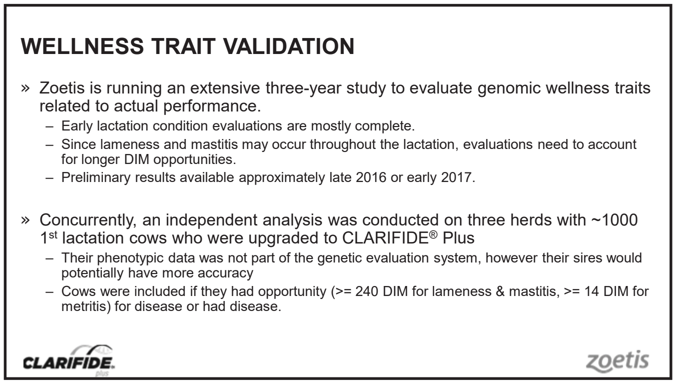
BY RANKING ANIMALS & IMPLEMENTING SELECTION STRATEGIES



CLARIFIDE® plus

HOW ARE WELLNESS TRAITS WORKING IN U.S. DAIRIES TODAY?

zoetis



WELLNESS TRAIT VALIDATION

- Zoetis is running an extensive three-year study to evaluate genomic wellness traits related to actual performance.
  - Early lactation condition evaluations are mostly complete.
  - Since lameness and mastitis may occur throughout the lactation, evaluations need to account for longer DIM opportunities.
  - Preliminary results available approximately late 2016 or early 2017.
- Concurrently, an independent analysis was conducted on three herds with ~1000 1st lactation cows who were upgraded to CLARIFIDE® Plus
  - Their phenotypic data was not part of the genetic evaluation system, however their sires would potentially have more accuracy
  - Cows were included if they had opportunity (>= 240 DIM for lameness & mastitis, >= 14 DIM for metritis) for disease or had disease.

CLARIFIDE plus

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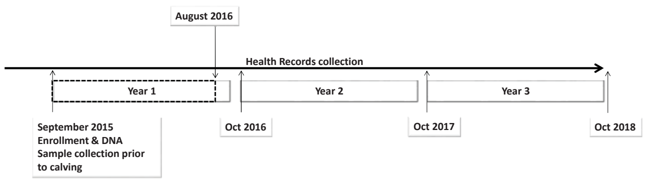
STUDY TIMELINE



August 2016

Health Records collection

Year 1

Year 2

Year 3

September 2015
Enrollment & DNA
Sample collection prior
to calving

Oct 2016

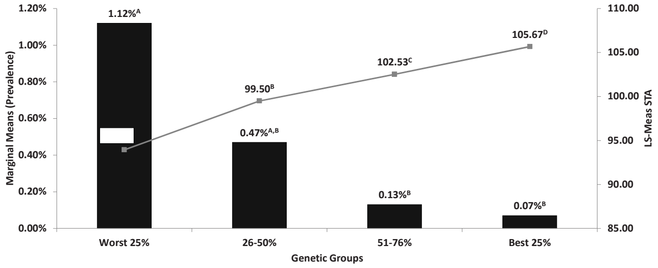
Oct 2017

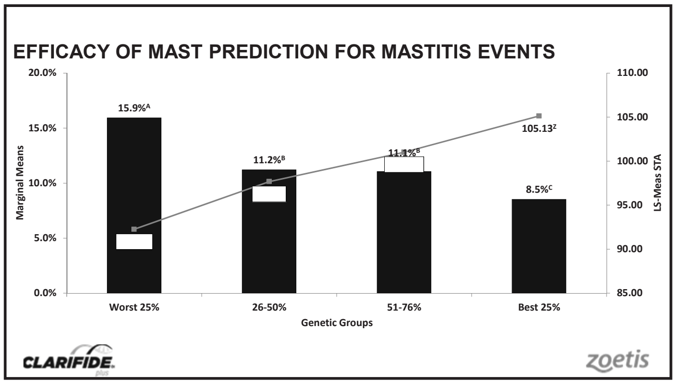
Oct 2018

LOCATION AND SAMPLING OF ANIMALS

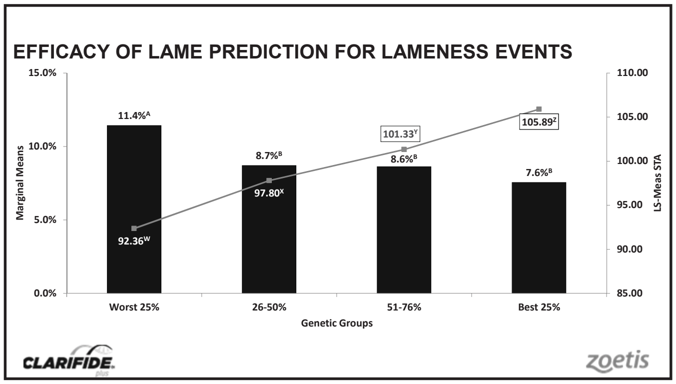
Herd	State	Number of Randomly Sampled Animals
1	MI	318
2	MN	308
3	ID	344
4	CA	350
5	CA	350
6	WI	292
7	NY	253
8	GA	305
9	CA	334
10	WI	363
11	ID	350
Animals Sampled		3567
	Animals censored Calving date outside desired window Breed Conflict, Sample failures	-660
Animals included in the study		**2907**

EFFICACY OF DA PREDICTION FOR DISPLACED ABOMASUM EVENTS

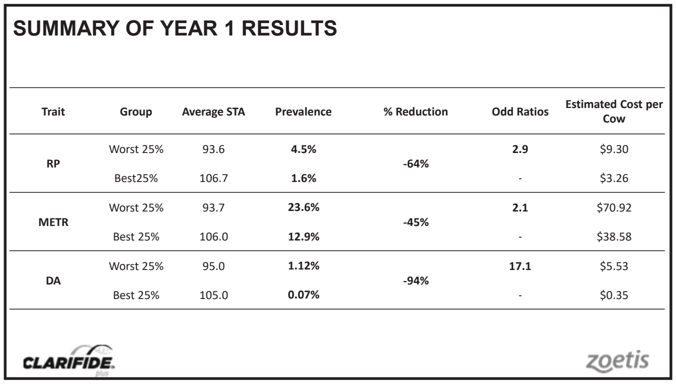




EFFICACY OF MAST PREDICTION FOR MASTITIS EVENTS



EFFICACY OF LAME PREDICTION FOR LAMENESS EVENTS



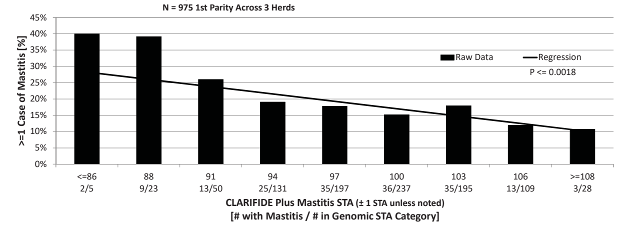
SUMMARY OF YEAR 1 RESULTS

Trait	Group	Average STA	Prevalence	% Reduction	Odd Ratios	Estimated Cost per Cow
RP	Worst 25%	93.6	**4.5%**	**-64%**	**2.9**	$9.30
	Best25%	106.7	**1.6%**		-	$3.26
METR	Worst 25%	93.7	**23.6%**	**-45%**	**2.1**	$70.92
	Best 25%	106.0	**12.9%**		-	$38.58
DA	Worst 25%	95.0	**1.12%**	**-94%**	**17.1**	$5.53
	Best 25%	105.0	**0.07%**		-	$0.35

SUMMARY OF YEAR 1 RESULTS

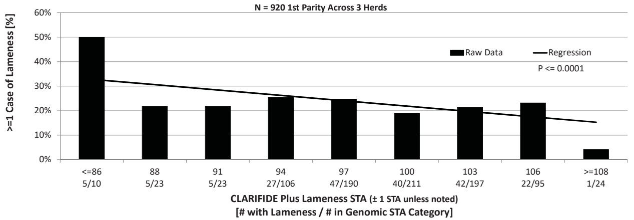
Trait	Group	Average STA	Prevalence	% Reduction	Odd Ratios	Estimated Cost per Cow
KETO	Worst 25%	94.0	**3.2%**	**-63%**	**2.2**	$3.75
	Best 25%	106.4	**1.5%**		-	$1.73
MAST	Worst 25%	92.4	**16.9%**	**-47%**	**2.0**	$35.74
	Best 25%	105.9	**8.9%**		-	$18.81
LAME	Worst 25%	92.4	**11.4%**	**-33%**	**1.6**	$20.23
	Best 25%	105.9	**7.6%**		-	$13.37

ASSOCIATION OF MASTITIS WITH WELLNESS TRAIT PREDICTION IN THREE HERDS

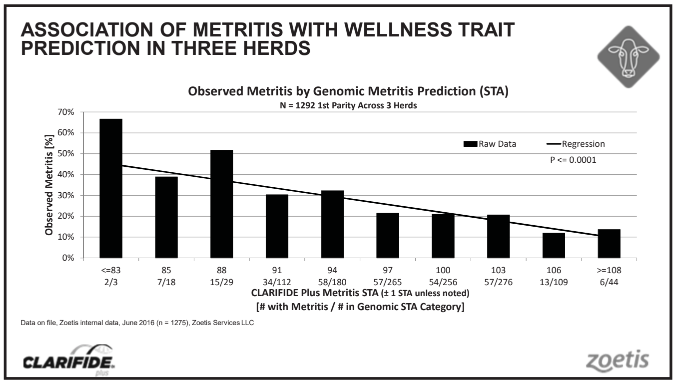


Data on file, Zoetis internal data, June 2016 (n = 975), Zoetis Services LLC

ASSOCIATION OF LAMENESS WITH WELLNESS TRAIT PREDICTION IN THREE HERDS

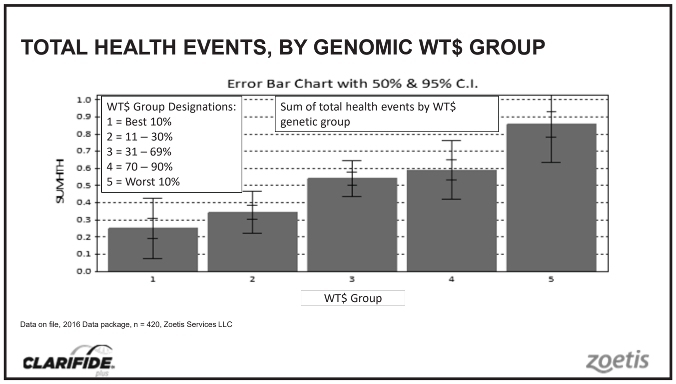


Data on file, Zoetis internal data, June 2016 (n = 920), Zoetis Services LLC



ASSOCIATION OF METRITIS WITH WELLNESS TRAIT PREDICTION IN THREE HERDS

Data on file, Zoetis internal data, June 2016 (n = 1275), Zoetis Services LLC

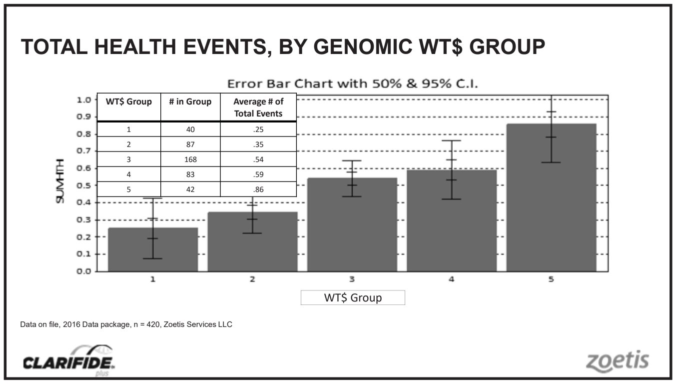


TOTAL HEALTH EVENTS, BY GENOMIC WT$ GROUP

WT$ Group Designations:
1 = Best 10%
2 = 11 – 30%
3 = 31 – 69%
4 = 70 – 90%
5 = Worst 10%

Sum of total health events by WT$ genetic group

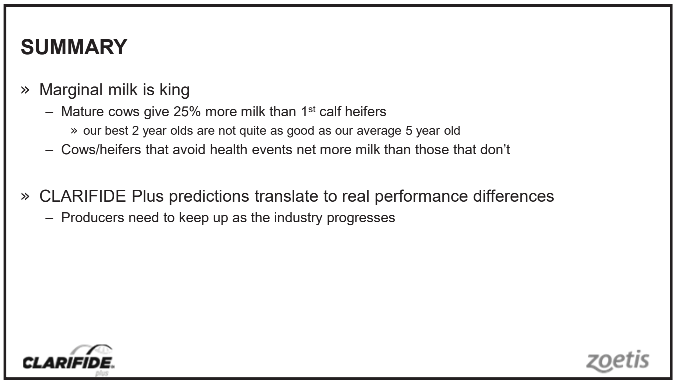
Data on file, 2016 Data package, n = 420, Zoetis Services LLC



TOTAL HEALTH EVENTS, BY GENOMIC WT$ GROUP

WT$ Group	# in Group	Average # of Total Events
1	40	.25
2	87	.35
3	168	.54
4	83	.59
5	42	.86

Data on file, 2016 Data package, n = 420, Zoetis Services LLC

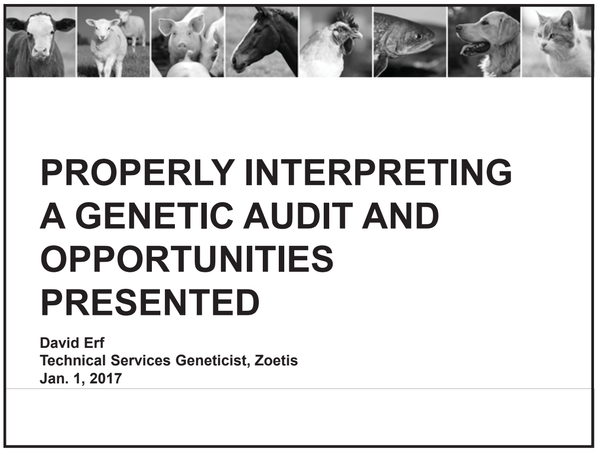


SUMMARY

- Marginal milk is king
  - Mature cows give 25% more milk than 1st calf heifers
    - our best 2 year olds are not quite as good as our average 5 year old
  - Cows/heifers that avoid health events net more milk than those that don't
- CLARIFIDE Plus predictions translate to real performance differences
  - Producers need to keep up as the industry progresses

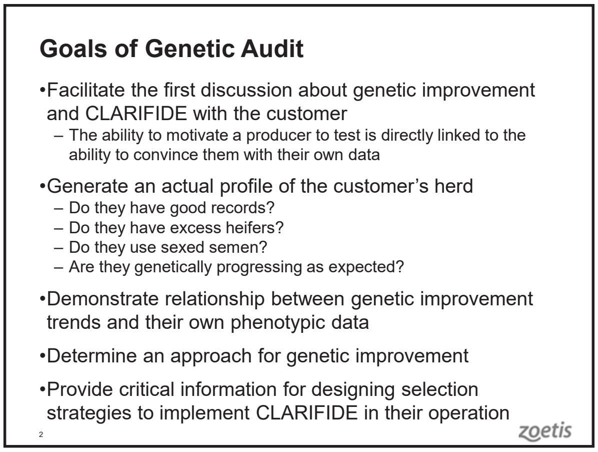
For More Information:

- www.clarifideplus.com
- Genetics Customer Service 877-233-3362
- Zoetis representative



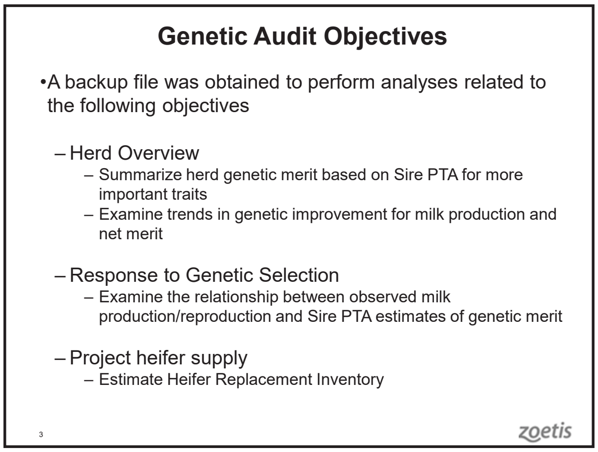
PROPERLY INTERPRETING A GENETIC AUDIT AND OPPORTUNITIES PRESENTED

David Erf
Technical Services Geneticist, Zoetis
Jan. 1, 2017



Goals of Genetic Audit

- Facilitate the first discussion about genetic improvement and CLARIFIDE with the customer
  - The ability to motivate a producer to test is directly linked to the ability to convince them with their own data
- Generate an actual profile of the customer's herd
  - Do they have good records?
  - Do they have excess heifers?
  - Do they use sexed semen?
  - Are they genetically progressing as expected?
- Demonstrate relationship between genetic improvement trends and their own phenotypic data
- Determine an approach for genetic improvement
- Provide critical information for designing selection strategies to implement CLARIFIDE in their operation



Genetic Audit Objectives

- A backup file was obtained to perform analyses related to the following objectives
  - Herd Overview
    - Summarize herd genetic merit based on Sire PTA for more important traits
    - Examine trends in genetic improvement for milk production and net merit
  - Response to Genetic Selection
    - Examine the relationship between observed milk production/reproduction and Sire PTA estimates of genetic merit
  - Project heifer supply
    - Estimate Heifer Replacement Inventory

GENETIC AUDIT INFORMATION

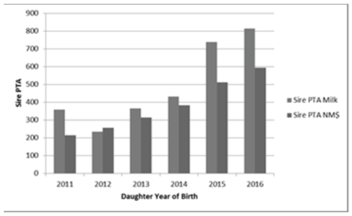
Herd Summary

Lactation	# Females	# HO Females with Sire PTA	% HO Females with Sire PTA
0 (Heifers)	1245	1214	98%
1	474	472	99%
2	394	394	100%
3	260	260	100%
4	186	180	97%
5	98	96	98%

- Only females with Holstein Sire PTAs will be analyzed in this audit
- Missing Sire Information: Blank, HBHB, 94JE3083, etc.

Genetic Trends:Sire PTA (Predicted Transmitting Ability)

Birth Year	# Females	Milk	Net Merit	Fat	Protein	Daughter Pregnancy Rate (DPR)	Productive Life (PL)
2011	90	359	214	21	11	0.6	2.1
2012	172	234	256	15	12	1.1	2.6
2013	201	366	315	19	17	1.2	3.3
2014	316	433	382	30	20	1.4	3.7
2015	353	739	513	47	32	1.3	4.3
2016	328	813	595	56	35	1.5	5.0
Genetic Progress		110lbs/year	78NM$/year	8lbs/year	5lbs/year	0.2%/year	0.6mo./year
Industry Progress		66lbs/year	34NM$/year	4lbs/year	3lbs/year	0.1%/year	0.4mo./year



- 92% of this herd have sire ids
- This herd's animals born in 2016 have an average Net Merit Sire PTA in the 89th percentile

Pedigree Index

- A custom index of genetic merit based on PTA available for the recorded sire and maternal grandsire

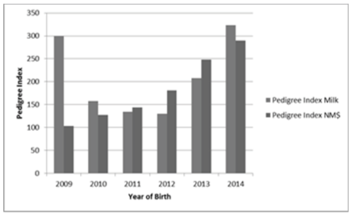
$$PI = \frac{Sire_{PTA} + \frac{MGS_{PTA}}{2}}{2}$$

  - Predictions and reliabilities estimated for milk, net merit, fat, protein, daughter pregnancy rate, and productive life
  - Subject to pedigree errors

NOTE: Pedigree Index is different than a Parent Average

Genetic Trends: Pedigree Index for Females

Birth Year	# Females	Milk	Net Merit (NM$)	Fat	Protein	Daughter Pregnancy Rate (DPR)	Productive Life (PL)
2009	126	299	103	10	9	0.2	0.8
2010	173	157	128	13	7	0.7	1.0
2011	329	134	144	9	7	0.8	1.5
2012	443	130	181	13	9	1.1	1.9
2013	539	207	248	18	12	1.3	2.7
2014	773	323	290	22	15	1.2	3.0
Genetic Progress		8lbs /year	38NM$ /year	2lbs /year	1lbs /year	0.2% /year	0.5mo. /year



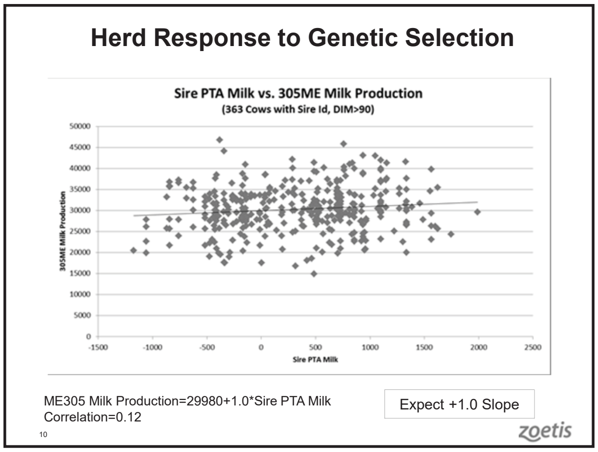
Sire of Conception

Bull	# Herd Pregnant	Milk PTA	NM$ PTA	DPR PTA	Rel.
Beef Semen	160				
MAMBO (1H11149)	83	834	529	-0.5	76
LOMBARDI (1H11200)	79	514	563	1.6	76
CABRIOLET (1H10396)	75	1168	827	0.8	76
BOYOBOY (1H10296)	72	-225	291	3.4	95
YOOHOO (1H10579)	70	836	611	0.6	77

- The strategy to using genomic-proven bulls is to use a group, spreading semen usage over more bulls.

- This strategy will minimize the impact of PTAs changing for any one sire due to the lower reliability.

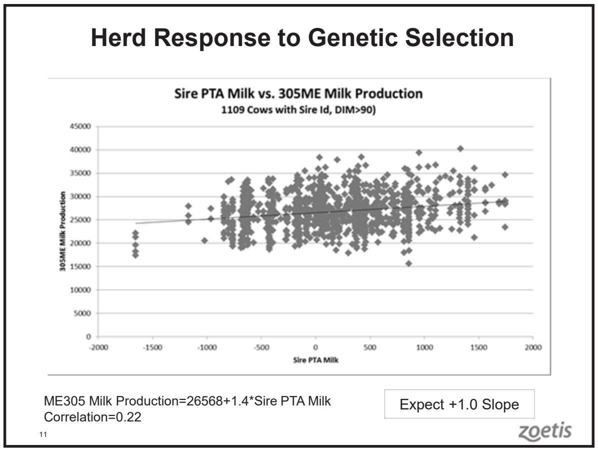
- This Dairy is using a combination of genomic-proven and daughter-proven bulls
  - 75% of conceptions are to genomic-proven bulls
  - 40% of conceptions are to sexed semen



Herd Response to Genetic Selection

ME305 Milk Production=29980+1.0*Sire PTA Milk
Correlation=0.12

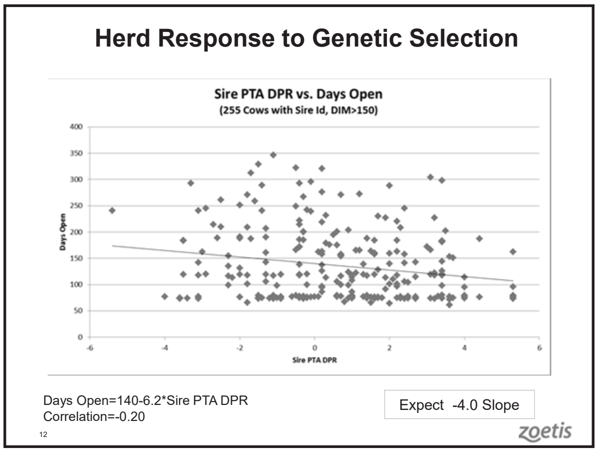
Expect +1.0 Slope



Herd Response to Genetic Selection

ME305 Milk Production=26568+1.4*Sire PTA Milk
Correlation=0.22

Expect +1.0 Slope

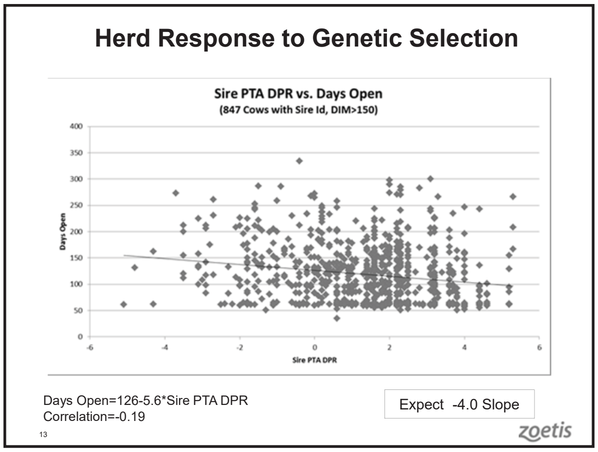


Herd Response to Genetic Selection

Days Open=140-6.2*Sire PTA DPR
Correlation=-0.20

Expect -4.0 Slope

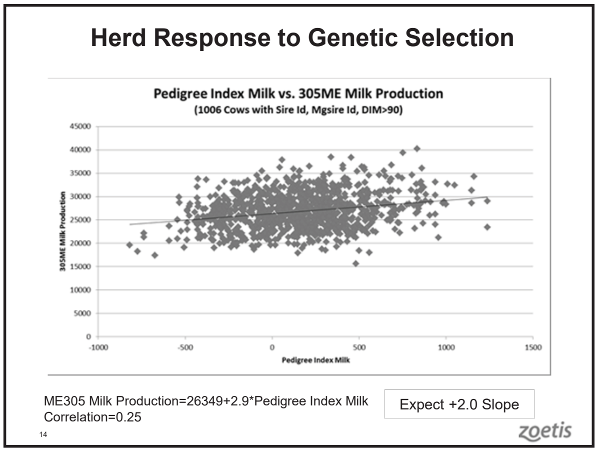
Herd Response to Genetic Selection



Days Open=126-5.6*Sire PTA DPR
Correlation=-0.19

Expect -4.0 Slope

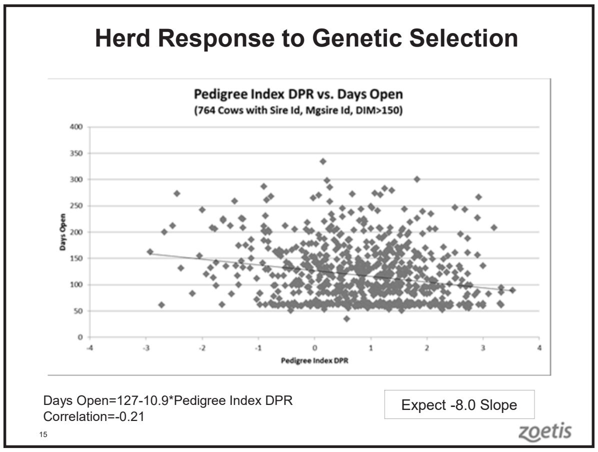
Herd Response to Genetic Selection



ME305 Milk Production=26349+2.9*Pedigree Index Milk
Correlation=0.25

Expect +2.0 Slope

Herd Response to Genetic Selection



Days Open=127-10.9*Pedigree Index DPR
Correlation=-0.21

Expect -8.0 Slope

Review of Herd Response to Genetic Selection

	Sire PTA		Pedigree Index	
	Milk	DPR	Milk	DPR
Observed Response	1.4lbs	-5.6days	2.9lbs	-10.9days
Expected Response	1lbs	-4days	2lbs	-8days

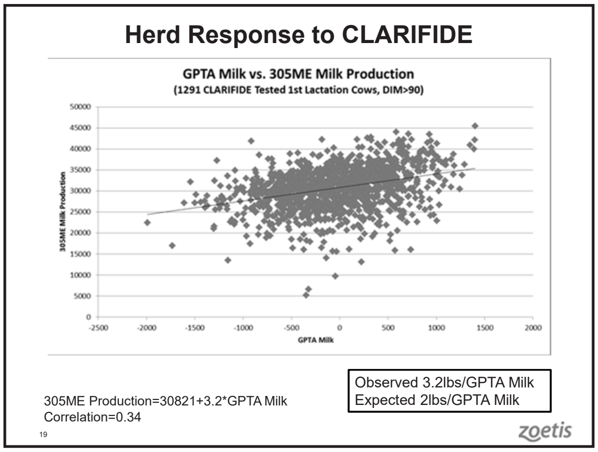
- This Dairy exhibits a favorable level of response to genetic selection
  - Evaluated as the impact of Sire PTA and Pedigree Index on the herd performance for milk production and daughter pregnancy rate (DPR)

- Anticipated response to selection for decisions/strategies based on genomic information looks promising at this dairy

GENETIC AUDIT INFORMATION ON PERFORMANCE OF CLARIFIDE TESTED COWS

Herd Summary

Lactation	# Females	# Females with Sire PTA	# CLARIFIDE Tested Females
0 (Heifers)	930	927	404
1	493	487	386
2	349	340	120
3	140	136	1
4	128	128	
5	43	43	

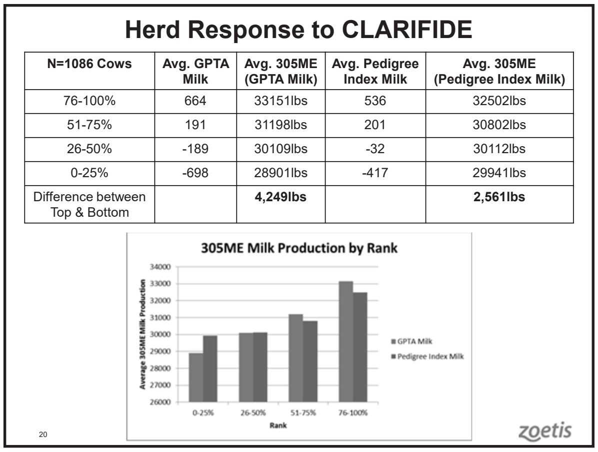


Herd Response to CLARIFIDE

Observed 3.2lbs/GPTA Milk
Expected 2lbs/GPTA Milk

305ME Production=30821+3.2*GPTA Milk
Correlation=0.34

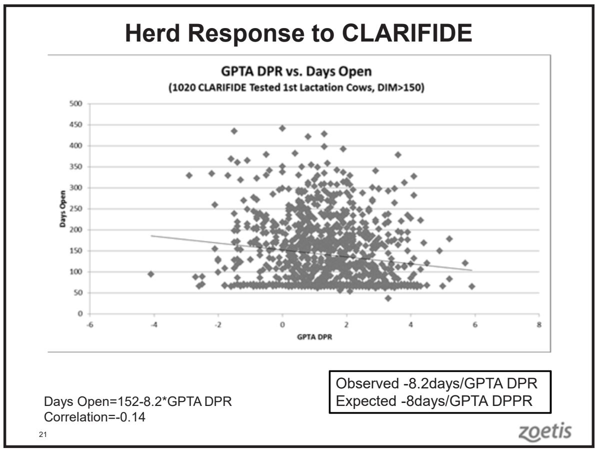
19



Herd Response to CLARIFIDE

N=1086 Cows	Avg. GPTA Milk	Avg. 305ME (GPTA Milk)	Avg. Pedigree Index Milk	Avg. 305ME (Pedigree Index Milk)
76-100%	664	33151lbs	536	32502lbs
51-75%	191	31198lbs	201	30802lbs
26-50%	-189	30109lbs	-32	30112lbs
0-25%	-698	28901lbs	-417	29941lbs
Difference between Top & Bottom		**4,249lbs**		**2,561lbs**

20



Herd Response to CLARIFIDE

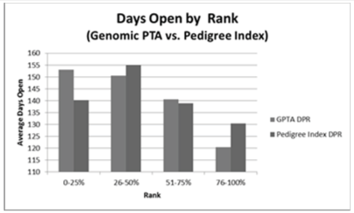
Observed -8.2days/GPTA DPR
Expected -8days/GPTA DPPR

Days Open=152-8.2*GPTA DPR
Correlation=-0.14

21

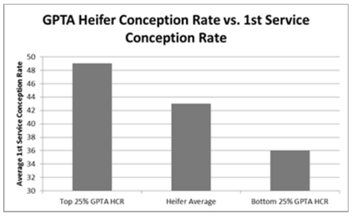
Herd Response to CLARIFIDE

N=861 Cows	Avg. GPTA DPR	Avg. Days Open (GPTA DPR)	Avg. Pedigree Index DPR	Avg. Days Open (Pedigree Index DPR)
76-100%	3.2	120days	2.5	130days
51-75%	1.8	141days	1.6	140days
26-50%	1.0	151days	1.0	155days
0-25%	-0.3	153days	0.1	140days
Difference between Top & Bottom		**33days**		**10days**

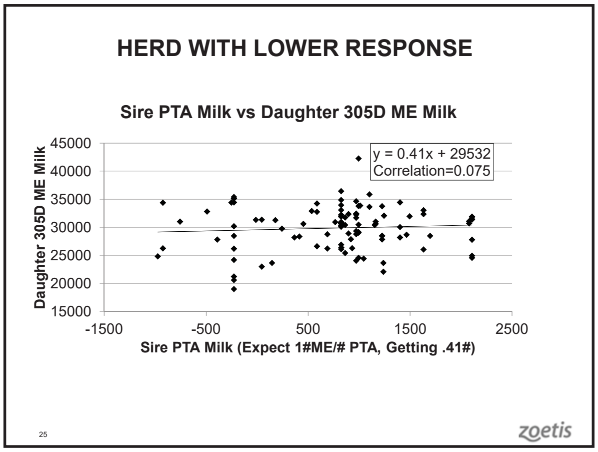


Herd Response to CLARIFIDE

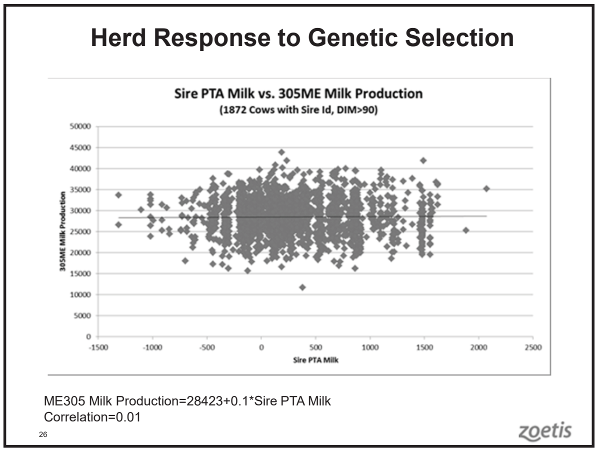
N=1504 Heifers	Avg. GPTA HCR	Avg. 1st Service Conception Rate
Top 25% GPTA HCR	2.0	49%
Heifer Average	0.4	43%
Bottom 25% GPTA HCR	-1.1	36%
Difference between Top & Bottom		**13%**



SOME HERDS WITH LOWER GENETIC RESPONSES AND THE OPPORTUNITIES THAT WERE DISCOVERED

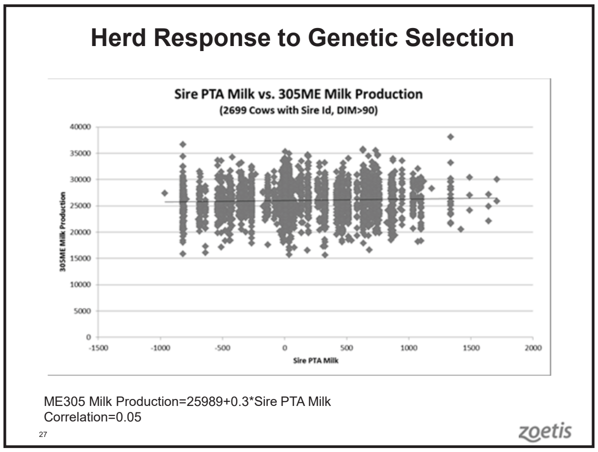


HERD WITH LOWER RESPONSE



Herd Response to Genetic Selection

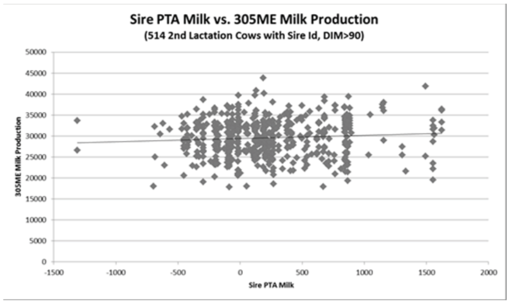
ME305 Milk Production=28423+0.1*Sire PTA Milk
Correlation=0.01



Herd Response to Genetic Selection

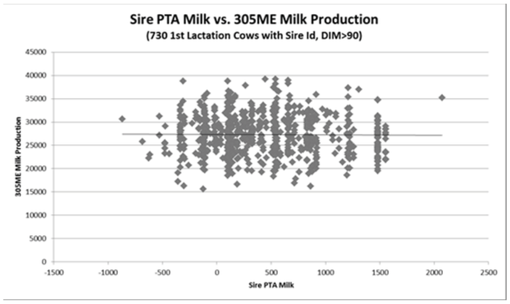
ME305 Milk Production=25989+0.3*Sire PTA Milk
Correlation=0.05

Herd Response to Genetic Selection



ME305 Milk Production=28402+0.8*Sire PTA Milk
Correlation=0.08

Herd Response to Genetic Selection



ME305 Milk Production=27308-0.1*Sire PTA Milk
Correlation=0.01

SUMMARY

- **Genetic Audits are ideal ways to introduce the possible potential and opportunities of Clarifide testing.**
- **We get to examine the level of genetics they have used and are using along with the herd response to genetic selection.**
- **We can also evaluate performance of genomic tested cows to see how the selection is working.**

zoetis

Managing Heifer Inventories – What is the right number and what options does this area create?

David Erf
Dairy Technical Services - Geneticist

Comprehensive Strategies

Nutrition
Heifer Mgmt
Genetics
Health
Milk Quality
Repro-duction

- Genetic improvement is part of a comprehensive plan to build and sustain profitable dairy production
- Genetics serve as a foundation

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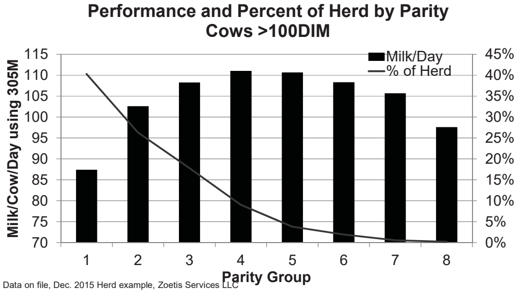
Longevity-driven profit



Data on file, Dec. 2015 Herd example, Zoetis Services LLC

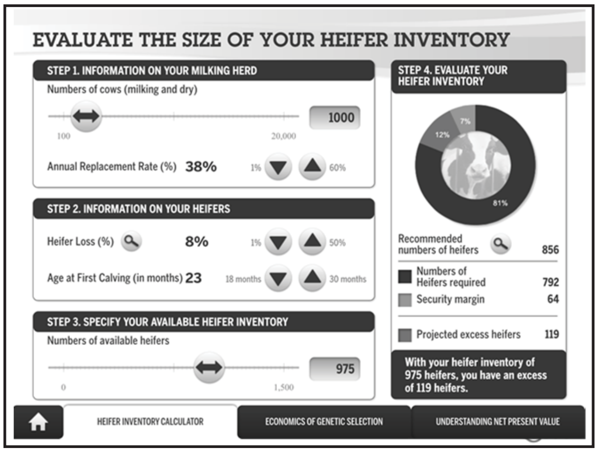
zoetis

WHY IS MANAGING REPLACEMENTS IMPORTANT TO MY OPERATION?

- It is an area of opportunity to make operations more efficient.
- Studies on Financial Drivers done by Agstar Financial and Zoetis show a strong correlation in lower average replacement costs and overall profit.
- Raising extra heifers just makes little sense.

What is the Heifer Inventory Calculator?

- This tool is very useful in helping to position CLARIFIDE in helping the herd to right size its replacement population
- This calculator can also be used in Calf and Heifer assessments to help identify overall inventory needs for herds, even if they are not using CLARIFIDE



EVALUATE THE SIZE OF YOUR HEIFER INVENTORY

STEP 1. INFORMATION ON YOUR MILKING HERD

Numbers of cows (milking and dry): 1000

Annual Replacement Rate (%) 38%

STEP 2. INFORMATION ON YOUR HEIFERS

Heifer Loss (%) 8%

Age at First Calving (in months) 23

STEP 3. SPECIFY YOUR AVAILABLE HEIFER INVENTORY

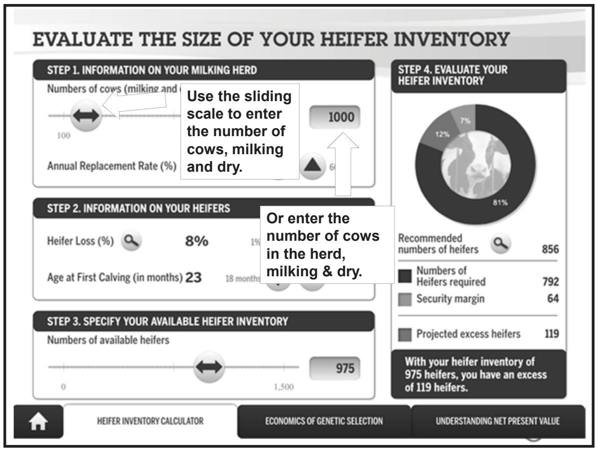
Numbers of available heifers: 975

STEP 4. EVALUATE YOUR HEIFER INVENTORY

Recommended numbers of heifers	856
■ Numbers of Heifers required	792
▨ Security margin	64
▨ Projected excess heifers	119

With your heifer inventory of 975 heifers, you have an excess of 119 heifers.

DATA POINT 1



EVALUATE THE SIZE OF YOUR HEIFER INVENTORY

STEP 1. INFORMATION ON YOUR MILKING HERD

Numbers of cows (milking and 1000

Annual Replacement Rate (%)

Use the sliding scale to enter the number of cows, milking and dry.

Or enter the number of cows in the herd, milking & dry.

STEP 2. INFORMATION ON YOUR HEIFERS

Heifer Loss (%) 8%

Age at First Calving (in months) 23

STEP 3. SPECIFY YOUR AVAILABLE HEIFER INVENTORY

Numbers of available heifers 975

STEP 4. EVALUATE YOUR HEIFER INVENTORY

Recommended numbers of heifers	856
■ Numbers of Heifers required	792
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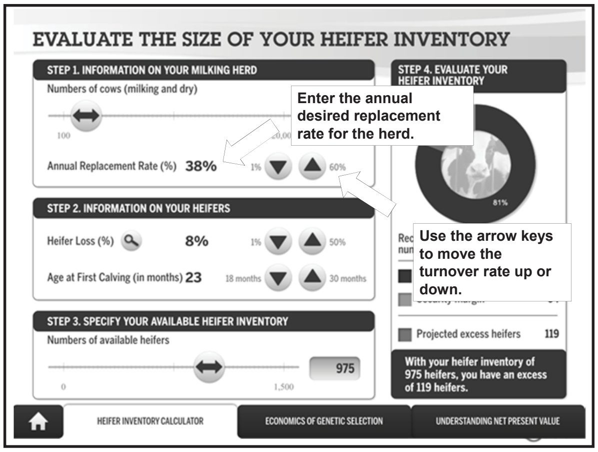
With your heifer inventory of 975 heifers, you have an excess of 119 heifers.

DATA POINT 2



EVALUATE THE SIZE OF YOUR HEIFER INVENTORY

STEP 1. INFORMATION ON YOUR MILKING HERD

Numbers of cows (milking and dry)

Annual Replacement Rate (%) 38%

STEP 2. INFORMATION ON YOUR HEIFERS

Heifer Loss (%) 8%

Age at First Calving (in months) 23

STEP 3. SPECIFY YOUR AVAILABLE HEIFER INVENTORY

Numbers of available heifers 975

STEP 4. EVALUATE YOUR HEIFER INVENTORY

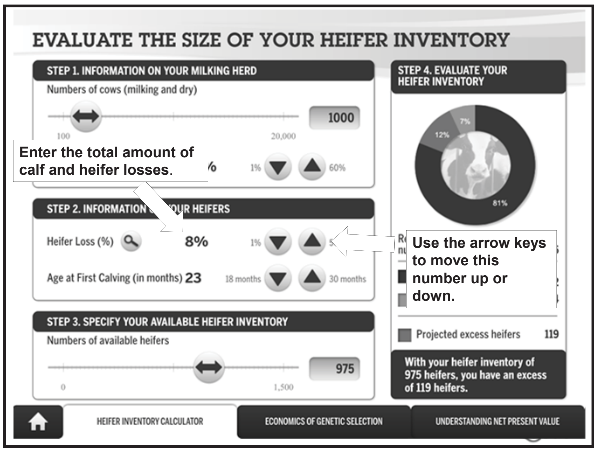
Projected excess heifers 119

With your heifer inventory of 975 heifers, you have an excess of 119 heifers.

Enter the annual desired replacement rate for the herd.

Use the arrow keys to move the turnover rate up or down.

DATA POINT 3



EVALUATE THE SIZE OF YOUR HEIFER INVENTORY

STEP 1. INFORMATION ON YOUR MILKING HERD

Numbers of cows (milking and dry) 1000

STEP 2. INFORMATION ON YOUR HEIFERS

Heifer Loss (%) 8%

Age at First Calving (in months) 23

STEP 3. SPECIFY YOUR AVAILABLE HEIFER INVENTORY

Numbers of available heifers 975

STEP 4. EVALUATE YOUR HEIFER INVENTORY

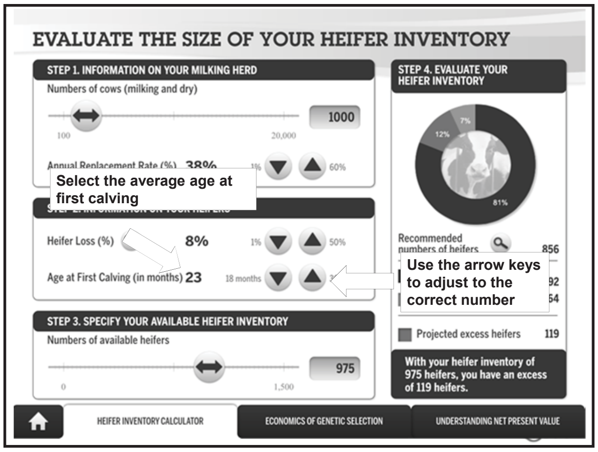
Projected excess heifers 119

With your heifer inventory of 975 heifers, you have an excess of 119 heifers.

Enter the total amount of calf and heifer losses.

Use the arrow keys to move this number up or down.

DATA POINT 4



EVALUATE THE SIZE OF YOUR HEIFER INVENTORY

STEP 1. INFORMATION ON YOUR MILKING HERD

Numbers of cows (milking and dry): 1000

Annual Replacement Rate (%) 38%

Select the average age at first calving

Heifer Loss (%) 8%

Age at First Calving (in months) 23

Use the arrow keys to adjust to the correct number

STEP 3. SPECIFY YOUR AVAILABLE HEIFER INVENTORY

Numbers of available heifers: 975

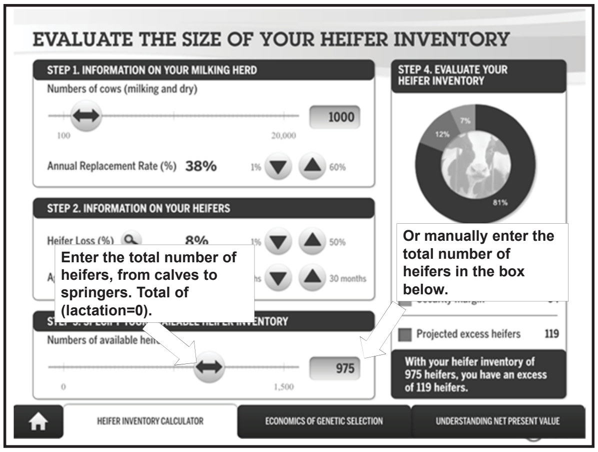
STEP 4. EVALUATE YOUR HEIFER INVENTORY

Recommended numbers of heifers 856

Projected excess heifers 119

With your heifer inventory of 975 heifers, you have an excess of 119 heifers.

DATA POINT 5



EVALUATE THE SIZE OF YOUR HEIFER INVENTORY

STEP 1. INFORMATION ON YOUR MILKING HERD

Numbers of cows (milking and dry) 1000

Annual Replacement Rate (%) 38%

STEP 2. INFORMATION ON YOUR HEIFERS

Heifer Loss (%) 8%

Numbers of available heifers 975

STEP 4. EVALUATE YOUR HEIFER INVENTORY

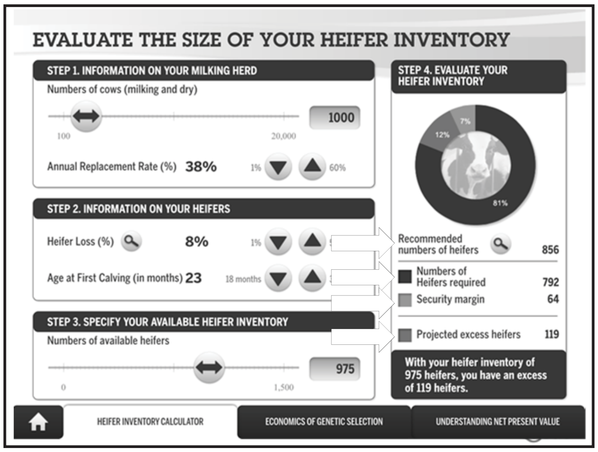
Projected excess heifers 119

With your heifer inventory of 975 heifers, you have an excess of 119 heifers.

Enter the total number of heifers, from calves to springers. Total of (lactation=0).

Or manually enter the total number of heifers in the box below.

RESULTS



EVALUATE THE SIZE OF YOUR HEIFER INVENTORY

STEP 1. INFORMATION ON YOUR MILKING HERD

Numbers of cows (milking and dry) 1000

Annual Replacement Rate (%) 38%

STEP 2. INFORMATION ON YOUR HEIFERS

Heifer Loss (%) 8%

Age at First Calving (in months) 23

STEP 3. SPECIFY YOUR AVAILABLE HEIFER INVENTORY

Numbers of available heifers 975

STEP 4. EVALUATE YOUR HEIFER INVENTORY

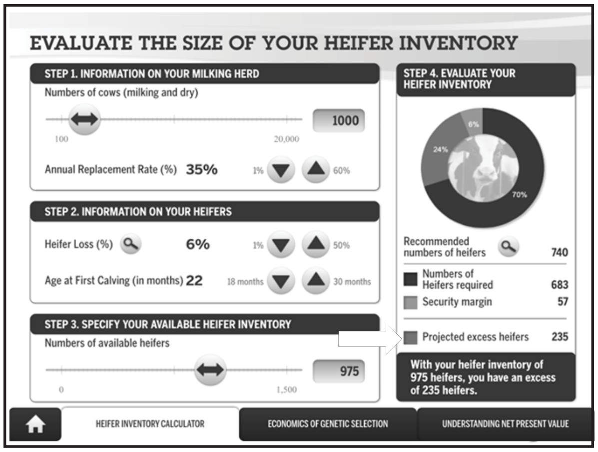
Recommended numbers of heifers 856

Numbers of Heifers required 792

Security margin 64

Projected excess heifers 119

With your heifer inventory of 975 heifers, you have an excess of 119 heifers.



EVALUATE THE SIZE OF YOUR HEIFER INVENTORY

STEP 1. INFORMATION ON YOUR MILKING HERD

Numbers of cows (milking and dry): 1000

Annual Replacement Rate (%) 35%

STEP 2. INFORMATION ON YOUR HEIFERS

Heifer Loss (%) 6%

Age at First Calving (in months) 22

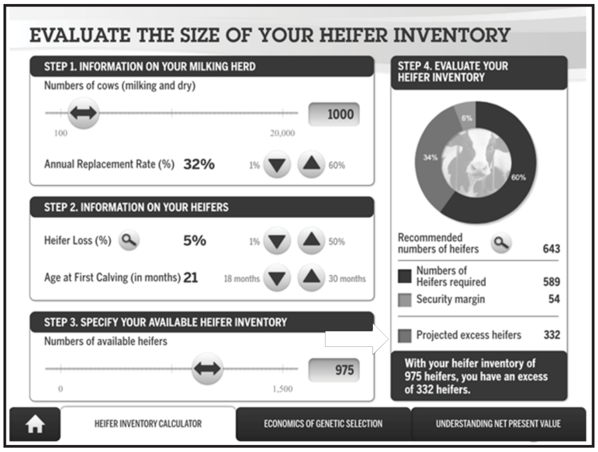
STEP 3. SPECIFY YOUR AVAILABLE HEIFER INVENTORY

Numbers of available heifers: 975

STEP 4. EVALUATE YOUR HEIFER INVENTORY

Recommended numbers of heifers	740
■ Numbers of Heifers required	683
▨ Security margin	57
▨ Projected excess heifers	235

With your heifer inventory of 975 heifers, you have an excess of 235 heifers.



EVALUATE THE SIZE OF YOUR HEIFER INVENTORY

STEP 1. INFORMATION ON YOUR MILKING HERD

Numbers of cows (milking and dry): 1000

Annual Replacement Rate (%) 32%

STEP 2. INFORMATION ON YOUR HEIFERS

Heifer Loss (%) 5%

Age at First Calving (in months) 21

STEP 3. SPECIFY YOUR AVAILABLE HEIFER INVENTORY

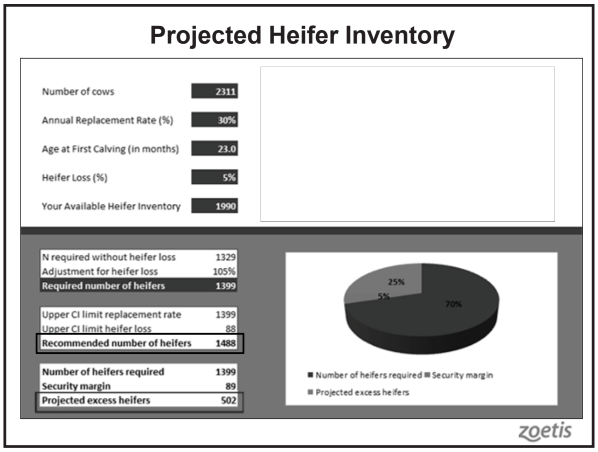
Numbers of available heifers: 975

STEP 4. EVALUATE YOUR HEIFER INVENTORY

Recommended numbers of heifers	643
■ Numbers of Heifers required	589
▨ Security margin	54
▨ Projected excess heifers	332

With your heifer inventory of 975 heifers, you have an excess of 332 heifers.

EXAMPLE HERDS



Projected Heifer Inventory

Number of cows	2311
Annual Replacement Rate (%)	30%
Age at First Calving (in months)	23.0
Heifer Loss (%)	5%
Your Available Heifer Inventory	1990

N required without heifer loss	1329
Adjustment for heifer loss	105%
Required number of heifers	**1399**
Upper CI limit replacement rate	1399
Upper CI limit heifer loss	88
Recommended number of heifers	**1488**
Number of heifers required	**1399**
Security margin	**89**
Projected excess heifers	**502**

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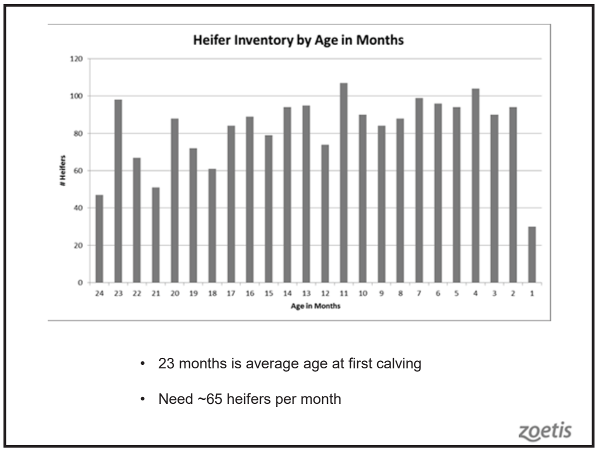
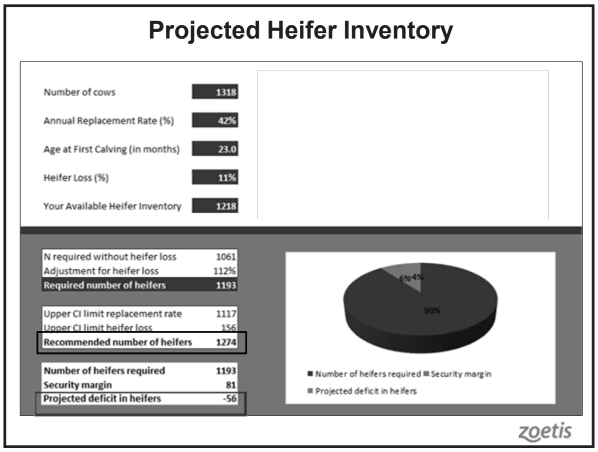


- 23 months is average age at first calving
- Need ~65 heifers per month

zoetis

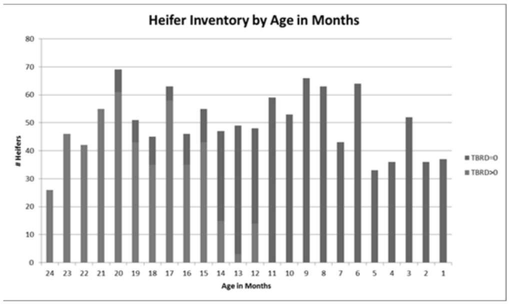


Projected Heifer Inventory

Number of cows	1318
Annual Replacement Rate (%)	42%
Age at First Calving (in months)	23.0
Heifer Loss (%)	11%
Your Available Heifer Inventory	1218

N required without heifer loss	1061
Adjustment for heifer loss	112%
Required number of heifers	**1193**
Upper CI limit replacement rate	1117
Upper CI limit heifer loss	156
Recommended number of heifers	**1274**
Number of heifers required	**1193**
Security margin	**81**
Projected deficit in heifers	**-56**

zoetis



- 23 months is average Age at First Calving
- Need ~55 heifers per month

SUMMARY

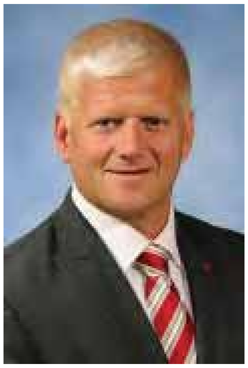
What can we do with the Heifer Inventory Calculator?

- Use the calculator to help position CLARIFIDE and CLARIFIDE Plus. Identifying ideal heifer inventory requirements helps to strategically plan areas that action items can be implemented.
- Utilize the calculator to show how improvements in genetics and management practices can have huge impacts on replacement needs.
- Even if the herd is not using or considering CLARIFIDE, the calculator can be a nice tool to help right size calf and heifer numbers.

zoetis

Rustin Moore, DVM, PhD, DACVS

Ruth Stanton Chair Dean, College of Veterinary Medicine, The Ohio State University



Dr. Moore joined Ohio State's faculty in 2006 as professor and chair of the Department of Veterinary Clinical Sciences, a position he held until 2014. In 2008, he was named the Bud and Marilyn Jenne Professor, a title he has held since then. In 2009, he also assumed the role of acting director of the Veterinary Medical Center and in 2011 assumed the roles of associate dean of clinical and outreach programs and executive director of the Veterinary Medical Center. He assumed the roles of associate executive dean and director of the Alice Lloyd Finley Memorial Veterinary Research Farm in 2014. He continued to serve as the executive director of the Veterinary Medical Center while he served during the past year as the college's associate executive dean and the director of the veterinary research farm.

He has taught at all levels of the undergraduate, professional and graduate curricula, both at Ohio State and at Louisiana State University (LSU), where he served on the LSU faculty from 1994 to 2006. He has served as an advisor, co-advisor or committee member for 21 doctoral or master's students, as well as the clinical advisor for more than 25 interns and residents.

His clinical interests include equine lameness, surgery and colic and its associated complications, and his research has led to his being a principal or co-investigator on approximately 120 funded grants. In addition, he has authored or co-authored more than 15 book chapters, and his work has been published in 120 peer- or editor-reviewed manuscripts and 175 scientific abstracts. His service on editor-reviewed boards includes the journal Veterinary Surgery, and he has served as a manuscript reviewer for several additional prestigious journals. He is also a frequently invited speaker at national and international equine veterinary clinical, research and educational symposia.

In addition to extensive and substantial service to his department, college and the university, Dr. Moore has contributed wide-ranging service and outreach efforts to his discipline, to the community and beyond. For example, while at LSU, he assumed emergency leadership of a large-scale rescue effort of nearly 500 horses and other animals during the aftermath of Hurricanes Katrina and Rita. A national leader, he has served as president of the American Association of Veterinary Clinicians, on the board of directors of the American Association of Equine Practitioners, on the board of regents of the American College of Veterinary Surgeons and as an equine health advisory board member for the Ohio Department of Agriculture, among others.

In addition, among his numerous awards, he received the Pfizer Award for Research Excellence, the School of Veterinary Medicine's Distinguished Faculty, and the University's Distinguished Scholar Award and Lifetime Achievement Award. While at LSU, he received the Lifetime Achievement Award by the International Equine Conference on Laminitis and Diseases of the Foot and was recently inducted into the West Virginia University's Academy of Distinguished Alumni.

A native of Spencer, West Virginia, he earned a BS degree, summa cum laude, from West Virginia University; a DVM, summa cum laude, and a PhD from The Ohio State University. In addition, he is a diplomate of the American College of Veterinary Surgeons.

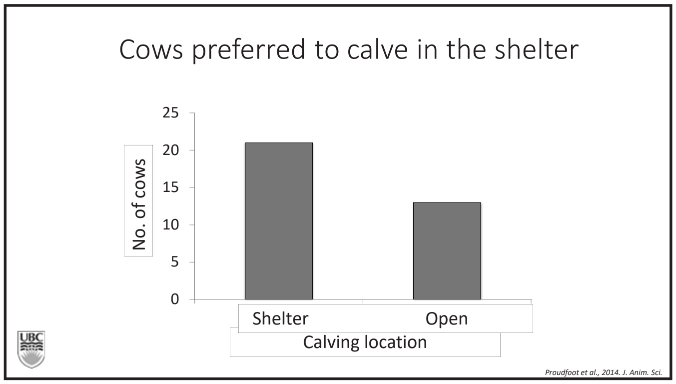
THE OHIO STATE UNIVERSITY

The calving pen from the cow's perspective

Katy Proudfoot, PhD
The Ohio State University College of Veterinary Medicine
Veterinary Preventive Medicine

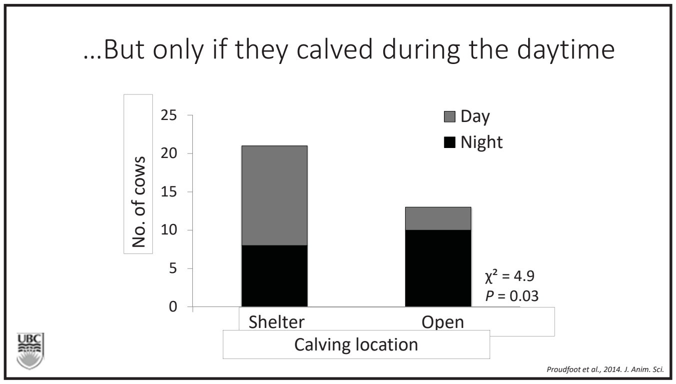
Natural cow behaviors → Best practice

Would cows seek seclusion in a commercial setting?



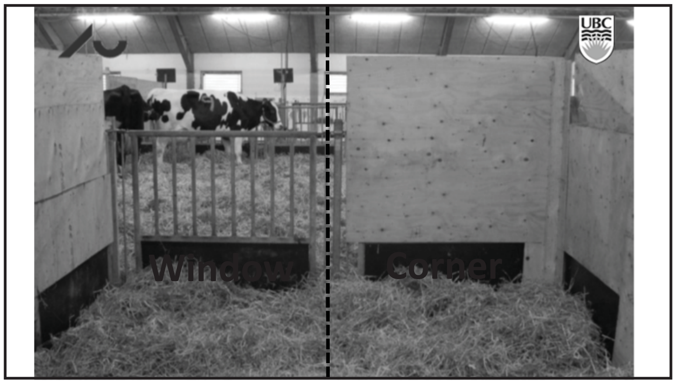
Cows preferred to calve in the shelter

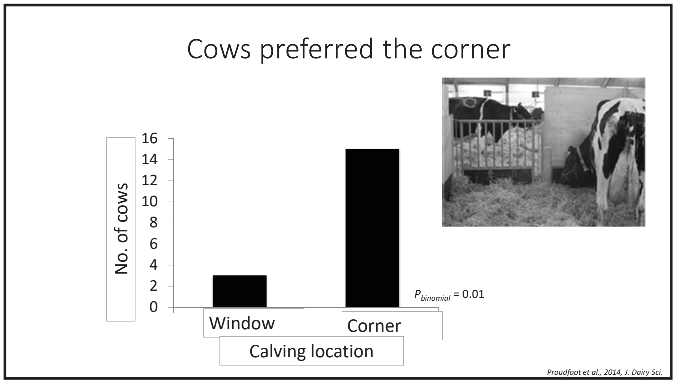
Proudfoot et al., 2014. J. Anim. Sci.



…But only if they calved during the daytime

Proudfoot et al., 2014. J. Anim. Sci.



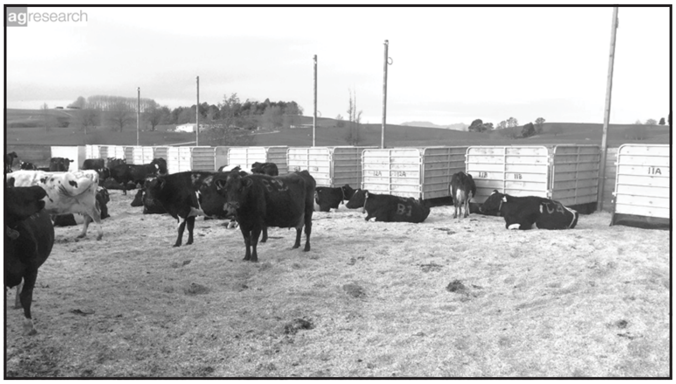


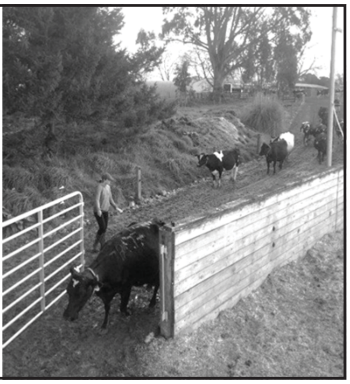
Cows preferred the corner

Proudfoot et al., 2014, J. Dairy Sci.

Photo courtesy of Dr. Ken Nordlund, University of Wisconsin-Madison

Photo courtesy of [illegible] Chapman and Vander Made Dairy, Ohio





- ✓ 101 cows enrolled before to calving
- ✓ **Daytime**: Pasture
- ✓ **Overnight**: randomized cows into one of 2 pads

Thank You!

Projects conducted at Dairy New Zealand were supported by AgResearch

Funding for the UBC Animal Welfare Program provided by the Natural Sciences and Engineering Council, Dairy Farmers of Canada and others listed at www.landfood.ubc.ca/animalwelfare/

Projects conducted in Denmark were supported by the Danish Ministry of Food, Agriculture and Fisheries for funding (2009-2012).

Effect of the Intrauterine Dextrose Infusion at non-Pregnancy Diagnosis on Fertility of Repeat Breeder Lactating Dairy Cows

Bas S., Barragan A.A., Pineiro J., Menincetti B., Schuenemann G.M.
Department of Veterinary Preventive Medicine
The Ohio State University

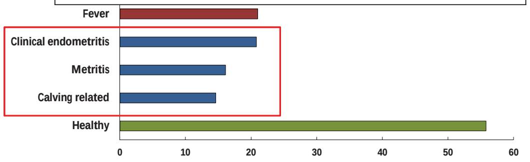
Factors Affecting Reproductive Performance in Dairy Cows

- Reproductive performance is affected by multiple factors

- Nutrition (Curtis et al., 1985)
- Cow comfort (Huzzey et al., 2006)
- Uterine diseases (LeBlanc et al., 2002; Sheldon et al., 2006)
- Mastitis (Santos et al., 2004; Ahmadzadeh et al., 2009)
- Lameness (Collick et al., 1989)
- Heat stress (Wolfenson et al., 2000)
- Compliance to synch protocols (Galvão et al., 2011; Schuenemann et al., 2011)
- AI technique (Bas et al., 2011)
- Hygiene score at calving (Schuenemann et al., 2011)

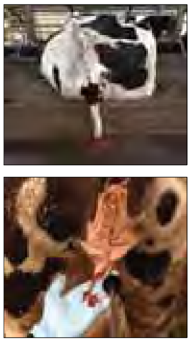
Incidence of Health Disorders in the First 60 Days Postpartum in Lactating Dairy Cows

	Cyclic (%)	*P*	Pregnant (%)	*P*	Loss (%)	*P*
Healthy	84.1	---	51.4	---	8.9	---
1 Case of Disease	80.0	0.83	43.3	0.001	13.9	<0.001
> 1 Case of Disease	70.7	0.001	34.7	<0.001	15.8	<0.001



Santos et al. (2010) Soc. Reprod. Fertil. 67:387-403

Treatment of Uterine Diseases



- **Conventional:**
  - Antibiotics: ceftiofur, ampicillin, penicillin, etc.
  - Hormones: prostaglandin & prostaglandin analogues
  - Others: flushing of the uterus with antiseptic solutions, dextrose infusion, uterflush infusion, ozone, etc.

Intrauterine Dextrose Therapy in Lactating Dairy Cows with Clinical Endometritis

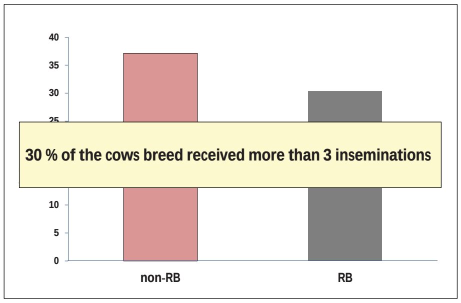
	Cows with PVD			
	CON (n = 491)	DEX (n = 456)	Cows without PVD (n = 1905)	P- value
Cycling cows[1] (%)	42.9 ± 2.9^{c}	53.8 ± 2.9^{b}	65.6 ± 2.5^{a}	<0.0001
First-service PAI for cows with PVD only (%)	22.7 ± 2^{b}	29.8 ± 2^{a}	—	0.01
First-service PAI for all cows (%)	22.5 ± 2^{c}	29.2 ± 2^{b}	37.0 ± 1^{a}	<0.0001
Pregnancy loss[2] (%)	8.9 ± 1^{a}	8.4 ± 1^{a}	5.6 ± 0.5^{b}	0.03

[1] The proportions (%; LSM ± SEM) of cycling lactating dairy cows based on serum concentrations of P4 were reported. Blood samples were collected from cows diagnosed with and without PVD at exam 1 (26 ± 3 DIM) and exam 2 (at 40 ± 3 DIM)

[2] The proportion of pregnancy losses between the pregnancy diagnosis (40 ± 3 d post-AI) and parturition (e.g., pregnant cows that returned to estrus, abortion) for cows with and without.

Maquivar et al. (2015), J. Dairy Sci. 98:3876-86

Pregnancies Per AI in Repeat and non-Repeat Breeder Dairy Cows



30 % of the cows breed received more than 3 inseminations

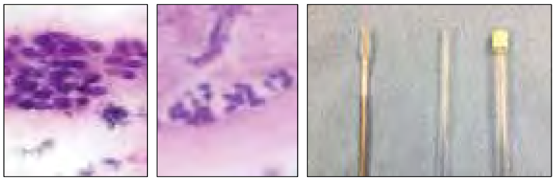
52,331 inseminations in lactating dairy cows from 11 herds

Repeat Breeder Dairy Cows

- Repeat breeders (RB), are cows without clinically detectable reproductive disorders that regularly cycle every 17 to 25 days and that fail to become pregnant after three or more inseminations/services (Yusuf et al., 2010)
- The prevalence of RB cattle in dairy operations ranges between 5% and 36% and accounts for approximately 26.3% of culled dairy cattle in the US (Perez-Marin et al., 2012)
- Many factors such as inadequate estrous detection, nutritional deficiencies, hormonal imbalances, diseases, AI technique, among others have been associated with RB cattle

Subclinical Endometritis

- Inflammation of the endometrium
- Diagnosed by cytology – neutrophils
- Affects 40 to 50% of lactating dairy cows being the most prevalent uterine disease
- Proposed as one of the main conditions leading to RB



Comparison Between Cytology and Histopathology to Evaluate SCE in Dairy Cows

	Diagnostic Method		
	In vivo cytology*	EV-CB*	Histopathology*
PMN cells[a]	1.50 ± 2.72	1.81 ± 2.53	4.44 ± 6.61
SCE prevalence (sample)[b]	18.75%	25%	37.11%
SCE prevalence (uterus)[c]	18.75%	37.50%	59.38%

[a] PMN cells mean and standard deviation.
[b] For individual locations (n = 256 in EV-CB and PMN-total).
[c] The whole uterus considered SCE-positive if greater than or equal to one location was considered positive (n = 32).

- A higher prevalence of SCE was observed using histopathology
- Cytology had a low/moderate sensitivity and a high specificity as a diagnostic method for SCE
- There is an uneven distribution of PMN cells throughout the endometrium

Pascottini et al., 2016

Strategies to Improve Fertility on RB Dairy Cows

- Improve estrus detection
- GnRH administration at the time of AI
- hCG administration after AI
- Natural service vs. AI
- Resynchronization strategies
- Embryo transfer
- Cow comfort and cooling

Alternative Strategies

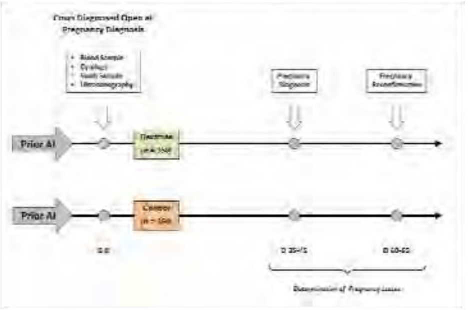
Effect of the Intrauterine Dextrose Infusion at non-Pregnancy Diagnosis on Fertility of Repeat Breeder Lactating Dairy Cows

Objective & Hypothesis

Objective1: assess the effect of the intrauterine infusion of a 50% dextrose solution on subsequent fertility of lactating dairy cows diagnosed open. The working *hypothesis* is that the intrauterine treatment with a 50% dextrose solution will improve pregnancies per AI in lactating dairy cows when compared to untreated controls

Objective2: estimate the prevalence of subclinical endometritis at the time of non-pregnancy diagnosis in repeat breeder and non-repeat breeder lactating dairy cows. We *hypothesize* that the prevalence of SCE will be higher in repeat breeder when compared to non-repeat breeder lactating dairy cows.

Experimental Design

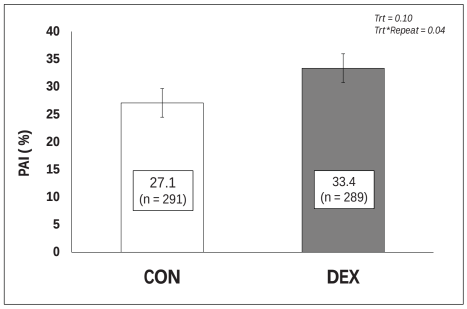


Preliminary Data (ongoing...)

	N	LACT	DIM	TBRD[1]	REP[2]	CL[3]	BCS	SCE[4]
CONT	291	2.1	176.4	2.9	50.0	84	2.9	13
DEXT	289	2.2	170.4	2.8	43.9	83	2.9	14

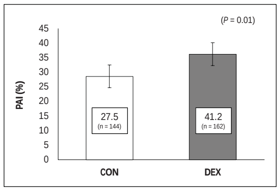
[1] Average number of services
[2] Number of repeat breeder cows (≥ 3 services)
[3] Number of cows with a corpus luteum (CL)
[4] Number of cows diagnosed with subclinical endometritis (SCE; ≥ 3 % polymorphonuclear cells)

Overall PAI



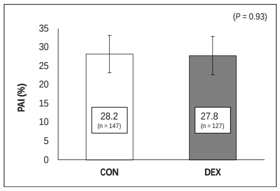
PAI – Repeat vs. non-Repeat

Effect of treatment (DEX vs. CON) on PAI in non-repeat breeder dairy cows[1]



[1] Cows that received less tan 3 inseminations

Effect of treatment (DEX vs. CON) on PAI in repeat breeder dairy cows[2]



[2] Cows that received 3 or more inseminations

Conclusions

- The cytological prevalence of SCE was not different between treatment groups
- Overall no difference in PAI was observed between cows treated with DEX and CON cows
- PAI were increased by almost 14 percentages points in non-repeat breeder cows treated with DEX when compared to CON

ACKNOWLEDGEMENTS

- Collaborating dairy farms
- Undergraduate students
- Drs. Bond, DeBruin and de Haan
- Department of Veterinary Preventive Medicine Food Animal Service

The Ohio State University

Thank You

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College of Veterinary Medicine
Dept. of Veterinary Preventive Medicine

The impact of clinical outbreaks of salmonellosis in calves on recovery of *Salmonella* from lymph nodes at harvest

Lohendy Munoz-Vargas, DVM, MPH

January 06, 2017
Ohio Dairy Veterinarians

Why Salmonella?

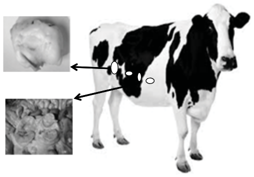
Major cause of morbidity and mortality

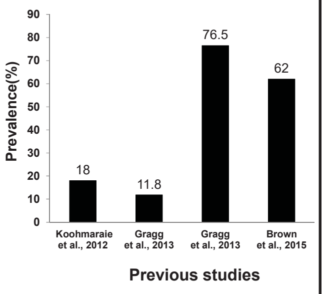
- ✓ 1.4 million human cases annually
- ✓ Serovars causing outbreaks in cattle are associated with human cases
- ✓ 95% cases caused by contaminated food

Is a clean carcass sufficient?

- ✓ **Among outbreaks attributed to ground beef, 45% are caused by *Salmonella* between 2002 and 2011** (Laufer et al., 2015)
- ✓ **Flank, chuck, round sirloin used as ground beef (plus fat, fascia, trimmed tissues, and lymph nodes)**

Lymph nodes harbor Salmonella





Why veal calves?

1. **Veal calves have high incidence of salmonellosis**
2. **Unknown prevalence in lymph nodes**
3. **Access to a vertically integrated system**

From farm to slaughter

Short production cycle
Slaughtered around 5-6 months of age

Hypothesis

1. Higher prevalence of *Salmonella* in feces and lymphatic tissues of veal calves from farms with a recent outbreak compared to farms with non reported outbreak

2. Indistinguishable genotypes of *Salmonella* isolates with similar antimicrobial susceptibility phenotypes recovered on farm and from lymphatic tissues.

Study design

a) Prospective cohort study

- 4 veal farms
- 40 calves per farm
- Sampled at **farm and slaughter**

b) Cross sectional

- Opportunistic sampling
- Recent salmonellosis outbreak with clinical isolates
- 2 veal farms
- 40 calves per farm sampled **at slaughter**

Sample collection

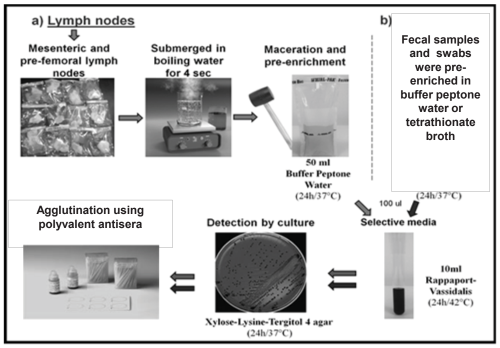
Fecal samples at farm → Fecal swabs at slaughter → Mesenteric lymph node → Pre-femoral lymph node

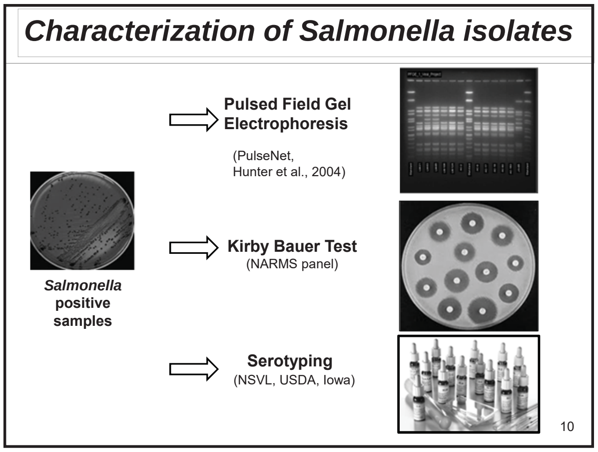
4 gram of feces

At harvest, fecal samples and mesenteric lymph nodes were collected from GI tract after evisceration

Laboratory protocol

Fecal samples and lymph nodes were processed for *Salmonella* isolation





Characterization of Salmonella isolates

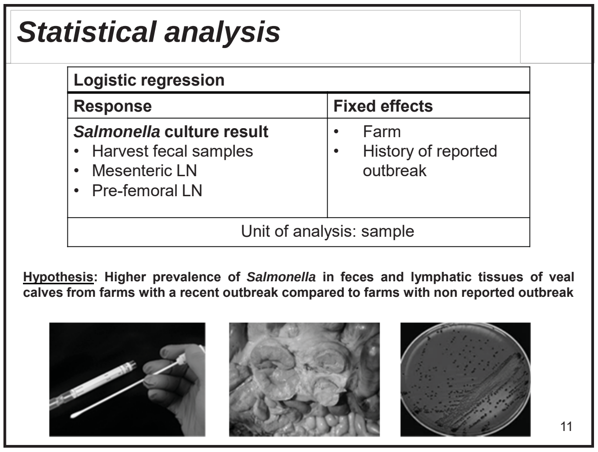
Salmonella positive samples

Pulsed Field Gel Electrophoresis

(PulseNet,
Hunter et al., 2004)

Kirby Bauer Test
(NARMS panel)

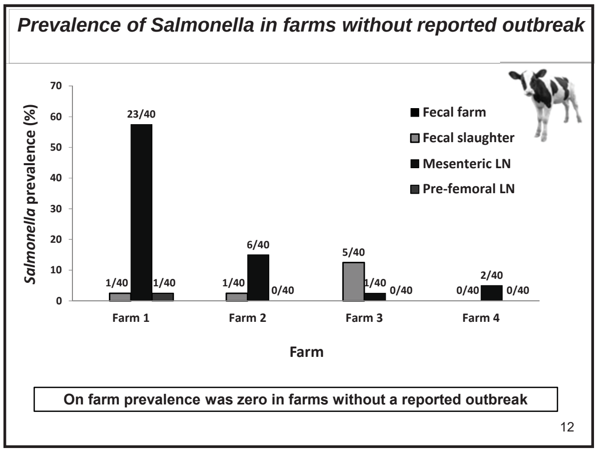
Serotyping
(NSVL, USDA, Iowa)



Statistical analysis

Logistic regression	
Response	**Fixed effects**
***Salmonella* culture result** • Harvest fecal samples • Mesenteric LN • Pre-femoral LN	• Farm • History of reported outbreak
Unit of analysis: sample	

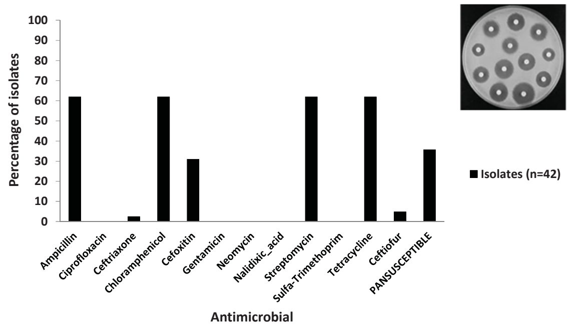
Hypothesis: Higher prevalence of *Salmonella* in feces and lymphatic tissues of veal calves from farms with a recent outbreak compared to farms with non reported outbreak



Prevalence of Salmonella in farms without reported outbreak

On farm prevalence was zero in farms without a reported outbreak

Antimicrobial resistance

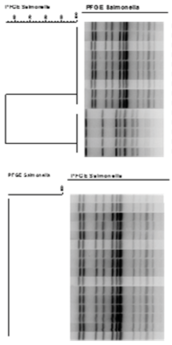


36% (15/42) isolates were classified as pansusceptible

Pulsed field gel electrophoresis

Serotype Typhimurium

Serotype Hartford



Sample type	Farm
Mesenteric lymph node	Non outbreak.1
Mesenteric lymph node	Non outbreak.1
Mesenteric lymph node	Non outbreak.1
Mesenteric lymph node	Non outbreak.1
Mesenteric lymph node	Non outbreak.1
Mesenteric lymph node	Non outbreak.1
Mesenteric lymph node	Non outbreak.1
Mesenteric lymph node	Non outbreak.1
Mesenteric lymph node	Non outbreak.1
Mesenteric lymph node	Non outbreak.2
Mesenteric lymph node	Non outbreak.2
Mesenteric lymph node	Non outbreak.2
Mesenteric lymph node	Non outbreak.2
Mesenteric lymph node	Non outbreak.2

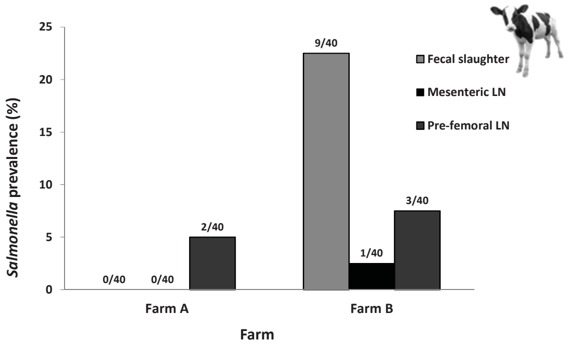
Distinguishable patterns and different serotypes between farms

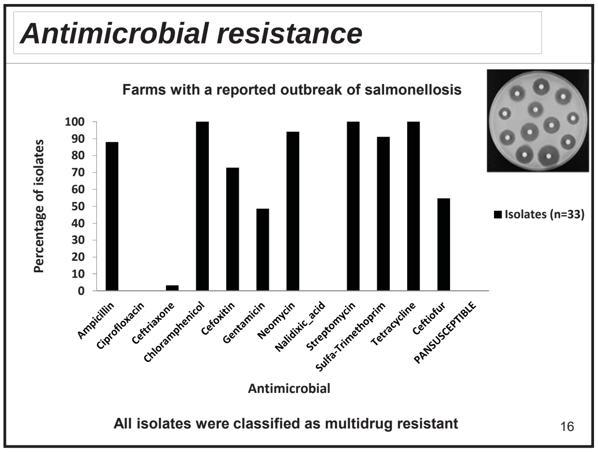
Serotype Typhimurium

Sample type	Farm
Fecal slaughter	Non outbreak . 1
Mesenteric lymph node	Non outbreak . 1
Mesenteric lymph node	Non outbreak . 1
Mesenteric lymph node	Non outbreak . 1
Mesenteric lymph node	Non outbreak . 1
Mesenteric lymph node	Non outbreak . 1
Mesenteric lymph node	Non outbreak . 1
Mesenteric lymph node	Non outbreak . 1
Mesenteric lymph node	Non outbreak . 1
Mesenteric lymph node	Non outbreak . 1
Mesenteric lymph node	Non outbreak . 1
Mesenteric lymph node	Non outbreak . 1
Mesenteric lymph node	Non outbreak . 1
Mesenteric lymph node	Non outbreak . 1
Mesenteric lymph node	Non outbreak . 1
Pre-femoral lymph node	Non outbreak . 1

Indistinguishable patterns and same serotype in samples within farm

Prevalence of Salmonella in farms with reported outbreak

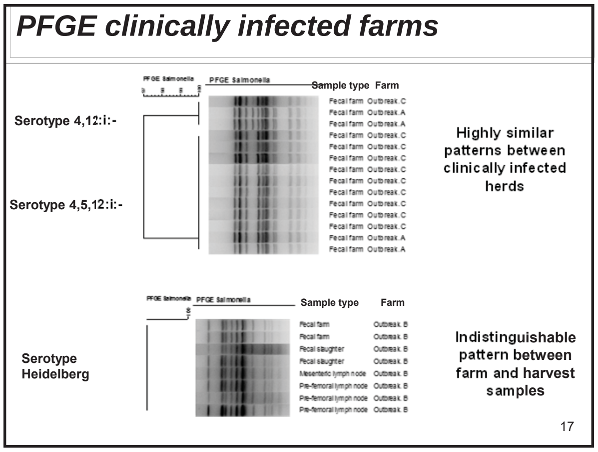




Antimicrobial resistance

Farms with a reported outbreak of salmonellosis

All isolates were classified as multidrug resistant



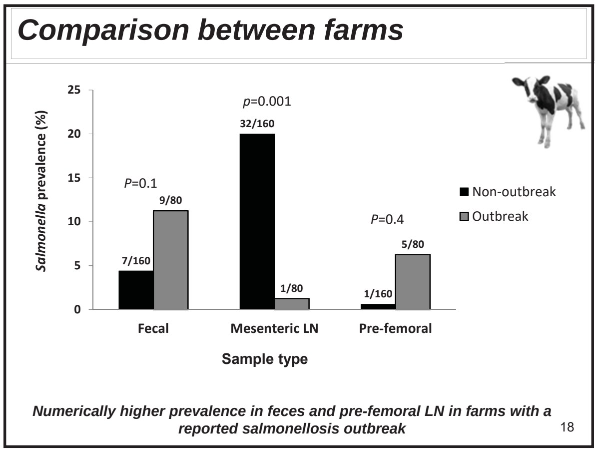
PFGE clinically infected farms

Sample type	Farm
Fecal farm	Outbreak.C
Fecal farm	Outbreak.A
Fecal farm	Outbreak.A
Fecal farm	Outbreak.C
Fecal farm	Outbreak.C
Fecal farm	Outbreak.C
Fecal farm	Outbreak.C
Fecal farm	Outbreak.C
Fecal farm	Outbreak.C
Fecal farm	Outbreak.C
Fecal farm	Outbreak.C
Fecal farm	Outbreak.C
Fecal farm	Outbreak.A
Fecal farm	Outbreak.A

Highly similar patterns between clinically infected herds

Sample type	Farm
Fecal farm	Outbreak. B
Fecal farm	Outbreak. B
Fecal slaughter	Outbreak. B
Fecal slaughter	Outbreak. B
Mesenteric lymph node	Outbreak. B
Pre-femoral lymph node	Outbreak. B
Pre-femoral lymph node	Outbreak. B
Pre-femoral lymph node	Outbreak. B

Indistinguishable pattern between farm and harvest samples



Comparison between farms

Numerically higher prevalence in feces and pre-femoral LN in farms with a reported salmonellosis outbreak

Conclusions

1. **Indistinguishable patterns between *Salmonella* isolates found in feces, mesenteric and pre-femoral LN**
2. **Farms with recent outbreak had numerically higher prevalence of *Salmonella* in pre-femoral LN and feces at slaughter**
3. **Highly pathogenic serotypes that cause disease in humans have been propagated between some veal farms causing clinical infections and were recovered from pre-femoral LN.**

College of Veterinary Medicine
Dept. of Veterinary Preventive Medicine

Thank you!

Dr. Greg Habing (Advisor)
Dr. Marty Masterson

Sarah Finney
Holden Hutchinson
Dr. Arati Sharma

All farmers and slaughter personnel

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TERRANCE M. ARTHUR,* DAYNA M. BRICHTA-HARHAY, JOSEPH M. BOSILEVAC, MICHAEL N. GUERINI, NORASAK KALCHAYANAND, JAMES E. WELLS, STEVEN D. SHACKELFORD, TOMMY L. WHEELER, AND MOHAMMAD KOOHMARAIE. 2008. Prevalence and Characterization of Salmonella in Bovine Lymph Nodes Potentially Destined for Use in Ground Beef. Journal of Food Protection, Vol. 71, No. 8, 2008, Pages 1685–1688

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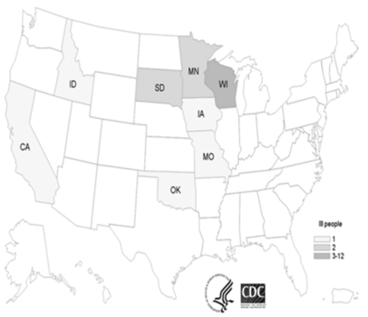
Why Salmonella?

Number of *Salmonella* isolates from healthy dairy cows, clinically affected cattle, and humans in 2007, by serotype

Healthy Cows (NAHMS)	Clinical Cattle (NVSL)	Humans (CDC)
Serotype	**Serotype**	**Serotype**
Cerro	Newport	Typhimurium
Kentucky	Typhimurium	Enteritidis
Montevideo	Orion var. 15+,34+	Newport
Mbandaka	Dublin	Heidelberg
Meleagridis	Montevideo	Javiana

Reference: USDA, APHIS. 2011. *Salmonella, Listeria, and Campylobacter on U.S. Dairy Operations, 1996–2007*

Why Salmonella?



S. Heidelberg outbreak 2016	
State	**#People**
California	1
Iowa	1
Idaho	1
Missouri	1
Oklahoma	1
Minnesota	2
South Dakota	2
Wisconsin	12
Total	21

CDC, Posted on November 28, 2016

Comparison between farms

Serotypes found in this study

Farms without oubreak report	Farms with outbreak report
Hartforf	4,[5],12:i:-
Cerro	4,12:i:-
Newport	Heidelberg
Typhimurium	Typhimurium

THE OHIO STATE UNIVERSITY

Ohio Dairy Veterinarians Meeting
1-6-17

Assessment of Daily Activity Patterns and Biomarkers of Pain, Inflammation and Stress in Lactating Dairy Cows Diagnosed with Clinical Metritis

**A.A. Barragan[1], J.M. Piñeiro[1], G.M. Schuenemann[1], P. J. Rajala-Schultz[1],
D.E. Sanders[2], S.Bas[1]**
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Outline

- Background:
  - Pain
  - Attitudes of Cattle Practitioners to Pain
  - Assessment of Pain and Stress in Cattle
  - Activity Patterns and Substance P
  - Metritis
- Objectives and Hypothesis
- Materials and Methods
- Experimental Design
- Results
- Conclusions

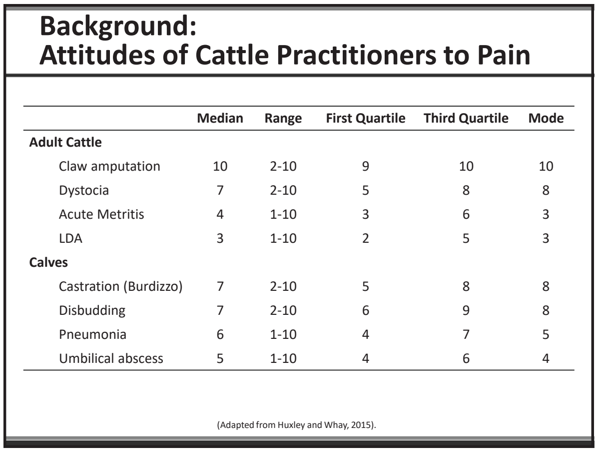
Background: Pain

International Association for the Study of Pain (IASP)

"An unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage"

"The inability to communicate verbally does not negate the possibility that an individual is experiencing pain and is in need of appropriate-pain relieving treatment"

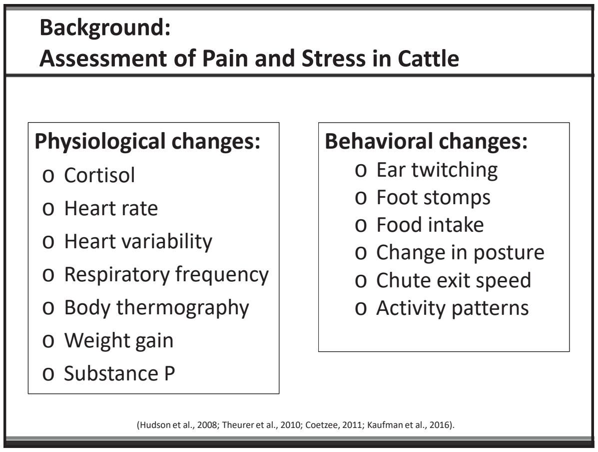
(http://www.iasp-pain.org/Education/Content.aspx?ItemNumber=1698)



Background: Attitudes of Cattle Practitioners to Pain

	Median	Range	First Quartile	Third Quartile	Mode
Adult Cattle					
Claw amputation	10	2-10	9	10	10
Dystocia	7	2-10	5	8	8
Acute Metritis	4	1-10	3	6	3
LDA	3	1-10	2	5	3
Calves					
Castration (Burdizzo)	7	2-10	5	8	8
Disbudding	7	2-10	6	9	8
Pneumonia	6	1-10	4	7	5
Umbilical abscess	5	1-10	4	6	4

(Adapted from Huxley and Whay, 2015).



Background: Assessment of Pain and Stress in Cattle

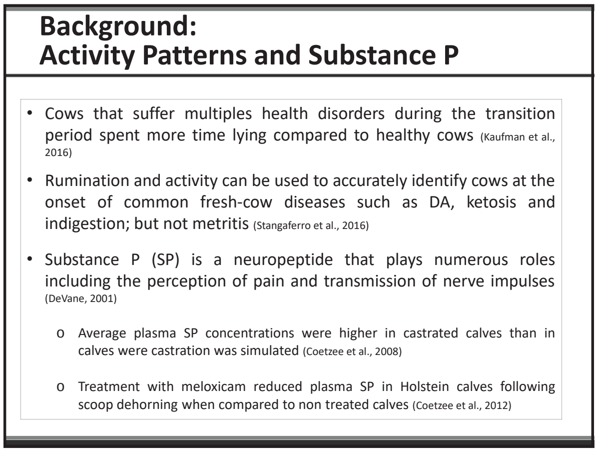
Physiological changes:

- Cortisol
- Heart rate
- Heart variability
- Respiratory frequency
- Body thermography
- Weight gain
- Substance P

Behavioral changes:

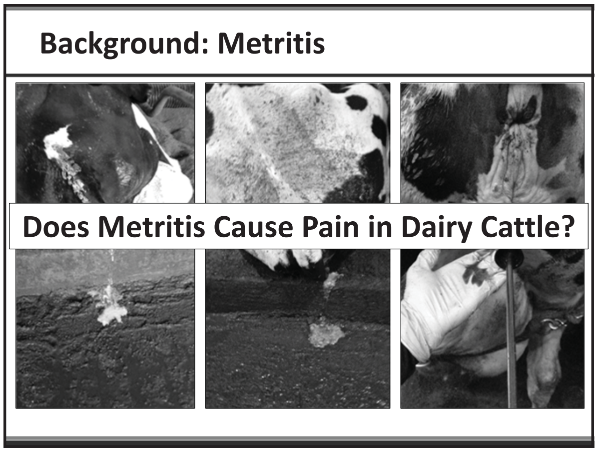
- Ear twitching
- Foot stomps
- Food intake
- Change in posture
- Chute exit speed
- Activity patterns

(Hudson et al., 2008; Theurer et al., 2010; Coetzee, 2011; Kaufman et al., 2016).



Background: Activity Patterns and Substance P

- Cows that suffer multiples health disorders during the transition period spent more time lying compared to healthy cows (Kaufman et al., 2016)
- Rumination and activity can be used to accurately identify cows at the onset of common fresh-cow diseases such as DA, ketosis and indigestion; but not metritis (Stangaferro et al., 2016)
- Substance P (SP) is a neuropeptide that plays numerous roles including the perception of pain and transmission of nerve impulses (DeVane, 2001)
  - Average plasma SP concentrations were higher in castrated calves than in calves were castration was simulated (Coetzee et al., 2008)
  - Treatment with meloxicam reduced plasma SP in Holstein calves following scoop dehorning when compared to non treated calves (Coetzee et al., 2012)



Background: Metritis

Does Metritis Cause Pain in Dairy Cattle?

Background: Metritis

- Metritis is defined by the presence of reddish or brownish foul smelling uterine discharge with or without pyrexia (Sheldon et al., 2006)
- Metritis prevalence can range from 15 % to 20 % in dairy herds (Gilbert et al., 2016)
- Metritis affects the profitability of dairy farms:
  - Milk yield (Rajala and Gröhn, 1998)
  - Reproductive performance (Erb et al., 1981; Fourichon et al., 2000; Galvão et al., 2009)
  - Culling rate (Gröhn et al., 2003)
  - Behavior (Huzzey et al., 2007; Titler et al., 2013)

Objectives and Hypothesis

Objectives:

1. Assess changes in daily activity patterns in lactating dairy cows diagnosed with clinical metritis
2. Assess circulating concentrations of biomarkers of pain (Substance P), inflammation (haptoglobin) and stress (cortisol) in lactating dairy cows diagnosed with clinical metritis

We hypothesized that cows with clinical metritis would have increased blood concentrations of biomarkers of pain, inflammation and stress, and altered activity patterns when compared to cows without clinical metritis

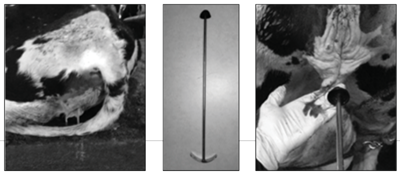
Materials and Methods

- Two conventional dairy farms in Ohio
- 200 lactating Holstein dairy cows
  - MET (n = 100): Cows diagnosed with clinical metritis
  - NO-MET (n = 100): Cows without metritis
- On farm computer records (DairyComp 305)
- DHIA milk yield records
- SAS (version 9.4; SAS Institute Inc., Cary, NC)
  - GLIMMIX procedure: Binomial variables
  - MIXED procedure: Continuous variables

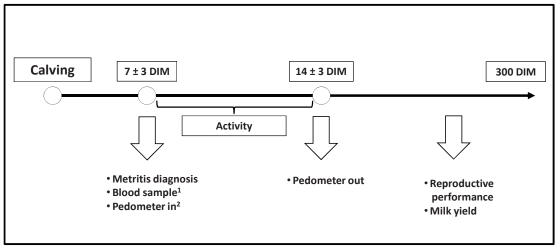
Materials and Methods

Metritis (MET): defined by presence of reddish or brownish foul smelling uterine discharge with or without pyrexia at 7 ± 3 DIM

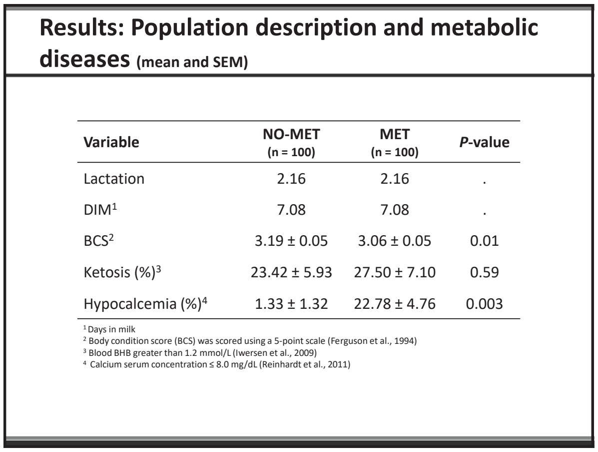
- Cows diagnosed with metritis (MET; n = 100) were matched to cows without metritis (NO-MET; n = 100) according to lactation number and DIM



Experimental Design



[1] Blood samples (substance P, haptoglobin, cortisol, BHBA, calcium and blood cells)
[2] Activity monitors (IceQube, IceRobotics, Edinburgh, UK)



Results: Population description and metabolic diseases (mean and SEM)

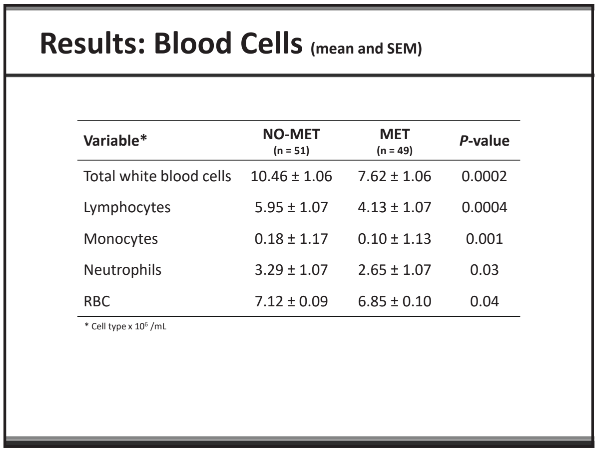
Variable	NO-MET (n = 100)	MET (n = 100)	*P*-value
Lactation	2.16	2.16	.
DIM[1]	7.08	7.08	.
BCS[2]	3.19 ± 0.05	3.06 ± 0.05	0.01
Ketosis (%)[3]	23.42 ± 5.93	27.50 ± 7.10	0.59
Hypocalcemia (%)[4]	1.33 ± 1.32	22.78 ± 4.76	0.003

[1] Days in milk

[2] Body condition score (BCS) was scored using a 5-point scale (Ferguson et al., 1994)

[3] Blood BHB greater than 1.2 mmol/L (Iwersen et al., 2009)

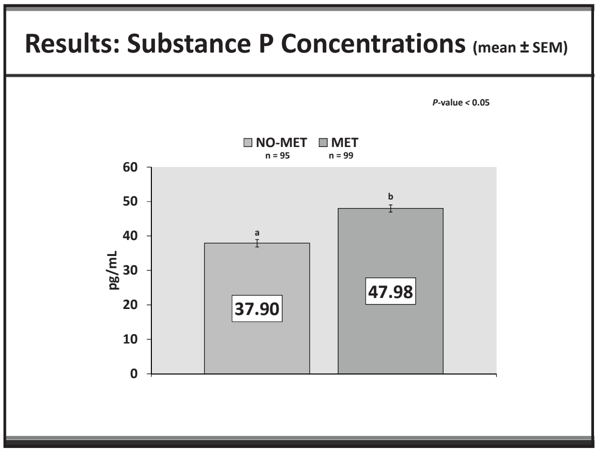
[4] Calcium serum concentration ≤ 8.0 mg/dL (Reinhardt et al., 2011)



Results: Blood Cells (mean and SEM)

Variable*	NO-MET (n = 51)	MET (n = 49)	*P*-value
Total white blood cells	10.46 ± 1.06	7.62 ± 1.06	0.0002
Lymphocytes	5.95 ± 1.07	4.13 ± 1.07	0.0004
Monocytes	0.18 ± 1.17	0.10 ± 1.13	0.001
Neutrophils	3.29 ± 1.07	2.65 ± 1.07	0.03
RBC	7.12 ± 0.09	6.85 ± 0.10	0.04

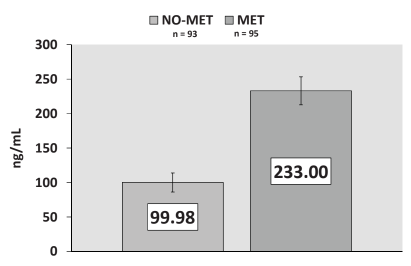
* Cell type x 10^6 /mL



Results: Substance P Concentrations (mean ± SEM)

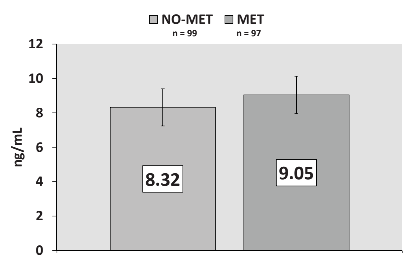
Results: Haptoglobin Concentrations (mean ± SEM)

P-value < 0.05



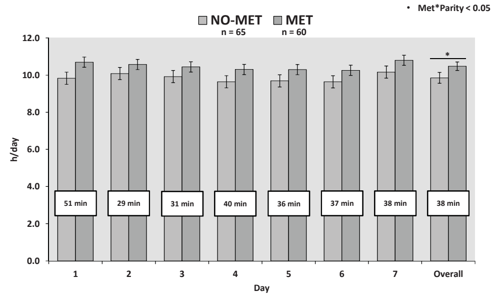
Results: Cortisol Concentrations (mean ± SEM)

P-value > 0.05



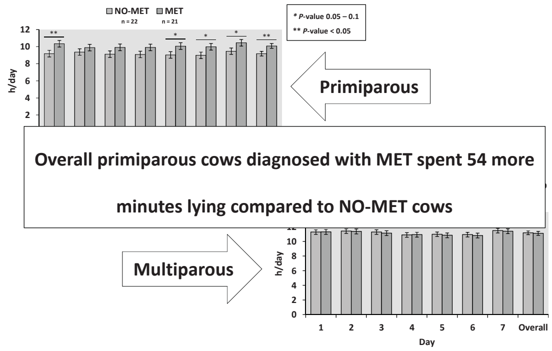
Results: Daily Lying Time (mean ± SEM)

- *Met* = 0.053
- Met*Parity < 0.05



n = 125

Results:
Lying Time – Primiparous vs Multiparous



* *P*-value 0.05 – 0.1
** *P*-value < 0.05

Primiparous

Overall primiparous cows diagnosed with MET spent 54 more minutes lying compared to NO-MET cows

Multiparous

Results: Other Activity Variables (mean ± SEM)

Variable	NO-MET	MET	*P*-value
Steps[1]	1727 ± 1.04	1773 ± 1.03	0.49
Lying bouts[2]	10 ± 1.04	11 ± 1.04	0.11
Lying bouts dur.[3]	61 ± 1.99	62 ± 2.07	0.91

[1] Number of steps (no./d)
[2] Number of lying bouts (no./d)
[3] Duration of lying bouts (min.)

Results: Production and Reproductive Performance (mean ± SEM)

Variable	NO-MET	MET	*P*-value
Milk Yield, 1st DHIA*	73.92 ± 2.4	71.16 ± 2.4	0.91
Milk Yield, 2nd DHIA*	78.52 ± 3.4	77.89 ± 3.4	0.78
Milk Yield, 3rd DHIA*	89.47 ± 9.4	88.68 ± 9.4	0.57
DIM to conception	104.11 ± 1.1	121.25 ± 1.1	0.02

*Pounds per day

Summary

- Circulating blood cells were increased in cows without MET compared to cows with MET
- Cows with MET had lower BCS compared to cows without MET
- There was a greater proportion of cows in the MET group that had hypocalcemia compared to NO-MET cows
- Biomarkers of pain (substance P) and inflammation (haptoglobin) were increased in MET cows compared to NO-MET cows
- MET group cows tended to spend more time lying and less time standing compared to NO-MET cows
- Primiparous cows with MET spend more time lying and less time standing compared to cows without MET
- DIM to conception was greater in MET group cows when compared to NO-MET cows

Conclusions

Metric parameters such as activity patterns (e.g., depression associated with sickness behavior) and circulating concentrations of biomarker of pain and inflammation have been used to assess welfare in food animals. Results from this study suggests that cows with metritis may experience discomfort due to pain and inflammation, and pain management may be required to improve animal welfare in dairy farms

Acknowledgements

- Ohio Dairy Producers Association Research Found
- Drs. Coutinho da Silva and Proudfoot
- Graduate and undergraduate students
- Collaborating dairy farms and personnel
- Department of Veterinary Preventive Medicine

OHIO DAIRY PRODUCERS ASSOCIATION

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Ohio Dairy Veterinary Meeting
1-7-17

Thank you

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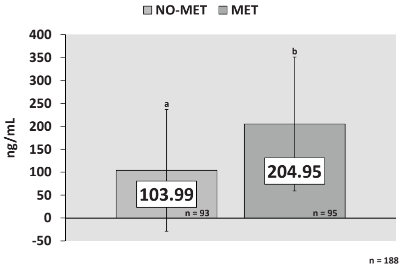
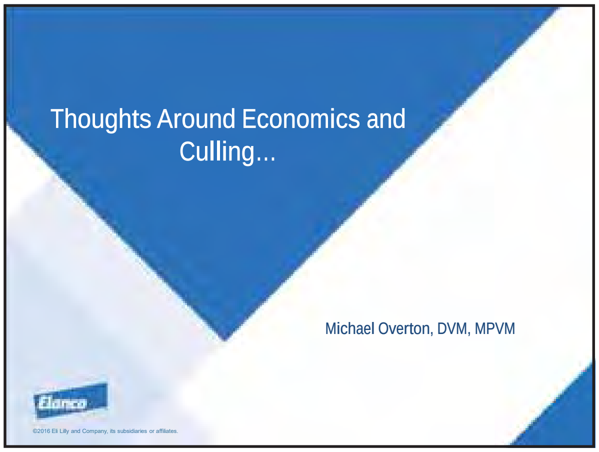
Results: Haptoglobin

***P*-value < 0.05**



Data analysis:

- Data was not normally distributed
- Data could not transformation could not achieved normality
- Kruskal-Wallis Test was performed



Thoughts Around Economics and Culling...

Michael Overton, DVM, MPVM

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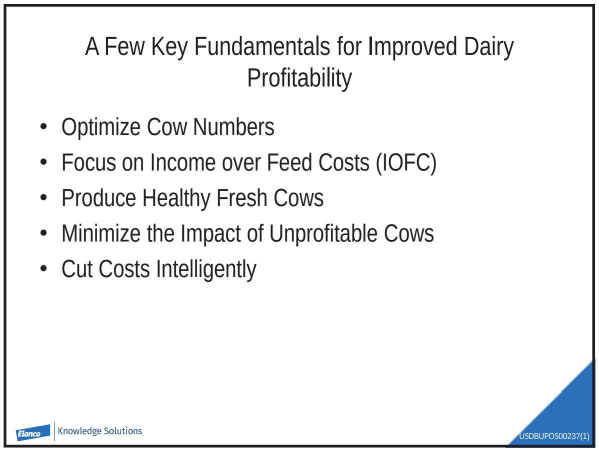
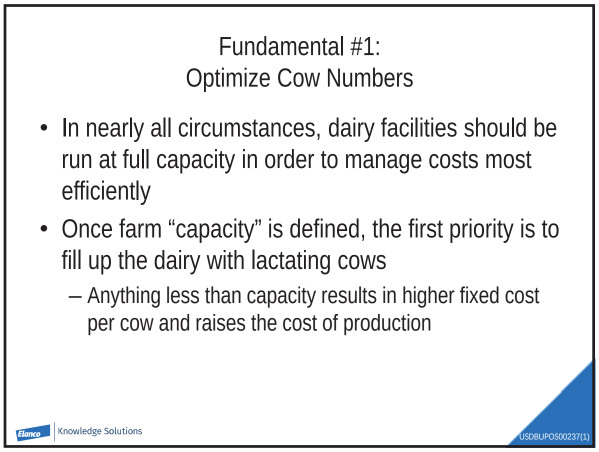


A Few Key Fundamentals for Improved Dairy Profitability

- Optimize Cow Numbers
- Focus on Income over Feed Costs (IOFC)
- Produce Healthy Fresh Cows
- Minimize the Impact of Unprofitable Cows
- Cut Costs Intelligently



Fundamental #1:
Optimize Cow Numbers

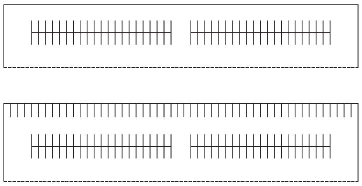
- In nearly all circumstances, dairy facilities should be run at full capacity in order to manage costs most efficiently
- Once farm “capacity” is defined, the first priority is to fill up the dairy with lactating cows
  - Anything less than capacity results in higher fixed cost per cow and raises the cost of production

Cow Slots

- A “slot” on a dairy is the space allocation for a single lactating cow
  - For a tie stall dairy – it is one stall
  - In a pasture dairy – depends on the rate of grass growth
  - For a free stall dairy – depends on many things:
    - # of beds in a pen
    - Amount of bunkspace
    - Amount of water access
    - Stage of lactation
    - Dairy preferences
    - Stocking density by pen

How Do We Express “Stocking Density”?

- Most commonly expressed as a percentage
  - Cows/feeding spots at the feed bunk
  - Cows/beds in a free stall system



Example:

- 2-row or 4-row
  - 100 cows
  - 102 feed slots (98%)
  - 80 stalls (125%)
- 3-row or 6-row
  - 130 cows
  - 102 feed slots (127%)
  - 131 stalls (99%)

There is No Easy Way of Determining the “Correct” Number of Cow Slots on Most Dairies

- Typically, it is done partially based on recommendations and partially based on experience
- Example for a 1000-cow (milking) herd maintained in a 4-row freestall housing system:
  - Fresh cow pen: 90% of feed bunk space (5 in 10 headlocks)
  - High cow pen and AI pens: 100% of feed bunk space (5 in 10 headlocks)
  - Pregnant cow and late lactation pens: 120% of feed bunk space (5 in 10 headlocks)

Cow “Slots”

- Once the dairy is “full”, the goal is to fill each “slot” with the most profitable cow possible but first priority is to fill up the cow slots
- Revenue is very dependent on how many cows are in milk AND on what kind of cow fills each slot
- Some expenses depend significantly on what cow is in a slot
  - Variable costs
    - Feed costs
    - Replacement costs
- Some expenses are largely independent of what cow is in a slot
  - Fixed costs
    - Labor, mortgage, interest, utilities, etc.
  - The focus for these fixed costs should be on cost control and making sure that savings here have minimal impact on cows

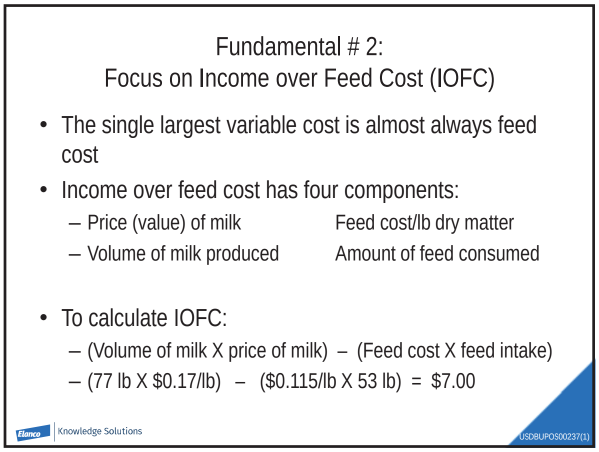
First Priority in Nearly all Circumstances… Fill up the available cow slots!

Assumptions: there are ~ 1000 cow slots for milking cows

Production	Current	Scenario A (full)	Scenario B (full+ more milk)
Lb of milk/cow/day	77.0	77.0	78.0
# of Cows in Milk	900	1,000	1,000
Milk price, $/lb	$0.17	$0.17	$0.17
Expenses			
Lb of feed/kg of marginal milk	0.42	0.42	0.42
Feed price, $/lb DM	$0.115	$0.115	$0.115
Maintenance feed cost/cow/day	$2.51	$2.51	$2.51
Variable feed cost per cow/day	$3.72	$3.72	$3.77
Total feed cost/cow/day	$6.23	$6.23	$6.27
Non-feed variable cost, $/lb	$0.003	$0.003	$0.003
Fixed non-feed cost/day for herd	$6,750	$6,750	$6,750
Milk sales, $/cow/day	$13.09	$13.09	$13.26
Fixed expenses, $/cow/day	$7.50	$6.75	$6.75
Variable expenses, $/cow/day	$6.46	$6.46	$6.51
Net income, $/cow/day	-$0.87	-$0.12	$0.00
Net income, $/herd/day	-$780	-$117	$2
Breakeven milk price, $/cwt	$0.181	$0.172	$0.170

Fundamental #1: Optimize Cow Numbers – Summary

- Often difficult to accurately determine the true, optimal cow capacity (or number of slots)
- Fixed costs are largely independent of which cow is in the slot
- Variable costs very much depend on which cow is in the slot
- First priority: fill up the dairy to dilute fixed costs and improve profit potential
  - Then, work to improve the quality of each cow in each slot



Fundamental # 2:
Focus on Income over Feed Cost (IOFC)

- The single largest variable cost is almost always feed cost
- Income over feed cost has four components:

– Price (value) of milk	Feed cost/lb dry matter
– Volume of milk produced	Amount of feed consumed

- To calculate IOFC:
  - (Volume of milk X price of milk) – (Feed cost X feed intake)
  - (77 lb X $0.17/lb) – ($0.115/lb X 53 lb) = $7.00

Elanco Knowledge Solutions

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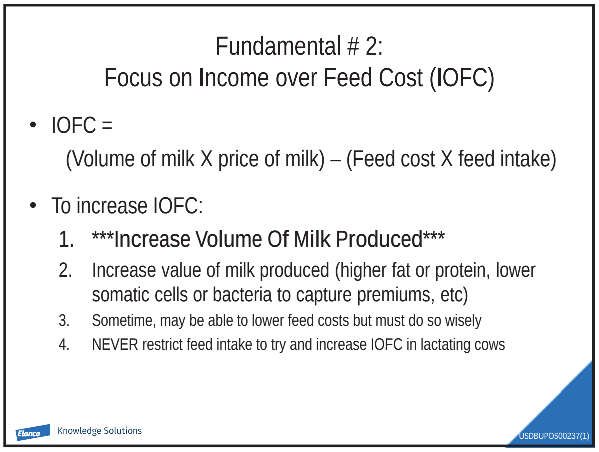

Fundamental # 2:
Focus on Income over Feed Cost (IOFC)

- IOFC =
  (Volume of milk X price of milk) – (Feed cost X feed intake)
- To increase IOFC:
  1. ***Increase Volume Of Milk Produced***
  2. Increase value of milk produced (higher fat or protein, lower somatic cells or bacteria to capture premiums, etc)
  3. Sometime, may be able to lower feed costs but must do so wisely
  4. NEVER restrict feed intake to try and increase IOFC in lactating cows

Elanco Knowledge Solutions

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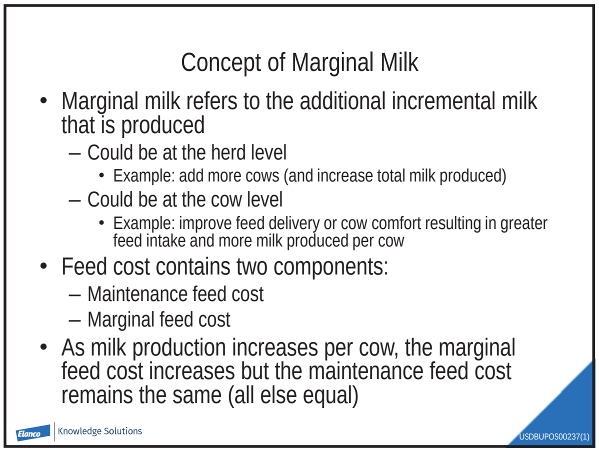

Concept of Marginal Milk

- Marginal milk refers to the additional incremental milk that is produced
  - Could be at the herd level
    - Example: add more cows (and increase total milk produced)
  - Could be at the cow level
    - Example: improve feed delivery or cow comfort resulting in greater feed intake and more milk produced per cow
- Feed cost contains two components:
  - Maintenance feed cost
  - Marginal feed cost
- As milk production increases per cow, the marginal feed cost increases but the maintenance feed cost remains the same (all else equal)

Elanco Knowledge Solutions

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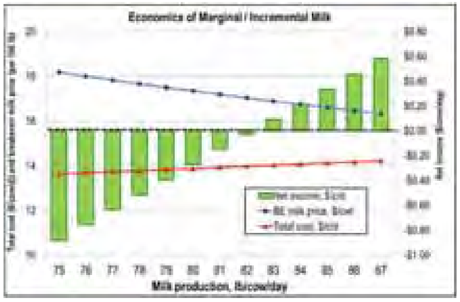
- When estimating the cost of incremental milk and feed, we do not have to consider maintenance feed - we only have to account for the energy required to produce the marginal milk
- To produce 1 liter of milk with 3.8% fat, 3.1% protein, and 4.8% lactose:
  - Each gram of fat requires 9.3 kcal gross energy: 38 g milk fat * 9.3 = 353 kcal
  - Each gram of protein requires 5.5 kcal gross energy: 31 g protein * 5.5 = 171 kcal
  - Each gram of lactose requires 4.0 kcal gross energy: 48 g lactose * 4.0 = 192 kcal
  - Total 716 kcal
- 716 kcal/ liter (or 321 kcal NE / lb) = 0.33 Mcal NE_L/lb marginal milk
- If TMR = 0.78 Mcal NE_L/lb, 1 lb TMR DM supports 0.78/0.33 = 2.42 lbs milk
- If feed cost = $0.12/lb, 1 lb marginal milk = $0.12/2.42 = $0.05 feed cost

(NRC. 2001. 7th ed. National Academy Press, Washington, p. 19.)

The Value of Incremental (Marginal) Milk

Economics of Marginal / Incremental Milk
Assumptions:

Production	Current	Scenario A	Scenario B
Pounds of milk/cow/day	76.0	80.0	90.0
Milk price, $/cwt	$16.50		
Expenses			
Pounds of feed/lb of milk	0.42		
Feed price, $/lb DM	$0.120		
Variable feed cost per cwt of milk	$5.04		
Other cost of marginal milk, $/cwt	$0.50		
Variable cost per cwt of milk	$5.54		
Fixed cost per cow per day	$9.00	$9.00	$9.00
Milk sales, $/cow/day	$12.54	$13.20	$14.85
Fixed expenses, $/cow/day	$9.00	$9.00	$9.00
Variable expenses, $/cow/day	$4.21	$4.43	$4.99
Net income, $/cow/day	-$0.67	-$0.23	$0.86
Breakeven milk price, $/cwt	$17.38	$16.79	$15.54



- As production increases from 75 to 87 lb/cow/day:
  - Total cost increases ($13.63 to $14.21/cow/day)
  - Breakeven milk price decreases ($18.17 to $16.33/ cwt)
  - Net income increases (-$0.88 to $0.58/cow/day)

Fundamental # 2:
Focus on Income over Feed Cost (IOFC) - Summary

- Feed cost is almost always the largest variable cost of production
- Work to improve IOFC primarily by increasing milk production – within a given set of circumstances, more milk is almost always more profitable
- Increasing marginal milk production (more milk/cow/day) leads to greater profitability:
  - Raises net income per cow
  - Lowers cost of feed per unit of milk (dilutes maintenance feed cost)
  - Lowers breakeven cost of production

Fundamental #3:
Produce Healthy Fresh Cows

- Cows experience many challenges when transitioning from non-lactating (dry) stage through calving and into lactation
- Much management attention and effort should be devoted to minimizing disease risk in these cows
- Consultants can play key roles in improving preventive strategies and monitoring progress towards improved profitability

Management in the Vital 90™ Days is Critical:
RISK, COSTS, and OPPORTUNITY

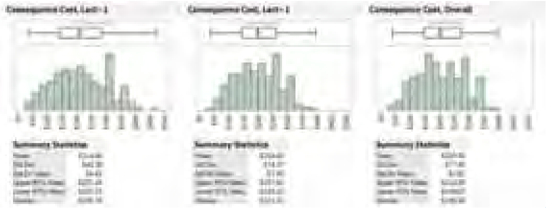
- *RISK*
  - The metabolic adaptation required for a successful new lactation is extraordinary
  - ALL transition dairy cows experience negative nutrient balance and immune dysfunction
  - Many adult dairy cow diseases are related to this challenge
  - 45-60% of cows experience one or more of the common transition cow problems such as metritis, mastitis, retained placenta, milk fever, etc[1]
  - Energy balance and immune dysfunction are at the root of these diseases

[1] Santos et al, Proc. 2013 Dairy Cattle Reproduction Council Conference, Indianapolis, IN, p 32-48 .

Consequence Costs During The Vital 90 Days

(Disease, Lost Milk, Culling Losses, Mortality Losses, Reproductive Losses)

The following information was based on 415 economic assessments performed between September 2013 and May 2016 by 107 consultants on herds across three global regions: North America, Latin America and Europe. More than 50% of the assessments (224) were performed in 2016.



Overton, M. W. 2016. Evaluating Periparturient Disease Costs in Dairy Cows Using dEconPro™in Poster abstract in proceedings of the XXIX World Buiatrics Congress, Dublin 2016.

Management in the Vital 90™ Days is Critical: *RISK, COSTS, and OPPORTUNITY*

- Opportunity:
  - With improved risk management and disease prevention efforts during The Vital 90 Days…
    - Reduced disease incidence
    - Lower treatment costs
    - Reduced mortality and culling
    - Higher milk production throughout lactation
    - Opportunity for improved reproductive performance
- Healthier transition cows = greater profit potential

Fundamental # 4:

Minimize the Impact of Unprofitable Cows

- Each dairy has an optimum inventory of cows that will optimize profitability
- Goal should be to fill each slot on a dairy with the cow that will make the dairy as profitable as possible
  - Much of the time, this means keeping the current cow (to dilute investment in replacement costs)
  - Other times, this means replacing the cow with one that is expected to be better (currently and over her lifetime)
- Key question: Is the value this slot brings to the dairy greater if I keep the *current cow* or if I replace her with an *average replacement heifer?*

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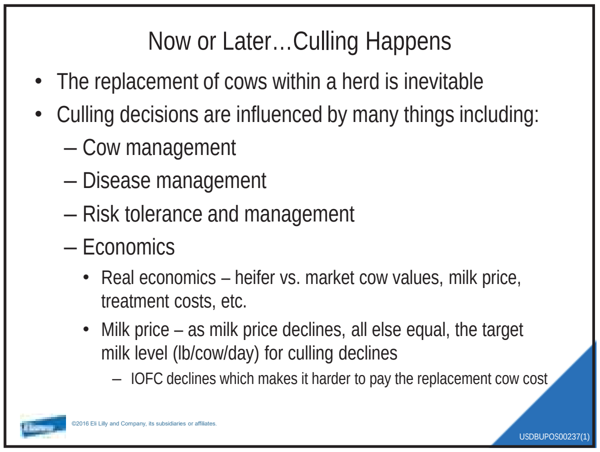

Now or Later…Culling Happens

- The replacement of cows within a herd is inevitable
- Culling decisions are influenced by many things including:
  - Cow management
  - Disease management
  - Risk tolerance and management
  - Economics
    - Real economics – heifer vs. market cow values, milk price, treatment costs, etc.
    - Milk price – as milk price declines, all else equal, the target milk level (lb/cow/day) for culling declines
      - IOFC declines which makes it harder to pay the replacement cow cost

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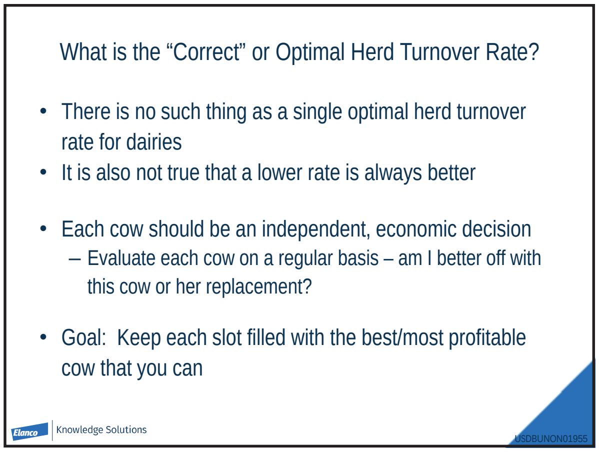

What is the "Correct" or Optimal Herd Turnover Rate?

- There is no such thing as a single optimal herd turnover rate for dairies
- It is also not true that a lower rate is always better
- Each cow should be an independent, economic decision
  - Evaluate each cow on a regular basis – am I better off with this cow or her replacement?
- Goal: Keep each slot filled with the best/most profitable cow that you can

Knowledge Solutions

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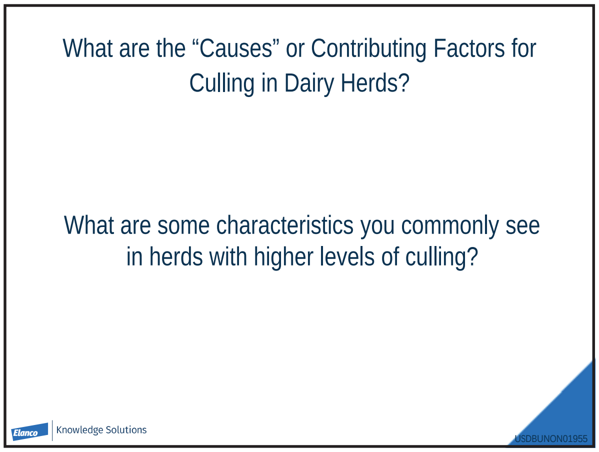

What are the "Causes" or Contributing Factors for Culling in Dairy Herds?

What are some characteristics you commonly see in herds with higher levels of culling?

Knowledge Solutions

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Characteristics of Herds That Have Higher Annual Turnover Rates…

- Usually have better reproductive performance in the cow herd
- Produce more replacement heifers (more efficient with “turning the system”)
  - More heifers calving (coming into a herd without expansion in cow numbers) means more cows leaving the herd as culls
- Have higher milk production

- Higher herd turnover or culling risk ≠ synonymous with more sick or lame cows

Herd Turnover Discussion

- What happens if springing heifers (replacements) are notably more expensive?
  - Does culling rate increase or decrease? Why?
- If milk price increases significantly (and is expected to stay high for a while), does culling increase or decrease?
  - Why?
  - Do you think herd turnover will be higher or lower than last year?
- What happened to herd turnover when beef cow prices were more than $1.00/lb?
- Culling at a herd level is fundamentally driven by economic and supply conditions

Thoughts about Culling

- At the single herd level:

  Starting inventory
  + New heifers calved (home raised or purchased)
  — Culls
  = Ending inventory

- If the herd is fairly stable, the herd turnover is about the same as the number of heifers available to calve, whether home raised or purchased

Convenience Sample from 7 Holstein Herds Across the US

		Herds							
Source	Measure	1	2	3	4	5	6	7	AVG
(EVENTS)	# Fresh	3270	1410	1832	6268	3247	6600	7058	4241
(EVENTS)	# Sold	1083	328	612	2041	1141	2202	2794	1457
(EVENTS)	# Died	185	103	35	225	167	569	391	239
	Total Culls	1268	431	647	2266	1308	2771	3185	1697
(ECON\ID)	Avg Inventory (M & D)	3140	1273	1717	5711	3011	6498	6451	3972
	Calculated Herd Turnover	40%	34%	38%	40%	43%	43%	49%	41%
	Mortality Risk	6%	8%	2%	4%	6%	9%	6%	6%
(EVENTS)	# Lactation = 1 Fresh	1198	529	650	2374	1308	2358	2644	1580
(ECON\ID)	Lactation = 1 Avg % of Herd (M & D)	42%	42%	38%	42%	43%	36%	41%	41%
	Fresh Events Over Avg Inventory	104%	111%	107%	110%	108%	102%	109%	107%

- Variation across herds but in general, # of first lactation animals coming into a herd = # of cull cows leaving herd
- Large factor is stable herd vs. herd expansion

Benchmarking:
How Does Culling on "My" Dairy Compare to Others?

- When people ask this question – what are they really asking?
  - Am I culling too much?
- The reason for asking is understandable, but the answer is complicated and comparing between herds may not be helpful
- For example: comparing sold and dead in the first 30 DIM
  - Herd A is close to a slaughter market and is very risk averse regarding cow mortality
  - Herd B does NOT have the same slaughter options, or wants to "save" more cows
    - Which one will have the higher mortality, assuming equal disease risk?
    - Which one will have the higher percent sold, assuming equal disease risk?

Benchmarking:
How Does Culling on "My" Dairy Compare to Others?

- Culling is fundamentally a cow-level economic decision
- Culling rates (herd turnover) vary between herds for both "good" and "bad" reasons:
  - Different economic conditions
  - Different health events
  - Different reproductive performance and heifer availability, etc.
- Often, a better question is - Am I culling too little?
- How many of your clients ask THAT question?

In My Opinion, There Is No Single Number That Can Measure Whether Culling On A Particular Dairy Is "Good" Or "Bad"

- There are strong economic (and ethical) incentives to reduce the rate at which cows lose value on a dairy and deserve to be culled
  - Good management seeks to mitigate and reduce those things that cause the value of a cow to decline
  - Ex: mastitis, metritis, lameness, DA, poor repro performance, etc.
- I much *prefer* to monitor transition disease issues and management factors that might contribute to them vs. measuring sold and dead cows AFTER the fact

Estimating Herd Turnover

- My approach to estimating herd turnover:

$$\frac{\text{\# of Culls (sold + died)}}{\text{Average Population at Risk (Milking + Dry)}}$$

This should be ~ equal to the following:

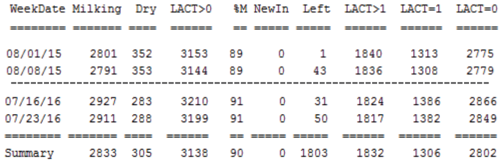
$$\frac{\textit{\# of New Cows Entering Herd (Calving + Purchases)}}{\textit{Average Population at Risk (Milking + Dry)}}$$

- Average population at risk estimation approach if the actual number by week or month is not available:

$$\frac{\text{(Initial population + Final Population)}}{2}$$

Estimating Average Inventory and Herd Turnover in DairyComp 305: An illustration

- Open up the demo herd file (Anonymous A)
- Type "ECON\ID" at the command prompt and hit enter
- Select start date, enter, end date, enter
- Do not change any of the events highlighted – just click "OK"
- Click on "Report" tab at bottom of screen



```
 WeekDate Milking  Dry  LACT>0   %M NewIn  Left  LACT>1  LACT=1  LACT=0
 ======== ======= ====  ======   == ===== =====  ======  ======  ======

08/01/15    2801  352    3153   89     0     1    1840    1313    2775
08/08/15    2791  353    3144   89     0    43    1836    1308    2779
 ------------------------------------------------------------------------
07/16/16    2927  283    3210   91     0    31    1824    1386    2866
07/23/16    2911  288    3199   91     0    50    1817    1382    2849
======== ======= ====  ======   == ===== =====  ======  ======  ======
Summary     2833  305    3138   90     0  1803    1832    1306    2802
```

What Should the Target Milk Level Be for Culling a DNB? (Culling with Replacement)

- Some people think: “As long as the cow is covering her costs, why cull her?”
  - “Breakeven” level of production: Revenue = Cost

Milk(lb) * Milk price/lb = (Maintenance feed(lb) + Marginal feed(lb)) * Feed cost/lb

(Where, Marginal feed = Milk (lb) * 0.47[1])

  - Simplified to:

$$\frac{\text{[Maintenance feed cost]}}{\text{[Milk price – marginal feed cost (per lb marginal milk)]}} = \text{Breakeven milk/d}$$

([1]Note: Ordinarily, this value is ~0.42 lb DM/marginal lb of milk, but in this case, a cow that is in later lactation is producing milk with higher solids)

What Should the Target Milk Level Be for Culling a DNB?

- Assumptions:
  - Maintenance energy requirement of ~16-17 Mcal NE_L/day
    - Maintenance requirements = 20 lb of feed if energy density = 0.78 Mcal NE_L/lb
  - It takes 0.47 lb feed dry matter to make 1 lb marginal milk (with higher solids)
  - Milk is $0.17/lb; lactating feed cost = $0.115/lb DM
  - “Breakeven” level of production:

$$\frac{\text{[Maintenance feed cost]}}{\text{[Milk price – marginal feed cost (per lb marginal milk)]}} = 20 \text{ lb milk/day}$$

- As milk price increases (decreases), the level of milk that a cow must produce to pay her variable costs decreases (increases):
  - At $0.22 milk, breakeven = 14 lb/day
  - At $0.14 milk, breakeven = 27 lb/day

In the Previous Example,

- Culling level of production for current example cow = 20 lb/day
- This approach focuses on trying to keep a cow as long as possible to derive as much profit from a *SPECIFIC* cow as possible
- Assumes:
  - No replacements are available or producer is unwilling/unable to buy one
  - Or, bad decision making…
- This approach is correct IF the alternative is an empty slot but a very expensive one if a replacement animal is available
  - Exact loss depends on how long the current cow is kept…
- BUT…is this really the decision that we want the dairy to make?

When to Replace a Cow That Has Been Identified for Culling

	Current Cow	Replacement
Projected 305d Milk, lb (lactation = 1)	xxx	24,000
Milk, lb/day	55.0	66.0
Milk, $/lb	$0.19	$0.17
Value, $/head	$750	$1,800
Annual herd turnover		35%
Expected life		2.9
Annual mortality risk		7%
Interest		8%
Maintenance feed, lb/day	20.0	20.0
Marginal milk feed, lb/lb of milk	0.47	0.42
Feed, lb	45.9	47.7
Feed, $/lb	$0.12	$0.12
Feed, $/day	$5.50	$5.73
IOFC	$4.95	$5.50
Replacement cost, $/day	$0.00	1.22
IOFC (incl. repl cost), $/day	$4.95	$4.27
Breakeven milk, lb	18.0	
Decline in milk/day, lb	0.17	
Days to breakeven	218	
Target level of milk to replace (lb/day)	49.9	
Target level of days to replace	29.7	
'Lost' IOFC if sold at breakeven milk. $/hd	$401.90	

- If the dairy kept the current cow until she reached her predicted absolute “breakeven”, it lost ~$400 of IOFC relative to replacing her at the target milk level

Culling Considerations for Cows within Herds

- Healthy, fresh or pregnant cows, adequate milk production – no consideration of culling these…
- Cows that are not pregnant and already designated as DNB (do not breed):
  - Regardless of previous level of production, once below “target milk”, strong consideration for culling
- Cows in breeding population: “How long do I keep trying to breed this cow?
  - Examine previous production history
  - Project when this cow will drop below target milk level
  - Estimate last day to breed and once past this day, make her a DNB and handle as above
- Low producing cows or cows with health problems
  - First, decide: do I really want to keep these cows?
  - If not, make them DNB and compare to target milk as above
  - Sometimes, this actually includes pregnant cows

Fundamental # 4:

Minimize the Impact of Unprofitable Cows - Summary

- Culling cows prematurely is very costly
- However, failing to cull cows appropriately is also costly
- Generally, it is easy to estimate the breakeven point for an individual cow’s profitability but this is not the desired approach
  - Simply too much lost opportunity due to keeping cow too long
- Carefully evaluate cows in herd on regular basis
- Stop breeding future cull cows
- Target milk for replacement is usually much higher than expected

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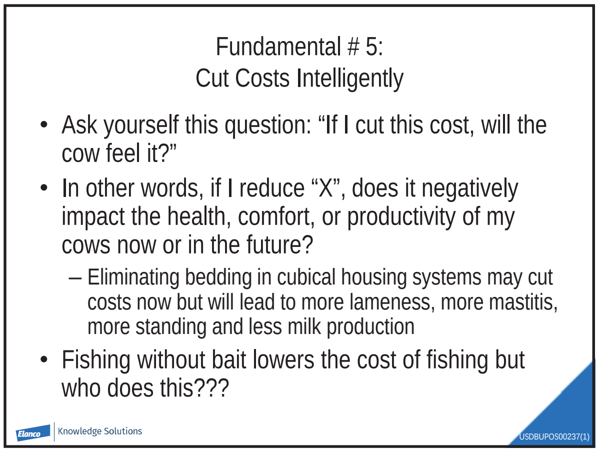
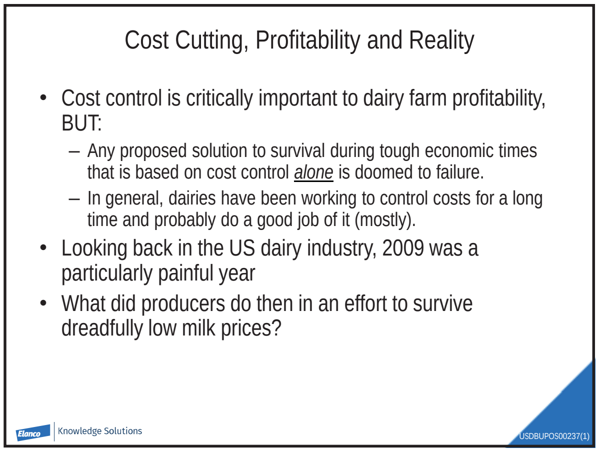


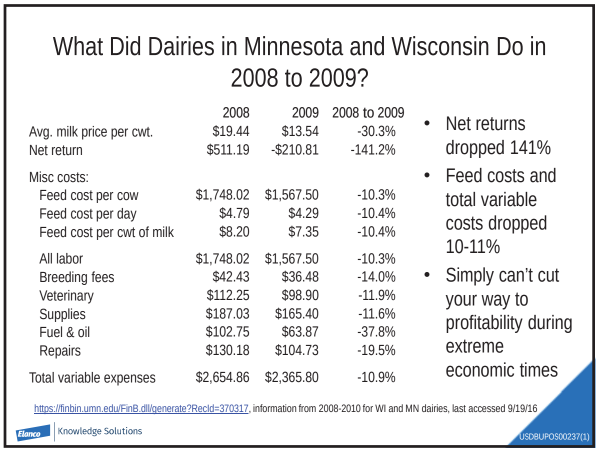
Fundamental # 5:
Cut Costs Intelligently

- Ask yourself this question: “If I cut this cost, will the cow feel it?”
- In other words, if I reduce “X”, does it negatively impact the health, comfort, or productivity of my cows now or in the future?
  - Eliminating bedding in cubical housing systems may cut costs now but will lead to more lameness, more mastitis, more standing and less milk production
- Fishing without bait lowers the cost of fishing but who does this???



Cost Cutting, Profitability and Reality

- Cost control is critically important to dairy farm profitability, BUT:
  - Any proposed solution to survival during tough economic times that is based on cost control *alone* is doomed to failure.
  - In general, dairies have been working to control costs for a long time and probably do a good job of it (mostly).
- Looking back in the US dairy industry, 2009 was a particularly painful year
- What did producers do then in an effort to survive dreadfully low milk prices?

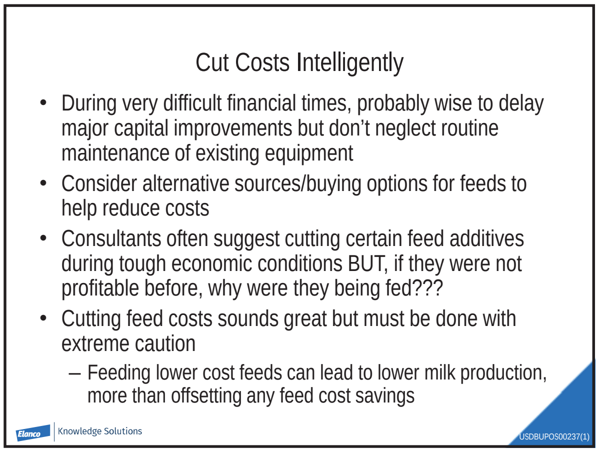


What Did Dairies in Minnesota and Wisconsin Do in 2008 to 2009?

	2008	2009	2008 to 2009
Avg. milk price per cwt.	$19.44	$13.54	-30.3%
Net return	$511.19	-$210.81	-141.2%
Misc costs:			
Feed cost per cow	$1,748.02	$1,567.50	-10.3%
Feed cost per day	$4.79	$4.29	-10.4%
Feed cost per cwt of milk	$8.20	$7.35	-10.4%
All labor	$1,748.02	$1,567.50	-10.3%
Breeding fees	$42.43	$36.48	-14.0%
Veterinary	$112.25	$98.90	-11.9%
Supplies	$187.03	$165.40	-11.6%
Fuel & oil	$102.75	$63.87	-37.8%
Repairs	$130.18	$104.73	-19.5%
Total variable expenses	$2,654.86	$2,365.80	-10.9%

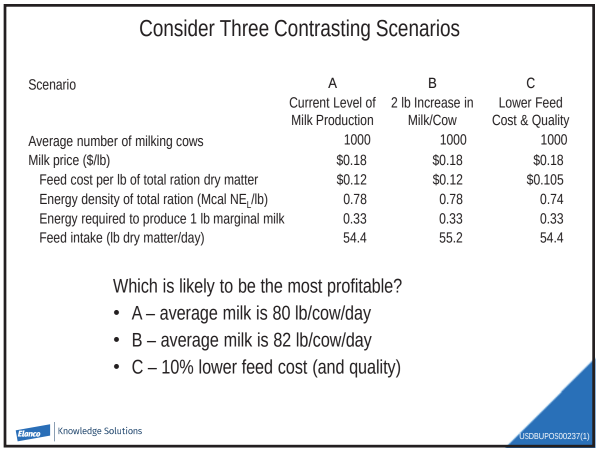
- Net returns dropped 141%
- Feed costs and total variable costs dropped 10-11%
- Simply can’t cut your way to profitability during extreme economic times

https://finbin.umn.edu/FinB.dll/generate?RecId=370317, information from 2008-2010 for WI and MN dairies, last accessed 9/19/16



Cut Costs Intelligently

- During very difficult financial times, probably wise to delay major capital improvements but don't neglect routine maintenance of existing equipment
- Consider alternative sources/buying options for feeds to help reduce costs
- Consultants often suggest cutting certain feed additives during tough economic conditions BUT, if they were not profitable before, why were they being fed???
- Cutting feed costs sounds great but must be done with extreme caution
  - Feeding lower cost feeds can lead to lower milk production, more than offsetting any feed cost savings

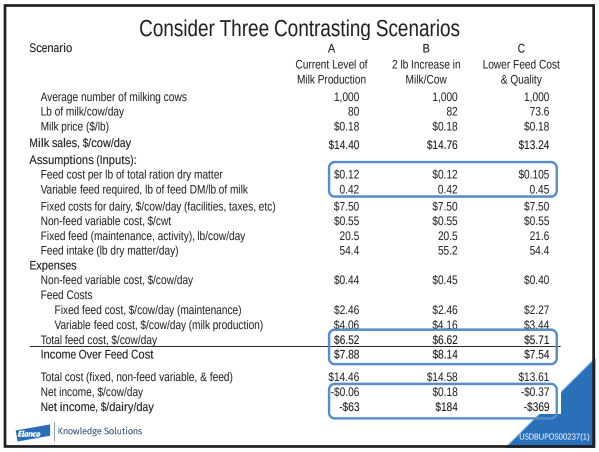


Consider Three Contrasting Scenarios

Scenario	A Current Level of Milk Production	B 2 lb Increase in Milk/Cow	C Lower Feed Cost & Quality
Average number of milking cows	1000	1000	1000
Milk price ($/lb)	$0.18	$0.18	$0.18
Feed cost per lb of total ration dry matter	$0.12	$0.12	$0.105
Energy density of total ration (Mcal NE_L/lb)	0.78	0.78	0.74
Energy required to produce 1 lb marginal milk	0.33	0.33	0.33
Feed intake (lb dry matter/day)	54.4	55.2	54.4

Which is likely to be the most profitable?

- A – average milk is 80 lb/cow/day
- B – average milk is 82 lb/cow/day
- C – 10% lower feed cost (and quality)



Consider Three Contrasting Scenarios

Scenario	A Current Level of Milk Production	B 2 lb Increase in Milk/Cow	C Lower Feed Cost & Quality
Average number of milking cows	1,000	1,000	1,000
Lb of milk/cow/day	80	82	73.6
Milk price ($/lb)	$0.18	$0.18	$0.18
Milk sales, $/cow/day	$14.40	$14.76	$13.24
Assumptions (Inputs):			
Feed cost per lb of total ration dry matter	$0.12	$0.12	$0.105
Variable feed required, lb of feed DM/lb of milk	0.42	0.42	0.45
Fixed costs for dairy, $/cow/day (facilities, taxes, etc)	$7.50	$7.50	$7.50
Non-feed variable cost, $/cwt	$0.55	$0.55	$0.55
Fixed feed (maintenance, activity), lb/cow/day	20.5	20.5	21.6
Feed intake (lb dry matter/day)	54.4	55.2	54.4
Expenses			
Non-feed variable cost, $/cow/day	$0.44	$0.45	$0.40
Feed Costs			
Fixed feed cost, $/cow/day (maintenance)	$2.46	$2.46	$2.27
Variable feed cost, $/cow/day (milk production)	$4.06	$4.16	$3.44
Total feed cost, $/cow/day	$6.52	$6.62	$5.71
Income Over Feed Cost	$7.88	$8.14	$7.54
Total cost (fixed, non-feed variable, & feed)	$14.46	$14.58	$13.61
Net income, $/cow/day	-$0.06	$0.18	-$0.37
Net income, $/dairy/day	-$63	$184	-$369

Fundamental # 5:
Cut Costs Intelligently - Summary

- Cost control is very important to dairy farm profitability, but any proposed solution to survival during tough economic times that is based on cost control *alone* is doomed to failure.
- Cutting feed costs simply to lower the total cost of production is NOT the answer
  - Some opportunities might exist to lower feed costs but
  - Large scale cuts likely lead to reductions in milk production, negating any planned benefit

Overall Summary

- Market variability is significantly higher today than in the past
- In commodity markets, being low cost *per unit of production* is critical to business survival
- Five important fundamentals for consideration regarding the economic performance of dairies:
  - Optimize Cow Numbers
  - Focus on Income over Feed Costs (IOFC)
  - Produce Healthy Fresh Cows
  - Minimize the Impact of Unprofitable Cows
  - Cut Costs Intelligently
- Cutting expenses is good as long as it does not reduce milk production
  - The goal should be to reduce cost/cwt of milk produced NOT cost/cow

Thanks For Your Attention!

Questions?

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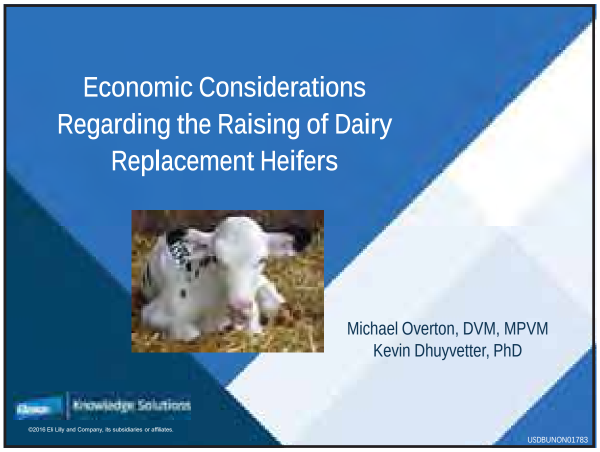

Economic Considerations Regarding the Raising of Dairy Replacement Heifers

Michael Overton, DVM, MPVM
Kevin Dhuyvetter, PhD

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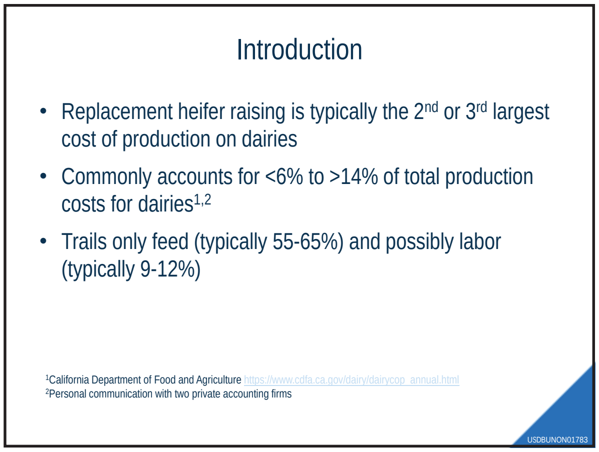
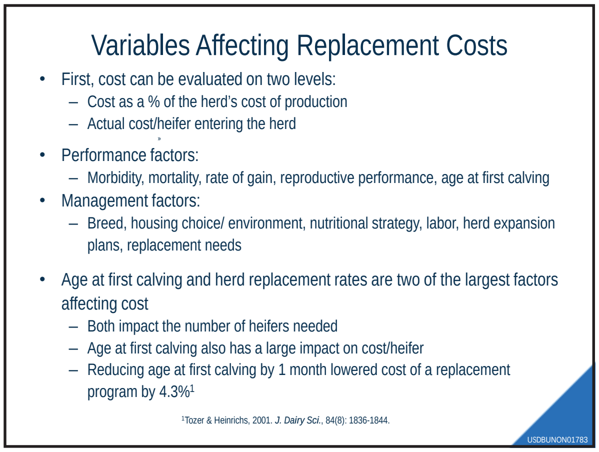


Introduction

- Replacement heifer raising is typically the 2nd or 3rd largest cost of production on dairies
- Commonly accounts for <6% to >14% of total production costs for dairies[1,2]
- Trails only feed (typically 55-65%) and possibly labor (typically 9-12%)

[1] California Department of Food and Agriculture https://www.cdfa.ca.gov/dairy/dairycop_annual.html

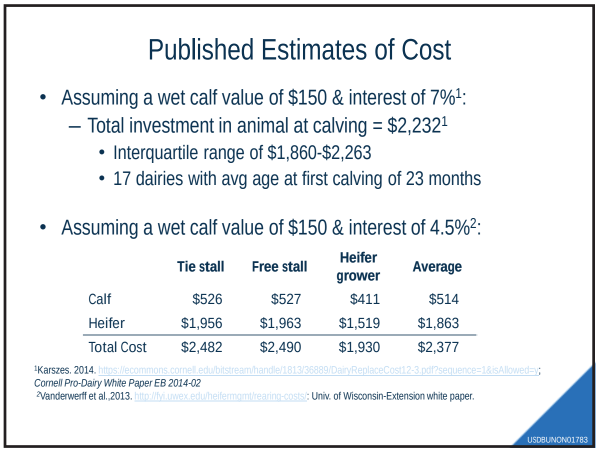
[2] Personal communication with two private accounting firms



Variables Affecting Replacement Costs

- First, cost can be evaluated on two levels:
  - Cost as a % of the herd's cost of production
  - Actual cost/heifer entering the herd
- Performance factors:
  - Morbidity, mortality, rate of gain, reproductive performance, age at first calving
- Management factors:
  - Breed, housing choice/ environment, nutritional strategy, labor, herd expansion plans, replacement needs
- Age at first calving and herd replacement rates are two of the largest factors affecting cost
  - Both impact the number of heifers needed
  - Age at first calving also has a large impact on cost/heifer
  - Reducing age at first calving by 1 month lowered cost of a replacement program by 4.3%[1]

[1] Tozer & Heinrichs, 2001. *J. Dairy Sci.*, 84(8): 1836-1844.



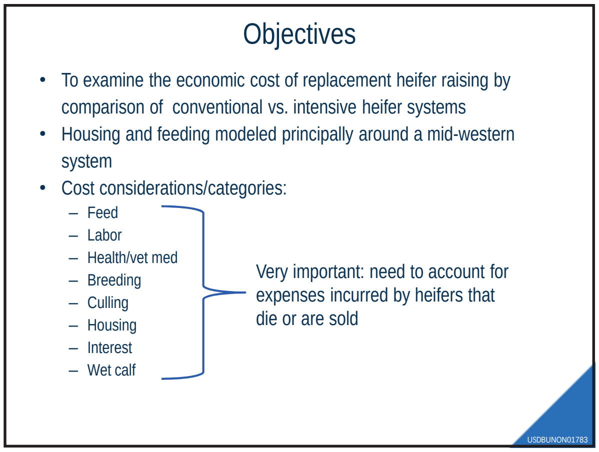
Published Estimates of Cost

- Assuming a wet calf value of $150 & interest of 7%[1]:
  - Total investment in animal at calving = $2,232[1]
    - Interquartile range of $1,860-$2,263
    - 17 dairies with avg age at first calving of 23 months
- Assuming a wet calf value of $150 & interest of 4.5%[2]:

	Tie stall	**Free stall**	**Heifer grower**	**Average**
Calf	$526	$527	$411	$514
Heifer	$1,956	$1,963	$1,519	$1,863
Total Cost	$2,482	$2,490	$1,930	$2,377

[1] Karszes. 2014. https://ecommons.cornell.edu/bitstream/handle/1813/36889/DairyReplaceCost12-3.pdf?sequence=1&isAllowed=y; *Cornell Pro-Dairy White Paper EB 2014-02*

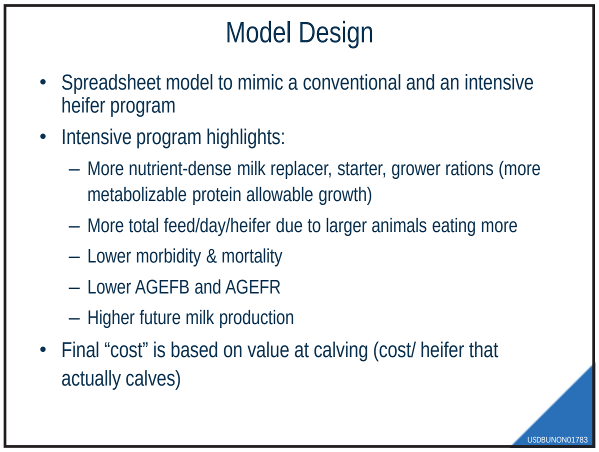
[2] Vanderwerff et al.,2013. http://fyi.uwex.edu/heifermgmt/rearing-costs/: Univ. of Wisconsin-Extension white paper.



Objectives

- To examine the economic cost of replacement heifer raising by comparison of conventional vs. intensive heifer systems
- Housing and feeding modeled principally around a mid-western system
- Cost considerations/categories:
  - Feed
  - Labor
  - Health/vet med
  - Breeding
  - Culling
  - Housing
  - Interest
  - Wet calf

Very important: need to account for expenses incurred by heifers that die or are sold



Model Design

- Spreadsheet model to mimic a conventional and an intensive heifer program
- Intensive program highlights:
  - More nutrient-dense milk replacer, starter, grower rations (more metabolizable protein allowable growth)
  - More total feed/day/heifer due to larger animals eating more
  - Lower morbidity & mortality
  - Lower AGEFB and AGEFR
  - Higher future milk production
- Final “cost” is based on value at calving (cost/ heifer that actually calves)

Model Design

- Feed:
  - Pre-weaning rations (milk replacer and starter grains) based upon published research
  - Post-weaning rations – built using Cornell Net Carbohydrate and Protein System; designed to meet growth targets by stage
- Housing[1-3]:
  - Age appropriate housing – hutch, small indoor group pens, large outdoor group pens, free stall, and bedded pack barn using published cost estimate/ft^2
- Labor[3,4]:
  - Hourly wage using published estimates by stage

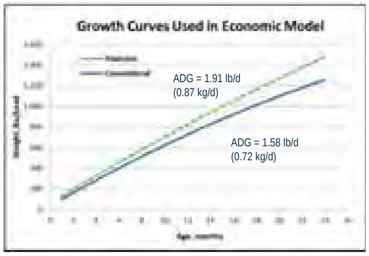
[1] Graves, R. E., Tyson, J. T., McFarland, D. F., & Wilson, T. H. 2008. Penn State Housing Plans for Calves and Heifers. *NRAES-201*: 278.
[2] Graves, R. E. 2006. http://extension.psu.edu/animals/dairy/news/2006/bedded-pack-barns-for-dairy-cattle Penn State Extension.
[3] Vanderwerff et al.,2013. http://fyi.uwex.edu/heifermgmt/rearing-costs/: Univ. of Wisconsin-Extension white paper.
[4] Karszes. 2014. https://ecommons.cornell.edu/bitstream/handle/1813/36889/DairyReplaceCost12-3.pdf?sequence=1&isAllowed=y;
Cornell Pro-Dairy White Paper EB 2014-02

The Model is Divided into *STAGES* Based on Major Management Needs (Feeding/ Housing/ Breeding)

Program	**Stage I** hutch calves	**Stage II**	**Stage III**	**Stage IV** prebreeding	**Stage V** postbreeding	**Stage VI** close-up
Conventional	Birth - 2 months	2 - 4 months	4 - 10 months	10.0 - 17.4 months	17.4 - 23.1 months	23.1 - 25.1 months
Intensive	Birth - 2 months	2 - 4 months	4 - 10 months	10.0 - 15.3 months	15.3 - 21.0 months	21.0 - 23.0 months

- Differences after 10 months are due to difference in age at first service
  - Based on different rates of growth prior to breeding (i.e, when they reach breeding size)

Growth Curves



Intensive:

Blend of private herd data (50%), 75th %ile (25%) & 95th %ile (25%)[1]

Conventional:

Average of median and 75th %ile[2]

DMI predictions based on NRC [3]:
NRC DMI = $(BW^{0.75}) *((-0.0466*NE_m^2)+(0.2435*NE_m)+(-0.1128))/Ne_m$

[1] Personal communication, Dr. Bob Corbett, unpublished data from Utah, 2011 and Penn State 2004 growth guidelines (http://www.das.psu.edu/research-extension/dairy/nutrition/heifers), accessed on February 2016
[2] Penn State 2004 growth guidelines (http://www.das.psu.edu/research-extension/dairy/nutrition/heifers), accessed on February 2016
[3] Nutrient Requirements of Dairy Cattle: Seventh Revised Edition, 2001: The National Academies Press; p. 6.

Growth Stages and Period-Specific Mortality Risks

Program	Stage I Birth – 2 mos	Stage II 2 – 4 mos	Stage III 4 – 10 mos	Stage IV 10 mos - breeding	Stage V Post breeding	Stage VI Final 2 mos)	Overall Mortality Risk
Conventional	7.0%	2.5%	1.0%	0.5%	0.3%	0.3%	11.5%
Intensive	3.0%	1.8%	0.5%	0.5%	0.3%	0.3%	6.3%

- •Mortality data adapted from NAHMS, 2007[1]
- •For intensive system, reductions in mortality were based on Corbett data[2] and clinical experience

[1] USDA. 2010. Dairy 2007, Heifer calf health and management practices on US dairy operations, 2007.

[2] Personal communication, Dr. Bob Corbett, unpublished data from Utah, 2011

Growth Stages and Period-Specific Morbidity Risk and Cost Estimates

Program	Stage I		Stage II	Stage III	Stage IV	Stage V	Stage VI
	Birth – 2 mos		2 – 4 mos	4 – 10 mos	10 mos - breeding	Postbreeding	Close-up
	Diarrhea	Respiratory	Respiratory	Any Treatment	Any Treatment	Any Treatment	Any Treatment
Conventional	40%	35%	15%	4.0%	2.0%	1.1%	0.8%
	$17.43		$4.10	$1.60	$1.37	$0.87	$0.73
Intensive	16%	14%	5%	2.0%	1.5%	0.8%	0.6%
	$6.97		$1.23	$0.80	$1.03	$0.65	$0.55

- •Morbidity data for conventional calves adapted and modified from NAHMS, 2007[1]
  - •Morbidity costs were estimated using standard tx protocols and reported medication costs
- •For intensive system, reductions in morbidity were based on Corbett data[2] and clinical experience

[1] USDA. 2010. Dairy 2007, Heifer calf health and management practices on US dairy operations, 2007.

[2] Personal communication, Dr. Bob Corbett, unpublished data from Utah, 2011

Quick reminder before looking at specific values…

- All costs, whether by growth stage, or in total, are adjusted to a "per surviving heifer" basis
  - i.e., with higher mortality rates, the remaining heifers must "carry" more expense
  - Hypothetical example (not considering initial calf value):
    - 10 calves enter hutches
    - 9 calves survive and move to next stage (actual cost = $297/ calf)
    - 1 calf dies the day before movement (total cost = $293)
    - Net cost/ surviving calf = (9*$297)+(1*$293)/ 9 = $329

Starting Assumptions

• Newborn heifer value	$200
• Birth weight	88 lbs
• Breeding weight	850 lbs (51” WH)
• Labor/ hr	$14
• Interest	6%
• AI cost/ service	$18
• Milk price	$18/ cwt

Milk Feeding Assumptions for Stage I:
24 hrs to 2 months (“hutch” calves)

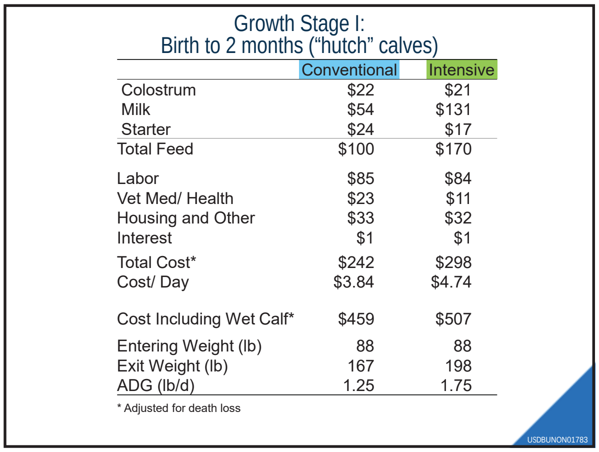
- Conventional :
  - 20/20 milk replacer
  - Cost: $53/50 lbs
  - Feeding rate: 1.0 lb/ gal
- Intensive:
  - 28/18 milk replacer
  - Cost: $68/50 lbs
  - Feeding rate: 1.25 lb/ gal

Stage	# of Days	Conventional: Amt/ d (gal)	Intensive: Amt/ d (gal)
1	7	1	1.25
2	35	1	1.75
3	7	1	0.875
Total	49 d	49 gal (49 lbs) (49 lbs)	76 gal (95 lbs) (95 lbs)
Avg gal/d		1	1.55
Total cost		$52	$129

Grain Feeding Assumptions for Stage I:
Birth to 2 months (“hutch” calves)

- Conventional
  - 20% CP starter (AF)
  - Cost: $295/ ton AF
- Intensive
  - 22% CP starter (AF)
  - Cost: $314/ ton AF

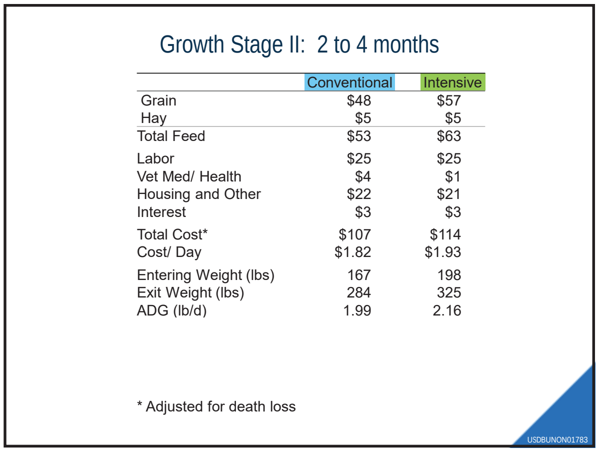
Stage	# of Days	Conventional: Amt/ d (lbs)		# of Days	Intensive: Amt/ d (lbs)
1	7	0.13		7	0.1
2	42	2.44		35	0.8
3	14	4.44		21	3.8
Total Feed	63	165		63	109
Total Cost		$23			$17



Growth Stage I:
Birth to 2 months ("hutch" calves)

	Conventional	Intensive
Colostrum	$22	$21
Milk	$54	$131
Starter	$24	$17
Total Feed	$100	$170
Labor	$85	$84
Vet Med/ Health	$23	$11
Housing and Other	$33	$32
Interest	$1	$1
Total Cost*	$242	$298
Cost/ Day	$3.84	$4.74
Cost Including Wet Calf*	$459	$507
Entering Weight (lb)	88	88
Exit Weight (lb)	167	198
ADG (lb/d)	1.25	1.75

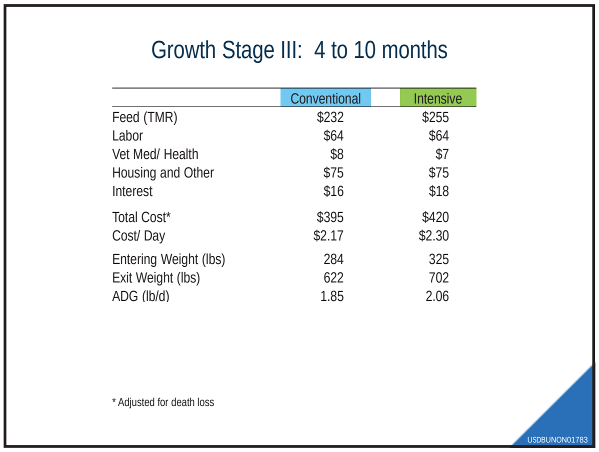
* Adjusted for death loss



Growth Stage II: 2 to 4 months

	Conventional	Intensive
Grain	$48	$57
Hay	$5	$5
Total Feed	$53	$63
Labor	$25	$25
Vet Med/ Health	$4	$1
Housing and Other	$22	$21
Interest	$3	$3
Total Cost*	$107	$114
Cost/ Day	$1.82	$1.93
Entering Weight (lbs)	167	198
Exit Weight (lbs)	284	325
ADG (lb/d)	1.99	2.16

* Adjusted for death loss



Growth Stage III: 4 to 10 months

	Conventional	Intensive
Feed (TMR)	$232	$255
Labor	$64	$64
Vet Med/ Health	$8	$7
Housing and Other	$75	$75
Interest	$16	$18
Total Cost*	$395	$420
Cost/ Day	$2.17	$2.30
Entering Weight (lbs)	284	325
Exit Weight (lbs)	622	702
ADG (lb/d)	1.85	2.06

* Adjusted for death loss

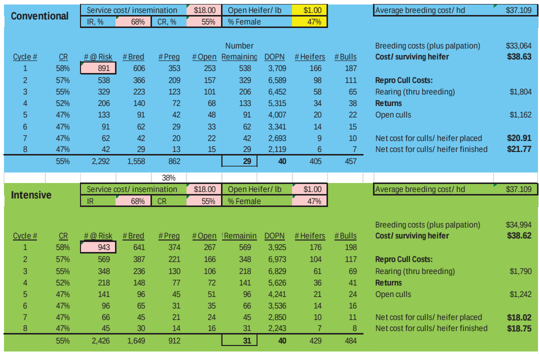
Growth Stage IV*:

Breeding	10.0 - 17.4 mo.	10.0 - 15.3 mo.
	Conventional	Intensive
Feed (TMR)	$303	$240
Labor	$63	$45
Vet Med/ Health	$3	$3
Breeding	$37	$37
Housing and Other	$30	$22
Interest	$35	$26
Total Cost	$471	$373
Cost/ Day	$2.10	$2.32
Entering Weight (lbs)	622	702
Exit Weight (lbs)	983	1,012
ADG (lb/d)	1.61	1.92

* Adjusted for death loss

*Duration of this stage depends on age at first service (a function of growth rate) and reproductive efficiency

Reproductive Management Costs



Conventional

Service cost/ insemination		$18.00	Open Heifer/ lb	$1.00	
IR, %	68%	CR, % 55%	% Female	47%	

Average breeding cost/ hd	$37.109

Cycle #	CR	# @ Risk	# Bred	# Preg	# Open	Number Remaining	DOPN	# Heifers	# Bulls
1	58%	891	606	353	253	538	3,709	166	187
2	57%	538	366	209	157	329	6,589	98	111
3	55%	329	223	123	101	206	6,452	58	65
4	52%	206	140	72	68	133	5,315	34	38
5	47%	133	91	42	48	91	4,007	20	22
6	47%	91	62	29	33	62	3,341	14	15
7	47%	62	42	20	22	42	2,693	9	10
8	47%	42	29	13	15	29	2,119	6	7
	55%	2,292	1,558	862		**29**	**40**	405	457
				38%					

Breeding costs (plus palpation)	$33,064
Cost/ surviving heifer	**$38.63**
Repro Cull Costs:	
Rearing (thru breeding)	$1,804
Returns	
Open culls	$1,162
Net cost for culls/ heifer placed	**$20.91**
Net cost for culls/ heifer finished	**$21.77**

Intensive

Service cost/ insemination		$18.00	Open Heifer/ lb	$1.00	
IR	68%	CR 55%	% Female	47%	

Average breeding cost/ hd	$37.109

Cycle #	CR	# @ Risk	# Bred	# Preg	# Open	Remainin	DOPN	# Heifers	# Bulls
1	58%	943	641	374	267	569	3,925	176	198
2	57%	569	387	221	166	348	6,973	104	117
3	55%	348	236	130	106	218	6,829	61	69
4	52%	218	148	77	72	141	5,626	36	41
5	47%	141	96	45	51	96	4,241	21	24
6	47%	96	65	31	35	66	3,536	14	16
7	47%	66	45	21	24	45	2,850	10	11
8	47%	45	30	14	16	31	2,243	7	8
	55%	2,426	1,649	912		**31**	**40**	429	484

Breeding costs (plus palpation)	$34,994
Cost/ surviving heifer	**$38.62**
Repro Cull Costs:	
Rearing (thru breeding)	$1,790
Returns	
Open culls	$1,242
Net cost for culls/ heifer placed	**$18.02**
Net cost for culls/ heifer finished	**$18.75**

Growth Stage V: Post-breeding to Close-up

Post-breeding	17.4 - 23.1 mo.	15.3 - 21.0 mo.
	Conventional	Intensive
Feed (TMR)	$293	$311
Labor	$37	$37
Vet Med/ Health	$2	$2
Repro Culls	-$39	-$42
Housing and Other	$24	$24
Interest	$39	$39
Total Cost	$356	$370
Cost/ Day	$2.05	$2.13
Entering Weight (lbs)	983	1,012
Exit Weight (lbs)	1,222	1,322
ADG (lb/d)	1.38	1.78

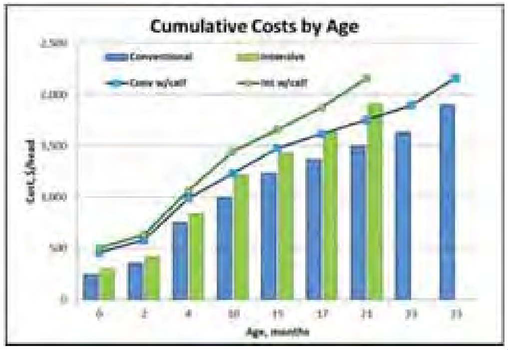
* Adjusted for death loss

Growth Stage VI: (Springers)

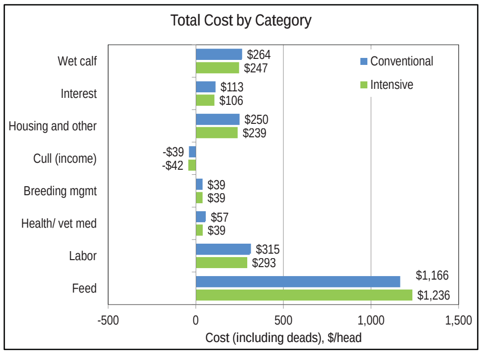
Springers	23.1 - 25.1 mo. Conventional	21.0 - 23.0 mo. Intensive
Feed (TMR)	$149	$159
Labor	$26	$26
Vet Med/ Health	$14	$14
Housing and Other	$57	$57
Interest	$16	$16
Total Cost	$261	$272
Cost/ Day	$4.29	$4.46
Entering Weight (lbs)	1,222	1,322
Exit Weight (lbs)	1,297	1,425
ADG (lb/d)	1.24	1.69

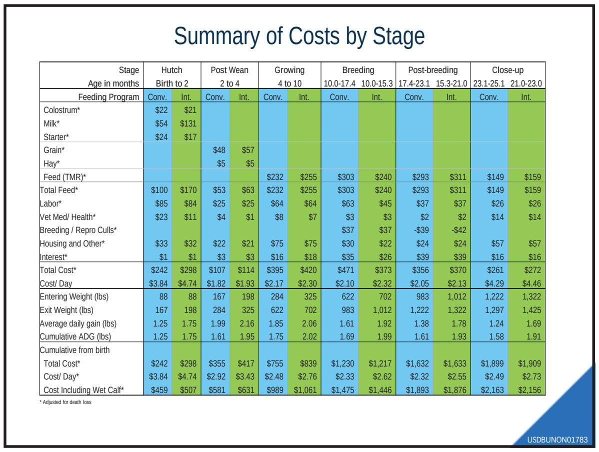
* Adjusted for death loss

Cumulative Cost Throughout the Rearing Period



Total Costs by Category

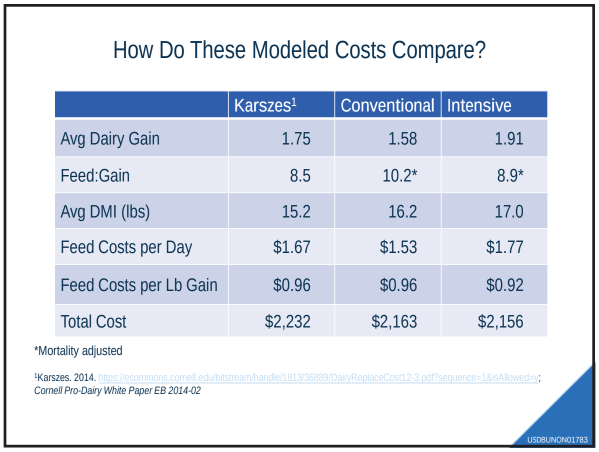




Summary of Costs by Stage

Stage	Hutch		Post Wean		Growing		Breeding		Post-breeding		Close-up	
Age in months	Birth to 2		2 to 4		4 to 10		10.0-17.4	10.0-15.3	17.4-23.1	15.3-21.0	23.1-25.1	21.0-23.0
Feeding Program	Conv.	Int.	Conv.	Int.	Conv.	Int.	Conv.	Int.	Conv.	Int.	Conv.	Int.
Colostrum*	$22	$21										
Milk*	$54	$131										
Starter*	$24	$17										
Grain*			$48	$57								
Hay*			$5	$5								
Feed (TMR)*					$232	$255	$303	$240	$293	$311	$149	$159
Total Feed*	$100	$170	$53	$63	$232	$255	$303	$240	$293	$311	$149	$159
Labor*	$85	$84	$25	$25	$64	$64	$63	$45	$37	$37	$26	$26
Vet Med/ Health*	$23	$11	$4	$1	$8	$7	$3	$3	$2	$2	$14	$14
Breeding / Repro Culls*							$37	$37	-$39	-$42		
Housing and Other*	$33	$32	$22	$21	$75	$75	$30	$22	$24	$24	$57	$57
Interest*	$1	$1	$3	$3	$16	$18	$35	$26	$39	$39	$16	$16
Total Cost*	$242	$298	$107	$114	$395	$420	$471	$373	$356	$370	$261	$272
Cost/ Day	$3.84	$4.74	$1.82	$1.93	$2.17	$2.30	$2.10	$2.32	$2.05	$2.13	$4.29	$4.46
Entering Weight (lbs)	88	88	167	198	284	325	622	702	983	1,012	1,222	1,322
Exit Weight (lbs)	167	198	284	325	622	702	983	1,012	1,222	1,322	1,297	1,425
Average daily gain (lbs)	1.25	1.75	1.99	2.16	1.85	2.06	1.61	1.92	1.38	1.78	1.24	1.69
Cumulative ADG (lbs)	1.25	1.75	1.61	1.95	1.75	2.02	1.69	1.99	1.61	1.93	1.58	1.91
Cumulative from birth												
Total Cost*	$242	$298	$355	$417	$755	$839	$1,230	$1,217	$1,632	$1,633	$1,899	$1,909
Cost/ Day*	$3.84	$4.74	$2.92	$3.43	$2.48	$2.76	$2.33	$2.62	$2.32	$2.55	$2.49	$2.73
Cost Including Wet Calf*	$459	$507	$581	$631	$989	$1,061	$1,475	$1,446	$1,893	$1,876	$2,163	$2,156

* Adjusted for death loss

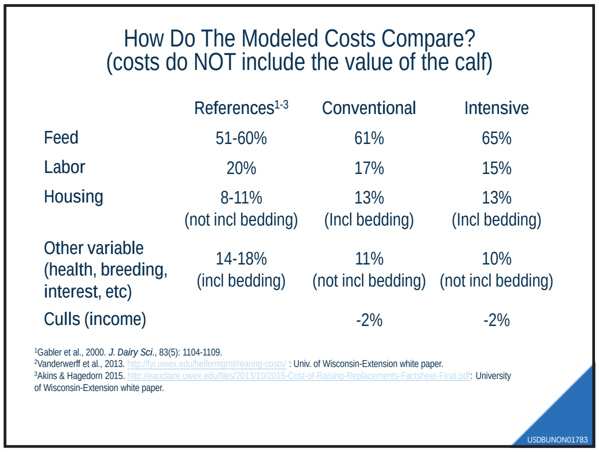


How Do These Modeled Costs Compare?

	Karszes[1]	Conventional	Intensive
Avg Dairy Gain	1.75	1.58	1.91
Feed:Gain	8.5	10.2*	8.9*
Avg DMI (lbs)	15.2	16.2	17.0
Feed Costs per Day	$1.67	$1.53	$1.77
Feed Costs per Lb Gain	$0.96	$0.96	$0.92
Total Cost	$2,232	$2,163	$2,156

*Mortality adjusted

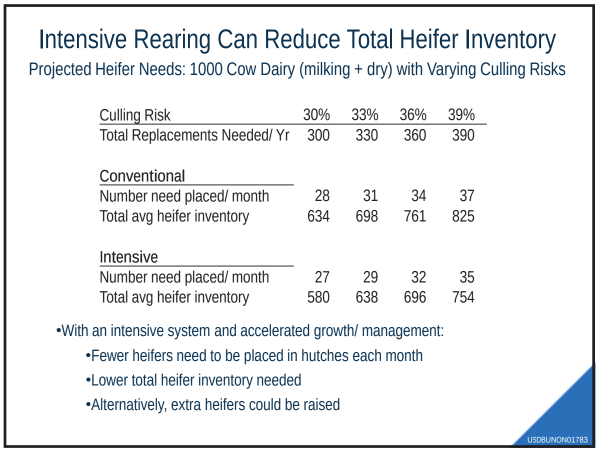
[1] Karszes. 2014. https://ecommons.cornell.edu/bitstream/handle/1813/36889/DairyReplaceCost12-3.pdf?sequence=1&isAllowed=y; *Cornell Pro-Dairy White Paper EB 2014-02*



How Do The Modeled Costs Compare?
(costs do NOT include the value of the calf)

	References[1-3]	Conventional	Intensive
Feed	51-60%	61%	65%
Labor	20%	17%	15%
Housing	8-11% (not incl bedding)	13% (Incl bedding)	13% (Incl bedding)
Other variable (health, breeding, interest, etc)	14-18% (incl bedding)	11% (not incl bedding)	10% (not incl bedding)
Culls (income)		-2%	-2%

[1] Gabler et al., 2000. *J. Dairy Sci.*, 83(5): 1104-1109.
[2] Vanderwerff et al., 2013. http://fyi.uwex.edu/heifermgmt/rearing-costs/ : Univ. of Wisconsin-Extension white paper.
[3] Akins & Hagedorn 2015. http://eauclaire.uwex.edu/files/2013/10/2015-Cost-of-Raising-Replacements-Factsheet-Final.pdf: University of Wisconsin-Extension white paper.



Intensive Rearing Can Reduce Total Heifer Inventory

Projected Heifer Needs: 1000 Cow Dairy (milking + dry) with Varying Culling Risks

Culling Risk	30%	33%	36%	39%
Total Replacements Needed/ Yr	300	330	360	390
Conventional				
Number need placed/ month	28	31	34	37
Total avg heifer inventory	634	698	761	825
Intensive				
Number need placed/ month	27	29	32	35
Total avg heifer inventory	580	638	696	754

- With an intensive system and accelerated growth/ management:
  - Fewer heifers need to be placed in hutches each month
  - Lower total heifer inventory needed
  - Alternatively, extra heifers could be raised

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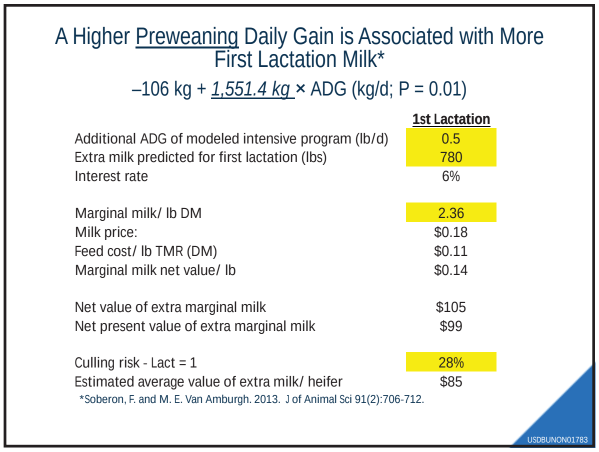

A Higher Preweaning Daily Gain is Associated with More First Lactation Milk*

–106 kg + *1,551.4 kg* × ADG (kg/d; P = 0.01)

	1st Lactation
Additional ADG of modeled intensive program (lb/d)	0.5
Extra milk predicted for first lactation (lbs)	780
Interest rate	6%
Marginal milk/ lb DM	2.36
Milk price:	$0.18
Feed cost/ lb TMR (DM)	$0.11
Marginal milk net value/ lb	$0.14
Net value of extra marginal milk	$105
Net present value of extra marginal milk	$99
Culling risk - Lact = 1	28%
Estimated average value of extra milk/ heifer	$85

*Soberon, F. and M. E. Van Amburgh. 2013. J of Animal Sci 91(2):706-712.

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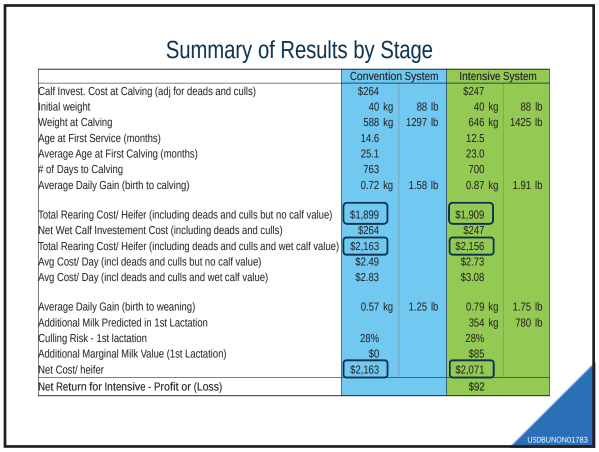

Summary of Results by Stage

	Convention System		Intensive System	
Calf Invest. Cost at Calving (adj for deads and culls)	$264		$247	
Initial weight	40 kg	88 lb	40 kg	88 lb
Weight at Calving	588 kg	1297 lb	646 kg	1425 lb
Age at First Service (months)	14.6		12.5	
Average Age at First Calving (months)	25.1		23.0	
# of Days to Calving	763		700	
Average Daily Gain (birth to calving)	0.72 kg	1.58 lb	0.87 kg	1.91 lb
Total Rearing Cost/ Heifer (including deads and culls but no calf value)	$1,899		$1,909	
Net Wet Calf Investement Cost (including deads and culls)	$264		$247	
Total Rearing Cost/ Heifer (including deads and culls and wet calf value)	$2,163		$2,156	
Avg Cost/ Day (incl deads and culls but no calf value)	$2.49		$2.73	
Avg Cost/ Day (incl deads and culls and wet calf value)	$2.83		$3.08	
Average Daily Gain (birth to weaning)	0.57 kg	1.25 lb	0.79 kg	1.75 lb
Additional Milk Predicted in 1st Lactation			354 kg	780 lb
Culling Risk - 1st lactation	28%		28%	
Additional Marginal Milk Value (1st Lactation)	$0		$85	
Net Cost/ heifer	$2,163		$2,071	
Net Return for Intensive - Profit or (Loss)			$92	

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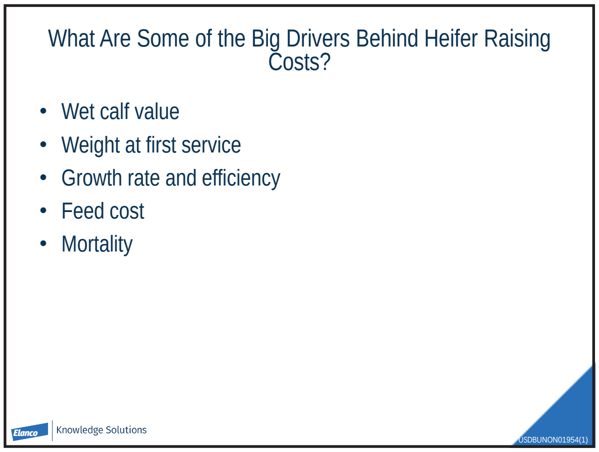
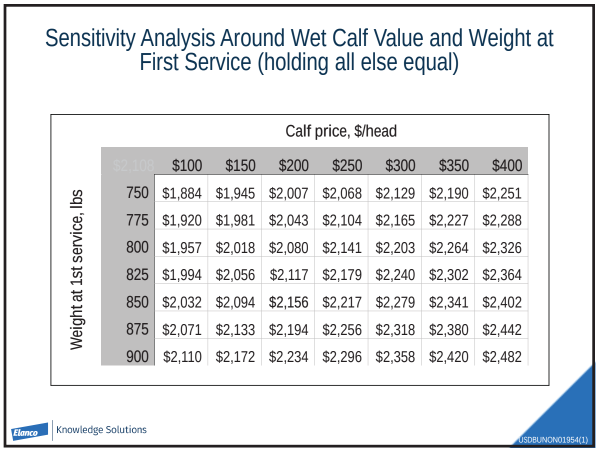


What Are Some of the Big Drivers Behind Heifer Raising Costs?

- Wet calf value
- Weight at first service
- Growth rate and efficiency
- Feed cost
- Mortality

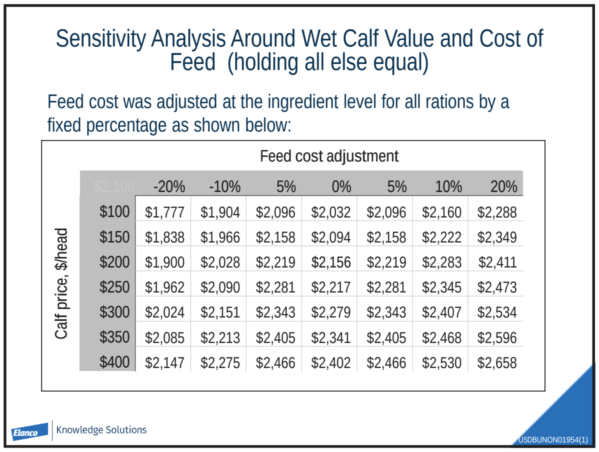


Sensitivity Analysis Around Wet Calf Value and Weight at First Service (holding all else equal)

Calf price, $/head

Weight at 1st service, lbs

$2,108	$100	$150	$200	$250	$300	$350	$400
750	$1,884	$1,945	$2,007	$2,068	$2,129	$2,190	$2,251
775	$1,920	$1,981	$2,043	$2,104	$2,165	$2,227	$2,288
800	$1,957	$2,018	$2,080	$2,141	$2,203	$2,264	$2,326
825	$1,994	$2,056	$2,117	$2,179	$2,240	$2,302	$2,364
850	$2,032	$2,094	$2,156	$2,217	$2,279	$2,341	$2,402
875	$2,071	$2,133	$2,194	$2,256	$2,318	$2,380	$2,442
900	$2,110	$2,172	$2,234	$2,296	$2,358	$2,420	$2,482



Sensitivity Analysis Around Wet Calf Value and Cost of Feed (holding all else equal)

Feed cost was adjusted at the ingredient level for all rations by a fixed percentage as shown below:

Feed cost adjustment

Calf price, $/head

$2,108	-20%	-10%	5%	0%	5%	10%	20%
$100	$1,777	$1,904	$2,096	$2,032	$2,096	$2,160	$2,288
$150	$1,838	$1,966	$2,158	$2,094	$2,158	$2,222	$2,349
$200	$1,900	$2,028	$2,219	$2,156	$2,219	$2,283	$2,411
$250	$1,962	$2,090	$2,281	$2,217	$2,281	$2,345	$2,473
$300	$2,024	$2,151	$2,343	$2,279	$2,343	$2,407	$2,534
$350	$2,085	$2,213	$2,405	$2,341	$2,405	$2,468	$2,596
$400	$2,147	$2,275	$2,466	$2,402	$2,466	$2,530	$2,658

Sensitivity Analysis Around Wet Calf Value and Cost of Feed (holding all else equal)

Mortality was adjusted using a fixed percentage multiplied across each stage-specific mortality risk. 100% = 6.3% mortality across the entire raising period. 50% = 3.2% and 200% = 12.4%.

Proportional mortality adjustment

Weight at 1st service, lbs	$2,108	25%	50%	75%	100%	125%	150%	200%
	750	$1,972	$1,984	$1,995	$2,007	$2,019	$2,033	$2,058
	775	$2,008	$2,020	$2,031	$2,043	$2,055	$2,069	$2,095
	800	$2,044	$2,057	$2,068	$2,080	$2,092	$2,106	$2,132
	825	$2,082	$2,094	$2,106	$2,117	$2,130	$2,144	$2,170
	850	$2,120	$2,132	$2,144	$2,156	$2,168	$2,183	$2,209
	875	$2,158	$2,171	$2,183	$2,194	$2,207	$2,222	$2,248
	900	$2,198	$2,210	$2,222	$2,234	$2,247	$2,261	$2,288

Sensitivity Analysis Around Varying Insemination Risk and Conception Risk (holding all else equal)

Average Insemination Risk

Average Conception Risk	$2,108	43%	48%	53%	58%	63%	68%	73%
	35%	$2,410	$2,368	$2,335	$2,307	$2,284	$2,266	$2,249
	40%	$2,353	$2,317	$2,287	$2,266	$2,246	$2,228	$2,213
	45%	$2,309	$2,277	$2,253	$2,232	$2,214	$2,198	$2,185
	50%	$2,274	$2,248	$2,224	$2,205	$2,189	$2,175	$2,163
	55%	$2,248	$2,222	$2,201	$2,183	$2,168	$2,156	$2,144
	60%	$2,224	$2,200	$2,181	$2,164	$2,151	$2,139	$2,129
	65%	$2,203	$2,181	$2,164	$2,149	$2,136	$2,125	$2,116

Disclaimer

- We have tried to represent the costs and benefits as closely as possible
- Approaches to raising heifers can vary tremendously for labor, feed, housing, etc – this model attempts to look at a "representative" operation that is bottle feeding calves in individual hutches
- More hard data for actual inputs (DMI, health and vet med costs, bedding/ housing, labor, etc) for the specific system being modeled would improve the accuracy and reliability of the estimates
- Of course, individual results may vary!

Summary

- The cost of raising heifers is typically higher than many realize
- Must consider costs incurred by heifers that die or are sold
  - Must also consider interest cost for money invested in raising
- This spreadsheet model:
  - Is consistent with published results
  - Demonstrates both the cost and the value of utilizing a more intensive (biologically normal) approach
  - Intensive = higher cost/d but lower total cost and greater value
- Several large factors impact heifer raising costs including feed, labor, mortality, wet calf value, and weight at first service
- Feed cost is the highest single source of costs for raising heifers (followed by labor)

Knowledge Solutions

USDBUNON01954(1)

Thanks For Your Attention!

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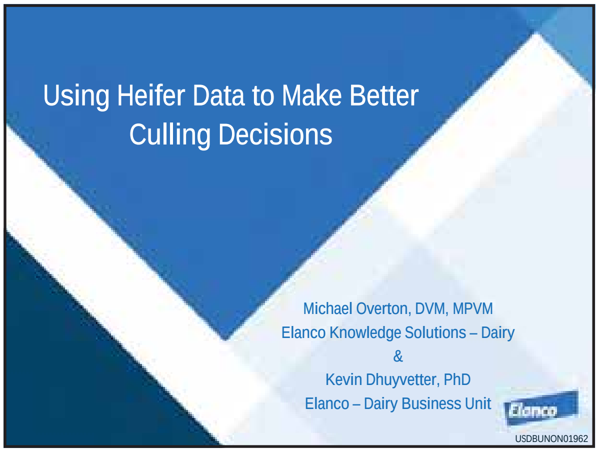
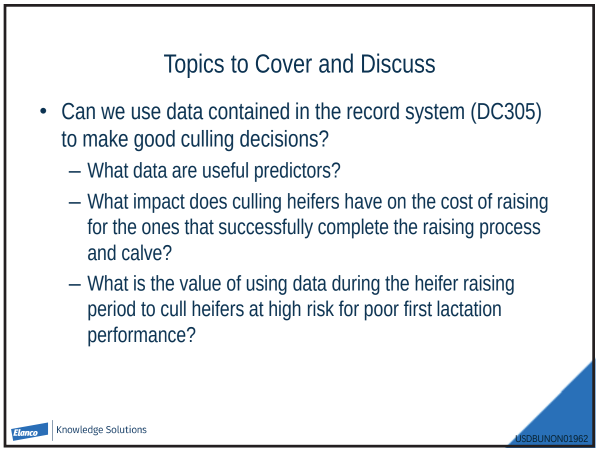


Using Heifer Data to Make Better Culling Decisions

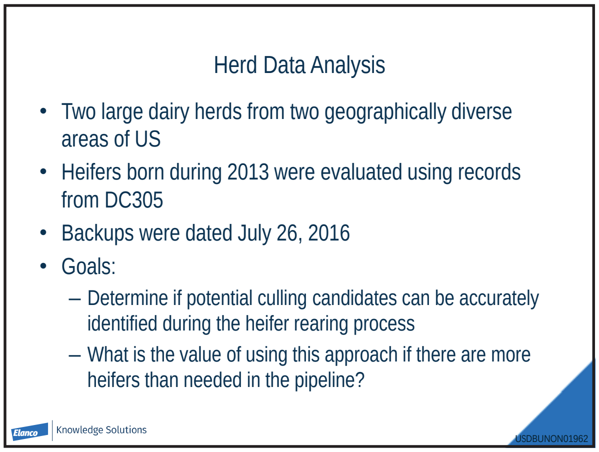
Michael Overton, DVM, MPVM
Elanco Knowledge Solutions – Dairy
&
Kevin Dhuyvetter, PhD
Elanco – Dairy Business Unit



Topics to Cover and Discuss

- Can we use data contained in the record system (DC305) to make good culling decisions?
  - What data are useful predictors?
  - What impact does culling heifers have on the cost of raising for the ones that successfully complete the raising process and calve?
  - What is the value of using data during the heifer raising period to cull heifers at high risk for poor first lactation performance?

Knowledge Solutions

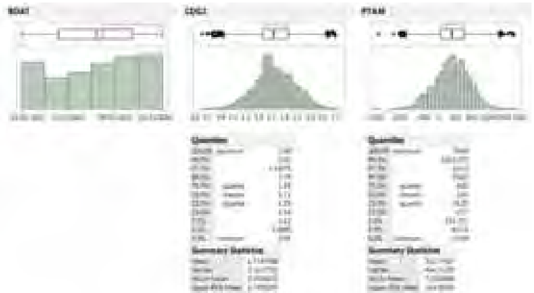


Herd Data Analysis

- Two large dairy herds from two geographically diverse areas of US
- Heifers born during 2013 were evaluated using records from DC305
- Backups were dated July 26, 2016
- Goals:
  - Determine if potential culling candidates can be accurately identified during the heifer rearing process
  - What is the value of using this approach if there are more heifers than needed in the pipeline?

Knowledge Solutions

Descriptive Data – All Heifers that Had Current Dairy Gain 2 (CDG2), Predicted Transmitting Ability – Milk (PTAM), and Current Dairy Gain 3 (CDG3) Recorded



Knowledge Solutions

USDBUNON01962

Descriptive Data – All Heifers that Had CDG2, PTAM, and CDG3 Recorded

Knowledge Solutions

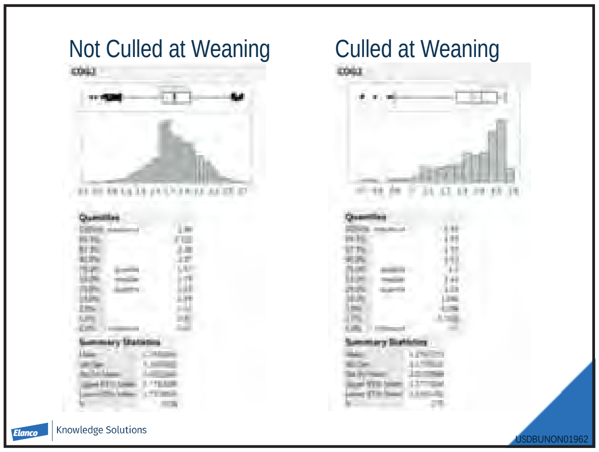
USDBUNON01962

Created Culling Criteria for Post-Weaning Evaluation

- First, eliminated the heifers that died/were sold by dairies prior to 63 days of age
- Then, if below the lower quartile for both CDG2 (1.55) *AND* PTAM (29), identified them as “Wean Cull”

Knowledge Solutions

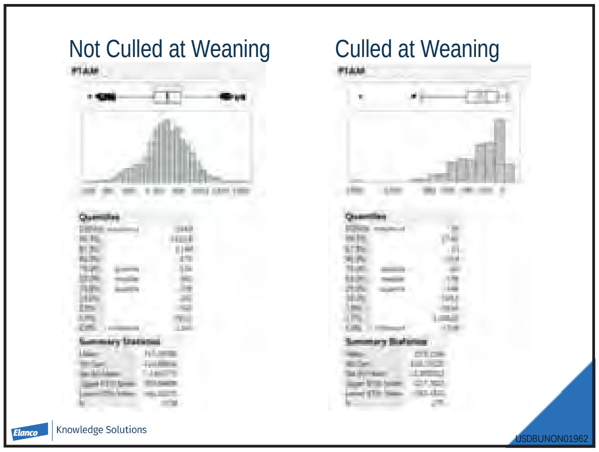
USDBUNON01962



Not Culled at Weaning

Culled at Weaning

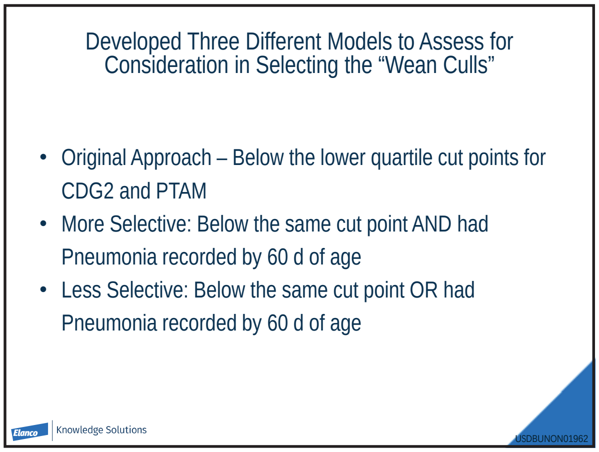
Knowledge Solutions



Not Culled at Weaning

Culled at Weaning

Knowledge Solutions



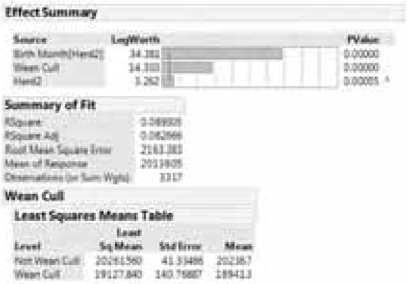
Developed Three Different Models to Assess for Consideration in Selecting the "Wean Culls"

- Original Approach – Below the lower quartile cut points for CDG2 and PTAM
- More Selective: Below the same cut point AND had Pneumonia recorded by 60 d of age
- Less Selective: Below the same cut point OR had Pneumonia recorded by 60 d of age

Knowledge Solutions

Created A Model To Predict 2nd305 Milk Using Variables Available At The Time Of Weaning

Original Approach:



Effect Summary

Source	LogWorth	PValue
Birth Month[Herd2]	34.381	0.00000
Wean Cull	14.333	0.00000
Herd2	3.262	0.00055 ^

Summary of Fit

RSquare	0.069005
RSquare Adj	0.062866
Root Mean Square Error	2163.383
Mean of Response	20139.05
Observations (or Sum Wgts)	3317

Wean Cull

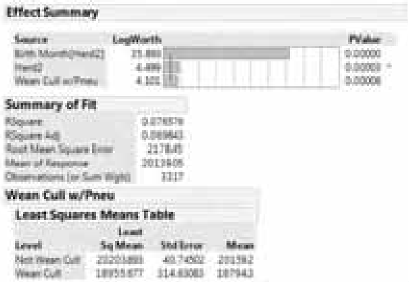
Least Squares Means Table

Level	Least Sq Mean	Std Error	Mean
Not Wean Cull	20261.560	41.33486	20236.7
Wean Cull	19127.840	140.75687	18941.3

Created A Model To Predict 2nd305 Milk Using Variables Available At The Time Of Weaning

More Selective:

Below cut points AND pneumonia prior to 60 days



Effect Summary

Source	LogWorth	PValue
Birth Month[Herd2]	25.880	0.00000
Herd2	4.499	0.00003 ^
Wean Cull w/Pneu	4.101	0.00008

Summary of Fit

RSquare	0.076576
RSquare Adj	0.069843
Root Mean Square Error	2178.45
Mean of Response	20139.05
Observations (or Sum Wgts)	3317

Wean Cull w/Pneu

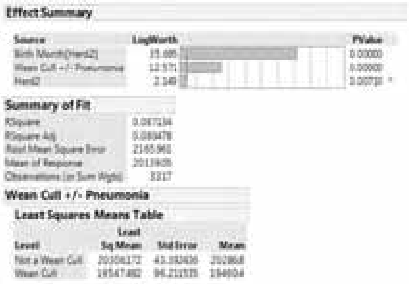
Least Squares Means Table

Level	Least Sq Mean	Std Error	Mean
Not Wean Cull	20203.893	40.74502	20159.2
Wean Cull	18955.677	314.63083	18794.3

Created A Model To Predict 2nd305 Milk Using Variables Available At The Time Of Weaning

Less selective:

Below cutpoints OR pneumonia prior to 60 days



Effect Summary

Source	LogWorth	PValue
Birth Month[Herd2]	35.695	0.00000
Wean Cull +/- Pneumonia	12.571	0.00000
Herd2	2.149	0.00710 ^

Summary of Fit

RSquare	0.087134
RSquare Adj	0.080478
Root Mean Square Error	2165.961
Mean of Response	20139.05
Observations (or Sum Wgts)	3317

Wean Cull +/- Pneumonia

Least Squares Means Table

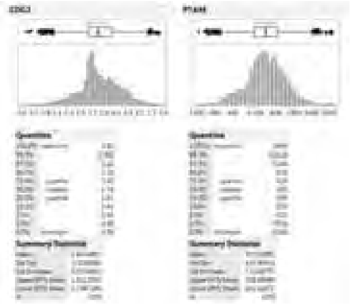
Level	Least Sq Mean	Std Error	Mean
Not a Wean Cull	20206.172	41.092436	20286.8
Wean Cull	19547.482	94.211535	19460.4

Also Considered Two Additional Different Approaches for Selecting “Wean Culls”

	Original Approach	More Selective: Below Cut Points AND Pneumonia by 60 d	Less Selective: Below Cut Points OR Pneumonia by 60 d
Not Wean Cull minus Wean Cull (LS Means)	1134 lb	1248 lb	759 lb
Not Wean Cull minus Full Population (LS Means)	567 lb	624 lb	379 lb

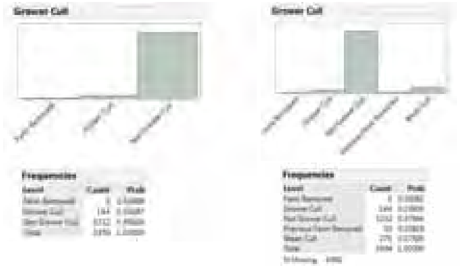
Continued the analysis with the Original Approach

Next, “Removed” the “Wean Cull” Heifers and the Farm-Removed Heifers Prior to 120-d and Re-Evaluated the Performance of the Remaining Heifers at 120 d of Age

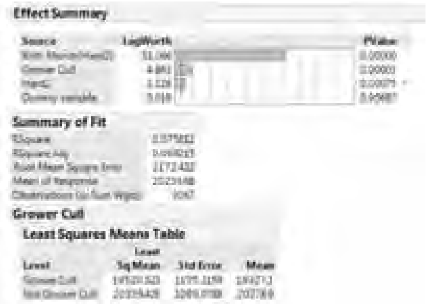


Created Culling Criteria for Grower Evaluation

- If below the lower quartile for CDG2 (1.62) and PTAM (109), identified them as “Grower Cull”



Grower Cull – Predicted 2nd305M Performance Using Data Available at ~4 Months of Age



Repeated the Three Different Selective Models as with the Weaning Evaluation

Original Approach	More Selective: Below Cut Points AND Pneumonia by 120 d	Less Selective: Below Cut Points OR Pneumonia by 120 d

Not Grower Cull minus Grower Cull (LS Means)	839 lb	930 lb	331 lb
Not Grower Cull minus Full Population (LS Means)	478 lb	660 lb	253 lb

Continued the analysis with the Original Approach

Finally, Evaluated Which Heifers Survived Through Breeding and Gestation to Actually Calve Into the Herd

Final results were based on using the original models at weaning and at 120 d

- “Culled Both” and “Natural Cull Only” did not actually calve – so, no milk weights
- “Performance Culls”:
  - Predicted to produce 1064 lb less 2nd305 Milk (p<0.01)
  - 1.33 X higher culling risk by 300 DIM (p=0.055)
  - 6% less likely to become pregnant by 300 DIM (p=0.32)
- “Not Performance Cull” heifers predicted to produce 286 lb more 2nd305 milk relative to whole populations LS Means

Assuming that We Can Predict Which Heifers will be of Lower Value, What is the Impact on the Cost of Raising?

- To examine this question, created three scenarios:
  - – Cull selected heifers post-weaning
  - – Cull selected heifers post-weaning and post-grower
  - – Cull selected heifers post-weaning and at springer stage

- Assumptions used:
  - – Housing costs are fixed: i.e., with additional selective culling, cost/remaining heifer for cost of housing increases
  - – Labor costs are partially fixed: i.e., with additional selective culling, cost/remaining heifer are treated as 50% fixed, 50% vary based on # of heifers

Cost of Raising Heifers ($/Heifer Calving)
Scenario 1: Cull Selected Heifers at Post-Weaning

- Assumed that a 70-d old heifer is sold for $350:

Baseline scenario

		Proportional mortality adjustment						
	$2,108	25%	50%	75%	100%	125%	150%	200%
Weight at 1st service, lbs	750	1,989	1,999	2,010	2,020	2,030	2,041	2,063
	770	2,018	2,028	2,039	2,049	2,059	2,070	2,092
	790	2,048	2,058	2,068	2,078	2,089	2,099	2,122
	810	2,077	2,088	2,098	2,108	2,119	2,129	2,152
	830	2,108	2,118	2,128	2,139	2,149	2,160	2,182
	850	2,138	2,148	2,159	2,169	2,180	2,191	2,213
	870	2,169	2,180	2,190	2,201	2,211	2,222	2,245

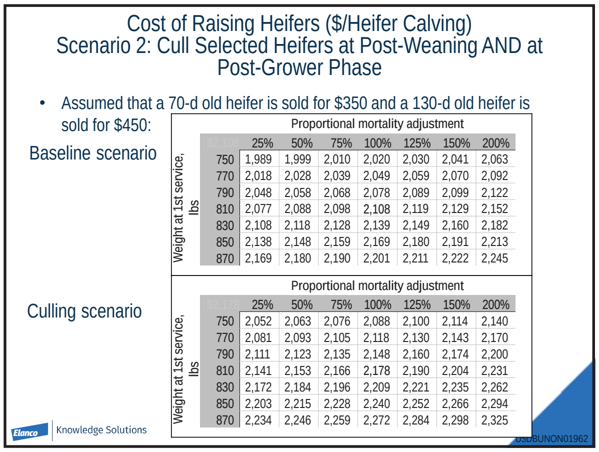
Culling scenario

		Proportional mortality adjustment						
	$2,152	25%	50%	75%	100%	125%	150%	200%
Weight at 1st service, lbs	750	2,029	2,040	2,052	2,063	2,074	2,086	2,111
	770	2,058	2,069	2,081	2,092	2,104	2,116	2,141
	790	2,088	2,099	2,111	2,122	2,134	2,146	2,171
	810	2,118	2,129	2,141	2,152	2,164	2,176	2,201
	830	2,148	2,160	2,171	2,183	2,195	2,207	2,232
	850	2,179	2,191	2,202	2,214	2,226	2,238	2,263
	870	2,210	2,222	2,234	2,246	2,257	2,270	2,295

Cost of Raising Heifers ($/Heifer Calving)
Scenario 1: Cull Selected Heifers at Post-Weaning (70-d old)

Cost = Culling Scenario - Baseline scenario

		Vol cull, $/hd culled						
	$44	$200	$250	$300	$350	$400	$450	$500
Heifer calf value at birth, $/hd	$100	$48	$43	$39	$34	$29	$24	$20
	$150	$53	$48	$44	$39	$34	$29	$25
	$200	$58	$54	$49	$44	$39	$35	$30
	$250	$64	$59	$54	$49	$44	$40	$35
	$300	$69	$64	$59	$54	$50	$45	$40
	$350	$74	$69	$64	$59	$55	$50	$45
	$400	$79	$74	$69	$65	$60	$55	$50



Cost of Raising Heifers ($/Heifer Calving) Scenario 2: Cull Selected Heifers at Post-Weaning AND at Post-Grower Phase

- Assumed that a 70-d old heifer is sold for $350 and a 130-d old heifer is sold for $450:

Baseline scenario

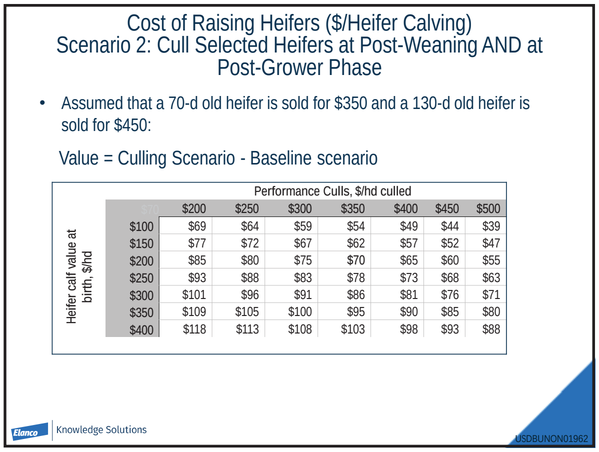
Proportional mortality adjustment

	$2,108	25%	50%	75%	100%	125%	150%	200%
Weight at 1st service, lbs	750	1,989	1,999	2,010	2,020	2,030	2,041	2,063
	770	2,018	2,028	2,039	2,049	2,059	2,070	2,092
	790	2,048	2,058	2,068	2,078	2,089	2,099	2,122
	810	2,077	2,088	2,098	2,108	2,119	2,129	2,152
	830	2,108	2,118	2,128	2,139	2,149	2,160	2,182
	850	2,138	2,148	2,159	2,169	2,180	2,191	2,213
	870	2,169	2,180	2,190	2,201	2,211	2,222	2,245

Culling scenario

Proportional mortality adjustment

	$2,178	25%	50%	75%	100%	125%	150%	200%
Weight at 1st service, lbs	750	2,052	2,063	2,076	2,088	2,100	2,114	2,140
	770	2,081	2,093	2,105	2,118	2,130	2,143	2,170
	790	2,111	2,123	2,135	2,148	2,160	2,174	2,200
	810	2,141	2,153	2,166	2,178	2,190	2,204	2,231
	830	2,172	2,184	2,196	2,209	2,221	2,235	2,262
	850	2,203	2,215	2,228	2,240	2,252	2,266	2,294
	870	2,234	2,246	2,259	2,272	2,284	2,298	2,325



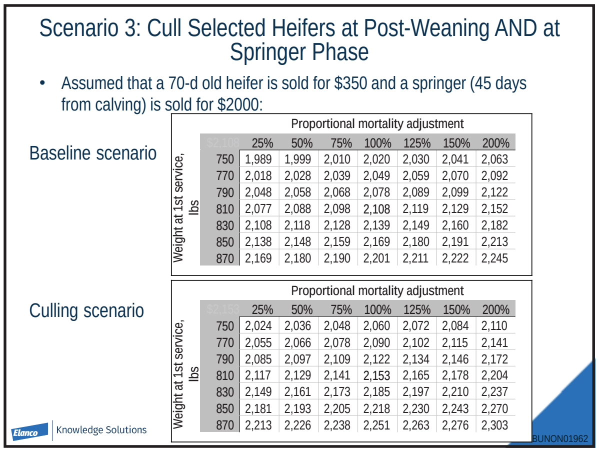
Cost of Raising Heifers ($/Heifer Calving) Scenario 2: Cull Selected Heifers at Post-Weaning AND at Post-Grower Phase

- Assumed that a 70-d old heifer is sold for $350 and a 130-d old heifer is sold for $450:

Value = Culling Scenario - Baseline scenario

Performance Culls, $/hd culled

	$70	$200	$250	$300	$350	$400	$450	$500
Heifer calf value at birth, $/hd	$100	$69	$64	$59	$54	$49	$44	$39
	$150	$77	$72	$67	$62	$57	$52	$47
	$200	$85	$80	$75	$70	$65	$60	$55
	$250	$93	$88	$83	$78	$73	$68	$63
	$300	$101	$96	$91	$86	$81	$76	$71
	$350	$109	$105	$100	$95	$90	$85	$80
	$400	$118	$113	$108	$103	$98	$93	$88



Scenario 3: Cull Selected Heifers at Post-Weaning AND at Springer Phase

- Assumed that a 70-d old heifer is sold for $350 and a springer (45 days from calving) is sold for $2000:

Baseline scenario

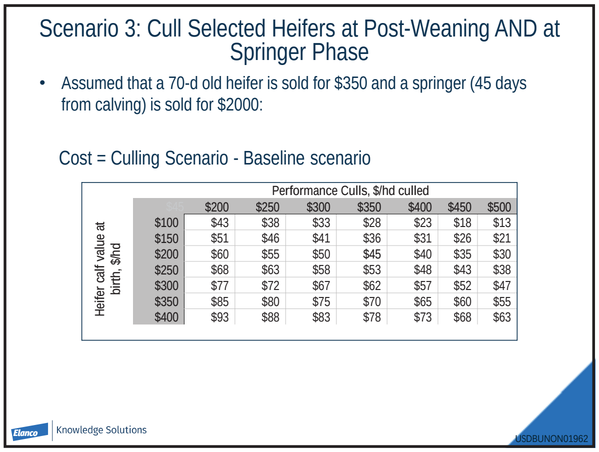
Proportional mortality adjustment

	$2,108	25%	50%	75%	100%	125%	150%	200%
Weight at 1st service, lbs	750	1,989	1,999	2,010	2,020	2,030	2,041	2,063
	770	2,018	2,028	2,039	2,049	2,059	2,070	2,092
	790	2,048	2,058	2,068	2,078	2,089	2,099	2,122
	810	2,077	2,088	2,098	2,108	2,119	2,129	2,152
	830	2,108	2,118	2,128	2,139	2,149	2,160	2,182
	850	2,138	2,148	2,159	2,169	2,180	2,191	2,213
	870	2,169	2,180	2,190	2,201	2,211	2,222	2,245

Culling scenario

Proportional mortality adjustment

	$2,153	25%	50%	75%	100%	125%	150%	200%
Weight at 1st service, lbs	750	2,024	2,036	2,048	2,060	2,072	2,084	2,110
	770	2,055	2,066	2,078	2,090	2,102	2,115	2,141
	790	2,085	2,097	2,109	2,122	2,134	2,146	2,172
	810	2,117	2,129	2,141	2,153	2,165	2,178	2,204
	830	2,149	2,161	2,173	2,185	2,197	2,210	2,237
	850	2,181	2,193	2,205	2,218	2,230	2,243	2,270
	870	2,213	2,226	2,238	2,251	2,263	2,276	2,303



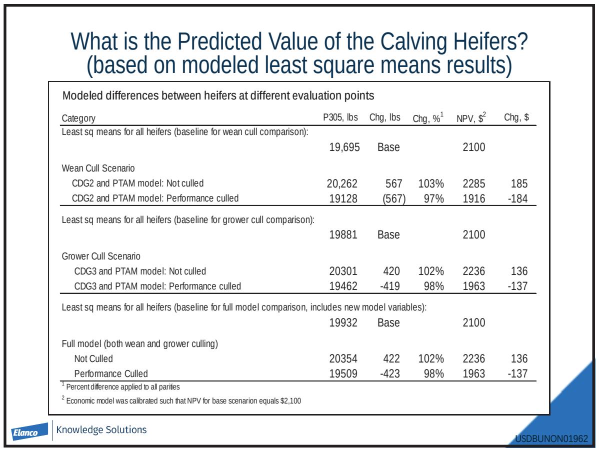
Scenario 3: Cull Selected Heifers at Post-Weaning AND at Springer Phase

- Assumed that a 70-d old heifer is sold for $350 and a springer (45 days from calving) is sold for $2000:

Cost = Culling Scenario - Baseline scenario

Performance Culls, $/hd culled

Heifer calf value at birth, $/hd	$45	$200	$250	$300	$350	$400	$450	$500
	$100	$43	$38	$33	$28	$23	$18	$13
	$150	$51	$46	$41	$36	$31	$26	$21
	$200	$60	$55	$50	$45	$40	$35	$30
	$250	$68	$63	$58	$53	$48	$43	$38
	$300	$77	$72	$67	$62	$57	$52	$47
	$350	$85	$80	$75	$70	$65	$60	$55
	$400	$93	$88	$83	$78	$73	$68	$63



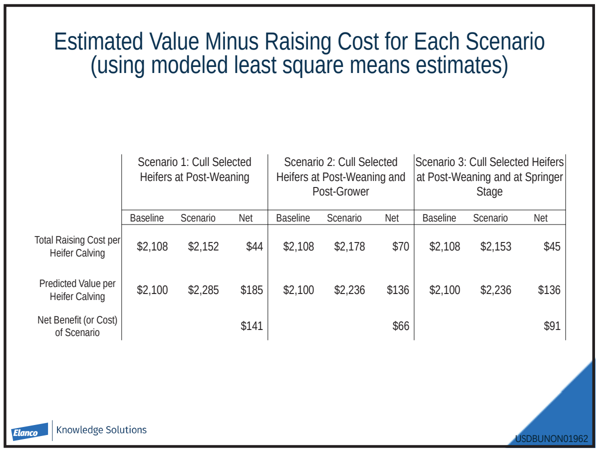
What is the Predicted Value of the Calving Heifers? (based on modeled least square means results)

Modeled differences between heifers at different evaluation points

Category	P305, lbs	Chg, lbs	Chg, %[1]	NPV, $[2]	Chg, $
Least sq means for all heifers (baseline for wean cull comparison):					
	19,695	Base		2100	
Wean Cull Scenario					
CDG2 and PTAM model: Not culled	20,262	567	103%	2285	185
CDG2 and PTAM model: Performance culled	19128	(567)	97%	1916	-184
Least sq means for all heifers (baseline for grower cull comparison):					
	19881	Base		2100	
Grower Cull Scenario					
CDG3 and PTAM model: Not culled	20301	420	102%	2236	136
CDG3 and PTAM model: Performance culled	19462	-419	98%	1963	-137
Least sq means for all heifers (baseline for full model comparison, includes new model variables):					
	19932	Base		2100	
Full model (both wean and grower culling)					
Not Culled	20354	422	102%	2236	136
Performance Culled	19509	-423	98%	1963	-137

[1] Percent difference applied to all parities

[2] Economic model was calibrated such that NPV for base scenarion equals $2,100



Estimated Value Minus Raising Cost for Each Scenario (using modeled least square means estimates)

	Scenario 1: Cull Selected Heifers at Post-Weaning			Scenario 2: Cull Selected Heifers at Post-Weaning and Post-Grower			Scenario 3: Cull Selected Heifers at Post-Weaning and at Springer Stage		
	Baseline	Scenario	Net	Baseline	Scenario	Net	Baseline	Scenario	Net
Total Raising Cost per Heifer Calving	$2,108	$2,152	$44	$2,108	$2,178	$70	$2,108	$2,153	$45
Predicted Value per Heifer Calving	$2,100	$2,285	$185	$2,100	$2,236	$136	$2,100	$2,236	$136
Net Benefit (or Cost) of Scenario			$141			$66			$91

Outcomes of Heifers in Modeled Exercise

	Actual Results		Performance Culling	
Total Heifers Starting			3664	
Heifers Culled after Weaning			275	8%
Heifers Culled after Grower			144	4%
Heifers Sold/Died by Farm	243	7%	243	7%
Total Heifers Actually Calving	3421	93%	3002	82%

- Very low actual culling level:
  - 93% of heifers in system calved
- With performance culling:
  - 82% of heifers in system calved
  - Must have extra heifers (or be willing to purchase heifers) to make this approach work

Summary

- This early-stage modeling exercise demonstrates that with good data and careful analyses, selective pressure can be applied to replacement programs to improve the quality of heifers calving
- MUST have extra heifers for this program to work
- MUST have good records to make more accurate decisions
- This approach needs to be repeated across herds to validate the process
- Highly unlikely that a single modeling approach will work across all herds
  - Will need to develop customized approaches for each herd

Thanks For Your Attention!

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Associations between Age at First Calving and First Lactation Performance

Michael Overton, DVM, MPVM

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Three Big Drivers For Achieving A More Efficient And Profitable Earlier Age At First Calving:

- Nutritional management
  - Efficient and increased rate of gain
  - Achievement of puberty and adequate frame at earlier age with less variation
- Health management
  - Proper housing, vaccination, therapeutic and culling management are key
- Reproductive management
  - Less variation around time of first service
  - Improved pregnancy rates once breeding starts
  - An established, limited period of breeding

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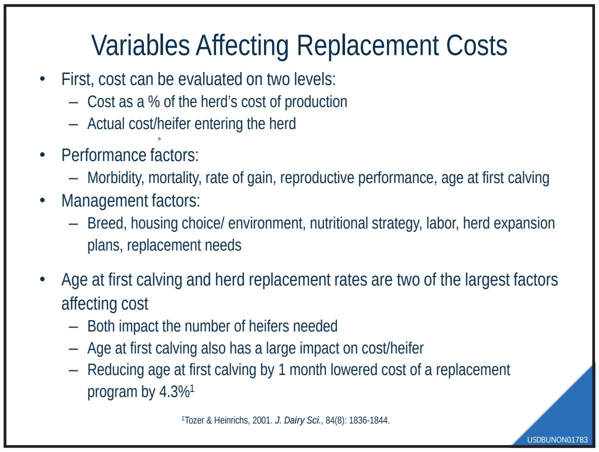

Variables Affecting Replacement Costs

- First, cost can be evaluated on two levels:
  - Cost as a % of the herd's cost of production
  - Actual cost/heifer entering the herd
- Performance factors:
  - Morbidity, mortality, rate of gain, reproductive performance, age at first calving
- Management factors:
  - Breed, housing choice/ environment, nutritional strategy, labor, herd expansion plans, replacement needs
- Age at first calving and herd replacement rates are two of the largest factors affecting cost
  - Both impact the number of heifers needed
  - Age at first calving also has a large impact on cost/heifer
  - Reducing age at first calving by 1 month lowered cost of a replacement program by 4.3%[1]

[1] Tozer & Heinrichs, 2001. *J. Dairy Sci.*, 84(8): 1836-1844.

DDAS Date Set Analyzed in JMP 12.2

- Herds had >19,000 305M
- AGEFR = 19-30 months
- Calved in 2014

- 48 Holstein herds
- 65,202 first lactation cows

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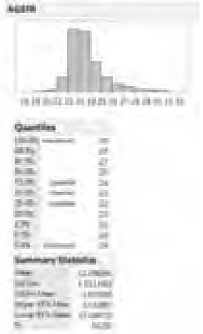
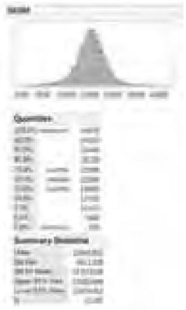
Limited Data Set to Herds with >19,000 305M AGEFR = 19-30 months





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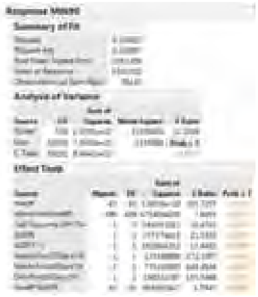
Milk Production: Milk90



AGEFR	Difference in Milk90 from Prev AGEFR
19	-
20	109
21	99
22	89
23	79
24	69
25	59
26	49
27	39
28	29
29	19
30	9

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Milk Production: Milk90 (same model, but without disease data)

AGEFR	Difference in Milk90 from Prev AGEFR
19	-
20	114
21	103
22	91
23	80
24	69
25	58
26	47
27	36
28	25
29	13
30	2

Elanco Knowledge Solutions

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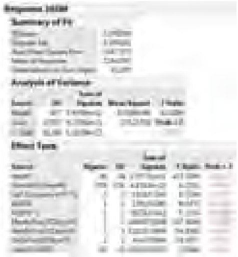
Milk Production: 305 Milk (not mature equivalent)



AGEFR	Difference in 305M from Prev AGEFR
19	-
20	241.2
21	219.3
22	197.3
23	175.4
24	153.5
25	131.6
26	109.6
27	87.7
28	65.8
29	43.8
30	21.9

Consider: ~150 lb more milk at $0.13/lb marginal milk = $20, BUT

- What does it cost to feed a heifer per day?
  - $1.25, $1.50, $1.75???
- Now what about multiplying that by 30 days?

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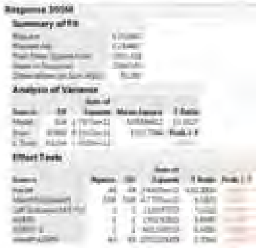
Milk Production: 305 Milk (not mature equivalent) (same model, but without disease variables)



AGEFR	Difference in 305M from Prev AGEFR
19	-
20	248.3
21	224.1
22	199.8
23	175.6
24	151.3
25	127.1
26	102.8
27	78.6
28	54.4
29	30.1
30	5.9

Consider: ~150 lb more milk at $0.13/lb marginal milk = $20, BUT

- What does it cost to feed a heifer per day?
  - $1.25, $1.50, $1.75???
- Now what about multiplying that by 30 days?

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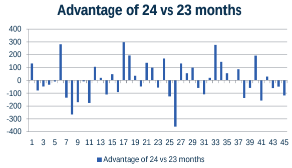
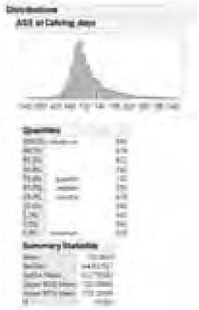
Milk production (305M)

- In this model, we still have an overall predicted advantage of 142 lb per additional month AGEFR from 22 to 26 months but there is also a herd-specific impact
- Some herds gain 300 lb more by calving at 24 vs. 23 months
- BUT, for some herds, we see less milk at 24 vs. 23 months

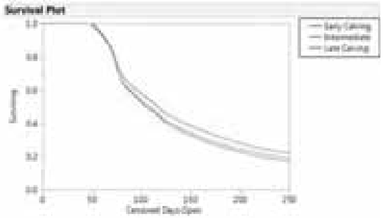


Age at First Calving Categories



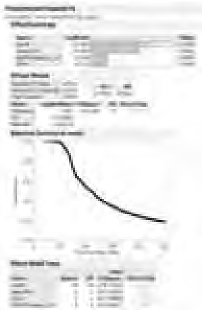
- Early calving:
  - 556 – 674 d
- Intermediate:
  - 675 – 721 d
- Late calving:
  - >721 d

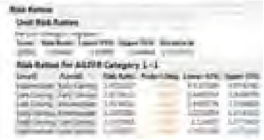
Reproductive Performance



Group	% Preg by 250 DIM	Median DOPN
Early Calving	76%	104
Intermediate	74%	108
Late Calving	70%	116
Combined	73%	110

Reproductive Performance Through 250 DIM





- Late calving heifers:
  - 13% lower odds of becoming pregnant by 250 vs. Early Calving
  - 8% lower odds of becoming pregnant by 250 vs. Intermediate

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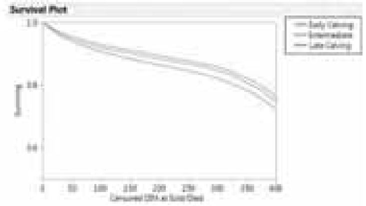
Culling Info



Group	% Culled by 400 DIM	Total 1st Lactation Culling Risk
Early Calving	18%	26%
Intermediate	19%	28%
Late Calving	22%	29%
Combined	19%	28%

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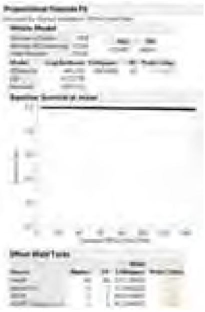
Culling by 150 DIM



- Late calving heifers:
  - 44 % higher odds of being culled by 150 vs. Early Calving
  - 30% higher odds of being culled by 150 vs. Intermediate

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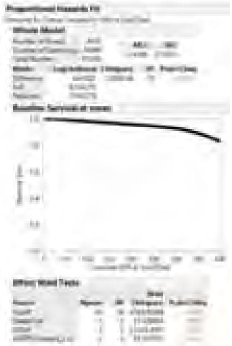
Culling by 400 DIM



- Late calving heifers:
  - 33% higher odds of being culled by 400 vs. Early Calving
  - 23% higher odds of being culled by 400 vs. Intermediate

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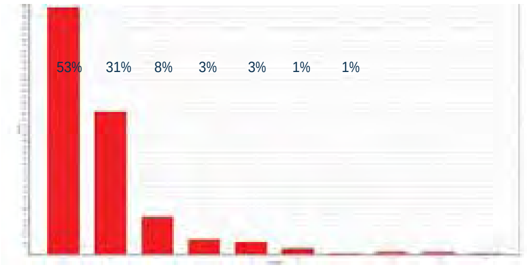
How Many Breeding Opportunities Do We Give Heifers?

GRAPH TBRD FOR LACT=0 AGCON=12-20



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My Suggestion…

- Cull after 3-4 unsuccessful services or no more than 6 cycles of breeding opportunity
- Don't turn open heifers into a bull pen after AI
  - Often results in keeping heifers that would have been culled otherwise

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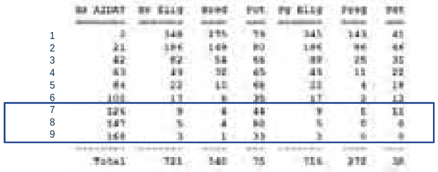
21-day Pregnancy Rate

(VWP based on movement into AI pen: AIDAT)

- Fairly typical herd (in my experience):



- If we stopped after 6th cycle…
  - Would result in culling ~ 5% or less in most herds

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Second Lactation Performance

- Impact of calving age category at First Calving on 305 Milk in 2nd Lactation:
  - Early: - 94 lb
  - Intermediate: 24
  - Late Calving: 70

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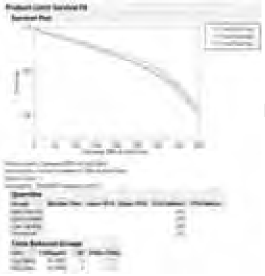

Group	Surviving through 400 DIM in 2nd Lact
Early Calving	54%
Intermediate	52%
Late Calving	50%
Combined	52%

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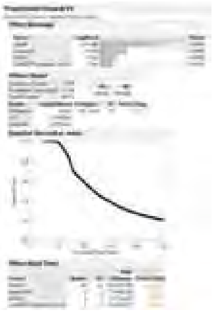
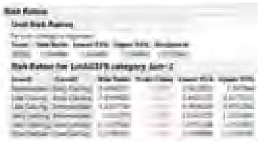
Reproductive Performance in 2nd Lactation





- Late calving heifers:
  - 10% lower odds of becoming pregnant by 250 vs. Early Calving
  - 7% lower odds of becoming pregnant by 250 vs. Intermediate

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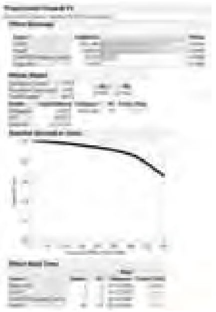
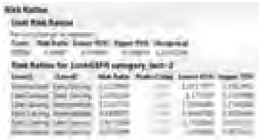
Culling in 2nd Lactation by 400 DIM





- Late calving heifers:
  - 24% higher odds of being culled by 400 vs. Early Calving
  - 10% higher odds of being culled by 400 vs. Intermediate

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Conclusions Based on This Data Set

- Younger calving heifers produce slightly less milk but…
  - Significant herd effect
  - Extra milk not cost effective (?)
- Younger calving heifers have better reproductive performance
- Younger calving heifers have lower culling risk
- These differences carry over into 2nd lactation
  - Milk differences now smaller
  - Reproductive and culling advantages for younger heifers but impacts are smaller

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Thanks For Your Attention!

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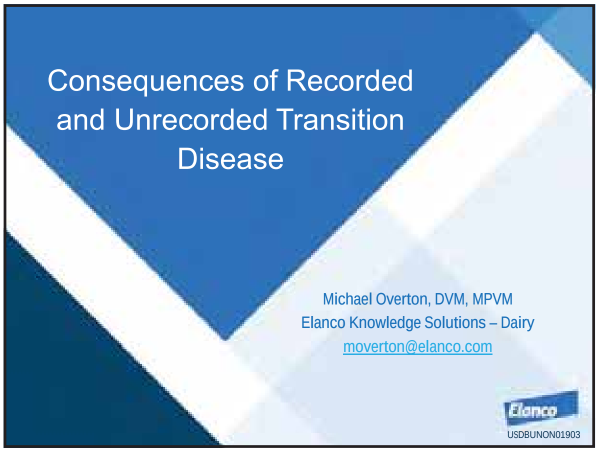

Consequences of Recorded and Unrecorded Transition Disease

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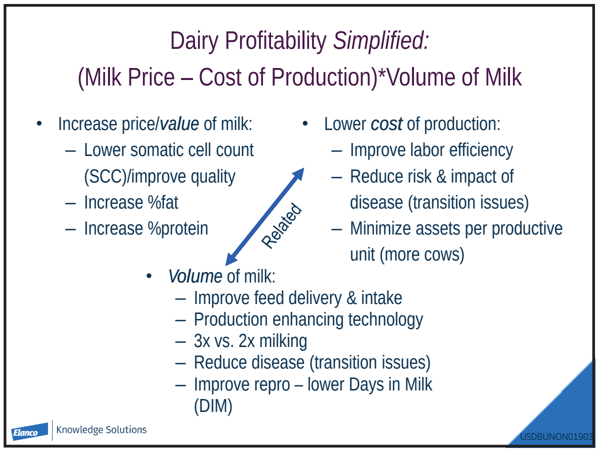

Dairy Profitability *Simplified:*
(Milk Price – Cost of Production)*Volume of Milk

- Increase price/*value* of milk:
  - Lower somatic cell count (SCC)/improve quality
  - Increase %fat
  - Increase %protein
- Lower *cost* of production:
  - Improve labor efficiency
  - Reduce risk & impact of disease (transition issues)
  - Minimize assets per productive unit (more cows)
- *Volume* of milk:
  - Improve feed delivery & intake
  - Production enhancing technology
  - 3x vs. 2x milking
  - Reduce disease (transition issues)
  - Improve repro – lower Days in Milk (DIM)

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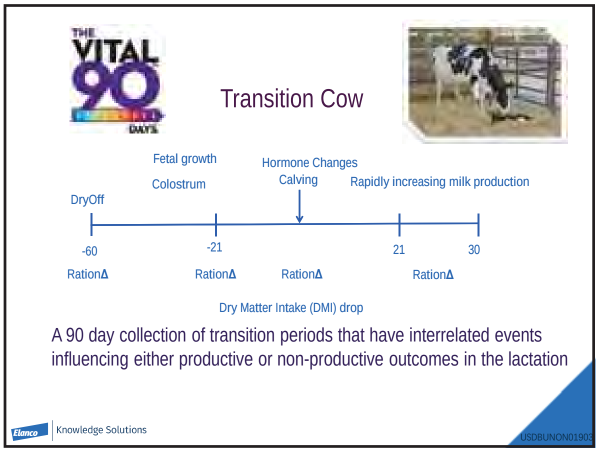

Transition Cow

A 90 day collection of transition periods that have interrelated events influencing either productive or non-productive outcomes in the lactation

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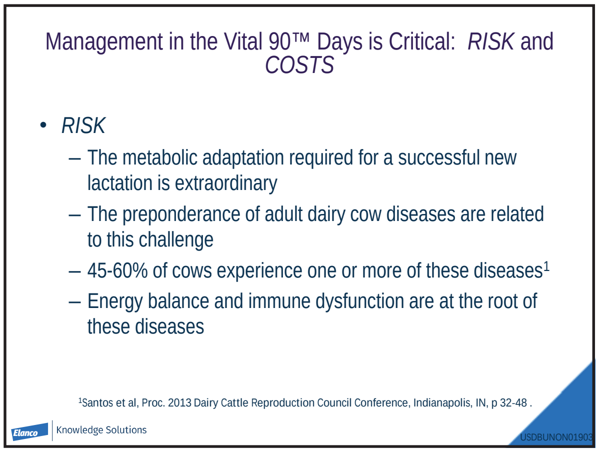
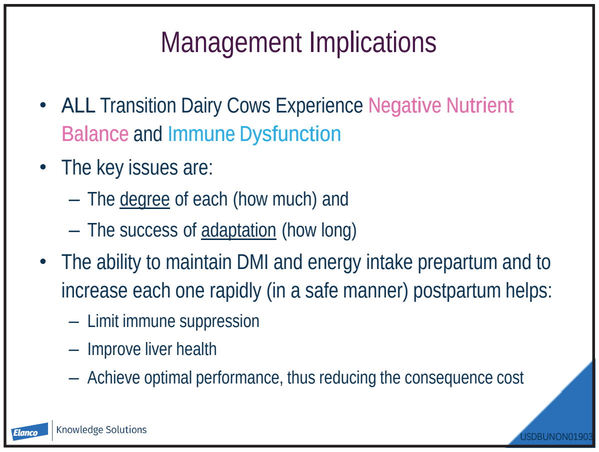


Management in the Vital 90™ Days is Critical: *RISK* and *COSTS*

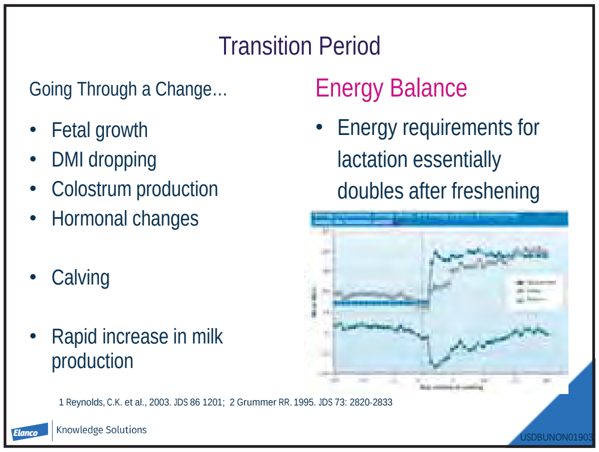
- *RISK*
  - The metabolic adaptation required for a successful new lactation is extraordinary
  - The preponderance of adult dairy cow diseases are related to this challenge
  - 45-60% of cows experience one or more of these diseases[1]
  - Energy balance and immune dysfunction are at the root of these diseases

[1] Santos et al, Proc. 2013 Dairy Cattle Reproduction Council Conference, Indianapolis, IN, p 32-48 .



Management Implications

- ALL Transition Dairy Cows Experience Negative Nutrient Balance and Immune Dysfunction
- The key issues are:
  - The degree of each (how much) and
  - The success of adaptation (how long)
- The ability to maintain DMI and energy intake prepartum and to increase each one rapidly (in a safe manner) postpartum helps:
  - Limit immune suppression
  - Improve liver health
  - Achieve optimal performance, thus reducing the consequence cost



Transition Period

Going Through a Change…

- Fetal growth
- DMI dropping
- Colostrum production
- Hormonal changes
- Calving
- Rapid increase in milk production

Energy Balance

- Energy requirements for lactation essentially doubles after freshening

1 Reynolds, C.K. et al., 2003. JDS 86 1201; 2 Grummer RR. 1995. JDS 73: 2820-2833

Management in The Vital 90 Days is Critical: *RISK* and *COSTS*

Two Major Types of Costs During The Vital 90 Days

Investment Costs

- Dairy producers often invest heavily to mitigate the *RISK* associated with calving
- Many products and procedures are justifiably used to reduce disease and optimize performance

Consequence Costs

- Direct and indirect costs of disease are a major source of economic loss and frustration for dairy producers
- Lowering consequence costs through reducing disease and refining treatment decisions is a great opportunity to improve profitability

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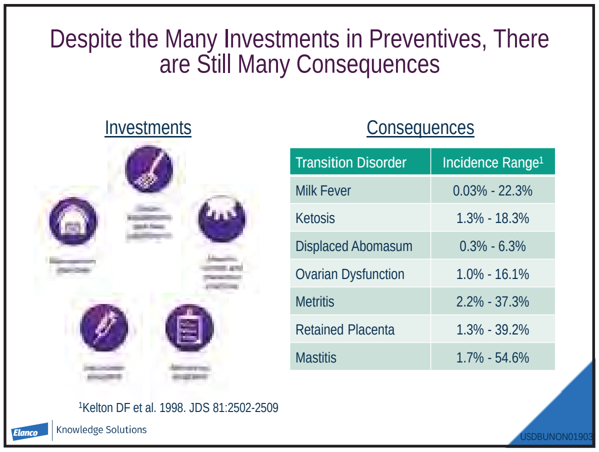

Despite the Many Investments in Preventives, There are Still Many Consequences

Investments

Consequences

Transition Disorder	Incidence Range[1]
Milk Fever	0.03% - 22.3%
Ketosis	1.3% - 18.3%
Displaced Abomasum	0.3% - 6.3%
Ovarian Dysfunction	1.0% - 16.1%
Metritis	2.2% - 37.3%
Retained Placenta	1.3% - 39.2%
Mastitis	1.7% - 54.6%

[1] Kelton DF et al. 1998. JDS 81:2502-2509

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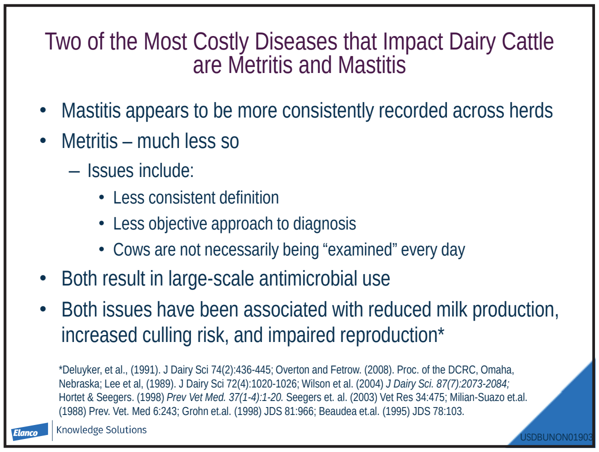

Two of the Most Costly Diseases that Impact Dairy Cattle are Metritis and Mastitis

- Mastitis appears to be more consistently recorded across herds
- Metritis – much less so
  - Issues include:
    - Less consistent definition
    - Less objective approach to diagnosis
    - Cows are not necessarily being "examined" every day
- Both result in large-scale antimicrobial use
- Both issues have been associated with reduced milk production, increased culling risk, and impaired reproduction*

*Deluyker, et al., (1991). J Dairy Sci 74(2):436-445; Overton and Fetrow. (2008). Proc. of the DCRC, Omaha, Nebraska; Lee et al, (1989). J Dairy Sci 72(4):1020-1026; Wilson et al. (2004) *J Dairy Sci. 87(7):2073-2084;* Hortet & Seegers. (1998) *Prev Vet Med. 37(1-4):1-20.* Seegers et. al. (2003) Vet Res 34:475; Milian-Suazo et.al. (1988) Prev. Vet. Med 6:243; Grohn et.al. (1998) JDS 81:966; Beaudea et.al. (1995) JDS 78:103.

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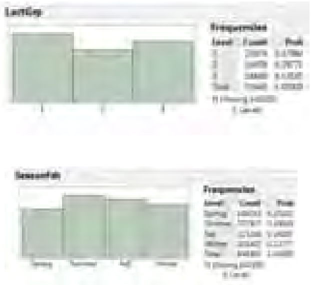
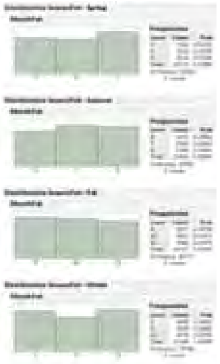
The Subsequent Data are from U.S. Dairy Herds that are Enrolled in Elanco’s Dairy Data Access System

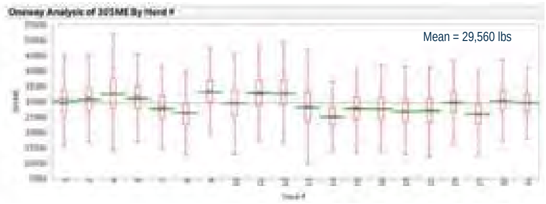
- All herds use DC305 and reported milk production data
- Initial data set had 396,000 lactation records over a 3-year period of calvings
  - Filtered to a 12-month period of calvings (8/1/13-8/1/14)
    - Allows for *at least* a 12 month follow up period after calving
  - Eliminated herds that had unreasonably low recorded incidences of mastitis and metritis (many of the removed herds failed to record one or the other)
  - Filtered to include only Holstein
  - Result: 55,643 lactation records from 20 herds
- REMEMBER: This is observational analyses of farm reported information

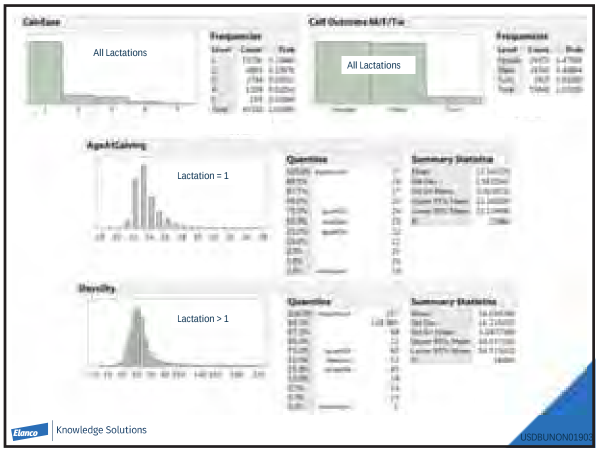
Descriptive Statistics for the Included Herds



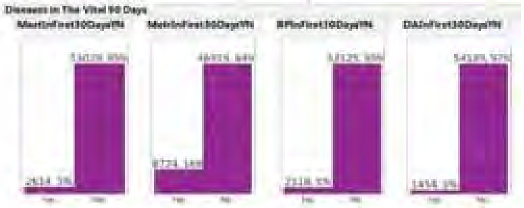


305ME Milk Production by Herd in Data Set





Average Disease Incidence Across Herds (All Parities Included)



Disease incidence in high producing Holstein herds that intensively detected and recorded disease[1]:

Clinical Mastitis	Clinical Metritis	Retained Placenta	Displaced Abomasum
5.5 – 26.1%	18.5 – 27.6%	2.9 – 15%	1.0 – 6%

[1]Santos et al., 2015. proceedings of the Dairy Cattle Reproduction Council, p 3-9, Buffalo, NY.

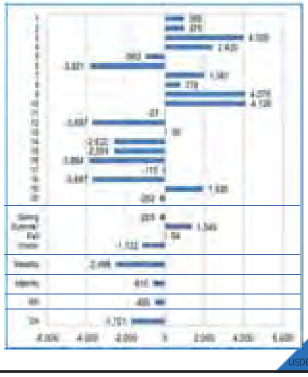
Milk Production Impact for Mastitis and Metritis

- Goal: derive estimates for milk loss for major postparturient issues using commercial data
- Approach:
  - Multivariate modeling for milk production as the outcome:
    - 2nd test 305me, Milk120, 305me
  - Factors in the model (separate models for lactation =1 and lactation >1):
    - Lact=1: Herd, Season fresh, Mastitis, Metritis, RP, and DA
    - Lact>1: Herd, Season fresh, Mastitis, Metritis, RP, DA, LactGrp and PrevLact305me

Lactation = 1 Milk Model Results (305ME)

- Final model:
  - = Intercept (29,778)
  - + Herd
  - + Season fresh
  - + Mastitis (yes/no)
  - + Metritis (yes/no)
  - + RP (yes/no)
  - + DA (yes/no)

Mastitis = -2,496 lbs
Metritis = -610 lbs
RP = -495 lbs
DA = -1,721 lbs



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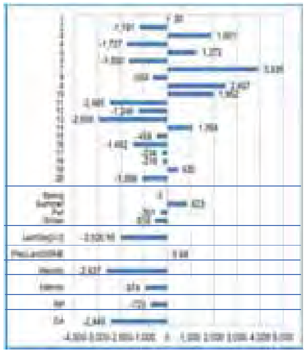
Lactation > 1 Milk Model Results (305ME)

- Final model:
  - = Intercept (14,726)
  - + Herd
  - + Season fresh
  - + LactGrp (2,3)
  - + PrevLact305me
  - + Mastitis (yes/no)
  - + Metritis (yes/no)
  - + RP (yes/no)
  - + DA (yes/no)

Mastitis = -2,637 lbs
Metritis = -974 lbs
RP = -723 lbs
DA = -2,449 lbs



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To Examine the Association Between Disease and Culling, Used Multivariate Approach with Separate Models (Primiparous and Multiparous)

- Primiparous model
  - Herd
  - Season fresh
  - Age at Calving
  - 305me
  - Metritis
  - Mastitis
  - RP
  - DA
- Multiparous model
  - Herd
  - Season fresh
  - LactGrp
  - 305me
  - Metritis
  - Mastitis
  - RP
  - DA

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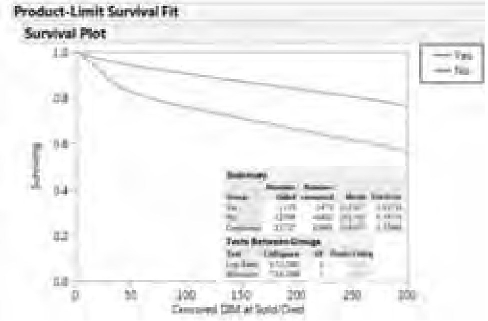
Time to Removal (Sold or Died)
Univariate Survival Plot for Mastitis (within 1st 30 DIM) Yes/No



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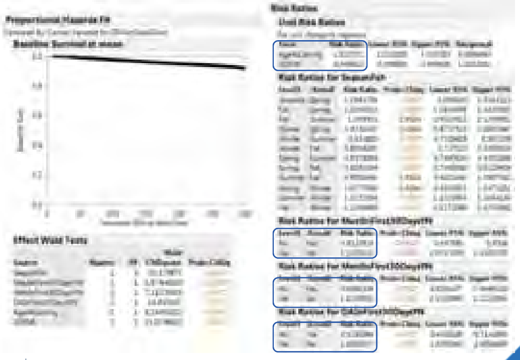
Mastitis and Metritis Impact on Primiparous Culling (Sold & Died)



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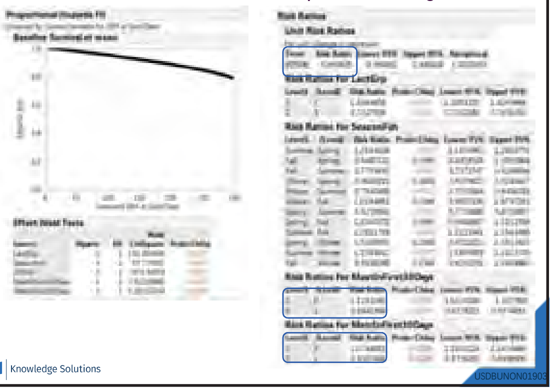
Disease Associations with Multiparous Culling Risk



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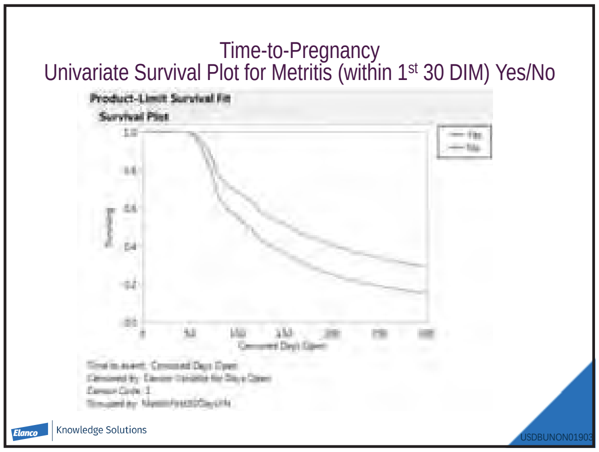

Time-to-Pregnancy
Univariate Survival Plot for Metritis (within 1st 30 DIM) Yes/No

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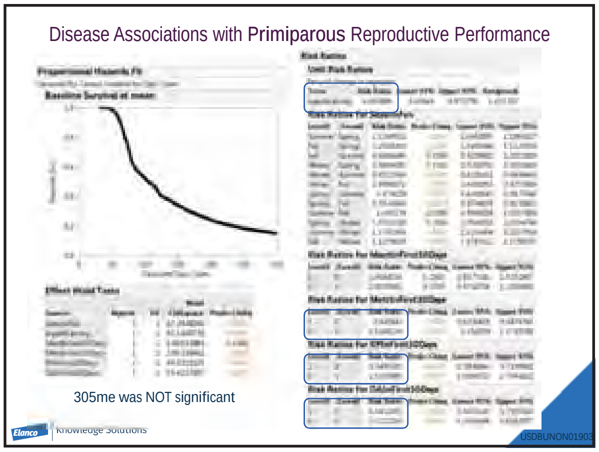

Disease Associations with **Primiparous** Reproductive Performance

305me was NOT significant

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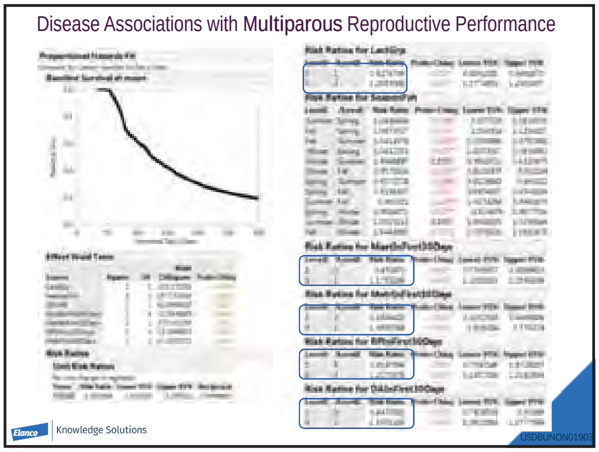

Disease Associations with **Multiparous** Reproductive Performance

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Lots of Data….What Does it All Mean?

- Cows with mastitis were predicted to:
  - Lose ~2,500 lbs of 305ME
  - ~1.12-1.23 X higher odds to be culled by 300 DIM
  - ~0.85-0.94 X lower odds to become pregnant by 300 DIM
- Cows with metritis were predicted to lose:
  - ~600-975 lbs of 305ME
  - 1.07-1.12 X higher odds to be culled by 300 DIM
  - ~0.66 X lower odds to become pregnant by 300 DIM
- Due to inadequate/ inconsistent disease definitions, as well as detection and recording issues, the true impact in the dairy industry is likely greater than this review shows

Estimating Cost of Disease: Issues that Need to be Considered

- Direct disease costs:
  - Diagnostics – is there any kind of special screening or lab test that is performed?
  - Therapeutics – what are the various antimicrobials, supportives, anti-inflammatories, etc that are used in treatment?
  - Discarded milk – how much milk is being discarded and for how long? What is the true value of this milk? Is it used to feed calves or discarded?
  - Veterinary service – is the vet involved with either diagnosis or treatment of this issue?
  - Labor – how much of my on-farm labor's time is used to diagnose or treat this issue?
  - Death – how many cows die as a consequence of this disease and what is the true economic impact to the dairy?

Estimating Cost of Disease: Issues that Need to be Considered

- Indirect disease costs:
  - Milk production loss – how much marginal milk is NOT produced throughout lactation as a result of this disease issue and what is that worth?
  - Culling loss – how many cows leave the herd prematurely as a consequence of this issue and what is the economic impact to the dairy?
  - Reproductive loss – how much is my reproductive performance negatively impacted by this issue and what could that be costing the herd?
  - Losses due to other attributable disease issues – are there any other disease issues that are impacted by the occurrence of this issue?

The Economic Assessment Tool

Goal: To estimate the total cost incurred by cows during The Vital 90 Days, *excluding basic ration and housing costs*.

Questions:
- How much does your dairy spend on prevention and treatment?
- What are your herd's transition disease costs?
- What is the cost to get a cow in your herd through The Vital 90 Days?
- What if the transition disease incidence were different?

Data Inputs:
- General herd parameters
- Preventive protocols
- Treatment protocols
- Disease incidence

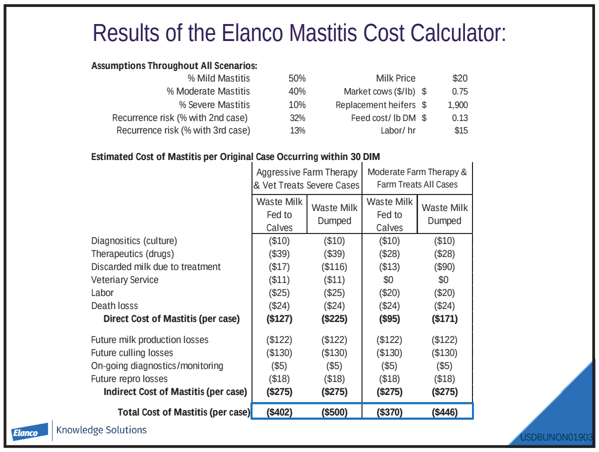
Modeling:
- Cost analysis and "what if" scenarios

Outputs of the Economic Assessment Tool

Estimated Cost of Ketosis in a Holstein Herd

(Where Ketosis is Defined as BHBA > 1200 µmol/L (serum) or > 100 umol/L (milk))

Ketosis	All Cows	Lact = 1	Lact > 1
Total Ketosis Incidence (BHBA > 1200 µmol/L)	35%	35%	35%
Clinical Ketosis Incidence (% treated)	7%	7%	7%
Diagnostics (i.e., testing for CK)	$0	$0	$0
Therapautics (Clinical Cases Treated)	-$2	-$2	-$2
Discarded milk during tx and the withdrawal period	$0	$0	$0
Veterinary service (CK)	$0	$0	$0
Labor (CK)	-$2	-$2	-$2
Death loss	-$38	-$38	-$37
Direct Cost of Ketosis per Case (BHBA > 1200)	-$42	-$43	-$42
Direct Cost of Ketosis per Cow Calving (BHBA > 1200)	*-$15*	*-$15*	*-$15*
Future milk production losses	-$21	-$22	-$21
Future culling losses	-$18	-$26	-$14
Repro losses	-$20	-$20	-$20
Indirect Cost of Ketosis per Case	-$59	-$68	-$55
Indirect Cost of Ketosis per Cow Calving	*-$21*	*-$24*	*-$19*
Avg Total Cost of Ketosis per Case in Early Lact	-$102	-$111	-$97
Avg Total Cost of Ketosis per Cow Calving	*-$36*	*-$39*	*-$34*



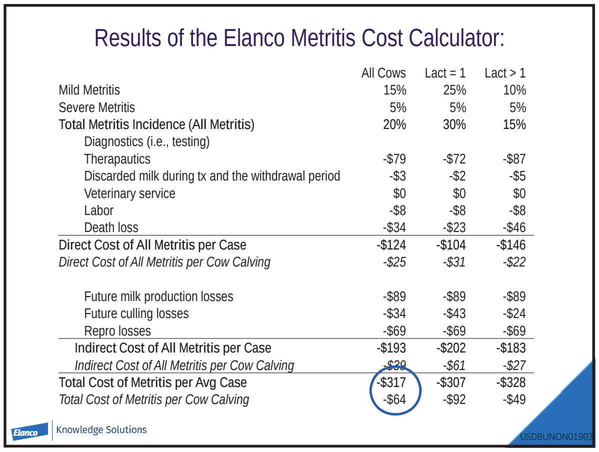
Results of the Elanco Mastitis Cost Calculator:

Assumptions Throughout All Scenarios:

% Mild Mastitis	50%	Milk Price		$20
% Moderate Mastitis	40%	Market cows ($/lb)	$	0.75
% Severe Mastitis	10%	Replacement heifers	$	1,900
Recurrence risk (% with 2nd case)	32%	Feed cost/ lb DM	$	0.13
Recurrence risk (% with 3rd case)	13%	Labor/ hr		$15

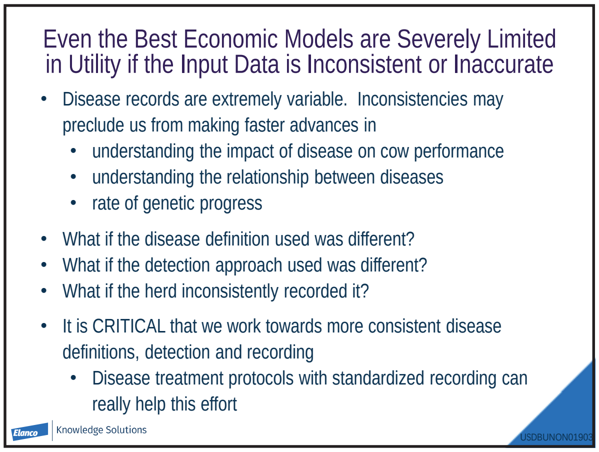
Estimated Cost of Mastitis per Original Case Occurring within 30 DIM

	Aggressive Farm Therapy & Vet Treats Severe Cases		Moderate Farm Therapy & Farm Treats All Cases	
	Waste Milk Fed to Calves	Waste Milk Dumped	Waste Milk Fed to Calves	Waste Milk Dumped
Diagnositics (culture)	($10)	($10)	($10)	($10)
Therapeutics (drugs)	($39)	($39)	($28)	($28)
Discarded milk due to treatment	($17)	($116)	($13)	($90)
Veteriary Service	($11)	($11)	$0	$0
Labor	($25)	($25)	($20)	($20)
Death losss	($24)	($24)	($24)	($24)
Direct Cost of Mastitis (per case)	**($127)**	**($225)**	**($95)**	**($171)**
Future milk production losses	($122)	($122)	($122)	($122)
Future culling losses	($130)	($130)	($130)	($130)
On-going diagnostics/monitoring	($5)	($5)	($5)	($5)
Future repro losses	($18)	($18)	($18)	($18)
Indirect Cost of Mastitis (per case)	**($275)**	**($275)**	**($275)**	**($275)**
Total Cost of Mastitis (per case)	**($402)**	**($500)**	**($370)**	**($446)**



Results of the Elanco Metritis Cost Calculator:

	All Cows	Lact = 1	Lact > 1
Mild Metritis	15%	25%	10%
Severe Metritis	5%	5%	5%
Total Metritis Incidence (All Metritis)	20%	30%	15%
Diagnostics (i.e., testing)			
Therapautics	-$79	-$72	-$87
Discarded milk during tx and the withdrawal period	-$3	-$2	-$5
Veterinary service	$0	$0	$0
Labor	-$8	-$8	-$8
Death loss	-$34	-$23	-$46
Direct Cost of All Metritis per Case	-$124	-$104	-$146
Direct Cost of All Metritis per Cow Calving	*-$25*	*-$31*	*-$22*
Future milk production losses	-$89	-$89	-$89
Future culling losses	-$34	-$43	-$24
Repro losses	-$69	-$69	-$69
Indirect Cost of All Metritis per Case	-$193	-$202	-$183
Indirect Cost of All Metritis per Cow Calving	*-$39*	*-$61*	*-$27*
Total Cost of Metritis per Avg Case	-$317	-$307	-$328
Total Cost of Metritis per Cow Calving	-$64	-$92	-$49



Even the Best Economic Models are Severely Limited in Utility if the Input Data is Inconsistent or Inaccurate

- Disease records are extremely variable. Inconsistencies may preclude us from making faster advances in
  - understanding the impact of disease on cow performance
  - understanding the relationship between diseases
  - rate of genetic progress
- What if the disease definition used was different?
- What if the detection approach used was different?
- What if the herd inconsistently recorded it?
- It is CRITICAL that we work towards more consistent disease definitions, detection and recording
  - Disease treatment protocols with standardized recording can really help this effort

Steps to Making Impactful Decisions with Disease Records

- Define and describe disease issues
  - Consistent definitions are key to training and consistency
- Monitor and detect disease issues
  - Strategic and consistent approach to monitoring cows and detection of disease is critical
- Record and treat using protocols
  - Standardized protocols simplify treatment decisions, data recording & entry into record system
- Analyze results and modify management as needed
  - Routine, consistent approaches to records review can lead to more timely and accurate decision making and greater profitability

(Define and Describe)

Common Disease Issues that Should be Properly Defined On-Farm

- Milk Fever
- Retained Placenta
- Ketosis
  - Hyperketonemia: ≥ 1200 µmol/L (serum) or ≥ 100 umol/L (milk)
    - Clinical ketosis
- Metritis – mild and severe
- Clinical Mastitis – mild, moderate, and severe
- Displaced Abomasum
- Ovarian Dysfunction (+/-)
- Lameness - Foot and leg problems
- Pneumonia

(Define and Describe)

Disease Definitions - Example

Clinical Mastitis (MAST)

- Description: Mastitis is an inflammation of the mammary gland. Clinical mastitis is characterized by visibly abnormal milk (e.g., clots or flakes and may be watery or discolored).
- Definition: MAST is recognized by visually abnormal milk from a quarter. Clinical mastitis is further classified as mild, moderate, or severe
  - Mild: Abnormal milk only
  - Moderate: Abnormal milk + inflammed udder
  - Severe: Abnormal milk + inflammed udder + sick cow

Adapted from Kelton, 1998. J Dairy Sci 81:81:2502–2509.

(Record and Treat)

Together with the Standardized Definition, There Should be a Standardized Recording Approach

```
## Protocol          Event   REMark   Pen  Milk Meat Days
== =============== ======= ======== ==== ==== ==== ====
 1 PIRSUE.IMM       MAST   PIR2QQ.S  99    2    9    2
 2 HETACIN-K.IMM    MAST   HET3QQ.S  99    3   10    3
```

REMark setup/ details (DC305 example): There are 8 characters per remark and are represented as 12345678.

123 A unique 3 letter pattern for the protocol used :
(HET = Hetacin-K, TOD = Today, MOX = Amoximast, SLC=Spectramast LC, PIR=Pirsue)

4 The labeled number of days the cow is on the protocol (typically 2-8)

56 Remark of the affected quarter: in the protocol set up, the placeholders are identified as QQ but in the actual REM, they are recorded as RF, RH, LF, LH or MQ for multiple quarters.

7 Use a period (.) Aids in later data retrieval – VERY important

8 A severity rating
1 - Mild - abnormal milk only
2 - Moderate - abnormal milk and swollen quarter
3 - Severe - abnormal milk, swollen quarter, sick cow

Example: HET3LF.1 = Hetacin-K IMM for 3 days in left front quarter. Severity rating of 1 (mild mastitis)

(Record and Treat)

Implementation

- On-Farm software programs can facilitate implementation of the treatment protocol strategy

How Much Does the Failure to Record Disease Affect the Measurable Impact of Disease?

- Introduces bias into the system

- Types of bias/recording issues:
  - Failure to record any disease
  - Failure to correctly distinguish mild from severe
  - Failure to record mild disease
  - Misclassification of a normal cow as “diseased”

Metritis Severity Score *Misclassification* Under Predicts Consequence Cost Of Disease*

- Convenience sample of DC305 data from 1 Mid-Western Holstein herd
  - 1 year of calvings (n = 3,485)
- Herd chosen because it does an excellent job of recording metritis incidence & severity
  - No metritis recorded (NR)
  - Mild metritis
  - Severe metritis

*McCarthy and Overton, Abstract 16288 presented at 2016 ADSA, Salt Lake City

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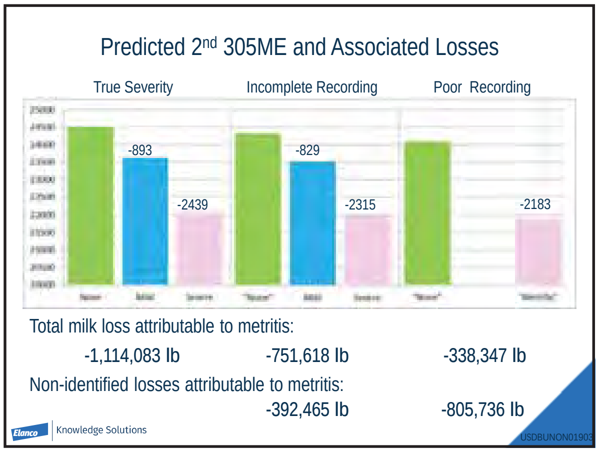
True Disease Severity (TS)	Inconsistent Disease Recording (IR)	Poor disease recording (PR)
Normal herd recorded data	Randomized 40% of mild cases to "not recorded"	All mild metritis cases reclassified as "not recorded"
1. No metritis recorded 2. Mild metritis 3. Severe metritis	1. No metritis recorded 2. Mild metritis 3. Severe metritis	1. No metritis recorded 2. Severe metritis

Statistical analysis

- TS, IR, and PR datasets analyzed separately in JMP 12.1.0
- ANOVA conducted for second test 305 day mature equivalent (2nd305ME)
- Lactation group (1, 2, 3+), month fresh, early lactation mastitis (+/-), and DA (+/-) were included in all models



Predicted 2nd 305ME and Associated Losses

Total milk loss attributable to metritis:

-1,114,083 lb	-751,618 lb	-338,347 lb

Non-identified losses attributable to metritis:

	-392,465 lb	-805,736 lb

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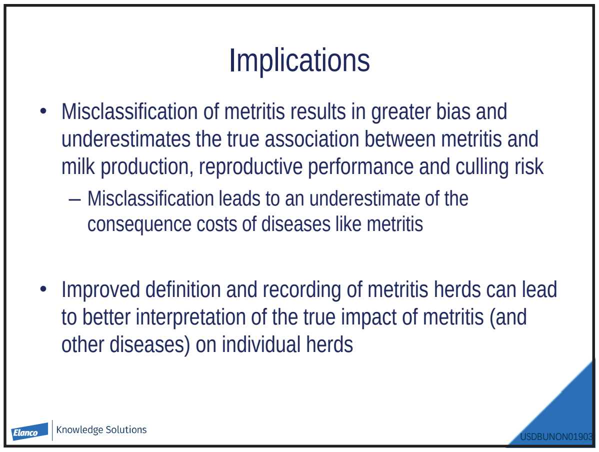

Implications

- Misclassification of metritis results in greater bias and underestimates the true association between metritis and milk production, reproductive performance and culling risk
  - Misclassification leads to an underestimate of the consequence costs of diseases like metritis
- Improved definition and recording of metritis herds can lead to better interpretation of the true impact of metritis (and other diseases) on individual herds

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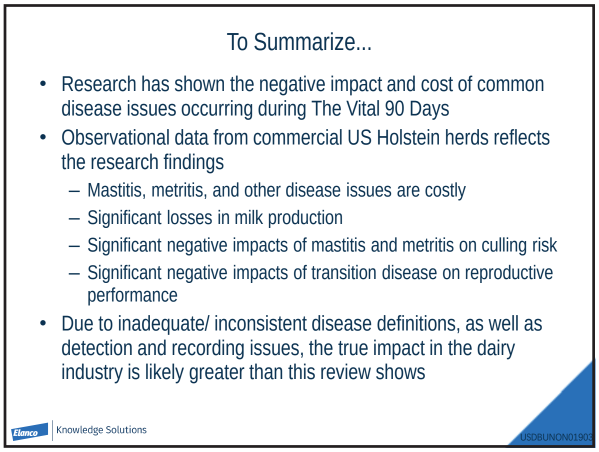

To Summarize…

- Research has shown the negative impact and cost of common disease issues occurring during The Vital 90 Days
- Observational data from commercial US Holstein herds reflects the research findings
  - Mastitis, metritis, and other disease issues are costly
  - Significant losses in milk production
  - Significant negative impacts of mastitis and metritis on culling risk
  - Significant negative impacts of transition disease on reproductive performance
- Due to inadequate/ inconsistent disease definitions, as well as detection and recording issues, the true impact in the dairy industry is likely greater than this review shows

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Thanks For Your Attention!

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