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HEALTH CONSIDERATIONS FOR THE CALF, SETTING UP FOR SUCCESS

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"Health Considerations for the Calf, Setting Up for Success." Or "Health Assurance/Insurance for Cattle"

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Introduction: Setting up for Success

- Health Assurance/Insurance
  - The Health Equation
- Health Assurance
  - Genetics
    - Selection pressure
  - Nutrition
    - Developmental programming
  - Colostrogenesis
    - Passive transfer
  - Stressors
    - Handling
    - Weather
    - Bio-security
- Health Insurance
  - Vaccination

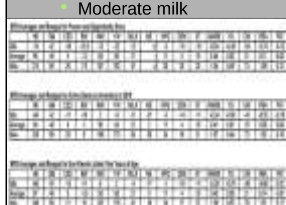
The Health Assurance Equation

- *Relationship of calf health and genetic potential to a set of risk factors.*
- *Calf health and performance =*
  - *FPT = failure of passive transfer (immune stress) +*
  - *Nut = nutrition (developmental programming) (stress) +*
  - *Env = environment (stress) +*
  - *Str = stress (social, psychological, processing) +*
  - *Exp = exposure (pathogen stress, synergy) +*
  - *Com = commingling (exponential exposure stress) +*
  - *Imm = immune response (lack of response stress) +*
  - *Labor = lack of, both quantity and quality(labor stress)*

Health Assurance: Genetic Selection

- Selection of genetics to achieve high levels of maternal immunity are critical to managing health.
  - Zero calving difficulty due to birth weight and shape
  - Adequate growth
  - Moderate milk

HB 70 CE – 6 BW – -0.7
WW – 55 YW – 80 Milk – 16
ME – -4



Health Assurance: Genetic Selection

Progeny Summary – 7 year old home raised

Males	Females	CI	BirthWt	WeanWt	YearWt	MPPA
2	3	374	99 (4)	99 (4)	103 (1)	99.23

HB – 93 CE – 13 BW – -4.7
WW – 32 YW - 48 Milk – 11
ME – -7

HB – 118 CE – 12 BW – -3.7 WW – 47 YW – 79 Milk – 14 ME – -3

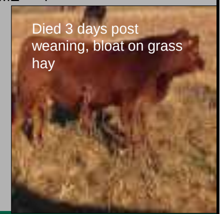
Health Assurance: Genetic Selection

Progeny Summary – 7 year old home raised

Males	Females	CI	BirthWt	WeanWt	YearWt	MPPA
5	0	367	99 (5)	106 (5)	113 (1)	104.62

HB – 88 CE – 8 BW – -1.9
WW – 38 YW – 69 Milk – 18
ME – -4

HB – 84 CE – 8 BW – -1.5
WW – 58 YW – 90 Milk – 15
ME – -4



Health Assurance: Molecular Genetic Technology

- Identifies parentage and verifies animal identity
- Clarifide Plus for Dairy
  - Wellness trait index
    - Mastitis
    - Metritis
    - Displaced abomasum
    - Ketosis
    - Retained Placenta
    - Lameness

Health Assurance: BRD and Heritability

- BRD is moderately heritable, and may be possible to reduce the incidence of BRD through genetic selection.
  - Variation in the BRD phenotype and immune system traits suggested herd health improvement may be achieved through genetic selection.
    - Cockrum RR, Speidel SE, Salak-Johnson JL, Chase CC, Peel RK, Weaber RL, Loneagan GH, Wagner JJ, Boddhireddy P, Thomas MG, Prayaga K, DeNise S, Enns RMJ Anim Sci. 2016 Jul;94(7):2770-8. Genetic parameters estimated at receiving for circulating cortisol, immunoglobulin G, interleukin 8, and incidence of bovine respiratory disease in feedlot beef steers.

Health Assurance: Genetic Effect - Heterosis

- Cows producing crossbred calves had greater immunoglobulin concentrations in the milk than cows producing purebred calves (Bos taurus X Bos indicus).
  - Sire of fetus effect on dam’s lactation.
  - Heterosis of the fetus influences maternal production of colostral immunoglobulins.

Vann et al J.An.Sci. 1996

Health Insurance/Assurance: Genetic Effect - Crossbreeding

- **Antibody and cell-mediated immune responses and survival between Holstein and Norwegian Red × Holstein Canadian calves.**
- Results suggest that crossbreeding could improve resistance to certain diseases in dairy **calves**, resulting in decreased input costs to producers for **crossbred calves** compared with purebred **calves**.
  - Cartwright SL, Begley N, Schaeffer LR, Burnside EB, Mallard BA. J. Dairy Sci. 2011 Mar;94(3):1576-85.

Application: Genetic Management

- Cull Heavy
- Sell Out
- Start Over?



Health Assurance: Nutrition


Health Assurance: Nutrition

- Developmental Programming
  - Runt piglets.
    - The lower preweaning growth of runt pigs cannot be entirely explained based on their lower birth weight, nor do they show full postnatal compensatory growth.
  - Effects of uterine crowding are analogous to the detrimental effects of nutritional restriction in gestating sows on fetal myogenesis, birth weight, and postnatal growth.
    - The biological basis for prenatal programming of postnatal performance in pigs G. R. Foxcroft, W. T. Dixon, S. Novak, C. T. Putman JAS 2006

Health Assurance: Developmental Programming

Table 1. Parturition parameters of beef cows that were fed control or control plus supplementation from d 201 to 270 of gestation

	Diet			
Variable	CON[1]	SUP[1]	SEM[2]	P-value
Gestation length, d	277	276	1.1	0.43
Second stage labor length, min	48	57	15	0.66
Calving ease[3]	1.87	1.44	0.36	0.39
Colostrum weight, g	614	837	95	0.10
Colostrum IgG, mg/mL	119.1	130.2	6.6	0.23
Colostrum IgG, g	79	107	14	0.18

[1]Maternal diets; CON (n = 15), control group consuming basal diet; SUP (n = 12), supplemented group consuming basal diet + DDGS at 0.30% BW.
[2]SEM for n = 12.
[3]Calving ease score (1 = no assistance; 5 = caesarian section).

Health Assurance: Developmental Programming

Table 5. Blood parameters in offspring of beef cows that were fed control or control plus supplementation from d 201 to 270 of gestation

	CON[1]		SUP[1]			P-value		
Variable	0 h	24 h	0 h	24 h	SEM[2]	Diet	Time	Diet × time
pH	7.38	7.52	7.34	7.44	0.41	0.11	0.002	0.71
Hemoglobin, g/L	125.0	112.8	131.6	122.2	4.6	0.07	0.02	0.75
IgG, mg/dL	380	3150	300	3790	270	0.21	<0.001	0.21
Protein, g/dL	4.15	5.85	4.22	6.45	1.8	0.05	<0.001	0.12

[1]Maternal diets; CON (n = 15), control group consuming basal diet; SUP (n = 12), supplemented group consuming basal diet + DDGS at 0.3% BW.
[2]SEM for n = 12.

Application

- Genetic selection and Nutrition during pregnancy are critical risk factors to managing for health


Colostrogenesis, Colostrum & Transfer

Colostrogenesis

- Transfer of immunoglobulins (Ig's) from maternal circulation to mammary secretions (colostrum) begins several weeks prior to parturition (calving).
  - 500 g/week
  - IgG1 concentrations in colostrum 5-10X that of circulation.
- Rapidly declines immediately at parturition.

–Tizzard IR, Veterinary Immunology 2000
–Brandon, MR et al. Aust J exp bio 1971

Passive Transfer & CMI

- Maternal cells in colostrum cross intestinal barrier and become systemic.
- Transfer of live maternal cells from colostrum to neonatal calves enhanced responses to antigens against which the dams had previously responded (BVDV), but not to antigens to which the dams were naïve.
- Cell-mediated immune transfer to neonates can be enhanced by maternal vaccination.
  - Archambault et al AJVR 1988
  - Donovan et al. Am J Vet Res 2007;68:778-782

Risk of Disease & Failure of passive transfer (FPT)

- Calves with inadequate immunoglobulin concentrations at 24 hours of age were 3.2-9.5 times more likely to become sick and 5.4 times more likely to die prior to weaning.
- Levels <u><800mg</u> of IgG/dl are considered inadequate.
  - Wittum, TE, Perino, LJ AJVR Sep 1995

Risk of Disease and Partial FPT

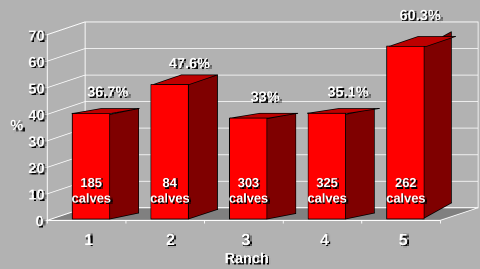
- <u>Calves with serum IgG1 levels up to 2500 mg/dl were 1.5X more likely to get sick before weaning and 2.4X more likely to die before weaning than calves with higher IgG1 levels.</u>
  - Dewell, RD., Hungerford, LL., Keen, JE., Grotelueschen, DM., Rupp, GP., Griffin, DD., 2002 Proceedings AABP

Relationship between Serum IgG Values and BRD in Calves

- 2 groups of 93 Holstein calves, severe BRD with 82% morbidity and 39% mortality
- Mortality
  - BRD deaths, the mean IgG was 1267 mg/dl
  - Surviving calves, the mean IgG was 2698 mg/dl
- Calves with lower IgG had
  - Higher morbidity
  - Were treated earlier
  - Were treated more frequently

Davidson, et al, JAVMA 179:7 (1981) 708-710

Immunoglobulins
5 Ranches, %<1500 mg/dl



Unpublished data,Grotelueschen & Hudson 1993

Colostrum Replacements/Supplements

- Serum IgG concentrations from calves fed natural colostrum averaged 2720 $\pm$ 1020 mg/dl with total serum protein 6.2 $\pm$ 0.7
- Serum IgG concentrations from calves fed 2 packages of colostrum replacements averaged 1690 $\pm$ 620 with total serum protein 5.6 $\pm$ 0.5
  - Land O' Lakes colostrum replacement

Foster et al, Serum IgG and total protein.. JAVMA 2006 229:1282-1285

Calving Stress & Environmental Stress

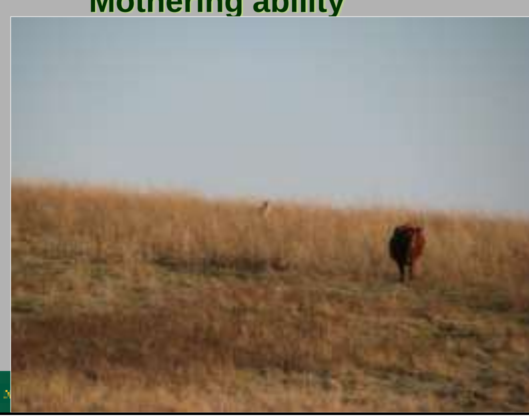
Health Assurance: Calving Stress

- In Herefords, increased calving difficulty was associated with a decrease in calf IgG1 levels (P<.05).
- Calves from Hereford lines selected for performance had lower IgG1 concentration than calves from the randomly selected control line.
  - Muggli,N.E.; Hohenboken,W.D.; Cundiff,L.V.; Kelley,K.W. JAS 1984 pp39-48

Health Assurance: Colostral Absorption & Calving Stress

- Decreased IgG1 absorption from colostrum was associated with respiratory acidosis (stress).
- Acidosis was frequently observed in calves that experience dystocia.
  - Besser,T.E.; Szenci,O.; Gay,C.C. JAVMA 1990 pp1239-1243

Mothering ability



Impact of Mothering Ability

- The presence of dams in the first hours of life and only at the time of first colostrum feeding (the most important part of received colostrum) can increase serum gamma -globulin concentrations of calves
- Mean serum gamma -globulin concentration in calves nursed in presence of dams was greater on days 2, 14 and 28.
  - Lotfollahzadeh,S.; et al. Journal of the Faculty of Veterinary Medicine, University of Tehran

Impact of Artificial Mothering

Table 2. Description of newborn heifer calves either artificially mothered by verbal and physical stimulation or handled with minimal stimulation (not mothered) before and after colostrum feeding

	Treatment group		
Item	Not mothered (n = 20)	Mothered(n = 21)	*Pval*
Prefeeding sample (0 h)			
Total protein (g/dL)	4.5 ± 0.3 (3.9 to 5.0)	4.6 ± 0.2 (4.0 to 5.1)	0.18
IgG (mg/mL)	0.3 ± 0.1 (0.2 to 0.5)	0.2 ± 0.1 (0.2 to 0.6)	0.38
Postfeeding sample (24 h)			
Total protein (g/dL)	**5.3 ± 0.2 (4.9 - 5.6)**	**5.4 ± 0.3 (4.9 - 6.0)**	**0.10**
IgG (mg/mL)	**13.9 ± 2.9 (8.0 - 19.8)**	**15.0 ± 2.5 (10.4 - 18.8)**	**0.21**
AEA of IgG	**36.4 ± 6.8 (21.8 - 47.4)**	**36.7 ± 4.3 (30.6 - 45.0)**	**0.86**

Haines, DM, Godden, SM, J. Dairy Sci. 94 :1536–1539

Health Assurance: Transportation & Environment Stress

Health Assurance: Pre-partum Stress

- Maternal stress (5 min restraint stress of pregnant sows in the last five gestational weeks) resulted in significant decreased serum immunoglobulin G (IgG) concentrations in suckling piglets at 1 and 3 days of age.
- Immunosuppressive effect on T and B cells.
- Morbidity and mortality were significantly increased during the suckling period.
  - Tuchscherer, M. et al Vet Imm and Immunopath 2002 86;195-203.

Health Assurance: Transportation Stress

- Exposing cows to repeated transportation stress during gestation altered their calf's physiological response to stress, and these alterations could have a profound influence on the calf's ability to adapt to stress.
  - Lay DC, et al. Effects of prenatal stress on suckling calves. JAS 1997 75:3143-3151

Health Assurance: Heat Stress

- Calves born to cows exposed to heat stress during the last 6 wk of gestation and fed their dams' colostrum have compromised **passive** and cell-mediated immunity compared with calves born to cows cooled during heat stress. Thus, heat stress negatively affects the ability of the calf to acquire **passive** immunity, regardless of colostrum source.
  - **Effect of heat stress during late gestation on immune function and growth performance of calves: isolation of altered colostral and calf factors.**
    - Monteiro AP, Tao S, Thompson IM, Dahl GE **J Dairy Sci.** 2014 Oct;97(10):6426-39.

Health Assurance: Cold Stress

- .
- Severe dystocia (Calving Difficult Score 3) resulted in lower calf rectal temperature, reduced serum cortisol, and increased serum glucose which could affect the ability of the calf to withstand cold stress. Minor dystocia did not cause and timely cesarean delivery prevented the physiological aberrations encountered in severe dystocia.
  - Effects of severity of dystocia on cold tolerance and serum concentrations of glucose and cortisol in neonatal beef calves.
    - Bellows RA1, Lammoglia MA Theriogenology. 2000 Feb;53(3):803-13.

Health Assurance: Maternal Nutritional Stress

- Extra inputs supplied to meet requirements
- Genetic selection to reduce need for extra inputs, $EN, ME

Health Assurance: Nutrition Stress & Calf Health

	Condition Score 2	3	4	5	6	Significant Level
Interval from calving to standing (min)	--	59.9(8)*	63.6(30)	43.3(35)	35.0(1)	0.24
Colostrum prod. (ml)	750.0(1)	1525.0(2)	1111.5(13)	1410.9(11)	--	0.19
Calf serum IgG_1 (mg/dl)	1787.6(1)	1998.1(8)	2178.8(33)	2309.8)34)	2348.9(1)	0.23
Calf serum IgM (mg/dl)	159.5(1)	145.9(8)	157.2(33)	193.1(34)	304.1(1)	0.05

* Numbers in parentheses are the number of observations.

Source: K. Odde

Health Assurance: Impact of Inadequate Maternal Immunity

- Growth performance was impacted in calves with inadequate colostral intake/absorption due to its effect on neonatal morbidity(sickness).
- Neonatal morbidity(1st 28 days) resulted in a 35 pound reduced weaning weight.

- **Wittum TE, Perino LJ AJVR Sep. 1995**

Health Assurance: Far Reaching Impact of Inadequate Maternal Immunity

Calves with inadequate colostral intake/absorption were at much greater risk of illness or death post weaning.

- **Wittum TE, Perino LJ AJVR sep. 1995**

Health Assurance: Far Reaching Impact of Maternal Immunity

- Animals fed 4 L of colostrum at birth produced significantly more milk compared with those fed 2 L.
- Calves fed 4L had an advantage of 550 kg of actual milk produced per cow over the first two lactations.
- The direct economic return to the producer was approximately $160 per cow in additional milk produced over two lactations.
  - Faber, SN, et al The Professional Animal Scientist 2005

Health Insurance

- Vaccination – High Quality Control
  - Necessary
    - Based on risk
  - Effective
    - Science
  - Safe
    - Limited local and systemic reactions

Health Insurance

- Calves
  - Respiratory virus vaccination, 2 doses prior to weaning
    - IBR, BRSV, PI3, BVDV
    - Coronavirus?
  - Repiratory bacterial vaccination
    - *Mannheimia hemolytica, Pasteurella multocida?, Histophilus somni ?, Mycoplasma bovis ?*
  - Clostridial vaccination, 2 doses prior to weaning
    - *Clostridium chauvoei, Cl. septicum, Cl. novyi, Cl. sordellii*, and *Cl. Perfringens* types C and D

Summary

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