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Symposium Paper: Health Management Programs: Integrating Biological and Management Principles in Analysis, Design, and Implementation of Programs for Two-Year-Old Beef Cows[1]

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Abstract

*Designing a health program for cow-calf operations requires a scientific approach and knowledge of ranch resources, environment, genetics, nutrition, management, and a biosecurity program. These areas are interrelated and must be considered to assess and manage the risk of disease. A comprehensive health program should 1) identify potential risks related to production and disease; 2) determine and understand appropriate benchmarks for production, disease, and production costs; 3) diagnose the problem when benchmarks are not achieved; and 4) use appropriate records to verify results. The 2-yr-old cow is at the greatest risk of failing to meet financial and production benchmarks because of her additional nutritional requirements. This group may also have reduced herd immunity and generally produce lower quantity and quality of colostrum, resulting in greater risk of disease and potentially reduced production in their offspring. As a result, this group may require more inputs in all aspects of the health program. Risk assessment includes the specific risks to biosecurity, such as raising or purchasing females that are persistently infected with bovine viral diarrhea virus (**BVDV**) or Mycobacterium paratuberculosis. Risk assessment of exposure to common infectious reproductive disease pathogens, such as infectious bovine rhinotracheitis (**IBR**), leptospirosis, trichomoniasis, vibriosis, and neopsora should be conducted and vaccination protocols implemented as needed. Finally, an understanding of the concept of herd immunity is important when defining realistic expectations regarding immunizations. With proper implementation, health programs can significantly reduce the risk of disease and economic loss.*

(Key Words: Beef Cattle, Disease, Health, Two-Year-Old Cow, Vaccination.)

Introduction

The goal of a health program is to decrease health risk and improve the opportunity for profit. Input costs to health programs are a minor component of annual cow costs. On average, veterinary costs, which typically include vaccinations, deworming, pregnancy diag-

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nosis, consultation, and other services, will range from \$7.70 to \$13.00/100 kg (\$3.50 to \$6.00 per cwt) of weaned calf (Dunn, 2000a). Discussion of health programs is often confined to vaccination protocols. Vaccination protocols are, in many instances, based primarily on convenience and price instead of science and logic. Proper analysis of health programs must begin with an assessment of risks to profitability. This step will usually result in an analysis of production outputs, but needs to include production costs as well. In addition, an assessment of health and its contribution to production is necessary to define a health program that is manageable and based on risk assessment and effective prevention strategies. The purpose of this manuscript is to review health and management programs that impact productivity and profitability of 2-yr-old beef cows.

Establishing the Benchmark

Production numbers or benchmark numbers that veterinarians and producers can use as standards of comparison are useful. A 1997 NAHMS study provides some comparison numbers (NAHMS, 1997). This study reported approximately 5.5% of all beef calves are lost from birth to weaning. Of this number, 2.1% were born dead, 1.1% died within 24 h, an additional 1.1% died prior to 3 wk of age, and 1.2% were lost between 3 wk of age and the time at which they were weaned. The actual etiologies for these losses were not discussed, but based on our knowledge of calves this age, certainly scours, respiratory disease, gastric ulcers, congenital defects, and weak calves all likely contributed to this number. Contributing factors were identified as weather, infectious disease, and calving problems. The addition of females that experience abortions and those that were not pregnant at the time of pregnancy diagnosis results in a quantification of production that can be very meaningful when assessing profitability. The percentage of pregnancy losses will range from 1 to >2%, and the percentage of females that failed to breed will range from 5 to 10% (NAHMS, 1999; SPA, 2002, 2003). In the younger female group, this number is usually higher than in the adult population (Geary, 2003). The addition of these numbers results in a weaned calf crop of 5.5 + 1 + 10 = 16.5% loss or an 83.5% calf crop. Is this number in line with our expectations or should changes be made to the health program to improve upon these numbers? Each category needs to be dissected as each one might have several causes. For example, the percentage of open cows by age group can usually be reduced by increasing the body condition score (**BCS**) of the age group in question if the group has a combined BCS <5. This may improve the percent open category considerably, but at a cost. In some cases, the cost of making changes may be greater than the benefit.

Multi-Factorial Nature of Disease. When assessing losses to disease, it is important to understand that the actual cause of disease is most often multi-factorial. Infection with a pathogen does not usually result in disease in the absence of other contributing factors. For example, scours in neonatal calves is almost always a result of several other events and factors that resulted in clinical disease (Perez, 1990). An acceptable way to quantify the causative factors with this clinical disease would be to construct a regression equation that includes all of the causative factors and how much they contribute to the disease. A regression equation $Y = b_0 + b_1X_1 + b_2X_2 + ... + b_kX_k$, for scours may look like this: $Y = 0.2 + 0.2(X_1) + 0.1(X_2) + 0.1(X_3) + 0.15(X_4)$. . ., where X_1 = degree of failure of passive transfer, X_2 = nutritional status of the cow and newborn calf, X_3 = environmental influences such as rain or snow and cold temperatures, and X_4 = exposure to pathogens. Although this approach helps to provide an understanding of the risk factors and explain the cause of the disease, the diagnostic ability to identify or even influence some of these factors is not always that apparent. Thus, producers become frustrated with control programs that only focus on one or two factors.

A Holistic Approach to Health Programs—Interactions with Management Factors. Health programs that utilize a holistic approach to health will, over time, be more successful and rewarding than those that focus primarily on extra inputs and vaccines to impact disease prevention programs (Radostits, 2001). A holistic approach must include genetic selection, nutrition, environmental management, land management, and animal husbandry skills.

Selection for Increased Production. Beef cow/calf operations tend to focus on parameters of production that are easily measured and achievable. Two commonly used parameters are simple weaning weight and selling price per pound. Other traits that have a greater impact on profitability are not often used when discussing potential profit and future strategies to increase profit (Dunn, 2002b). Weaning BW is influenced by the growth potential of the sire and dam, the milk production of the dam, and the feed resources. Sire selection to increase growth, both weaning and yearling, almost always selects for larger framed animals (Jenkins and Ferrell, 2002). The progeny, including replacement females from high growth bulls, can be several frame scores larger than the previous generation and will increase the mature size of the cow herd. Selection for growth might have a negative influence on health programs. The genetic correlation between calf birth, weaning, and yearling BW is positive (Cundiff et al., 1986). Birth weights will increase the stress on the newborn calf at parturition, increase the risk of failure of passive transfer, and increases the risk of sickness or death loss (Wittum and Perino, 1995; Odde, 1996; Filteau, 2003). Therefore, while attempting to achieve greater productivity through increased production, one may inadvertently select for decreased profitability because of fewer live weaned calves or decreased production caused by sickness and death loss. In addition, larger, mature females require greater feed resources, adding to production costs that may not be offset by improved production.

Other Selection Criteria. Other genetic selection criteria are important in the profitability equation; these include fertility, fleshing ability, mothering ability, teat and udder conformation, feet and leg conformation, disposition, and uniformity.

These criteria are not usually included in expected progeny differences calculations, but may be as important in achieving profitability for beef cattle operations.

Fertility is a trait that should translate into raising a live calf each year for 12 to 15 yr. Fertility has a low heritability, and selection for only this trait will result in very slow progress (Philipsson and Lindhe, 2001). It appears that crossbreds and certain breeds have higher natural predisposition to breed, conceive, and raise a live calf every year. (Cundiff et al., 1992; Martin et al., 1992).

The term “fleshing ability” does not refer only to animals with more flesh or muscle, but describes cattle that are able to maintain a greater amount of fat cover and muscle, particularly under less than optimal nutritional conditions. Females in body condition score ≥4 (scale 1 to 9) have a greater percentage of cycling and conception rates (Stevenson et al., 2000). In addition, research indicates that calves born to females in lower body condition have reduced absorption of immunoglobulins from colostrum and, thus, put their calves at greater risk of sickness and death loss (Odde, 1997).

Udder and teat conformation is a selection trait that generates good discussion but little science. In the beef industry, there are no expected progeny differences for good udder and teat conformation; yet, this selection trait is critically important to profitability. Females with poor udder and teat conformation (pendulous udders, unbalanced udders, balloon teats, or increased susceptibility to mastitis) may contribute to failure or partial failure of passive transfer and, thus, increase production loss caused by poorer performance, sickness, and death loss (Goonewardene et al., 2003; Riley et al., 2001).

Feet and leg conformation does not necessarily contribute to increased risk of illness or death loss but do contribute to longevity (Hansen et al., 1999). Females that produce a calf each year for 12 to 15 yr have a greater chance of being profitable. They must have sound conformation without feet and hoof problems, as well as stifle injuries.

Temperament is a heritable trait that may result in decreased animal performance (Gauly et al., 2001). It is important to remember that the beef cow is designed to harvest grass and produce calves with minimal human interference. When intervention is needed, humans must be secure that risk to bodily injury is unlikely.

Herd Immunity. Biological methods to control clinical disease in beef cattle populations have focused primarily on immunizations to control clinical disease; however, immunization to prevent disease transmission from animal to animal is of primary importance (John and Samuel, 2000).

In literature related to disease in humans, the concept of herd or population immunity has successfully been used to implement vaccination programs designed to protect populations. Specifically, they include diphtheria, tetanus, and pertussis; measles, mumps, and rubella; and poliomyelitis (Anderson, 1992). Although we are concerned about each individual being protected, the greater purpose is to immunize as many as possible within the population so that susceptible individuals within a population are also protected. The level of vaccination needed to achieve herd immunity varies by disease but ranges from 83 to 94% (May and Silverman, 2003). This concept is the basic premise of herd vaccination programs.

The greatest risk of IBR and BVDV infection is economic loss associated with abortion, increased morbidity and mortality, and BVDV persistent (**PI**) shedding animals (Larson et al., 2002). Label recommendations of commercial vaccines require that cattle populations be vaccinated annually to protect against these reproductive diseases (IBR and BVDV). Whether these vaccines actually need to be administered on an annual basis or not is an issue of risk analysis and risk management. What is the risk of the herd being exposed to a field challenge with either IBR or BVDV? In most commercial operations, this risk exists, but it is difficult to quantify. Females are often purchased without benefit of testing or quarantine. Bulls are purchased without any knowledge of current herd disease status. Even when vaccination programs are outlined in sale catalogs, most bull buyers do not seek veterinary advice as to the quality of the health program. In the majority of cases, this approach does not have negative consequences; however, in a quality control system with responsibility for disease control, the veterinarian will likely seek to lower the risk of exposure and increase the specific immunity.

The risk of exposure to common pathogens is really not known; however, there is some information as to the number of immune animals necessary to prevent spread of disease. The spread of disease depends on the basic reproductive rate (**R_0**; i.e., how many new cases arise on average from one infectious animal) of an infectious disease agent. If R_0 in a vaccinated population is >1, then the vaccine cannot totally prevent the spread of infection, and other biosecurity principles must be employed (Noordhuizen et al., 1997). For IBR, using two different vaccines, it was estimated that R_0 was 2.4 and 1.1 (Bosch, 1997). This result suggests that, within a susceptible population, 2.4 and/or 1.1 new cases will arise from one case. Within real populations, these numbers must be considered within the context that, as animals become infected and are contagious, the number of susceptible animals will decline, and the number of recovered and immune animals will increase. It has been estimated that the critical proportion of immune animals is expressed by the equation, critical proportion = $1 - 1/R_0$. The higher the R_0, the greater the number of animals that must be immune to prevent spread of the infectious agent. If we assume in a vaccinated population, the R_0 is 2.4 and 1.1, then transmission cannot be effectively stopped. Estimates for limiting the spread of BVDV within a population have been made based on mathematical models. In herds without PI animals, 57% of the animals must be immune to stop transmission. For herds with PI animals, 97% must be immune (Cherry et al., 1998). Of course, the issue of herd immunity is further complicated by the amount of cross protection afforded by commercial vaccines, as no vaccine will contain every strain or every possible antigen (Kelling, 2004). A sound recommendation for vaccines can only be made based on actual trials utilizing sound science and proper design.

Implications

To achieve the goal of successful health programs, a total review of current management strategies is necessary. The review must include genetic selection, nutrition, environmental management, land management, and animal husbandry skills. A risk assessment can be included and the correct vaccines utilized to lessen risk of specific cattle diseases. Then, significant changes can be made that can result in profitable beef production.

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