CASE STUDY # XX

APPLICANT NAME CREDENTIALS

A 30-day old Charolais cross bull calf (patient #XXXX) was presented to XXXX Veterinary Services on April XX, 20XX, with signs of dehydration, diarrhea and lethargy. The owner stated the calf had been experiencing diarrhea for 6 days, and he had been treating the calf with CalfSpan® (sustained – release sulfamethazine) boluses.

On physical exam the calf was hypothermic (34.9C/94.8F), had moderately sunken eyes, a slow skin tent (5 seconds), and was very lethargic. While he was sternal, he had no suck reflex, and a cool oral cavity, leading to a hydration status of 7-8% dehydrated. His heart rate was 100bpm and respiration was shallow and rapid at 42bpm. An approximate weight of 60kg/132lbs with a BCS of 3/9 was noted. The calf passed yellowish stool with no visible frank blood or melena.

Based on the clinical symptoms and history the veterinarian diagnosed infectious enteritis with a probable *Escherichia coli*, and corona virus combination. A medical, and nutritional plan was made with the veterinarian and technician.

Calf scours (enteritis) is not a singular disease, but multiple clinical signs associated with several diseases. Diarrhea is the classic clinical sign observed in cases of scours. The causes can be: 1) Non-infectious (nutrition, inadequate environment, insufficient care for the newborn calf, or 2) Infectious (bacterial – *Escherichia coli* (enterotoxigenic), *Salmonella* spp., *Clostridium perfringens*, viral – coronavirus, rotavirus, bovine viral diarrhea, infectious bovine rhinotracheitis, protozoan parasite – Cryptosporidium, Coccidiosis, yeast and molds - usually are secondary invaders, and due to overuse of antibiotics, sulfa drugs and calves that are non-treated dehydration). Most cases of scours are a result of several infectious and/or non-infectious factors.

Prevention of diarrhea in calves begins with nutrition in the pregnant heifer or mature cow. Inadequate nutrition during pregnancy, particularly the third trimester will: 1) Affect the quality of colostrum. The quality of an animal's milk is directly correlated to the quality, quantity and bioavailability of the nutrition it digests. There must be also be sufficient calories offered to cover daily energy requirements (lbs DM required / %DM of the feed = lbs of feed needed). A lack of quality nutrition, along with stress and other factors, may result in a lower immune system or inability to obtain therapeutic titre levels and increase the risk of contracting disease. The colostrum will reflect the level of the dam's immunity. 2) Cause a deficiency in energy and protein. If the available nutrients are deficient the cow will take from her reserves resulting in a loss of muscle mass, lack of viable integument and bone density in the event of inadequate mineral supplementation. A bred heifer is still growing and must have sufficient energy and protein to meet not only her fetus' growing needs but sufficient calories to finish her maturation. This can equate to a 2-2.5lb daily growth where a cow may be 1-1.5lb/day. If protein intake is low, nutrient absorption from the intestines may be decreased, particularly vitamin A/carotene. 3) Cause a deficiency in vitamin A and E which have been associated with scours in calves. Vitamin A, coming from carotene (green grasses), may be deficient in cattle with no access to green grass and fed straw or yellow hay throughout the winter months. The liver of a mature cow has a high capacity for vitamin A storage, but calves are born with very low reserves of vitamin A. Low intake of vitamin A in the pregnant cow will most likely result in a vitamin A deficient calf. Vitamin A in colostrum is high, thus the need to receive colostrum within a few hours post birth is important for the adequate uptake through the intestines. Dietary antioxidants (vitamin E) have an important effect on the utilization of carotenoids. It may aid in absorption or possibly as a protectant from oxidative stress.

Once the calf is born, conditions such as stressful birthing, congenital defects, adverse weather (storm, or strong wind) or a mother leaving her calf for long periods of time can disrupt the calf's normal pattern of nursing. The calf may miss the ideal time of absorption of immunity through colostrum. It may be unable to nurse appropriately or for an adequate length of time. The calf may become excessively hungry, and when it does get up to nurse the cow has produced more milk. A calf would be likely to overload resulting in nutritional scours; a white diarrhea caused by undigested milk passing through the intestines, resulting in an osmotic maldigestive diarrhea. Maldigestive diarrhea usually occurs in dairy calves but may occur in calves of heifers or inappropriate mothers.

Treatment for scours is to correct the deficit of hydration, acidosis (an excessive loss of bicarbonate from the blood (metabolic), or a build up of carbon dioxide due to ineffective respiratory function (respiratory) causing the pH of the blood to drop below the normal measurement of 7.4), electrolyte imbalances and still meet minimum energy requirements. Shortened, blunted intestinal villa must also be healed for the calf to have a chance of survival.

The technician prepared and aseptically placed a jugular catheter for the administration of IV fluids. The level of dehydration = % dehydration x body weight which was 4.8L for this calf. It was determined that the base deficit was 15mmol/L or 15mEq (due to being sternal, no suck reflex, and a cool oral cavity). To determine the mEq of bicarb needed: mEq= body weight x base deficit x volume of distribution (0.6 = 60%). Volume of distribution for bicarbonate range is based on the amount of total body water in a patient (50-100%). Based on these equations, 540mEq was needed to correct the metabolic acidosis. Knowing that 1g bicarb will correct 12mEq of deficit, 45g of bicarb was the measurable amount needed. The veterinarian used 52g (624mEq) bicarb in 4L sodium chloride 0.9%, which equals a 1.3% sodium bicarb solution. This was an acceptable amount to use based on the variance of the volume of distribution factor. The treatment plan was initiated with 8L isotonic HCO_3 (bicarbonate) over first 4 hours.

During diarrhea episodes, there is increased intestinal loss of sodium, potassium and chloride with a concurrent decrease in plasma sodium concentration. This results in hypo-osmotic plasma and extracellular fluid, enteric hypochloremia and hypokalemia due to the profound diuresis. The high retention of sodium in the cells (hypernatremia), causes fluid to move from the extracellular to the intracellular space, resulting in an increase in swelling of the cells, thus contributing to the development of hypovolemic shock. There is also a prevention of absorption of fluids from the intestines, while allowing extracellular fluids to pass into the intestines. Serum potassium levels are very insignificant (only 2%), and with potassium moving in and out of cells while the body as in an acidotic state (due to hypernatremia), the blood pH must first be corrected before a true potassium reading could be obtained or cell level corrected.

Energy is an important factor when treating scours. A calf would utilize limited stores quickly and become hypoglycemic. Dextrose is a good source of parenteral nutrition for calves to initially increase its blood glucose until enteral nutrition can be administered. Calves do not have the enzyme sucrase and therefore are unable to utilize dietary sucrose. Sucrose (table sugar), can induce osmotic diarrhea and would be counterintuitive in scour cases. It should be not used as a substitute for dextrose in parenteral or oral electrolyte solutions.

This calf had been having diarrhea for several days increasing the risk of potassium loss from the intracellular space. Once the dehydration, and acidosis were corrected, blood sugar, and electrolytes could be balanced. Upon completion of the isotonic bicarbonate solution, 4L isotonic sodium chloride 0.9% with 5% dextrose, infused with 80mEq of potassium chloride was administered IV over approximately 8 hours (approximately 1 drop/second). Potassium can be given at a maximum rate of 0.5mEq/kg/hr (30mEq/hr for this calf) so it is important to ensure that the rate of infusion does not exceed this amount.

Once the deficits were replaced, it is important to start enteral nutrition, inducing peristalsis and start healing the intestinal tract. A calf needs approximately 10-12% of its body weight in milk per day. This calf being 60kg needed 7.2kg or 7.5L (7.2kg x 2.2 = 15.8lbs /2 = 7.92 quarts x 0.96 = 7.49L) milk per day. The calf was administered a calf milk replacer (ME 4500kcal/kg, each 227g package = 1021.5kcal mixed in 1L warm water) via oral-gastric tube. Milk is the choice nutrient over electrolyte solutions (a limited amount of dextrose can be added to keep the osmolarity of the solution low), or dry meal such as hay or grain, as milk is digested in the abomasum with 90% of the gross energy (GE) becoming metabolized energy (ME) compared with hay in the rumen at only 50-60% of the GE becoming

ME. 30mg meloxicam was administered SQ, and 200mg/1000mg trimethoprim/sulfadoxine was administered slowly IV. The milk replacer at the same dose via oral-gastric intubation was repeated 4 hours later.

The following morning the calf was brighter and standing though weak. Temperature, pulse, and respiration were within normal limits and there was improved hydration status. An attempt to nurse the calf via a bottle was mildly successful. The calf had a moderate suck reflex but was only strong enough to finish 1/3 of the volume. The calf was administered the remaining milk replacer solution via oral-gastric intubation. The calf was administered 200mg/1000mg trimethoprim/sulfadoxine slowly IV.

When discharged later that morning, it was recommended that the owner continue with not only the milk replacer but with an electrolyte solution with added dextrose (high energy). The milk replacer should be done four times daily, with an electrolyte solution administered once between treatments. The electrolyte solution (Calf-lyte 11 HE ®) provides approximately 112.5mEq/L sodium, 15mEq/L potassium, 6mEq/L hydrogen, 43mEq/L chloride, 10.5mEq/L phosphate, 45mMol/L glycine, 413.6mMol/L dextrose and 80mEq/L acetate (which when metabolized is equal to 80mEq/L bicarb). One 185g pouch should be mixed in 2L hot water. It can be administered via oral-gastric tube or bottle fed. The calf would ideally be able to be reintroduced to the cow and return to normal nursing behaviour. Most owners will keep the cow and calf separate and supplement treatments as needed, case dependant. This owner was sent home with the Colossal Milk Replacer ® to be administered every 6 hours and Calf-lyte 11 HE ® to be administered in place of one milk replacer once every 24 hours until the calf was fully back on the cow. The calf was supplemented on farm for 2 days then was left to nurse the cow. He recovered well and continues to grow at the same rate as similar aged calves.