

Written by Dr. Drew Vermeire

We take care of calves, naturally!

THE FOUR D'S OF SCOURS: **DIARRHEA, DEHYDRATION, DEPRESSION, DEATH**

According to the USDA National Animal Health Monitoring Service, scours is the number one killer of young dairy calves. The proportion of calves that die due to scours has increased. In the 1992 study, 52.2% of calves died due to scours and increased to 60.5% in 1996 and 62.1% in 2002. Nationally, more than 5% of all calves born die because of scours.

Calves with scours generally follow a similar pathway which I call the "Four D's of Scours." These D's are Diarrhea, Dehydration, Depression, and Death. This NRV newsletter will describe the Four D's causes and cures.

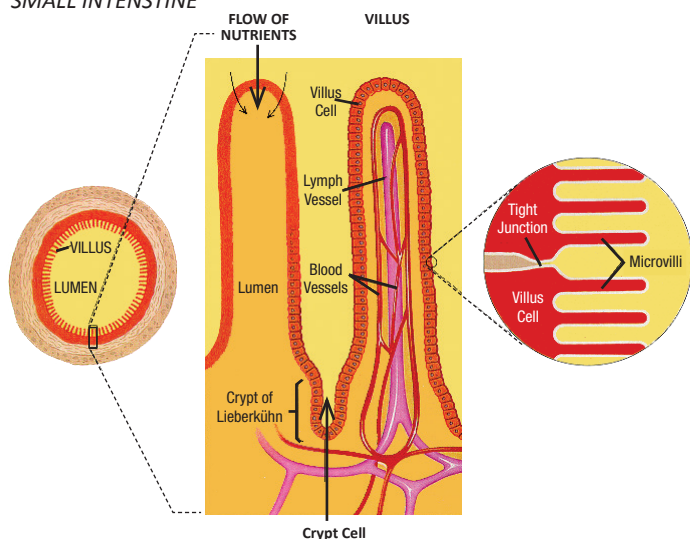
THE FOUR D'S OF SCOURS **#1 DIARRHEA**

Calves become infected by bacteria or viruses that cause scours - the outward symptom is an increase in stool volume and an increase in stool water content. In other words, calves have diarrhea.

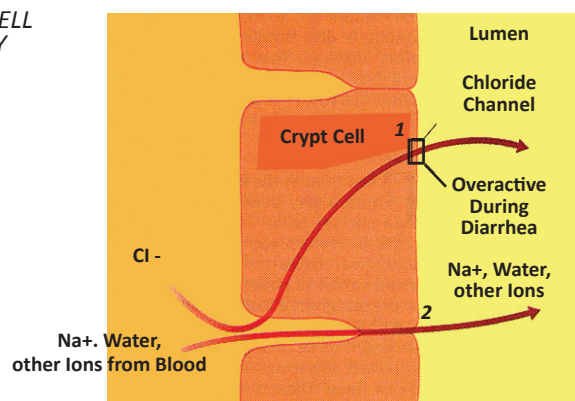
THE NORMAL INTESTINE GOES WITH THE FLOW

The lining of the small intestine is covered with thousands of tiny finger-like projections called "villi" or individually, villus. Each villus has an artery, a vein, and a lymph vessel to absorb nutrients into the blood. At the base of the villus is the Crypt of Lieberkühn. Cells are "born" in the crypt and migrate to the end of the villus where they are eventually sloughed off into the lumen of the intestine.

SMALL INTESTINE



CRYPT CELL ACTIVITY



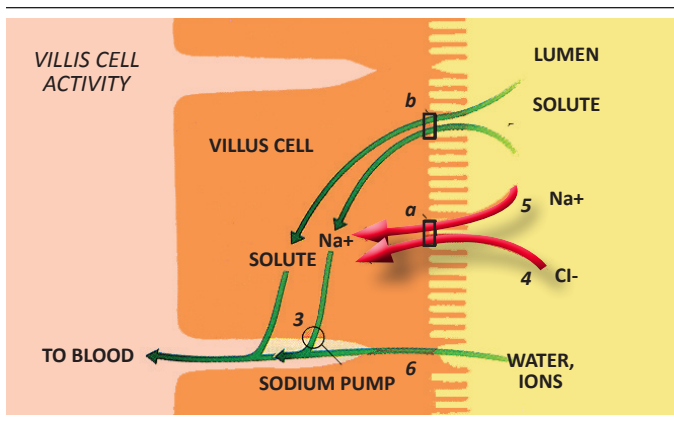
Crypt cells and villus cells normally have opposite functions. Crypt cells secrete water to help digestion while villus cells absorb water along with other nutrients so the nutrients can be metabolized by the body. Each day, a 100 lb calf secretes and absorbs about 100 liters (26.4 gallons) of water in this process. Causes of diarrhea will be discussed as we go along.

Crypt Secretes Water Into Intestine

Crypt cells secrete chloride ions (Cl-) into the lumen of the intestine. Sodium ions (Na+) and water follow the chloride ions into the lumen. Some scours are caused by bacterial toxins causing the crypt cell to secrete more chloride ions than normal into the lumen. Over-activity of crypt cells results in more water drawn to the intestine than normal. In essence, water is "stuck" in the intestine because there is an imbalance between water flowing from the crypt cells into the intestine and re-absorption of water via the villi cells. Too much water flowing into the intestine and too little water being re-absorbed increases stool volume and water content - what we call diarrhea.

THE FOUR D'S OF SCOURS

Intestinal Function and Water Balance for Normal and Scoured Calf



Villi Cells Absorb Water and Nutrients

The normal villus cell absorbs water by first absorbing sodium ions, then water and chloride ions follow. Under normal circumstances, sodium and chloride are absorbed together or sodium can be linked with a solute like glucose (dextrose) or an amino acid. But, some bacteria cause scours by secreting a toxin that blocks the normal sodium-chloride absorption.

One of the great discoveries of the last century was the discovery that the solute-linked sodium absorption pathway still functions during diarrhea. This discovery was made during the Bangladesh War for Independence and literally saved the lives of thousands of war refugees when IV solutions were not available. This discovery led to electrolyte solutions for animals - Generation I Oral Rehydration Therapy (ORT) solutions which contain dextrose, sodium chloride, potassium chloride, and sodium bicarbonate.

Several types of viruses cause diarrhea by attacking the villi cells and causing the end of the villi to slough off. Diarrhea occurs because villi cells are no longer present to absorb water, resulting in increased stool water content and volume. It takes several weeks for the villi to heal and regenerate new absorptive tissue.

THE FOUR D'S OF SCOURS - #2 DEHYDRATION

Table 1 shows the tremendous difference in water balance between a normal calf and a calf with scours. The normal calf gains more water each day because the scoured calf doesn't readily consume milk or milk replacer while it is sick. The scoured calf loses about 10 times as much water as the normal calf because of the huge increase in fecal volume and increased fecal moisture content. Urinary and insensible losses are less in the scoured calf, but it is not enough to compensate for fecal losses. The net balance is that the normal calf gains about 1 quart of water per day but the scoured calf loses nearly 1 gallon of water per day. Is it any wonder that the calf soon develops the outward symptoms of dehydration which are recessed eyeballs, droopy ears, loss of skin elasticity, reduced blood volume, and cold ears, nose, and feet?

Dehydration Not Evident Until 5% Weight Loss

Outward signs of dehydration are not readily evident until the calf has lost 5% or more of its body weight. With 6-8% body weight loss, eyes are slightly sunken, ears are slightly droopy, and skin remains tented for 1-3 seconds when pinched. As dehydration becomes more severe, symptoms become more pronounced. With 9-11% body weight loss, eyes become deeply sunken, ears are very droopy, and skin remains tented for 4 or more seconds when pinched.

THE FOUR D'S OF SCOURS - #3 DEPRESSION

Depression is the outward expression of metabolic acidosis, a condition which occurs when the blood becomes too acidic. Symptoms include loss of suck reflex, loss of menace and tactile responses, and the inability to stand. Calves that stick out their tongues instead of drinking are not being contrary - they can't suck because of acidosis. Depression can occur separately from dehydration. It's possible for a calf to be unable to stand, but not have sunken eyes. Other calves may have sunken eyes but still be able to stand and suck normally. Acidosis must be corrected by giving metabolizable bases, which raise body pH.

Generation I ORT solutions contain sodium bicarbonate to help neutralize metabolic acidosis. In the 1970's, the World Health Organization (WHO) removed sodium bicarbonate from its ORT solution and replaced it with sodium citrate. Citrate does not raise pH of the stomach or interfere with milk or protein digestion like sodium bicarbonate. Bases such as sodium citrate, sodium propionate, sodium acetate, and calcium acetate do not interfere with stomach acid which normally prevents re-infection by pathogens. Acetate and propionate also provide some energy for calves. ORT solutions which don't contain sodium bicarbonate are called "Generation II ORT solutions."

Call the Fire Department!
Give fluids When 1st Symptoms Appear!

THE FOUR D'S OF SCOURS - #4 DEATH

When the dehydration reaches 11-12%, death occurs. Normally, death is caused by the imbalance of potassium and sodium which results in a heart attack.

Calves Are "Half-Dead" When You First See It!

How can we keep calves alive? First, recognize that calves have lost 5-6% of their body weight when we can first visibly detect symptoms of dehydration. Calves will die when they reach 11-12% body weight loss. This means that calves are half-dead when we can first visibly detect symptoms of dehydration!

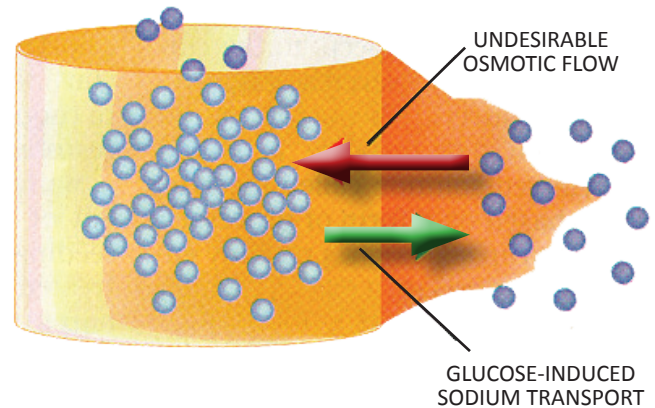
Secondly, scoured calves will die if we don't take immediate action. ***If the house was on fire, how long would we wait before we called the fire department?*** We must begin fluid therapy immediately when we first see scours or detect dehydration. Calves which have lost 5-6% of their body weight require 3-5 quarts of ORT solution to replenish lost fluids. **Continue feeding 3-5 quarts of milk replacer per day.**

The Negative Side of Glucose - Osmotic Penalty

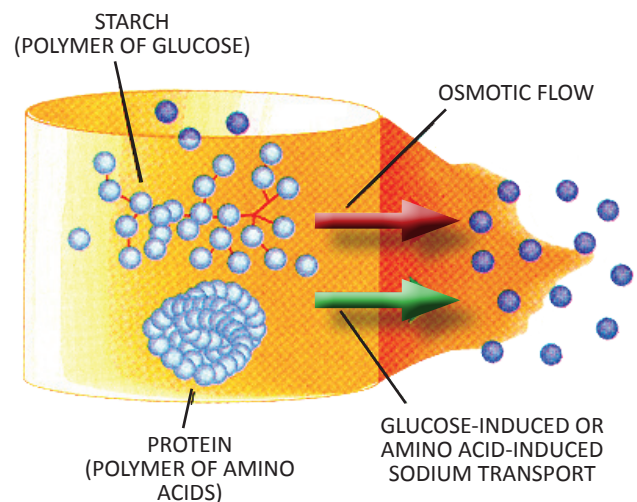
Glucose is linked to sodium absorption, but there is a risk of osmotic penalty. Water moves through body membranes to balance the number of dissolved particles on each side of the membrane. Particles cannot move across the membrane - only water moves from areas of high concentration to areas of low concentration to maintain osmotic balance.

When a calf is given an ORT solution with a low concentration of dissolved particles (glucose and electrolytes), water moves from the intestine into the blood until the concentration of dissolved particles is equal. Next, water moves by glucose-induced sodium transport. Water automatically moves across the membrane to balance osmotic pressure and doesn't require energy to occur. The pressure is based on the number of particles - not the size of the particles.

Most ORT solutions have a high concentration of particles and cause an initially negative flow of water from the blood into the intestine - called "osmotic penalty." Giving a Generation I or Generation II ORT solution to severely dehydrated calves results in water moving the wrong way, from the blood where it is needed into the intestine which causes more scours and often results in death of the calf. Preventing death due to osmotic penalty is the reason why most ORT solutions recommend administering intravenous solutions to severely dehydrated calves. Finding a vein to administer an IV in a severely dehydrated calf is not an easy task but choices are few for severe dehydration.

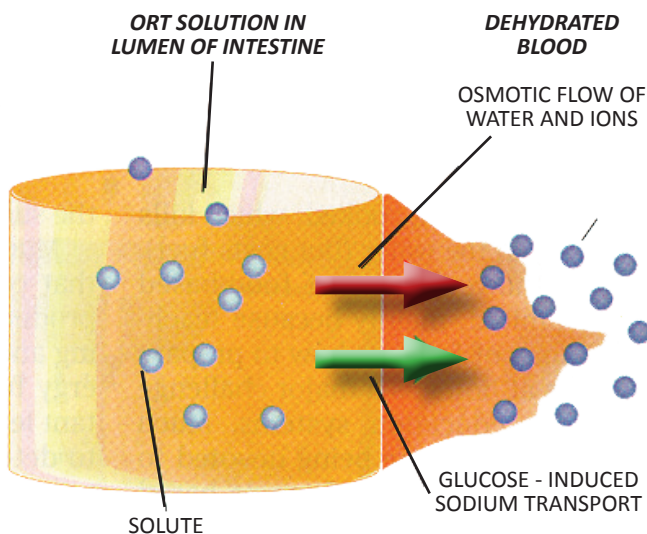


Osmotic Penalty occurs in dehydrated long distance runners when they drink Gatorade® or a similar high-concentration drink after finishing a race. Water flows into the intestine. Reduced blood volume results in insufficient oxygen to the brain, potentially causing the runner to collapse or pass out. Recovery usually takes 5-10 minutes before fluid absorption from the intestine restores blood volume to supply oxygen to the brain again.



The Solution to Prevent Osmotic Penalty

To prevent osmotic penalty, a long chain or polymer of amino acids or glucose (dextrose) is used instead of individual units. Each polymer is seen by the body as one unit of osmotic pressure so it "pushes" water from the intestine into the blood - the opposite of osmotic penalty. Low-osmotic pressure ORT solution is called "Generation III ORT" and uses specialized starches and proteins to create a superior solution that can be given orally to severely dehydrated calves without killing them. In the realm of human nutrition, the WHO abandoned glucose-based solutions and embraced the Generation III technology in the 1980's.



Gen-III Lyte™ - Unique Generation III Life Saver

NRV, INC. INTRODUCED
Gen-III Lyte™

**WHICH INCORPORATES
GENERATION II AND III TECHNOLOGY.**

Young calves cannot effectively digest most starches and dextrose polymers, so the difficulty was finding a polymer with a chain length long enough to reduce osmotic pressure but one in which calves could digest. This quest required 5 years of research to find an ideal polymer for calves and resulted in the most effective ORT solution available to calf growers.

Unique Maltodextrin Formula

Gen-III Lyte™ is truly superior to other electrolyte products. The unique maltodextrin in Gen-III Lyte™ has a very low osmotic pressure while giving the osmotic “push” to replenish lost fluids quickly. Severely dehydrated calves can be given Gen-III Lyte™ using an esophageal feeder instead of giving IV fluids without fear of osmotic penalty.

No Sodium Bicarbonate - Keep Calves on Milk

Gen-III Lyte™ contains multiple sources of metabolizable bases (sodium citrate, sodium acetate, sodium propionate, calcium acetate) to correct metabolic acidosis. Calves can drink milk or milk replacer without interfering with protein digestion because Gen-III Lyte™ does not contain sodium bicarbonate.

Extremely Palatable

Calves readily consume Gen-III Lyte™ which reduces labor. Gen-III Lyte™ was tested on a large calf ranch for several years where palatability is critical. Flavor adjustments were made to improve palatability until the present formula was developed. Calves drink it!



KEEP CALVES ALIVE!

- 1) **Keep feeding scoured calves milk or milk replacer twice per day, but do not force-feed milk replacer to calves if they won't readily consume it.**
- 2) **Mix 5 ounces (145 grams) of Gen-III Lyte™ powder into warm water (120°F) to make 2 quarts of electrolyte solution.**
- 3) **Feed 2 quarts of Gen-III Lyte™ electrolyte solution between milk feedings to calves with scours and calves with signs of dehydration. Feed 2 quarts 2-3 times per day to calves with moderate to severe dehydration. Continue feeding 8-10% of body weight in electrolyte solution per day plus milk or milk replacer every day until stools are normal. If necessary, feed depressed calves electrolyte solution using an esophageal feeder to replenish body fluids.**



**TREATING SCOURS BASED ON
OUTWARD SIGNS OF DEHYDRATION IN CALVES
FEEDING ELECTROLYTES EARLY SAVES LIVES!**

1 BOTTLE ZONE	2 BOTTLE ZONE	3 BOTTLE ZONE	DEAD ZONE
Mild dehydration	Moderate dehydration	Severe dehydration	Calf likely dies
1-6% loss of body weight body weight	6-8% fluid loss	8-10% fluid loss	10-12% fluid loss
Calves have scours or known stress such as shipping	Scours	Scours	Scours
	Skin Tents 1-3 seconds	Skin Tents 4+ seconds	Skin Tents 4+ seconds
	Eyes sunken sunken Ears droopy	Eyes deeply sunken Ears droopy & cold	As last resort, give Gen-III Lyte® plus, I.V. Ringers
No visible signs of dehydration but calf has lost body fluid	Calf is Halfway Dead! Start Feeding Gen-III Lyte® Now!	Calf stops eating Calf cannot suck Calf cannot stand	← Start Sooner! Give Gen-III Lyte® at the first sign of scours or dehydration
		Always give electrolytes between milk/milk replacer feedings. Give electrolytes for 5 days after arrival for shipped calves	

0% 1% 2% 3% 4% 5% 6% 7% 8% 9% 10% 11% 12%
LEVEL OF DEHYDRATION, % BODY WEIGHT LOSS

- **Identify - Treat - Repeat!** Systematically take action early and keep more calves alive!
- **Always wait 2-3 hours** after feeding milk or electrolyte before giving another bottle of milk or electrolyte.
- **Always offer milk** or milk replacer 2-3 times per day.
- **If calves cannot or will not drink**, give calf electrolytes using thoroughly cleaned and sanitized esophageal feeder.
- **Never give milk** to calves with an esophageal feeder.
- **Sound the alarm!** I mmediately start feeding electrolytes to calves when first signs of scours appear. Dehydrated calves need 2-3 bottles of electrolytes plus milk replacer every day.



We take care of calves, naturally!

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