

Veterinary Public Health in Nicaragua June 9th - June 20th, 2012

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Over the course of 10 days in Nicaragua, we visited two rural villages. We experienced five major cities in Nicaragua during our travels between villages, namely Managua, Granada, San Ramón, Masaya, and Matagalpa. Our team spent June 9th—June 14th in the village of Rodeo Grande near Somotillo, and June 15th—June 19th in the village of Fila Grande. June 14th was a travel day and gave us the chance to visit Rancho Ebenezer, a sustainable agriculture organization in Niquinohomo.

Our team included five veterinary students from Ohio State, one full time veterinarian from Williamsburg, Virginia (Dr. Pamela Dumont), and a full time veterinarian from Mississippi (Dr. Rick Ervin) who now lives in Nicaragua year-round. Dr. Ervin's wife Mary is a full time nurse who also lives with her husband in Nicaragua. The Ervins have been working in Nicaragua for over 10 years and are members of the Christian Veterinary Mission organization that helped to coordinate our team.

Our program involved continued education and encouragement of local health promoters in each of the two villages. One of the health promoters, Evelio Guzmán, traveled with our team for the entire trip. We worked in Rodeo Grande from June 9th to June 14th. Donald Aguilera, the health promoter in that village, works from his own plot of land but will also make farm visits within the surrounding area. Individuals come to his home for medical aid, either for human medical care or veterinary-related concerns. Donald Aguilera is pictured here with the family's horse in his village of Rodeo Grande.



Rodeo Grande is a remote village in the hilly state of Chinandega in northwestern Nicaragua. There were no electric lines to most of the homes although some families did generate enough electricity to power one or two light bulbs at night, which was definitely a luxury. Donald's family also employed a traditional clay adobe oven (seen here) for cooking beans and rice, which we ate on a daily basis.

Rodeo Grande is not far from a reliable water source, which comparatively is a significant problem for other third world countries. Nicaragua in general does not have this problem, although the sanitary nature of the water source is of great concern. Outhouses are usually constructed far away from vital water sources, which is an improvement that helps promote some degree of sanitation. Of course, the river is a valuable asset to the village. The water from it is used for washing clothes, cooking, hydration of both people and animals, and bathing. Below, a woman from Rodeo Grande washes clothing.



The licensed veterinarians on our team performed the surgeries required in the villages. They castrated 3 horses the first day (June 10), 2 horses and a mule the second day (June 11), one horse on the third day (June 12), and 2 pigs the fourth day (June 13). We also examined a hen that wasn't laying as many eggs as usual.

Castration is a worthwhile surgery due to the energy used by animals to either heat or cool the testicles to optimize sperm motility. Eliminating the testicles allows the animal to divert that energy into other metabolic processes, and the animal will gain weight more efficiently or be able to keep a healthier weight should food ever be less available. In non-breeding males, it makes sense to castrate for the sake of the animal's welfare and also benefits the family. Weight gain is especially important in bovine and porcine animals since these animals are intended for meat consumption. Cattle are also used for plowing the fields, a demand that requires a great deal of the animals' energy. Weight maintenance is important for horses as well since they are asked to work especially hard in Nicaraguan culture. Horses are crucial to the survival of lower income families because they are used for plowing, transportation, and shipping of necessary goods. Other health concerns for horses include dehydration, sarcoids, lameness, bacterial infections, parasites, sores on the back caused by saddles, sores on the dorsal aspect of the nose caused by rope halters, and painful dental problems caused by improperly fitted bits. Additionally, castration of horses may produce behavioral changes that allow for the animal to be safer and more easily handled, less flighty and more predictable.

Veterinary students were allowed to observe the castrations or participate in basic tasks like applying antibacterial scarlet oil at the end of the surgery; we were also allowed to deworm cattle, horses, and dogs. Of course, we always double checked the dosages of ivermectin or albendazole with a veterinarian or health promoter to make sure we had not over- or under-estimated the weight of the animal to be dewormed. During our time in Rodeo Grande, our team dewormed approximately 50 head of cattle and at least 10 horses. Evelio Guzmán, a health promoter, is helping me to deworm a 15 head herd of cattle in the picture to the right.

Evelio often shouted the dosages in Spanish as



we moved from animal to animal, so students traveling to Nicaragua should brush up on their Spanish numbers in order to be efficient workers. It is not sufficient to carry a Spanish dictionary, since students will be asked to think quickly while on the job. Veterinary students should also be aware that the most common breed of cattle in Nicaragua is Brahman, not the Holstein or Jersey breeds that we encounter most often in the U.S.

Deworming increases weight gain and decreases the risk of anemia, two benefits that can be seen for dogs, cattle, sheep, and horses, as well as people. *Strongylus vulgaris* is endemic to Nicaragua and an intestinal worm of particular importance for horses since it can cause colic and thrombosis, both of which are life threatening. *Giardia* and *Ascaris* infections are hypothesized to be related to malnutrition and developmental disabilities in humans (Oberhelman, et. al. 1998). Occasionally the health promoters will recommend that the children of their locality be administered a dewormer along with the animals, but this was not necessary during the 10 days that we were there. Children are especially susceptible to intestinal roundworms due to the close proximity of their livelihoods with animals that are also infected with parasites (see picture below).



June 14th was a travel day. Most of the rural roads were unpaved dirt roads, and some roads were more rocky and impassable than others. Travelling even short distances by motor vehicle took an hour or more in some cases, and we frequently drove on washed-out roads and through streams.

We also used our travel day to visit Rancho Ebenezer in Niquinohomo, a progressive agricultural organization run by Nicaraguans, for Nicaraguans. The website for Rancho Ebenezer is <http://www.ranchoebenezer.org/>, and is worth perusal. As a Christian-oriented organization, Rancho Ebenezer does much more than promote religious values. The organization's main goal is to train families to sustainably provide for a family of five. Rancho Ebenezer trains families to raise goats, rabbits, pigs, and chickens at very little cost to the family. These are perhaps the most practical food animal species for the typical Nicaraguan family since they are smaller and more easily managed. Recently there has been a new effort to explore tilapia as a potential protein source. Egg laying hens are also beneficial assets, as they can provide protein for the family on a regular basis. Rancho Ebenezer teaches good animal husbandry, such as better ways to sustainably feed their livestock as well as animal housing strategies that minimize the burden of ectoparasites like

ticks and lice. Earthworm farming and soil quality are other sustainable farming practices that Rancho Ebenezer emphasizes. Sustainable farming should ensure healthy soil and minimal destruction to the surrounding environment. Worms also produce a fertilizer that helps to enrich the soil and can be used to nourish the family's crops. Families are also taught how to use the excrement generated by their animals as fertilizer for their plant-based food sources, promoting a sustainable cycle. Aside from animal husbandry, Rancho Ebenezer also strives to teach families about sustainable farming of plant-based food sources such as lettuce, plantains, bananas, coffee, mangoes, corn, beans, rice, green peppers, spinach, a variety of herbs, and tomatoes. One strategy is to use tire gardens, which are easily transported and moveable for transplantation into richer soil conditions. Terracing methods, as shown in the picture below, are a way to efficiently use water when conditions are not ideal.



We visited a second village, Fila Grande, from June 15th to June 19th. This village differed from Rodeo Grande in many ways. This village was fortunate to have at least one school in operation on a daily basis. Additionally, there were electrical lines to most of the homes, and some even had a television. The health promoter in Fila Grande, Petronilo Gaitan Hernández, works from an actual clinic location rather than from his own home. The clinic was also equipped with running water for private bathing. One got the impression that Fila Grande was slightly more wealthy than Rodeo Grande, judging not only by the access to electricity and a school but also by the larger herds of cattle and better body condition scores of the horses (less emaciated, more full bodied). The dogs of Fila Grande were still thin and cachexic just as in Rodeo Grande, with body condition scores estimated to be as low as 2 or 1 on the 5-point scale employed by U.S. veterinarians. As veterinary students, we were allowed to deworm these dogs. The dogs were not very acclimated to direct human contact, so 90% of the time we could not simply restrain the dog in order to administer the albendazole orally. Instead, we soaked pieces of bread and offered the dogs the medicated food at a safer distance. We dewormed approximately 13 dogs in Fila Grande, and one of the veterinarians in our group (Dr. Dumont) performed an exploratory surgery on a hound's painful carpal abscess (shown below). Veterinary students helped to provide the extra hands that veterinary technicians would have provided at animal hospitals in the U.S. I put my new veterinary stethoscope to good use and monitored the dog's

heart rate during the 11-minute surgery, with no abnormalities worth noting. This was also a teaching moment for the health promoters, and Dr. Rick Ervin observed in the background (light blue scrubs, back left). This dog was later adopted by one of the Nicaraguan health promoters in training, Carlos Ivan Sandoval Diaz, who agreed to monitor the surgery site and redress the incision as necessary after our team had returned to the U.S.



Fila Grande was a different experience than was Rodeo Grande in that we made no farm visits and did not deworm any cattle. We left that job for the health promoters in training, and provided them with enough medicine to do so. As veterinary students, we were more than happy to pass on that job since we had already gained experience in Rodeo Grande

and understood the importance of training the Nicaraguan health promoters. Even though we left that job for the health promoters, we did still deworm a handful of pigs and horses. Pigs are dewormed differently than are horses, in that horses are administered the drug orally with a syringe while pigs are injected subcutaneously behind the ear with a needle.

Fila Grande presented us with more than the opportunity to deworm, however. As veterinary students, we were allowed to help with the variety of cases that showed up on our doorstep. We saw a mare with weak back legs post-foaling (likely due to estrogen imbalance), young horses with papilloma growths, horses with cutaneous sarcoid lesions, one horse with fistulous withers, horses with saddle sores, and horses with abnormally heavy tick loads in their ears. On multiple occasions we were able to douse the horses' ears with ivermectin to kill the ticks, then removed them manually. We also observed the castration of 3 pigs and two horses during our time in Fila Grande. Veterinary students were allowed to apply the antimicrobial scarlet oil to the incision post-surgery. We did run out of ketamine halfway through our visit to Fila Grande, since two of the boars we castrated were larger than normal and required an unpredicted amount of the anesthetic drug. This limited our potential aid in this village, although we more than compensated with other non-surgical cases that did not require any anesthetic.

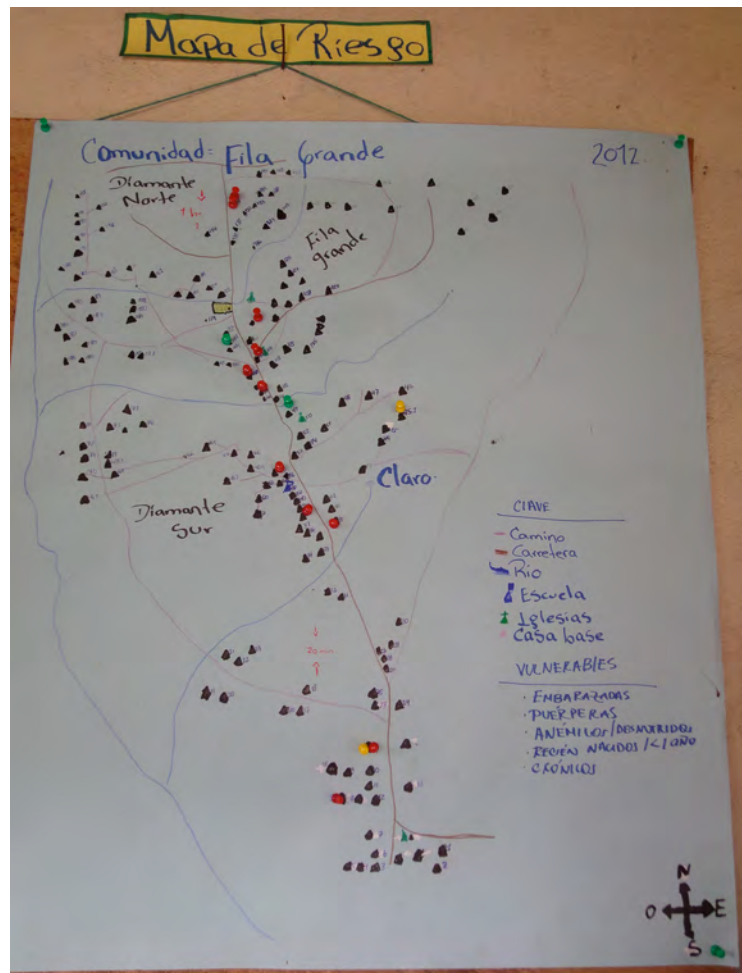
One memorable case was a puppy with demodectic or sarcoptic mange (mites) that was placed in our care for treatment (the type of mange could not be determined without a proper microscope as the two species of mite are too small to differentiate with the naked eye). Differentiating the two is important, since *Sarcoptes* mites can also infect humans (zoonotic) while *Demodex* mites do not. Unfortunately, the only thing we could do was deworm the pup since this was the only cost effective treatment at our disposal (expensive medicated shampoos are commonly prescribed in the U.S.). Since mange is related to environmental stress and possibly



intestinal parasite load, there is a relatively good prognosis that this puppy could recover without the expensive treatments used in the U.S. Of course, some training of the owner was necessary to limit the environmental stressors in the puppy's life that may have exacerbated the mite infestation. We also checked the puppy for fleas, ticks, and lice but found none. In the future, donations of Frontline Plus or other flea and tick medications would probably be of use in Nicaragua; unfortunately this was not a need that we anticipated during our original preparations for the trip.

There were more than animal patients in Fila Grande. One night was particularly distressing, when the veterinary doctors and health promoters received an emergency request to visit a woman with a retained placenta. The veterinary students did not accompany the health promoters on this visit, as the large group would have likely been an invasion of privacy and probably would have overwhelmed the woman. There was a debriefing the following morning, when we were allowed to ask our questions. The woman was in her 30s and had had her first child when she was 16. The doctors on our team did not have any oxytocin available to stimulate the loss of the placental membranes, so the health promoters recommended that she encourage her baby to suckle in order to promote natural release of the hormone. After some unsuccessful attempts, the decision was made to call for an ambulance. This was another reason for more anxiety, considering that the nearest hospital was at least an hour away in Matagalpa and given the fact that a retained placenta is potentially life threatening. The woman did go to the hospital for care, and the doctors and health promoters were hopeful that she would recover.

That said, the clinic in Fila Grande did have a focus on women and children, and more specifically on anemia. In the past year, the health promoters in Fila Grande have seen a decrease in chronic anemia and anemia in children less than 1 year of age. A "Mapa de Riesgo" for 2012 (pictured here) was posted on the wall of the Fila Grande clinic. In English, "Mapa de Riesgo" means "Risk Map". This map, although not elaborate by U.S. standards, is a useful tool that shows churches, schools, households, rivers and roads, in addition to pregnant women (embarazadas), women who recently gave birth (puérperas), anemic women and children (anémicos), and those who are chronically anemic (crónicos). Anemia risk in Nicaragua will be discussed in more detail in an additional document to be submitted with this report.



In summary, my responsibilities as a veterinary student included deworming horses, cattle, pigs, and dogs. Each animal had species differences regarding route of administration of the drug, a topic with which I was grateful to have had more experience. We also treated several cases of ticks and lice. Additionally, students were allowed to aid the veterinarian during surgery, such as preparing the chlorhexidine scrub bucket and cleaning surgical tools. Even this simple task was a wealth of knowledge, as we were able to become more familiar with the different clamps, hemostats, and forceps used in equine and porcine medicine. In particular, I learned that Rochester Carmalt hemostatic forceps have a lot of unique purposes for clamping large bleeding vessels or for minimizing damage when it is necessary to clamp bundles of tissue during surgery. Dr. Ervin used Rochester Carmalt forceps for castrating one of the larger boars in Fila Grande.

Of course, there were several moments during my time in Nicaragua that were somewhat troubling. Fortunately, I was traveling with an experienced veterinarian, Dr. Rick Ervin, who made sure that we had safe bottled water to drink and frequently reminded us to not walk around bare-footed due to the ease of transmission of hookworm from contaminated soil. There were some encounters with wildlife that could not be prevented, however. We found scorpions in our outdoor sleeping areas, poisonous cane toads in the streams, fruit bats in the outhouses, vampire bat wounds on the necks of many cows and bulls that we dewormed, and a species of insect that transmits Chagas disease. An every day occurrence also involved “tick checks” of our fellow teammates, and inevitably we found a few ticks on one or more of our colleagues. Furthermore, Nicaraguan society is solidly based in a “machismo” mentality where the men enjoy most of the power. Men would frequently stare at us as if we were spectacle, and admittedly at times it did feel uncomfortable. There may have been some tension and hesitation in letting women help alongside Dr. Ervin with surgery and deworming, since this is not the typical place of women in Nicaraguan society. We also hoped that our example proved to be of some encouragement to the Nicaraguan women and children that we met throughout our trip.

Rarely did I feel that I was in any danger, however. I signed up for this practicum with the firm belief that in order to help a family and their animals, I had to embrace Nicaraguan customs completely no matter how different they might be. One of the responsibilities that I adopted during the practicum included basic interpretation for the rest of the veterinary students on our team, due to my previous 8 years of Spanish study in high school and at my undergraduate university. I rekindled my love of the Spanish language during my time in Nicaragua and was actually able to learn several things from the health promoters. Despite the language barrier, I learned about proper dosages of anthelmintic drugs for different sizes of animals and about the vampire bats in the region that prey on the blood of the livestock. One of the health promoters also pointed out a species of insect that transmits Chagas disease. Toward the end of the trip, I was glad to see many of my peers embracing the language and picking up on words that they could never have done previously. I was also surprised to realize how immersed I felt in the Nicaraguan culture by the end of the trip.

The sheer breadth of programs available for volunteers and students was only barely realized during my 10-day experience there. We focused primarily on animal health but there are many other places to help as well, namely local community dental clinics, women’s rehabilitation refuges, and drug/alcohol rehabilitation centers. Therefore, dentistry students, medical students, public health students, and veterinary students would all benefit highly from an experience in Nicaragua. In general, most U.S. students could

learn a lot from working alongside the people of Nicaragua, especially about making do with less while still maintaining the same work ethic and family values.

Perhaps one of the best aspects of this practicum was the fact that we helped Nicaraguans use their skills to promote the health of their own country. This trip was not about students from the United States coming down to do all of the work and gain experience in their field of study, but rather to train and instruct the people of Nicaragua to sustainably do it for themselves.

Finally, I would like to emphasize again how important animal health is for ensuring human health, and reiterate just how intertwined human medicine and veterinary medicine really are. Nicaragua is an excellent example of a country that relies heavily on animals for their livelihoods, especially food, transportation, and working for an income. Of course, it is our job as veterinarians to facilitate the healthy weight gain of these animals for the strenuous tasks they are asked to perform, such as providing meat or plowing fields. Judging by the closeness of animals in the everyday lives of Nicaraguans, we also saw first hand just how easy it might be for zoonotic diseases to spread between humans and animals. Such diseases include brucellosis, leptospirosis, and several different parasitic species such as hookworm, giardia, and ascaris. We also value the welfare of the animals and tried to inspire families to do the same. The impact of veterinary care on improving welfare for workhorses in Nicaragua is currently an increasing area of focus (Willgert 2010). If there was any doubt that veterinarians are also ardent promoters of human health, may this report dispel that misconception. Indeed, the people we met and helped in Nicaragua are the ones I will remember most from this experience, not necessarily the animals we treated or saved.

Anemia Risk in Nicaragua

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Anemia refers to a deficiency in either red blood cells (RBCs) or of hemoglobin, the oxygen-carrying portion of the RBC. Anemia can be life threatening and leads to loss of productivity, so it is a worthwhile concern in developing nations such as Nicaragua, the second poorest country in Latin America (following Haiti). Anemia has many potential causes that may even act in unison to worsen the symptoms, so a diagnosis of anemia is not pathognomonic for any one cause. Some causes of anemia include but are not limited to malaria, brucellosis, hookworms, trichuriasis, ascariasis, giardiasis, menstruation, pregnancy, childbirth, diet-related iron-deficiency, and several vitamin deficiencies (Vitamin A, B12, folate). Therefore, even if a diagnosis of anemia is found, it still tells the health promoter very little about the reason for the person's illness. This can make treatment difficult in countries like Nicaragua, where exhausting all of the differential diagnoses for anemia is not economic or even possible given the limited resources.

The literature cites the anemia threat in Nicaragua, especially Dr. Mora's 2007 report on the Integrated Anemia Control Strategy (IACS). The report addresses hookworm load, iron deficiency, poor hygienic practices, and vitamin deficiencies as important causes of anemia in children between the ages of 1 and 4 years and young women of childbearing age. Components of the IACS program included deworming, administration of oral contraceptives to decrease the risk of iron-deficiency anemia, promoting dietary supplementation (such as Vitamin-A fortified flour and iron supplements), and malaria control. Notably, the IACS recommends that children between the ages of 2 and 10 be administered an anthelmintic dewormer twice per year (this may warrant caution regarding parasite resistance, discussed later). Overall the IACS is very holistic in nature, not addressing any one cause of anemia, and emphasizes a "multipronged, integrated approach." The World Health Organization agrees that monotonous diets lacking in variety, such as the rice-and-beans diet common in Nicaragua, may potentiate the risk of anemia (WHO 2012). Dr. Mora's report also identified further challenges to continued implementation of the program, namely inadequate record keeping, improper dosing of anthelmintic drugs and iron/vitamin supplements, as well as long term cost efficiency of the program (Mora 2007).

I first became aware of the anemia problem in Nicaragua while visiting the village of Fila Grande. During our time in the village, we did interact with some young children that came with their mothers to watch us treat their animals. In some cases the surgeries were quite a spectacle, such as the horse castration (shown below) where the horse and Dr. Ervin are not even visible through the crowd. Although our primary focus during this practicum was veterinary in nature, we did get the opportunity to meet many of the people from the community.



Most of the knowledge we gained about the overall health of the human population in Fila Grande was from the health promoters. So far this year, Fila Grande has seen a decrease in anemic children from 92 to 54 since 2011 (it is only June, however, so the 2012 numbers may still increase before the end of the year). One boy in particular that visited the clinic during our trip (below) really struck me with the importance of finding and treating anemia in women and children, and the overwhelming number of health threats that Nicaraguans face on a daily basis. Although we had no health records for the boy, I did feel the sense of urgency and need to address the anemia problem in the target population that both he and his mother represent.



The reliance on poorly sanitized water sources such as nearby rivers and streams was also evident during our short time in Nicaragua. This common behavioral pattern raises questions about its relation to anemia risk. Diarrhea from drinking contaminated water sources is a concern that many people recognize, but the risk of anemia from transmission of waterborne parasites is perhaps less well-known. Waterborne diseases that may be related to anemia are Schistosomiasis, malaria (transmitted by mosquitoes that live near these water sources), and hookworms (WHO 2012). All three infectious agents are potential risks of anemia in Nicaragua, but the literature is not consistent as to which of these is most important. Some believe that hookworms are probably at the top of the list (Mora 2007). Another publication cites giardia and ascaris roundworms as more important (Télliez et. al 1997). Since the prevalence of certain parasites can change significantly over time, it would be prudent to consistently monitor parasite loads in water sources. Not surprisingly, prevalence of specific parasites varies greatly by location and based on the quality of water sanitation to which different populations are exposed. Younger children may also be more at risk of infection (Télliez et. al. 1997). The prevalence of giardia-related anemia in Nicaragua should be reevaluated in order to assess whether this organism deserves more attention, as it is known to be a ubiquitous waterborne parasite that can cause anemia. It goes without saying that construction of outhouses at greater distances from vital water sources, as well as education about fecal-oral routes of transmission and hygienic practices, should continue to be a priority.

Brucella organisms are another infectious agent shown to cause anemia (Sauret and Vilissova 2002). This bacterial species is known to cause abortions and is important due to its zoonotic transmission via contaminated raw milk, meat, and cheese. Brucellosis is more

of a threat in rural areas where access to pasteurization facilities is limited. The disease is predicted to be under-diagnosed and underreported in the U.S., which likely holds even more truth in Nicaragua due to fewer medical laboratory resources in rural areas. Diagnostic testing such as cerebrospinal fluid evaluation, PCR, and ELISA tests may be too elaborate to be practical in rural Nicaragua (Sauret and Vilissova 2002). Inability to diagnose *Brucella* raises further possibilities that other bacterial species may be causing the anemia; other bacterial species that may cause anemia in Nicaragua include *Shigella*, *E.coli* O157 H7, and *Leptospira*. All of these bacterial species may cause anemia by the similar mechanism of erythrocyte hemolysis, so a diagnosis of hemolytic anemia does not prove that a person is infected with one bacterial species over the other. In summary, anemia is a vague clinical symptom that requires advanced training and resources to accurately diagnose a specific bacterial cause.

As mentioned in my original recount of the practicum, our last night in Fila Grande was particularly unnerving when an emergency retained placenta had the veterinarians and health promoters out for several hours in the middle of the night. On account of the focus on anemia in rural villages such as Fila Grande, my natural thought process led me to wonder if anemia and retained placentas are at all related. The consensus in the literature is that anemia is not a risk factor for retained placentas but is rather a complication resulting from the hemorrhagic blood loss relating to retained placentas (Rizwan 2009). Perhaps this raises concerns about addressing anemia in pregnant women prepartum so as to prevent this complication from becoming even more severe should a retained placenta occur. While pre-existing anemia is not a common cause of retained placentas, pre-existing anemia is an important risk factor of mortality caused by a retained placenta (Chhabra and Dhorey 2002). Although my original assumption that anemia may be a predictor of retained placentas was incorrect, women suffering from anemia and the life-threatening severity of retained placentas does have the potential to be directly correlated.

By far, the most frequent anemia risks that we encountered during the practicum were parasitic worms. We used ivermectin and albendazole to deworm animals on a daily basis, which presents legitimate concerns about parasite resistance against these frequently used anthelmintics. A 2010 study in Nicaragua tested the resistance against ivermectin and fenbendazole, both common deworming drugs. Fortunately, the study did not find resistance against either drug, although ivermectin was shown to be more effective against *Strongylus* worms (Kyvsgaard, et. al. 2011). Despite these findings, it is still important to consider the potential for emerging parasite resistance against anthelmintics. Practices that limit the amount of times that an animal must be dewormed per year is not only cost effective but may also help to delay resistance. Families should continue to be educated about maintaining healthy pastures, free of eggs that may be ingested by the animals and lead to reinfection. After all, deworming a horse only to have it eat infected hay or grass the same day does not achieve any benefits for the animal or for the family.

Overall, finding the exact diagnosis for a case of anemia is an obstacle given the diversity of nutritional and infectious causes and the lack of resources in rural villages. Anemia is easily found based on clinical symptoms such as pale gums and lethargy, but treatment usually must take a holistic approach since any one cause of the anemia could be at work. The focus on anemia is indeed warranted, but a goal for the future might be to more accurately address individual cause(s) so as to better conserve the few resources that are available while also prolonging future anthelmintic resistance.

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