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# Tackling disease complexes: Respiratory disease

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## Introduction

***Perspective-*** I have been privileged to work with a number of great swine veterinarians. From that experience, there are a few quotes that have deeply shaped my approach to swine medicine. The first is from Al Leman: "We are all prisoners of our experiences." Accordingly, my perspective is formed mainly by research and second opinion investigations and somewhat less by practice experience. The second is from Dave Ellis at Michigan State: "The good old days are today, tomorrow and the next day." This latter quote mirrors the expression "The greatest barrier to future success is past success." Accordingly, this paper will provide a mixture of philosophy and science with the ultimate goal of providing ideas that will hopefully lead to success.

***The world is different-*** After I graduated from veterinary school in 1978 up through the late 1980's, respiratory disease was becoming nearly a non-issue on many farms. Atrophic rhinitis (AR) came under control by improving nursery environments, age segregated rearing, reducing weaning age, vaccination, strategic medication, changing genetics and depopulation. *Mycoplasma hyopneumoniae* (*Mhyo*) came under control by some of the same methods but the biggest impact on this disease was all-in, all-out production (AIAO) methods as simple as building walls in finishing barns to attain AIAO by room. Swine influenza (SIV) was a sporadic disease that came and went and rarely caused significant and/or long lasting problems. Treatement of SIV breaks was mainly targeted at controlling secondary infections such as *Pasteurella multocida* (Pm) with antibiotics by feed, water and/or injection. *Actinobacillus pleuropneumoniae* (App) was a serious problem and ultimately herd depopulation was the best method for controlling this disease. Strict age segregated rearing methods such as AIAO by site were implemented in new systems and severe respiratory disease problems were believed to be a thing of the past.

Since the early 1990's, viruses such as porcine reproductive and respiratory syndrome virus (PRRSv), new subtypes of SIV and more recently porcine circovirus type 2 (PCV2) emerged and their control has been elusive, especially with regard to PRRSv. Several bacterial diseases such as *Streptococcus suis*, *Hemophilus parasuis* and *Actinobacillus suis*, known as the sui-cide diseases have become constant, rather than sporadic problems, most likely due to underlying PRRSv infection. The most effective method for controlling PRRSv is exclusion of the virus but area spread is a major risk factor that counters this method. Vaccination of pigs has been shown to be effective but PRRSv vaccination of pigs is not routinely done even though the need for better control of PRRSv induced disease is recognized by both producers and veterinarians. Fortunately, PCV2 can be controlled fairly well by vaccination. SIV control is possible by vaccination but timing of administration, cross protection and maternal antibody interference are problematic.

In my view, the most important change has been the shift from an endemic pattern where respiratory disease was a constant but predictable problem with regard to pig age and disease severity to a more epidemic pattern where pig age at the onset of disease can be variable and the severity of the disease varies depending on the number of pathogens that are circulating through the pigs and the immune (passive) status of the pigs. For example, several studies have demonstrated that SIV outbreaks in multi-site production systems occur later during the finishing period compared to single site or traditional farrow-to-finish operations. This situation has been observed with *Mhyo* as well. Fortunately, the prevalence of breaks is less in multi-site systems. Infection later in life occurs when passive immunity is long gone and because overall population immunity is low, outbreaks can be more severe.

The other dilemma with later and less frequent outbreaks is related to managing the outbreak at the farm level. Intensive swine production is a repetitive business and success is based on continual reinforcement of tasks. Lack of reinforcing experiences becomes problematic when a grower who manages a wean-to-finish site that receives two groups of pigs per year and may have a respiratory disease outbreak in every fourth group is called on to successfully handle an outbreak. This is why service people and veterinarians are so critical in managing disease problems in multi-site systems. However, they need to be good teachers unless they plan on being at the site every day until the outbreak is resolved.

## Diagnostic topics

The goals of any diagnostic investigation are to determine how to manage the sick pigs at hand and to develop strategies for preventing the problem in the future. This involves identifying the offending pathogens, potential risk factors that might have triggered or exacerbated the outbreak, the timeline of when things happened and the expected resolution of the problem. Everyone involved, including the producer/grower, service person and veterinarian, need to take an active role in the process. The following discussion emphasizes selected topics that are important, and sometimes overlooked, for successfully characterizing respiratory disease outbreaks.

***Husbandry and clinical skills: farm level-*** The following points are made:

1. Early detection of sick groups of pigs is best done by monitoring water and/or feed intake. Reduction in intake precedes observation of individual sick pigs within the group by 1-2 days.
2. Early detection of sick pigs is essential for identifying pigs for individual treatment. Pigs can be off-feed for up to two days before they appear empty.
3. A rectal thermometer is a neglected but valuable tool for identifying sick pigs and characterizing the type of disease they might have.
4. Selection of representative sick pigs for necropsy and laboratory testing must be done carefully. Select acutely ill pigs for identifying what initiated the outbreak. Select pigs that are further along in the disease process to identify pathogens that will influence how the initial disease will resolve.

***Diagnostic testing: farm level-*** The following points are made:

1. Collect the right samples into the right containers. If in doubt, collect more than might be necessary. Work with the diagnostic lab with regard to sample collection. Have the laboratory evaluate sample quality.
2. For formalin fixation, one dimension of the tissue sample needs to be 1 cm or less.
3. For PCR testing, cross sample contamination should be avoided. Accordingly, a new needle and/or syringe should be used for each sample. Using the vacutainer system facilitates clean sample collection.
4. Diagnostic testing trend for viral disease is away from serum antibody testing and towards agent identification by PCR using pooled samples.
5. Consider oral fluid testing by PCR for surveillance activities.
6. For serological testing, understand what the percentage of positive samples means with regard to the number samples tested (see Table 1).
7. Old diseases still exist. I have observed several cases of AR that had gone undiagnosed because snouts had not been sawed for examination.

***Diagnostic testing: laboratory level and veterinarian's role-*** The following points are made:

1. Recognize that the attending veterinarian is ultimately responsible for the diagnosis:
   a. Work closely with laboratory diagnosticians with regard to implementing effective diagnostic strategies. Best to do this by phone. E-mail can work if both parties are capable of communicating effectively in writing.
   b. Become an educated consumer of the information the lab provides. Understand what the pathologist's histopath lesion descriptions really mean. Don't just look at the case summary.
   c. Discuss new findings with the diagnosticians such as a different lesion that was identified by histopath, a new serology test has been used or if a new pattern of serology test results is found.
   d. Understand the limitations of the testing that was

**Table 1:** Number of samples to collect from a 1,000 head finishing barn to provide an estimate of prevalence depending on expected prevalence and degree of precision (± %).

| Expected prevalence | Number to test (± 10%) | Number to test (± 20%) | Number to test (± 30%) |
|---|---|---|---|
| 5% | 18 | 5 | 2 |
| 25% | 67 | 18 | 8 |
| 50% | 88 | 24 | 11 |
| 75% | 67 | 18 | 8 |
| 95% | 18 | 5 | 2 |

done. Do the lab results fit with what you are observing clinically? If not, refine testing strategy and communications with the diagnostic lab.

2. Align the diagnostic effort with the eventual impact on the production system. Sometimes sketchy lab results are used to make decisions that could impact system profitability by thousands and in some case millions of dollars.

3. Presence of organism is not equivalent to disease. Corresponding histopath lesions should be present and should be supported by research findings. However in some cases, research studies that mimic the field situation are not available.

## Treatment topics

Treating respiratory disease mainly involves the use of antibiotics administered by injection, water or feed. The use of anti-inflammatory products such as aspirin or NSAIDs is used in some situations to control fever and inflammation in the lungs. The following discussion emphasizes selected topics that are important, and sometimes overlooked, for successfully treating respiratory disease outbreaks.

***Antibiotic selection-*** Guide selection decisions by:

1. Inherent sensitivity of organism which are usually aligned with label indications.
2. Prior effectiveness in the corresponding population.
3. Sensitivity testing. On the front end is directed more towards what not to use.
4. How rapidly therapeutic levels need to be reached.
5. Logistical considerations with regard to timing and administration accuracy.
6. Regulatory requirements and economics.

***Route-*** The route of administration is based on:

1. How rapid therapeutic levels are needed on a group and individual pig basis. This varies by the type of medication used.
2. Labor availability and effectiveness.
3. Feed and water intake. Limited with some diseases so those routes are contra-indicated.
4. Follow through or dose verification. Not done rigorously in swine production. Testing of blood levels or concentrations in feed or water is rarely done.

***Dose-*** The following points should be considered with regard to dose level:

1. Verify intended versus actual dose.
2. With oral medications, consider wastage.
3. Follow regulatory requirements. For variable dosing levels, be able to alter dose based on intake of water or feed (see Tables 2 and 3 for feed and water, respectively, medication rates based on dose and daily intake).

***Duration of medication-*** Duration is based on the following:

1. Label directions.
2. Type of antibiotic. For those antibiotics where time over MIC is important, there is greater emphasis on adequate treatment times. For antibiotics where the maximum concentration is important, duration may be shortened.
3. Spread of disease through population. If slow, duration of treating entire group may need to be longer or retreatment may be necessary.

**Table 2:** Feed medication levels in grams per ton based on daily feed intake as a percentage of body weight and medication dose.

| | Dose in mg/lb | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Daily intake** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** |
| 1% | 200 | 400 | 600 | 800 | 1000 | 1200 | 1400 | 1600 | 1800 | 2000 |
| 2% | 100 | 200 | 300 | 400 | 500 | 600 | 700 | 800 | 900 | 1000 |
| 3% | 67 | 133 | 200 | 267 | 333 | 400 | 467 | 533 | 600 | 667 |
| 4% | 50 | 100 | 150 | 200 | 250 | 300 | 350 | 400 | 450 | 500 |
| 5% | 40 | 80 | 120 | 160 | 200 | 240 | 280 | 320 | 360 | 400 |
| 6% | 33 | 67 | 100 | 133 | 167 | 200 | 233 | 267 | 300 | 333 |
| 7% | 29 | 57 | 86 | 114 | 143 | 171 | 200 | 229 | 257 | 286 |
| 8% | 25 | 50 | 75 | 100 | 125 | 150 | 175 | 200 | 225 | 250 |

**Table 3:** Water medication levels in grams per 1 gallon of stock solution (1:128 proportion rate) based on daily water intake (% body weight) and medication dose.

| | Dose in mg/lb | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Daily intake** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** |
| 4% | 26 | 51 | 77 | 102 | 128 | 154 | 179 | 205 | 230 | 256 |
| 5% | 20 | 41 | 61 | 82 | 102 | 123 | 143 | 164 | 184 | 205 |
| 6% | 17 | 34 | 51 | 68 | 85 | 102 | 119 | 137 | 154 | 171 |
| 7% | 15 | 29 | 44 | 59 | 73 | 88 | 102 | 117 | 132 | 146 |
| 8% | 13 | 26 | 38 | 51 | 64 | 77 | 90 | 102 | 115 | 128 |
| 9% | 11 | 23 | 34 | 46 | 57 | 68 | 80 | 91 | 102 | 114 |
| 10% | 10 | 20 | 31 | 41 | 51 | 61 | 72 | 82 | 92 | 102 |
| 11% | 9 | 19 | 28 | 37 | 47 | 56 | 65 | 74 | 84 | 93 |
| 12% | 9 | 17 | 26 | 34 | 43 | 51 | 60 | 68 | 77 | 85 |
| 13% | 8 | 16 | 24 | 32 | 39 | 47 | 55 | 63 | 71 | 79 |
| 14% | 7 | 15 | 22 | 29 | 37 | 44 | 51 | 59 | 66 | 73 |
| 15% | 7 | 14 | 20 | 27 | 34 | 41 | 48 | 55 | 61 | 68 |



***Anti-flammatories-*** The following points are made:

1. Little is known regard to effectiveness. Hopefully more data will be available in the future. Some products/regimens are unlikely to be effective based on dosing levels and extrapolation to human dosages.
2. Welfare considerations will increase their importance and use.

## Prevention topics

For the most part, prevention rather than treatment is the preferred method of controlling respiratory disease. Unfortunately, uniformly effective and/or economical prevention methods are not available for even the common diseases. The following discussion emphasizes selected topics that are important, and sometimes overlooked, for successfully preventing or reducing the impact of respiratory disease outbreaks in the future.

***Risk factors-*** A useful scheme is to consider the 5 main production inputs: genetics, health/disease, nutrition, environment and management/husbandry. Accordingly, the following points are made:

1. Genetics- Differences in inherent resistance/susceptibility has been demonstrated with PRRSv. Relevance to production settings has not been well established.
2. Nutrition- Less likely now to encounter situations where feeding programs have significant impact on the health status of the pigs. This may become a more important issue as more byproducts are used to formulate diets.
3. Environment- Still a major risk factors, especially in nurseries in cold weather where low ventilation rates may lead to inadequate oxygen and excessive carbon dioxide levels.
4. Management/husbandry- Perhaps a greater concern with multi-site production where the grower or employee works alone and daily supervision is not provided.
5. Health/disease- Has emerged as the major risk factor group as we have added diseases, especially the viruses, and studied the impact of co-infections.

***Vaccination compliance-*** Immunization success depends on the inherent efficacy of the vaccine, the responsiveness of the animal and the accuracy of administering the vaccine. Vaccination for PCV2 has taught us the importance of achieving high immunization success rates. Unlikely other diseases such as *Mhyo* where overall population immunity enables effective control even when not all of the animals are vaccinated effectively, individual pig immunity is critical with PCV2 and poorly vaccinated pigs are at high risk of developing disease. However, even with *Mhyo*, high immunization success rates may be more important than recognized due to its potentiating role in other diseases such as PRRSv. With regard to vaccination compliance and administration accuracy, the following points are made:

1. Develop vaccination protocols that enable and promote compliance including the timing of the vaccination related to production practices in the operation.
2. Reinforce the important of vaccination on disease control.
3. Where possible, monitor compliance via serology.

***Vaccination timing-*** With regard to timing vaccinations, the following points need to be considered:

1. Administer vaccine before pigs are exposed to the disease. With some diseases such as *Mhyo*, exposure may be gradual over time so vaccination during exposure may be weighed against other factors that will impact immunization success.
2. Avoid maternal immunity if it is known to interfere with vaccinations. Main diseases to consider are SIV and *Mhyo* with one dose regimens. Appears to be less important with PCV2 vaccination.
3. Avoid vaccination during active PRRSv infection, which has been shown to reduce the effectiveness of SIV and *Mhyo* vaccination in laboratory studies.

***Metaphylactic antibiotic therapy-*** The following points are made:

1. Effective control by reducing bacterial populations during stress periods and thereafter.
2. Metaphylaxis is often confused with growth promotion. They are not the same although more difficult to differentiate for enteric disease control because dose levels and medications are similar. Metaphylaxis for respiratory disease control is typically done at dosages that are considered to be therapeutic. Educate the producer and others to understand the difference.

## Summary

Respiratory disease in pigs is a broad topic and a number of factors need to be addressed with regard to diagnosis, treatment and prevention. "The devil is in the details." Not addressing the details can result in incomplete diagnosis, poor treatment responses and ineffective prevention.