DEALING WITH POST-WEANING DISEASES
CSI – SWINE: “CRIME SCENE” INVESTIGATION

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ABSTRACT
The investigation of disease outbreaks in any herd are a complex process. It requires teamwork between the veterinarian and the producer. Taking a good history, utilizing veterinary profiling, and determining the right tests to do, are critical in helping solve disease problems. It is not the result which determines the outcome; it is the correct interpretation of the result which can impact the correct intervention and thus the outcome.

INTRODUCTION
The objective of a veterinary investigation is to solve a problem. Pigs cannot speak to us directly so the veterinarian and pig producer work together to identify the problems so they can be stopped as well as prevented from occurring in the future. The ultimate goal is to help pigs, producers, and the industry.

HISTORY
The first thing to do when there is a problem is gather information that will be helpful to clarify the problem as well as provide guidance on possible causes. The process starts by asking the individuals working on-site to find out what all happened. At times, these workers feel like they are being interrogated, but the reality is that the veterinarian is just trying to form an accurate picture and timeline of what is going on. It is through team effort that the investigation can gain strength. Quantification of the problem is critical as it not only provides a feeling for the severity of the problem but also provides a snapshot for comparison so that improvements can be measured. This process of data collection is helpful as most things are not 100% black and white.

ODDS RATIOS
Odds ratios (OR) are a statistical/epidemiological tool that can be utilized to show associations between two binary variables. By simply collecting data into a 2 X 2 table (yes and no for two separate variables) the strength of the association between two variables can be seen. Odds ratios can be used to help decipher some of the gray areas in data interpretation.
Table 1. General data layout for a 2 X 2 table.

<table>
<thead>
<tr>
<th>variable 1</th>
<th>yes</th>
<th>no</th>
</tr>
</thead>
<tbody>
<tr>
<td>variable 2</td>
<td>yes</td>
<td>a</td>
</tr>
<tr>
<td></td>
<td>no</td>
<td>c</td>
</tr>
</tbody>
</table>

Using the above Table, the OR can be calculated by simply cross multiplying and dividing. Therefore:

\[
OR = \frac{(a \times d)}{(b \times c)}
\]

The nice thing about OR is that one does not have to worry about which variable is on top and which one on the side; either way, the calculation will result in the exact same value. The value of OR will vary between zero and infinity. An OR = 1 would indicate that there is no association between two variables. A value < 1 would indicate a protective association, meaning that an event is less likely to occur in that group. The association is said to be stronger or more likely to be related the higher the value (> 1) for the OR.

A 95% confidence interval for OR can be calculated but that takes more work. The key thing to remember is to not rely heavily on the result unless a confidence interval is calculated. It is also important to remember that an association does not mean causation.

VETERINARY PROFILING

According to Wikipedia:

“Offender profiling is a method of identifying the perpetrator of a crime based on an analysis of the nature of the offence and the manner in which it was committed. Various aspects of the criminal's personality makeup are determined from his or her choices before, during, and after the crime. This information is combined with other relevant details and physical evidence, and then compared with the characteristics of known personality types and mental abnormalities to develop a practical working description of the offender.”

This criminal investigation technique has many similarities to what is done in veterinary medicine. Veterinarians look for patterns of behavior in the evidence. For example, when dealing with a respiratory outbreak, the necropsy of a pig will provide some guidance based on the type of lesions found. When dealing with bacterial infections, the lesions tend to feel firm and are usually located in the front bottom part of the lungs (cranio-ventral consolidation). On the other hand, viral infections tend to spread though the blood vessels and therefore result in patchy lesions throughout the lung tissue.

Viruses from the same family tend to have similar behavior patterns so information from different species can be utilized especially when new diseases are emerging. There are always a
few outliers just like in street gangs; sometimes individuals from a gang do not always follow their signature trait.

As a general rule from a clinical perspective it is important to break down viruses based on two important characteristics: RNA vs. DNA and enveloped vs. non-enveloped. Genetic material in the DNA format is very stable. There are special proofreading mechanisms that are in place to ensure that as these viruses replicate, minimal changes in their genetic makeup occur. On the other hand, RNA viruses are very unstable genetically and are constantly mutating creating a very challenging situation for vaccine development. Enveloped viruses are usually highly susceptible to environmental inactivation compared to non-enveloped viruses. The categorizations of different swine viruses of concern are summarized below in Table 2.

Table 2. **Viral grouping of some important swine pathogens.**

<table>
<thead>
<tr>
<th>DNA</th>
<th>Non-enveloped</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Enveloped</strong></td>
<td></td>
</tr>
<tr>
<td>African Swine Fever (ASF)†</td>
<td>Porcine Circovirus Type 2 (PCV2)</td>
</tr>
<tr>
<td>Pseudorabies (PRV)*</td>
<td>Parvovirus</td>
</tr>
<tr>
<td>Porcine Reproductive and Respiratory Syndrome (PRRS)</td>
<td>Foot and Mouth (FMD)†</td>
</tr>
<tr>
<td>Transmissible Gastroenteritis (TGE)</td>
<td>Rotavirus</td>
</tr>
<tr>
<td>Classical Swine Fever (CSF)†</td>
<td>Swine Vesicular Disease (SVD)†</td>
</tr>
<tr>
<td>Japanese Encephalitis†</td>
<td></td>
</tr>
<tr>
<td>Influenza (IAV)</td>
<td></td>
</tr>
<tr>
<td>Vesicular Stomatitis (VS)</td>
<td></td>
</tr>
<tr>
<td><strong>RNA</strong></td>
<td></td>
</tr>
</tbody>
</table>

† Foreign animal disease.  
* PRV has been eradicated from Canadian and U.S. domestic swine population.

**AGENT OR ANTIBODES**

When veterinarians are looking to identify the culprit of the disease outbreak, they are focused on determining the time frame of events. This will allow them to decide whether they need to focus on finding the organism/agent (or parts thereof) or try and find antibodies. The agent is usually found earlier in infections whereas antibodies take time to develop (usually 10 -14 days).

The interpretation of antibodies is not always easy. As can be shown (Figure 1), an antibody titer of X can actually represent three different time frames in the exposure life of an animal. Time X₁ would be at the start of the first time the animal has been exposed to the agent and antibody production is on its way up (log phase). On the other hand, time X₂ represents the decline phase of antibodies. The difference between time period X₁ and X₂ is clinically relevant. Finally time period X₃ represents the log phase of a second exposure.

**TIME**

Time is also a critical part of the puzzle. As mentioned above, time will dictate if you might be able to find the agent or antibodies. But time also plays a critical role in helping determine what
is going on. More time does allow for an increased chance for finding out what is going on in disease outbreak situations. Usually with more time, more animals will be infected (Figure 2). This can explain why one veterinarian may not find the agent causing problems in the early stages of an outbreak and another veterinarian can appear to be the heroine when she is called for second advice three weeks later. It is also important to realize that sometimes time can make things more complicated as secondary agents can compound issues.

**Figure 1.** Possible explanations/interpretations for obtaining an antibody titer value of X without knowing the animals actual time of exposure.

**Figure 2.** Prevalence of new infected cases as well as cumulative cases in a disease outbreak affecting a 1000 head barn of pigs.

**TESTING**

Deciding what to test for as well as how many to test is a challenging decision. It takes knowledge, experience and a full understanding of the pros and cons of each test along with their
respective costs. All this information is needed to make the right decision. There is no simple answer to all cases. Veterinarians must consider all the evidence at hand as well as the clinical picture in making their decision. Ultimately only tests are performed which will have an impact on the outcome. That is, a test should never be done unless one knows what will be done with the results. How many samples to test for is really a matter of insurance. How much is the producer willing to pay in return for how much risk? Statistics are used to help provide us the necessary data to support those decisions.

Some of the best tests are those that allow one to identify the agent at the site of the lesion, with pathology that supports the clinical signs noted. A good example for this is trying to show the effects of TGE in the intestines of pigs. Most of the time just finding the TGE virus in a group of pigs is diagnostic for having a problem. Being able to show the agent present at the tips of the intestinal villi (brown coloring) that have been shortened is strong evidence for the virus not only being present, but also causing problems.

![Normal and TGE intestines](image)

**Figure 3.** Two histologic sections of intestines showing normal and TGE affected intestines. The TGE affected intestines have been stained with immunohistochemical compound which attaches to TGE viral particles and is brown in color.

**CONCLUSIONS**

The diagnosis of diseases is not an easy task. Veterinarians and producers need to work together to make sure the right information is collected and that the results are interpreted correctly. This takes knowledge that is constantly being updated, field experience, understanding practical implications of the different diseases, and patience as our diseases today seem to be multifactorial and complex. As a team, the ultimate goal is to help pigs, producers, and the industry move forward in maximizing pigs’ health, welfare as well as protecting the public’s health.