INTRODUCTION
With changes in the structure of the swine industry, there have also been changes in the roles of swine veterinarians. Swine veterinarians today focus more on preventive medicine and improving overall herd health rather than responding after disease occurs, the latter common in traditional “fire engine” practices of 20+ years ago. Swine veterinarians now have a proactive role in anticipating problems and preventing disease with a concurrent responsibility to provide care to each pig. This is a challenge as resources (money, labor, and time) are becoming more limited. Consequently, swine veterinarians are highly motivated to be innovative. The use of modern technology, epidemiological principals, biostatistics, and improved diagnostic methods guides them through the diagnosis as well as the prioritization and allocation of resources to improve the health and welfare of pigs. A successful veterinarian is one who not only solves a problem, but also creates opportunities and promotes the financial success of his or her clients.

Before starting any evaluation of a farm, it is important to understand the objectives and goals of each individual involved in the farm operation. This is critical as ultimately the success of any intervention requires actions by the client or those working for the client. Better understanding of the client’s goals and constraints will ensure that recommendations on herd health are made in that context. The context often requires swine veterinarians to innovate because recommendations will often vary between clients and may change for a particular client over time. For example, a client may be focused on improving average daily gain for a period but may transition to reducing cost of gain as his or her facts, business inputs, or understanding changes. The most important question for an owner or manager who is requesting veterinary services to answer is “What is my primary concern?”

Investigation of health or production issues is best approached by site visits—that is, inspection of pigs in their environment. As will be seen in the following discussion, there are many factors that contribute to compromised health and well-being of pigs. Many of the assumptions made by clients or swine veterinarians can only be validated by a well-designed, systematic on-farm site visit.

PREPARING FOR A SITE VISIT
History and Records
History and record evaluation should occur prior to any herd evaluation or investigation. Looking at the operation’s medical records and past diagnostic laboratory reports helps to provide a picture of previous areas of concern and guidance on the expected health status of the herd. It is important to see the actual past reports rather than rely on client’s interpretation of results, particularly when serving a new client or as a second opinion. Experience dictates that even with the best intentions, managers and owners are more likely to recall some results while downplaying or neglecting to mention others based on their particular biases.

Production records, usually computerized, are common in modern swine operations. The value of computerized records lies in the ability to instantly query the data and summarize it in meaningful ways. Morris (1982) is reported to be one of the first to suggest the concept of “performance-related diagnosis.”
capability to evaluate herd performance and then determine the need for interventions has created a dilemma in regard to the term “subclinical” (Polson et al. 1998). The true definition of subclinical implies not measurable, but today modern records allow for measuring slight differences in productivity (clinical manifestation), which without records would have gone unnoticed (subclinical). All information gathered on a farm, including records, should be evaluated objectively from a perspective of “trust yet verify.” Inaccurate or misinterpreted information and records will often lead to misdiagnosis and inappropriate recommendations.

**Benchmarks**

Benchmarking is a unique tool that allows operations to identify areas of concern or areas where improvements can be made. Many studies have reported different benchmarks to use as targets (see review by Polson et al. 1998). Others have suggested that the best production benchmarks are those set by the herd’s own records (Lloyd et al. 1987). Over time, productivity and processes change such that older benchmarks may no longer be relevant. Depending on the objectives and changing constraints of a specific operation, a particular benchmark may not have the utility or impact that it did under previous conditions. As information suggesting benchmarks becomes more available in the age of the Internet, it is increasingly important to determine the characteristics of the operations from which these benchmarks were derived. Experienced swine veterinarians are able to decipher the intricate methods of data reporting and have insight for which circumstances certain parameters are achievable. For those just starting to learn about swine production medicine, it is best to use benchmarks as means to understand the appropriate magnitudes of different parameters rather than use them as specific goals per se.

From the veterinary and diagnostic perspectives, it is better then to focus on understanding the relationship of different production parameters rather than memorize specific values. A good example of this conceptual thinking can be seen in Figure 1.1. This figure helps show the interrelationship of several different parameters on their impact on a breeding herd’s weaned pig output. Basically, throughput (i.e., pigs weaned) is determined by multiplying capacity (female inventory or facility space) by efficiency (how many pigs are produced per female inventory or facility space). The advantage of understanding this productivity tree is that all factors influencing throughput can be evaluated at the same time and interventions can be implemented in different areas of the tree. Extending this example to the evaluation of the number of pigs weaned, issues like preweaning mortality are obvious, but others such as female removal and replacement rates or lactation length may not initially come to mind. In the case of a producer with a target of >28-day weaning age, the number of litters weaned/female/year will automatically be impacted (fewer) by the system design.

**Reporting Structure**

Reporting structure refers to the organization of workers, management, and owners as it occurs in larger production systems. It also refers to whom a veterinarian is to report findings and recommendations. It is important for swine veterinarians to ask and understand the proper reporting structure for any new client. This is true for operations of all sizes. For the small or family farm, it is important to know what information

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**Figure 1.1.** Weaned pig output productivity tree for investigating variables that impact the number of pigs weaned per year. Adapted from Gary Dial.
the owner wants to share with workers. In a larger corporate setting (corporate ownership or part of a producer cooperative), it is even more important to understand how decisions are made, who makes decisions, and who should get veterinary reports. Understanding reporting structures is critical in ensuring that the veterinarian and managing team are working together and a single consistent message is being delivered to workers. Providing information to the wrong person may actually hinder progress, as many times those closer to the pigs and daily processes may not be fully aware of all considerations influencing a business decision.

Frequently in the United States, the owner of the pigs is different than the caretaker. The caretaker may be focused on minimizing his labor efforts while the owner may be more focused on the cost of a particular treatment or prevention option. The veterinarian is focused on food safety, maximizing pig health and welfare, operational sustainability, and owner profitability. Ultimately, the owner decides what is to be implemented.

Biosecurity
Biosecurity has been a major topic of concern for the swine industry from many years. Protocols to prevent disease transmission into the farm and within the farm are now commonplace. Swine veterinarians need to proactively follow proper biosecurity protocols to ensure the safety and security of our food supply. See Chapter 11 for complete details regarding biosecurity. The key points when performing a herd examination are for the veterinarian to be fully aware, and fully comply, with all biosecurity guidelines for the operation he or she is visiting. To do this, the veterinarian has to be proactive and always ask for biosecurity requirements before visiting the site. Being informed ahead of time will help ensure that the veterinarian is prepared and able to follow proper biosecurity protocols once on site.

SITE VISIT
Introduction to the Four Circles
One of the most important concepts of a proper herd evaluation is to be consistent! It is critical to ensure that herd examinations are performed in a consistent manner so as to be thorough and efficient, and minimize the opportunity for missing something important. Checklists may be helpful for specific, routine evaluations, but many times they are not practical for a complete and thorough investigation. Checklist approaches limit the problem-solving ability of the veterinarian and are especially poor approaches to new problems. There are too many areas of interest as well as too many differences in facility type and design to make a single valid checklist across all farms. Farm-specific checklists or checklists for particular aspects of operation can, however, be useful.

One systematic approach involves the concept of the four circles (Figure 1.2). The overall objective is to be systematic in the evaluation of an operation to make sure that all relevant information is evaluated when looking after pigs’ health and welfare. Each successive circle becomes more focused, culminating in the evaluation of individual pigs. The most important question the veterinarian must be able to answer after going thought the four-circle process is, “Is there currently a disease or welfare issue or is one imminent?”

Circle 1: Evaluation of the Outside of the Building
The first circle involves walking around the outside of the building to assess the overall site. This first circle is especially important when visiting a new site. Evaluation of the outside of the building has value both clinically for the pigs, as well as practically with respect to informing the veterinarian about the caretakers’ attention to maintenance and facility management.

As one walks around the site, biosecurity risks for the operation will be better understood. Are there any other hog sites in close proximity? Is the health status of these other operations known? How close are public roads from hog buildings? What appears to be the traffic pattern for this particular site (feed delivery, removal of dead carcasses, employee parking)? How well maintained is the site? If the site is not well maintained, could it be due to lack of attention to details or insufficient staffing? Either of these reasons would suggest that the veterinarian’s recommendations should be tailored to accommodate these realities. For example, a manager who is very attentive to detail is more likely to follow a complex or detailed treatment protocol.

Circle 2: Evaluation of the Inside of the Building
The second circle involves walking through the inside of the building. In this case, the objective is to get a
better feel for the overall environment of the pigs covering all regions of the building. One must walk from one end of the building all the way through to the other. If one takes too long to walk from one end to the other, it becomes more difficult to identify ventilation differences as one starts to become adapted to the new environment.

Stocking density is also evaluated at this time. It is important to note differences in stocking densities between pens as well as between barns. Lower stocking densities may indicate high mortalities in a particular pen or barn. Recommended stocking densities are listed in Table 1.1. Pig sizes are also assessed using the guidelines in Table 1.2 on expected pig weights based on age.

The general health of all pigs in the barn is evaluated at this time. Is there coughing, sneezing, or signs of diarrhea? The magnitude of the problem should be quantified. This is easily done by estimating the number of affected pigs in a pen as well as the total number of pigs in the pen. For example, if there are approximately 5 pigs coughing in every pen and there are around 25 pigs per pen, then it would suggest that approximately 20% of the pigs are affected. On the other hand, if it is found that only one or two pigs are affected in every other pen, then it would suggest the prevalence to be 2–4% of the barn. The quantification of prevalence does not have to be exact, as usually we are more concerned on the size of the magnitude of the problem (60% vs. 10%) rather than knowing the exact prevalence of the clinical sign (8% vs. 12%). Determining prevalence has three main goals. It allows for the correct perspective on the extent of the problem (i.e., is there currently a disease or welfare issue or is one imminent?). It helps to differentiate herd problems from individual pig issues, thus helping to determine the correct level of treatment (i.e., whole herd treatment or individual pig treatments). Finally, it provides a baseline for determining the effect of any intervention. This is especially important as although coughing may still be present after 5 days of treatment, the change in prevalence from 25% to 4% is a good indicator of improvement, suggesting that further intervention may not be warranted.

Circle 3: Evaluation of Individual Pens

The third circle is performed by doing an evaluation of individual pens. Based on the second circle, pens identified in the evaluation of the room are selected for further evaluation of the extent of the problem. Veterinarians must get in the pens with pigs. One cannot make a full assessment of the problem by simply walking the alleyway of the barn as many pig issues will be missed. This is the point in time that feeders and waterers are also checked for proper function (Table 1.3). Also, see Chapter 5 for the effect of the environment on swine health.

The overall behavior/attitude within the pen is evaluated, identifying individual pig concerns as well as pen concerns. Differences in sizes of pigs in a pen are again noted at this time (Table 1.2). It is very important to always ask if any type of size sorting (regrouping by size) has occurred as well as knowing the expected age difference for the barn. This is a good time to look closely for evidence of diarrhea. Many times the diarrhea is first noted by the fecal character that may be present on the floor or walls of the facility, and extra observational time is needed to identify the individual pigs that may be affected.

There are no specific recommendations on how many individual pens need to be evaluated. A key point is to make sure several pens from different parts of the building are evaluated to have a true representation of the potential herd issues recognized by the second circle evaluation. Individual pig issues of concern, especially those related to welfare (severe, chronic, or moribund individuals) should also be identified at this time.

Table 1.4 provides a summary of the expected normal temperature, respiratory, and heart rates of pigs based on size. A key point to remember is that as the environmental temperature increases, so will the average respiratory rates and body temperatures for healthy pigs.

For breeding herd examinations, the body condition of females should be evaluated periodically (Table 1.5).
<table>
<thead>
<tr>
<th>Age (Days)</th>
<th>Slow Weight (lb, kg)</th>
<th>Moderate Weight (lb, kg)</th>
<th>Ideal Weight (lb, kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Daily Gain in the Previous 20 Days</td>
<td>Daily Gain in the Previous 20 Days</td>
<td>Daily Gain in the Previous 20 Days</td>
</tr>
<tr>
<td>20</td>
<td>8–10</td>
<td>3.6–4.5</td>
<td>10–12</td>
</tr>
<tr>
<td>40</td>
<td>18–22</td>
<td>8.2–10.0</td>
<td>0.50–0.60</td>
</tr>
<tr>
<td>60</td>
<td>33–40</td>
<td>15.0–18.2</td>
<td>0.75–0.90</td>
</tr>
<tr>
<td>80</td>
<td>54–64</td>
<td>24.5–29.1</td>
<td>1.05–1.20</td>
</tr>
<tr>
<td>100</td>
<td>82–95</td>
<td>37.3–43.2</td>
<td>1.40–1.55</td>
</tr>
<tr>
<td>120</td>
<td>110–126</td>
<td>50.0–57.3</td>
<td>1.40–1.55</td>
</tr>
<tr>
<td>140</td>
<td>138–157</td>
<td>62.7–71.4</td>
<td>1.40–1.55</td>
</tr>
<tr>
<td>160</td>
<td>165–187</td>
<td>75.0–85.0</td>
<td>1.35–1.50</td>
</tr>
<tr>
<td>180</td>
<td>191–216</td>
<td>86.8–98.2</td>
<td>1.30–1.45</td>
</tr>
<tr>
<td>20–60</td>
<td>0.63–0.75</td>
<td>284–341</td>
<td>0.75–0.88</td>
</tr>
<tr>
<td>0–180</td>
<td>1.06–1.20</td>
<td>482–545</td>
<td>1.20–1.34</td>
</tr>
</tbody>
</table>

Source: Dewey and Straw (2006).
When making recommendations for feed or feeding changes, the stage in the reproductive cycle must be considered. Females entering the farrowing house should be in their best body condition (target body condition score [BCS] of 3) while gilts exiting the farrowing house (end of lactation) will have lower BCSs. Feed changes are best executed by making small changes (0.5–1.0 kg) in the daily feed allotments.

This is also a good time to identify individual pigs requiring treatment as well as acutely infected animals that would be useful for diagnostic sample collection. Animals appropriate for euthanasia, necropsy, and tissue collection are also identified at this time. When selecting pigs for diagnostic tissue sample collection, there are several important points to consider:

1. An animal’s life will be sacrificed for the good of the herd and due consideration should be placed into selecting the appropriate pig(s).
2. Animals must be selected which truly represent the major clinical signs of concern in the herd.
3. Animals should be in the early stages of the disease process. The selection of acute cases will increase the probability that the primary causative agent and compatible lesion is identified.
4. An animal that has received no antimicrobials or therapy is usually preferred.

The number of animals selected for necropsy and tissue sample collection depends on the objective. As a general rule, animals that are found dead are necropsied first. Mortalities are necropsied until a pattern of disease process is apparent, which suggests the primary herd disease issue rather than unrelated individual animal afflictions. Based on necropsy findings and clinical evaluation, representative live animals are euthanized for fresh tissue sample collection. The number of

### Table 1.3. Recommended water requirements, water flow rate, and feeder space per pig by phase of production

<table>
<thead>
<tr>
<th>Water Requirements</th>
<th>Feeder Space/Pig</th>
</tr>
</thead>
<tbody>
<tr>
<td>l/day</td>
<td>l/minute</td>
</tr>
<tr>
<td>Restricted feed</td>
<td></td>
</tr>
<tr>
<td>Gestating sows</td>
<td>12–25</td>
</tr>
<tr>
<td>Lactating sow</td>
<td>10–30</td>
</tr>
<tr>
<td>Boar</td>
<td>20</td>
</tr>
<tr>
<td>Nursing</td>
<td>1</td>
</tr>
<tr>
<td>Nursery</td>
<td>2.8</td>
</tr>
<tr>
<td>Grower</td>
<td>7–20</td>
</tr>
<tr>
<td>Finisher</td>
<td>10–20</td>
</tr>
<tr>
<td>Ad libitum</td>
<td></td>
</tr>
<tr>
<td>Nursery</td>
<td>2.8</td>
</tr>
<tr>
<td>Grower</td>
<td>7–20</td>
</tr>
<tr>
<td>Finisher</td>
<td>10–20</td>
</tr>
</tbody>
</table>

Sources: Dewey and Straw (2006). Adapted from Baxter (1984a,b,c), Patience and Thacker (1989a,b), Swine Care Handbook (2003), and Muirhead and Alexander (1997a,b).

### Table 1.4. Temperature, respiration, and heart rate of pigs of different ages

<table>
<thead>
<tr>
<th>Age of Pig</th>
<th>Rectal Temperature (Range ± 0.30°C, 0.5°F)</th>
<th>Respiratory Rate (breaths/min)</th>
<th>Heart Rate (beats/min)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>°C</td>
<td>° F</td>
<td></td>
</tr>
<tr>
<td>Newborn</td>
<td>39.0</td>
<td>102.2</td>
<td>50–60</td>
</tr>
<tr>
<td>1 hour</td>
<td>36.8</td>
<td>98.3</td>
<td></td>
</tr>
<tr>
<td>12 hours</td>
<td>38.0</td>
<td>100.4</td>
<td></td>
</tr>
<tr>
<td>24 hours</td>
<td>38.6</td>
<td>101.5</td>
<td></td>
</tr>
<tr>
<td>Unweaned piglet</td>
<td>39.2</td>
<td>102.6</td>
<td></td>
</tr>
<tr>
<td>Weaned piglet (20–40lb) (9–18kg)</td>
<td>39.3</td>
<td>102.7</td>
<td>25–40</td>
</tr>
<tr>
<td>Growing pig (60–100lb) (27–45kg)</td>
<td>39.0</td>
<td>102.3</td>
<td>30–40</td>
</tr>
<tr>
<td>Finishing pig (100–200lb) (45–90kg)</td>
<td>38.8</td>
<td>101.8</td>
<td>25–35</td>
</tr>
<tr>
<td>Sow in gestation</td>
<td>38.7</td>
<td>101.7</td>
<td>13–18</td>
</tr>
<tr>
<td>Sow</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>24 hours prepartum</td>
<td>38.7</td>
<td>101.7</td>
<td>35–45</td>
</tr>
<tr>
<td>12 hours prepartum</td>
<td>38.9</td>
<td>102.0</td>
<td>75–85</td>
</tr>
<tr>
<td>6 hours prepartum</td>
<td>39.0</td>
<td>102.2</td>
<td>95–105</td>
</tr>
<tr>
<td>Birth of first pig</td>
<td>39.4</td>
<td>102.9</td>
<td>35–45</td>
</tr>
<tr>
<td>12 hours postpartum</td>
<td>39.7</td>
<td>103.5</td>
<td>20–30</td>
</tr>
<tr>
<td>24 hours postpartum</td>
<td>40.0</td>
<td>104.0</td>
<td>15–22</td>
</tr>
<tr>
<td>1 week postpartum until weaning</td>
<td>39.3</td>
<td>102.7</td>
<td></td>
</tr>
<tr>
<td>1 day postweaning</td>
<td>38.6</td>
<td>101.5</td>
<td></td>
</tr>
<tr>
<td>Boar</td>
<td>38.4</td>
<td>101.1</td>
<td>13–18</td>
</tr>
</tbody>
</table>

Source: Dewey and Straw (2006).
animals euthanized depends on the individual case presentation and necropsy findings in the euthanized pig. When considering multifactorial etiologies, it is important to remember that not all animals in the herd will have all pathogens present at any one time point. This suggests that in a large herd, it may be necessary to euthanize sufficient animals to completely represent the full range of clinical and pathological findings and to identify the multiple, interacting disease agents. In other cases where there may be only one primary pathogen of concern, one or two euthanized pigs may be sufficient to answer the diagnostic question. The goal is to sacrifice the least number of animals yet maximize the diagnostic value for the benefit of the rest of the herd, thereby benefitting the current group as well as future groups. Live-animal (antemortem) sampling is commonly done. For some pathogens (e.g., influenza A virus via nasal swabs), simply finding the agent in the herd is all that may be necessary. In other cases, finding a common, endemic potential pathogen of interest (e.g., porcine circovirus type 2) must be in association with compatible lesions to support the role of such agent in the current clinical presentation.

Summary of Four Circles
The concept of the four circles is to obtain a systematic and complete picture of the clinical status of the site. It provides a systematic view that is important in deciding what interventions need to be implemented to mitigate the effects of the current disease. It starts with a big-picture overview and then narrows the focus to individual pigs. It helps separate unrelated individual pig afflictions from whole herd disease problems, both of which need to be addressed, but priorities and recommendations will be different depending on context and the client's goals and objectives. The role of the veterinarian is to help guide the client to maximize the impact of any intervention. Information obtained from this systematic approach will also help differentiate what issues are primarily due to pathogens and which ones are being confounded or even caused by management practices or management failures. It will help veterinarians formulate a more complete assessment of the prognosis and expected outcomes of the current health situation. Once mastered, the process can be quick and very efficient.

Asking Questions
The process of data collection should not be restricted to the veterinarian's observations. It is very helpful to ask others working on the farm or within the operation for their perspectives. This should be done not only from upper management individuals (i.e., managers or owners) but also from the workers themselves. Often, the managers make many assumptions as to what they believe is being done on the farm, but the actual workers have a different perspective. This may be due to lack of training, poor communication of protocols, or inadvertent deviations in protocols of which participants are unaware. This is why it is useful to ask the same questions to different people in the same production system for confirmation and to assess consistency. Questions should be formulated as open ended rather than seeking a simple yes or no answer. It is also very helpful to have employees demonstrate how to perform a task (“show me how”) rather than providing an explanation (“tell me how”). This ensures that the actual process and technique are observed and allow evaluation of significantly more details than are

### Table 1.5. Sow body condition scoring

<table>
<thead>
<tr>
<th>Body Condition Score (BCS)</th>
<th>Condition</th>
<th>Back fat mm (in.)</th>
<th>Description</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>BCS 1</td>
<td>Excessively thin</td>
<td>&lt;10 (&lt;0.39)</td>
<td>Ribs, hips, and backbone are easily visible and palpable.</td>
<td>Sow is in poor condition and needs large amounts of muscle and fat gain to maintain productivity. Needs a significant increase in feed.</td>
</tr>
<tr>
<td>BCS 2</td>
<td>Moderately thin</td>
<td>10–15 (0.39–0.58)</td>
<td>Ribs, hips, and backbone can be palpated with slight pressure.</td>
<td>A moderate increase in feed is required.</td>
</tr>
<tr>
<td>BCS 3</td>
<td>Ideal condition</td>
<td>15–22 (0.59–0.89)</td>
<td>Ribs, hips, and backbone can be palpated with firm pressure, but cannot be observed visually.</td>
<td>Monitor feeding to maintain this body condition.</td>
</tr>
<tr>
<td>BCS 4</td>
<td>Moderately fat</td>
<td>23–29 (0.90–1.13)</td>
<td>Ribs, hips, and backbone cannot be palpated.</td>
<td>May be appropriate to cut back slightly on feeding.</td>
</tr>
<tr>
<td>BCS 5</td>
<td>Excessively fat</td>
<td>≥30 (≥1.14)</td>
<td>Ribs, hips, and backbone cannot be palpated.</td>
<td>Sow has excessive amounts of fat tissue. Reduce feeding to bring her back to a BCS 3.</td>
</tr>
</tbody>
</table>

Adapted from Ken Stalder.
apparent in a verbal description. This has been especially useful in troubleshooting intensive, high-impact procedures such as artificial insemination.

As a site visit is performed, it is also important to examine storage and utility areas and to investigate refrigerators or medicine cabinets. This process should help support and validate the different worker’s answers to questions regarding processes and protocols. For example, an operation that claims routine vaccination of sows prefarrowing and yet has no vaccine on-site may need further evaluation and discussion to ascertain vaccine management and handling procedures.

**On-site Records**

Production sites should have treatment and mortality records on-site. These records are helpful in determining the total number of pigs in the original lot, number of mortalities, and the chronology of mortalities to date. Caretakers should be instructed to record euthanized animals in a different manner. A good practice is to also record a presumed “death reason” and educate clients on how to properly evaluate mortalities and record such. However, research has shown there are significant differences between recorded and actual death reasons (Lower et al. 2007). To facilitate this process, the focus should be on the actual observations that can be accurately made by caretakers. For example, it is difficult for a caretaker to diagnose *Escherichia coli*-associated diarrhea as cause of death. Instead, the mortality should be recorded as due to diarrhea. There should also be a second code to identify whether the animal died on its own or was euthanized. Practical and more valid mortality records can be collected by simply narrowing down the options provided, focusing on general clinical signs rather than a specific disease etiology, and training all individuals on how to properly categorize mortalities.

Records for farrowing, nursery, and finishing sites may include daily water consumption and daily high and low barn temperatures. This information is easy to collect in today’s modern facilities and can be helpful (especially the water) in predicting a possible respiratory outbreak (Brumm 2006). The high and low barn temperature recording is helpful in identifying possible concerns with the ventilation system. It is best to utilize an independent high–low thermometer to record temperature fluctuations rather than use the barn’s electronic control system in order to validate the proper function of the controller.

For breeding herds, there are many other records that are kept on-site. These records can vary in form and content, from hand notes to an actual computer on-site. Log sheets are very helpful in ensuring that jobs are routinely done. For example, a simple semen log can track the date, time, current temperature of the semen storage unit, and initials of the individual who rotated the semen (e.g., manually resuspended semen in extender by gently rocking the semen bags/bottles back and forth). The advantage of having this type of manual record is that it ensures this important job is done routinely, and having individuals write down their initials facilitates accountability. It is a reality that in operations with multiple workers, duties are sometimes not performed because a worker believes that someone else was doing the job.

Computer records can be accessed either through daily/weekly reports provided to the farm or through direct access to a computer. The number and variety of reports that are available from computerized sow record systems precludes discussion here. It is important for the swine veterinarian to understand and objectively evaluate different herd performance parameters. The greatest advantage of computerized record systems is their ability to summarize relevant data in many different ways, and as previously mentioned, compare with relevant internal or external benchmarks to help identify those performance parameters in need of improvement.

When looking at reports, it is important to remember that data are usually summarized based on time or by cohort. In a time-based report, data are simply attributed to a particular time period. For example, January breeding and farrowing number summarizes data for all the sows that were bred in January as well as the sows that farrowed in January, which are two distinct groups of animals. This information is helpful in monitoring the overall herd’s performance, but it is not helpful in evaluating cause and effect within a particular group. To better evaluate a particular group, a cohort-based report must be used. In this case, all parameters reported are specific to a common group of animals the breeding and farrowing data pertain to the same group of animals although accumulated at different dates. This cohort-based report is very useful in evaluating the effects of different interventions by keeping all the relevant data associated with the particular group of interest in one report.

The most important part of any data collection is the desire to take action when an abnormality is detected. When a veterinarian requests data to be collected by workers or caretakers, effective communication should outline the importance of the data, how the data will be used, at what threshold they are expected to take action, and the consequences of failing to act. For example, simply recording the daily temperature of the semen storage unit has no value unless action is taken when temperature is outside of the desired range.

**DIAGNOSIS**

Once a site’s evaluation has been performed (four circles) and data have been collected, it is then necessary to interpret all the findings in the context of the
veterinarian's clinical observations. The Greek word “diagnosis” literally means “through thinking” (Morley 1991). The process of arriving at a diagnosis can vary among individuals and clinical presentations. What is important is to be systematic, once again, to ensure that decisions are focused and objective. Figure 1.3 summarizes the field investigation and case management process. The following brief summaries are a few examples of different approaches/aspects that can be considered.

**Subjective Observations, Objective Data, an Assessment, and the Resulting Plan**

One of the traditional means for summarizing data in the medical profession is to utilize a process in which subjective observations, objective data, an assessment, and the resulting plan (SOAP) are all specified. Four senses (sight, hear, smell, and touch) are generally used when gathering data. Subjective data are focused on identifying issues reported by the owner, manager, or
other workers, as well as any other qualitative observations. The objective section is focused on quantitative data. The assessment is an evaluation or interpretation of both subjective and objective data. Finally, a plan of action is provided in response to the assessment. Using this SOAP approach allows for a complete and thorough thought process to occur before any diagnosis is made. It is a systematic way to ensure completeness. Consistency is king!

**Grouping Observations**
Many times it is helpful to group observations based on commonalities. It is especially helpful to categorize based on organ system relationships. Grouping observations helps apply Occam’s razor (the simplest explanations are more probable). In other words, it is more likely that the pulmonary edema, ascites, and respiratory dyspnea in a pig are caused by circulatory system failure rather than the pig having three completely different pathogens, each independently causing one of the clinical findings noted. After grouping observations, a possible differential list can then be compiled.

**DAMNIT**
This approach focuses on coming up with a complete differential list to ensure all possibilities, so as to avoid too narrow a focus on infectious diseases. The following list helps identify the terms associated with each letter of the acronym:

D = Degenerative  
A = Anomaly  
M = Metabolic  
N = Nutritional or neoplasia  
I = Inflammatory, infectious, or immune mediated  
T = Trauma or toxicity.

One of the disadvantages of this particular acronym is that it does not help prioritize the list. It also encourages veterinarians, especially those in their early career, to generate a very long list of possible, yet not probable, differentials.

**Five Production Inputs Model**
One other approach in thinking of differential diagnosis and risk factor list is to think more holistically and ensure that all aspects of production are considered. The five production inputs model of integrating cause and risk factors includes consideration of nutrition, environment, disease, genetics, and management. This model is very useful as it helps ensure multifactorial causes contributing to the clinical issue of concern. The nutritional aspect of veterinary medicine has become more important in recent years as feed prices have dramatically increased. High feed prices have promoted the use of alternative feedstuffs including the use of dry distiller grains (DDGs). The effects of these changes in diets and variability in quality of ingredients on the health of pigs have not been fully investigated. Environment also plays a key role in the health and welfare of pigs as is mentioned throughout this book but especially in Chapters 3 (behavior and welfare), 4 (longevity in breeding animals), and 5 (effect of the environment on swine health). The disease component is typically the first focus of veterinarians and is the focus of many chapters in this book. Genetics is an input that many times can be confusing as genotype and phenotype expressions are very complex especially when focused on clinical significance. Finally, management, especially all the people involved, is a very integral part of livestock production and can have a tremendous influence on the health, welfare, and success of raising animals. With the urbanization of the world and increasingly fewer people with an agricultural background, training workers on basic husbandry practices is becoming an integral part of any successful operation. New entry-level workers generally have very limited, if any, experience and knowledge on how to raise pigs.

The five production inputs model works to integrate the interactions of different factors that may be working together and, at the same time, are influencing the health of a pig. The diagram in Figure 1.4 demonstrates the interaction of possible contributing factors associated with a simple example case of piglet diarrhea.

**Determining Interventions and Prioritization**
After observations are made and a list of differentials has been created, the next step is to identify appropriate interventions and prioritize their implementation. This step of the process becomes easier with experience. Personal experiences, client constraints and capabilities, ease, likelihood of success, and impact of intervention all play an important role in helping guide prioritization. It is important to always keep in mind the client’s goals and objectives.

From the pigs’ point of view, the priorities for survival and health are (fresh) air, (clean) water, (wholesome) food, and appropriate vaccination or treatment as needed. A producer’s expectation and a veterinarian’s training sometimes places therapeutic intervention as first priority. Vaccines will not be successful unless the pig is placed in an environment that allows the vaccine to work to its full potential. From the pig’s perspective, the last area of need is vaccination or treatment as compared with having good quality air as the top priority, with access to good-quality feed and water of similar priority.

Many times a diagnostic workup may be necessary to rule different differentials either in or out. Necropsies have been mentioned above and sample collecting (blood and oral fluid) will be discussed at the end of this chapter. Chapter 2 will cover some lists for differ-
ential diagnosis. Further general information on diagnostics is covered in Chapters 6 and 7.

Usually, priority is given to interventions that will have the greatest impact on the greatest number of animals. Because resources (time and money) are always limited, priorities need to be evaluated based on their cost and benefit as well as overall welfare of pigs and sustainability of operations. The benefit does not always have to be financial, although many times this is the primary objective. Priorities that require substantial investment in resources usually will require a justification on the expected return.

Reporting

Once interventions have been identified and prioritized, it is critical to provide this information to the client in a concise and clear manner. A farm report or client letter is a very helpful tool in making sure the correct information is being communicated. Written reports and instructions will minimize miscommunications. Reports should be short (usually) and should include a prioritized list (bullet points) with only two or three top interventions. Personal experience suggests that providing too many recommendations allows for the clients to lose focus. They may select only recommendations that are desired or easiest to implement. The client may feel as though the veterinarian’s recommendations are being followed but in reality have a false sense of security and may be neglecting the most important recommendations. The report should be short (preferably up to one page long and definitely no more than two pages), which helps ensure the client will actually read it. Very long reports are conducive for a quick skimming by the client and thus many important points can be missed. Certainly, there are times when a comprehensive report is needed, but for routine investigations, simpler is better. Client letters need to be provided back to the client in a timely manner (usually within a few days) in order to maximize implementation of recommendations. Integrated or complex production systems also require knowledge and understanding of the farm or company reporting structure.

Veterinarians must understand and follow the proper reporting structure in order to meet clients’ expectations. The structure serves as means for the central entity and decision maker(s) to have an understanding on the issues of the entire system. Following proper reporting structures ensures that everyone is working together as a team.

Client reports are no substitutes for medical records. Veterinarians should keep detailed records on clinical observations and diagnosis. These complete medical records will serve as an excellent reference for future visits and have legal implications, including the justification for the use of any antibiotic per label or in an extra label manner.

**MONITORING OUTCOMES**

It is important for the client to be able to measure outcomes that can help determine the effectiveness of the intervention plans (Figure 1.3). Veterinarians must demonstrate the value they bring in order to be viewed as an asset rather than just a liability (expense).

**SAMPLE COLLECTION**

**Blood Sampling**

Blood sampling is one of the most common sample collecting techniques practiced in the United States today. There are several different techniques used in blood sample collecting in swine. Blood sample collecting requires a good understanding of pig’s anatomy as all major blood vessels are nonvisible, and thus a blind stick is performed. Mastery is achieved through practice. Much of this blood sampling information has been summarized in Dewey and Straw (2006).

**Pig Restraint.** It is important to properly restrain pigs for safe sample collecting both from the perspective of the pig as well as the person. The size of the pig and the comfort level of the restrainer will dictate the desired method. Figures 1.5 and 1.6 depict two approaches commonly used for restraint. In both cases, the person doing the restraining is just as important as the person collecting the blood sample. Pigs need to be immobilized and held in the correct position to facilitate access to the target veins. In the standing pig, it should have all four feet squarely placed on the ground. Its neck should not be stretched too much otherwise access to the veins will be much more difficult.

**Anterior Vena Cava.** The pig’s right jugular groove is identified, and the needle is inserted just cranial to the thoracic inlet. The needle is inserted aiming to the top of the opposite shoulder. This is approximately at a 30° angle from the median and 90° angle from the neck line (line from thoracic inlet to the head). Figure 1.7
The pig’s right side is used for sample collection as the right vagus nerve provides less innervation to the heart and diaphragm than the left vagus nerve. Vagus nerve puncture can cause the pig to start showing signs of dyspnea, cyanosis, and convulsions (Dewey and Straw 2006).

Jugular Vein. To reach the jugular vein, the procedure is similar to that of the anterior vena cava with the needle being inserted about 5 cm cranially from the thoracic inlet (Figure 1.5). The right side of the pig is still preferred. The jugular vein is located more superficial than the anterior vena cava but cannot be visualized as in many other species. The process still requires a blind stick.

Ear Veins. Ear veins can be raised by using a slight tourniquet (usually a rubber band around the ear or pressure with one’s thumb) as seen in Figure 1.8. Slight slapping of the back of the ear with one’s back of the fingers can help stimulate the raising of the veins. Veins in pigs with colored ears are more difficult to visualize. Venipuncture is done starting at the most distal point (toward the ear tip) of the largest vein, so if a hematoma is formed, a more cranial point can still be used for sample collection. A butterfly catheter and syringe should be used. For a quick polymerase chain reaction (PCR) testing, a simple prick of an ear vein with the tip of a 20-gauge needle can provide enough blood for collection with a Dacron swab.

Miscellaneous Methods. Tail bleeding (Muirhead 1981), femoral vein (Brown et al. 1978), cephalic vein (Sankari 1983; Tumbleson et al. 1968), cardiac puncture (Calvert et al. 1977), and orbital venus sinus bleeding (Huhn et al. 1969) have all been described.
Oral Fluids Collection

Oral fluids collection for veterinary testing is becoming a more common practice in swine medicine especially in the United States. Oral fluid is a mixture of saliva and oral mucosal transudates. Oral fluids can contain both organisms and antibodies of interest (Prickett et al. 2008).

The process of oral fluid collection is simple and practical. It involves the following steps:

1. A cotton rope is hung from a pen by using a special bracket, by plastic tie, or simply by tying it with a knot. A cotton rope is used because it is highly absorbent with greater yield. The suggested rope sizes are 1.3 cm (1/2 in.) for nursery or 1.6 cm (5/8 in.) for grow-finish pigs. Ropes should be cut to the correct length so that they reach the top of the shoulders of the pigs. As pigs chew the ropes, the ropes will unravel and stretch, so longer lengths are not recommended.

2. Allow the pigs in the pen to chew on the rope for 20–30 minutes.

3. Extract the oral fluids from the rope by inserting the bottom (wet) end of the rope in a clean plastic bag (or disposable plastic boot). Squeeze the rope so that fluid accumulates in one of the corners of the bag. Cut the corner of the bag and collect the fluid into a sample tube. Ideally, at least a 4-mL sample will be obtained.

The sample then needs to be refrigerated until testing. The sample may be centrifuged for 10 minutes if it contains large number of particulates. The sample needs to be identified as an oral fluid sample when submitting for testing as special testing protocols need to be used by the diagnostic laboratory.

REFERENCES


