
Guide for Herd Problem Investigations

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Contents:

Scenario (For Block Students):

You have formed a veterinary consulting firm with your block classmates. A private practitioner has referred a client that is currently experiencing a serious problem to your firm. Your task is to investigate this herd problem and to make appropriate recommendations to solve the problem.

Learning Objectives:

- Describe the general strategy for investigating a herd problem and its implementation.
- Describe how to identify, access and interpret the relevant clinical literature beyond the textbook and course notes level.
- Develop an understanding of the specifics of the disease problem at hand.

> Realize that course knowledge and textbook materials alone are likely not sufficient to solve complex problems such as these. Developing solutions usually requires integration of knowledge from the professional knowledge base with specific information unique to the premises. These solutions may be definitive ("To prevent . . ., do the following specific things.") or may mean further on-farm investigation, the important component being the producer's confidence in your recommendations and course of action.

Group problem investigation vs. individual problem investigation:

- Describe how the clinical diagnostic process and therapeutic goals differ when extended from the individual animal to the group.
- List the additional useful information that is available from the herd when dealing with a group vs.

dealing only with an individual (e.g., affected vs. non-affected, degrees of severity, degrees of exposure to potential risk factors) and describe its importance in problem solving.

- Describe the difference in the outcomes and interventions relevant to the individual animal vs. a group of animals (e.g., detection and prevention vs. treatment and salvage).
- Demonstrate skills in the collection, analysis and summary of group data using widely available software.
    - Establish risk cohorts and calculate descriptive statistics and risk of occurrence in each over time
    - Compare risk groups and calculate odds ratios or relative risks by possible exposures
    - Plot risk over time, using moving averages and apply smoothing to reduce the effects of random noise.
    - Include on plots other exposures that vary over time (e.g., calving pen density, temperature-humidity index)
    - Plot survival curves of binary variables (e.g., days open, calf mortality)
- Demonstrate skills in writing a concise report for the producer.

Block Investigation Objectives:

- Develop a herd problem investigation strategy for a herd problem. For background material and specific strategies for attacking herd problems, see **Herd Outbreak Investigation Resources for Veterinarians.**
- Conduct the on-farm investigation of the problem.
- Analyze the results of your investigation. For general on-line information on epidemiology and biostatistics, see **WWWeb Epidemiology & Evidence-based Medicine Sources for Veterinarians**. For information on disease epidemiology in animal groups, particularly for infectious diseases, see **Epidemiology Concepts for Disease in Animal Groups.**
- Write a formal report summarizing your investigation with prioritized interventions that is sent to the livestock producer(s) through their veterinarian. See the **Student Guidelines for Written Recommendations** for guidance in writing this report.

    Warning: This report is considerably more difficult to write well than students usually anticipate. Thus, they usually need hours longer to do a good job than they typically anticipate!

- Be prepared to present your investigation in a rounds format (if requested to do so). The block presentation should be based on the contents of the above report and should require considerably less time to prepare, using many of the reports components (graphs, charts).

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Logical Components of Herd Problem Investigations:

The unique strength of herd investigation is that because the individuals are grouped into a herd, you can compare affected animals, both clinical and subclinical, with unaffected animals, in both a cross-section (at one point in time) and over time to determine the differences between both the animals themselves and the factors affecting them. Basically, herd problem investigation is a thorough search for and interpretation of **clues** with the goal of arriving at a solution quickly and efficiently. **Note that the**

flow of this search is often "multithreaded", meaning that a number of these are occurring at once, and "recursive", meaning that new information causes a previous step to be revisited. Beware that common sense is often misleading. Following in approximate order are the typical components of investigations (modified from Lessard and Perry, 1988). See the outbreak investigation flow diagram below.

1. **A Problem is Detected**

A farm event triggers the investigation. The event can be dramatic, such as a series of unexpected deaths or a sudden, dramatic production declines, or it can be finally the recognition of a chronic problem that has been occurring for some time. The earlier problems are detected, generally the more successful the interventions. Much of herd production medicine is geared toward establishing systems for the early detection if not the outright prevention of common problems. ***He who detects the problem is often called on to solve it*** (Fetrow).

> What is the primary complaint? Be careful of situations where the manager has reasoned from a primary complaint (e.g. low milk production) to what they suspect is the cause (e.g., pneumonia in adult cows) to an almost ubiquitous infectious agent (e.g., *Mannheimia* (Pasteurella) *hemolytica*) or to a key determinant known to be associated with this cause (e.g. poor barn ventilation). In this case, the actual cause was a mis-calibrated scale on a grain auger (Hancock).

The three types of problems are

1. **Acute:** The problem was precipitated by a temporally-associated management or husbandry error of sufficient magnitude to be a sole cause of the problem.
2. **Additive or Cyclic:** The problem was precipitated by a combination of management or husbandry errors over time and the effects of cyclical factors such as season or production cycle stages such that the combination was sufficient to precipitate the problem. Ex: the summer coliform mastitis outbreak that is associated with the previous winter change to sawdust bedding.
3. **Chronic:** The problem was precipitated by the long action of management or husbandry errors that required the passage of time for before the consequences became of sufficient magnitude to be recognized, such as the slow spread of a contagious mastitis agent or of *Mycobacterium paratuberculosis*. Ex: the recognition of a *Staph. aureus* mastitis problem associated with the adoption of a less efficacious teat dipping procedure more than a year previously.

2. **Establish or Verify the Pathological and Etiological Diagnosis**

If the diagnosis is not definitive and if one is needed, start the process to obtain a definitive pathologic and etiologic diagnosis by collecting samples and submitting these to diagnostic laboratories. If dead or dying animals are involved, have <u>complete</u> field necropsies been done of a <u>sufficient number</u> of representative animals? Often only a few animals have been necropsied, often the necropsies are incomplete (e.g., a wide selection of tissues not submitted from all major organ systems) and often the necropsied animals aren't representative even when fairly large numbers of animals are dying. Be careful of accepting a provisional etiologic diagnosis as definitive without sufficient empirical evidence. If you do, you are likely to overlook contrary clues and thus seriously mislead yourself, which can have serious consequences both for the producer and for your credibility. On the other hand, recognize that **in many cases only establishing a definitive pathological and etiologic diagnosis does not solve the producer's problem**. For example, many calf scour agents are ubiquitous and often sampling scouring calves will only confirm this fact. The real question is "**Why does this farm have a problem with this agent when many others do not even though the infection is most likely present there as well?**".

Failure to perform complete necropsies and to submit a full set of tissue samples from the major organ systems is a common failure. Don't make the error of submitting only the samples that would confirm your leading differential diagnosis. In a continuing problem in a large dairyherd, the underlying problem was believed to be a severe respiratory condition but laboratory findings on the lung samples from partial necropsies were inconclusive. Complete necropsies subsequently performed on several sacrificed animals revealed a severe uterine condition subsequent to improper postparturient treatment.

3. **Establish a Case Definition**

   Establish a case definition, precise as reasonable, to exclude those cases that are due to endemic background problems. For example, in a group of pregnant cattle approximately 10% of all pregnancies diagnosed prior to 45 days of gestation are lost and approximately 20% of these losses are observed. Including cases that are due to other problems will confuse the analysis and resolution of the problem. Even in general herd problems (e.g. low milk production), some individuals are affected more severely than others. You may wish to establish a case definition with different degrees of certainty (e.g., certainly affected, possibly affected, possibly unaffected, certainly unaffected). Remember the iceberg principle and the spectrum of disease. If you overlook these concepts, in your search for clues you could be comparing clinically affected animals with subclinically affected animals while you believe you are comparing affected to unaffected . This may lead to erroneous conclusions about the factors involved in the problem, which defeats the strength of herd investigation (comparison between groups of animals over time). On the other hand, more severely affected animals may have experienced higher levels of a common risk factor than lesser or unaffected animals.

4. **Establish the Presence and Magnitude of the Problem with Objective Data**

   Obtain objective data to document and verify the magnitude of the problem; do not rely only on the memories and perception of management and employees. Unless based on objective evidence (e.g., analysis of records), their perception of the problem may be correct but more often than not it is off the mark. Subjective perceptions of employees, managers and practitioners are valuable sources of hypotheses about risk factors; your task is to support or refute these and other hypotheses with objective evidence. Compare the actual number of cases to the expected number to determine whether or not the frequency is excessive. ***Be very careful of "dangling numerators", that is counting the number of cases without considering the number of animals actually at risk of becoming a case during that time period.*** A large increase or decrease in the number of animals susceptible to a condition causes a corresponding change in the number of cases of that condition even though the underlying risk remains constant. Because of seasonal effects, few herds maintain a constant number of animals passing through the period of susceptibility year around.

   In a large dairy herd, 1/3 of the retained heifer calves were dying due to salmonellosis. However, the producer did not recognize the magnitude of these losses because the calves were dying one by one and were removed by the rendering service during their regular visits. Only by comparing the current youngstock inventory on the farm with the calving events recorded on a calendar did the producer recognize the magnitude of this loss. In another large dairy, the manager knew that 10% of the cows calving during a two week period were clinically affected by a problem. However, when the records of all of the cows that had calved during this period were reviewed, much to his surprise he found that all had been culled from the herd.

   Be careful of what the producer accepts as "normal" or endemic occurrence. In one high producing herd, the producer believed that 3rd or higher parity Holsteins going down with milk fever was a "normal" occurrence. Thus, he accepted most of his older cows going down with milk fever and did not recognize that as an abnormal situation warranting correction. Neither his veterinarian nor his nutritionist were aware of the high incidence of milk fever on this farm (this was before IV calcium solutions were classified as legend drugs).

Be careful of the events that the producer is omitting because of assuming that it is not related to the problem of concern. For example, the recent episode of late term abortions that isn't mentioned may well be related to the more prevalent metritis problem. Remember: ***More mistakes are made from not looking than from not knowing!***

a. **Establish the <u>Timing</u> of the problem (the temporal pattern - *When*?)**

When in calendar time did the problem actually begin? What is the pattern of performance over time? **If possible, do not rely on fallible human recollections alone; verify.** Clearly establishing the timing of the onset of the problem from objective data (i.e., herd records) is crucial to determining what management changes or other sporadic events may be related to this event, such as a decline in milk production or an increased risk of death. Changes in individual animal performance must be distinguished from changes in total output due to changes in the numbers of producing animals. With count type data, plot epidemic curves. When did the index case occur?

> **Be very careful of "pseudoepidemics" caused by the onset of producer awareness of a more chronic problem or caused by a change in problem definition.** For example, changing from detection of fetal loss by visual evidence of a conceptus to detection of open cows post early pregnancy diagnosis will cause a pseudoepidemic of fetal loss in virtually any dairy herd. In one case, a dairy producer invested almost $1,000 in lab fees trying to establish the cause of such a pseudoepidemic. They had recently started using a personal computer dairy herd records program, which classified any cow returning to heat after a positive pregnancy exam as an abortion in addition to those with visible signs of late gestation fetal losses.

b. **Establish the <u>Place</u> of the problem (the spatial pattern - *Where*?)**

Where are the affected vs. unaffected animals located? Because different groups or pens of animals often have different levels of exposures (e.g., different amounts of feed ingredients, different water sources, different housing, different pasture, different origins, different stages of the production cycle) and a dose-response relationship exists for many etiologic agents, this is an important set of clues.

c. **Establish the <u>Demographics</u> of affected vs. non-affected animals (*Who*?)**

The strength of herd investigation rather than individual investigation is the opportunity to compare affected animals to uninfected animals. What are the characteristics of affected vs. unaffected animals in terms of exposure to potential risk factors, age, production level, stage of production cycle and source? As noted above, because of the spectrum of disease be very careful when classifying animals into affected and unaffected groups.

5. **Assemble and Analyze the Data**

Using a spreadsheet, plots of production data smoothed over time are easy to create. From count data of the numbers of affected and the numbers of susceptible animals, calculate case morbidity and fatality rates by exposure and relative risks. For an outbreak, establish an epidemic curve. For endemic problems, plot risk over time by cohort group. Examine the effects of other factors that vary over time (e.g., calving pen density, average of weekly high temperature, sources of animals) on risk of occurrence or production. For definitions of terms, see Terminology Specific to Epidemiology. If the herd doesn't have a good production accounting system, don't overlook clues in indirect sources of similar information. **Concentrate on the data that will support or refute hypotheses.**

> For example, the delivery dates and weights on feed invoices can provide approximate information on feed batch disappearance and thus approximate information on consumption patterns. On this basis, expected disappearance of feeds can be compared to actual disappearance. Invoices from rendering services may provide information on dates of animal deaths if they have not been recorded. Often, events such as calvings and breedings are written on calendars or in pocket books.
>
> Gathering and analyzing this objective data on a herd problem is an examination process that is analogous to using laboratory tests or imaging procedures in the diagnosis in an individual animal. This objective data supports or refutes clinical impressions of the herd problem much like the testing or imaging supports or refutes clinical impressions of the clinical case.

6. **Generate Hypotheses (Differential Diagnoses) about Key Determinants**

   Key determinants are those risk factors causing the problem that can be modified on this premises. Based on your knowledge of the natural history of the given disease problem and the objective information that you have collected to this point, generate hypotheses about what key determinants might be involved. If necessary, search the literature for hypotheses about plausible risk factors. Subjective observations by the producer and other professionals are often valuable sources of hypotheses. What risk factor or factors is causing this problem on this premises that can be changed? These hypothesis are important because they provide the basis for further strategic sampling and data analysis rather than scatter-shot sampling and data overload. New hypotheses usually lead to revisiting prior steps in this process. Prioritize your hypotheses by their likelihood and focus your efforts on those with the highest priority until they are either more fully supported or are refuted.

   > A serious, but not uncommon, error is to jump to generating hypotheses without first developing the quantitative information (the who, when, where counts) beyond vague clinical impressions (e.g., these animals seem to be affected more than those) to support or refute a specific hypothesis. This is analogous to "scattershot" ordering of laboratory tests in diagnosing individual animal cases, hoping something will pop up rather than using the laboratory tests to rule specific differentials in or out, and will likely be as unrewarding.
   >
   > Note that for additive, cyclic or chronic problems, the initial occurrence of the underlying management or husbandry deficiencies are usually not close in time to the recognition of the problem. In many cases, because of the lag between a management change and the recognition of the problem, the manager is reluctant to acknowledge that change precipitated the problem.

7. **Test Your Hypotheses**

   Establishing and executing good tests of your hypotheses requires a large amount of ingenuity. Based on the above hypotheses, predict what you should find in other animals, such as test results or production effects, and proceed accordingly to test your predictions. **Make predictions of the form "if this cause is present, then this finding should be present"**. Because many causes have multiple effects, finding more of these multiple effects provides stronger support for the presence of the cause than finding only one. Often a single effect can result from several different causes. Finding what you predict supports your hypotheses; not finding what you predict weakens your hypotheses. The key is figuring out what predictions will provide good tests and are "doable". Perform any additional sampling and data gathering needed to confirm or refute your hypotheses. **Avoid the error of only taking samples that if test positive will confirm your hypotheses but not taking samples that if test positive will refute it. Avoid scattershot sampling because doing so without an objective in mind is seldom useful and is expensive in money for the client and in credibility and time for you.** What is the simplest set of explanations that covers the most findings?

> Example predictions are: "If this infectious agent is being transmitted between animals in this manner, then these other animals are at risk and some should be infected while these others are not and will not be." "If this risk factor (e.g. overcrowding in the fresh pen) is causing the metabolic disease (e.g., displaced abomasums), then I expect see the following pattern in the associated data (e.g., higher proportion of cows experiencing DA's in the cohorts with more crowding in the fresh pen compared to those with less crowding)."

8. **Design Interventions and/or Prospective Studies**

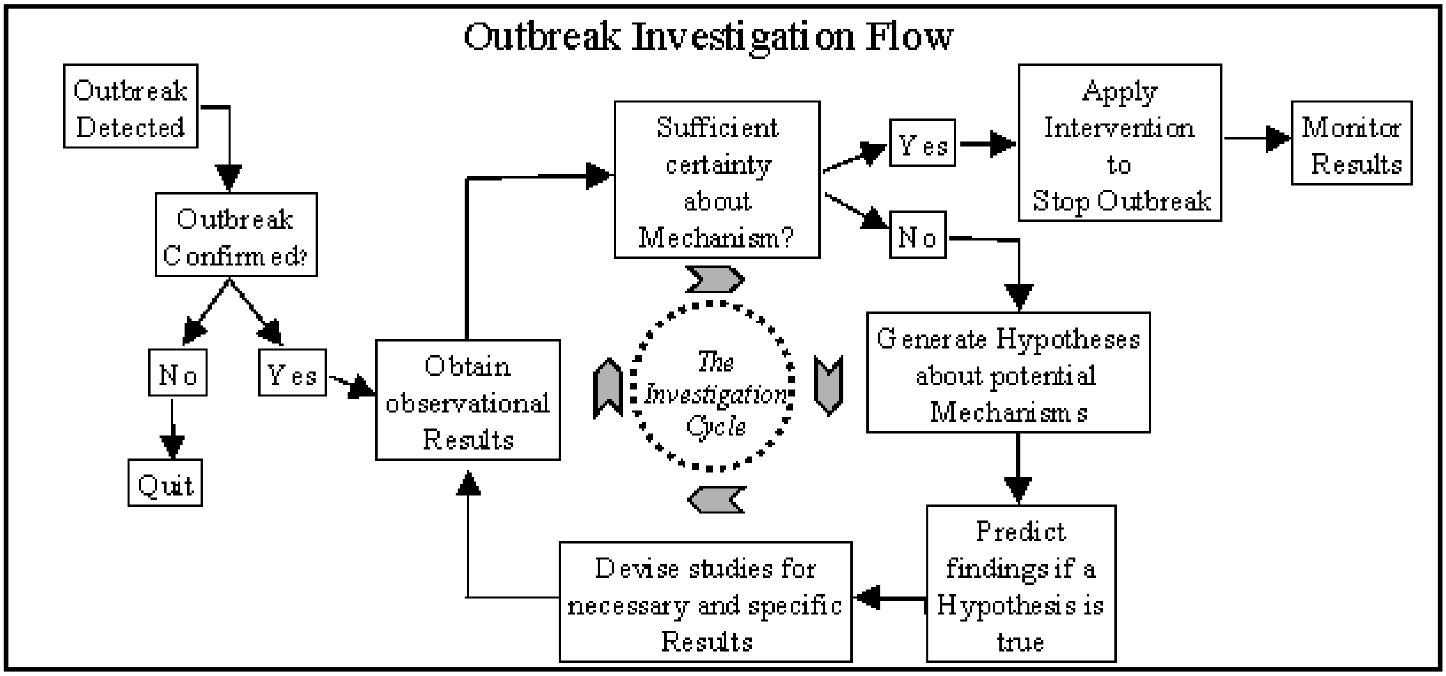
   Generate action items that are compatible with the specific facilities, economic limitations and management scheme of the premises. Considering the limitations of the facilities and the management and how these factors led to the occurrence of the problem in the first place in the design of these interventions is crucial to their success. If uncertain about the effectiveness of an intervention and the management situation is appropriate, propose a prospective clinical trial or other follow-up studies.

9. **Report Your Findings**

   See Student Guidelines for Written Recommendations. Remember the old truths that "***The faintest pen is stronger than the strongest mind***" and that "***Success has many fathers but failure is an orphan.***" If your recommendations are successful, because of the passage of time you will not likely get the credit due you unless they were documented.

10. **Monitor Results of Interventions**

    For problems with a significant subclinical component, develop a monitoring scheme to provide early warning of the problem. If the herd doesn't have a good production accounting system to monitor changes in production but one is warranted, propose one. In productivity problems, establish benchmarks of performance if they aren't being used already. Monitoring of the results of your recommendations also provides you important information about the efficacy of your advice. The key is to figure out an economical, easily doable scheme for monitoring a herd. For example, for problems caused by an infectious agent, can pooled samples of effluent or milk be obtained on a regular basis to effectively monitor for the continuing presence of that agent in the herd?



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Initial Telephone Contact Outline:

The following are specific points of information that should be acquired on initial contact. If these are not available, such as the actual case occurrence dates for the timeline, the producer can begin establishing them.

Date of Last Up-date:
Initial Contact Date:

Veterinarian:
Telephone:
E-mail:

Client Name:
Client Telephone:

Primary Problem:

WADDL Case No's: (Submitting vet, approximate date, (same herd name?))

Other Laboratory Information: (Other lab results, submission dates, interpretations)

Initial Herd Information and Observations:

- Herd size, production level, general management level
- Vaccination practices, parasite practices relevant to type of problem (e.g., fetal loss or respiratory disease)

- Feeding constituents and practices relevant to type of problem (e.g., displaced abomasums, peripaturient paresis)
- Specific management practices relevant to type of problem (e.g., milking time hygiene for mastitis outbreak)
- Any recent changes in these relevant practices, weather, housing or environmental conditions?

Initial Problem History:

- Case Information: Clinical signs, post-mortem observations
- Timeline: Actual case dates, problem duration
- Demographics: Affected's age, production phase, actual number of group affected and size of group
- Any interventions applied to stop problem (success?), any initial ideas about contributing factors?

Initiated Actions:

- Any samples that need to be taken, even if only held, before the opportunity is lost (e.g., offending feed is fed up)?
- Any sampling that can be initiated prior to visit to reduce time required for laboratory information (e.g., serum samples from affected and unaffected animals, infectious agent isolation)?

Specific Questions: ("What specific information do you (producer or their veterinarian) want or what specific questions do you want answered?")

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Investigation Planning Strategy:

Develop your background on the problem as it is currently stands on the premises.

Obtain all WADDL and previous FDIU reports that are available from this premises.

Develop your background knowledge and understanding of the biology of the problem.

Although clearly the place to start, do a thorough search of the literature beyond the class note and textbook level (through literature citations, book bibliographies, Vet CD and Vet Beast, Cornell Consultant, NLM PubMed, ...). **The more you understand about the problem process beforehand, the more fruitful your farm visit will be.** Think about how you will identify resources and build this background knowledge when you are faced with these problems in practice. If necessary, contact experts in the area to discuss the problem with them.

- What is the evidence from the primary literature about the etiologies of this problem in this species? What is the strength of this evidence?
- What is the evidence from similar species that can be used by analogy? What is the strength of this

evidence?
- What interventions have been described and evaluated? What is the strength of these evaluations?
- What are the currently plausible hypotheses (differential diagnoses)?
- What "tests" (history, on farm observations, population "exam", laboratory tests, necropsy, future studies) may be useful in ruling hypotheses in or out? ¨ What are the "key determinants" (the points at which interventions can be made) for these produces?

Develop your understanding of the potential causal pathways (causal webs) for the problem at hand. An example of some causal pathways are located under "The Causal Web Concept" in Epidemiology Concepts for Disease in Animal Groups. **Drawing out detailed "concept maps" or "idea maps" will both improve your understanding of the complex biology underlying the problem and will help you focus your pre-investigation library work by clarifying those areas in which you need better a understanding.**

> (For on-line background information on concept maps, enter "Concept Mapping" as a page search term in the page "WWWeb Communication, Grant-Writing, Learning & Critical Thinking Sources")

- Draw out potential causal pathways back to the key determinants. What is related to what? If something is happening at one point, what should be happening elsewhere? Draw out a "concept map" of the relationships.
- What corollary conditions could be used as indicators of a likely "key determinant"?
- What might be happening that can be prevented?

Develop a plan for the on-farm investigation ¨ What do you want to do and how do you want to do it? ¨ Written outline of plan (who will do what?):

- What specific questions do you need to ask of the producer? What is a logical "thread" or sequence for these questions? These need to be planned ahead of time. Who will ask them? Too many people asking too disjointed questions of the producer will lead to confusion of all parties.
- What data do you need to collect? If a source of that data isn't available, what other data can you use?
- What observations do you need to make during the visit?
- What specific samples do you need to collect? **Do not ignore what unaffected animals can tell you, the most common mistake!**
- What materials do you need for the on-farm investigation?

Collect additional pre-visit information

- What questions could the producer or his veterinarian answer before the visit, the answers of which will definitely assist you in your pre-visit planning?

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Investigation Execution:

Be careful to follow good on-farm etiquette.

- Use producer and employee time carefully. They likely want to cooperate but they also have their daily chores that have to be done. Their time may be particularly scarce if the herd is in the midst of a big outbreak with an unusual number of sick animals. Although they likely regard meeting with you as important, getting a welder out to fix the broken feed truck so that they can feed is of the greatest importance.
- Minimize interference with on-going routine farm activities (e.g., feeding animals, milking cows).
- Avoid keeping cows locked up for sampling longer than an hour. If possible, sample animals during their normal lockup times.
- Don't contaminate feed alleys and feed with dirty boots.
- Pick up after yourself. Don't leave behind any trash such as used sleeves, needles, needle covers, wrappers and so on.
- Maintain a professional appearance and behavior at all times.

Producer Interview Objectives:

Obtain information on management policies, concentrating on those issues related to the affected and susceptible groups of animals and the associated hypotheses. Make **written** notes of all of your observations, including the following. **The faintest pencil is better than the strongest mind.**

1. **Record the physical layout of premises**.

    Draw and label a map of all pen locations, pastures or other physical characteristics that demarcate groups of animals. Identify the pens or areas using the producer's system (otherwise the results from groups may be meaningless to all parties). If feeds are involved, indicate storage locations.

2. **Record the current numbers of animals in each pen or area and the intended maximum capacity of these areas**.

    This establishes the current numbers for denominators. Establishing the number of susceptible animals at the time of the outbreak peak, their current status and their current location requires further work. These are needed to establish risk and potentially other factors, such as average dry matter intake.

    Later, you may need to count stanchions and free-stalls to establish maximum capacity if overcrowding is potentially involved.

3. **Record the animal "calendar" intended by management for the relevant animals**

The animal calendar is what happens to animals as they move through their production cycle. These are the what's and when's (what age or days in production cycle) for being moved, fed, vaccinated or otherwise handled (e.g., dried off, dehorned, implanted, bred, pregnancy checked) and otherwise exposed to potential risk factors. The easiest way to do this is to start at a point in their production cycle and work your way around the cycle, recording the management policy for each thing that happens to them. Then remember to double-check later with the people who actually do it that this is indeed what happens to them.

Record animal movement and group membership policies.

Record the policy that determines when or why animals are routinely moved from one group to another during normal operation. For example, the policy for drying cows off may be that lactating cows are dried off when they fall below a particular production level or when they reach so many days before calving, whichever comes first, or it may be when the low production pen reaches a certain capacity. A related issue is how often and on what schedule is production assessed and cows moved. For example, is this done on a certain day of the week, monthly after testing or when? Be reasonable. If investigating a calf scour problem, the policy for moving cows from the high string to the low string is not relevant but the policy for moving cows during the dry period may be.

Later, for those policies that may be related to the problem at hand compare evidence of the actual practice to the management policy. Has this policy been enforced well, is enforcement variable, or is the policy becoming lax? Continuing the example above, determine if the dry off policy is actually practiced by assessing the lengths of dry periods of recently calved cows or by establishing the pen census at several recent time points. Management often has one policy (e.g., calves are weaned at 30 days) but employees may be executing another (e.g., calves are weaned at 60 days) or animals have simply been missed (e.g., cows fresh 120 days without detected heats).

Record management policies for the relevant routines performed on individual animals (e.g., vaccination).

When are what animals vaccinated, with what and how? For example, once every two weeks the calves between 7 and 21 days of age are vaccinated with 5 cc's of SuperBac IV subq.

Later, for those policies that may be related to the problem at hand, determine if animals could have been missed or overlooked.

Record who is responsible for actually carrying out these policies.

Later, compare management policies to what those who actually carry out the policies believe these polices are and then observe what they actually do. **These three things are often significantly different (what management wants done, what the employees believe management wants done, and what actually is done).**

4. **Record management policies for other issues relevant to these routines.**

Record the management policies for issues associated with these procedures that are relevant to the problem at hand. For example in situations involving a viral disease that is being vaccinated against, the following questions are relevant. How are vaccines stored and used? Is left over MLV vaccine discarded if it is not used up within hours of opening? How are the syringes used to administer the MLV's sterilized?

Obtain specific information on practices. For example, if the transmission of an infectious agent by treatment equipment is potentially involved, ask how and when the equipment is sterilized. Between animals? Is it washed with soap first? What concentration of what disinfectant is used? How long is the contact time?

Later, evidence of the actual practice can be compared to the management policy. continuing the above example, look for partially used vials of MLV's in the refrigerator used to store the MLV's. Examine equipment to see if it is clean (visual, feel and odor). If possible, unobtrusively watch things being done to see if the practice matches management policy.

Hands-on Farm Investigation:

Proceed to execute the observation component of the investigation.

1. Get an overall impression of intensive operations, such as dairies, calf raising operations or feedlots, by observing all the major components and activities of the operation, such as feed storage locations, feed quality, feed handling equipment, water sources, animal handling and processing facilities and equipment, animal treatment equipment and supplies, animal housing, milking parlor and so on.
2. Verify those important aspects of the history, such as the amounts of disinfectant being mixed for sanitation or amounts being feed. For example, in a feed-associated problem, how much does the "bucket of grain" actually weigh?
3. Obtain necessary feed, water and environmental samples.
4. Select animals from affected and unaffected groups for clinical examination and sampling. To avoid transferring an infectious agent from the affected to the unaffected animals, sample and examine the unaffected animals first if possible.
5. Necropsy several relevant dead or moribund animals if they are available. Perform complete necropsies. **A common mistake is to focus only on those samples that could confirm the tentative diagnosis.** In a severe disease outbreak in which the preliminary clinical diagnosis was respiratory disease, only the thorax was examined and sampled for laboratory submission. Actually, severe uterine disease was the primary condition and respiratory disease was a minor terminal component of the problem.

Balance the expense of obtaining samples against the potential cost of needing further samples to examine a hypothesis. In cases where long travel time or the rounding up on animals is involved, consider taking extra samples that can be frozen or refrigerated in case they are needed.

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Problems and Pitfalls:

- Don't jump to conclusions; don't jump to interventions before establishing the key determinants associated with the problem.

  Settling on a diagnosis, hypothesis and intervention too soon will cause you to overlook important clues.

- Don't overlook the potential for "cheap" information that will later become "expensive" if you need it.

For example, taking additional serum or fecal samples from animals when the animals are available, banking them and then discarding them when you later find that you don't need the information is much less expensive for both you and the client than having the animals gathered again and returning to the herd when you later recognize that you need them.

- Don't submit samples for scatter-shot laboratory testing in the hopes of finding something useful. Most likely you won't.

  Submit strategic samples for testing with a hypothesis clearly in mind that the results will either support or refute.

- Don't select only samples only for confirmatory laboratory testing; submit complete sets (keep diagnosticians happy!).

  Veterinarians often make the mistake of submitting only those specimens that if test positive will confirm their diagnosis but don't submit other specimens that the diagnostician could use to make other diagnoses if the initial clinical diagnosis is not confirmed. For example, submit complete fetal loss kits. The proportion of incomplete abortion kit submissions with a definitive diagnosis is considerably lower than that proportion in complete abortion kit submissions.

- Don't overlook observing those routine procedures that may be associated with the problem, such as the harvesting and feeding of colostrum and the sanitation of the associated equipment.

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Endpoint Considerations:

What events motivated the request for an investigation?

What management shortcomings or events likely led to the problem? Will these impede the solution? If so, what is your role in correcting these? Recognize that if any of the following occurred but are not corrected, your intervention will likely not work but you likely will be blamed for that failure.

- Lack of motivation of management and/or employees?
- Lack of specific knowledge and/or action on incorrect knowledge by management or employees?
- Lack of or improper allocation of resources or inputs (e.g. skills, money, labor, managerial time)?
- Weaknesses in management system (e.g., poor new employee training, weak work procedures (TQM))?
- Failure of communication or presence of conflict?
- Outside factors beyond practical control by management (e.g. imported infectious agents in a feeding operation, toxins in purchased feeds)?

What are the characteristics of a good outcome?

- Interventions that are believed as correct, are perceived as feasible to implement, and are adopted.
- Interventions that are implemented and practiced successfully.

- Interventions that control and/or prevent the problem.
- Interventions that are timely and economical solutions.

A major component of most successful solutions is behavior change. Changing the behavior of others is very difficult to do but the ability to motivate necessary changes is required of successful consultants. This aspect of professional practice is not a component of the traditional veterinary curriculum.

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Requirements for Block Success:

- Thorough familiarization with relevant clinical literature on the problem.
- Thorough pre-planning of an investigation strategy.
- Good, thorough execution of investigation.
- Good follow-through on letter.
- Good group interaction and effort.

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