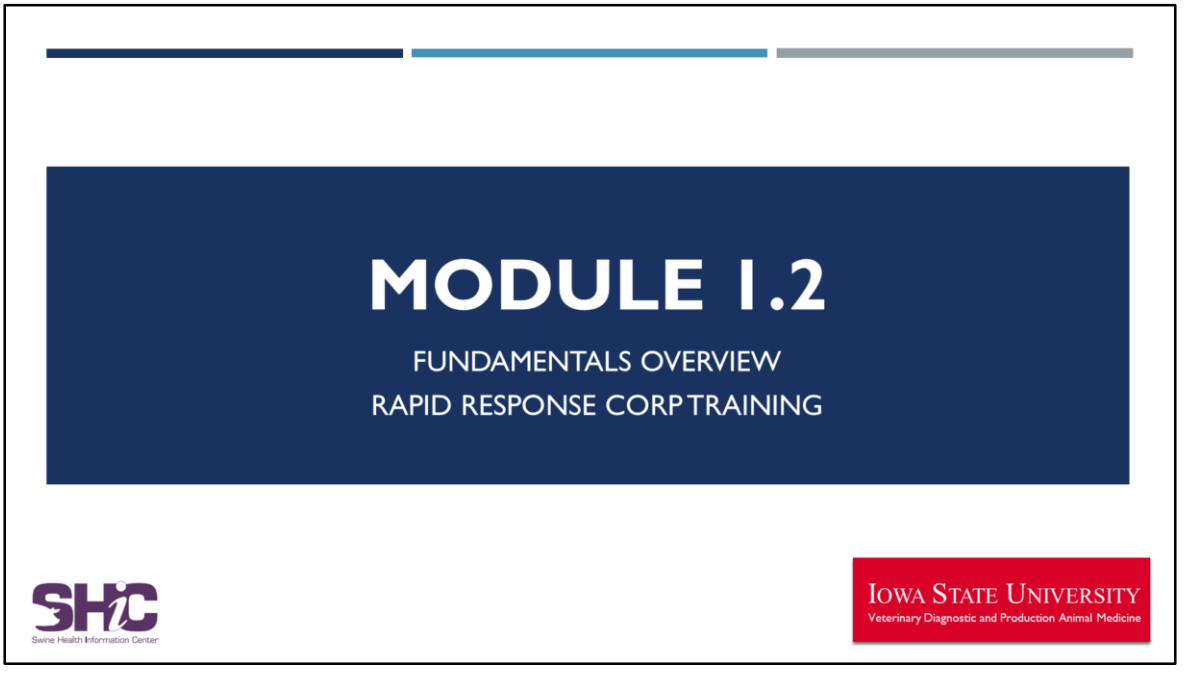
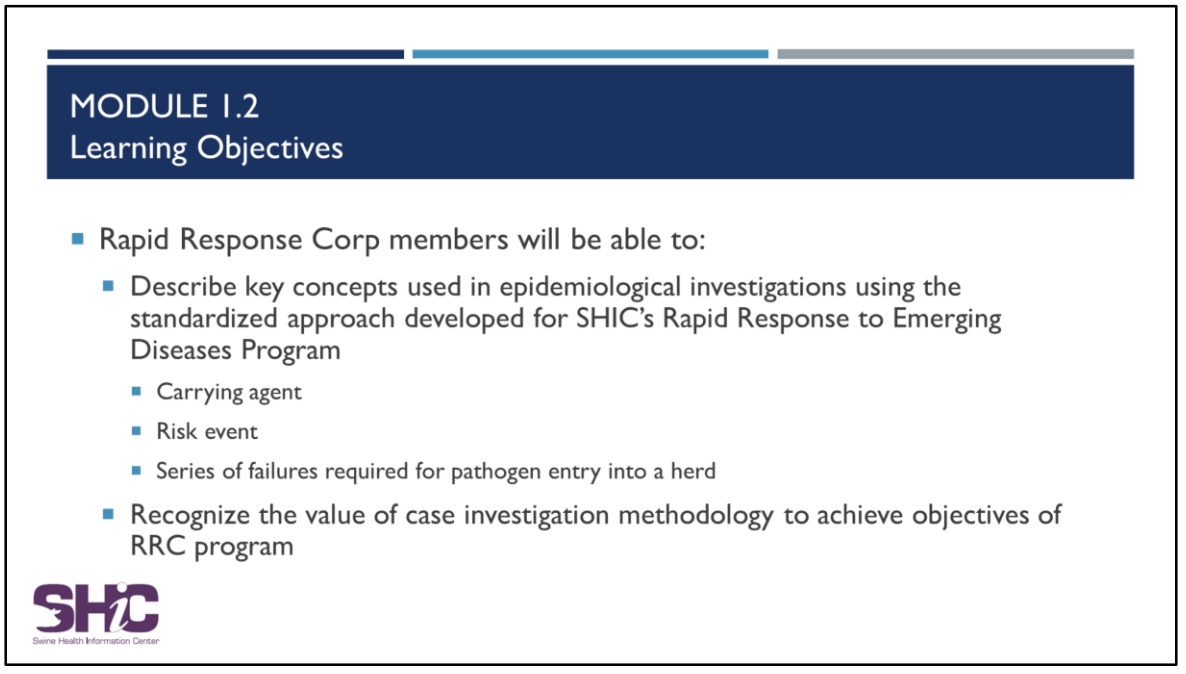


Welcome to Module 1.2 of the SHIC Rapid Response to Emerging Diseases training program. Module 1.2 will cover some fundamental concepts that you need to keep in mind as you conduct transboundary or emerging disease investigations.



Module 1.2 will discuss terms and fundamental concepts that are the basis for conducting an epidemiological investigation using the standardized approach developed for SHIC's Rapid Response to Emerging Diseases Program, including carrying agents and risk events. You will then apply your understanding of carrying agents and risk events to understanding the series of failures required for pathogen entry into the herd. Finally, you will be reminded why case investigations are used to study disease outbreaks and why case investigations will effectively further the objectives of the program.

THE BUGS
Swine Disease Matrix

Criteria for Average Risk Score
1) Likelihood of entry
2) Economic effects on production post entry
3) Effects on domestic and international markets

- SHIC website: http://www.swinehealth.org/swine-disease-matrix/

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Top 25 Pathogens of Concern	Prioritized Risk Score
Foot and Mouth Disease (FMD)	8.42
Classical Swine Fever (CSF)	8.26
African Swine Fever (ASF)	7.83
Influenza A Virus	6.17
* Pseudorabies Virus - Pathogenic Chinese Strain	6.08
PRRS	5.95
* Nipah Virus	5.87
PRRS - Chinese High Pathogenic Strain	5.51
Porcine Epidemic Diarrhea Virus (PED)	5.31
Swine Vesicular Disease Virus	5.07
* Japanese Encephalitis	4.83
* Vesicular Stomatitis Virus	4.50
* Porcine Teschovirus (Teschen/PTV1)	4.27
* Ebola Virus - Restin	4.20
Porcine Circovirus	4.11
* Vesicular Exanthema of Swine Virus	3.96
Circovirus 3	3.95
* Porcine Rubulavirus (Blue Eye)	3.89
Transmissible Gastroenteritis (TGE)	3.88
* Seneca Valley Virus	3.88
Lassa Fever	3.87
* Menangle Virus	3.86
Porcine Deltacoronavirus	3.79
Porcine Rotavirus	3.60

Remember the pathogens or diseases to think about as you move through this module. These are the pathogens or diseases of concern and will likely be assessing using the series of failures mentioned in the previous slides. SHIC, in collaboration with several industry experts determined a risk score per pathogen or disease. The pathogen's prioritized risk score evaluated three criterion. First, the likelihood of the pathogen entering the US or the likelihood of the endemic pathogen becoming recognized as the cause of an emerging disease syndrome. Second, the expected effects of disease from pathogens on production economics, including likely morbidity, mortality, and production losses. Third, the probable effect on domestic and/or international markets. As you may notice, the asterisk next to the pathogen or disease indicates that the fact sheets were available on the SHIC website, as of February 2016. By the time you listen to this module, most of them should be available by accessing the link on the slide to the SHIC website.

WHAT IS A CARRYING AGENT?

- Pathogens are not capable of independent locomotion
- Must be carried by something else
- Call this "something else" a **carrying agent**
  - Contamination
  - Infection

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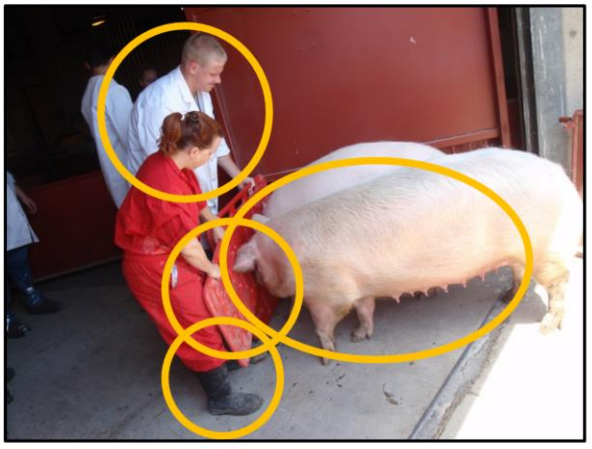
Before conducting an investigation, it is important to understand the vocabulary used because this will shape the way that you will talk about and think about the investigation. First, you will be using the word "carrying agent" to describe anything that can carry a pathogen into a herd. Remember that pathogens cannot move themselves. Something else must transfer them from one place to another. This "something else" is called a "carrying agent". As you think about potential carrying agents, remember that a carrying agent can either be contaminated or infected. An example of contamination would be if a pathogen traveled on the surface of a boot. An example of infection would be if a live animal was shedding virus.

EXAMPLES OF CARRYING AGENTS

- People
- Tools
- Clothing
- Swine



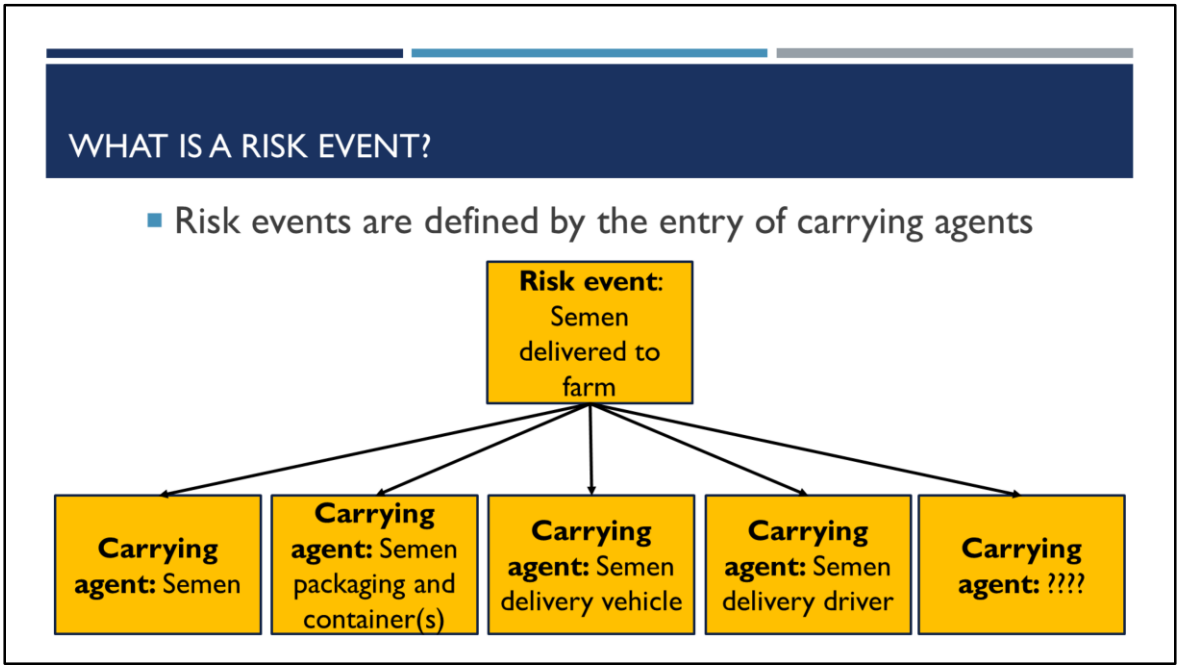
Broadly speaking, people, tools, clothing, and swine can all be carrying agents. In reality, carrying agents can be as large or as small as is relevant. For example, a single person can be thought of as the carrying agent or the disposable glove on that person's left hand can be thought of as the carrying agent. But this has two issues. First, you cannot definitively say that a specific carrying agent is truly responsible for pathogen entry into the herd without extensive testing in a controlled environment. Second, it would be very difficult to look at every carrying agent that enters a herd on a given day, because there are a lot of them. This is why it is important to understand the term "risk event".

A “risk event” is the point in time when carrying agents enter the premises. It occurs at a specific, identifiable point in time. This means that the moment a carrying agent enters the premises, a risk event has occurred. However, it is important to note that risk events in which carrying agents exit and re-enter the barns throughout the day are slightly different, which will be addressed in the next slide. For the investigation, you will record both the frequency of risk events during the investigation period and the date on which the risk events occurred.

WHAT IS A RISK EVENT?

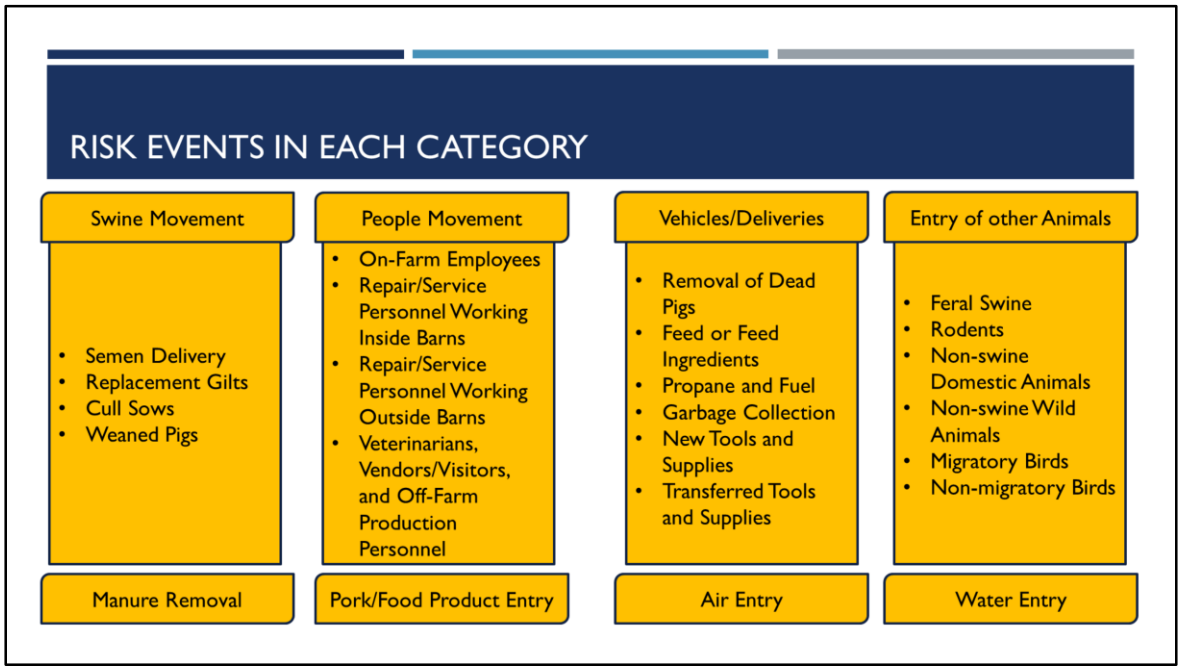
- On-farm employee entry
  - A **risk event** is the point in time when carrying agents enter the **barn**
  - One risk event = one barn entry

On-farm employee entry is a unique risk event because a potential carrying agent, the employee, has the opportunity to enter the barn more than once per premises entry. An on-farm employee can enter in the morning to conduct pig chores and then exit the barn in the afternoon to take the trash out. This may involve walking around the premises, which has been exposed to any number of the carrying agents that has access to the outside of the barn. Then, that employee can re-enter the barn contaminated with the pathogens contacted outside of the barn. This is very different than gilt entry or feed delivery, where the truck or driver will enter the premises or enter the barn once, and then leave for good. So when considering on-farm employee entry, every barn entry or re-entry counts as a risk event.

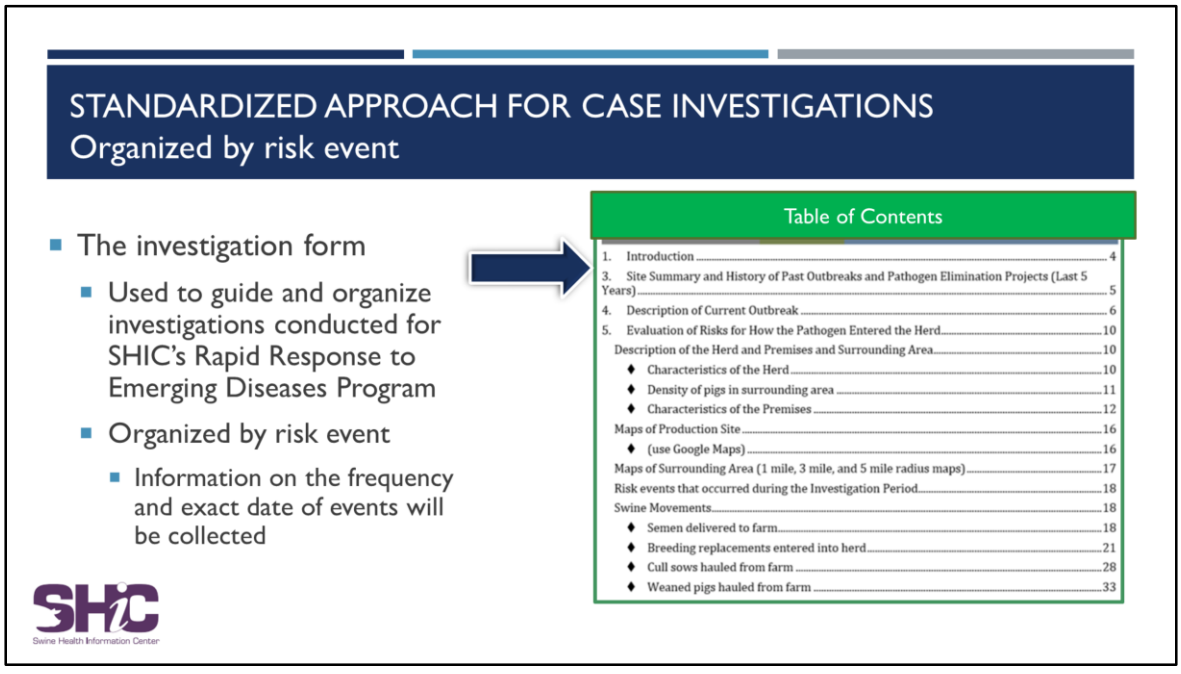


It is helpful to think about carrying agents in terms of risk events. This is because you could come up with hundreds of possible carrying agents entering any given swine farm, but there is a finite list of risk events to analyze. This is why the investigation is sorted by risk event, rather than by carrying agent. It is your job to think in terms of risk events, but be aware of possible carrying agents. A list of possible carrying agents will be provided to you.

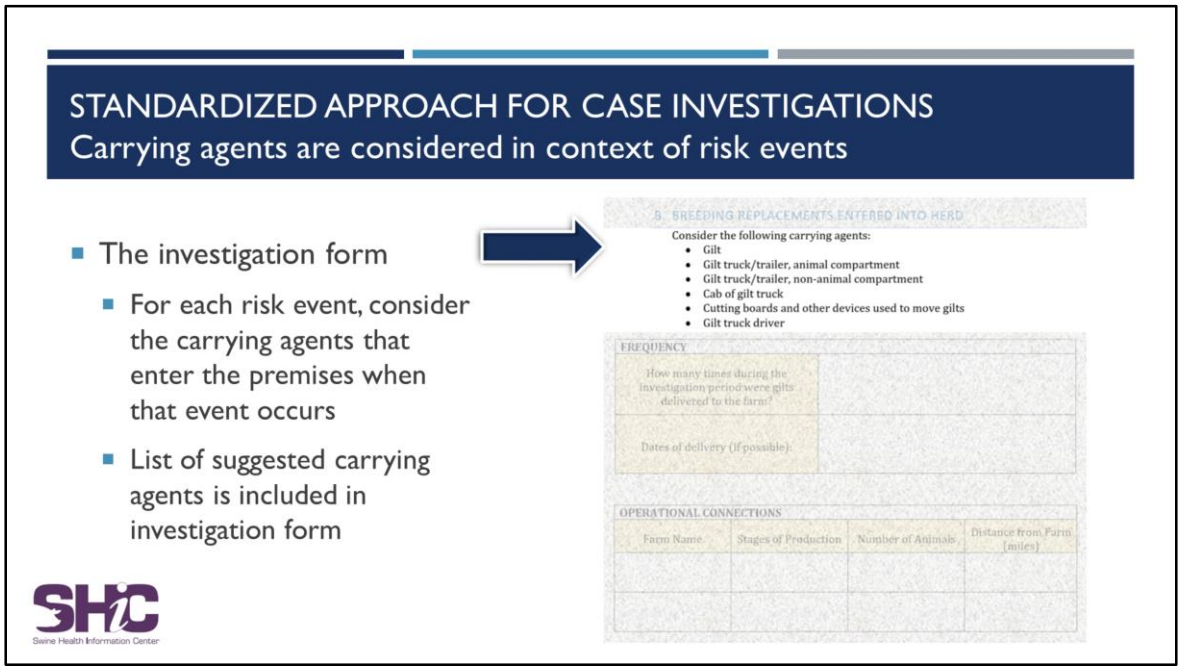
The risk events on the investigation form are divided into 8 broad categories. Swine Movement, People Movement, Vehicles and Deliveries, Entry of Other Animals, Manure Removal, Pork/Food Product Entry, Air Entry, and Water Entry.



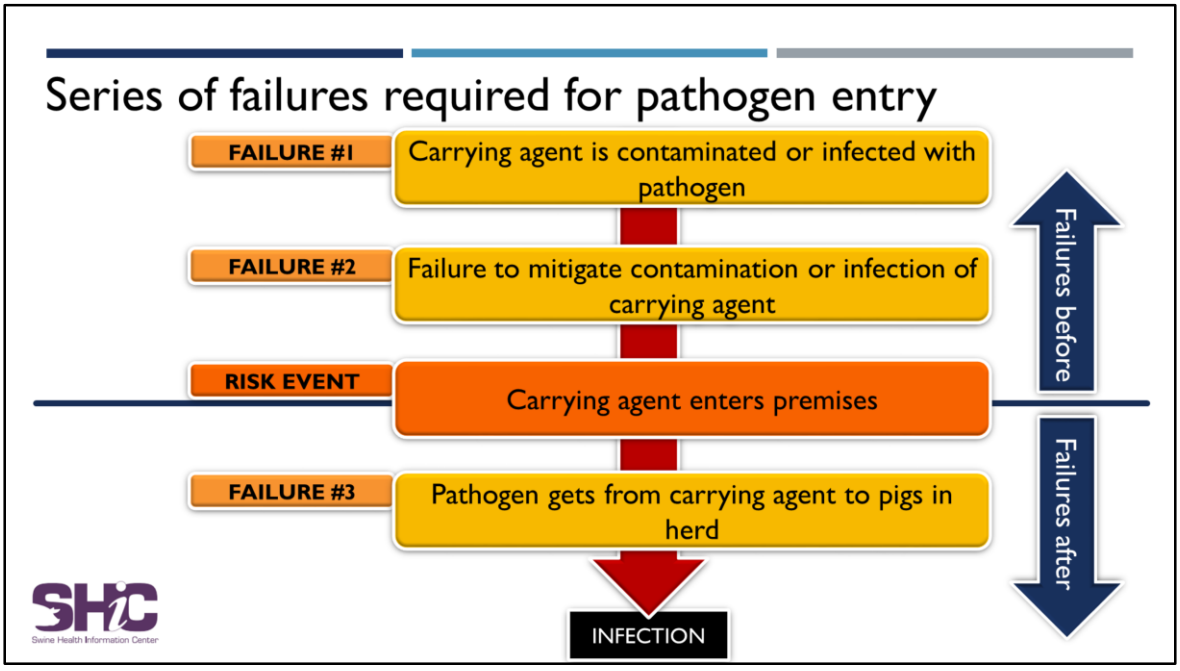
These categories are further subdivided into specific risk events. Take a moment to familiarize yourself with the risk events associated with each category. For example, semen delivery, the hauling of replacement gilts, the hauling of cull sows, and the hauling of weaned pigs are all swine movements . The people movement category includes “on-farm employee entry” as discussed in the previous slide. You can take a closer look to review risk events under the People Movement category, the vehicles and deliveries category , and the entry of other animals category .



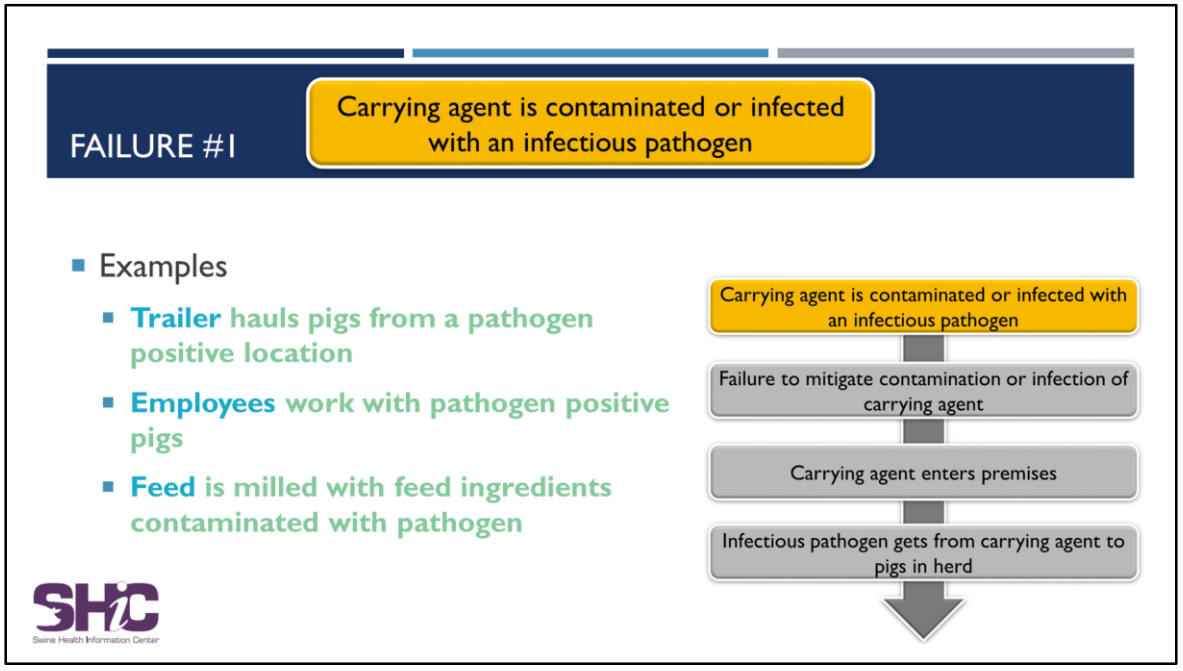
These risk events are sorted into broader categories so that we can move systematically through them during the investigation process. The investigation form pictured in the slide will guide and organize this process. This form will also contain the required questions that you must turn in at the end of the investigation in order to receive your stipend. Throughout the investigation, you will be moving through the questions in the form to capture the frequency, the dates, and other information associated with each risk event.



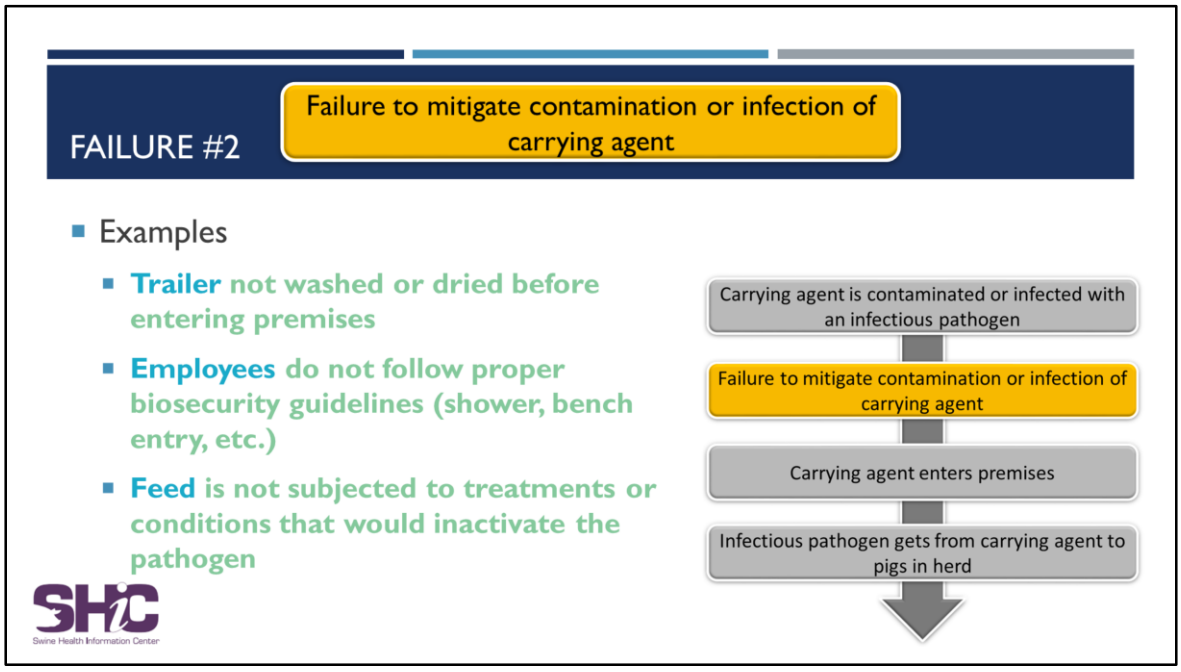
The investigation form will provide you with a list of suggested carrying agents that should be considered when discussing the event. For example, when investigating the risk event “Delivery of replacement gilts”, consider the animals themselves, the animal compartment of the trailer, the non-animal compartment of the trailer, the cab of the truck, the tools used to move the gilts, n and the gilt truck driver. Although this is not a comprehensive list of carrying agents, it will give you a good idea for where to start as you go through the investigation questions with the farm personnel.



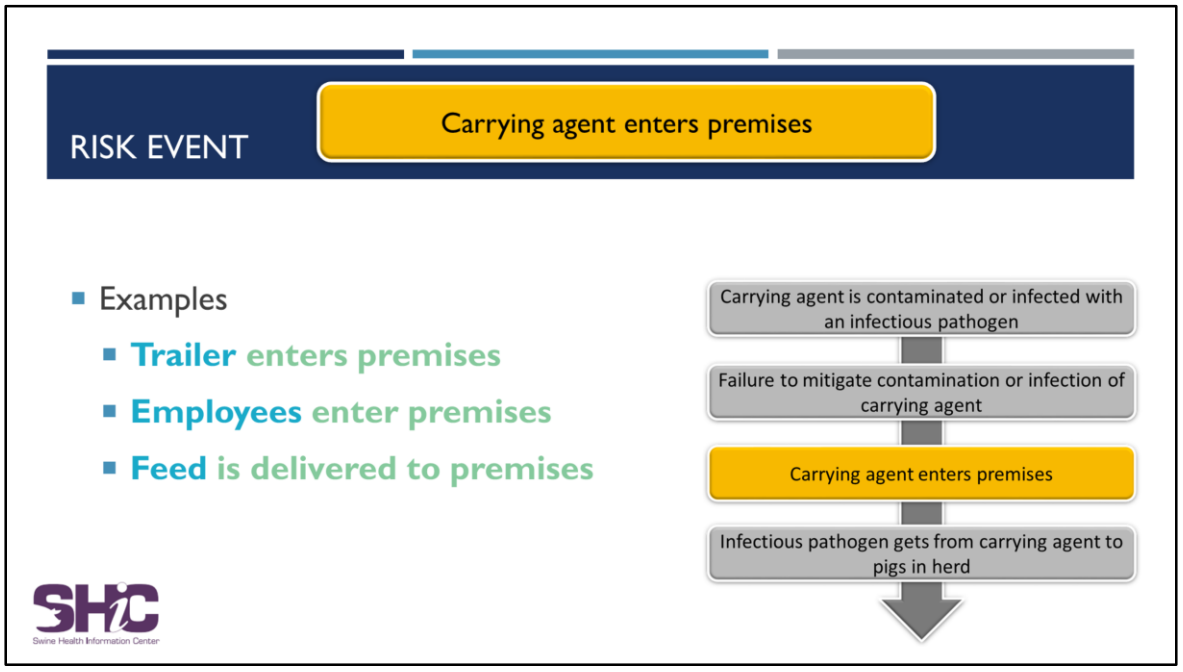
In order for a herd to become infected, a series of failures must occur. If you are familiar with the language of Hazard Analysis and Critical Control Points, you may recognize these as “hazards.” While you are quite likely very familiar with how pathogens are introduced into a herd, using this language serves as a reminder to assess all of the things that can and do go wrong. This will lead to a more consistent assessment of the likelihood that any given risk event was responsible for the introduction of the pathogen into the herd. Over the next few slides, we will be going over each step in this series of failures individually, but for now, notice how each failure is chronological. The first two failures occur in time before the risk event. The last failure occurs after the risk event. Every single step in this process must occur for the herd to become infected.



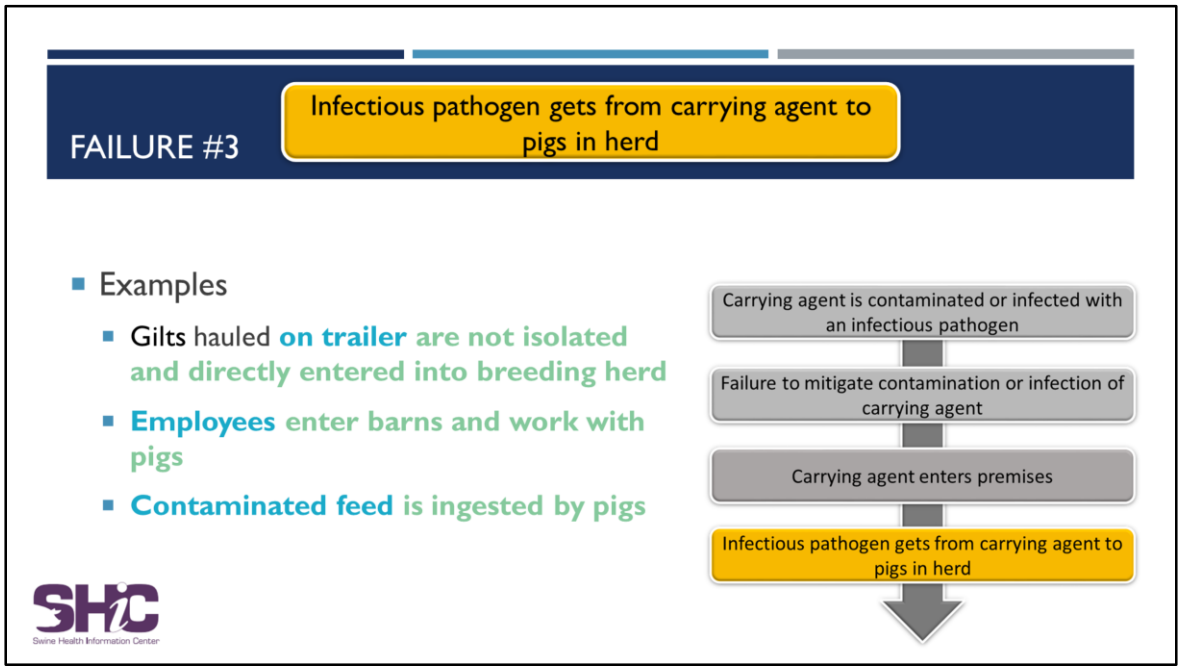
The first failure occurs when a carrying agent becomes contaminated or infected with an infectious pathogen. This is usually thought of as happening off-site at a location such as another farm, a cull plant, the gas station. A few examples of failure #1 are described in the slide. The bolded, blue words are the carrying agent, and the bolded green words describe the specific failure, or the source of contamination. If a trailer hauled pigs from a pathogen positive location and became contaminated, then the trailer would be the carrying agent and the trailer exposed to positive pigs would be the failure. Similarly, Failure #1 may occur when on-farm employees work with pathogen positive animals on a different farm or if feed is milled with feed ingredients contaminated with the pathogen.



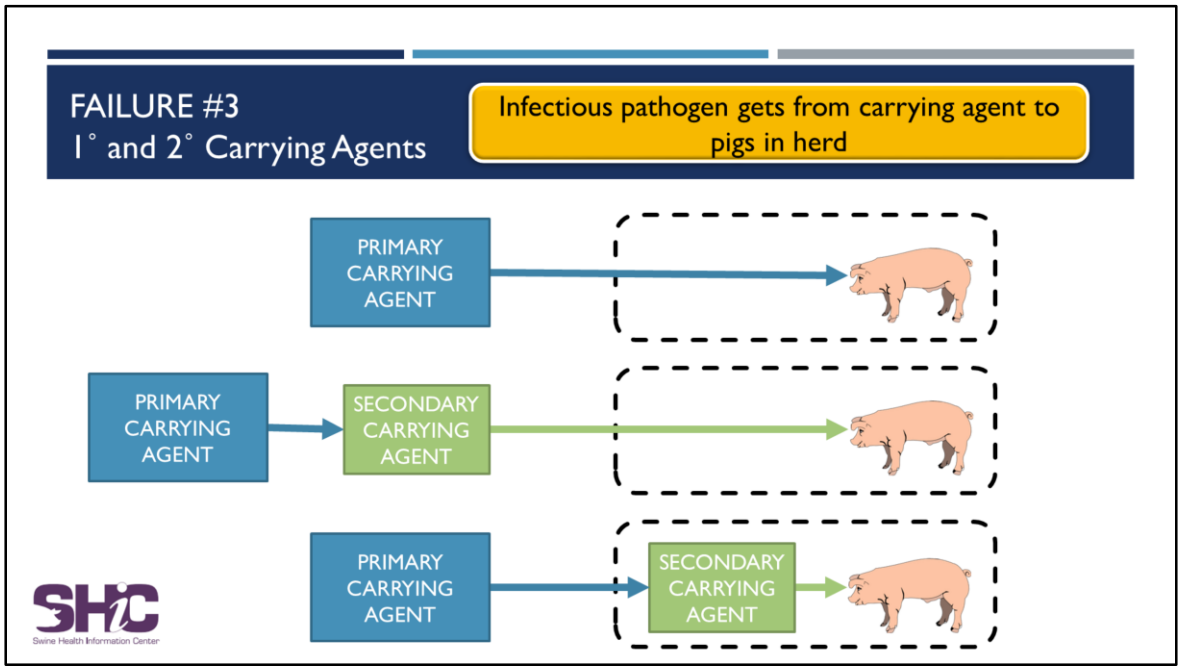
The second failure occurs when biosecurity procedures fail to mitigate the contamination or infection. In this failure, considerations include biosecurity compliance and auditing, as well as the SOPs and practices in place on the farm. These considerations may indicate the effectiveness of biosecurity procedures in place to mitigate or detect infectious pathogens. Examples of this failure include when a contaminated livestock trailer is not properly washed, disinfected or dried before entering the premises. Failure #2 also occurs when employees do not shower in to the barns or if feed is not subjected to treatments or conditions that would inactivate the pathogen before it is fed to the pigs.



The risk event occurs the moment when the carrying agents associated with the risk event enters the premises. Although this step in the series of failures would not necessarily be considered a “failure”, it must occur in order for the pathogen to enter the premises. Without the occurrence of a risk event, the pathogen has no mode of entry into the premises. By understanding this, it follows that the first two failures will occur in time BEFORE the risk event, and the last failure will occur in time AFTER the risk event.

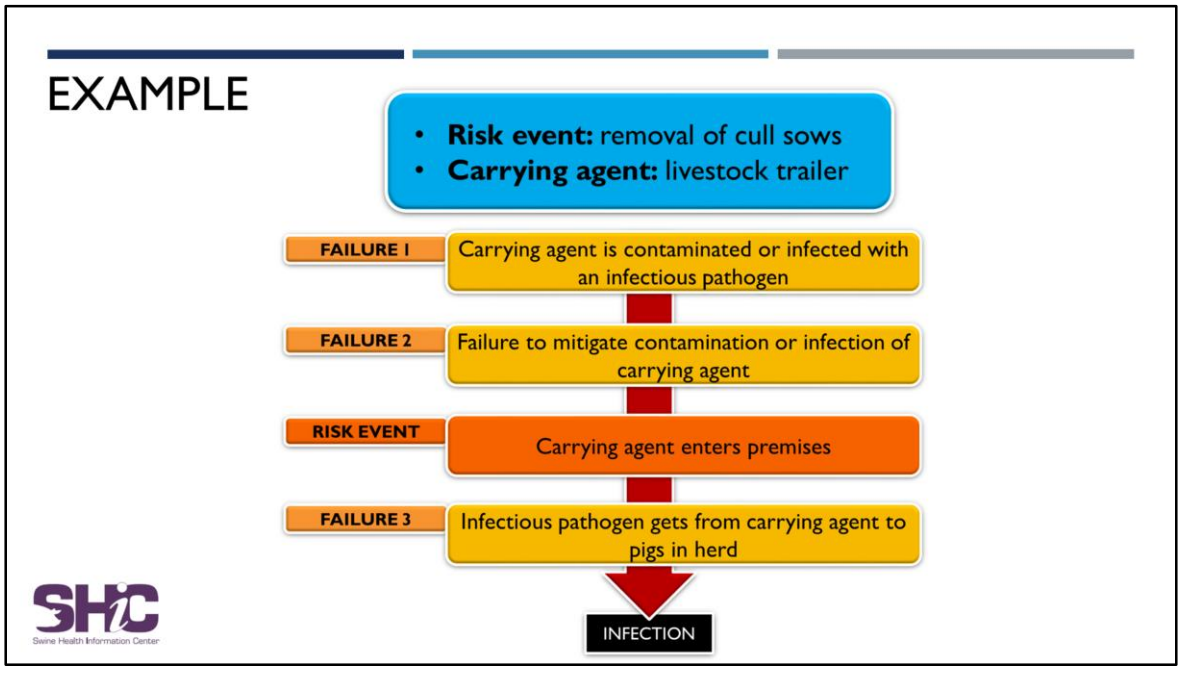


The final failure occurs when the pathogen comes into direct contact with the pigs on the premises. In order for this to happen, the pathogen must enter the barn, as in on the hand of an employee or in an infected pig. In the example above, in which a contaminated trailer hauls gilts that were not isolated before entering the farm, the trailer is considered the primary carrying agent. However, the gilts would be the secondary carrying agent because they would actually bring the pathogen to the rest of the pigs in the herd. Other examples include when infected or contaminated employees work on pigs in the barn or when contaminated feed is ingested by the pigs. Although this is a fundamental step in the series of failures required for pathogen entry into the herd, remember that the opportunity would not be made possible without the previous three failures.

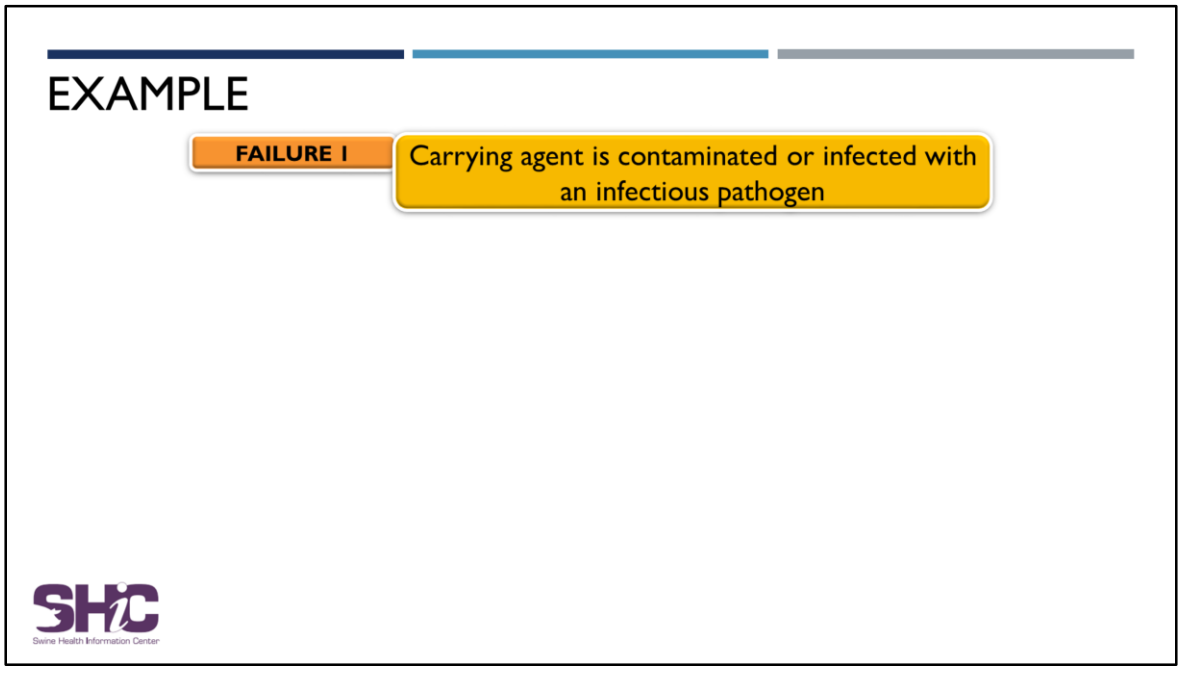


In some cases, only one carrying agent is required for the third failure, leading pathogen introduction to the herd. For example, feed milled with contaminated ingredients will be the sole carrying agent because the feed will come in direct contact with the pigs on the premises. However, other cases require more than one carrying agent because the primary carrying agent may not have direct contact with the pigs in the herd. This may happen when a contaminated trailer hauls gilts to a farm. In this scenario, gilts are infected as a result of being hauled on a trailer (CLICK,CLICK). These animals then contact the pigs in the herd . Although the contaminated trailer is the primary carrying agent, the gilts are necessary to infect the pigs on the premises. Similarly, people often act as this secondary carrying agent if they bring a pathogen from outside the barns to inside the barns. You

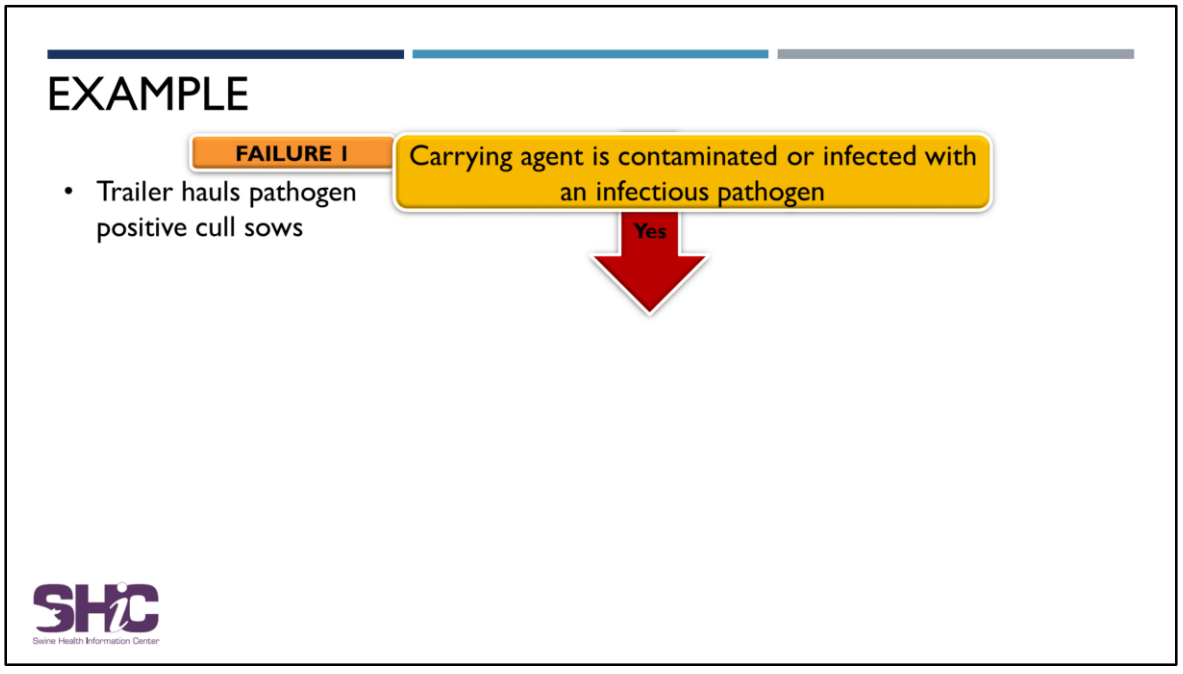
will see an example of this scenario in the following slides, where the trailer hauling cull sows is the carrying agent, but an on-farm employee (CLICK,CLICK) who comes in contact with the trailer carries the pathogen to the pigs in the herd.



Now, this example walks through each of the steps in the series of failures one more time with a specific example. Consider the removal of cull sows as the risk event and the livestock trailer as the carrying agent.



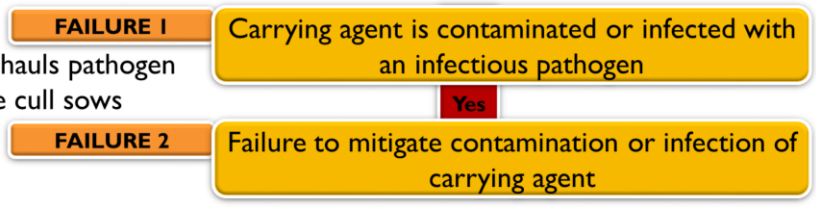
As a reminder, the first failure in the series is when the carrying agent is contaminated or infected with a pathogen.



A trailer hauling cull sows would be contaminated by an infectious pathogen.

EXAMPLE

- Trailer hauls pathogen positive cull sows



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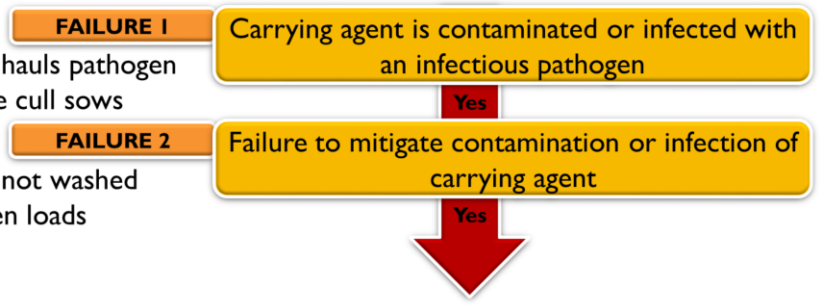
The next failure occurs when the contaminated carrying agent is not mitigated or detected before entering the premises.

EXAMPLE

- Trailer hauls pathogen positive cull sows
- Trailer not washed between loads



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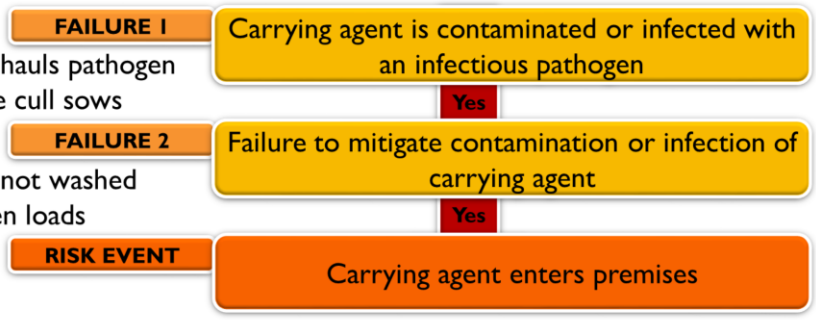
Since the trailer is not washed between loads of cull sows, biosecurity practices do not mitigated the contaminated carrying agent.

EXAMPLE

- Trailer hauls pathogen positive cull sows
- Trailer not washed between loads



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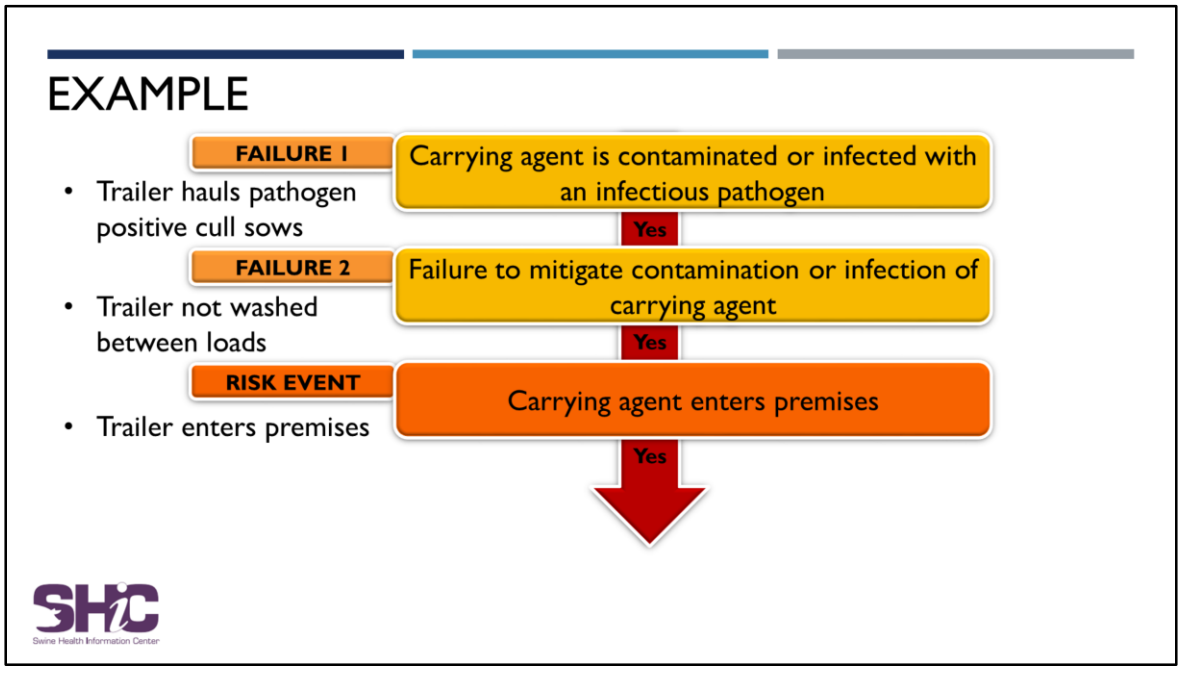
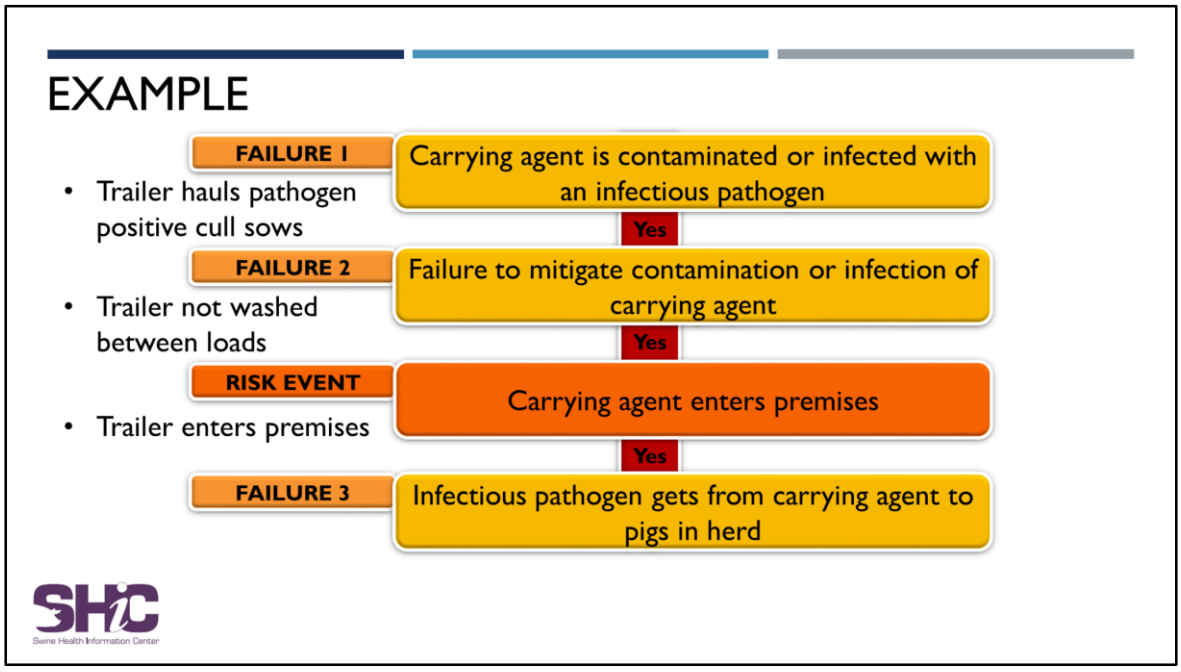
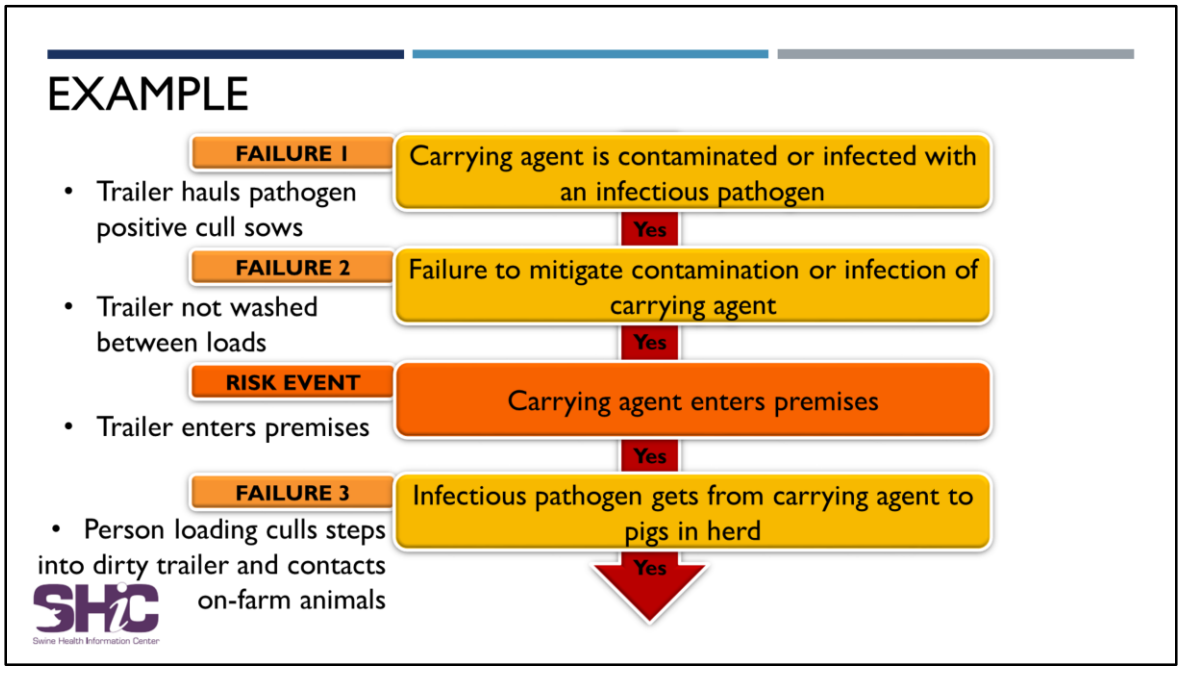
The risk event occurs when the carrying agent enters the premises.



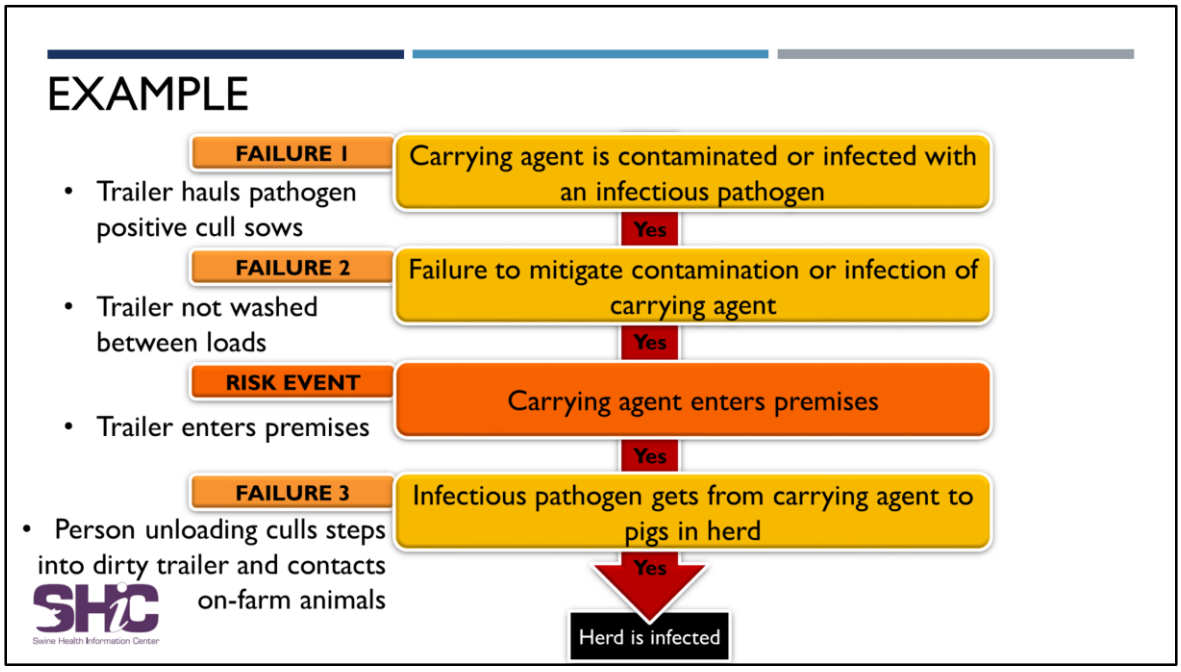
So when the contaminated trailer enters the premises, a risk event has occurred.



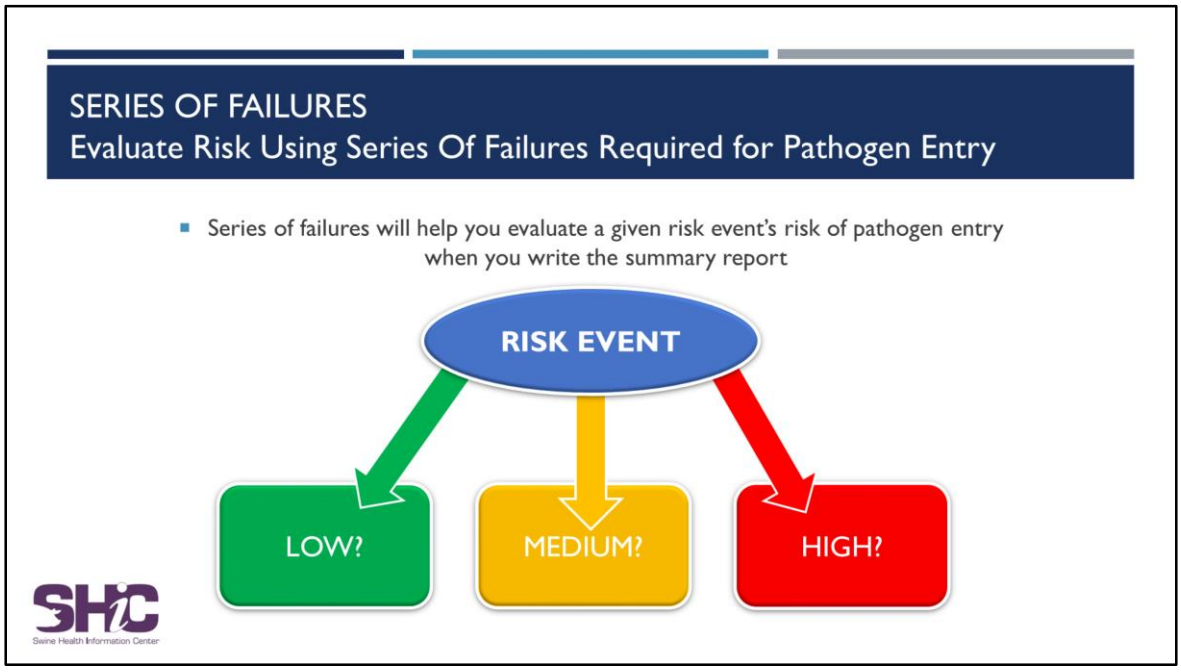
And the last step in this series of failures happens when the pathogen gets from the carrying agent to the pigs in the herd.



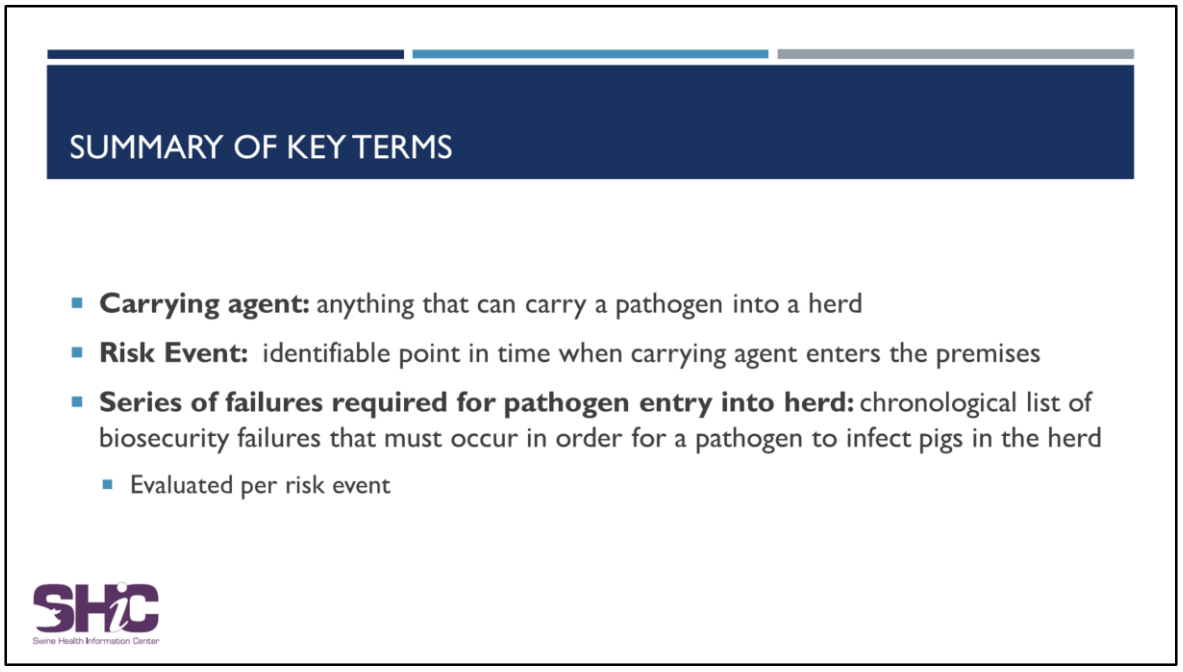
If an on-farm employee loads cull sows and steps onto the contaminated trailer, the pathogen has the opportunity to access the pigs through the activities of that on farm employee. The on-farm employee would be the secondary carrying agent because he would be responsible for bringing the pathogen to the pigs in the herd, even though he was not initially contaminated.



After this final failure, the herd will be infected. Please note that every single one of these steps in the series of failures must occur for the herd to become infected. Now take the time to think through each of the risk events and consider possible failures. This thought process will guide you through evaluating the individual likelihood of each risk event as a potential source of infection.



As you write the summary report, you will be required to evaluate the likelihood of pathogen entry per a given risk event with a "low", medium", or "high" risk score. The series of failures required for pathogen entry into the herd should guide your thought process as you learn to evaluate risk. Start practicing using this mentality so that you know what to expect when you write the summary report.



Moving forward through your training, it will be important to remember these concepts. As a review, remember that a carrying agent is anything that can carry a pathogen into a herd. It can be contaminated or infected. For example, gilts or the trailer used to haul them could be the carrying agent. A risk event is the identifiable point in time when carrying agents enter the premises. The frequency of risk events will be recorded and accurate dates and times of specific risk events should be taken. Finally, RRC members will use both of the previous concepts to understand the series of failures required for pathogen entry into the herd. The three failures, in addition to the risk event, will leave the herd infected with the pathogen.

WHY CONDUCT CASE INVESTIGATIONS?

- Outcomes of case investigations support program objectives:
  - Risk factor generation
  - Hypothesis generation
  - Improve industry biosecurity

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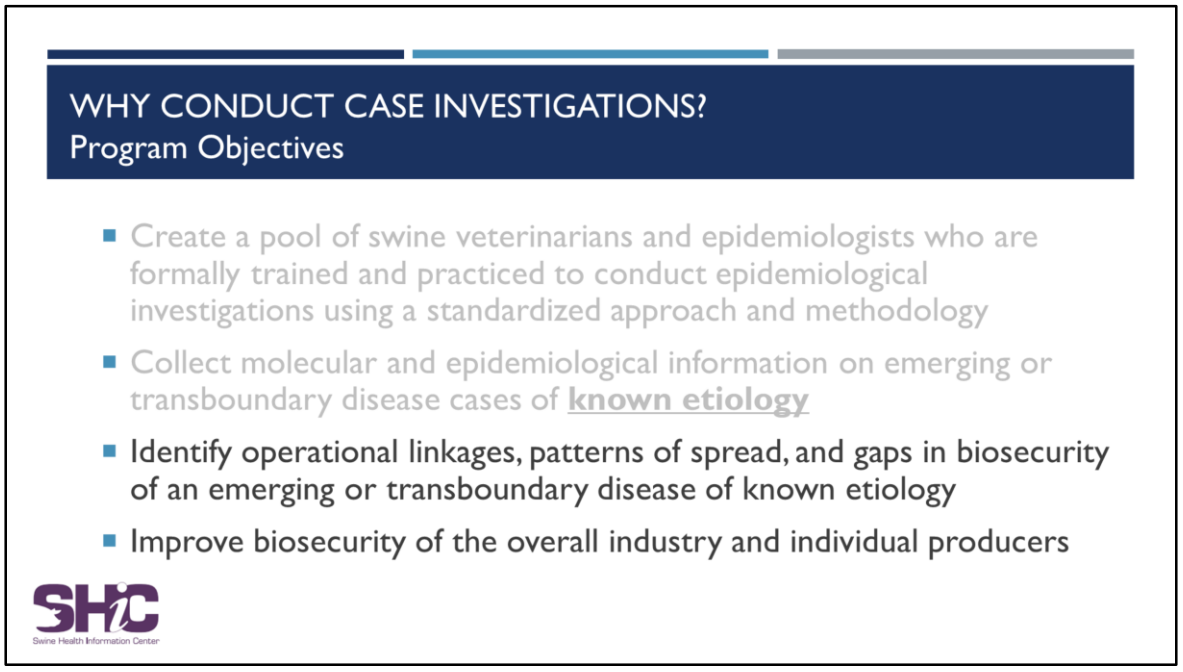
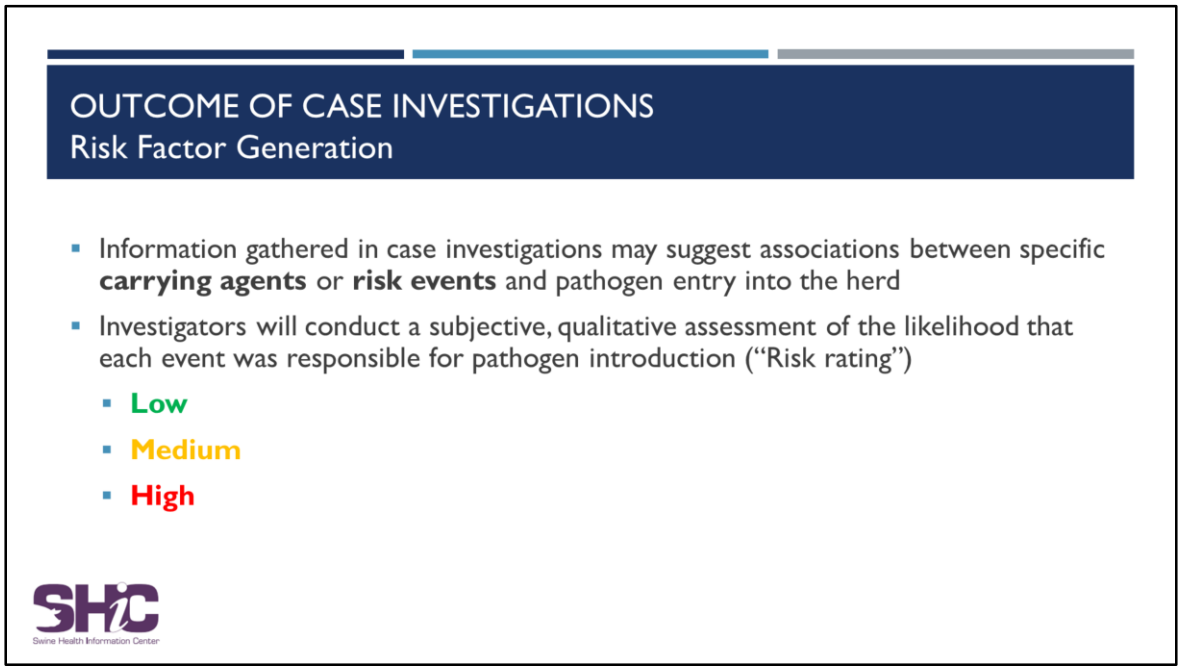
After reviewing the concepts associated with case investigations, RRC members should understand why they are conducting case investigations. It is because the outcome of case investigation support the objectives of the Rapid Response to Emerging Disease program. That is, case investigations allow for risk factor generation, hypothesis generation, and industry wide biosecurity improvement.

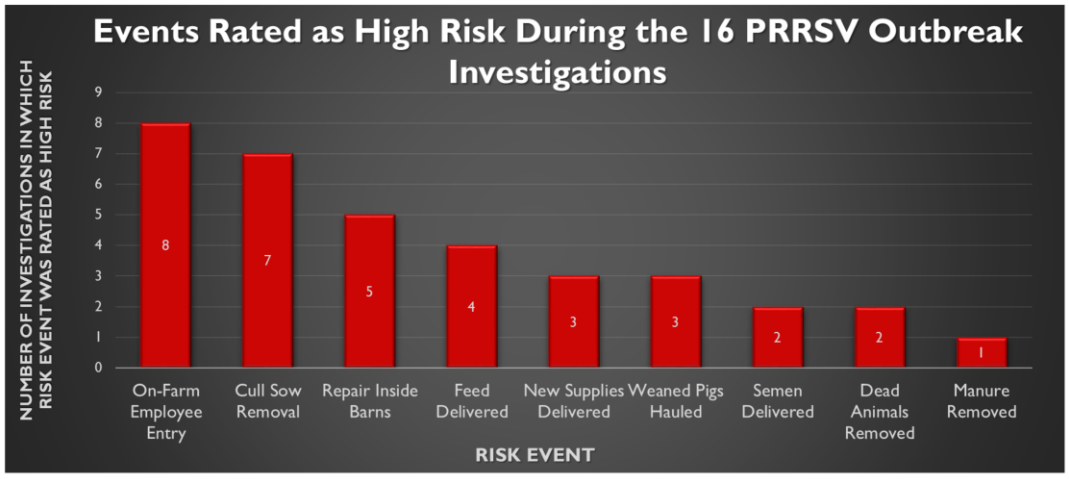


For now, focus on the last two objectives of the program: to identify operational linkages, patterns of spread, and gaps in biosecurity of an emerging disease of known etiology and improve biosecurity of overall industry and individual producers.

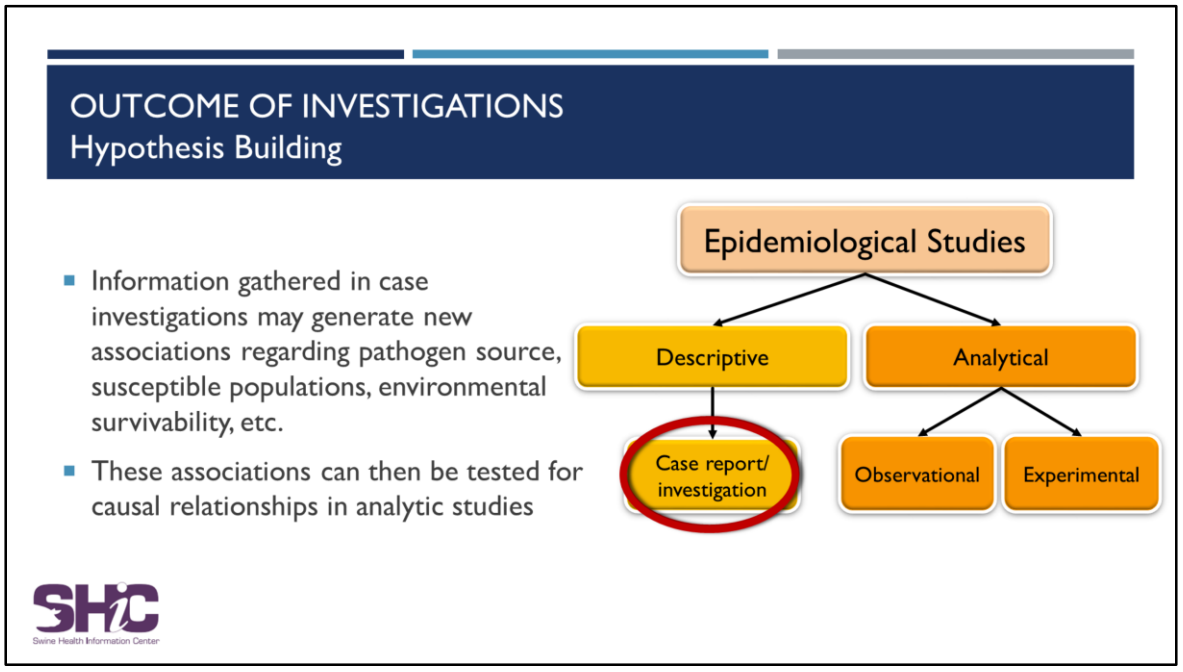


Case investigations serve to identify patterns of spread and gaps in biosecurity because they may suggest associations between specific carrying agents or risk events and pathogen entry into the herd. These associations are made through a subjective, qualitative assessment of the likelihood that each risk event was responsible for pathogen introduction. RRC members will be tasked with evaluating risk events as low, medium, or high risk for pathogen entry into the herd.

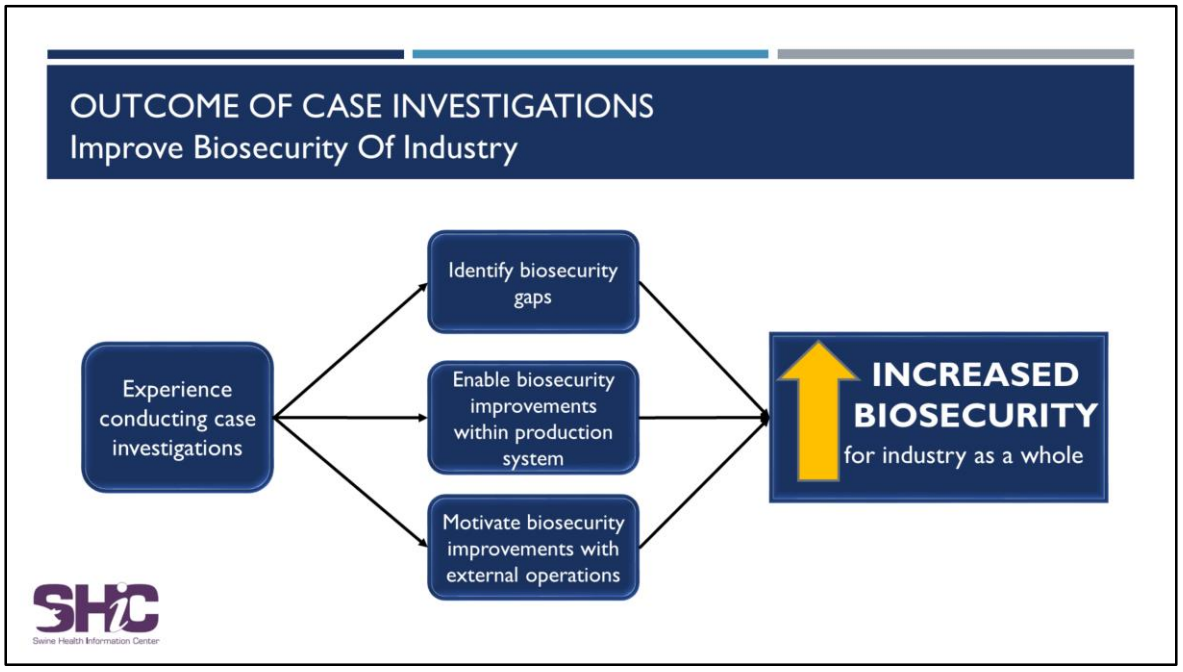
OUTCOME OF CASE INVESTIGATIONS
Risk Factor Generation



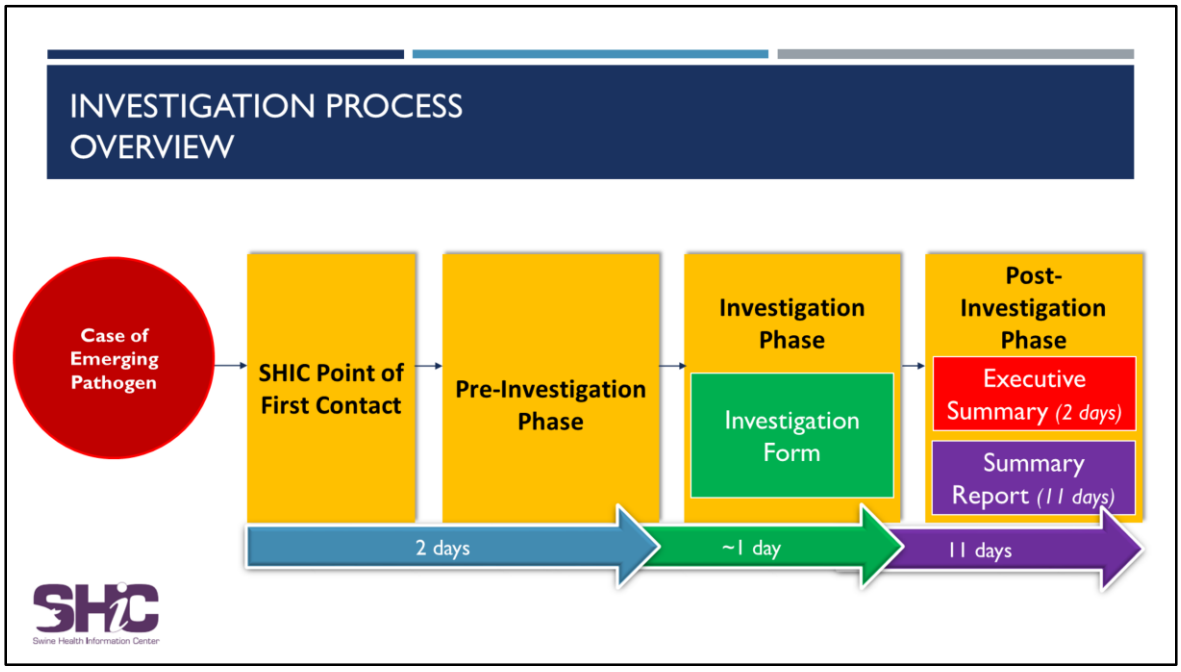
In the past, these evaluations have served to identify some high risk events for PRRSV. Out of 16 case investigations represented in this histogram, 8 of them identified on-farm employee entry as a high risk event for pathogen entry into the herd. Second was the removal of cull sows, where 7 of the 16 investigations were identified as a high risk event. This type of information may be valuable when determining how the pathogen is spreading and where to focus biosecurity resources.



Furthermore, case investigations are a type of epidemiological descriptive study that describes the occurrence of an outcome. On the other hand, analytical studies describe the association between the exposure and the outcome. But if you do not know what the exposures are, then you cannot connect it to an outcome. Therefore, case investigations and the assignment of risk scores per risk event suggests possible connections between exposures and outcomes that can then be further tested in analytical studies.



Finally, these case investigations will continue to improve the biosecurity of the overall industry. By conducting case investigations, RRC Members will have to think critically about pathogen entry into the herd and gain significant experience assessing on-farm biosecurity. Ideally, this will allow RRC members to identify gaps in biosecurity and push for continuous biosecurity improvements throughout the production system that they are working with. With a pool of trained veterinarians operating in their normal positions with this biosecurity risk assessment experience, case investigations will help increase the biosecurity of the industry as a whole.



Congratulations on finishing Module 1.2. Now you can move on to Module 2.1 to walk through the Investigation process in the event of a disease outbreak.