

Animal Disease Spread Model Control Measures



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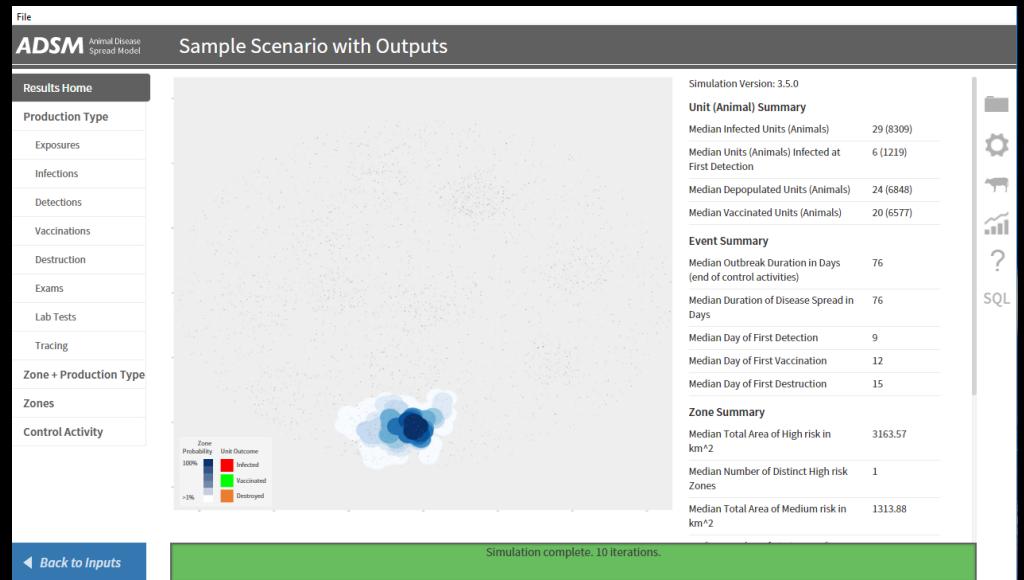
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Document Conventions

The following conventions are used throughout the training modules:

TRAINING MODULES other than the one you are currently in will use all capital letters, bold face, italics and underline.

Rhetorical questions and *extra notes* will be in orange italics.

Conventions applying to the ADSM application are:

Navigation tabs on right and Admin panels on left are designated with an underline. Examples are Project Panel or Population tab.

Items with an action on click, such as [Apply] Button or [Save As] icon are enclosed in square brackets.

Parameter fields (inputs) are in blue italics and *Variables* (outputs) are in green italics.

Navigation Tabs > *Parameter field* indicates to go to the given navigation tab to find the given field.

Hyperlinks appear in bright green type with underline <http://navadmc.github.io/ADSM/>

Overview



Control Measures

ADSM allows great flexibility in how it can apply control measures. These measures can be described as integrated controls, as you can use a combination of controls in the same scenario. A possible goal might be to compare different control combinations for effectiveness and cost.

For example:

- ✿ *What happens if we increase the destruction ring size?*
- ✿ *What happens if we destroy detected units and vaccinate in a ring around those detections?*
- ✿ *What are the government costs of depopulation, including indemnity, appraisal, and disposal?*

Many questions can be explored by modifying parameters.



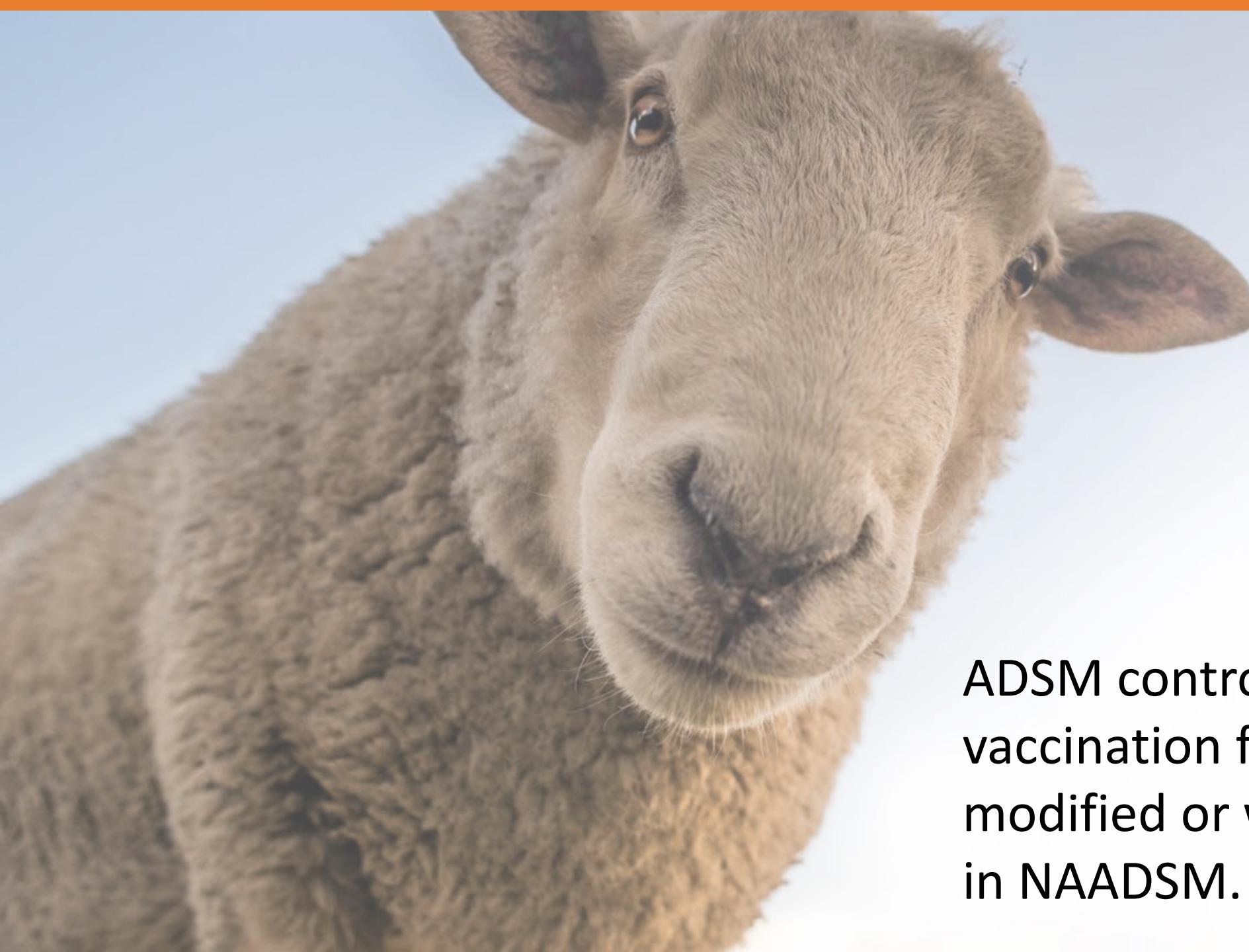
[Scenario Description](#)[Population](#)[Disease](#)[Disease Progression](#)[Assign Progression](#)[Disease Spread](#)[Review Disease Spread](#)[Controls](#)[on](#)[Control Protocol](#)[Vaccination Triggers](#)[Vaccination Rings](#)[Vaccination Global](#)[Destruction Global](#)[Assign Protocols](#)[Zones](#)[Zone Effects](#)[Assign Effects](#)[Output Settings](#)

The Controls tab gives brief descriptions of how control measures can be applied. It is necessary to give your Control Master Plan a descriptive *Name*.

All Controls can be turned off completely using the [on/off toggle] on the Controls tab. This parameter allows a baseline to be run with no controls.

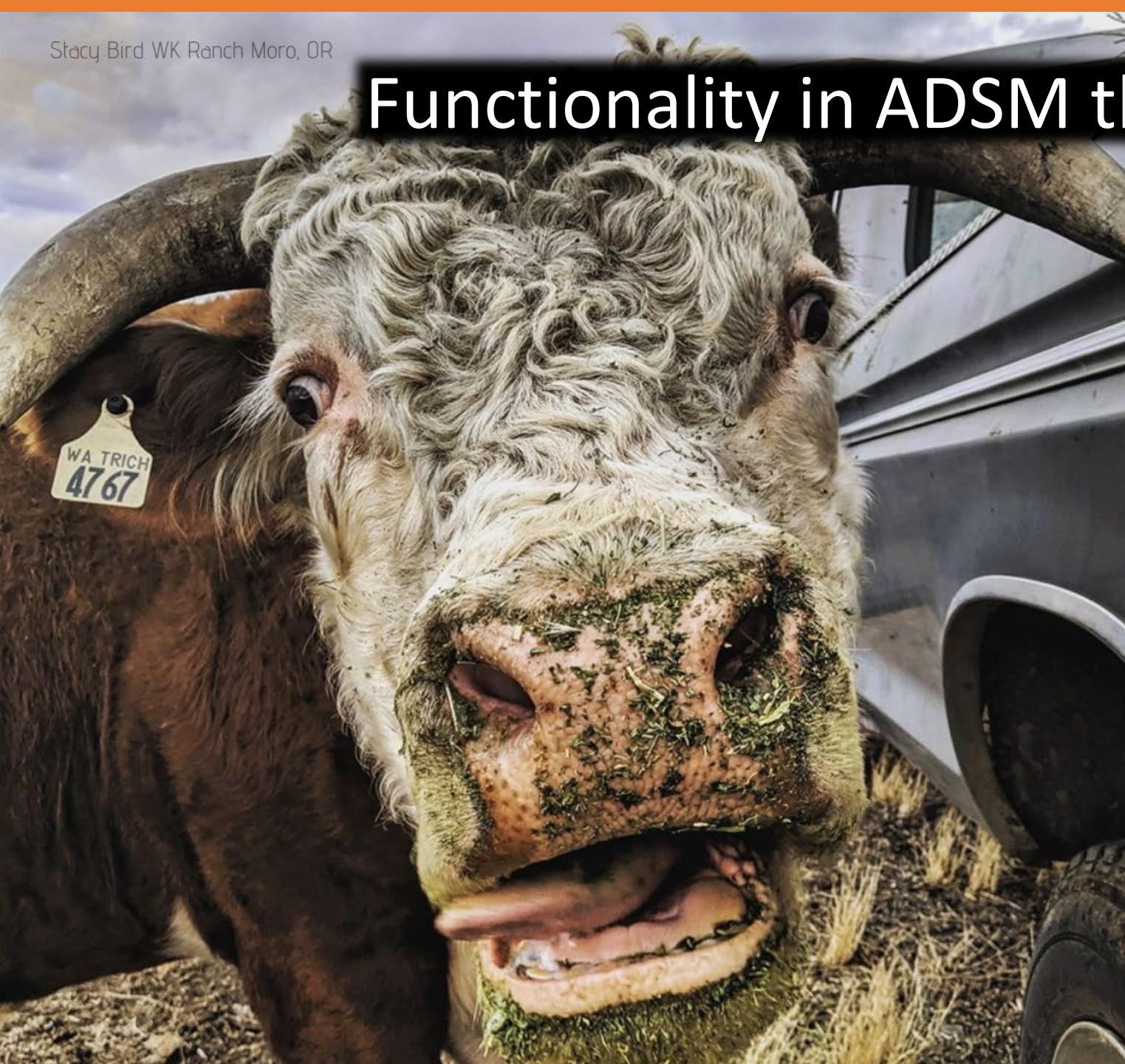
What does that mean when the simulation runs uncontrolled spread?

If disease were spreading in an area, people would change their behavior. For example, producers would not take animals to their regular market if they believed the market to be infected. The simulation cannot account for this change in human behavior.



ADSM controls have several vaccination features that were modified or were not available in NAADSM.

Functionality in ADSM that was not in NAADSM



Additional Triggers
Start, Stop, and Restart
Retrospective Vaccination
Vaccination Rings
Vaccination Priorities

VACCINATION STRATEGY
will be covered in a
separate training.



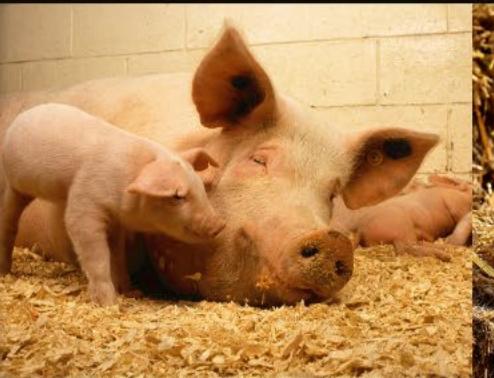
Control parameters are applied at 3 levels:

Some parameters interact with a specific production type.

Some parameters are applied when an event in one production type triggers an event in another production type.

Some parameters happen across all production types.

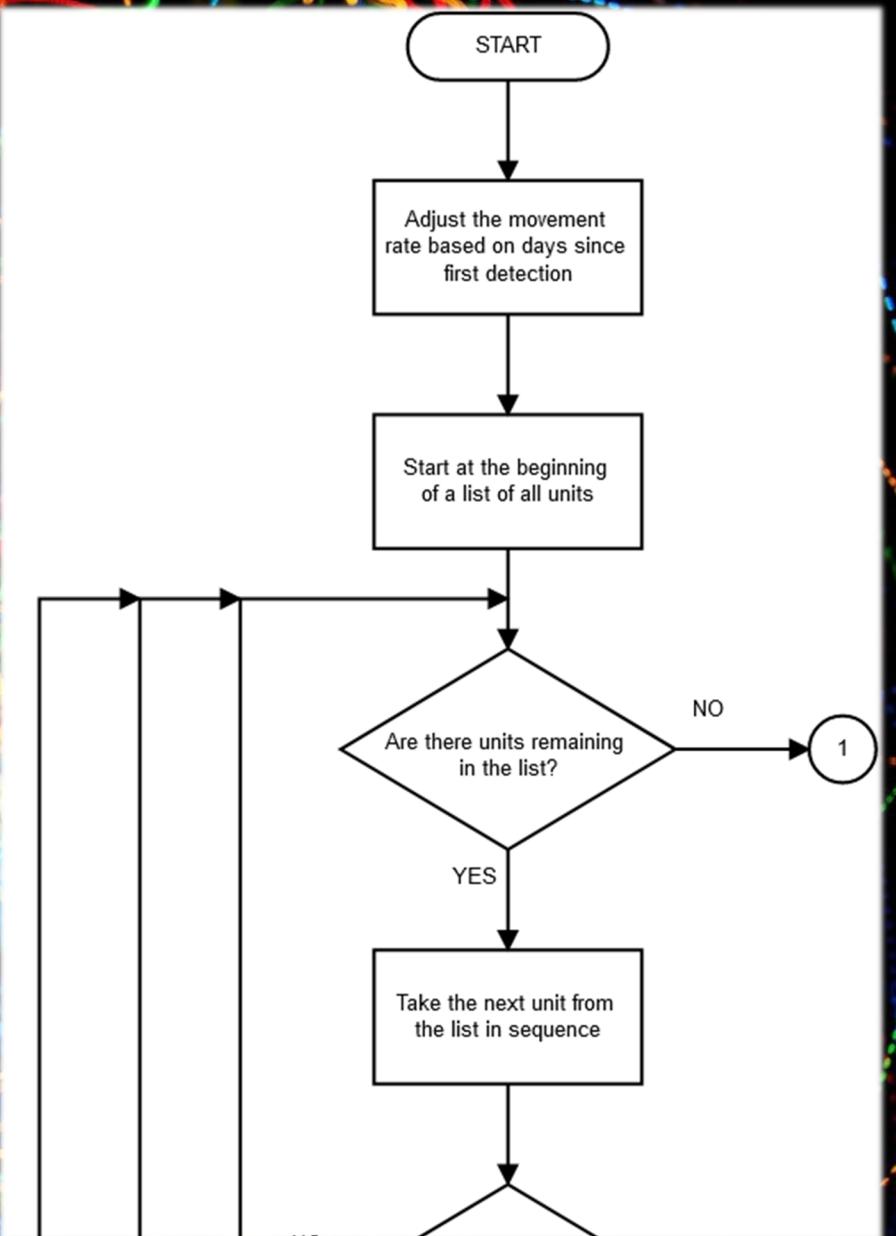
As a result, control parameters are not in a single navigation tab in ADSM.



Behind the Scenes

The decision process and the methods for each control measure are detailed in Model Specifications in the wiki.

[Model Specification](#) · NAVADMC/ADSM Wiki · GitHub

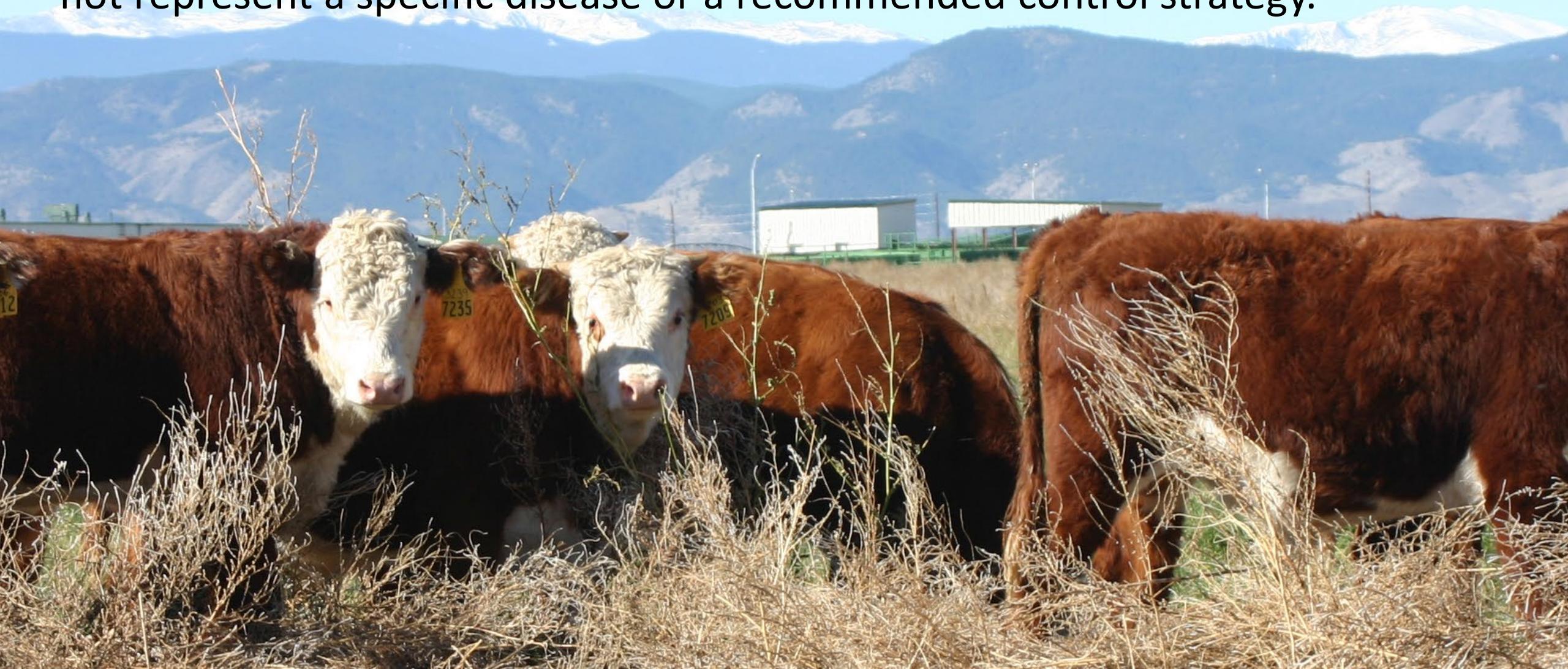


Example Model Specification

Control Protocol



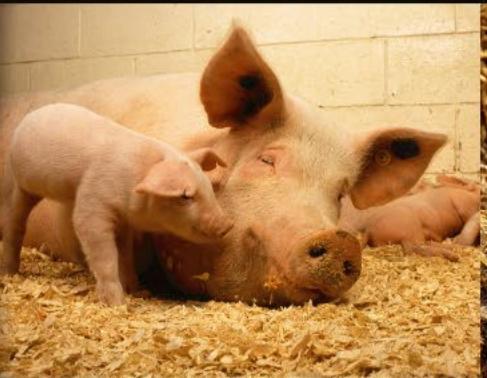
The Sample Scenario uses all controls except *Cost Accounting*. Note that the parameters in the Sample Scenario are for demonstration purposes only and do not represent a specific disease or a recommended control strategy.





Control Protocol is applied at a production type level.

The Control Protocol allows you to make as many unique sets of parameters as needed based on the production types you are using.



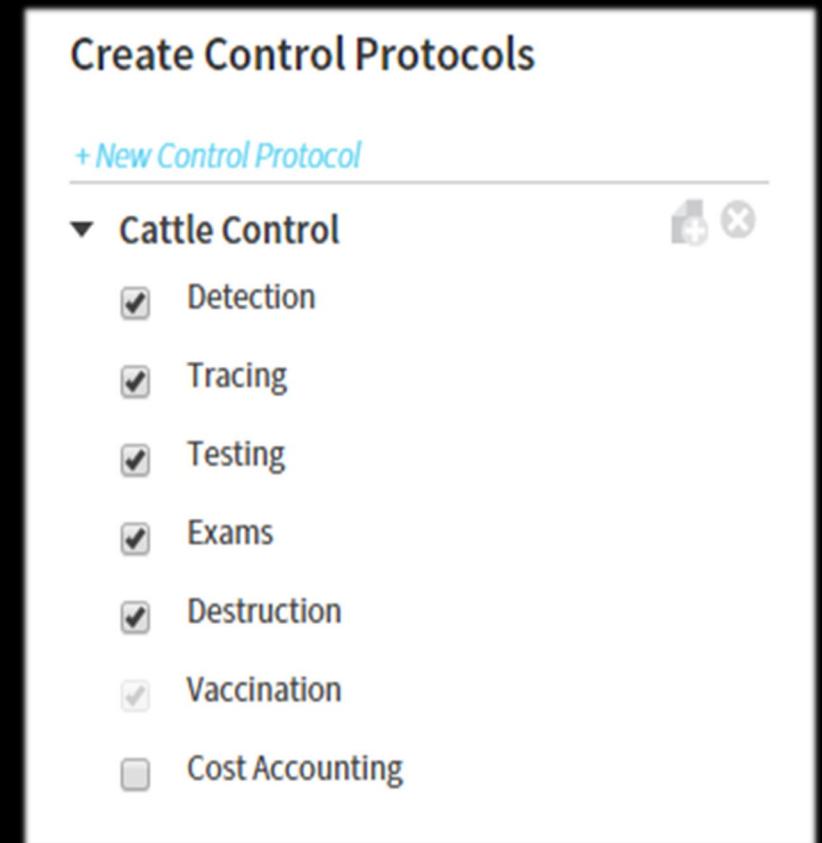
Control Protocol in Sample Scenario

The Sample Scenario is using all controls except *Cost Accounting*.

Check the box to use a specific control measure.

Notice that *vaccination* is both checked and is set as inactive (greyed out). Control Protocol is not the place to flip the switch to turn the vaccination strategy on. The vaccination switch is turned on because of a vaccination ring on Vaccination Rings tab.

Use the [+ New Control Protocol] to add an additional control protocol.



Control Protocol in Sample Scenario - Detection

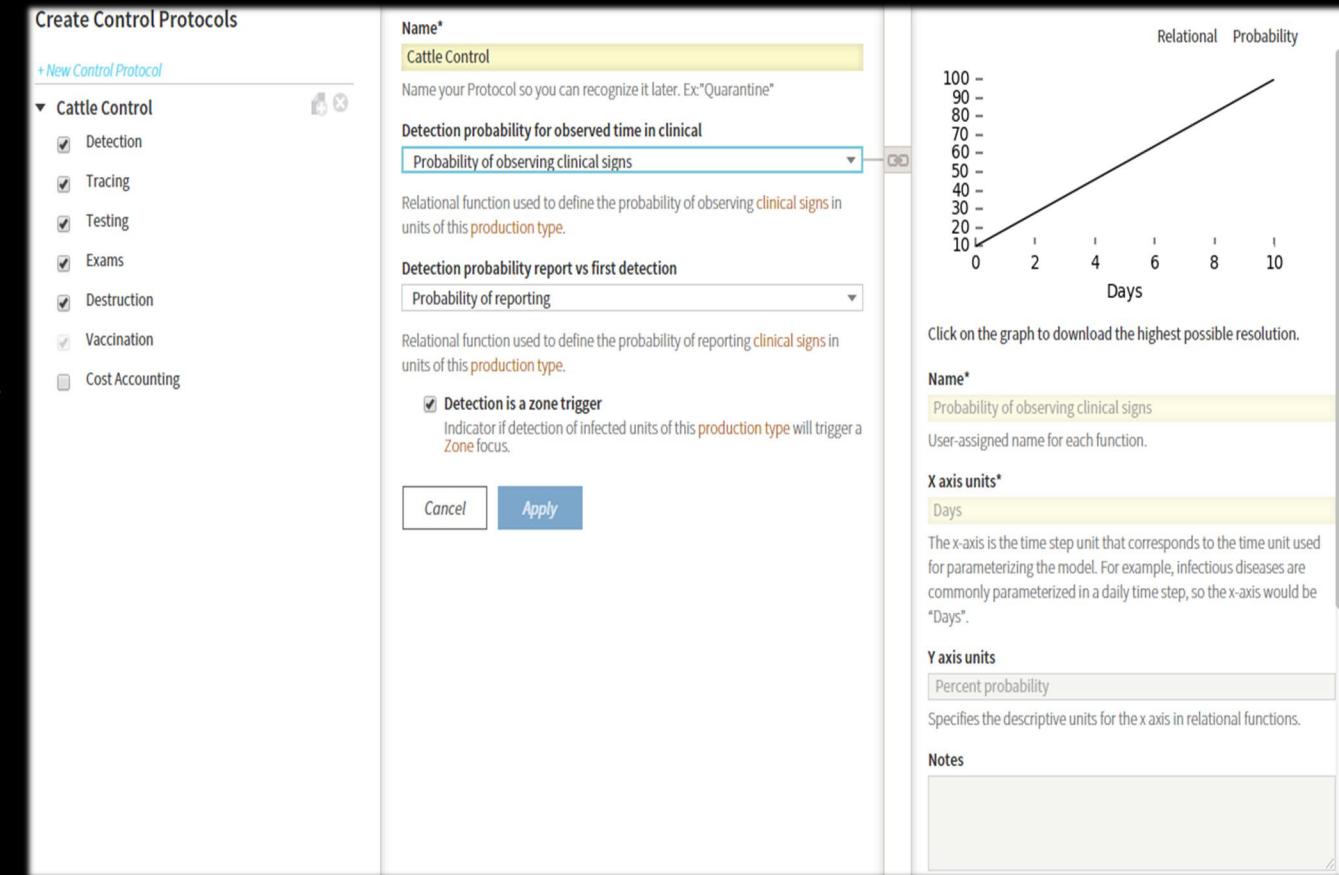
Detection will be used by the simulation. This stage of detection could be considered Passive Surveillance. There are three parameters within detection.

Name parameter describes the integrated control measures in one Control Protocol.

Probability of observing clinical signs – This parameter sets the days that pass before clinical signs become visible and can be observed. This clock starts counting from the time of infection.

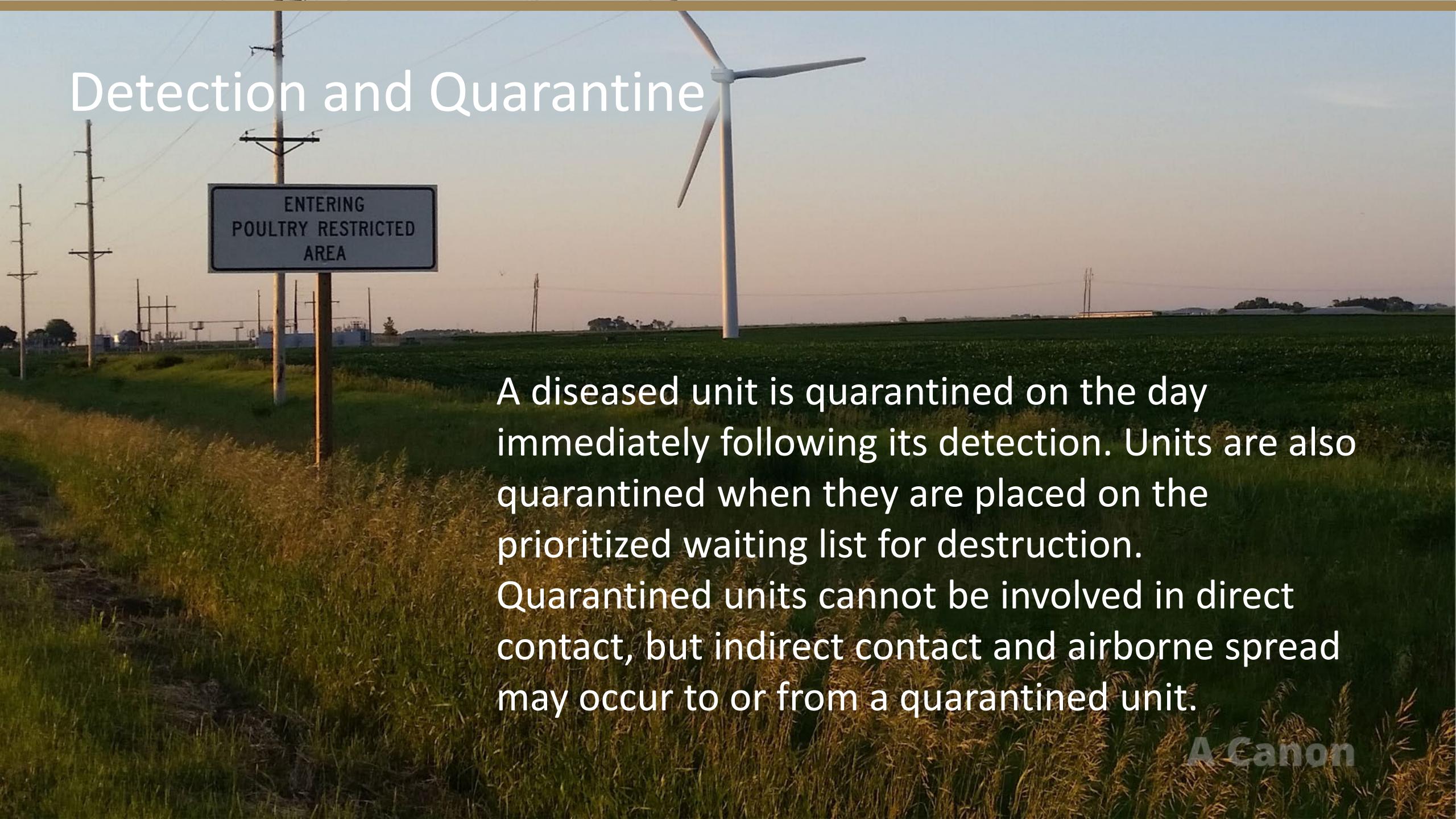
Probability of reporting disease after first detection – This is based on producer behavior in reporting disease to the authorities. This clock starts counting at first detection.

Detection is a zone trigger – This parameter will create control zones. Details of Zone and Zone Effects will be covered later in this training.



Clicking [Apply] is necessary to save changes.

Detection and Quarantine



ENTERING
POULTRY RESTRICTED
AREA

A diseased unit is quarantined on the day immediately following its detection. Units are also quarantined when they are placed on the prioritized waiting list for destruction. Quarantined units cannot be involved in direct contact, but indirect contact and airborne spread may occur to or from a quarantined unit.

Control Protocol in Sample Scenario - Tracing

Tracing will be used in the simulation. Tracing is also called contact tracing or a dangerous contact. It is a task used during disease outbreaks to determine where disease may have spread. When an undetected unit is identified by a trace investigation, it will be quarantined.

This process traces one step in the spread network. It identifies units that were recipients of contact from infected, detected units (referred to as “trace out” or “trace forward”) or units that were sources of contact to infected, detected units (“trace in” or “trace back”).

There are 11 parameters within tracing. The concepts are similar and will be described in groups.

Using a check box, users can turn on:

- ⚙️ *Direct spread forward tracing*
- ⚙️ *Direct spread back tracing*
- ⚙️ *Indirect spread forward tracing*
- ⚙️ *Indirect spread back tracing*

The form displays various tracing parameters:

- Trace direct forward**: Indicator for direct forward tracing. Description: "Indicator that trace forward will be conducted for direct contacts where the reported unit was the source of contact and was of this production type."
- Trace direct back**: Indicator for direct back tracing. Description: "Indicator that trace back will be conducted for direct contacts where the reported unit was the source of contact and was of this production type."
- Direct trace success rate**: Input field with value 0.9. Example: 0.37 = 37%. Description: "Probability of success of trace for direct contact."
- Direct trace period**: Input field with value 14. Description: "Days before detection (critical period) for tracing of direct contacts."
- Trace indirect forward**: Indicator for indirect forward tracing. Description: "Indicator that trace forward will be conducted for indirect contacts where the reported unit was the source of contact and was of this production type."
- Trace indirect back**: Indicator for indirect back tracing. Description: "Indicator that trace back will be conducted for indirect contacts where the reported unit was the source of contact and was of this production type."
- Indirect trace success**: Input field with value 0.1. Example: 0.37 = 37%. Description: "Probability of success of trace for indirect contact."
- Indirect trace period**: Input field with value 14. Description: "Days before detection (critical period) for tracing of indirect contacts."
- Trace result delay**: Input field with value "No tracing delay [NAADSM update default]". Description: "Delay for carrying out trace investigation result (days)."
- Direct trace is a zone trigger**: Indicator for direct tracing triggering a zone focus. Description: "Indicator if direct tracing of infected units of this production type will trigger a Zone focus."
- Indirect trace is a zone trigger**: Indicator for indirect tracing triggering a zone focus. Description: "Indicator if indirect tracing of infected units of this production type will trigger a Zone focus."

Model Specifications in the Wiki has examples of how tracing could work.

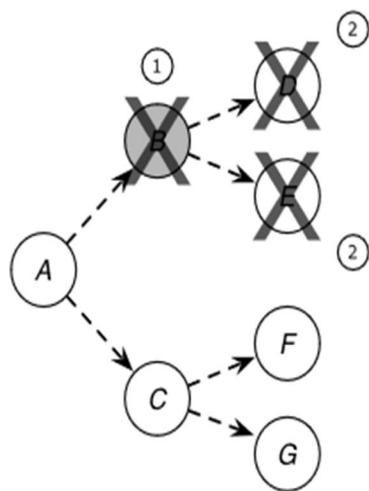


Figure 10. Trace out (trace forward) with preemptive destruction. When unit B is detected (1), units to which B has shipped animals or sent people or equipment are destroyed (2). Such units may be assessed clinically and may have samples collected for laboratory testing immediately prior to preemptive destruction.

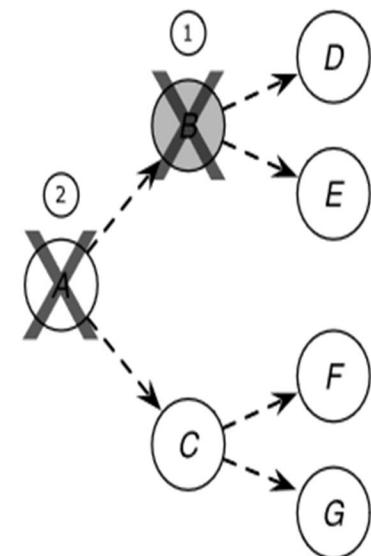


Figure 11. Trace in (trace back) with preemptive destruction. When unit B is detected (1), units which have shipped animals or sent people or equipment to B are found by trace in (2).

Control Protocol in Sample Scenario – Tracing Success

Both types of spread have a *trace success rate*. This parameter describes how often the simulation successfully traces a contact.

Does the simulation find 100% of traces or 1% of traces? You will have to decide for your situation. Tracing makes you ponder the theoretical question “*How many staff do we have to dedicate to tracing activities in the case of an outbreak?*”

The Sample Scenario has the direct trace set to 0.9 successful traces. Therefore, out of 100 possible traces, 90 were successful.

The Sample Scenario has the indirect trace set to 0.1 successful traces. Therefore, out of 100 possible traces, 10 were successful.

There is no tracing for airborne spread.

The output data provides the total number of possible contacts. This allows you to verify how the trace success rate was implemented.

The screenshot shows the 'Control Protocol' configuration for the 'Sample Scenario'. It highlights two key parameters: 'Direct trace success rate' (set to 0.9) and 'Indirect trace success rate' (set to 0.1). Red arrows point from the text descriptions above to these respective settings in the interface.

Trace direct forward
Indicator that **trace forward** will be conducted for **direct contacts** where the reported unit was the source of contact and was of this **production type**.

Trace direct back
Indicator that **trace back** will be conducted for **direct contacts** where the reported unit was the source of contact and was of this **production type**.

Direct trace success rate
0.9 example: 0.37 = 37%
Probability of success of trace for **direct contact**.

Direct trace period
14
Days before detection (critical period) for tracing of **direct contacts**.

Trace indirect forward
Indicator that **trace forward** will be conducted for **indirect contacts** where the reported unit was the source of contact and was of this **production type**.

Trace indirect back
Indicator that **trace back** will be conducted for **indirect contacts** where the reported unit was the source of contact and was of this **production type**.

Indirect trace success
0.1 example: 0.37 = 37%
Probability of success of trace for **indirect contact**.

Indirect trace period
14
Days before detection (critical period) for tracing of **indirect contacts**.

Trace result delay
No tracing delay [NAADSM update default]
Delay for carrying out trace investigation result (days).

Direct trace is a zone trigger
Indicator if direct tracing of infected units of this **production type** will trigger a **Zone focus**.

Indirect trace is a zone trigger
Indicator if indirect tracing of infected units of this **production type** will trigger a **Zone focus**.

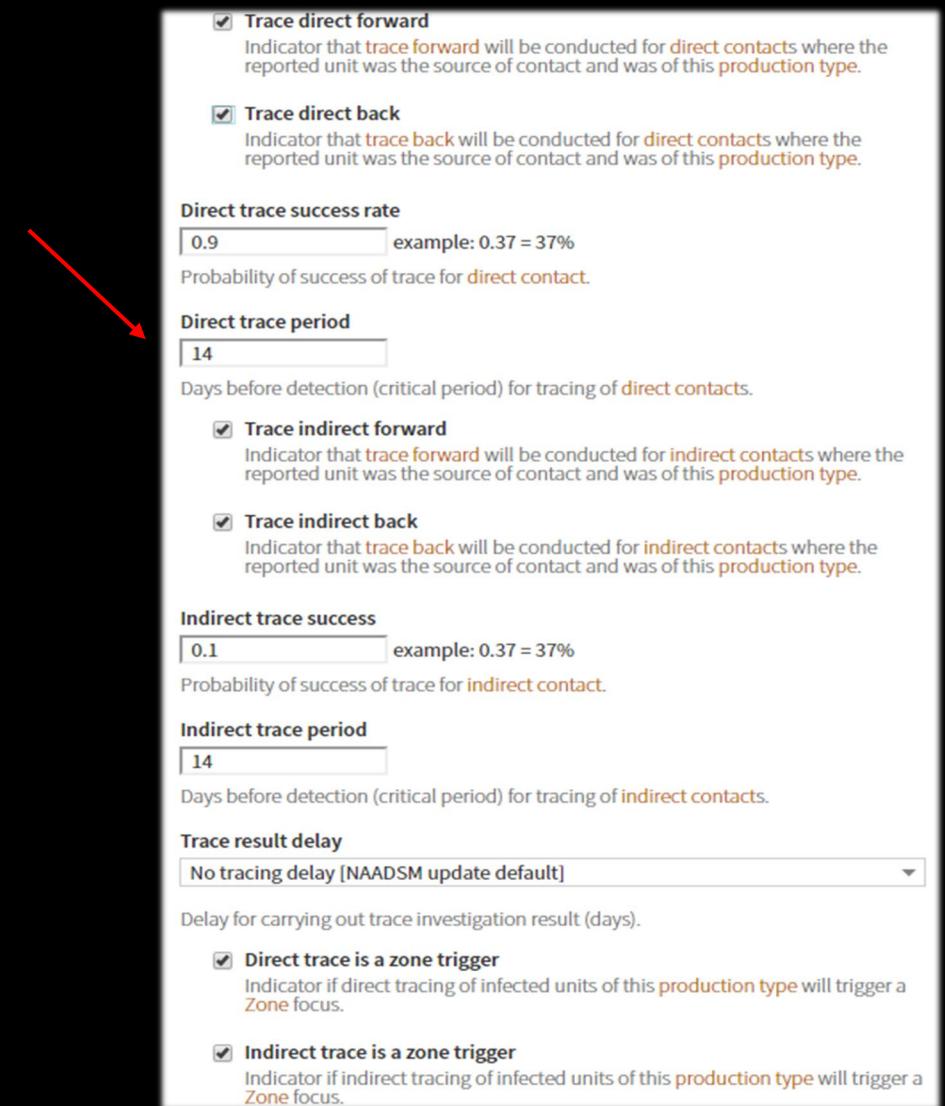
Control Protocol in Sample Scenario – Tracing Period

Both types of spread have a *trace period*. This parameter describes the number of days before detection that should be considered for contact tracing. *Would you ask the detected farms to recall all direct movement for the last 7 days? For the last 14 days, or more?*

The time window to perform tracing will depend on the characteristics of the disease you are modeling. The Sample Scenario has the direct trace set to 14 days and indirect trace set to 14 days.

Tracing is an event that requires administrative time. A *trace result delay* can be set with a relational function to mimic a time delay before the administrative resources are in place.

Traces, both direct and indirect, can *trigger a zone focus*. Details of Zone and Zone Effects will be covered later in this training.



Trace direct forward
Indicator that **trace forward** will be conducted for **direct contacts** where the reported unit was the source of contact and was of this **production type**.

Trace direct back
Indicator that **trace back** will be conducted for **direct contacts** where the reported unit was the source of contact and was of this **production type**.

Direct trace success rate
0.9 example: 0.37 = 37%
Probability of success of trace for **direct contact**.

Direct trace period
14
Days before detection (critical period) for tracing of **direct contacts**.

Trace indirect forward
Indicator that **trace forward** will be conducted for **indirect contacts** where the reported unit was the source of contact and was of this **production type**.

Trace indirect back
Indicator that **trace back** will be conducted for **indirect contacts** where the reported unit was the source of contact and was of this **production type**.

Indirect trace success
0.1 example: 0.37 = 37%
Probability of success of trace for **indirect contact**.

Indirect trace period
14
Days before detection (critical period) for tracing of **indirect contacts**.

Trace result delay
No tracing delay [NAADSM update default]
Delay for carrying out trace investigation result (days).

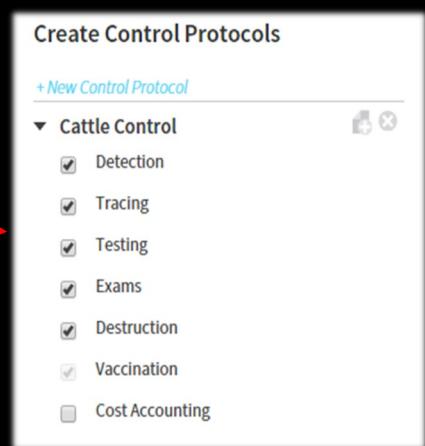
Direct trace is a zone trigger
Indicator if direct tracing of infected units of this **production type** will trigger a **Zone focus**.

Indirect trace is a zone trigger
Indicator if indirect tracing of infected units of this **production type** will trigger a **Zone focus**.

Control Protocol in Sample Scenario

If tracing is used to identify connected units, there are two other steps that we can use as control measures:

- ⚙️ *Laboratory testing*
- ⚙️ *Clinical examinations*



Dee Griffin

Based on *Tracing*, you can decide to test any of the four possible trace methods.

You can turn on testing for:

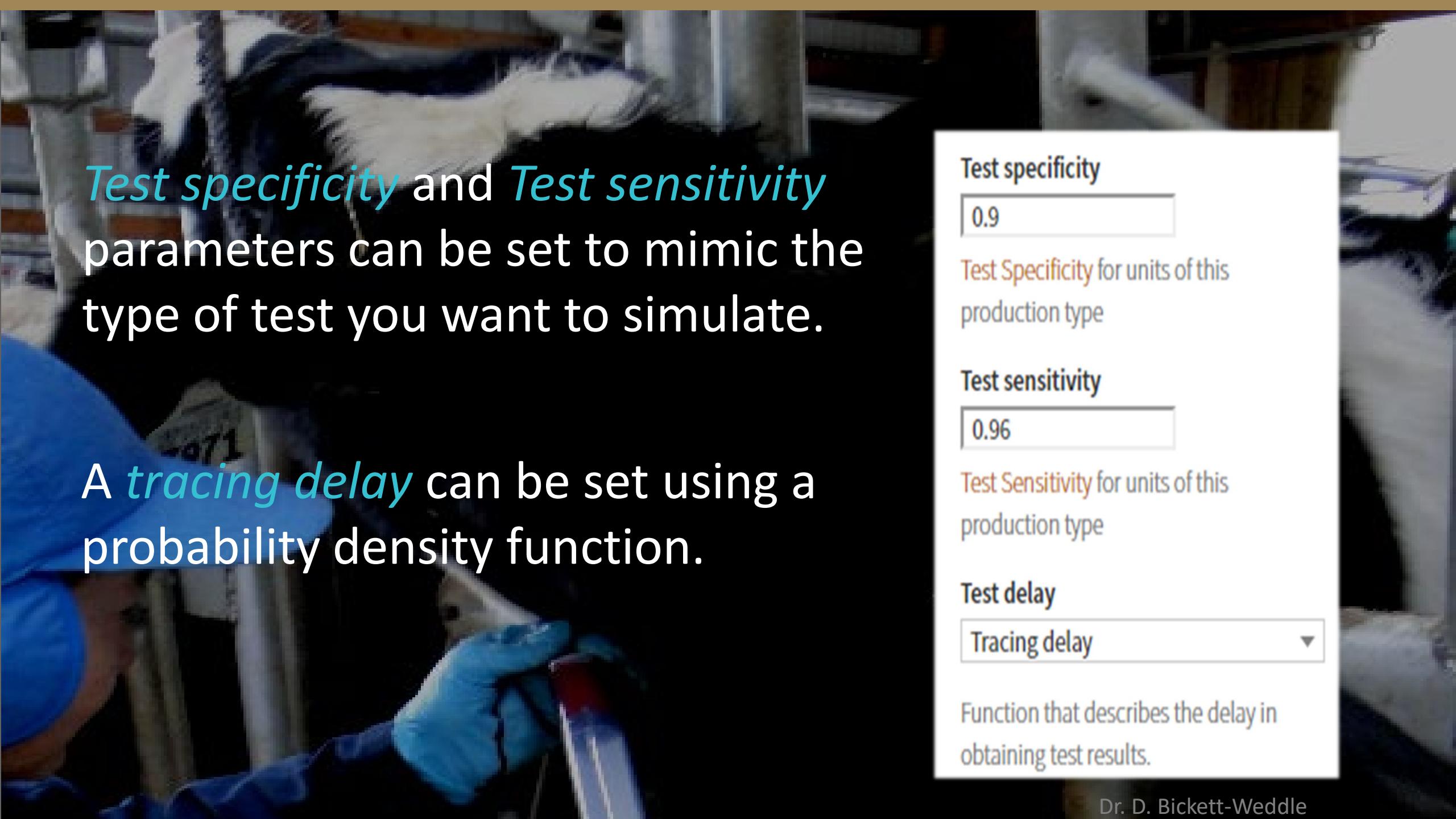
- ⚙️ *Direct spread forward tracing*
- ⚙️ *Direct spread back tracing*
- ⚙️ *Indirect spread forward tracing*
- ⚙️ *Indirect spread back tracing*

Test direct forward traces
Indicator that diagnostic testing should be performed on units identified by **trace forward** of direct contacts.

Test indirect forward traces
Indicator that diagnostic testing should be performed on units identified by **trace forward** of indirect contacts.

Test direct back traces
Indicator that diagnostic testing should be performed on units identified by **trace back** of direct contacts.

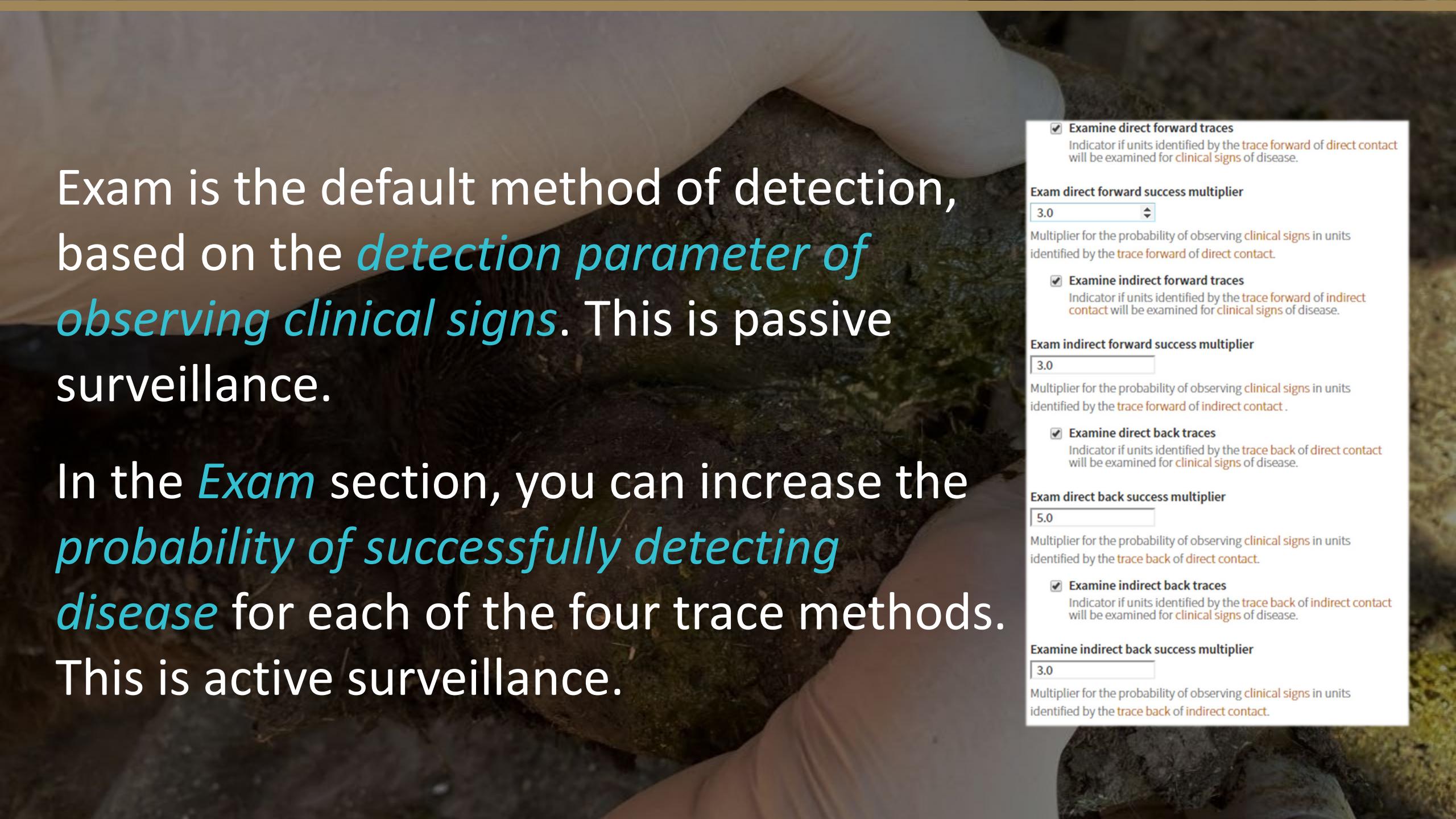
Test indirect back traces
Indicator that diagnostic testing should be performed on units identified by **trace back** of indirect contacts.



Test specificity and *Test sensitivity* parameters can be set to mimic the type of test you want to simulate.

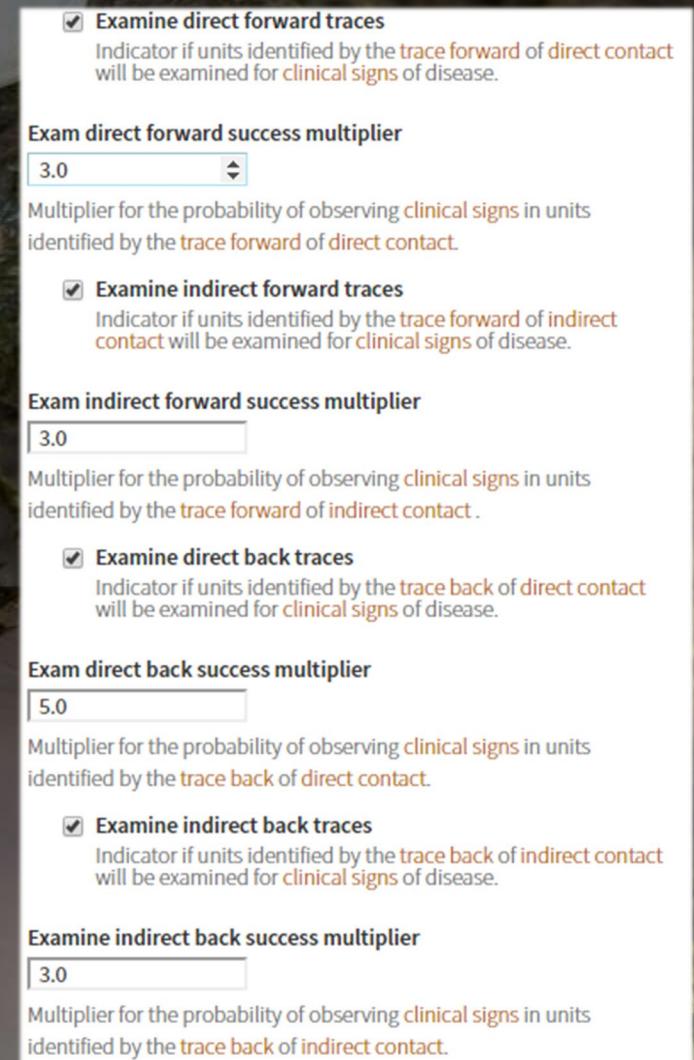
A *tracing delay* can be set using a probability density function.

Test specificity	0.9
Test Specificity for units of this production type	
Test sensitivity	0.96
Test Sensitivity for units of this production type	
Test delay	Tracing delay
Function that describes the delay in obtaining test results.	



Exam is the default method of detection, based on the *detection parameter of observing clinical signs*. This is passive surveillance.

In the *Exam* section, you can increase the *probability of successfully detecting disease* for each of the four trace methods. This is active surveillance.



Examine direct forward traces
Indicator if units identified by the **trace forward** of direct contact will be examined for **clinical signs** of disease.

Exam direct forward success multiplier
3.0

Multiplier for the probability of observing **clinical signs** in units identified by the **trace forward** of direct contact.

Examine indirect forward traces
Indicator if units identified by the **trace forward** of indirect contact will be examined for **clinical signs** of disease.

Exam indirect forward success multiplier
3.0

Multiplier for the probability of observing **clinical signs** in units identified by the **trace forward** of indirect contact.

Examine direct back traces
Indicator if units identified by the **trace back** of direct contact will be examined for **clinical signs** of disease.

Exam direct back success multiplier
5.0

Multiplier for the probability of observing **clinical signs** in units identified by the **trace back** of direct contact.

Examine indirect back traces
Indicator if units identified by the **trace back** of indirect contact will be examined for **clinical signs** of disease.

Exam indirect back success multiplier
3.0

Multiplier for the probability of observing **clinical signs** in units identified by the **trace back** of indirect contact.

A photograph showing a massive pile of dead salmon, likely chinook, piled up on a dirt embankment. In the foreground, the dark, silvery bodies of the fish are visible. A large piece of heavy machinery, possibly a grader or excavator, is positioned on the left, with its bucket resting near the fish. The background features a steep, dry hillside under a clear blue sky. A white vehicle is parked further up the hill. Several utility poles are scattered across the landscape.

Destruction may also be known as depopulation or euthanasia and is a possible control measure that can be used in ADSM.

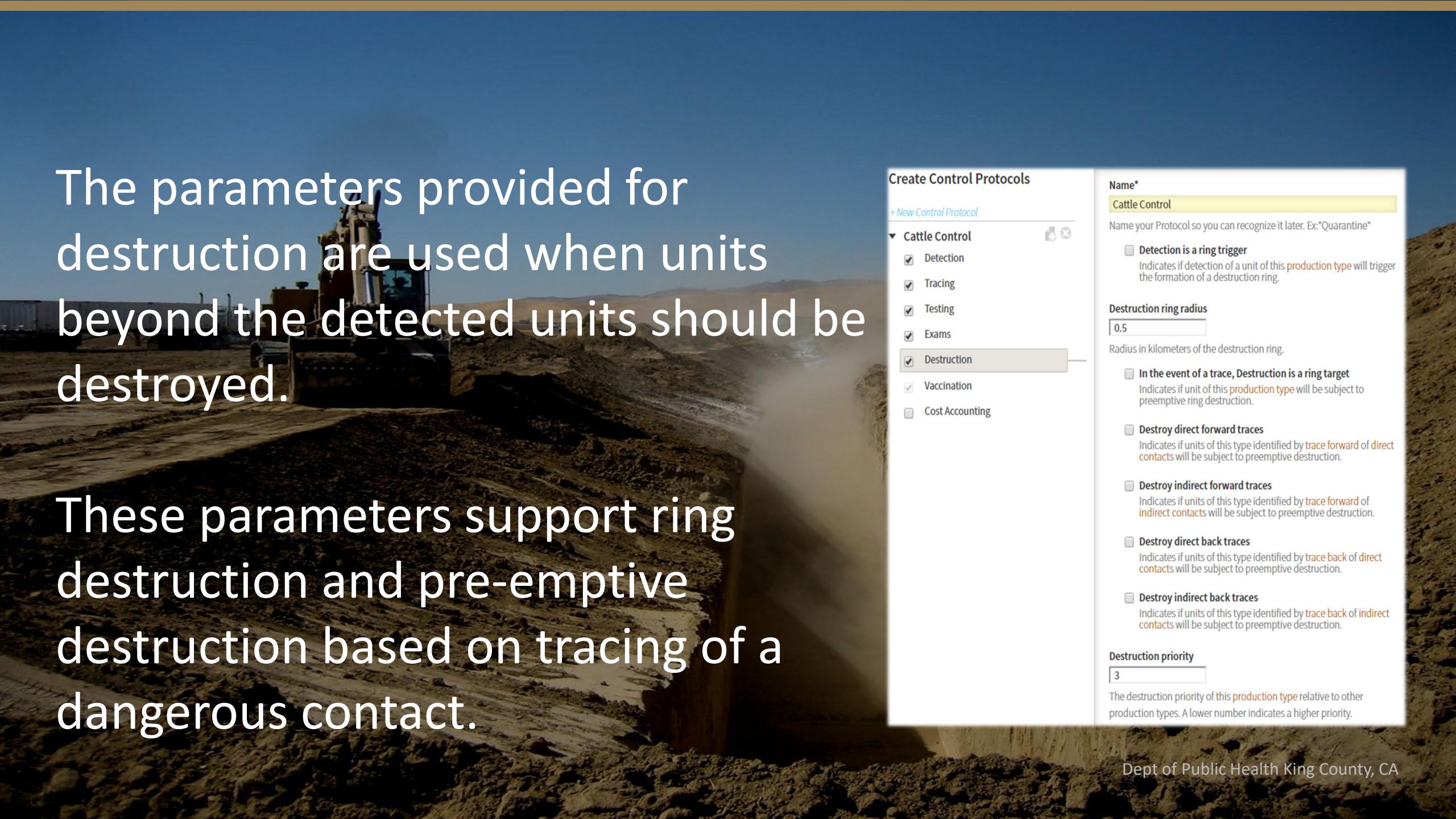
Destruction is used in the Sample Scenario. Recall that control protocols are assigned at a production type level. When destruction is checked in the control protocol list, then destruction will happen to assigned production type units that are detected.

Create Control Protocols

+ New Control Protocol

▼ Cattle Control  

- Detection
- Tracing
- Testing
- Exams
- Destruction
- Vaccination
- Cost Accounting

A large white truck is spraying a cloud of dust onto a dirt road in a rural, hilly landscape under a clear blue sky.

The parameters provided for destruction are used when units beyond the detected units should be destroyed.

These parameters support ring destruction and pre-emptive destruction based on tracing of a dangerous contact.

Create Control Protocols

+ New Control Protocol

▼ Cattle Control

- Detection
- Tracing
- Testing
- Exams
- Destruction
- Vaccination
- Cost Accounting

Name*

Cattle Control

Name your Protocol so you can recognize it later. Ex:"Quarantine"

Detection is a ring trigger
Indicates if detection of a unit of this production type will trigger the formation of a destruction ring.

Destruction ring radius

0.5

Radius in kilometers of the destruction ring.

In the event of a trace, Destruction is a ring target
Indicates if unit of this production type will be subject to preemptive ring destruction.

Destroy direct forward traces
Indicates if units of this type identified by trace forward of direct contacts will be subject to preemptive destruction.

Destroy indirect forward traces
Indicates if units of this type identified by trace forward of indirect contacts will be subject to preemptive destruction.

Destroy direct back traces
Indicates if units of this type identified by trace back of direct contacts will be subject to preemptive destruction.

Destroy indirect back traces
Indicates if units of this type identified by trace back of indirect contacts will be subject to preemptive destruction.

Destruction priority

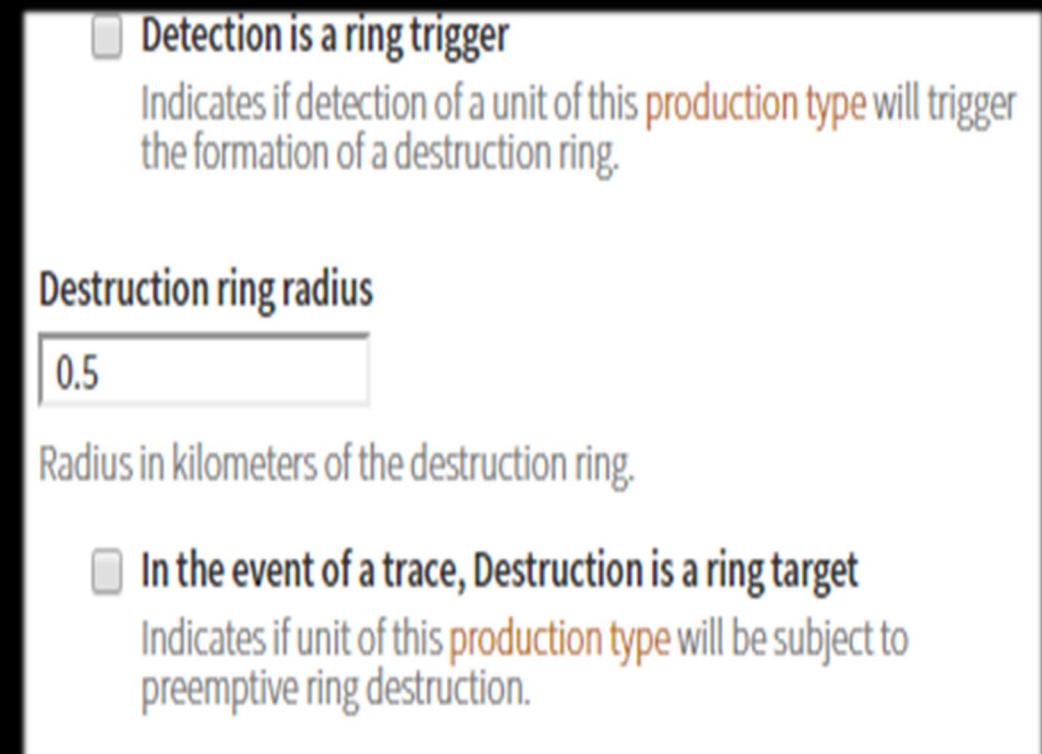
3

The destruction priority of this production type relative to other production types. A lower number indicates a higher priority.

There are two options for ring destruction.

The first option, *ring trigger*, applies destruction in a ring around the detected unit; it is also known as pre-emptive destruction. It allows you to set the *radius* of the ring.

The second option for *ring destruction targets* units that have had traces (dangerous contacts). This ring uses the same radius as the pre-emptive destruction.



There are four options for destruction based on a trace, which is the concept of destroying a dangerous contact.

Using a check box, you can turn on destruction for:

-  *Direct spread forward tracing*
-  *Direct spread back tracing*
-  *Indirect spread forward tracing*
-  *Indirect spread back tracing*

Destroy direct forward traces

Indicates if units of this type identified by **trace forward of direct contacts** will be subject to preemptive destruction.

Destroy indirect forward traces

Indicates if units of this type identified by **trace forward of indirect contacts** will be subject to preemptive destruction.

Destroy direct back traces

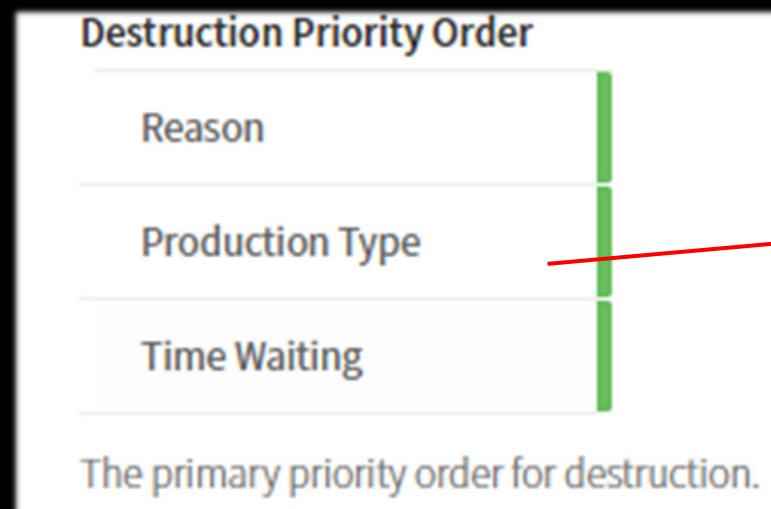
Indicates if units of this type identified by **trace back of direct contacts** will be subject to preemptive destruction.

Destroy indirect back traces

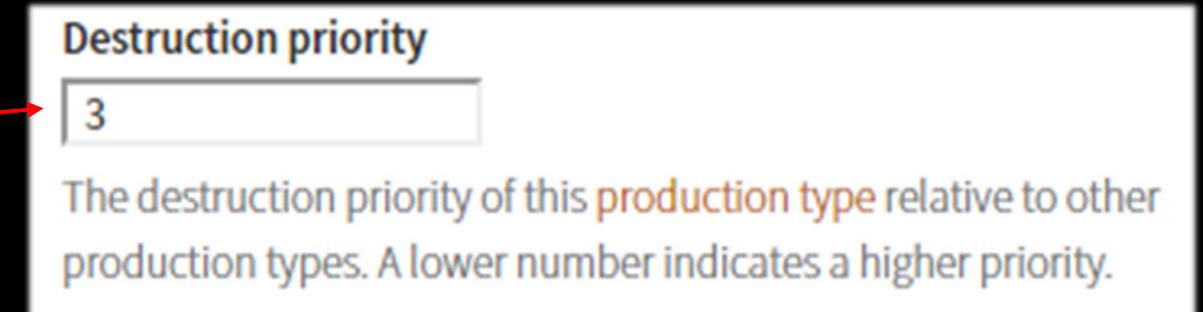
Indicates if units of this type identified by **trace back of indirect contacts** will be subject to preemptive destruction.

Destruction also sets the *priority* of a given production type. This number is used as the secondary sort for the drag-and-drop priority widget on the [Destruction Global tab](#).

Primary Sort



Secondary Sort of the production types



Vaccination

Vaccination has many parameters.

Some are applied across all production types.

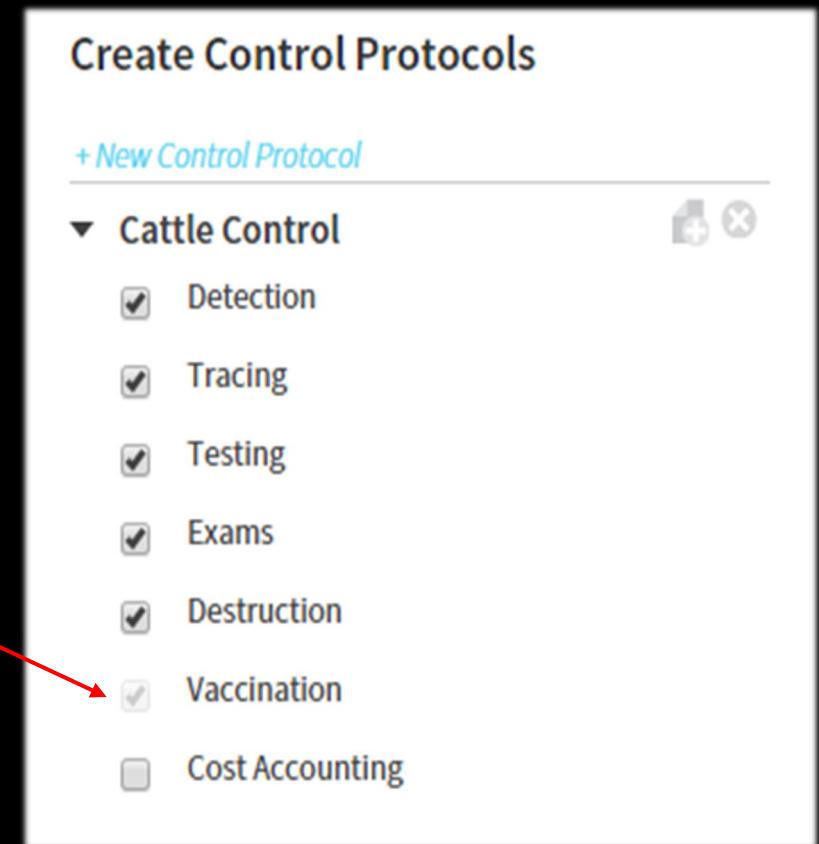
Some are applied between production types.

Some are applied at the production type level.

In this training module, we will cover vaccination at a high level. There is an additional training to address **VACCINATION STRATEGY** in more detail.

In this case, we are looking specifically at the vaccination parameters that are applied based on the production type.

Notice the check box is inactive (greyed out) but still checked. Vaccination is not initiated from this parameter. Vaccination starts when a trigger and a ring have been set. These items will be covered at a high level in this Vaccination section and in more detail in the **VACCINATION STRATEGY** training module.



Sample Scenario's Control Protocol: Cattle Control

These parameters assume that vaccination has been triggered, is applied in a ring, and has a priority set.

Name describes the integrated control measures in one Control Protocol.

Vaccinate Detected units is a yes/no option.

Minimum time between vaccinations allows for a secondary (booster) vaccination to happen at an appropriate interval after the initial vaccination. The default value is set to 99,999 days, which results in only one vaccination per unit during the iteration. If needed, the parameter is changed to a more reasonable value, down to 1 day between vaccinations. The parameter cannot be empty.

Days to Immunity describes the number of days (whole number) needed for the vaccine to generate an immune response and is required.

Vaccine Immune period is a probability density function that allows a range to be set for the window of vaccine-induced immunity.

The screenshot shows a configuration dialog for a 'Control Protocol'. The 'Name*' field is filled with 'Cattle Control'. A note below says 'Name your Protocol so you can recognize it later. Ex:"Quarantine"'.

The 'Vaccinate detected units' checkbox is checked, with a note explaining it indicates if detection in units of this production type will be included in vaccination.

The 'Minimum time between vaccinations*' field is set to '90', with a note explaining it is the minimum time in days between vaccination for units of this production type. The default value is set to 99999 to stop duplicate vaccinations.

The 'Days to immunity' field is set to '7', with a note explaining it is the number of days required for the onset of vaccine immunity in a newly vaccinated unit of this type.

The 'Vaccine immune period' dropdown is set to 'Immune period vaccination', with a note defining the vaccine immune period for units of this production type.

At the bottom are 'Cancel' and 'Apply' buttons.

Cost Accounting

Cost Accounting allows you to calculate the costs of a scenario. Be aware that the costs ADSM estimates are the cost the responding government agency would incur in an outbreak.

There are many other costs involved in an outbreak that ADSM does not address, such as:

- ⚙️ Personnel costs for deployment, lodging, overtime pay, and others
- ⚙️ Producer costs from business disruption
- ⚙️ Trade costs for losing trade partners that are unwilling to allow imports

Cost Accounting is not activated in the Sample Scenario. However, there are values saved if you want to toggle the functionality on.

Cost Accounting does not change the progression of a simulation. Rather, it uses counts of units/animals affected in an iteration and multiplies that count to provide an estimate of costs.

*Cost of carcass disposal per animal * count of animals = total disposal cost*

Create Control Protocols

+ New Control Protocol

▼ Cattle Control

- Detection
- Tracing
- Testing
- Exams
- Destruction
- Vaccination
- Cost Accounting

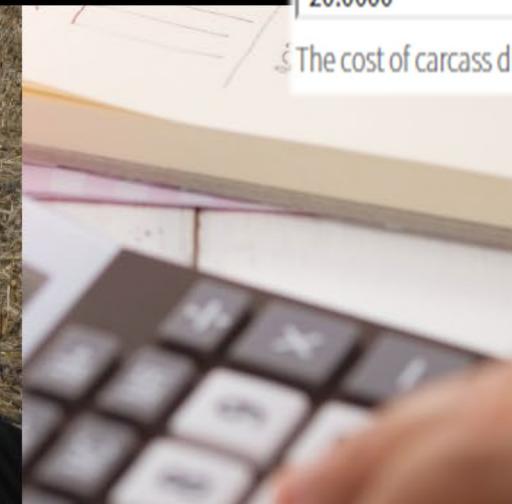
A blurry background image showing a red barn with a grey door and a window, situated on a grassy hillside. In the foreground, there is a stop sign on a black pole and a smaller green sign below it.

Cost Accounting has two groups in the Control Protocol that are summarized in the data outputs:

- ⚙️ Destruction costs
- ⚙️ Vaccination costs

We might also expect additional costs due to increased surveillance. Those costs vary by both the surveillance zone and the production type. The Zone Effects tab will cover that parameter.

Destruction costs cover the variety of activities that would support a control strategy including destruction.



Cost of destruction cleaning per unit*
10.0000
The cost associated with cleaning and disinfection for each destroyed unit of this type.
Cost of euthanasia per animal*
75.0000
The cost associated with euthanizing each destroyed animal of this type.
Cost of indemnification per animal*
125.0000
The cost of indemnification for each destroyed animal of this type.
Cost of carcass disposal per animal*
20.0000
The cost of carcass disposal for each destroyed animal of this type.



Vaccination costs cover the variety of activities that would support a control strategy including vaccination.



Cost of vaccination setup per unit*

12.0000

The cost of site setup for each vaccinated unit of this type.

Cost of vaccination baseline per animal*

2.0000

The baseline cost of vaccination for each vaccinated animal of this type. This cost applies to all vaccinations before the threshold is met.

Vaccination demand threshold

50000

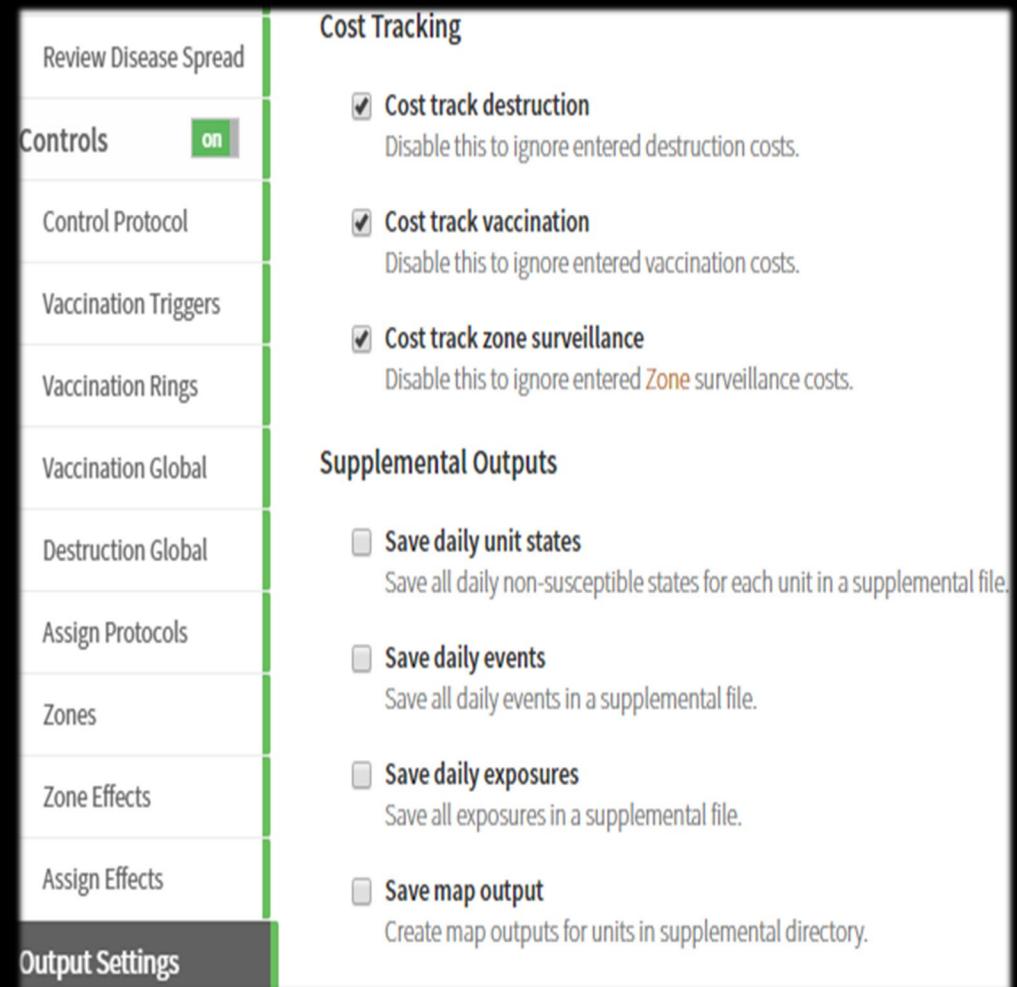
The number of animals of this type that can be vaccinated before the cost of vaccination increases.

Cost of vaccination additional per animal*

2.0000

The additional cost of vaccination for each vaccinated animal of this type after the threshold is exceeded.

To include calculations of costs in your output data, be sure to check the appropriate *Cost Tracking* options on the Output Settings tab.



Control Protocol Summary



We have covered all the sections within Control Protocol. The next step is to assign the Control Protocol to the production type that matches your parameters.

Assign Control Protocol: Cattle Control

The Assign Protocol tab is used to associate a Control Protocol to a specific production type.

Scenario Description	Assign a Control Protocol to each Production Type		
	Production type	Control protocol	Notes
Population	Swine	-----	
Disease	Cattle	Cattle Control	

Controls on

Control Protocol

Vaccination Triggers

Vaccination Rings

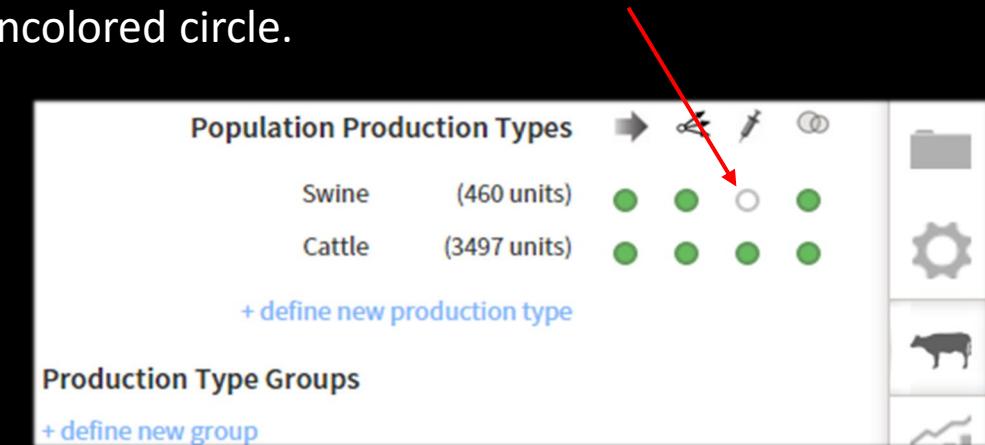
Vaccination Global

Destruction Global

Assign Protocols

The list of available production types is presented by the application. A pull-down list is displayed, showing all the Control Protocols that have been created. The dashed line (----) indicates that no assignment has been made.

Assign Control protocols as needed to a given production type. In the Sample Scenario, the Swine Production type is set to null, or no assignment. Notice the lack of assignment can also be seen in the Production Type panel, indicated by an uncolored circle.



Vaccination



Scenario Description

Population

Disease

Disease Progression

Assign Progression

Disease Spread

Review Disease Spread

Controls

on

Control Protocol

Vaccination Triggers

Vaccination Rings

Vaccination Global

Destruction Global

Assign Protocols

Zones

Zone Effects

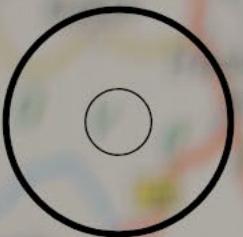
Assign Effects

Output Settings

The two parameter blocks that are implemented between production types support vaccination and are:

⚙️ Vaccination Rings tab - the switch that indicates a vaccination strategy will begin if certain detection conditions have been met.

⚙️ Vaccination Triggers tab - details the conditions needed to start vaccination.



Vaccination Rings

The Vaccination Ring tab holds the ring parameters. The ring radius is the area to be covered by a vaccination strategy.

Sample Scenario has a ring rule implemented. Hover over the name to see the full text name of the Ring Rule.

Create Vaccination Ring Rules

▼ **Vaccination Ring Rule**

Cattle detection triggers Cattle vaccination within 5.0 km  

+ New Vaccination Ring Rule

 Cattle detection triggers Cattle vaccination within 5.0 km

Use the [+ New Vaccination Ring Rule] to add an additional ring.

Sample Scenario's ring rule

The *ring rule*

Cattle detection triggers **Cattle** vaccination within 5.0 km

The screenshot shows the 'Create Vaccination Ring Rules' dialog and the 'Population Production Types' panel.

Create Vaccination Ring Rules

- Vaccination Ring Rule**
 - Cattle detection triggers Cattle vaccination within 5.0 km** (selected)
 - + New Vaccination Ring Rule

Population Production Types

Production Type	Units	Icon
Swine	(460 units)	● ● ○ ●
Cattle	(3497 units)	● ● ● ●

+ define new production type

Production Type Groups

+ define new group

Export Population

- Export Population as XML
- Export Population as CSV

The exported population will be saved in a folder titled "Exports" in your workspace folder.

Create Vaccination Ring Rules

Once a vaccination program has been initiated by any start/restart trigger, then detection of disease in these production type(s)

Cattle

To add Production Types to this list, click in this box then click on a Type in the Population Panel

will result in vaccination of units of these production type(s)

Cattle

To add Production Types to this list, click in this box then click on a Type in the Population Panel

within a ring with an inner radius of km (optional) and outer radius of 5.0 km

Cancel **Apply**

Hint: Select the yellow box first; the box will have a highlighted outline when selected. Click on production type from the production type list to add to box. Click again on production type within the yellow box to remove. Hover text appears on both Add and Remove.

Cattle detection triggers **Cattle** vaccination within 5.0 km

Let's break this down

- 1) After trigger conditions are fulfilled (set on [Vaccination Triggers tab](#)), then...
- 2) Detection of disease in **Cattle** production types...
- 3) Results in vaccination in **Cattle** production types, and...
- 4) A vaccination ring around each detected unit will include all units of **Cattle** within a radius of **5 km** from the detected production type.

Note that the vaccination pattern can omit the inner section if needed by including an inner radius value.

Sample Scenario

Create Vaccination Ring Rules

Vaccination Ring Rule

Cattle detection triggers Cattle vaccination within 5....

+ New Vaccination Ring Rule

Once a vaccination program has been initiated by any start/restart trigger, then detection of disease in these production type(s)

Cattle

To add Production Types to this list, click in this box then click on a Type in the Population Panel

will result in vaccination of units of these production type(s)

Cattle

To add Production Types to this list, click in this box then click on a Type in the Population Panel

within a ring with an inner radius of km (optional) and outer radius of km

Population Production Types

Swine (460 units) Cattle (3497 units)

+ define new production type

Production Type Groups

+ define new group

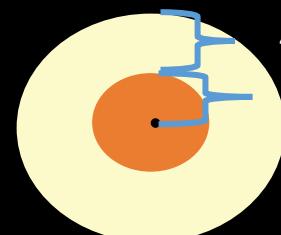
Export Population as XML

Export Population as CSV

The exported population will be saved in a folder titled "Exports" in your workspace folder.

In what situation would an inner radius make sense?

There may be many reasons to use an inner radius. One example is when a destruction ring has been set to pre-emptively depopulate units that are within 1 km of a detected production type. There is no reason for the simulation to apply both a destruction event and attempt to apply a vaccination event.



4 km vaccination ring

1 km pre-emptive depopulation

Once a vaccination program has been initiated by any start/restart trigger, then detection of disease in these production type(s)

Cattle

To add Production Types to this list,
click in this box then click on a Type in the Population Panel

will result in vaccination of units of these production type(s)

Cattle

To add Production Types to this list,
click in this box then click on a Type in the Population Panel

within a ring with an inner radius of km (optional)

and outer radius of km

Cancel

Apply

Production types in rings

Which production types can be used?

Create Vaccination Ring Rules

▼ **Vaccination Ring Rule**

Swine, Cattle detection triggers Swine, ...  

[+ New Vaccination Ring Rule](#)

The combinations are only constrained by the number of production types you have used in your scenario. One or more production types can be added in the **detection** box, and one or more production types can be added in the **resulting vaccination** box.

The Sample Scenario is a very simple example and shows only Cattle as the trigger and Cattle as the recipient.

Once a vaccination program has been initiated by any start/restart trigger, then detection of disease in these production type(s)

Swine

Cattle

To add Production Types to this list, click in this box then click on a Type in the Population Panel

will result in vaccination of units of these production type(s)

Swine

Cattle

To add Production Types to this list, click in this box then click on a Type in the Population Panel

within a ring with an inner radius of km (optional)
and outer radius of 5.0 km

Cancel **Apply**

What are the conditions that trigger vaccination to begin?

The Sample Scenario has a trigger implemented as the condition to start vaccination, named *3 infected units detected in Swine, Cattle*.

There are six conditions that can be set by one or more production types.

In addition, there is also a trigger than can be set to *stop vaccination*.

If vaccination has been stopped, it is possible to *restart vaccination* with the same six triggers that are used to start the vaccination strategy initially.

Capacity for vaccination will be covered later; note that start capacity and restart capacity can be different.

The screenshot shows a software interface for managing vaccination triggers. On the left, a vertical menu lists various scenario components: Scenario Description, Population, Disease, Disease Progression, Assign Progression, Disease Spread, Review Disease Spread, Controls (with a green 'on' button), Control Protocol, Vaccination Triggers (which is currently selected, indicated by a white background and a green border), and Vaccination Rings. To the right of this menu is a main panel titled 'Vaccination Triggers'. It contains three sections: 'Start Triggers', 'Stop Triggers', and 'Restart Triggers'. The 'Start Triggers' section is expanded, showing a list of triggers: '3 infected units detected in Swine, Cattle' (with a green plus icon and a red X icon to its right), '+ New Disease Detection', '+ New Rate Of New Detections', '+ New Dissemination Rate', '+ New Spread Between Groups', '+ New Time From First Detection', and '+ New Destruction Wait Time'. Below this is a horizontal line. The 'Stop Triggers' section is collapsed, showing '+ New Stop Vaccination'. Another horizontal line follows. The 'Restart Triggers' section is collapsed.

Trigger - 3 infected units detected in Swine, Cattle

Note that the *trigger group* contains both Swine and Cattle. The Sample scenario example is triggered by the *number of units detected*. Therefore, the trigger name reflects the details of the trigger. To make the trigger a *restart trigger*, use the yes/no checkbox at the bottom of the parameter.

The screenshot shows the 'Vaccination Triggers' configuration interface. On the left, under 'Start Triggers', a trigger named '3 infected units detected in Swine, Cattle' is selected. A red arrow points from this trigger to the 'Trigger group*' section in the center. The 'Trigger group*' section lists 'Swine' and 'Cattle'. Below it is a yellow box with the text: 'To add Production Types to this list, click in this box then click on a Type in the Population Panel'. To the right of the central panel is a 'Population Production Types' panel showing 'Swine (460 units)' and 'Cattle (3497 units)' with their respective icons. At the bottom right of the central panel is a note: 'Allows you to setup less strict criteria for restarting a vaccination program after an outbreak.' with a 'Restart only' checkbox.

Hint: Select the yellow box first; the box will have a highlighted outline when selected. Click on a production type from the list to add to the box. Click again on production type within the yellow box to remove. Hover text appears on both Add and Remove.

What if I have multiple triggers? Which one starts vaccination?

Multiple triggers can be used. When any one of the triggers meets the requirements, vaccination will start.

Vaccination Triggers

▼ Start Triggers

3 infected units detected in Swine, Cattle + X

+ New Disease Detection
+ New Rate Of New Detections
+ New Dissemination Rate
+ New Spread Between Groups
+ New Time From First Detection
+ New Destruction Wait Time

▼ Stop Triggers

+ New Stop Vaccination

▼ Restart Triggers

Trigger group*

Swine
Cattle

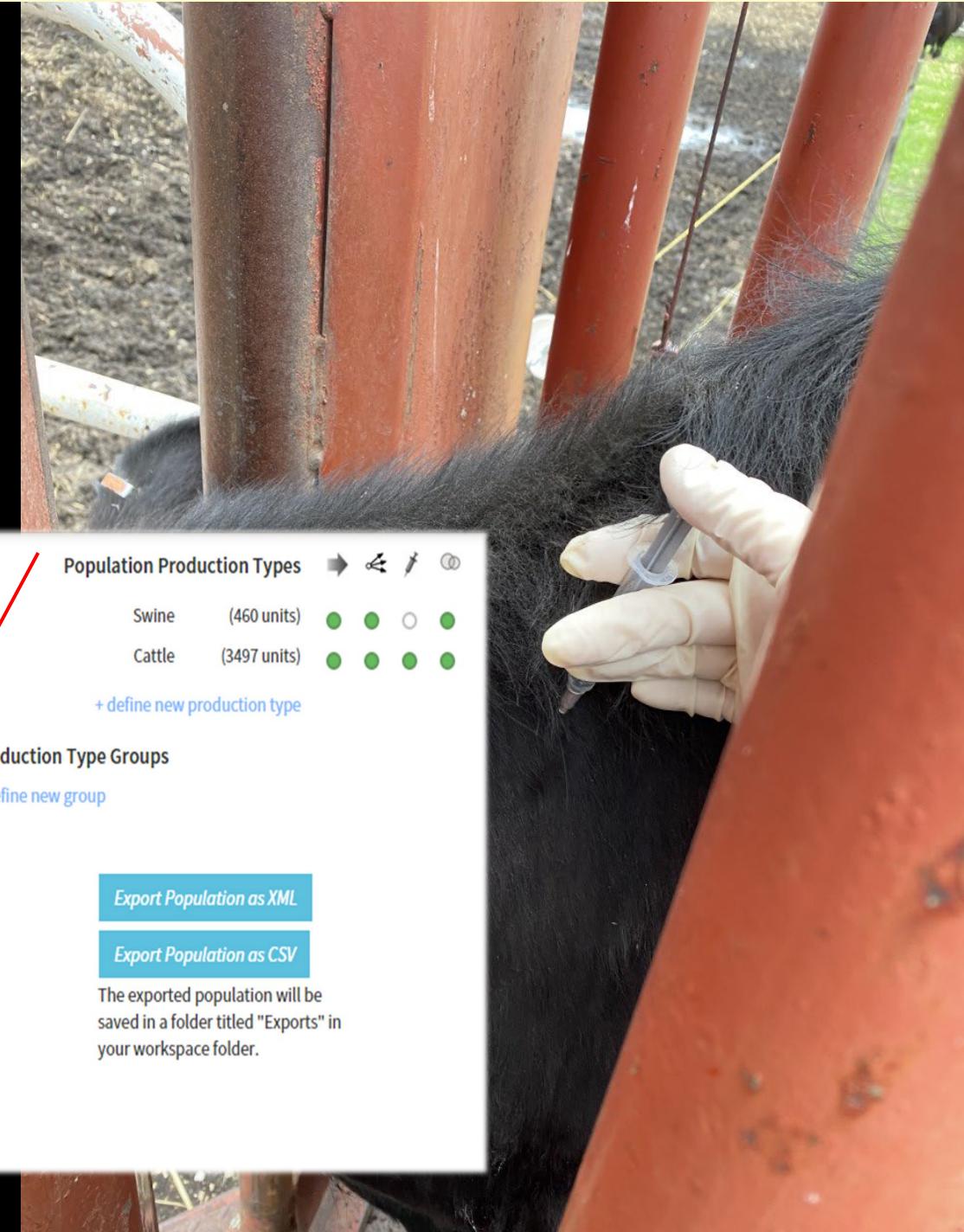
To add Production Types to this list, click in this box then click on a Type in the Population Panel

Number of units*

3

Restart only
Allows you to setup less strict criteria for restarting a vaccination program after an outbreak.

Cancel Apply



Population Production Types ✖️ ↻ ⌛ ⓘ

Swine	(460 units)	● ● ○ ●
Cattle	(3497 units)	● ● ● ●

+ define new production type

Production Type Groups

+ define new group

Export Population as XML

Export Population as CSV

The exported population will be saved in a folder titled "Exports" in your workspace folder.

Summary - Vaccination

This section has looked at parameters for vaccination at a very high level. A separate training module covers more vaccination concepts and details on how to build a vaccination strategy.

Next, we will review the parameters applied across all production types. They are called Global parameters.

Global Parameters





What does Global mean?

There are certain parameters that apply across all production types. We describe these parameters as being “Global.”



Disease
Disease Progression
Assign Progression
Disease Spread
Review Disease Spread
Controls
on
Control Protocol
Vaccination Triggers
Vaccination Rings
Vaccination Global
Destruction Global
Assign Protocols
Zones
Zone Effects
Assign Effects
Output Settings

Reason
Production Type
Days Holding
Size
Direction

Vaccination capacity

▼

Relational function used to define the daily vaccination capacity.

Restart vaccination capacity

▼

Define if the daily vaccination capacity will be different if started a second time.

Vaccinate retrospective days

Once a trigger has been activated, detected units prior to the trigger day can be retrospectively included in the vaccination strategy. This number defines how many days before the trigger to step back, and incorporate detected units.

Terminology - Global

There are two blocks of parameters that apply across all production types. The word “Global” is used to describe these parameters.

Vaccination Global
Destruction Global

Vaccination Global adds functionality to a vaccination strategy. Destruction Global adds functionality to destruction.

Disease

Disease Progression

Assign Progression

Disease Spread

Review Disease Spread

Controls

on

Control Protocol

Vaccination Triggers

Vaccination Rings

Vaccination Global

Destruction Global

Assign Protocols

Zones

Zone Effects

Assign Effects

Output Settings

Reason

Production Type

Days Holding

Size

Direction

Vaccination capacity

High vaccination capacity

Relational function used to define the daily vaccination capacity.

Restart vaccination capacity

Define if the daily vaccination capacity will be different if started a second time.

Vaccinate retrospective days

0

Once a trigger has been activated, detected units prior to the trigger day can be retrospectively included in the vaccination strategy. This number defines how many days before the trigger to step back, and incorporate detected units.

Vaccination Global

Vaccination Global allows vaccination to be *prioritized* at a primary and secondary level.

The number of vaccinations that can be accomplished in a day are driven by the capacity. The restart capacity is used with the *Stop vaccination trigger*. The concept is that vaccination would be easier to resume if resources were already in place.

Vaccinate retrospective days allows the inclusion of detections that happened before the trigger.

Additional details are provided in the VACCINATION STRATEGY module.



Destruction also has several parameters that are applied globally.

Destruction Global

Destruction Priority Order

Reason

Production Type

Time Waiting

The primary priority order for destruction.

Destruction program delay

5

The number of days that must pass after the first detection before a destruction program can begin.

Destruction capacity

Virtually unlimited capacity ▾

The relational function used to define the daily destruction capacity.

Destruction Reason Order

Detection

Trace Fwd Direct

Ring

Trace Fwd Indirect

Trace Back Direct

Trace Back Indirect

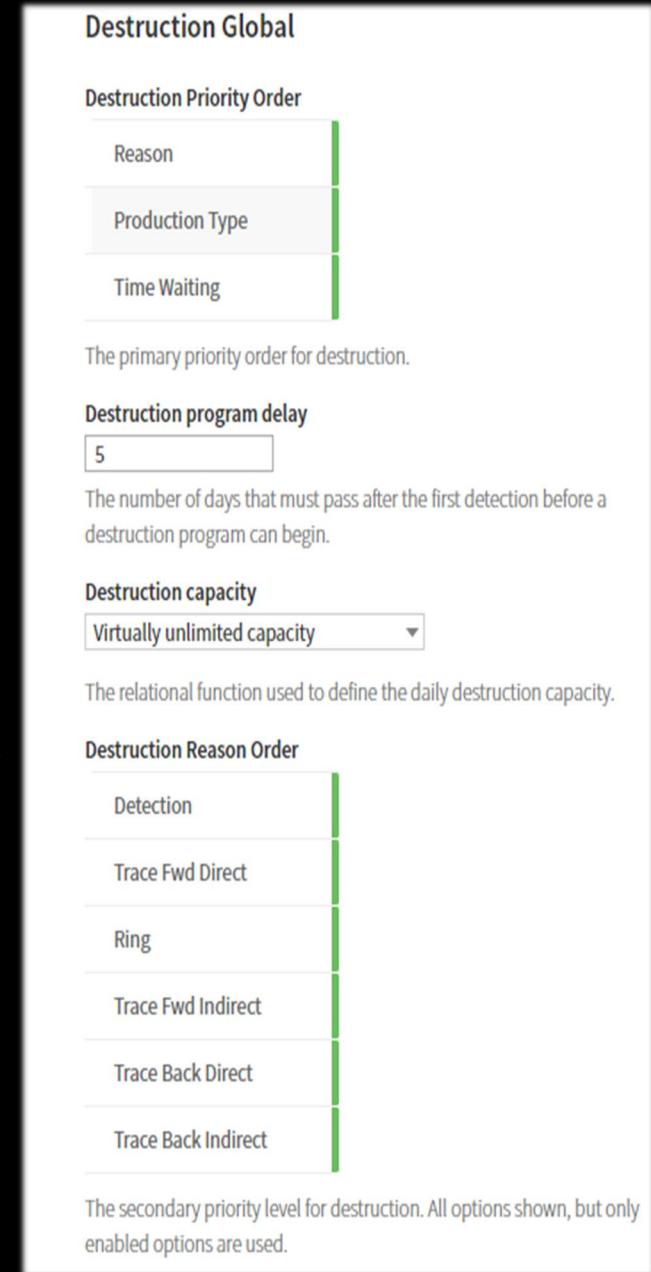
The secondary priority level for destruction. All options shown, but only enabled options are used.

The *priority order* interacts with other parameters to implement a primary and secondary sort.

The priority order *Reason* refers to the *Destruction Reason order* widget at the bottom of the form.

All the reason options are shown, regardless if used in your scenario. Recall that all the trace options are activated back in the Control Protocols tab.

On each widget, drag items to rearrange the order for your scenario.

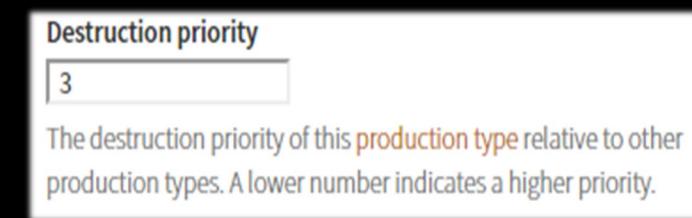


The *priority order Production Type* refers to the *Destruction priority* setting from Control Protocol > Destruction.

Primary Sort



Secondary Sort of the production types



The priority order ***Time Waiting*** refers to the number of days a unit has been in the destruction queue. The simulation will destroy those units that have been waiting the longest.

Destruction Priority Order

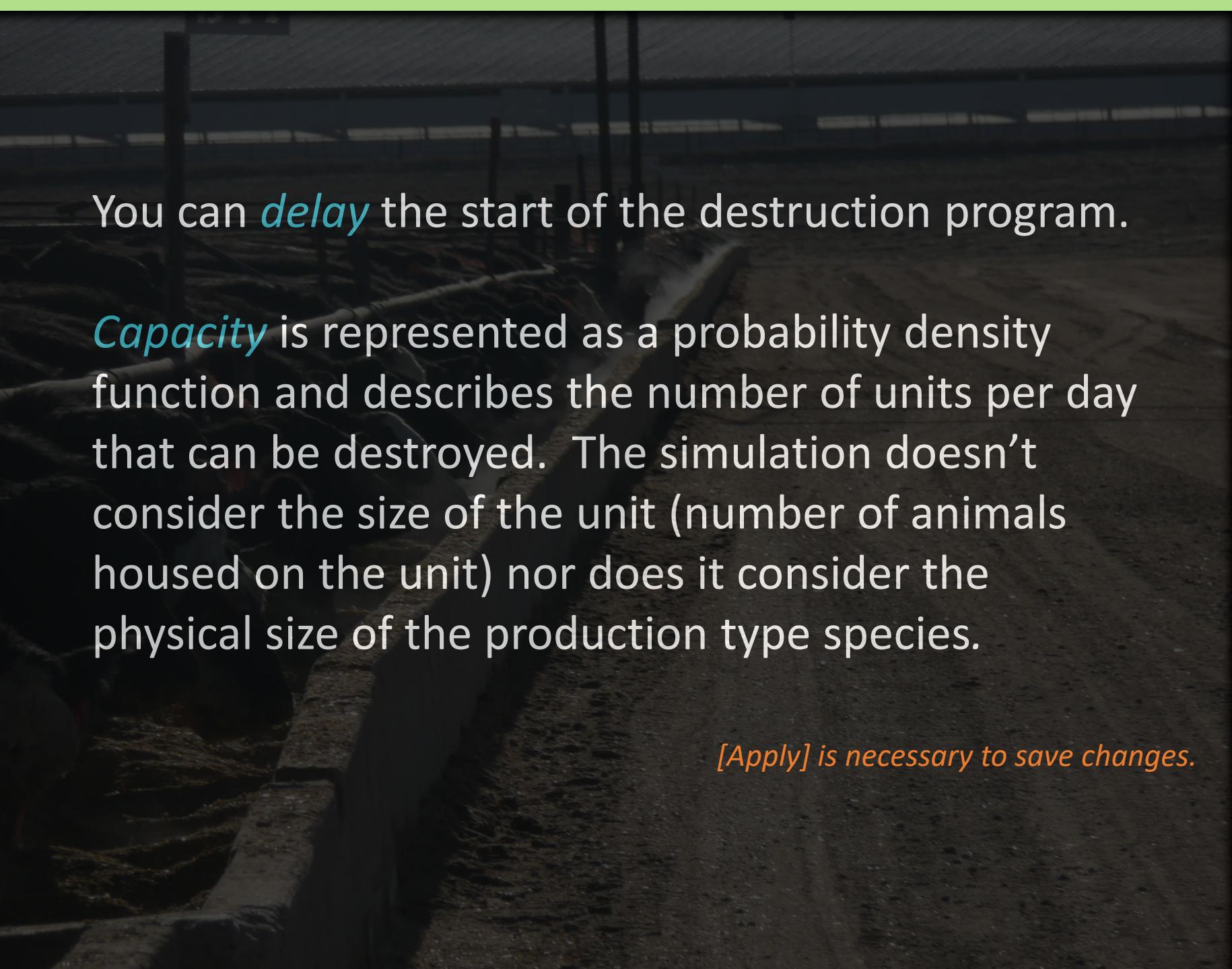
Reason

Production Type

Time Waiting

The primary priority order for destruction.

See <https://github.com/NAVADMC/ADSM/wiki/Model-Specification#destruction-capacity> for additional details.



You can *delay* the start of the destruction program.

Capacity is represented as a probability density function and describes the number of units per day that can be destroyed. The simulation doesn't consider the size of the unit (number of animals housed on the unit) nor does it consider the physical size of the production type species.

[Apply] is necessary to save changes.

Destruction Global

Destruction Priority Order

Reason

Production Type

Time Waiting

The primary priority order for destruction.

Destruction program delay

5

The number of days that must pass after the first detection before a destruction program can begin.

Destruction capacity

Virtually unlimited capacity

The relational function used to define the daily destruction capacity.

Destruction Reason Order

Detection

Trace Fwd Direct

Ring

Trace Fwd Indirect

Trace Back Direct

Trace Back Indirect

The secondary priority level for destruction. All options shown, but only enabled options are used.

Summary – Global Parameters

This section has looked at parameters that apply across all production types. This process supports destruction and the vaccination strategy after it has been started.

Zones and Zone Effects will be the next topic.

Zones and Zone Effects



Zones are areas of differing surveillance and control policies. There can be an arbitrary number of zones, each with a unique name. The basic form of a zone is a circle around a unit. Typically, higher levels of surveillance correspond to smaller circles.

Areas outside the circle also constitute a zone, with the lowest surveillance level. The outside zone uses the parameters established to describe the background zone. For example, the probability of detection in the background zone uses the probability value that was set in the Control Protocol.



Scenario Description

Population

Disease

Disease Progression

Assign Progression

Disease Spread

Review Disease Spread

Controls on

Control Protocol

Vaccination Triggers

Vaccination Rings

Vaccination Global

Destruction Global

Assign Protocols

Zones

Zone Effects

Assign Effects

Output Settings

A zone requires a descriptive *name* and a *radius*.

Create Zones

▼ Zone

- High risk: 10.0km + X
- Medium risk: 15.0km + X
- + New Zone

Name*
High risk

Description of the Zone

Radius*
10.0

Radius in kilometers of the Zone

Cancel Apply

[Apply] is necessary to save changes.

Zone Effects provide parameters to change *direct* and *indirect movements*, such as a movement standstill or a quarantine control zone.

Within the zone, the *probability of detection* can also be increased.

Zones have a specific *cost* that combines both the production type and the specific zone.

The image shows a composite scene. On the left, there's a view into a barn with several cattle in stalls. In the foreground, a white sign stands with a red octagonal 'STOP' sign graphic and the text 'DISEASE CONTROL AREA' in large letters, with 'HELP US MAINTAIN HERD HEALTH PLEASE KEEP OUT' below it. To the left of the barn, a software window titled 'Create Zone Effects' is open. It shows a tree view under 'Zone Effect' with 'Surveillance' selected. A graph titled 'Relational Probability' plots probability against Days, showing a step function starting at 0.20 and rising to 0.40. The software interface includes fields for 'Name' (Surveillance, direct movement control), 'Function that describes direct movement rate.', 'Zone indirect movement' (indirect movement control), 'Function that describes indirect movement rate.', 'Zone detection multiplier*' (4.0), 'Multiplier for the probability of observing clinical signs in units of this production type in this Zone.', 'Cost of surveillance per animal day*' (0.0200), and 'Cost of surveillance per animal per day in this Zone.'

The Assign Effects tab is used to associate the effects in the zone with both the zone and the specific production type.

Scenario Description	Assign a Control Protocol to each Production Type		
Population	Production type	Control protocol	Notes
Disease	Swine	-----	
Disease Progression	Cattle	Cattle Control	

Controls on

Assign Progression

Disease Spread

Review Disease Spread

Control Protocol

Vaccination Triggers

Vaccination Rings

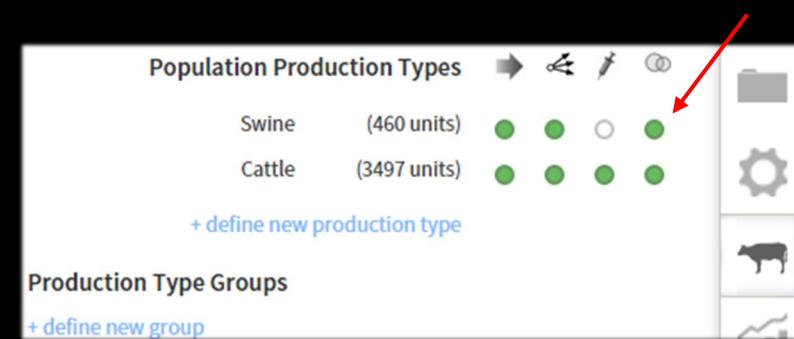
Vaccination Global

Destruction Global

Assign Protocols

The list of available Zones and production types is presented by the application. A pull-down list is provided of all Zone Effects that have been created. The dashed line (-----) indicates that no assignment has been made.

Assign Zone Effects as needed to a given production type and zone. In the Sample Scenario, all combinations are assigned to the one Zone Effect strategy. The assignment can also be seen in the Production Type panel, indicated by the colored circles.



Zones or Rings?

ADSM uses both rings and zones. They appear similar, as they are both circles with a user-defined radius. However, the action within the circle varies between the two concepts.

- Infected Zone
- High Risk Zone
- Medium Risk Zone



Zones in ADSM are circular areas created around detected, infected premises. Inside zones, more stringent controls on movements may be applied and more intensive surveillance activities may be carried out. Zones have a user-defined name that appears in outputs.

A ring is an area of action specifically for the control activities depopulation and vaccination. The ring is radial, and the user defines the radius. A ring does not get named and cannot be distinctly identified in the results outputs. Within the simulation, a ring does not act in the same way as a zone.

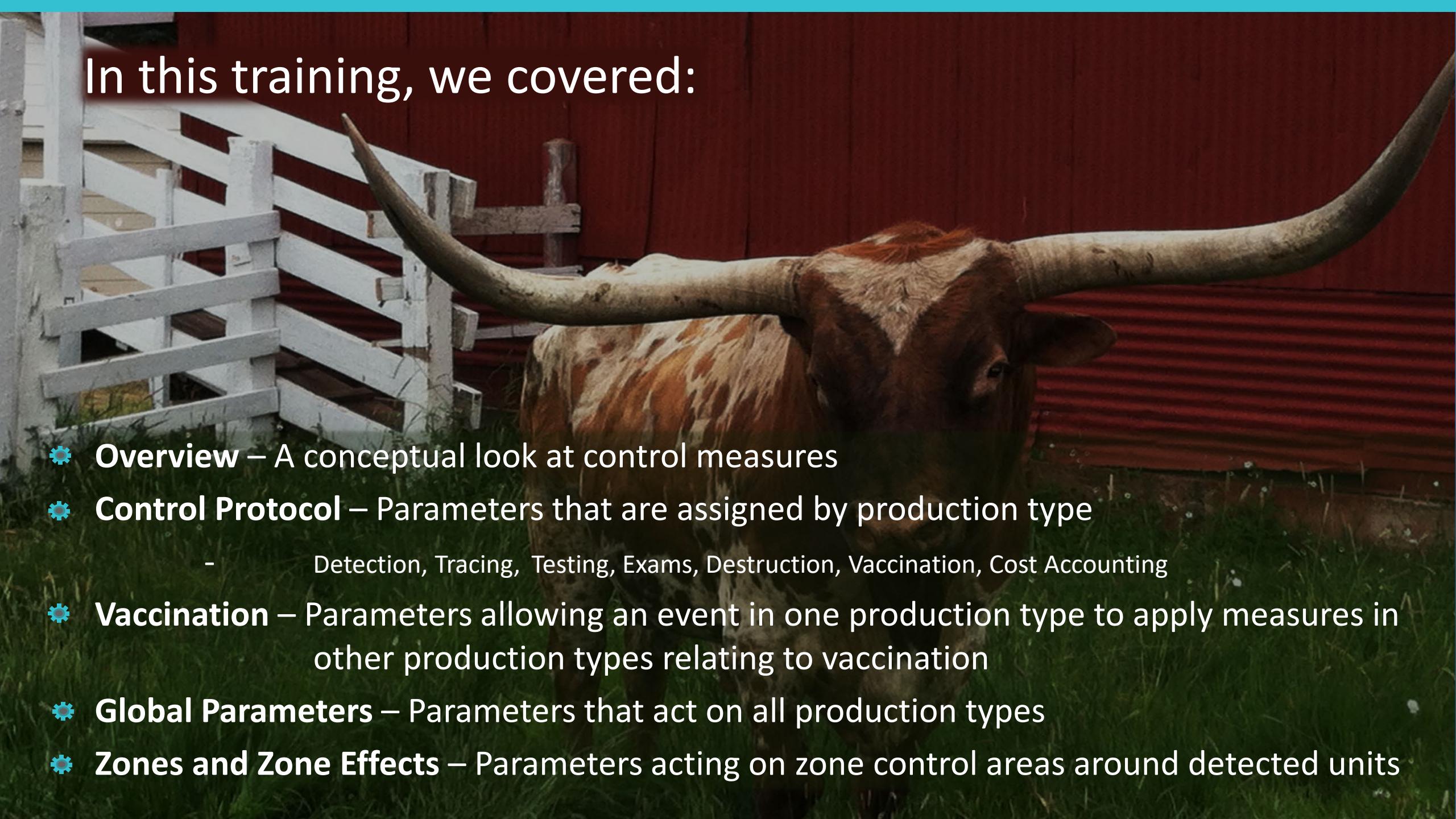
Summary – Zones and Zone Effects

This section has looked at parameters for zones and zone effects that apply to both a production type and a zone. The parameters allow us to change the actions of control measures within a given area around a detected unit.

What's Next?



In this training, we covered:

- 
- A photograph of a large brown cow with prominent, curved horns, standing behind a white wooden fence in a grassy field. The cow is facing towards the right side of the frame. The background shows a red wooden building.
- ✿ **Overview** – A conceptual look at control measures
 - ✿ **Control Protocol** – Parameters that are assigned by production type
 - Detection, Tracing, Testing, Exams, Destruction, Vaccination, Cost Accounting
 - ✿ **Vaccination** – Parameters allowing an event in one production type to apply measures in other production types relating to vaccination
 - ✿ **Global Parameters** – Parameters that act on all production types
 - ✿ **Zones and Zone Effects** – Parameters acting on zone control areas around detected units



Join the flock!

Learn more about ADSM or try an example

ADSM is currently available at <https://github.com/NAVADMC/ADSM/releases/latest>

Try the sample scenario

<https://github.com/NAVADMC/ADSM/wiki/A-Quick-Start-Guide:-Running-the-sample-scenario>

Read the wiki pages link

<https://github.com/NAVADMC/ADSM/wiki>

Additional training materials is posted at <http://navadmc.github.io/ADSM/>

Training includes:

Overview

Populations and Production Types

Getting Started

Defining Disease

Control Parameters

Output Settings and Run

Results

Detailed Evaluation of Results - Verification and Validation

Vaccination Strategy

Administration



The outcome of an ADSM simulation (as with any computer simulation model) depends heavily on the quality of the scenario input parameters; the assumptions of the modeler who created the scenario; and the capabilities and limitations of the model framework itself. The utility of disease models like those created with ADSM critically depends on input and interpretation of experts familiar with the behavior of disease within populations, and with the limitations, assumptions, and output of the model. While ADSM is available as a service to animal health communities, the ADSM team does not necessarily endorse results obtained with the ADSM application or any conclusions drawn from such results. Note that the parameters provided in the Sample Scenario are simple examples to clarify concepts in the application. These parameters do not represent any real population or disease event.



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Photo credits

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Sean Porea
Icons made by Eucalyp, Pixel Buddha from www.flaticon.com



Animal Science