

Internal biosecurity project and geofencing for infection control in swine farms

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MERCK
Animal Health

This presentation will cover the introduction to technologies that are being explored in order to help us monitor and improve biosecurity in swine farms under commercial conditions; so we can better control animal diseases.

This project is funded by Merck Animal Health, and has as a main collaborator Pig Champ Europe; which is behind the development of the technology per se.

Pathogens of importance in swine farms



Porcine Reproductive and
Respiratory Syndrome (PRRS)



Porcine Epidemic Diarrhea (PED)



Senecavirus A (SVA)

Swine sites have different rates of success in controlling/ eliminating pathogens.

Swine sites have different risks for disease introduction

Where should we focus our money/ efforts? How do we find the “smoking gun”?



We have emerging and re-emerging pathogens that have recently been an issue in pig farming. A couple examples include PRRS virus, which causes reproductive and respiratory symptoms in pigs of all ages; PED virus, which causes diarrhea and very high mortality in young piglets; and SVA virus, which resembles FMD and causes growth retardation in animals but, most importantly, triggers a foreign animal disease investigation which can be very costly.

However, what we observe as veterinarians and scientists is that farm's success in dealing with these pathogens once they get into a farm, and farm's success in keeping these pathogens out of the farms vary immensely. Identifying what make some farms more successful than others when it comes to disease prevention and control is extremely challenging under field conditions.

Internal biosecurity – how does it commonly work?

1.2	Feed	Recommended practices	Yes	No	N/A	Comments	Tools & resources
1.2.1	Is stock feed inspected on delivery to ensure it is fit for purpose (e.g. free from pest damage and visual contaminants)? If damaged or contaminated, is there a plan in place for its return or disposal?	Inspect stock feed on arrival and ensure stockfeed matches what was ordered. If stock feed is spoilt return the feed or implement a disposal plan.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<i>Introduced stock feed</i>
1.2.2	Is stock feed stored in a manner that prevents contamination by livestock, vermin, wildlife, feral and domestic animals and other feed types, e.g. those containing Restricted Animal Material (RAM)?	Segregate RAM products from non-RAM products to minimise accidental feeding.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<i>Ruminant feed ban producer checklist</i>
2	PEOPLE, VEHICLES AND EQUIPMENT	Recommended practices	Yes	No	N/A	Comments	Tools & resources
2.1	Are there strategies in place to minimise the risk of disease incursion onto the property by visitors or machinery?	Where reasonable and practical, control people, equipment and vehicles entering the property (e.g. reduce the number of entry points). Provide entry signage such as farm biosecurity signs, or directions to office/house for sign-in. Maintain a visitor log of people in regular contact with farm animals (contractors, shearers, vets, stock agents). Use own vehicle to transport contractors and visitors rather than their	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<i>Visitor log</i> <i>Farm biosecurity sign</i> <i>Come clean go clean factsheet</i>

Example of an on-farm biosecurity plan template- Livestock Production Assurance (LPA) Program

**Biosecurity plans
Training of employees
How do we measure it?**



Internal biosecurity refers to measures that occur inside the farm in order to minimize or preferentially stop the spread of diseases and, therefore, keep animals healthy.

What do we currently do in regards to internal biosecurity? Farmers usually work with their veterinarians to come up with biosecurity plans, which have the main objective of addressing different areas that may affect pathogen spread to or inside a farm. This is showing in this Figure, where aspects such as feed delivery process and protocols for visitors, vehicles and equipment, are discussed.

Some farms also provide training sessions for their employees, but these efforts really vary from farm to farm. How to “measure” biosecurity is a challenge, and we usually do it through audits, but this is not usually a consistent or frequent way of measuring biosecurity and its change over time.

Internal biosecurity – how can we innovate?

We can measure and describe internal movements inside swine farms:

- Optimize internet services
- Install “devices” in main rooms/ doors
- “Beacons” individually distributed to farm personnel
- Bluetooth connection and real-time updates



Pictures courtesy of PigChamp Pro Europa



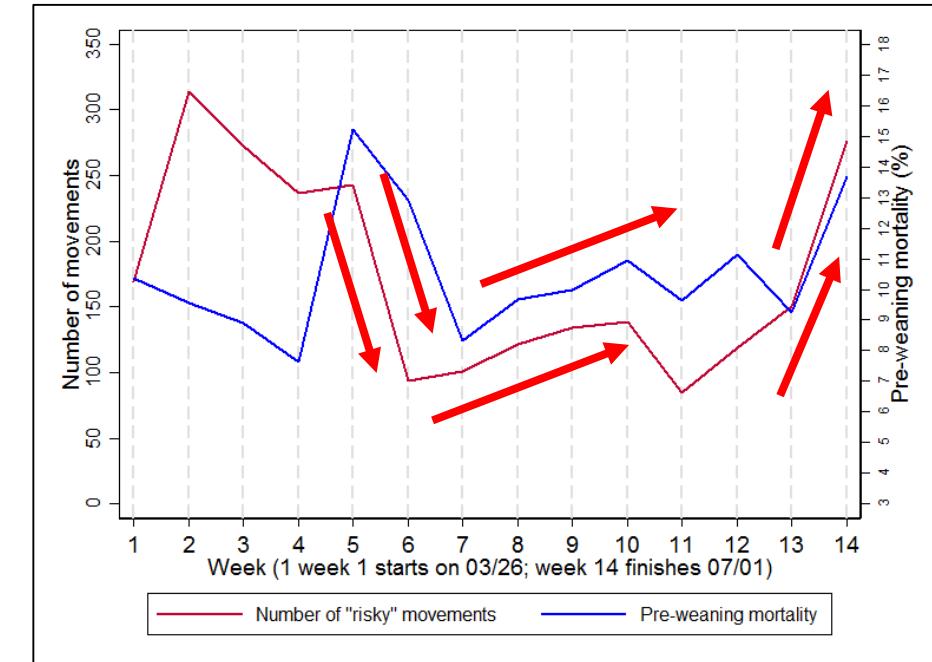
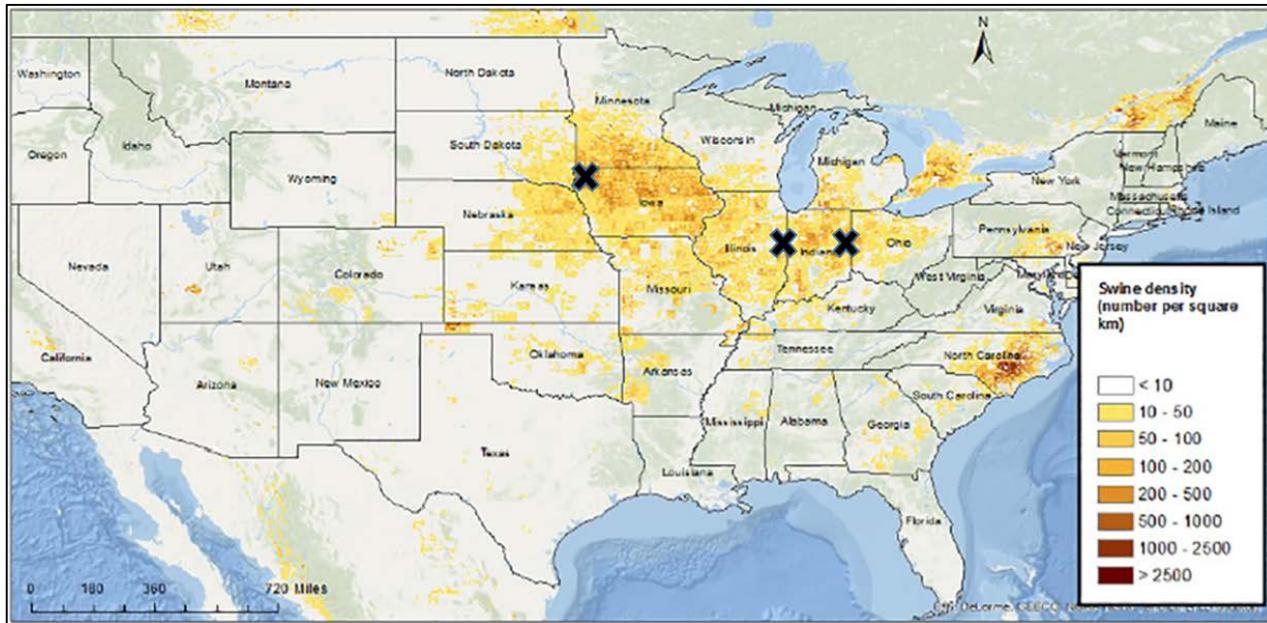
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Over the past year, OSU has been working with collaborators at Merck and PigChamp to test a novel system in many countries around the globe, including Asia, the Americas, and Europe. We have enrolled three farms in the USA to participate in this project, and we installed the system; which included making sure the whole farm was “online” (i.e. had internet connection), had Bluetooth-enabled devices on the wall as shown in this bottom picture on the left; and we distributed small beacons to each one of the farm employees; these beacons are shown in the picture on the right. We refer to this system as B-eSecure.

The way the system works is that, every time a worker carrying a beacon comes close to one of the wall devices, these two devices communicate via Bluetooth and a signal is sent to our central database and registers a movement.

Internal biosecurity – how can we learn?

Is an increase in “risky” movements associated with production parameters of interest (e.g. pre-weaning mortality)?



Yes- an increase in “risky” movements in a previous week increased pre-weaning mortality in a current week by approximately 3%.



Once we collected movement data, we were able to ask the question: "If we have an increase in risky movements inside my farm, does that impact my farm's production?"

To examine this question, we selected **pre-weaning mortality** (i.e. percentage of born piglets that die before weaning) as our parameter of interest. As expected, the lower this parameter, the better the farm's production. What we saw was that an increase in risky movements in a previous week increased pre-weaning mortality in a current week by approximately 3%. In the graph we can see the blue line which represents pre-weaning mortality and the red line which represents the number of risky movements – the red arrows show that in several occasions throughout the examined period, once the number of risky movements goes down, mortality appears to be reduced following that; while when one goes up (increase in risky movements), the other one tends to go up as well (increase in mortality)

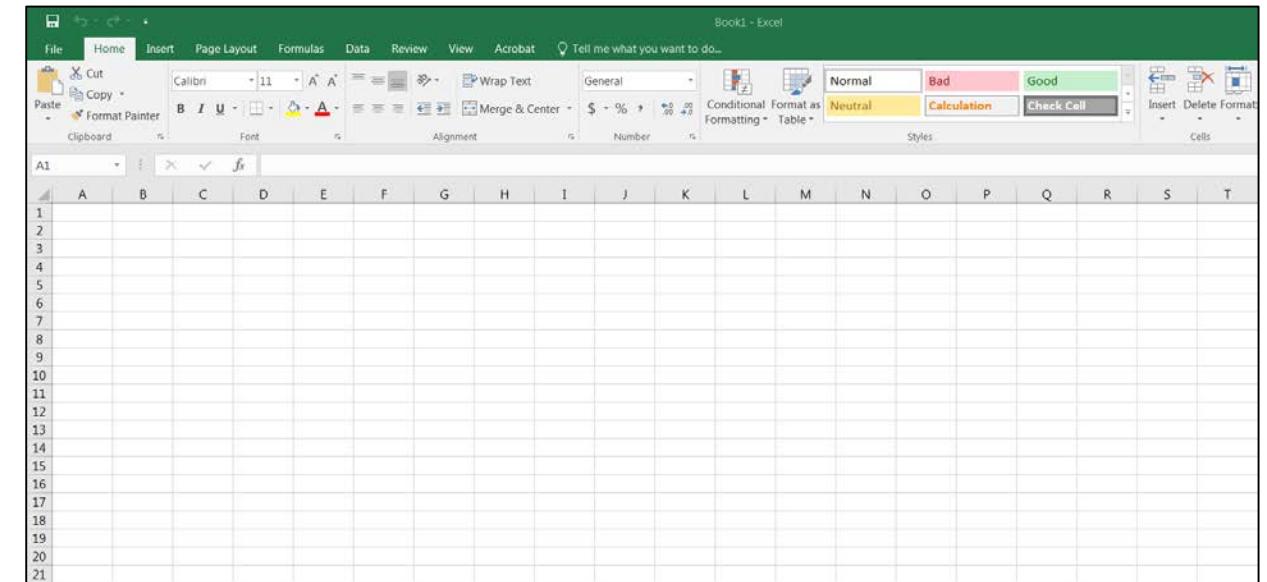
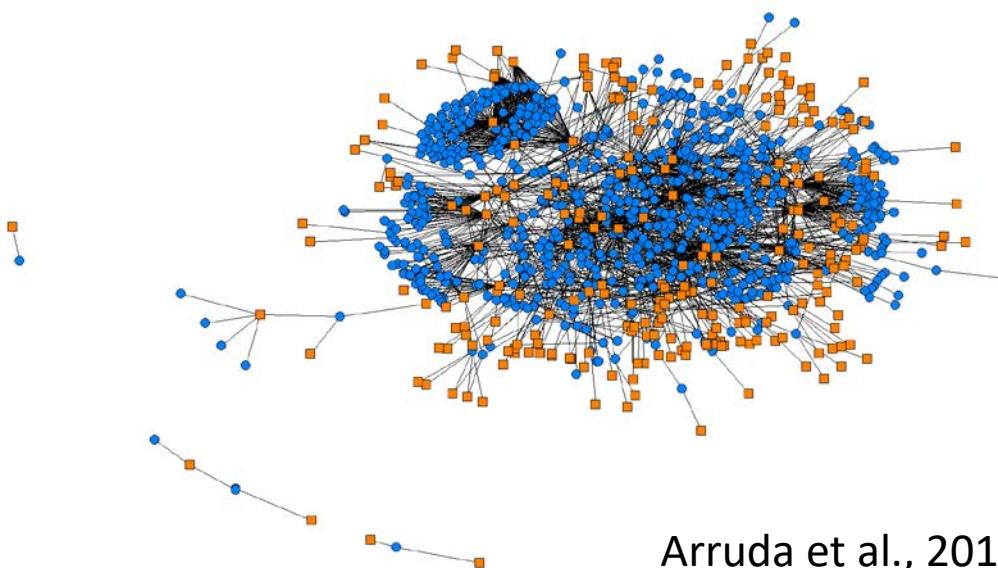
These preliminary results indicate that this technology allows us to measure the amount of risky movements within a given week, relate that to parameters of interest for farmers and consumers, and work towards reduction of risky movements and improvement of animal health in an informed manner.

External biosecurity – how does it commonly work?

Swine sites are indirectly connected via truck, feed, gilt, semen, boar networks

How much “connectedness”? ~ 94%.

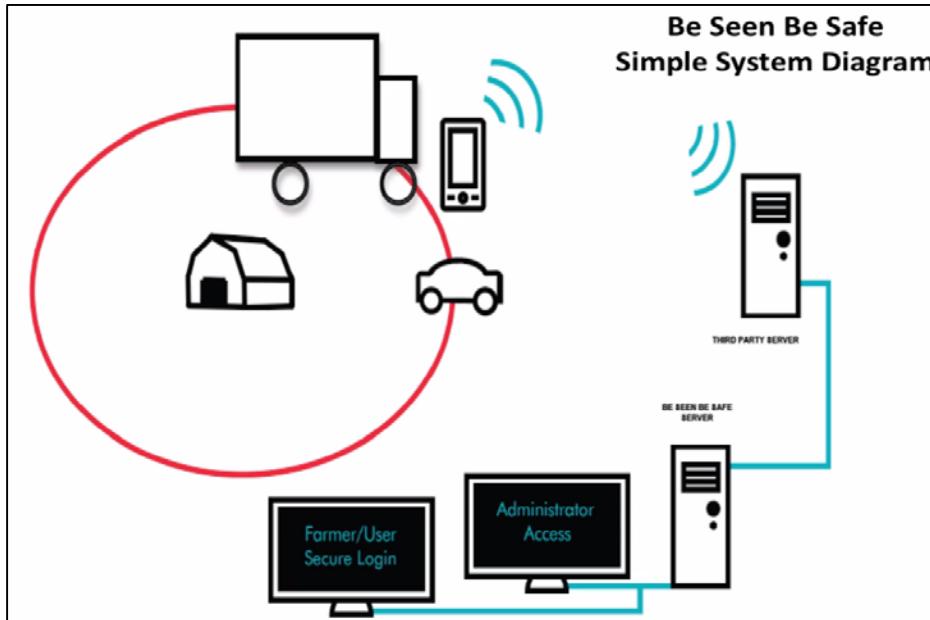
How do we measure it? How do we “keep track” of it?



External biosecurity is used to refer to actions we do to try and keep pathogens outside of farms. We know that farms are highly connected, for example they share transportation for animals, feed, they also share semen, boar, and gilt sources to name a few. This connectedness has shown to be really high in North America, approaching 94% for swine sites located in a province of Ontario, Canada; which means that over 90% of farms in a given region indirectly share one or more of these mentioned connections – which could potentially serve as a way of spreading pathogens. You can have an idea of this connectivity by looking at the picture on the left- each blue point represents a farm, each orange point represents a service provider, and the lines represent potential connections between them.

The challenge is to once more measure how these connections are happening, and how to detect them when needed, for example in cases we could face the incursion of a new disease in a naïve population. Nowadays, production systems are using their own way of recording, for example Excel-based spreadsheets as shown on the bottom of the slide – but these are not consistent throughout the industry, and are most times not readily informative or complete.

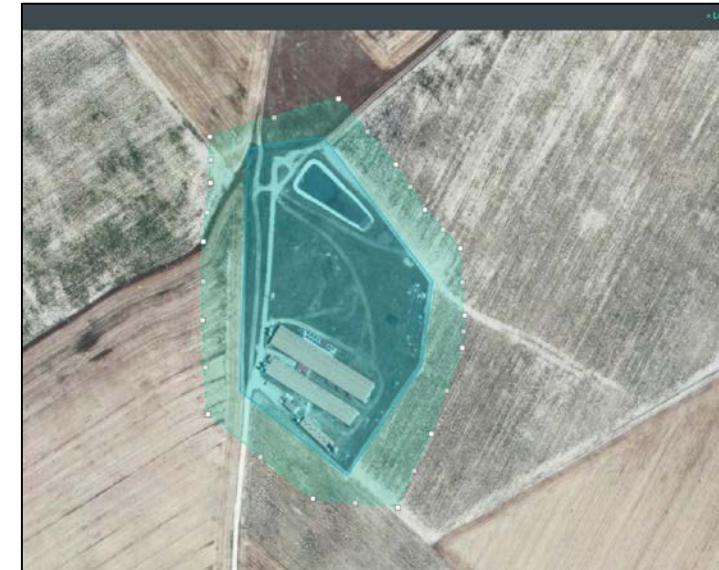
External biosecurity – how can we innovate?



Information provided by Tim Nelson

Are certain movements associated with higher chances of a site having an outbreak?

Which sites should be quarantined/ tested?



A screenshot of the 'PigChamp Pro' software interface. On the left, there's a sidebar with options like 'Vista General', 'Directorio de propiedades', 'Crear libro de visitas', 'Envío de mensajes', 'Simular el brote' (which is highlighted in blue), 'Directorio de usuarios', and 'Configuración de la cuenta'. The main area is titled 'Crear Simulación de Brote' and contains three steps: 'INFECTION DATE: 18/03/2017', 'INCUBATION PERIOD: 5', and 'STEP 3: Please select the property on which the disease was reported'. To the right is a map of a region in Spain, specifically Segovia, with several locations marked with orange pins. A search table at the bottom lists properties: Gilsampa (Propietario(s) Feb 17, 2017), Avícola Subirats, and Porcináguila - pollos (Propietario(s) Mar 17, 2017).



Along those lines and in an effort to understand and inform external movements between farms, the second technology we are testing in our pilot study is called ‘geofencing’. Basically, when “geofencing”, we put a virtual barrier around properties of interest, and we enable devices to be detected as people or vehicles come in and out of the geofenced properties.

The figure on the left shows how the system works- the red circle represents a geofenced area, and as a vehicle with a person carrying an enabled cell phone crosses this barrier, a signal is sent to a central database in which this visit will be registered. An aerial photograph is shown on the top right picture as to how this geofence looks like in a fictitious participating farm.

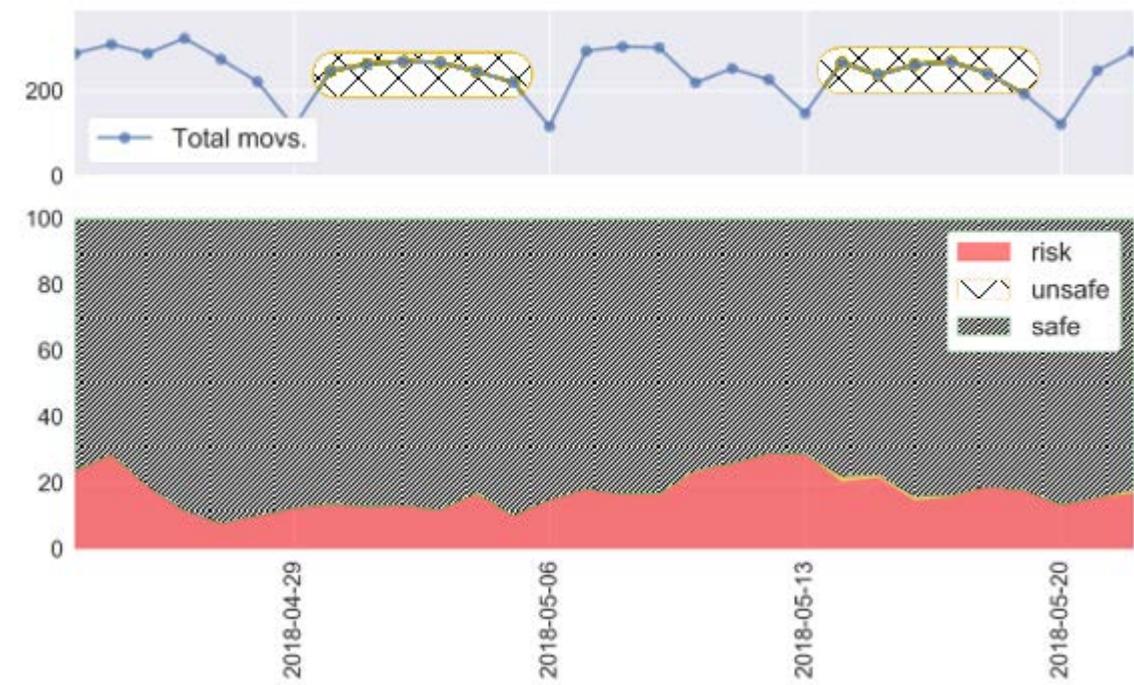
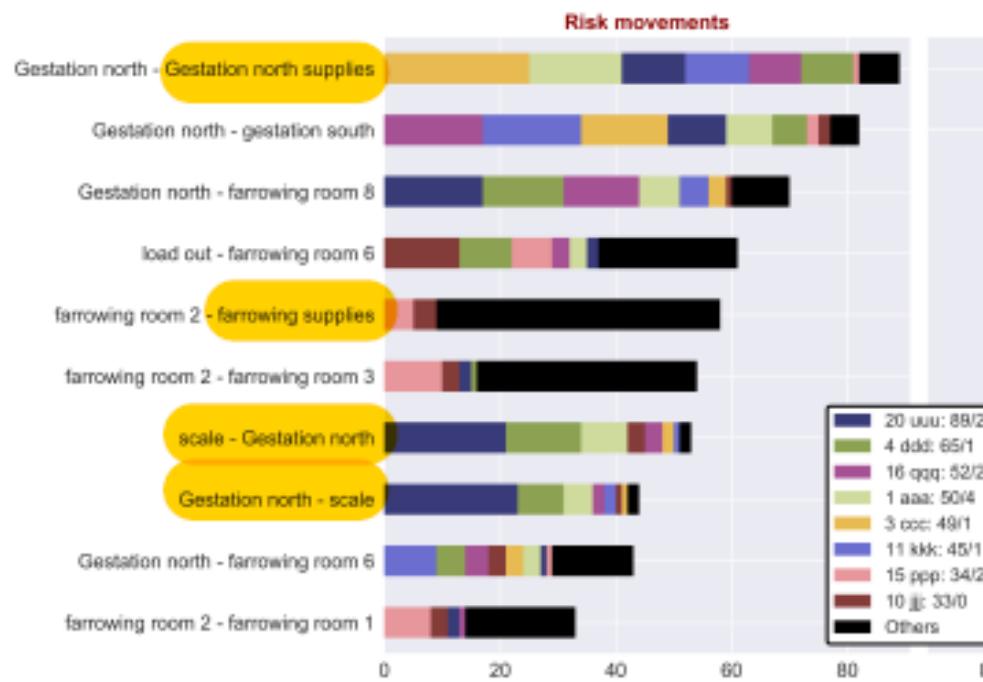
This system allows for generation of a list of past visited sites, which can be instrumental upon detection of an emerging pathogen, allowing for timely informed decisions on which further sites should be tested or quarantined in a timely manner. The bottom right figure shows how the interface with this database look like, with farms represented in a map, and possible queries that could be done to generate lists of interest for the visits.

Technologies – how can we bring short-term value to facilitate uptake?

Better understanding on frequency of “risky” avoidable movements

Evolution of “risky” movements over time

Better understanding system flow and easier “flagging” of “risky” movements



Now, implementation of these systems can be difficult, at times simply because they are new. An important part of our project has been to investigate how these systems can provide short-term value to veterinarians and producers, who will be using this data during their routine lives.

A few immediate uses include that people have a better understanding on the amount and type of risky movements inside their properties, so they can act upon them, implement and measure improvements over time – this is shown in the figure on the right, where the percentage of risky movements is shown in red over time. The figure on the left shows the number of risk movements by type. For example, for this farm, we were able to “flag” that movements from virus positive rooms (infected) to supply rooms (rooms where general farm supplies are located) were happening, followed by movements from this supply room to negative areas of the farm. This can be a problem because the commingling of workers in these locations can spread pathogens by fomites (e.g. boots or coveralls).

Take-home messages

The use of new “tracking systems” is doable under commercial conditions in U.S. swine farms

These technology are not disease-dependent and may help with better understanding the epidemiology of emerging and endemic diseases in livestock production



We are approaching one year of testing these technologies in US conditions, and so far our main take home messages are:

- 1) this is doable in the sense of technicalities (e.g. getting internet connection throughout farms in relatively remote locations) and logistic aspects; and
- 2) we learnt very fast that we do not need to focus on a specific disease or pathogen to benefit from the use of these systems, as we saw by looking at production parameters.

Acknowledgements



Participating swine veterinarians

Participating swine producers

