Proceedings
of the

21st LONDON SWINE CONFERENCE

March 28-29, 2023

London, Ontario

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PROCEEDINGS

of the

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Edited by

J.H. Smith

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CHAIR'S MESSAGE

Benjamin Franklin once said, "Tell me and I forget, teach me and I may remember, involve me and I learn." That sums up the intent of the London Swine conference program. After what seems like a long pause, we are here today, in person, to learn about the things that are affecting our business now and in the future.

One thing I have learned over the years, that we can't do this on our own. We're fortunate in the swine industry to be supported by a wide range of experts who are dedicated to helping us reach our next level. As a committee, we have pulled a number of them together for this year's London Swine Conference, and I hope you're as excited as I am about the opportunity to learn from them.

Over the next two days, we'll discuss market uncertainty, economic outlook, new technologies, explore changing farm practices and planning for the future of your business. I urge you to participate in our main sessions as well as a wide range of workshops — both are a chance to learn from informative speakers as well as from each other. Take advantage of the peer-to-peer learning in these sessions and during networking breaks. For more peer-to-peer learning, be sure to visit the hospitality suite at the end of an information-packed day.

I would like to thank the London Swine Conference committee. It is a please working with all of you these last 15 years. The quality of this conference speaks volumes to your expertise and dedication. Thanks, too, to all of those attending the conference, and for the work you do to help grow high-quality, great-tasting and safe food for the world.

Greg Simpson

Steering Committee • 2023 London Swine Conference

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Program Development

We greatly appreciate the ideas and input from the many industry participants who attended the program development meeting on April 27th, 2022, or sent ideas and suggestions directly to the planning committee.

thank you!

LSC
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Thank you to all our sponsors and participants for investing in the future of our industry by supporting the London Swine Conference.
We look forward to seeing you again in 2024!
- The London Swine Conference Organizing Committee

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Day 1: Main Sessions

ONE HEALTH – A WIN-WIN FOR PIGS PRODUCERS AND THE PUBLIC

The CFM DE LANGE Lecture

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ABSTRACT

The health of animals, people, plants, and the environment are interdependent. Finding solution for complex health problems at this juncture requires a One Health approach. The approach enables community members, multiple disciplines, governments, and non-governmental organizations to work together. Examples of complex health issues include pandemics, climate change, exotic diseases in livestock, antimicrobial resistance, and food and waterborne illnesses. The discussion of pandemics, neglected tropical diseases, outbreaks of exotic livestock diseases and the relationship between food choices and climate change will illustrate how a One Health approach has not worked in the past but how it can work in the future.

ONE HEALTH DEFINITION

One Health is a collaborative effort of multiple disciplines working together to solve complex health problems ultimately reaching optimal health for people, animals, plants and the environment while incorporating the culture and perspectives of all of the people in the community. Thinking about One Health from the perspective of pigs and pork, the 'people in the community' include all of the participants in the pork value chain, from farmers who produce breeding stock, piglets, finisher pigs, those who produce pig feed, the neighbours of those farmers, the trucker, the abattoir, where the pork is sold, the consumer and the allied industry personnel, the veterinarian, those who produce vaccinations, and the government who impose regulations, and the export marketing chain and likely many more that I am not considering. We also need to include the environment, as we know, humans and animals impact the environment and in turn, the environment impacts our health and wellbeing.

The definition developed by an international expert panel by the World Health Organization, World Organization for Animal Health (formally OIE), UN Food and Agriculture organizations, and UN Environment Program is as follows: One health is an integrated, unifying approach that aims to sustainably balance and optimize the health of people, animals and ecosystems. Recognizing the health of humans, domestic and wild animals, plants, and the wider environment (including ecosystems) are closely linked and inter-dependent (WHO(b)).

A zoonotic disease is one that spreads from animals to people. Some of these such as Salmonella and E.coli, we acquire through food – causing food borne illness. Approximately 70% of new and emerging diseases in people come from animals – so there is a concern about the next new disease. Viruses like corona and influenza viruses happily grow in both

animals and people. Today, through air travel we can be in another part of the world in just a few hours – carrying viral diseases from one continent to another.

An endemic disease situation is one where we see the 'typical' amount of disease over a specific time period in a specific geographic region. You might consider a certain amount of piglet diarrhea on the farm to be typical – or endemic. In most years, we can say the same about the common cold. An epidemic disease situation is when we have more disease that would be expected over a certain time period in a place. The numbers of children with severe respiratory disease this past fall was higher than normal in Ontario so that would be considered an epidemic. A pandemic is when we have epidemics of the same disease occurring in multiple countries around the world at the same time. Two recent pandemics are the 2009 H1N1 Influenza pandemic and the SARS-CoV-2 or COVID pandemic.

EXAMPLES OF COMPLEX ONE HEALTH PROBLEMS

H1N1 Influenza Pandemic 2009

You will remember the 2009 Pandemic H1N1 influenza virus first identified in Mexico, that the CDC called Swine Influenza H1N1. This was a complex, human health problem. It was a disease that could be transmitted between humans and animals. This is an example of where a One Health approach was not used and resulted in a devastating effect. This variant caused illness in young people and spread to multiple countries. Within a month, the virus was found on a pig farm in Alberta. The source of the virus was a farm worker who had recently returned from vacation in Mexico. Sixteen countries stopped importing Canadian pigs and pork.

This was a triple reassortment virus – with parts of the virus sequence from people, birds and pigs. What we know about the virus is that it came from people and spread from person to person and from people to pigs but not from pigs to people. While we often talk of zoonotic diseases moving from animals to people, this went in the other direction. I want to illustrate the impact of bad communication on the Canadian swine industry. The name Swine Flu caused the public to be afraid of pigs and pork. When an official from the WHO announced that the virus could survive freezing in pork – this was a communications disaster. As a swine veterinarian, I know that influenza viruses stay in the upper respiratory tract of pigs and do not travel to the muscle. Further, while many media outlets stopped calling the virus swine flu and referred to it as the Novel H1N1 or pandemic H1N1, – CBC refused to change- even after I asked.

The 3 billion dollar pork export market was hit, prices for market hogs dropped below what it cost to raise a pig, without an export market, abattoirs bought few pigs, farmers had to culls pigs due to overcrowding and welfare concerns, and pig farmers lost their farms, the numbers of farms and pigs in Canada dropped dramatically. This example shows the importance of all of us working together, across disciplines of health, agriculture, and social sciences, understanding social determinants of health and the role of communications. And most importantly, we must work directly with farmers and allied industries to understand how they are being affected and to determine how to engage them as part of the solution. We also need to reach out to our consumers to maintain the strength of our agriculture industries.

Epilepsy Caused by *Taenia solium* – the Pork Tapeworm

This second case is far from home – but illustrates a One Health project with measurable outcomes. The project would not have been possible without a significant contribution by Dr. Kees de Lange.

Between 2006 and 2018, I worked on a One Health research project in Kenya and Uganda. The aim of my research was to reduce epilepsy in people caused by a human tapeworm *Taenia solium.* According to the World Health Organization, *T. solium*, the pork tapeworm is the most frequent preventable cause of epilepsy in world. In high-risk communities, it causes 70% of all cases of epilepsy. More than 80% of the world's 50 million people who are affected by epilepsy live in low and lower-middle income countries (Africa, Asia, Latin America). WHO Foodborne Disease Burden Epidemiology Reference Group: *T. solium* is a leading cause of deaths from food-borne diseases. The WHO states that prevention requires veterinary health + human health + environmental sectors- I would add it requires the entire pig/pork value chain – from pig farmer, to butcher, to consumer (WHO(c)).

The tapeworm sheds eggs in human stool which are eaten by pigs, in areas where pigs are allowed to roam and scavenge, particularly where the small holder farmers do not have money to buy pig food and they do not have access to running water or toilets. The eggs migrate to the muscle of the pigs where they hatch into larva. People who eat undercooked pork containing the larva become infected with the tape worm.

When a person inadvertently eats a microscopic tapeworm egg, it travels to the brain and develops into larval cysts. This then causes epilepsy. To begin the research we conducted focus group discussions with farmers, buthermen, and local and provincial government personnel in agriculture, veterinary medicine and public health (Mutua et al., 211a). We asked everyone about their challenges. Farmers' concerns were that they could not afford to buy commercial pig ration, were not sure what to feed a pig, did not know how or when to breed the sow and keep piglets alive, did not think they received enough money from the butcherman when the pig was sold, did not know what the pig weighed, and had trouble with their neighbours who did not like their pig. Butchermen wanted larger, healthier pigs, had to close their business in January because they could not pay for the business and health licenses, lost money on some of the pigs they bought, and could not always afford to get the pig carcass inspected (Levy et al., 2013; Levy et al., 2014a). The government staff wanted all carcasses to be inspected and they wanted knowledge to help support the farmers.

We developed a system to estimate pig weight with a tape measure (Mutua et al., 2011b), and developed complete feeds from locally available feed stuff (Carter et al., 2015a, 2015b), we taught butchermen about business recording and accounting (Dewey et al., 2011), and taught everyone about how to prevent human epilepsy due to *T. solium* by confining the pig, inspecting the carcass, and cooking pork well. We encouraged farmers to breed their sows twice during estrus and to keep the sows for more than one litter (Mutua et al., 2011c), to keep newborn pigs dry and warm, and we discussed pig diseases, biosecurity and parasites. We taught the government extension officers who taught the farmers. Engaging the whole community we were able to effect change (Wohlgemut et al., 2010). In 2010 farmers, butchers and consumers had changed their behaviour.

We still had a problem. The local pigs were only growing at 130 gm/day (Carter et al., 2017b). Farmers were willing to keep their pigs confined but they needed to know what to feed the pigs to meet their nutrient requirements. Dr. Kees de Lange was key to our success. He helped us to conduct nutrient analyses many weeds, freely available food stuffs, such as banana leaves, and other human food that was available to build a complete ration (Carter et al., 2016). He and Dr. Natalie Carter created complete feeds based on the time of year when various foods were available. Then Natalie conducted a 6-month feed trial beginning with piglets born on local small holder pig farms (Carter et al., 2018). The results showed that pigs grew slowly on the home-made diet from 8 – 18 weeks of age. They did much better on the commercial ration. It would cost a farmer about $5 in commercial ration for the first 10 weeks after weaning. Once the pig reached 12 kg, at about 18 weeks of age, the pigs grew well on this homemade diet. The ADG was 310 kg/day and this diet costs $0.70 to $1.63 per kg weight gain. Women raise the pigs and in Kenya keep most of the money from the sale of the pig. For them, it was worth the extra time and effort to gather the raw materials and make the diet for the pigs. In Uganda, in male-headed households, the money from the sale of the pig went to the man. Those women did not want the extra labour of making homemade diets for their pigs. However, the women in women headed households chose to use the homemade diets (Carter et al., 2017a). Dr. Carter was very grateful to Dr. Kees de Lange for teaching her how to analyse nutrient information to build a complete ration. We were very grateful that Kees took an interest in the project and helped us so very much.

PANDEMICS

Let's think about the SARS cov-2, covid pandemic. How did it all begin? We are certain it came from wildlife but which one. Pork is the meat of choice in China – China has more than half of the world's pigs. But African Swine Fever ravaged the pig population. There was a severe shortage of pork. The people turned to meat from wild animals. Scientists obtained samples from local wildlife. Pangolins – an anteater – carried a coronavirus that was almost identical to the original coronavirus that started the COVID pandemic. There is no record of pangolins being sold in the market in that area of China where the pandemic began– but pangolins are an endangered species. People who kill and sell pangolins can be sent to jail for 10 years. Interestingly, the scales and the meat of pangolins are used for Chinese medicine – so perhaps they were being sold secretly – we cannot rule them out. The Horseshoe bats also carry a similar coronavirus to that of the virus that started the pandemic. These bats are eaten but they also scavenge at the markets so could easily have spread the virus to other animals being sold at the market such as the civet cat. These animals are part of the mongoose family and we know that they can harbour the coronavirus and are a meat of choice at the market (Lytras et al., 2021). This is a complex web of domestic animal disease, leading to consumption of wild animals, Chinese medicine and wildlife – leading to a spill over event – where there was transmission of a zoonotic disease from wild animals to people.

ENVIRONMENT – THE THIRD ARM OF ONE HEALTH

Farmland in Ontario

Southern Ontario has the most fertile land in all of Canada and it is also where people choose to live. Only 5% of Ontario's land is arable – so we do not have an unlimited supply. We have all heard about the housing shortage – and regardless of your politics – there is a conflict between housing and the green belt that is serious. The Ontario Federation of Agriculture's website provides startling statistics (ofa.ca). Ontario is losing 319 acres of farmland Every Day!! In the 1980's we had more than 15 million acres of farmland, today it is 11.7 million acres. Agriculture contributes $47 Billion dollars to the provincial economy but the agriculture workers represent only 1% of the population. We need the general public to add voice to the call to action. To solve the housing crisis, we need to build up not out, we need to build on land that is not arable.

Farms and Biodiversity

We can only feed the world with large farms. On average, Canadians consumed 9.2 kg of apples, 15.9 kg of pork, and 242 eggs in 2021 (agriculture.canada.ca). Consumption of meat is expected to grow by 2.7% between 2022 and 2026 to reach 2.6 million tonnes. In 2026, pork sales are expected to be 752.9 thousand tonnes. Corn and soybeans are grown to feed livestock. These mono-cultures of crop land have reduced the biodiversity of birds and insects. Alternative Land Use Services (ALUS) is a Toronto based charity aiming to create farmer-delivered programs that produces, enhances and maintains ecosystem services on agricultural land. Farms across Canada have completed projects for wetland restoration, riparian buffers, shelterbelts and forestation that all lead to enhanced habitat, cleaner water and air, carbon sequestration and climate resiliency. These farmers sustain agriculture and build nature-based solutions on their land. Research by Dr. Amy Newman and others at the University of Guelph have measured increases in song birds, insects, acres of pollinator habitat, mammals, native plant trees and shrubs and soil microorganisms where farmers give a portion of their fields back to nature. https://alus.ca/communities/

CLIMATE CHANGE

Climate change is causing forest fires and extreme weather events such as floods and droughts. Warming weather has resulted in the spread of vector borne diseases in Canada and other parts of the world. A common example is the movement of the black legged tick into Ontario that has spread lyme disease to people and dogs, rodents and deer. Another is West Nile virus.

Japanese Encephalitis Virus

March 2022 headlines from The Guardian in Australia 'The mosquito-borne virus has been found in dozens of piggeries and human cases have emerged'. By then, Japanese Encephalitis Virus was in pigs in Victoria, New South Wales, Queensland and South Australia. Excessive rains enabled water birds to migrate farther south into Australia than normal. Mosquitoes can pick up the virus from water birds for 7 days and from pigs for 4 days. Warmer conditions around the globe are leading to an expansion of mosquitoes from

tropical climates into temperate climate zones. Mosquitoes also multiply well in wet weather. (The Gardian, 2022)

Japanese encephalitis virus (JEV) is spread by mosquitoes and causes disease in pigs and people. The mosquito has to bite an infected water bird or pig to transmit the disease to a person. This virus is endemic in many South-East Asian and Western Pacific countries causing about 68,000 cases of encephalitis humans each year. Of these cases, about 30% of people will die and up to 50% will have permanent neurological problems. There are safe and effective vaccines for people but not for pigs. (WHO(a)).

In pigs, JEV causes abortion, stillbirths, mummified pigs and piglet abnormalities depending on the time of gestation when the sow is infected. In some farms, 60% - 80% of production was affected. This has a mental health impact on people, dealing with dead piglets every day. Currently there is not a vaccine for pigs. (ABC rural, 2022)

Climate Change and Us – Buy Local

In this section, I am likely preaching to the converted but perhaps we can all make small differences to help the environment. In 2007 in the United States it was estimated that each person was consuming 1500 litres of oil per year in their food. Twenty percent of this includes equipment like tractors and combines, inputs such as synthetic fertilizers, pesticides and herbicides with oil and gas as the building block. There is more used drying, milling, cooking, packaging, warehousing, and refrigeration. BUT the lions share of the cost is traveling to our plates. In the USA, food typically travels 2,400 km. (Kingsolver, 2017). One estimate is that the average Canadian meal travels 3,000 km to get to our plates and even higher in the winter months. A study done in Waterloo, Ontario on 58 commonly eaten, imported foods showed they traveled an average of 4,500 km accounting for 51,709 tons of greenhouse gas emissions per year (Xureb, 2005). The recent droughts and floods in California have resulted in more of our food coming from Mexico, Peru and South Africa. Again from Stephen Hopp, If every US citizen ate one meal per week of locally, organically raised meat and produce, we would reduce the country's oil consumption by 1.1 million barrels of oil every week. Small changes in buying habits can make big differences. Translated into litres, ONE meal per week of locally sourced, organic meat and produce saves 175 million litres of oil (Kingsolver, 2017). We should all grow something we can eat. If that is not possible, we can participate in a local community garden or buy a share in a CSA (community shared agriculture). We can support local farmers at the farmers market and through the winter buy tomatoes from an Ontario greenhouse rather than one in Mexico.

CONCLUSIONS

If we think of complex health issues such as pandemics, zoonotic disease, incursions of exotic diseases into our pig farms, spread of vector borne diseases into temperate climates, food borne illness, climate change leading to forest fires, floods and droughts, reducing the affordability of food for people and production animals, – One Health is not difficult to understand. We have complex problems in our world that show the close links between the health of our environment, animals and ourselves. A One Health approach looks at the whole picture and the connections as a way to solve these complex problems. It is not easy

to do and it requires us to work together with community members to find and enact the solutions.

ACKNOWLEDGEMENTS

I acknowledge the funding from Veterinarians without Borders for the research on Kenyan butchermen, and from the International Livestock Research Institute in Nairobi Kenya for helping to support the field work in Kenya and for the financial support of Dr. Natalie Carter's PhD. I appreciate the participation of the farmers, butchermen and government officials in Western Kenya and Uganda. Most importantly, I thank the PhD students who completed the work: Drs. Florence Mutua, Mike Levy and Natalie Carter and the members of their supervisory committees including Dr. Kees de Lange.

LITERATURE CITED

ABC Rural, Japanese encephalitis detected in 30 NSW piggeries, pork supply set to plunge. David Claughton and Olivia Calver. April 20, 2022. https://www.abc.net.au/news/rural/2022-04-20/japanese-encephalitis-30-nsw-piggeries-pork-shortage/100996708#:~ :

Alternative Land Use Services. https://alus.ca/communities/

Carter, N.A., Dewey, C.E., Lukuyu, B., Grace, D., and de Lange C.F.M. (2015a). Nutritional value and seasonal availability of pig feeding ingredients in Uganda. *Agricultura Tropica et Subtropica*. 48(3-4):91-104

Carter, N.A., Dewey, C.E., Lukuyu, B., Grace, D., and de Lange C.F.M. (2015b). Nutritional value and seasonal availability of local pig feedstuffs in Western Kenya. *Canadian Journal of Animal Science*. 95(3):397-406.

Carter, N.A., Dewey, C.E., Thomas, L.F., Lukuyu, B., Grace, D., and de Lange C.F.M. (2016). Nutrient requirements and low-cost balanced diets, based on seasonally available local feedstuffs, for local pigs on smallholder farms in Western Kenya. *Tropical Animal Health and Production*. 48(5): 337-47.

Carter, N.A., Humphries, S., Grace, D., Ouma, E.A., and Dewey, C. (2017a). Men and women farmers' perceptions of adopting improved diets for pigs in Uganda: decision-making, income-allocation, and intra-household strategies that mitigate relative disadvantage. *Agriculture and Food Security*. 6(18).

Carter N.A., Dewey C.E., Grace D., Lukuyu, B., Smith, E., and de Lange C.F.M. (2017b). Average daily gain and the impact of starting body weight of individual nursery and finisher Ugandan pigs fed a commercial diet, a forage-based diet, or a silage-based diet. *Journal of Swine Health and Production.* 25(3):121–128.

Carter N.A., Dewey C.E., Grace D., Lukuyu, B., Smith, E., and de Lange C.F.M. (2018). In the search for low-cost year-round feeds: Pen-level growth performance of local and crossbred Ugandan pigs fed forage- or silage-based diets versus commercial diet. *Journal of Agriculture and Rural Development in the Tropics and Subtropics.* 119(2):23-29.

Dewey CE, Mutua F, Levy M, Wohlgemut JM. Educating people participating in the pig industry to reduce epilepsy due to *Taenia solium.* In: Novel Aspects on Epilesy, Chapter 12. IntechOpen, ed Humberto Foyaca Sibat. (2011). DOI 10.5772/1137.

Kingsolver B, Kingsolver C, Hopp S, Hopp S. Animal, Vegetable, Miracle – A year of food life. Harper Perennial. 2007. Pp5.

Levy MA, Dewey CE, Weersink A, Mutua FK, Poljak Z. Pig marketing and factors associated with prices and margins in Western Kenya. J Ag. Econ. and Dev. (2013) 2(10);371-383

Levy MA, Dewey CE, Weersink A, Poljak Z, Mutua FK. (2014a) Comparing the operations and challenges of pig butchers in rural and peri-urban settings of western Kenya. Afr. J. Agric. Res. (2014a) 9(1): 125-136

Lytras S, Xia W, Hughes J, Jiang X, Robertson D. Trading of animals susceptible to bat coronaviruses is the likely cause of the COVID-19 pandemic. Science. (2021) 373(6558): 968-970.

Mutua FK, Dewey CE, Arimi M, Ogara WO , Githigia SM et al. Indigenous pig management practices in rural villages of Western Kenya. Livest Res Rural Dev. (2011a) 23 (7).

Mutua FK, Dewey CE, Arimi SM, Schelling E, Ogara WO. (2011b) Prediction of live body weight using length and girth measurements for pigs in rural Western Kenya. J Swine Health Prod. (2011b) 19(1): 26–33.

Mutua FK, Dewey CE**,** Arimi SM, Schelling E, Agara WO, Levy M. Reproductive performance of sows in rural communities of Busia and Kakemega Districts, Western Kenya. African Journal of Agricultural Research. 2011(c);6(31):6485-6491.

Ontario Federation of Agriculture. https://ofa.on.ca/ (accessed March 2, 2023).

The Guardian, What is Japanese encephalitis and why is it spreading in Australia? Melissa Davey, Medical editor. https://www.theguardian.com/australia-news/2022/mar/08/what-is-japanese-encephalitis-and-why-is-it-spreading-in-australia

Xureb, M. Food miles: environmental implication of food imports to Waterloo Region. Accessed from Food miles: background and marketing. Hill, H. NCAT sustainable agriculture. https://attra.ncat.org/publication/food-miles-background-and-marketing/

WHO(a), Japanese encephalitis https://www.who.int/news-room/fact-sheets/detail/japanese-encephalitis (accessed March 2, 2023)

WHO(b), One Health. https://www.who.int/news-room/questions-and-answers/item/one-health (accessed March 2, 2023)

WHO (c) (2022). Taeniasis/cysticercosis Factsheet. Accessed February 14, 2023. https://www.who.int/news-room/fact-sheets/detail/taeniasis- (accessed March 2, 2023)

Wohlgemut J, Dewey CE, Levy M, Mutua FK. Evaluating the efficacy of teaching methods regarding prevention of human epilepsy caused by Taenia solium neurocysticercosis in Western Kenya. Am J Trop Med Hyg. (2010) 82(4): 634-642.

INCREASE YOUR KNOWLEDGE, INCREASE YOUR POTENTIAL: HOW AND WHEN TO USE ON-FARM DATA

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INTRODUCTION

Throughout the swine industry there are thousands of data points being collected. Becoming easily overwhelming by an end user is not uncommon so it can be said that it is just easier to remember or to guestimate. What and where to look for information can be daunting but understanding the importance and relevance of data can give you the leg up to prevent a larger problem or to minimize a potentially larger one. Extracting, simplifying and delivering data to the appropriate end user can lead to a higher potential performance outcome.

SOW FARM

Giving data can tell a person not just what has happened to date, but the outcomes that a sow farm or system could predict the future. This can be done by applying easy to read and understand information to the end user. Having a television in the break room can draw a person's eye, that displays information that is simple along with goals can inform and motivate. With more responsibilities comes more of a need to understand more of the factors of production. Sow farm production is the conduit to several aspects for the outcome in grow finish.

Here are a few key performance metrics, and/or focus areas, that different sow farm personnel roles should look at on a regular basis:

- Sow Technician:
    - Weekly breed target
    - Cumulative pigs weaned
- Farm Manager:
    - All areas within sow technician
    - Gilt performance
    - Technician performance
    - Sow indexing for cull management
    - Wean pig cost
- Farm Supervisor:
    - All areas within sow technician and farm manager
    - Trends and outliers
    - Individual metric ranking against other peer farms
    - Educational development

GROW FINISH

The benefit that sow farms have with data is the learning environment is localized, however that cannot be said for the grow finish end of pig production. Site locations can be spread out across counties and even states. Communication and visibility to know what's going on has been a challenge for years but with newer technology coming into the pork industry, less can be assumed with more being known.

Here are a few key performance metrics, and/or focus areas, that different grow finish personnel roles should look at on a regular basis:

- Barn caretaker:
    - Closeout performance
    - Closeout performance comparison against peers
- Service staff:
    - All areas within barn caretaker
    - Mortality trends
    - Marketing information
- Regional supervisor:
    - All areas within barn caretaker and service staff
    - Closeout trends and outliers
    - Cost management
    - Opportunity areas
    - Educational development

CONCLUSION

Sharing information is useful in all phases of production. Whether there is a threat of something actually occurring or an incident has already occurred, both threats and incidents have indicators to help determine what has occurred (in case of an incident) or what may occur (in the case of a threat). Some important rules for sharing information would be: Necessary, accurate, timely and relevant. This ensures that information you share is necessary for the purpose for which you are sharing it. Give the necessary tools to give each person the best opportunity to be successful.

THE POWER OF PLANNING IN FARM TRANSITION

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INTRODUCTION

Farm Transition is not a transaction or an event. It is a journey of change that requires preparation. The purpose of this presentation is to help you understand there is power in planning your farm transition. We at BDO believe farm transition occurs in stages. Stage I is Planning. Stage II, which includes numerous substages, is Implementation.

The Power of Planning in Farm Transition will explain:

1. What is Farm Transition
2. The impact of transition on the farm and the family
3. How to focus transition planning on tomorrow rather than yesterday
4. Why planning is critical to farm transition
5. The process of planning
6. The power of planning
7. The Big Payoff

The Workshop – Farm Transition Myths – Busted By the Experts – will focus on Implementation. Our experts will debunk some common Farm Transition Myths. You will next hear from a Farm Transition Advisor that experienced her own family farm transition. Our panel of transition experts will then answer the questions that are keeping you up at night.

WHAT IS FARM TRANSITION?

Transition means change – going from one state or situation to something different. The transition of a family farm typically includes changes in roles, changes in decision authority and changes in leadership. Ultimately, there will be changes in farm ownership which means a change in financial arrangements, legal agreements and possibly estate arrangements. Farm transition may result in changes in lifestyle and in family relationships.

Transition, or change, is always disruptive. By nature, most people resist or avoid change because it involves moving from the known to the unknown. Change that is imposed by a person or an organization on another person may invoke anxiety or outright fear. Change without a voice in the process can cause resentment and even conflict.

Transition can be voluntary – when, how and to whom you want, or involuntary – forced upon you by events such as Death, Disability, Disagreement, Debt or Divorce. Proper planning and execution for a voluntary farm transition has the added benefit of protecting the farm and the family against the damaging impact of an involuntary transition.

CHANGE IMPACTS MORE THAN THE FARM: THE 3 CIRCLE MODEL….PLUS 1

The Three Circle Model of Family Business was developed by Harvard Professors, Renato Taguiri and John Davis, in 1978. The model helps explain the interdependent and overlapping groups that comprise the Family Business System. Including the overlap areas, there are 7 different groups of stakeholders in a family business system, each with their own perspectives, goals and group dynamics. "The long term success of the family business systems depends on the functioning and mutual support of each of these groups." (John A. Davis). To this model we have added another system, that being Self.

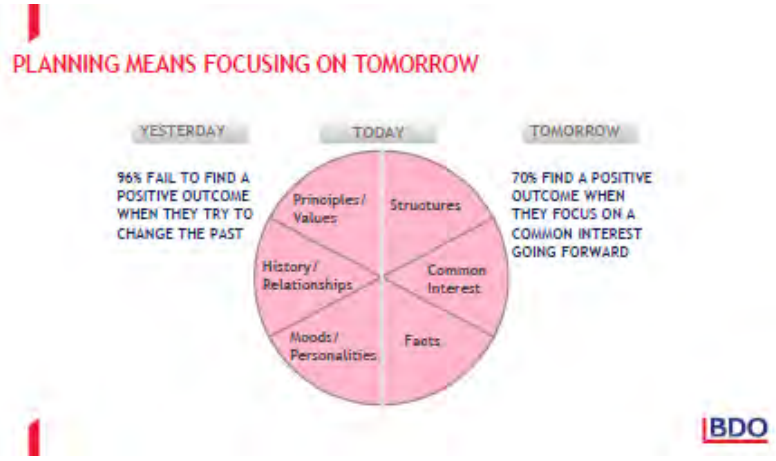
The 3 main systems have very different principles and membership criteria: The Family Circle is based on birth or marriage. Members are nurtured and loved equally. Membership in the Business Circle is derived from merit and ambition. The Ownership Circle protects the family wealth and distributes it to the family fairly. Equal, Merit, Fair: It's complicated.

There are differing levels of access to information in each of the systems. Members form their own perspectives on the transition results based on the information to which they have been privy. Misunderstandings occur frequently, sometimes evolving into resentment and conflict. Inclusiveness should be a guiding principle in the Transition process.

Each of these systems requires preparation for the Transition Journey. A change in one system will inevitably impact one or more of the others. Business Families require understanding and tools to cope with the challenges of the overlapping systems.

The stakes are very high in transitioning a family business. Not only are the Business and the Family Wealth at risk, the Family itself may not remain in tact if the transition is unsuccessful. As a result, Collaboration should be another principle that guides the transition process.

THE POSITIVE OUTCOME MODEL



Effective Transition Planning is focused on Tomorrow rather than Yesterday.

A family's History and the Relationships amongst its members influences greatly Today's circumstances. The Principles and Values of the Family and each of its members are foundational in its current state, and in forming its future direction. Each family member has

their own Personality and Moods. Each is special and unique in their own way. A family's ability to accept and manage the differences amongst their members is a big factor in their functionality as a family and as business operators.

These elements are part of Yesterday. They need to be understood and appreciated, especially by a Transition Advisor, to guide the family into the future. They cannot, however, be changed. Efforts to change the past will most likely be met with failure.

The purpose of effective Transition Planning is to focus the stakeholders on Tomorrow. If they can align around a common view of the future, they can channel their energies towards the same purpose. This is often the biggest challenge so requires considerable effort.

The stakeholders and their Transition Advisors must understand the Facts of their situation to prevent misunderstandings and to develop effective transition strategies. Access to information should be appropriate to the system(s) in which each stakeholder resides, but must be sufficient to provide a clear picture of the transition goals and each member's place within the Common Interest.

To help Business Families succeed, they need some level of formality in the way they manage each of the systems and their overlap areas. We help families build Structures for communication and decision making, business planning, roles and responsibilities, legal arrangements, tax planning, etc. Structures promote clarity and certainty, the goal being to reduce the opportunity for conflict in each system.

WHY DO WE NEED TO PLAN? LET'S JUST GET'ER DONE

The tendency of an entrepreneur, farmers included, is to seek immediate solutions to their challenges. In Farm Transition this often means jumping right to the tax and legal structures without addressing all of the other matters.

As mentioned before, each system requires preparation for change to guard against conflict and possible business failure. The actions a family takes, and the order in which they are taken, should be planned carefully in light of their goals and their current situation.

Parents generally have 3 primary fears – loss of wealth, loss of control and, most importantly, family conflict. The next generation needs clarity and certainty about their

future. Everyone needs a roadmap for the transition journey.

Farm families generally have lots of ideas and theories about transition. Many families have frequent discussions and good intentions but lack structure. Other families ignore

the situation because transition is difficult and not well understood. Some families are mired in conflict, making good communication difficult. The result is procrastination. Eventually, there is a tragic event or an ultimatum that triggers some type of reaction. The outcome is often bad for the family and for the farm business.

Good planning can help families communicate about the right things at the right time. It helps to relieve the fears of the senior generation and creates clarity and certainty for the next generation. The inclusiveness and transparency of the planning process helps align all stakeholders while creating a sense of family unity and fairness.

THE TRANSITION FUNNEL

We use a Funnel analogy to help explain the Transition Journey.

At the top of the funnel, things are Fuzzy. There is no clarity or understanding of Farm Transition. The family may not agree on the picture of the future. Even if they agree on the future, they generally don't know how to get there. They don't fully understand their current situation or their preparedness for the transition journey.

As a result, many business families are stuck. They procrastinate and tend to avoid taking action.

The purpose, and the power of transition planning is to gather all of the facts, goals, perspectives and visions and clarify the journey.

As the family progresses through Stage I, which is the Planning Stage (the top of the funnel), they learn, they begin to align around their future, and they understand the facts of their situation. As they collaborate to develop transition strategies things begin to make sense. They become empowered to take action.

At the bottom of the funnel their direction becomes clear. They are implementing the transition plan, creating structures and moving towards their vision of the future.

MOVING DOWN THE FUNNEL

Understanding Transition

- BDO Family Workshop
- Family Enterprise Canada
- Google - literature, research, etc.

Discovery – Where are We Now?

- Discovery process for each system
- Assess transition preparedness
- Findings and Themes
- Transition Strengths and Challenges

Vision – Where are We Going?

- Values
- Vision (overall and for each system)
- Level of detail depends upon alignment and family harmony

Strategies and Action Plan – How Will We Get There?

- Strategies to address challenges
- Preparation for each system
- Action Plan – prioritize, assign leaders, timeline, process

Implementation

- Workshop – Farm Transition Myths – Busted By the Experts

THE POWER OF PLANNING FOR TRANSITION

Family will have a better understanding of:

- The transition process
- The complexities of being part of a business family
- The challenges of farm transition

Promotes communication amongst family members

- Talk about the right things at the right time
- Include the right family members in the appropriate stages to get the right information
- Talk about subjects that have been difficult in the past

Gives the next generation a voice in their future

- Collaborate with family members to set direction and develop strategies

Creates clarity

- Eliminate ambiguity and doubt
- Clarify intentions and expectations
- Prevent misunderstandings

Promotes Alignment and Harmony

- Understand the goals and steps to get there
- Pulling in the same direction

Achieves buy-in from all stakeholders

Fosters Commitment

- Focus on “We” rather than “Me”

Creates Accountability

FARMING FORWARD TO NET ZERO

Korb Whale
Clovermead Farms, Wellington County

As a seventh generation farmer in Wellington County, my family has long espoused the values supporting sustainability. The three pillars revolve around Our Planet (environmental sustainability), Our People (a healthy community or social sustainability), and Our Profit (economic sustainability). Without any one of these pillars, our farm would not have survived this long. Frankly, as farmers, we have lived and breathed these values forever, but have never had to name them.

As agriculture becomes less and less understood in people's daily lives, especially animal agriculture, farmers need to show society that we provide solutions for a growing world and are not squarely to blame for the problem. I am proud to be a part of a group of producers who work hard at this every day.

When my father returned from the University of Guelph with a degree in crop science in the 70's, he understood the importance of soil health, manure management, erosion control, and return over feed. He began making changes to the traditional way his father farmed, in order to become more efficient, use his resources more effectively and ultimately become more profitable. This set our farm on the path to implement many best management practices in order to keep improving our productivity, profitability and provide opportunities for more projects. From grass waterways to windbreaks, from cover cropping to no till, from Green energy to energy efficiency, the list of opportunities to become better stewards of the planet and more profitable continue to be a priority for our operation.

In 2021, Dairy Farmers of Canada announced our goal to achieve net zero GHG emissions by 2050. As a member of the board, I am proud that our industry has publicly announced our ambition to achieve net zero. It is not an easily achieved goal. Many in our industry don't see the benefit in making the announcement, or even trying to achieve this ambitious target. However, by working together, as a national industry, this is not only achievable, but will be a competitive advantage for our industry in the coming years. If we can produce dairy sustainably and do a good job of explaining to our consumers how we are achieving it, effectively bringing them along on the journey, we will achieve three things. First, we will continue to build on agriculture's prominent place as an economic driver, not only in rural areas, but across the country. Secondly, we will enhance our integrity and our social acceptability with our customers, so they can consume our products, understand how it was made and feel good that they are supporting ethical, nutritious, environmentally responsible, locally raised food. Finally, we will provide opportunity for the next generation to farm.

In conclusion, Agriculture has an opportunity to embrace the sustainability movement to become more efficient, more responsible, and more profitable. We can achieve these goals within our industries before regulators enforce goals on us. To go one step further, if we work together, we can create opportunity to get there faster, to create additional revenue streams, and gain support from consumers and regulators, that will allow us to continue to feed the hungry world.

Day 1: Workshop Sessions

LIQUID FEEDING VS TRADITIONAL FEEDING — COMPARING THE EXPERIENCE

Darryl Terpstra, Perth County Pork Producer
Matt Ische, Kenpal

With 25 years' experience with liquid fed sows, as well as finisher barns, Darryl along with his wife and children own and operate a 2100 farrow to finish operation in Perth County, just South of Listowel.

Starting into the swine industry 25 years ago, diversifying into swine from dairy, Darryl and Tanya began with a build for 600 sows. Included in this build was the liquid feeding system.

COMPUTER VISION AND WEARABLES FOR SUSTAINABLE SWINE BREEDING

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Innovation is at the core of Hendrix Genetics' business. We can invest in new technologies in one species and then leverage that development to another. It's an efficient way of multiplying the effectiveness of R&D and innovation. We want to demonstrate two new technologies that have deployed in the last year across multiple species, including at Hypor, our Swine business unit.

First, we have a look at how Hendrix Genetics is using computer vision and smart algorithms to automatically detect farrowing performance of individual sows. Then we switch to wearables. In an interactive demo, you can mimic a pig's feeding and tail biting behaviour (using your hand). The movement data will be analyzed wirelessly afterwards.

We have used imaged analysis in all our species, from shrimp to pigs and from trout to turkeys. It is nowadays straightforward to recognize objects in an image. The trick is to come up with smart ways to make the information useful. We show how we put a single computer-camera module above a farrowing crate, take images at set intervals, send them to the cloud, and then extract information from the images. In the first prototype we looked specifically at sow farrowing performance. Metrics were total farrowing time, total number of piglets and time between piglets. During a farrowing event, our cloud algorithm automatically counts the piglets in view. If plotted over time, this creates what we started to refer to as the "staircase". Every sow has her own staircase shape that can be used to rank her farrowing performance.

Everybody is walking around with a wearable nowadays. Your phone knows whether your sitting, walking, or driving a car. We take advantage of sensor algorithms that have been developed for humans and apply them to livestock. During a short interactive session, we will look at what such a sensor measures. And how we can use streaming data to say something about behaviour of the wearer in real-time. In a demo adapted from laying hen feather pecking, we will look at pig feeding and tail biting behaviour.

MAKING DATA-BASED DECISIONS

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ABSTRACT

Objectively measuring the current status of a pig herd, using data related to health and productivity, is the cornerstone of both the health management cycle and the process of continuous improvement of the biological and financial performance of the farm.

Our ability to gather data had increased tremendously in recent years, with the advancements in cost and power of sensors and computers. This revolution has created emerging challenges around synthesis, analysis, visualization, review and storage of performance data.

In our presentation we hope to demonstrate some of the data analysis tools we use to help our clients measure their herds' performance and develop appropriate action plans. Some key aspects of data-based decision-making will be discussed, including:

Timeliness of Collection

Data can help businesses optimize the quality of work, draw valuable insights, predict trends, prevent risks, save time, drive profits and make better decisions. From controllers and bin scales to mobile applications, on-farm data collection has improved the accuracy and timing of data.

Data Trends

Trend analysis is a technique used to examine and predict movements in current or historical data. Trend analysis can improve your business by using trend data to inform your decision-making. Common examples include internal comparisons among pig flows, health statuses, personnel, feeder types and ventilation.

Data Outliers

In data analytics, outliers are values within a dataset that vary greatly from others, either much larger or significantly smaller. Outliers may indicate variabilities in certain measures, such as mortality rates, feed conversion or average daily gain. Common reasons for data outliers would include human errors, intentional or unintentional errors and data processing errors with calculation or business logic.

THE CARBON NEUTRAL PIG FARM

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Consumer demand, corporate responsibility and other factors have all come together to show the requirement for sustainability metrics in pork production. Life Cycle Assessment (LCA) capabilities are now the benchmark for carbon footprint reporting. Key metrics have been identified globally to report greenhouse gas emissions associated with pork production. These values being reported account for feed ingredient production and transport, milling, animal consumption and excretions, and manure storage. This creates a robust reporting of the carbon production associated with all types of swine production across multiple regions.

Every decision that is made on a swine operation can have immediate, long term, or ripple effects. This is why it is important for pork producers to be able to see the impacts of their decisions prior to making them. With the embedding of LCA capabilities into a Swine modelling tool such as Watson, it is possible to provide pork producers new insights into their farms' productivity, profitability and now sustainability which ultimately help them make better decisions that support both economic and environmental goals.

While advances in the barn and with the pig itself are important, there are also important emissions-reduction opportunities beyond animal. In the workshop participants will have an opportunity to see data and have discussion that will shed light on which practices such as energy use, activities in the field at feed production and manure pit management create opportunities for significant greenhouse gas reductions. All these in an attempt to identify what 'carbon neutrality' might look like in the swine sector.

PEOPLE – YOUR MOST IMPORTANT ASSET

Jennifer Wright, Canadian Agricultural Human Resource Council
Marsha Chambers, Demeter Veterinary Services
Graham Learn, Producer

Recognizing the Human side of Ag: Putting a focus on employee retention.

Sometimes keeping a good employee is as hard as finding them in the first place. This engaging session will help you build a strategy to recognize and retain your employees through benefits, bonuses, and career development strategies that pay dividends.

Additionally, this session will discuss temporary foreign workers and the work CAHRC is conducting to quantify their contribution to agriculture sector.

Day 2: Main Sessions

ANIMAL AGRICULTURE, THE COURTS, AND THE FUTURE OF FOOD

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ABSTRACT

Last year saw a disturbing uptick in public displays of extreme animal rights activism. From trespassing on farms and stealing animals to protesting during televised sports games, incidents of extremist demonstrations continue to be on the rise. While harassing elected officials to include animal rights in their legislative campaigns isn't a new approach, this tactic is becoming increasingly more discussed and encouraged among the animal rights movement. In this session, you will learn about the individuals and organizations behind the animal rights movement, as well as their strategies and tactics to push farmers out of business and remove milk, meat, poultry, eggs, and seafood from consumers' diets. The speaker will share insights into what you can do to combat this extremism as we work together to safeguard the future of animal agriculture.

MITIGATING INFECTIOUS DISEASE RISKS AND INTERRUPTIONS

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Like many other species, including humans, domestic pigs have had to face a series of emerging or re-emerging infectious diseases over the past several decades. Several factors may be associated with the rise of infectious diseases. Among them, an increase in regional farm density, in people, animal, and material movements, as well as climate change having an impact on wildlife, from insect vectors to wild boars. These risk factors are largely known. On-farm biosecurity measures, from traffic control, sanitation, anteroom management and air filtration have also been well described and shown to be effective. Except that, in practice, infectious diseases are still prevalent and causing significant economic damages.

At the end of 2021, a conference was held at Pennsylvania State University on emerging animal infectious diseases. The conference concluded that the biosecurity of livestock operations is critical for minimizing the devastating impact of these diseases (Kuchipudi et al., 2022). But there is "biosecurity fatigue" among growers, farm personnel, and even technicians. Although, conceptually, most would agree that biosecurity is important, the failure to contain diseases such as porcine reproductive and respiratory syndrome (PRRS) and porcine epidemic diarrhea (PED) is often perceived as evidence that it does not work.

In this context, the purpose of this presentation is to review briefly the main risks associated with infectious swine diseases, and to look at ways, present and future, to optimize risk mitigation.

RISK ASSESSMENT

To properly assess a risk, we need to determine the conditions that may result in the occurrence of this risk. In other words, what are the conditions that would favor the presence of a given infectious pathogen and the exposure of a herd to this pathogen. These conditions include the prevalence of the agent in the region, the age of the animals at risk, their vaccination status, etc.

We need to assess the likelihood of exposure by describing the biological pathway(s) that would lead to an effective contact to the agent from a given source. This would include the infectious properties of the agent, the presence of potential vectors, and geographical and environmental characteristics that would favor the survival of the agent in sufficient quantities to effectively infect pigs.

Lastly, we must assess the potential consequences of a given exposure. Here, direct (severity of disease, production losses, public health impact) and indirect (surveillance costs, trade losses, environmental impact) consequences need to be factored in. These assessments can then be integrated to determine the relative importance of these risks and the best way to minimize them. For example, a large farrowing unit in a region where PRRS

is prevalent and that is located near a few large finishing units with herds made of pigs from multiple origins would face a high likelihood of infection to the PRRS virus. The consequences of such an infection would also be severe. This assessment could justify installing air filtration (Desrosiers and Cousin, 2023). In this case, the decision process leads to a technical solution that has been shown to substantially reduce the risk of infection, as long as the equipment is installed and maintained properly. Although this is by no means a simple or easy measure to apply, the challenge is largely technical. The problem is when risk mitigation requires long term and sustained compliance by people in the application of a series of measures.

Table 1 highlights the main risks associated with infectious disease transmission in commercial swine production. Many are associated with the location and the environment surrounding the farm and farm management.

Table 1. Main categories and risk factors related to the transmission of infectious pathogens in swine and the associated biosecurity issues.

Category	Risk	Reduce[1]	Separate[2]	Regional[3]	Human[4]
Location	Multi-species site/size of farm		X		X
	Type of pig production		X		X
	Access outdoor		X	X	X
	Proximity to neighbor/road			X	X
	Size of neighbor's pig farm			X	
	Type of neighbor's pig production			X	
	Regional density			X	X
	Aerosols	X	X	X	
	Insects/vectors	X	X		
	Wildlife (wild boar)/rodents	X	X		
Pigs	New arrivals	X	X		X
	Manure	X	X	X	X
Management	Owner, employee, visitor	X	X		X
	Equipment, vehicles	X	X		X
	Semen	X	X		X
	Water	X			X
	Feed	X			X
	Dead pig disposal	X	X	x	X

[1]Reduce: measures designed to reduce the sources of infection
[2]Separate: measures designed to separate healthy pigs from the sources of infection
[3]Regional: regional measures, such as coordinated movement of vehicles and personnel
[4]Human: indicate that human issues are strongly associated with the risk, such as lack of compliance

Typically, all on-farm biosecurity measures aim at either reducing or eliminating sources of infection, or maintaining a distance (separation) between any potential source of infection and the herd we want to protect. Both reduction and separation are often part of biosecurity measures designed to mitigate management related risks. Measures of separation, such as changing boots and coveralls between barns serve a dual purpose of internal and external biosecurity. In some cases, regional biosecurity measures are needed, such as the coordination of activities in a given region in order to minimize risks of cross-contamination between vehicles and personnel. In many cases, mainly for management related measures, the most critical elements are linked to human issues. These are human characteristics, attitude and beliefs that will widely impact biosecurity compliance. Too often, these issues are neglected. To address them effectively, a mix of technical and behavioral methods may be needed.

TECHNICAL ASPECTS TO IMPROVE COMPLIANCE

Barn Entrance Design

The absence of a hygiene barrier (separation of entrance or anteroom in two or three zones) has been shown to be an important risk factor for the introduction of infectious pathogens (Hald et al., 2000). So, having an anteroom separated in different zones is now a well accepted barn entry design in swine and poultry productions.

A study by Racicot and colleagues described the application of biosecurity measures in anterooms of 24 poultry barns in Quebec, Canada, using hidden cameras. Results showed that when the barn entrance design makes it difficult to perform a given measure, individuals are 13 times less likely to comply (Racicot et al., 2012). To work, a barn entrance should facilitate the systematic application of the biosecurity protocol related to the entrance and exit from the barn. The type of zone separation has a significant impact on compliance. A bench is preferable to a simple line on the floor. Furthermore, to avoid cross-contamination, a specific sequence needs to be observed in the application of the measures. This was shown during an investigation related to a cryptosporidiosis outbreak. Disease transmission was related to the fact that personnel washed their hands before removing their clothes and boots. Some would even dry their hands using contaminated clothing (Kiang et al., 2006). So, to avoid cross-contamination, it is necessary to provide an environment allowing the sequential application of the required hygiene measures. To increase the likelihood of compliance, several technical points must be considered: The contaminated zone, near the outdoor, must have enough space to facilitate removing and storing what should stay out of the clean zone (e.g., coat). While moving from the contaminated zone to the clean zone, it must be possible to decontaminate hands. If a transition zone exists, it is best if it is equipped with a sink, soap, paper towels and a trash bin. To increase compliance, having access to warm water is useful, as some personnel may refuse to wash hands in winter if water is too cold (Racicot et al., 2013). The clean zone should also be large enough to facilitate the application of the biosecurity measures. The whole entrance should be unclogged and easy to clean and disinfect. This implies a floor (with a drain), walls and ceiling made of a non-porous material. In addition, all entrances should be locked at all times and, ideally, have a system for unlocking without having to return to the contaminated zone in order to open the door for a visitor (Racicot et al., 2011).

REAL-TIME FEEDBACK AND MONITORING

In addition to a design favoring the application of required biosecurity measures, real-time feedbacks greatly contribute to compliance. Indeed, according to social and behavioral sciences, feedbacks are needed to maintain compliance with a desired behavior (Yiannas, 2015). The main challenge with on-farm biosecurity is to evaluate compliance of daily behaviors, such as changing boots when entering a barn. Two pilot studies using radio-frequency-identification-based (RFID) real-time continuous automated monitoring systems were conducted to determine whether this approach, used in hospitals, would work under farm conditions (Racicot et al., 2022). The technology is relatively simple, using pressure mats and antennas to record boot movements (boots tagged with a microchip) and the activation of an alcoholic gel dispenser.

The first study aimed at monitoring and evaluating the frequency of two biosecurity measures: hand washing and changing of boots according to the different biosecurity zones (clean/contaminated) during a visit to a barn, and providing real-time feedback and employee performance evaluations. The anterooms of an egg-layer barn and a broiler barn were monitored for about two weeks.

The system was able to monitor boot changing and hand sanitizing compliance when entering and exiting the barn. In the event the sanitizing device was not used, an immediate feedback via a sound alarm was triggered, reminding people to comply. The same occurred if boots were not changed between the two zones. The system was also designed to monitor if the biosecurity breach was corrected after hearing the alarm.

For the egg layer barn, 254 entries and exits (i.e., 127 visits) by four different employees were recorded over a 17-day period. Boots were put on in the clean area 122 times out of 131 opportunities (accounting for back and forth in the barn entrance during the same visit) (93%). Hands were sanitized 173 times out of 254 opportunities (68%). Three out of four employees fully complied with boot change as their personal shoes were not detected by the RFID system during the entire trial. For the 9 non-compliant shoe events, farms boots were changed twice (2/9; 22%) after hearing the alarm. Out of the 81 non-compliant hand sanitizing occurrences, 26 (32%) were corrected after the alarm rang. For the broiler barn, 56 entries and exits (i.e. 28 visits) by three different employees were recorded over 13 days. Boot compliance was at 100% for the entire period and hand sanitizing compliance was at 73.2% (41 hand sanitizing events out of 56 opportunities). Out of the 15 non-compliant hand sanitizing occurrences, one was corrected after the alarm rang. The compliance obtained on both farms was far superior to what was observed in a previous study when real-time feedback was not available (Racicot et al., 2011).

In the second study, a more robust RFID-based system with an additional pressure mat and antenna was tested. This RFID prototype was installed on a turkey farm for one month. The barn had a three-zone entrance (contaminated, intermediate and clean). Preliminary results in this environment made us realize that RFID systems are very sensitive to the design of the anteroom. Several issues were identified. The main challenge was the recording of multiple people entering at the same time. Also, the three-zone entrance was L-shaped and the clean area was located in a corridor where traffic between two rooms was common. These features require adjusting the equipment in order to mainly avoid triggering alarms when

individuals are passing by an antenna without entering or exiting. So, much work is needed to validate this technology under different barn designs. But studies in the medical field and our original pilot study strongly suggest that RFID technology could play a major role in improving biosecurity compliance.

Regional Biosecurity

Real time track and trace processes using sensor technologies are also being developed to improve disease outbreak response time and consequently minimize regional disease spread. This is important as traditional paper-based systems are inadequate given that less than half farm visitors register their visits (Racicot et al., 2011) and these systems do not have the ability to collate all the data in a useful central manner necessary for quick decision making.

Currently, different technologies are being tested (BlueTooth Low Energy (BLE), GPS, Mid-range and short-range RFID and LoRa, a low-power wide-area network modulation technology). Each must have cloud storage in order to facilitate the secured access and analysis of very large datasets.

For example, in a recent test, sensors on a feed truck over a 24-hour continuous monitoring period determined that this vehicle traveled to 10 different poultry sites as part of 15 separate farm visits, including six on one of these farms. The truck was on the road visiting farms during 10.2 hours, in maintenance during 6.5 hours, and parked the rest of the time. Since wash bays were monitored, it was possible to determine that at no time was it washed between farms, since none of them were equipped for on-site vehicle decontamination.

In a project currently conducted in Western Canada, a company using sensors to determine who is visiting farms and for what reason, could show that 60% of the time, visitors were barred from entry because they did not meet the company's established standards, such as one day without prior farm visit or no recent travel from countries currently experiencing outbreaks of diseases such as African Swine Fever (Tim Nelson, personal communication).

Using artificial intelligence, it will be possible to use existing disease spread models for a given disease with the real-time data being recorded in order to inform decision makers and accelerate reaction time to contain the disease. Such technology could significantly reduce the risk of production interruptions.

BEHAVIORAL CONSIDERATIONS TO IMPROVE COMPLIANCE

A biosecurity program must be understood and supported by all personnel. But some employees may not fully appreciate the significance of each measure. They are usually not rewarded specifically for following these rules. Under these circumstances, it may be difficult to get buy-in from everyone associated with a given production site.

We must also consider the lack of knowledge by many employees about disease transmission. They may not appreciate the chain of events required to favor the spread of disease. This lack of understanding is a major determinant of people's perception of the level of risk they and their animals are exposed to. It has been clearly demonstrated that, for a given disease, people's perception of their own vulnerability (or that of their pigs), of the potential severity of the outcome, of the value of any given intervention (e.g. biosecurity

measures), and their ability to physically, psychologically and financially deal with the issue play a significant role in whether or not they will comply and follow the rules.

The challenge is to convince all personnel of the impact of their actions on the risk of breaking with an infectious disease. Education is key if one wants to substantially change people's perception of disease risks and, consequently, increase their level of awareness of the importance of biosecurity measures.

We also need to find ways to motivate people to correctly apply biosecurity measures. We can learn from social and behavioral sciences to achieve this. Key elements include continuous monitoring and having feedback mechanisms targeting farm personnel. We saw that sensors (RFID) can be used to harvest data and to trigger real-time reactions. Adapting training based on personality profile and emotional intelligence of farm personnel should also be developed and validated.

Racicot (2011) demonstrated that certain personality traits were associated with compliance, namely responsibility, action orientation and complexity. Personality is a characteristic that does not change much over time. However, a better understanding of personality patterns could help us to modulate interventions in order to improve compliance. For example, the way we train people who are sensitive, stressed and resistant to change should be different from the way we train people who are calm and open to ideas. Personality assessment can therefore be an important tool in any interventions with existing employees.

Emotional intelligence refers to the potential to develop expertise in self-awareness, self-management, social awareness, and relationship management in the context of job success and satisfaction (Faguy, 2012; Goleman, 1998; Nowack, 2012). Akintayo (2010) confirmed that emotional intelligence has a positive impact on employee effectiveness and efficiency, conflict management, and employee retention. Higher levels of emotional intelligence and lower motivation to leave the organization, in turn result in higher retention rates, better task coordination, and improved goal achievement (Tsui & Wu, 2005). Emotional intelligence is also important for leadership, motivation, communication, decision making, interpersonal relationships, and change management (Trehan & Shrivastav, 2012, p. 66).

According to Goleman (2002), emotional intelligence is a learned characteristic that can be developed over time. Given its malleability, it is therefore possible to modulate training programs, supervision and reinforcement of employees in order to have an impact on employee performance and compliance.

The lack of motivated employees can cause organizations to have a high turnover rate and absenteeism (Kim & Fernandez, 2017; Lee, 2018). By contrast, motivated employees are generally influenced by their manager (Bradberry, 2016). These findings support the opportunity to identify different factors related to motivation that can be implemented to enhance employee performance.

The human characteristics described above play a central role in employee performance, satisfaction and retention. It is our belief that these characteristics will also have a critical influence on employee compliance regarding biosecurity measures.

CONCLUSIONS

Mitigating risks implies having effective structural (e.g., anteroom design) and operational biosecurity measures. The key is to achieve good compliance of these measures by all individuals associated with a given production site. The vast majority of on-farm and regional biosecurity measures require a focus on who is involved. Sensor technology offers several opportunities, such as monitoring compliance, evaluating the optimal feedback approach to improve compliance, evaluating the effect of peer performance comparison, and evaluating the effectiveness of biosecurity training programs, interventions, or incentives. At the regional level, the potential is enormous regarding the ability to monitor and plan vehicle movements in such a way as to reduce the probability of disease spread. Real-time traceback is possible and should have a very significant impact on our ability to minimize disease spread between farms.

But long-term improvement in biosecurity compliance will require better consideration of people's characteristics. The key is to adjust training and supervision in such a way as to positively impact emotional intelligence and motivation.

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LITERATURE CITED

Akintayo, D. I. 2010. Influence of emotional intelligence on work-family role conflict management and reduction in withdrawal intentions of workers in private organizations. *International Business & Economics Research Journal (IBER)*, *9*(12).

Bradberry, T. 2016. 70% of employees say they are disengaged at work. Here's how to motivate them. In *World Economic Forum* (pp. 1–5). https://www.weforum.org/agenda/2016/11/70-of-employees-say-they-are-disengaged-at- work-heres-how-to-motivate-them/

Desrosiers, R. and Cousin, V. 2023. Air filtration to prevent porcine reproductive and respiratory syndrome virus infection. J Swine Health Prod.; 31(2): 77-81. https://doi.org/10.54846/jshap/1303

Faguy, K. 2012. Emotional intelligence in health care. Radiologic Technology, 83(3), 237-253. Retrieved from http://www.radiologictechnology.org/content/83/3/237.long

Galbraith, J.K. 1965. May 16, New York Times, Section: Book Review, Came the Revolution by John Kenneth, (Book review of "The General Theory of Employment, Interest, and Money" by John Maynard Keynes), Start Page BR1, Quote Page BR34, New York. (ProQuest). https://quoteinvestigator.com/tag/john-kenneth-galbraith/

Goleman, D. 1998. What makes a leader? *Harvard Business Review*. November – December

Goleman, D., Boyatzis, R., & McKee, A. 2002. The emotional reality of teams. *Journal of Organizational Excellence*, *21*(2), 55-65.

Hald B., Wedderkopp A., Madsen M. 2000. Thermophilic *Campylobacter* spp. in Danish broiler production: a cross-sectional survey and a retrospective analysis

of risk factors for occurrence in broiler flocks. Avian Pathology, 29(2), 123-131.
Kiang K.M., Scheftel J.M., Leano F.T., Taylor C.M., Belle-Isle P.A., Cebelinski E.A., Danila R., Smith K.E. 2006. Recurrent outbreaks of cryptosporidiosis associated with calves among students at an educational farm program, Minnesota, 2003. Epidemiology and Infection, 134(4), 878-886.

Kim, S., & Fernandez, S. 2017. Employee empowerment and turnover intention in the U.S. federal bureaucracy. *American Review of Public Administration*, *47*(1), 4–22. https://doi.org/10.1177/0275074015583712

Kuchipudi SV, Behring D, Nissly R, Chothe SK, Gontu A, Ravichandran A, Butler T. 2002. Mitigating the Impact of Emerging Animal Infectious Disease Threats: First Emerging Animal Infectious Diseases Conference (EAIDC) Report. Viruses 14(5):947. doi: 10.3390/v14050947. PMID: 35632689; PMCID: PMC9147003.

Lee, S. 2018. Employee turnover and organizational performance in U.S. federal agencies. *American Review of Public Administration*, *48*(6), 522–534. https://doi.org/10.1177/0275074017715322

Nowack, K. M. 2012. Emotional intelligence. *Training et Development*, *66*(8), 60.

Racicot, M., Venne, D., Durivage, A., & Vaillancourt, J. P. 2011. Description of 44 biosecurity errors while entering and exiting poultry barns based on video surveillance in Quebec, Canada. *Preventive Veterinary Medicine*, *100*(3-4), 193-199

Racicot M, Venne D, Durivage A, Vaillancourt J-P, 2012. Evaluation of strategies to enhance biosecurity compliance on poultry farms in Quebec: effect of audits and cameras, *Preventive Veterinary Medicine*, 103 (2–3); pp. 208–218

Racicot, M., Kocher, A., Beauchamp, G., Letellier, A., & Vaillancourt, J. P. 2013. Assessing most practical and effective protocols to sanitize hands of poultry catching crew members. *Preventive veterinary medicine*, *111*(1-2), 92-99.

Racicot, M., Cardinal, A. M., Tremblay, D., & Vaillancourt, J. P. 2022. Technologies monitoring and improving biosecurity compliance in barn anterooms. *Frontiers in Veterinary Science*, *9*.

Trehan, D. R., et Shrivastav, 2012. Perception of top management executives towards importance of EI for professional success. *IUP Journal of Management Research, 11*(3), 54-67. Retrieved from http://search.proquest.com/docview/1033786348?accountid=35812

Tsui, A. S., et Wu, J. B. 2005. The new employment relationship versus the mutual investment approach: Implications for human resource management. *Human Resource Management, 44*(2), 115-121. doi:10.1002/hrm.20052

Yiannas, F. 2015. Food safety= behavior. *New York: Springer Science Business Media. doi*, *10*, 978-1.

UNDERSTANDING THE FUTURE OF ANIMAL PROTEIN

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The landscape for protein is changing dramatically. Changes in consumer preferences means the amounts and types of protein demanded are changing quickly. Technological change also means that there are more choices for consumers and more coming. This presentation will review key trends driving changes in consumer demand for protein today and in the future,

We begin by looking at the emerging technologies with an eye to the impact on traditional animal proteins. Plant based proteins, lab grown meats, and the ability to gene edit animals will provide a significant change in the products available in the marketplace. Understanding these products and the timelines for these products will be important context.

Shifting demand for meat and some of the drivers of that change. We also consider issues of both trust and understanding of agricultural production and the implications of these factors on the long-term demand for animal proteins. Issues such as antibiotic use and animal welfare will play an increasingly important role in influencing the demand for animal proteins. Engaging consumers to understand their concerns and providing them with honest, plain language information will be critical to developing and sustaining a committed demand. Committing to consumers that we are working towards improvement can create value for the industry in advance of achieving of that change.

Despite significant changes in the demand for protein and the choices available, there remain significant opportunities for traditional animal proteins. Responding to changing consumer expectations and engaging with the broader public will ensure that those opportunities are maximized.

ECONOMIC OUTLOOK

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ABSTRACT

In the post-pandemic environment, economic uncertainty still looms for many countries. Inflationary pressures have been persistent and caused food prices to rise. Globally, meat production is expected to continue trending higher with USDA Foreign Agricultural Service (FAS) forecasting global meat production of pork, chicken, and beef at more than 276 million metric tons (MMT) in 2023, a record and up less than one percent from 2022. The North American hog industry, comprised of the U.S., Canada, and Mexico, saw its highest hog inventory level of nearly 103 million head in 2021, but levels are expected fall about 1% to 3% to about 100 million head in 2023. For U.S. producers, profitability continues to be in the forefront. Feed costs for corn, soybean meal, and dried distillers grains are expected to remain elevated and likely be a headwind to profitability in the near term.

ECONOMIC OUTLOOK

Globally, economic uncertainty still looms as many countries are recovering post-pandemic while others have just started to loosen pandemic related measures. Inflationary pressures have persisted in most economies which has led to rising food prices. The International Monetary Fund (IMF) Global Price of Food Index showed a short dip in food prices in April 2020 to 92.93 during the initial onset of the pandemic (IMF, 2023). Since that point, the index was on an upward trajectory reaching a peak value two years later of 161.52 in April 2022. The index has since tracked lower with recent months above 130 which is still well above pre-pandemic levels. The quick rise in food prices has led to concerns that demand could slow, especially for meat proteins.

GLOBAL MEAT PRODUCTION

Global meat production of pork, chicken, and beef has been generally trending higher for several years with annual average increases around 1% to 3%, according to USDA Foreign Agricultural Service (FAS), Production, Supply and Distribution (PSD) data. USDA FAS has global meat production of pork, chicken, and beef at more than 276 million metric tons (MMT) in 2023, a record and up less than one percent from 2022. Globally, pork has been the main meat protein produced with production levels reaching above 100 million metric tons (MMT) for the last several years. Chicken production has seen the strongest growth pace with annual average increases of about 3% over the last two decades. Recent years production levels have reached above 100 MMT and are expected to continue rising. Globally, beef production has seen smaller increases with an annual average increase less than one percent.

GLOBAL PORK PRODUCTION

Much of global pork production comes from three main supplies: China, the European Union (EU), and the U.S. China is the top global pork producer and holds over half the world's hog inventory levels. For the last two decades China's hog inventory has routinely been over 400 million head, but in August 2018, China reported its first case of African Swine Fever (ASF). The disease ravished China's hog herd and severely disrupted their pork market and available supplies. In 2020, China's hog inventory levels fell to 310 million head, the lowest level since 1994. As a result of the lower hog inventory levels, China quickly became the leading importer of pork with imports of 2.5 and 5.3 MMT in 2019 and 2020, respectively. Imports cooled to 4.3 MMT in 2021 and are expected to be around 2.0 MMT in 2022.

The European Union (EU) was a primary supplier of pork to China when ASF outbreaks occurred. In 2019, the EU saw pork export levels increase to 4.3 MMT with levels in 2020 and 2021 near 5.0 MMT. As China slowed their imports of pork over the last few years, the EU has also seen their pork export levels fall with exports expected to be around 4.0 MMT. The EU has also seen pork production levels fall in the wake of the pandemic with levels nearing 22 MMT. The lower pork production has been the result of smaller sow inventory levels over the last four years which has reduced available hog supplies and pork production.

NORTH AMERICAN PORK PRODUCTION

The North American hog industry, comprised of the U.S., Canada, and Mexico, saw its highest inventory level of nearly 103 million head in 2021, but levels are expected to fall about 1% to 3% to about 100 million head in 2023. The U.S. and Canada are expected to see lower inventory levels near 73 and 14 million head, respectively, while Mexico is expected to increase slightly to just over 12 million head in 2023, according to USDA FAS data. Although inventory levels have moderated lower, pork production is expected to remain robust at more than 16 MMT in 2023, based largely on larger U.S. production.

North American pork exports reached a record level of nearly 5.2 MMT in 2020, which were record export levels for the U.S., Canada, and Mexico. Exports for the three countries have since fallen but total pork exports are expected to be over 4.5 MMT in 2023 for North America, which would be the fourth highest on record. Mexico leads North America in pork imports with the last two years over 1.0 MMT, and in 2023 Mexico's pork imports are expected to reach over that mark. Among global pork importers in 2022, Mexico ranked as the third highest at nearly 1.3 MMT, behind China (2.1 MMT) and Japan (1.5 MMT).

U.S. PORK PRODUCTION AND TRADE

The latest USDA NASS Hogs and Pigs report showed that as of December 1 all hogs and pigs supplies were 73.1 million head, down 1.8%. Breeding herd inventory levels have been hovering above 6 million head for the last several quarters and on December 1 there was a slight increase of 0.5% to just under 6.2 million head. Farrowings for the September to November period were down 1.5% to 3.0 million head with a pig crop 1.3% lower to 33.7 million head. The December 1 Hogs and Pigs report indicated tighter hog supplies based on the market weight categories which were reported to be about 2% lower than the prior year. Weekly slaughter levels through December to February tracked higher than expected which

has pressured prices lower in the near term. The March 1 Hogs and Pigs report will give further insights into hog supplies and production levels for 2023.

Profitability continues to be in the forefront for producers with the most recent available Iowa State University's estimated returns for a farrow-to-finish hog operation in January 2023 at a loss of $36.04 per head. Feed costs continue to be a headwind to profitability with January at $129.06 per head, up 22% from the same month a year ago. In 2022, the monthly average total feed cost was over $124 per head. Corn, soybean meal, and dried distiller grain costs are all up 20%-40% from a year ago, a trend that is expected to continue in 2023.

Global pork demand will continue to be a key driver in 2023, but continued inflationary pressures are likely to impact U.S. pork exports. Mexico has been a key destination for U.S. pork exports, a trend that is expected to continue especially if exchange rates are favorable. Japan and South Korea continue to be key destinations, but inflationary pressures may limit export potential. Philippines and Vietnam pose potential for further growth largely a reflection of ASF effects to their hog industries.

U.S. AND CANADA HOG TRADE

In 2022, total U.S. hog imports were nearly 6.5 million head, down 2.7% from 2021. Canada accounts for nearly all the U.S. hog imports, and a majority of those hogs are shipped as weaned pigs to be placed in feeding operations and fed to market weight. Feeder pig imports, hogs weighing less than 50 kg (110 lbs.), was just shy of 5.0 million head, a 2.4% decline from a year ago. This translates to 76.9% of the 6.5 million hogs imported in 2022 were feeder pigs. Last year, 76.7% were feeder pig imports. From 2009 to 2020, the percentage of feeder pig imports averaged at or just above 80% indicating a larger proportion have been shipped to the U.S. from Canada as market ready slaughter hogs.

Over the last two years, a higher number of hogs have been imported that weigh over 50 kg (110 lbs.). In 2022, hogs weighing over 50 kg (110 lbs.) totaled 1.5 million head, 3.4% below 2021 which was 1.55 million head. Although the number of hogs imported in 2022 weighing over 50 kg was down from 2021, both years were well above typical levels. Most of the hogs over 50 kg have been market ready slaughter barrows and gilts. The trend of a higher proportion of hog imports from Canada being slaughter barrows and gilts is likely to continue in 2023.

LITERATURE CITED

Daily Livestock Report, March 6, 2023, https://www.dailylivestockreport.com/documents/dlr%2003-06-23.pdf, Accessed March 10, 2023.

International Monetary Fund, Global price of Food index [PFOODINDEXM], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/PFOODINDEXM, Accessed March 3, 2023.

Iowa State University, Estimated Returns, Farrow to Finish, https://www2.econ.iastate.edu/estimated-returns/, Accessed March 10, 2023.

USDA Foreign Agricultural Service, Production, Supply, Distribution, https://www.fas.usda.gov/, Accessed March 3, 2023.

USDA NASS Hogs and Pigs, https://usda.library.cornell.edu/concern/publications/rj430453j?locale=en, Accessed March 10, 2023.

Day 2: Workshop Sessions

ALTERNATIVE INGREDIENTS TO CORN AS A FEED SOURCE TO ALLOW CROP ROTATION TO MANAGE ROOTWORM

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ABSTRACT

Corn rootworm is a pest that can cause significant damage to corn crops, by weakening the plant and reducing yield. Among the strategies to overcome corn rootworm is crop rotation, and use of alternative grain sources such as wheat, hybrid rye and barley. Pigs have a requirement for nutrients, not ingredients, thus growth performance can be maintained using these ingredient sources if diets are formulated to meet the nutrient requirements for the different stages of production. Considerations for which ingredients to use include the differences in nutrient content, the impact of processing on each grain and protein source as well as the economic value of each crop.

INTRODUCTION

Corn is a popular feed ingredient for pigs because of its high energy content, digestibility, and yield. The high energy of corn is due to its high concentration of starch and oil content, which can be easily digested by the pig. In addition to its nutritional benefits, corn is grown in large quantities throughout North America as it has a high yield per acre vs other crops, so it is readily available at a competitive cost. However, pests such as corn rootworm can cause significant damage to corn crops, thereby reducing yield. Strategies to overcome corn rootworm include use of insecticides, planting insect-resistant varieties of corn and crop rotation, as lengthening the time between crops on the same ground can decrease the prevalence of corn rootworm. The latter would include planting of alternative grain sources such as wheat, hybrid rye and barley, as well as protein sources such as soybeans, peas and edible beans. When fed well-balanced small grain-based diets, pigs can perform as well as those fed corn-based diets.

RELATIVE VALUE OF INGREDIENTS

When considering which crops to grow and ingredients to feed, it is important to consider their relative value. This includes the nutrient value of the ingredients, which depends on the type of grain, the quality of the grain and the way it is processed, as well as the economic value of the crops.

Nutrient Value

Corn has a high concentration of starch and contains some oil, which results in a net energy content that is 3-13% higher than that of wheat or barley. Small grains however are higher in protein, ranging from 10-15%, compared to 7-8% for corn, and contain 40 to 50% more lysine (the first limiting amino acid in swine diets) compared to corn. Thus, when using small

grains, diets will require lower inclusion levels of protein sources (soybean meal, canola meal, peas, etc.) than when formulating with corn. Small grains also have higher digestible phosphorus content than corn, which allows for reduced use of additional phosphorus sources, providing both an economic and environmental benefit. Table 1 shows the typical nutrient values of small grains relative to corn.

Table 1. Typical nutrient values (as fed) of small grains and corn.

Nutrient	Corn	HR Wheat	Soft Red Wheat	Hybrid Rye	Triticale	Barley	Hulless Barley
Dry Matter, %	88.3	88.7	86.4	89.4	88.5	89.9	89.6
Net Energy, kcal/kg	2,672	2,472	2,595	2,460	2,570	2,327	2,464
Starch, %	62.55	59.50	60.04	59.34	64.31	50.21	54.56
Crude Protein, %	8.24	14.46	10.92	11.66	13.6	11.33	12.77
NDF, %	9.11	10.60	10.60*	12.26	10.28	18.29	12.55
SID Lysine[1], %	0.18	0.32	0.29	0.32	0.36	0.30	0.33
STTD[2] Phosphorus, %	0.09	0.22	0.17	0.15	0.18	0.16	0.13
Rel NE value, %	100	92.5	97.1	92.1	96.2	87.1	92.2

NRC, 2012

[1] SID Lysine = standardized ileal digestible lysine

[2] STTD Phosphorus = standard total tract digestible phosphorus

* Data not available, used same value as hard red wheat

The fiber content of small grains is higher than that of corn, but it is important to note there are both benefits and drawbacks of using high fibre ingredients in swine diets. The benefits include the effect of high fibre on gut health of the animals. Small grains contain higher levels of soluble fibre compared to corn, which act as a prebiotic. Soluble fibre is fermented by bacteria in the gut, which produce short chain fatty acids. These short chain fatty acids not only provide a source of energy for endothelial cells within the gut but are also important in cell regulation and immune modulation within the gut (Bedford and Gong, 2018; den Bensten et al., 2013). Conversely, corn is higher in insoluble fibre, which is important for adding bulk to the stool and reducing constipation but has lower overall benefit on gut health. There are also consequences of high fibre ingredients that need to be considered, such as increased manure production and reduced dressing percentage. Since the digestibility of fibre is lower than that of other nutrients, more dry matter is excreted in the manure when pigs are fed high fibre ingredients. The result is more manure in the pits, and depending on the design of the pits, this can also impact flow within the pit. Further, feeding higher fibre diets can reduce the carcass dressing percentage of pigs, by increasing the weight of the intestine compared to pigs fed corn-soybean meal diets (Coble et al., 2018), but this tends to improve as the high fibre diet is withdrawn prior to slaughter.

Most importantly it is crucial to test ingredients and formulate based on the analyzed nutrient profile, as the variety of grain as well as the growing and harvesting conditions, will have an impact on the nutritional value.

Feed Processing

When using small grains, it is important to consider feed processing equipment. With small grains, processing requires the use of a hammer or disc mill. The use of a roller grinder does not result in optimal particle size for fibrous materials. While hammer mills are more versatile in grinding different grain types, they do tend to result in greater variation in particle size. This can be managed somewhat by use of air assist systems on the grinder, screen size, number and type of hammers. However, a hammer mill will not produce as uniform of grind as a disc mill with small grains or a roller grinder with corn. Many farm and commercial feed mills successful grind corn and small grains with hammer mills and produce mash or meal feed that works very well in wet/dry or liquid feeding systems. With roller grinders for small grains we simply cannot get grind size fine enough, even with 3 high roller grinder, as it is challenging to get below 800 microns consistently. This results in too great a loss in feed conversion due to loss in nutrient digestibility. Each 100 microns we reduce grind size we get 1.25% improvement in feed:gain which equates to approximately 5 kg of feed per pig marketed farrow to finish and a cost of $2.45 per pig or $6.4 per tonne.

Economic Value

While most wheat is produced in central and western Canada, wheat can be economic in primarily corn-based regions when it is fed on or near the farm where it is produced. It is important look at not only the yield of each crop, but the nutritional return. Table 2 shows the yield, and economic and nutritional return of major crops.

Table 2. Economic and nutritional return of major crops

	Corn	Wheat	Rye	Soybeans	Edible Beans
Yield, bushel per acre	200	80	120	70	48
Tonne/acre	5.07	2.18	2.54	1.91	1.30
Economic Return					
Revenue, $/bushel	8	12	11.75	20	46
Revenue, $/acre	1,600	960	1,410	1,400	2,200
Cost, $/acre	909	556	690	500	800
Margin, $/acre	691	410	720	900	1400
Nutritional Return NE, kcal/acre	13,537	5,335	6,248	3,986	2,786

EFFECT OF GRAIN SOURCE ON PERFORMANCE

There are considerable amounts of data comparing performance of pigs fed corn-based diets to those fed small grain-based diets. Even though small grains are lower in energy than corn, when gut fill is not a concern, pigs are able to compensate for the lower energy by consuming more feed. Wheat can be used as the primary cereal grain in growing-finishing pigs, and up to 90% of breeding herd diets. Some research indicates that while feeding increasing levels of hybrid rye up to 65% in the diet can reduce ADG and ADFI in growing-

finishing pigs, there was no effect on feed efficiency, carcass traits or cost parameters (feed cost/kg gain, feed cost/pig or income over feed cost; Smit et al., 2019). In sows, hybrid rye can replace up to 75% of corn in gestating and lactating sow diets without impacting sow and piglet performance (McGhee and Stein, 2021). Triticale fed to growing-finishing pigs reduced ADG, however resulted in no differences in feed efficiency or carcass traits compared to pigs fed corn-based diets (Brand et al. 1995). Research has shown that triticale could also replace all the corn (Monge et al. 2006) or all the wheat in nursery diets without affecting intake or growth (Beltranena et al. 2008).

CONCLUSIONS

In an effort to overcome corn rootworm, one long-term strategy would be the use of crop rotation to lengthen the time between crops on the same ground. Planting of small grains is a feasible alternative to corn as these crops can provide partial or even full replacement for the corn in swine diets. However, calculations should be made for your specific farm to verify growing an alternative grain source pencils out or if crop rotation involving soybeans or edible beans nets a higher return per acre and for your hog operation.

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LITERATURE CITED

Bedford A, and Gong J. 2018. Implications of butyrate and its derivatives for gut health and animal production. Anim Nutr. 4(2):151-159.

Beltranena, E., D. F. Salmon, L. A. Goonewardene, and R. T. Zijlstra. 2008. Triticale as a replacement for wheat in diets for weaned pigs. Can. J. Anim. Sci. 88:631–635

Brand TS, Olckers RC and van der Merwe JP. 1995. Triticale (Tritico secale) as substitute for maize in pig diets. Anim. Feed Sci. Technol. 53(3-4):345-352.

Coble KF, DeRouchey JM, Tokach MD, Dritz SS, Goodband RD, Woodworth JC. 2018. Effects of withdrawing high-fibre ingredients before marketing on finishing pig growth performance, carcass characteristics, and intestinal weights. J Anim Sci. 96(1):168-180

den Besten G, van Eunen K, Groen AK, Venema K, Reijngoud D, Bakker BM. 2013. The role of short-chain fatty acids in the interplay between diet, gut microbiota, and host energy metabolism. J. Lipid Res. 54 (9): 2325-2340.

Eastwood, L. 2021. Feeding Small Cereal Grains to Pigs. OMAFRA Factsheet #21-001 | AGDEX 444/54

McGhee ML, Stein HH. Hybrid rye may replace up to 75% of the corn in diets for gestating and lactating sows without negatively impacting sow and piglet performance. J Anim Sci. 2021 99(9):1-9.

Monge C, Hancock JD, Gugle T, Feoli C. 2006. Effects of replacing corn with triticale in diets for nursery and finishing pigs. Kansas Agricultural Experiment Station Research Reports. 10.4148/2378-5977.6949

NRC, 2012. Nutrient Requirements of Swine, 11th ed. Natl. Acad. Press, Washington, DC, USA.

Smit MN, Zhou X, Landero JL, Young MG, Beltranena E. Increasing hybrid rye level substituting wheat grain with or without enzyme on growth performance and carcass traits of growing-finishing barrows and gilts. Transl. Anim. Sci. 2019. 3(4):1561-1574.

SUSTAINABLE MANAGEMENT OF CORN ROOTWORM

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ABSTRACT

Corn rootworm is one of the most notorious corn pests in North America, not only because of their destructive behaviour in corn, but also because they have developed resistance to almost every management strategy deployed against them. In Ontario, crop rotation remains the best management strategy for this pest; however, some growers, especially livestock producers, depend on using their land for continuous corn production. Since the early-2000's, the development of corn hybrids expressing transgenic insecticidal proteins has been one of the most advantageous management strategies again corn rootworm in North America. However, resistance to these proteins has become widespread in the US and is increasing among CRW populations in Ontario. Therefore, new, or supplemental strategies for corn rootworm management are needed. A review of corn rootworm biology and management will be presented as well as recent research on the potential of entomopathogenic nematodes for biological control of corn rootworm in Ontario.

AFRICAN SWINE FEVER (ASF)- GLOBAL DISEASE STATUS AND RESEARCH UPDATE

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AFRICAN SWINE FEVER (ASF) AN OVERVIEW OF THE DISEASE

ASF is a viral disease that can affect all swine species. This virus poises no public health risk and does not infect humans. ASF is not a food safety risk, therefore pork is safe to eat. Infection with ASF is fatal to swine. This virus has never been reported in North America to date, but is spreading rapidly across Asia, Europe and in 2021 ASF was detected in the Dominican Republic and in Haiti (the Americas). This is the first time that ASF has been detected in the Americas in over 40 years. In most infected countries, wild pigs have played a significant role in disease spread and presented difficulties toward virus elimination efforts.

ASF can cause the following clinical signs in infected pigs:

- Diarrhea (sometimes bloody) and /or vomiting.
- Reddening or darkening of the skin, particularly of the ears and snout.
- Weakness and unwillingness to stand.
- Laboured breathing and coughing. Sometimes with a bloody nasal discharge.
- Abortion, stillbirth and weak litters.

Key take home message: Initially, ASF can look like many other endemic diseases that are currently present in Ontario swine farms and therefore can be difficult to detect early.

ASF RESEARCH- CONSTANTLY LEARNING

There is continuous newly published research on ASF virus. Staying up to date can be challenging. Below I have summarized a few key research finding that I feel are important to communicate.

Dr. Klaus Depner presented his ASF research findings at the 2020 Banff Pork Conference that shifted the mindset on what was previously understood. From this research he concluded the following:

- ASF in the field **<u>is not highly contagious.</u>**
    - Pigs infected with ASF have a high case fatality rate (>90%)
    - Low (initial) mortality rates (<5%)
    - Low prevalence (<5%)
    - ASF is not necessarily a density dependent process
- ASF is slow spreading, easy to control in domestic pigs, but difficult to control in wild boar.
- Survivors are not necessarily carriers and carriers are not necessarily shedders.
- Early detection is only by passive surveillance.

Key take home message: Biosecurity is the only tool to control further spread of ASF. ASF is a human driven disease and human error in biosecurity is inevitable.

OVERVIEW OF ASF VACCINES

There is no commercially licensed and available vaccine for ASF in North America. There are promising results on developing an efficacious vaccine for ASF from the U.S.A. Vietnam is the only country that has a commercially licensed ASF vaccine. This vaccine license was initially revoked due to inadvertent pig deaths associated with receiving the vaccine in an off-label manner. This vaccine license has since been reinstated.

The use of a vaccine would be the control method of choice if one becomes commercially available in developing countries with limited resources and poor veterinary structures in place.

Key take home message: Developed countries such as Canada and the U.S.A plan to control ASF through efficient and rapid detection and removal of infected and exposed animals. The decision to vaccinate against a foreign animal disease such as ASF could cause barriers with international trading partners so therefore would be considered as a last resort.

WHAT HAPPENS IF ASF IS DETECTED IN NORTH AMERICA?

All international trade of live hogs and pork products will stop immediately. Response activities will begin immediately to understand the scope and spread of disease. Federal government will lead disease response activities and provincial governments and industry will support. A discovery anywhere in North America will have implications for Canada due to the interdependency of the pork sector with the U.S.A.

The Canadian swine industry is dependent on international exports. Canadian swine farms are built using the "just in time" model. Each farm/systems ability to hold pigs longer than expected will vary from a few days up to a month in duration.

ASF EXECUTIVE MANAGEMENT BOARD (ASF EMB)- NATIONAL MODEL FOR COLLABORATION

In 2019, the ASF Executive Management Board (ASF EMB) was organized to develop and action the Pan-Canadian ASF Action Plan. The ASF EMB includes representation from Industry (Canadian Pork Council and Canadian Meat Council), Federal Government Agencies (Agriculture and Agri-food Canada, Canadian Food Inspection Agency, and the Canadian Border Services Agency), Provincial and Territorial Governments, and Animal Health Canada. Ex-officio representation also includes Environment and Climate Change Canada, Canadian Wildlife Health Cooperative and Territorial wildlife directors.

The ASF EMB has set the national model for collaborative planning in advance of a foreign animal disease being detected in Canada. This is the first time that this has been attempted in Canada in advance of response efforts for a foreign animal disease. There have been many successful strategies implemented and many lessons learned along the way. This structure will be of benefit when needed for response efforts.

CanSpotASF SURVEILLANCE

CanSpotASF surveillance is a national surveillance program designed for early detection of ASF if it arrives in Canada. Early detection will limit the spread of disease and therefore yield a more rapid response and recovery. This surveillance program is designed for situations where ASF is not suspected but cannot be definitively ruled out without laboratory diagnostics. If ASF is suspected, CFIA must be contacted directly. The ASF PCR test is an excellent test! VERY low false positive rates. Producers and veterinarians need to be engaged in and champion this program!

ASF COMMUNICATIONS

The importance of communications for both ASF prevention and for a response if detected in Canada cannot be overlooked. Nationally the ASF EMB has launched repetitive traveler awareness campaigns with the main message "Don't Pack Pork". All major international airports in Canada frequently promote this campaign. Look for these signs the next time you travel! Special attention was placed on travelers entering Canada from the Caribbean after ASF was detected in Haiti and in the Dominican Republic.

Federal, provincial/territorial governments and industry have also dedicated time to work pre-emptively together on ASF response communications to ensure that consistent messaging will be used in the case of need for an ASF response.

ASF ZONING AND COMPARTMENTALIZATION- WE NEED BOTH!

Zoning is a disease control tool that is **established after detection** of a disease. It evolves with time and **takes time to set up**. The Canadian Food Inspection Agency oversees zoning.

Compartmentalization is a disease exclusion tool that is **established in advance** of detection of a disease. Requires ongoing surveillance, traceability and biosecurity requirements that are audited routinely. Compartmentalization **causes little to no trade interruption.** The Canadian Pork Council provides oversite and administration of compartmentalization.

Take Home Message: Both compartmentalization and zoning are tools that work in synergy with each other. We need both in place simultaneously in Canada!

WEBSITE RESOURCES

Canadian Food Inspection Agency website

Animal Health Canada website

Canadian Pork Council website

CanSpotASF Surveillance website

Ontario Pork's website

Swine Health Ontario's website

Prairie Swine Center's small-scale producer website

AFRICAN SWINE FEVER: ONTARIO PLANNING AND PREPAREDNESS UPDATE

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INTRODUCTION

Since early 2019, Ontario has been developing prevention, preparedness, response and recovery plans due to the threat of African Swine Fever (ASF). This has been a collaborative effort between industry, provincial and federal governments with the aim of avoiding duplication of planning efforts across the different groups. Ontario has relied on expertise from different government ministries, industry, and academics to build an ASF planning and preparedness toolbox, that can be adapted to different farms and different scenarios. The following paper highlights some of the work done to date on ASF planning and preparedness in the province.

THE ONTARIO SITUATION

The Ontario pork industry is dynamic and a large part of Ontario's economy. In 2022, the industry generated $1.35 billion in GDP, $3.78 billion in economic output and provided over 19,000 full time job equivalents (Ontario Pork, 2022). In 2022, 997 producers marketed nearly 6 million pigs, and while the average number of pigs per farm is about 1,400, there is a wide variability in pig numbers from farm to farm. We also know that there are an estimated 620+ trucks on the road every week moving pigs to market and out of province (not including farm to farm movements). On average, Ontario exports 60-70% of the pork produced within its borders (either as live pigs or pork products).

To understand how an ASF incursion would impact Ontario, one must understand the weekly flow of pigs through the province. Ontario relies heavily on regular exports of live pigs, both to other provinces and into the United States. Table 1 summarizes the estimated weekly pig movement in early 2023, although the number does fluctuate on a week-by-week basis.

Table 1: estimated weekly pig movement of animals in early 2023.

Pig Type	Movement
Market pigs, processed in Ontario	~97,000
Market pigs, processed in USA	~20,000
Market pigs, processed in Quebec or other Provinces	~8,000
Cull sows and boars, processed in USA	~2000
Weaner pigs, to USA	~15,000
Weaner pigs, to Quebec	~8,000
Total pig flow to market or across borders per week	~150,000
Total pig flow that must leave Ontario per week	~53,000

Overall, we have estimated that 125,000 pigs move to slaughter within Ontario or across a border (provincial or federal) every week, and an additional 25,000 other pigs (cull sows and boars, weaners) move into the USA or Quebec. Of the 150,000 pigs that move to slaughter or across a border each week, 53,000 of those currently leave Ontario with the final product

marketed and sold outside of the province. This is important to remember in the context of an ASF or other foreign animal disease outbreak which would close our international borders to trade – thereby not allowing these pigs to move to their normal destinations.

In the event of an ASF incursion in Canada, we would have two separate pig populations to deal with. First, the population of infected pigs, for which response would be led by the Canadian Food Inspection Agency (CFIA) with the goal of controlling and eradicating the disease as fast as possible (including humane depopulation and safe disposal). Second, and likely the larger population, are the healthy pigs that no longer have a market due to borders closing and trading partners not accepting Canadian pork. This response will be led by industry with support from provincial and federal governments and will include the humane depopulation and disposal of surplus animals.

Depending on the farm situation and nature of the outbreak in the country, some pigs will have nowhere to go for processing, some pigs may be processed but either partially or minimally due to oversupply, and it is expected that market prices would collapse initially due to surpluses. In this situation, producers will be faced with various difficult decisions to work through for their own operations, including whether to keep feeding the existing growing hog inventory, whether to abort bred sows, whether to hold (open) existing sow inventory or even whether to stay in hog production at all.

ONTARIO'S PLANNING & PREPAREDNESS INITIATIVES

When dealing with an emergency response, governments use an Incident Command Structure (ICS) to work together to achieve the same goal. The structure is designed to prevent duplication of tasks, allows for efficient use of resources, provides a platform for communication, provides a common organizational structure, provides coordination for response efforts, and incorporates a risk-based approach to decision making. The CFIA and the Ontario Ministry of Agriculture, Food andRural Affairs (OMAFRA) both use this structure when dealing with a major animal disease response. In order to align with this structure, the swine industry, through Swine Heath Ontario, also developed an ICS structure for industry response called Ontario Swine Incident Command Centre (OSICC). Through proper communication structures, all three ICS's will be able to work collaboratively during an ASF event.

There are a lot of moving parts to the prevention, planning and recovery work that has been going on around the province, and a lot of different people involved in the work. The following list is a summary of some areas that the Ontario industry and provincial government have been working on (not an extensive list), with more in-depth descriptions of some areas following:

- Economics and funding programs
    - Existing Business Risk Management programs are available to assist producers in managing risks such as disease events and market volatility
    - Ontario Pork is assessing the need for new programs/supports and advocating with government for programs that suit Ontario industry needs

- Production planning
    - Understanding animal flow and impacts of disruptions on flow
    - Development of producer decision trees and other guidance materials
    - On-farm emergency planning
- Depopulation and disposal planning
    - Joint OMAFRA-Industry team since 2019
    - Identification of gaps, assessing resources and developing plans
    - Representation at the national level
- Other
    - Ontario's Wild Pig Strategy
    - Connecting with small scale (backyard) pig producers and development of resources
    - Tabletop exercises to test response activities
    - Coordinated communications plans

Depopulation and Disposal Planning

Ontario's depopulation and disposal planning group has been a collaborative effort since its inception in 2019. The primary team members are made up of staff from OMAFRA, Ontario Pork, Swine Health Ontario and the Ontario Ministry of Environment, Conservation and Parks (MECP). Additional groups were consulted regularly, including producers, academia, veterinarians, processors, livestock transporters, renderers, landfills and the CFIA. The aim of the team was to assess available methods, identify gaps, find solutions, and come up with a plan for managing the situation of both infected and non-infected animals.

For depopulation planning, the team developed a set of guiding principles and selection criteria for determining what methods would be acceptable for the province. The primary considerations were animal welfare, human welfare, and worker safety. Secondary considerations were given to animal flow, cost, ease of use and public perception. With this in mind, the team developed a list of acceptable and non-acceptable methods which could be used to depopulate large numbers of animals. Acceptable methods include the use of processing plants, mobile nitrogen gas-based trailers (these were conceptualized, designed, built and are now available), captive bolt guns (penetrating and non-penetrating based on pig size), firearms and on-farm CO_2 boxes. Unacceptable methods of depopulation are ventilation shut down (with or without added heat/steam) and release of animals into the wild.

For disposal planning, the team also developed a set of guiding principles and selection criteria for determining which methods would be acceptable in the province. These included consideration for diseased vs. healthy pigs, the method and location of depopulation, worker safety, environmental sustainability (operating with current deadstock regulations) and public perception. Acceptable methods include the partial salvage of pork (healthy animals only), rendering (healthy animals only), landfill, on-farm composting, and on-farm burial. Incineration and wilderness dumping are not permitted in Ontario, and above ground burial is currently in the research stage to determine its viability for the province.

Ontario's Wild Pig Strategy

In Ontario, a wild pig is defined as any pig outside of a fence that is not contained or under the physical control of any person or is otherwise roaming freely. This includes escaped/released Eurasian Wild Boar, escaped/released domestic pigs and any hybrids. Although we do not currently have any actively breeding populations of wild pigs in Ontario, there are observations of pigs out on the landscape around the province. To address this, the Ministry of Natural Resources and Forestry (MNRF) released Ontario's Strategy to Address the Threat of Wild Pigs (www.ontario.ca/wildpigs), with the goal of preventing the establishment of invasive wild pigs in the province. As of Jan 1, 2022, pigs (*Sus scrofa*) are now regulated as an invasive species under the Invasive Species Act, with the following restrictions:

- Release of any pig into the environment is prohibited (escapes must be reported)
- Import, possession, transport, propagation, lease, trade, buying and sale of Eurasian Wild Boar and their hybrids is prohibited
    - Existing live farmed Eurasian Wild Boar and their hybrids are being phased out of Ontario by Dec 31, 2023
- Hunting of wild pigs is prohibited (with exceptions for the protection of property)

If you see a wild pig on the landscape, it is imperative that you report the sighting, with as much information as possible, to MNRF at wildpigs@ontario.ca or 1-833-933-2355. MNRF can also set up trail cameras to confirm wild pig activity and trap and remove pigs when required. Additionally, the Ontario Federation of Anglers and Hunters (OFAH) is assisting the province by helping to find wild pigs and reporting them. To do this, they have created a wild pig trail camera detection protocol which provides science-based guidance on how to set up cameras to detect wild pigs. They may also be able to assist with obtaining and setting up cameras in certain areas. You can find more information on their activity at www.ofah.org/issues/wild-pigs-in-ontario.

Small Scale (Backyard) Producer Communications

Over the last few years there has been a large effort to connect with small scale pig farms across Ontario and Canada, to help educate producers on the risks of ASF and the importance of biosecurity and safe feeding practices. This effort has included delivery of courses by OMAFRA staff through Grey County Ag Services in 2020, 2021 and 2022, a presentation on best fencing practices for outdoor pigs at Canada's Outdoor Farm Show and development of OMAFRA Factsheets on fencing (www.ontario.ca/page/fencing-outdoor-pig-production-protecting-your-livestock-and-environment) and keeping livestock contained (www.ontario.ca/page/best-practices-keeping-your-livestock-contained). Ontario Pork released a small-scale producer manual (https://ontariopork.on.ca/producers/small), as did the Canadian Association of Swine Vets (https://www.casv-acvp.com/small-scale-pig-farming.html). Most recently, the Prairie Swine Centre developed a website dedicated to Canadian small-scale pig farmers, designed to provide science-based guidance on raising pigs outside in Canada (www.smallscalepigfarming.com).

CONCLUSIONS

As you can see, Ontario has been busy developing prevention, preparedness, response and recovery plans due to the threat of African Swine Fever (ASF). The collaboration between industry, government and academia has been key to the success of our planning efforts and has become a model for other provinces throughout the planning process. Development of an ASF planning and preparedness toolbox allows flexibility in dealing with a response, based on different farms and scenarios.

ACKNOWLEDGEMENTS

We would like to thank the vast number of people who have contributed to Ontario's ASF planning and preparedness initiatives over the last several years. It has not been an easy task, but with the collaboration and willingness of individuals across the Ontario government, industry and academia, Ontario is in a much better position to manage the impacts of an ASF outbreak than we were in 2019. Planning continues on many fronts, and we thank all of those who are still working on this task.

ON-FARM EMERGENCY PLANNING

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INTRODUCTION

An on-farm emergency can happen at any time, in any number of ways. Barn fires, accidents/injuries, environmental issues, natural disasters, animal care emergencies, protests, mental health, and foreign animal diseases are just some examples of different things that may hit unexpectedly. The thought of preparing for an emergency, especially something like an outbreak of African Swine Fever (or other foreign animal disease), can be daunting and scary. But it is much better to build a plan in advance of a crisis, so you can think through your options, understand your farm's limitations and not have to make critical decisions in the heat of the moment.

Planning for the potential arrival of African Swine Fever in Canada has been occurring at the provincial and national levels since early 2019 (for a snapshot of some of the work that is ongoing, visit Animal Health Canada's website at https://animalhealthcanada.ca/african-swine-fever). Now is the time for you to do your part and get ready on your farm by developing an on-farm emergency plan.

WHAT IS AN ON-FARM EMERGENCY PLAN?

An on-farm emergency plan is a document that:

- Details all pertinent information about your animals, production/management system, farm property, family members and farm workers.
- Helps inform others of how best to assist during an emergency (including family, staff, neighbours and first responders). Remember, many people assisting during an emergency may not have any knowledge of your farm.
- Sets out processes and procedures for dealing with specific situations so that time and resources are used most effectively and efficiently during an emergency.
- Helps producers assess the potential risks and identify where they can improve practices or mitigation efforts. A little time spent adopting proactive measures now may save a lot of time and money later.
- Should be stored in multiple locations off-farm.
    - It is best to have your immediate emergency contacts, address, 911 number in the barn, but store your completed plan off site in a home office or digitally. This prevents potential trespassers from gaining access to your completed plan.

WHY SHOULD FARMS HAVE AN ON-FARM EMERGENCY PLAN?

There are several reasons why an on-farm emergency plan is important:

- Decisions are made in a low stress time, not in the heat of the moment.

- Outlines what resources you have, and what the limitations are for your farm.
- Pulls together animal and human welfare, environmental considerations and financial implications.

Having an on-farm emergency plan can provide peace of mind to you, your family and your staff going forward. There will always be unforeseen circumstances during an emergency, but having a plan allows you to put your efforts into individual tasks during an incident, instead of figuring out the overall response needed. A plan also allows for financial planning with a focus on business continuity and may show confidence to your financial lenders and/or insurers. In an emergency that affects the whole industry, having on-farm emergency plans means the situation can be resolved more quickly and things can begin to return to normal sooner.

In the case of a foreign animal disease outbreak (e.g. ASF), it is important to know that you will be asked for your emergency plan by CFIA, OMAFRA and/or Ontario Pork. If you are a suspect positive farm, the CFIA will need your farm maps and layouts before they arrive on site to investigate. Ontario Pork and/or OMAFRA may require your plan when responding to a welfare cull situation, so we can figure out how to get equipment or personnel on and off farm safely and efficiently.

HOW TO BUILD AN ON-FARM EMERGENCY PLAN

There are tools and resources to help you through the process of building your on-farm emergency plan. In 2017, Ontario Pork released their On-Farm Emergency Response Planning guide, which you can access at http://ontariopork.on.ca/Resources/Emergency-Planning. This guide walks you through the development of a plan in a straight-forward, step by step manner. It includes chapters for barn fires, accidents, environmental issues, animal care, foreign animal disease, protests and mental health. Farm consultants such as your nutrient management consultant will also be able to provide valuable information needed for the plan. Additionally, Ontario Pork, Swine Health Ontario and OMAFRA staff can help you develop your plan through Ontario's On-Farm Emergency Planning Project. You can register for help by emailing emergplans@ontariopork.on.ca or Jessica.fox@swinehealthontario.ca.

A good On-Farm Emergency Plan should include the following information:

- Farm property information
  - Full address including the 911 number and directions
  - Aerial map showing the full farm layout with road access, building locations, etc. (Figures 1 and 2)
- Family member and farm worker information
  - Contact phone numbers and relationship to owners
- Animal information
  - Full inventory with types and ages
  - Location of animals within the barn
- Other contact information
  - Veterinarian, feed company, processors, animal owners/contractor, banker, insurance agent, etc.

- Depopulation and disposal plan
    - How long can you hold animals on farm if there is a stop movement?
    - When and how would you stop breeding sows?
    - Depopulation methods available on farm, and who is trained to use them?
    - What percentage of the herd population can be disposed of on farm (burial and/or composting)?
    - Where can disposal sites be located (Figure 3)?
        - Determining disposal sites needs to consider many regulatory setbacks as well as public view. Your nutrient management consultant can help you plot all of the different setbacks to determine the locations and sizes of disposal areas

SUMMARY

Developing an on-farm emergency plan is extremely important in helping prepare for a foreign animal disease outbreak such as African Swine Fever. Planning for the potential arrival of ASF in Canada has been occurring at the provincial and national levels since early 2019. Now it's time to make sure your farm is ready by developing your own on-farm emergency plan.

We know the task may be daunting, so help is available through Swine Health Ontario, Ontario Pork and OMAFRA. Please email emergplans@ontariopork.on.ca or Jessica.fox@swinehealthontario.ca to sign up for assistance. Students are available to work with you on building your farm maps and plans.

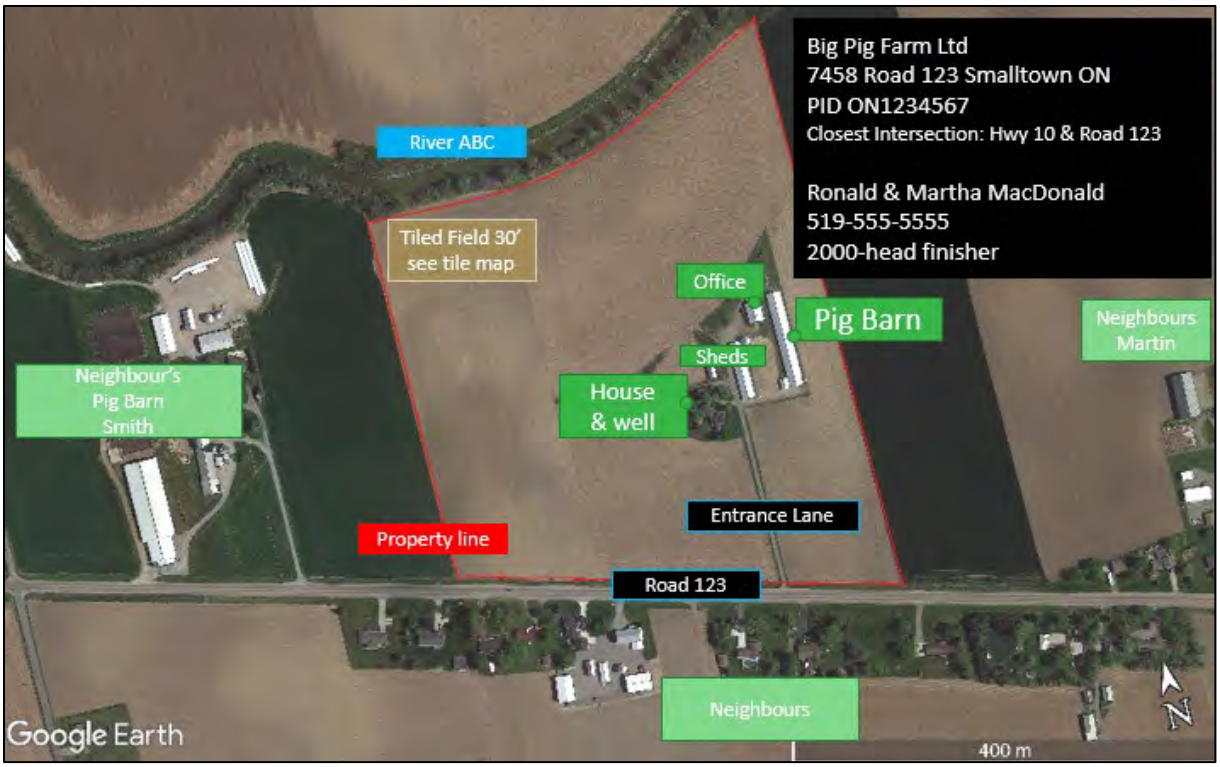

Figure 1: Aerial map showing full property view with property line marked and all buildings labelled (image obtained from Google Earth).

Figure 2: Aerial map showing closer farm detail, with barn layout, animal numbers, doors, etc. labelled (image obtained from Google Earth).

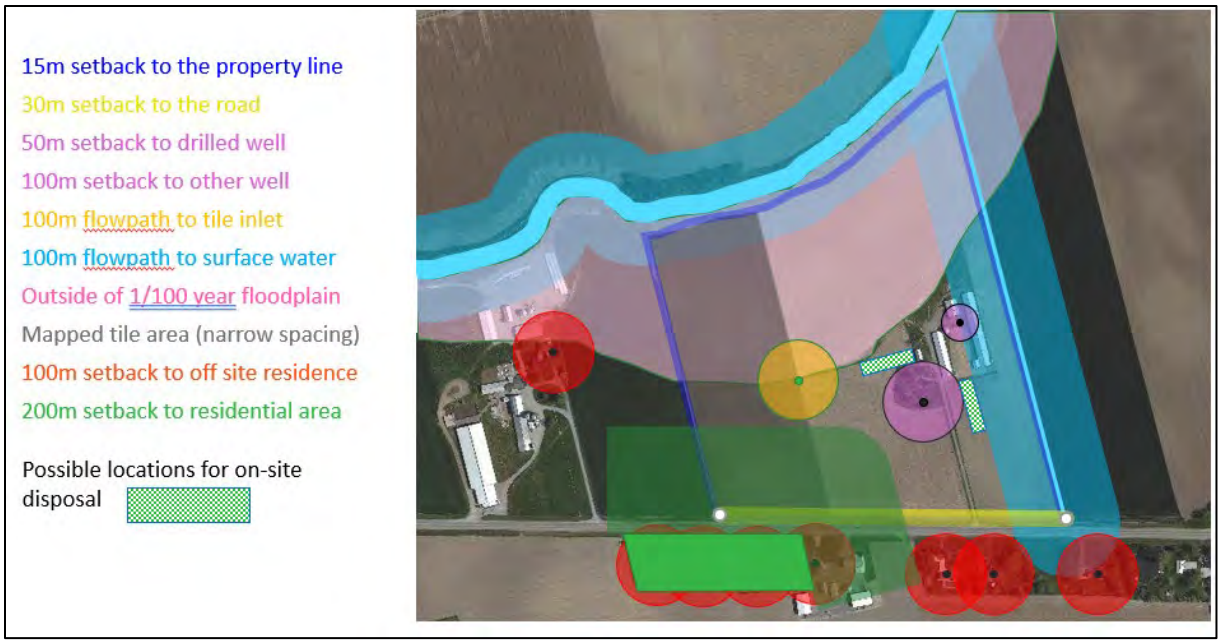

Figure 3: Aerial map showing potential deadstock disposal sites with all setback considerations highlighted (image obtained from Google Earth).

NURSERY DIETS - ANTIBIOTICS, ZINC, AND ALTERNATIVES

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BACKGROUND

Zinc oxide (ZnO) is an ingredient used in starter pig diets for decades to help reduce the incidence of post-weaning diarrhea and aid in growth promotion. Although we can see the positive benefits it provides to the animal, its microbiome, and its performance, we do not understand how it works. Likewise, antibiotic use is more heavily regulated and certain categories of antibiotics can no longer be used. If they are used, they must be properly scripted for administration. For the first two weeks post-weaning, piglets are faced with many stressors and challenges that can affect their health and growth throughout the nursery period, a time where they can grow quite efficiently. Ultimately, these stressors lead to reduced feed intake and growth and increases morbidity and mortality. Low feed intake is of particular concern as this contributes to a thinning mucosal layer in the intestine further contributing to the occurrence of enteric disease, reducing absorptive capacity and feed efficiency.

With each batch we wean, we come closer and closer to the deadline where our industry will no longer be able to use more than 500 ppm of ZnO in our starter feeds (exact level still to be determined). Zinc is considered the "magic" ingredient to help reduce post-wean fecal scours in newly weaned pigs. In our starter diets, it is common to include ZnO in levels between 2500 and 3000 ppm. Similarly, starter diets are often medicated to help pigs combat disease challenges at a time when their immune system is most fragile, and they face disease pressure. With the removal of antibiotics and ZnO in nursery diets it is essential to find alternative ways to maintain performance.

This change will not be a simple switch, simply one ingredient for another. When the deadline comes in 2026, to succeed, it will need to be a multifarious approach with nutrition and management practices.

FEED

Pre-Weaning Feed

One of the major issues with piglets at weaning, is that their digestive system is still specialized to digest milk. Once they are in the nursery phase, they are typically fed a diet formulated with corn, soybean meal and wheat, all containing starch. At this age, pigs have higher levels of lactase, the enzyme required to break down lactose, but have relatively low levels of maltase or sucrase, which are enzymes required for starch digestion. It is not until 5 weeks of age where maltase and sucrase levels exceed that of lactase. The activity of these enzymes is not only related to the age of the pig, but also to its weight and to the diet to pig is exposed to. As piglets get heavier, maltase and sucrase activities start to increase, therefore by providing feed pre-weaning, weaning weights can be increased, improving their

ability to digest plant-based carbohydrates. Additionally, exposure to feed pre-weaning can assist with increasing feed intake post-weaning, since pigs are already familiar with consuming pelleted feed. Therefore, pigs may benefit from the provision of plant-based diets pre-weaning. It was found that milk replacer was consumed the most readily in the suckling phase, leading to heavier weaning weights (1).

Starter Feed

It is important to remember that when a piglet has diarrhea in the first two weeks post-weaning, the challenge is not always health-related and could be related to a dietary change or improper feeding at certain phases. Feed budgets are formulated and targeted towards specific weights and ages of the pig to meet their physiological needs. Following budgets targeted toward the piglets' weight and age is essential to helping the gastrointestinal tract (GIT) transition as it becomes more complex. Looking at protein levels in the diet is important because, for the first two to three weeks post-weaning, the gut has a hard time digesting and absorbing high-protein ingredients such as soybean meal. Often, over-feeding protein can lead to diarrhea, which is why feeding for the optimal gastrointestinal environment is critical (2).

Fiber is an important ingredient to consider when looking at contributing to the microbiome and gut health post-weaning. Insoluble fiber has proven to help bind to *E. coli* bacteria to avoid it colonizing in the gastrointestinal tract (GIT) of the pig.

FEED ADDITIVES

Yeast

Yeast can be provided in three forms, a probiotic, prebiotic or postbiotic. Probiotics are live microorganisms which can be consumed to elicit a beneficial response. Typically, bacteria are used as probiotics, however non-bacterial microorganisms, such as yeast is also categorized as a probiotic. A prebiotic is a nondigestible substrate (i.e., fiber) that microorganisms can utilize as energy, which can assist in the proliferation of beneficial gut bacteria. A postbiotic differs from a pre- or probiotic such that it is an inactivated cell, that contains its cellular components and metabolites. One application of postbiotic yeast is in nursery feed as it has contains β-glucans and mannan oligosaccharides which are functional and are responsible for the immunomodulating properties and prevention of pathogenetic bacteria (e.g., *Escherichia coli*) binding and proliferating on intestinal surfaces. The mode of action differs from ZnO which improves growth performance by increasing feed intake and, therefore, alleviating the negative effects typically associated with the post-weaning growth lag (i.e., high intestinal pH, thinner mucosal layer, reduced expression of tight junction proteins). Recent work has demonstrated that HY40 had positive effects on growth, histomorphology, nutrient digestibility, and immune activation in nursery pigs (3).

The ability for the piglets to thrive post-weaning is not only a result of these different stressors but can also be related to their biological dam, and what she has been provided throughout gestation and lactation. The sow not only influences offspring performance through genetics, and milk production, but what she puts into her colostrum and milk and the microbes she exposes her piglets to play a large role in early piglet health and follows piglets through the nursery. The sow typically has high feed intake, meaning feed additives

can be applied in appropriate dosing more consistently than when provided to nursery pigs at weaning. Postbiotic yeast can be beneficial during this phase of production as well, as it can increase immunoglobulin transfer to the piglets. Yeast has also been proposed to assist in the maintenance of a healthy microbiome, which is particularly advantageous for gilts. This is because they have higher nutritional requirements due to mammary gland development, and higher maternal requirements going towards growth.

Acidifiers and Extracts

In the pig, protein digestion starts in the stomach with the enzyme pepsin. Pepsin requires an acidic environment to function. Pepsin is lacking in this neonatal animal. Undigested protein can move through the stomach to the small intestine where it often will cause diarrhea. Acidifying the animal's feed or water is an excellent way to help reduce the stomach content pH and help aid digestion. This will also allow the pig to use up more of the ingredient feedstuffs before it reaches the hind gut. Acidification can also be used to help mitigate or kill off bacteria in the stomach before moving to the small intestine where they could colonize and cause more severe illness. Enzymes can help aid in the digestion of nutrients in different parts of the GIT. Essential oils and abstracts can be offered in the diet to help kill bacteria or limit their effect under suitable conditions (4).

MANAGEMENT

Biosecurity and Hygiene

In a world where we are constantly battling high disease pressure and naïve immune systems, it is important that we do the best job possible to place piglets in a clean, disinfected, dry area with appropriate temperature. Proper sanitation is essential for the newly weaned animal because the transfer of passive antibodies from sow to piglet lasts only for a short time post-weaning. It is then that the piglet must rely on its own immune response from vaccination, which may not be built up to the fullest level within the first few days post-weaning (4). Following a standard operating procedure ensuring proper cleanliness and hygiene is critical to help these piglets transition in the first few days post-weaning. As we work towards a common goal of reducing ZnO and antibiotic use, this is a critical point in successfully helping the newly weaned pig enter its new environment.

Weaning Weight and Age

The age of the piglet at weaning can significantly affect how well the animal starts off in the first week in the nursery. Although this is not a change that can happen in sow operations overnight, considering pig flow and logistics, weaning a piglet later results in a neonate with a more developed digestive system and microbiome. This will enable them to take on a more efficient transition onto solid feed and a new environment (5). Weaning weight does not necessarily have as significant an impact as weaning age; however, these two factors are often correlated resulting in heavier weights with older weaned pigs.

Training the Piglet to Eat

It is our role when working with newly weaned piglets to take the time to teach them how to eat and adapt to solid feed. Prior to weaning, it is possible that they have never consumed

solid feed depending on milk consumption, particularly in the last week prior to weaning. Having as much fresh feed in front of these pigs as possible and allowing them to eat in a social environment, i.e. with round feeders, mat or pan feeding etc., can help promote feed consumption. Consider other management techniques to help the physiological and textural feed change such as gruel feeding which also aids in getting more water into the pig. ZnO and antibiotics have been used to help mask a post-wean challenge. Many of the issues faced post-weaning are a result of feed intake being too low to meet requirements. This low feed intake also allows opportunistic bacteria like E. coli to bind and proliferate in the intestine leading to diarrhea. Therefore, solid feed intake early on is key to aiding in a healthy gastrointestinal tract and mitigating scours and other health challenges.

CONCLUSION

As an industry, it is important that we are continually looking for ways to help our newly weaned pigs overcome post-weaning diarrhea. ZnO and antibiotics are useful tools to help reduce clinical signs of illness; however, their therapeutic use must come to an end. It lies with industry partners, farmers, researchers, and veterinarians to work together to find the best solutions to help our piglets avoid this additional stress at weaning and the impact it may have on their overall growth, health and efficiency.

By implementing different feed additives and management practices, it is possible to maintain growth of nursery pigs with the removal of ZnO and in-feed antibiotics. These will work together to maintain the pig's gastrointestinal barrier and boost their immune system. This will allow them to remain healthy in the nursery, reducing administration of antibiotics. However, to make the switch from ZnO and antibiotics, a combination of management practices and feed additives are going to be required. More work still must be done to determine what combinations of each will yield the best results.

REFERENCES

1. Christensen, B., and L. Huber. 2021. The effect of creep feed composition and form on pre- and post-weaning growth performance of pigs and the utilization of low-complexity nursery diets. Transl. Anim. Sci. 5:1–14.
2. Engelsmann, M.N. et al. Age-dependent development in protein digestibility and intestinal morphology in weaned pigs fed different protein sources. J. Anim. Sci 2022; 16.
3. Christensen, B.; Zhu, C.; Mohammadigheisar, M.; Schulze, H.; Huber, L.A.; Kiarie, E.G. Growth performance, immune status,gastrointestinal tract ecology, and function in nursery pigs fed enzymatically treated yeast without or with pharmacologicallevels of zinc. J. Anim. Sci. 2022, 100:1-14
4. Bouyahya, A.; Abrini, J.; Dakka, N.; Bakri, Y. Essential oils of Origanum compactum increase membrane permeability, disturb cell membrane integrity, and suppress quorum-sensing phenotype in bacteria. J. Pharm. Anal. 2019, 9, 301–311.
5. Shimoji Y, Oishi E, Muneta Y, Nosaka H, Mori Y. Vaccine efficacy of the attenuated Erysipelothrix rhusiopathiae YS-19 expressing a recombinant protein of Mycoplasma hyopneuniniae P97 adhesin against mycoplasmal pneumonia of swine. Vaccine. 32 2003;21:532–537.

GLOBAL ANIMAL HEALTH OUTLOOK AND HORIZON ISSUES

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ABSTRACT

Influenza A viruses infect swine worldwide and can result in serious economic losses. In addition, there is a great deal of concern about the public health aspects of influenza infection in pigs. In recent years, the number of different influenza viruses circulating in swine herds around the world has increased and this has made control much more challenging and much more important.

INTRODUCTION

The title was created by the conference organizing committee and implies a presentation that is possibly more ambitious than what we can accomplish in 90 minutes and is beyond our collective expertise. We have, out of necessity, reduced the scope of the talk to deal with just one emerging, global swine health issue, influenza. There certainly are numerous global health concerns involving pigs that could have been included, such as the remarkable spread of African swine fever and Japanese encephalitis far beyond their traditional regions of endemic infection. Porcine reproductive and respiratory syndrome continues to evolve and pose a serious economic threat to the swine industry worldwide. However, in the interest of time and in an attempt to encourage a meaningful discussion about a disease problem faced by many producers in Ontario, we have chosen influenza. This is a disease that probably doesn't receive enough attention and yet it is a global health concern to humans and animals and it has the potential to dramatically impact the world economy and social order.

HISTORY OF INFLUENZA

The name "influenza" is Italian, meaning influence, first used in the 1500's to describe disease outbreaks causing widespread illness in the city states such as Venice. Initially the term referred to a wide variety of plagues and disease outbreaks, possibly not all caused by influenza virus. The disease we know today as influenza, caused by the influenza virus, has likely been around for centuries but with certainty we know that a pandemic caused by influenza virus occurred in 1918-1919 and health researchers have studied this disease ever since.

Human influenza pandemics have occurred four times in the last 100 years (with pig to human transfer implicated in two of the outbreaks). In 1918, a disease (Spanish flu) caused by an H1N1 influenza A virus spread around the world and killed over 20 million people. In 1957, a distinctly different influenza virus (an H2N2 virus) caused a second pandemic, the disease commonly referred to as Asian flu. In 1968, the Hong Kong flu, caused by an H3N2

virus caused a third pandemic and then in 2009, a very different H1N1 virus caused a disease commonly referred to as “swine flu”.

The influenza virus has been more stable in the pig population compared to the human population and it is more likely that the transfer of influenza virus from humans to pigs is a far more common event than pig to human spread. After the 1918 pandemic the H1N1 influenza virus settled into the pig population around the world, being first isolated in 1930. Whereas the human population dealt with new viruses in 1957 and 1968, the same H1N1 virus remained the dominant virus in pigs in North America until an H3N2 virus appeared in the 1990’s and entered Ontario in 2004. Mixing of the two virus occurred creating a H1N2 strain and then the human pandemic strain of 2009 entered the pig population. Unfortunately now there are multiple virus types in the Ontario pig population, and this makes control much more difficult.

THE INFLUENZA VIRUS

There are a few important facts about the influenza virus that help to explain why this virus is such a problem. There are 4 major types, influenza A, B, C, and D. But only influenza A virus is recognized as a problem in swine and we will restrict the talk to this virus; sometimes the name is shortened to IAV or formerly SIV referring to swine influenza virus.

Influenza is a small RNA virus, like coronaviruses and PRRS virus, and like those viruses it frequently makes mistakes as it replicates and this causes mutations. So the virus is constantly changing slightly. This makes vaccination difficult because after a while the virus can change enough that previous antibody protection no longer protects completely. This helps it persist in a population.

In addition to this mutation process that causes small changes in the virus, influenza can make sudden big changes, essentially creating a new virus. This occurs when two different influenza A viruses infect the same host at the same time. The influenza A virus has 8 segments of genetic material (like Lego blocks), and these segments can be exchanged, resulting in new viruses when reassembled. There are 256 possible combinations when this happens. The 2009 pandemic virus is believed to be the result of the North American pig influenza virus mixed with the European pig influenza virus. The new virus was capable of infecting humans and readily spread from human to human around the world and eventually back to pigs.

In order to discuss the various types of influenza A viruses it is necessary to mention how they are characterized. The viruses have two types of projections on their surface. One is called hemagglutinin or “H” and the other is neuraminidase or “N”. Pigs have receptors for viruses carrying H1 or H3 projections. It should be noted that most of the receptors are found in the pigs lower respiratory tract with a smaller number in the nasal and tonsillar area.

CLINICAL DISEASE

It is relatively easy to identify an outbreak of influenza in a naïve herd that doesn’t have background immunity. Pigs show the same clinical signs as humans, including fever, barking

cough, sneeze and runny nose, muscle ache and lethargy. The disease spreads rapidly and can affect all age groups but may appear more severe in the older animals. Individual pigs are sick for about a week and mortality is usually low unless there are secondary infections. Combinations of infection of IAV and PRRS, along with bacterial pathogens such as *Mycoplasma hyopneumoniae* and *Pasteurella multocida* can result in severe lung damage. The term respiratory disease complex is sometimes used to describe this type of scenario. In Ontario many herds have at least one IAV strain circulating in the pig population. Pigs are weaned with some immunity gained from the sow but this passive immunity disappears in the nursery where the susceptible pig may encounter the virus from older pigs. Although the individual pig may overcome the infection within a week of exposure, the overall nursery population can remain continuously positive, with coughing and possibly slow growth rate.

DIAGNOSIS

A diagnosis cannot be made based only on clinical signs because there are a number of diseases causing respiratory disease in pigs, including numerous emerging pathogens. Virus isolation can be a little difficult because pigs remain positive for virus in the upper airways for only a few days, whereas the clinical signs may persist for much longer. Microscopic examination of the respiratory tract at post-mortem examination can be very helpful. Serological examination can also be useful to demonstrate previous exposure to the virus. Arriving at a diagnosis is often complicated by the presence of multiple pathogens.

CONTROL

Efforts to prevent influenza from entering should include screening incoming breeding replacement stock, but also keeping workers or visitors with signs of flu from entering the barn and encouraging workers to get their yearly flu shots.

Control of influenza when its present in a herd generally depends on vaccination. Vaccines need to be directed at the specific virus type that is present on the farm, and that has become much more difficult because of the numerous virus types now circulating on Ontario farms as well as the problem of the virus continuously making slight changes. Not everyone agrees regarding the timing of vaccination, for example, whether to vaccinate the sow herd, or vaccinate nursery pigs, or both. Vaccine technology is changing and there is now some choice in the type of vaccines available.

Although there are no anti-viral drugs available for swine, there are situations where antibiotics may be useful to control secondary bacterial infections and there may be a place for anti-inflammatory drugs to control fever.

We will use some case scenarios to discuss these issues in more detail.