

# Shortening Duration of Swine Exhibitions to Reduce Transmission of Influenza A Virus

*[Announcer] This program is presented by the Centers for Disease Control and Prevention.*

[Sarah Gregory] Hello, I'm Sarah Gregory, and today I'm talking with Dr. Andrew Bowman, an associate professor at The Ohio State University's Department of Veterinary Preventive Medicine. We'll be discussing shortening the number of hours for swine exhibitions to reduce influenza A transmission. This is Dr. Bowman's second time on our podcast.

And welcome back, Dr. Bowman.

[Andrew Bowman] Great, thanks for having me.

[Sarah Gregory] Some basics here, what is influenza A virus as opposed to the B strain?

[Andrew Bowman] Influenza A virus, if we think about influenza in general, there's multiple different strains, and one of those is the different types—and so, type A, type B, and then there's the lesser (at least, in people) C, and then type D. So type A and type B are the major ones that cause disease in people. Certainly, type A is the predominant one, as we think about major disease and pandemics, are type A. Type B is certainly a major disease burden, and we see it in seasonal epidemics, but type A is the big one that we really worry about from a not only seasonal strain, but also pandemic strains.

[Sarah Gregory] Okay. So it affects people, but it also affects pigs and birds and other animals, right?

[Andrew Bowman] Correct. That's one of the distinguishing features of type A influenza. It is the type A influenza that infects pigs and infects birds and infects people, dogs, mammals—multiple species are infected by type A influenza. And that becomes a major issue for us as we think about how we're going to try to prevent the next pandemic, due to the fact that pandemics arise due to an animal-to-people transmission.

[Sarah Gregory] How is it spread from these animals to people?

[Andrew Bowman] We've got to have an animal-human interface, and so, some sort of direct contact. So usually it's going to be shed from the animal species and whether it...if it's a respiratory pathogen in that host species, then airborne transmission is possible. Or we also have transmission occur through touching animals and then touching points of entry on people, and so that might be touching an animal and then wiping your nose or something like that. Certainly, the routes of transmission vary depending on the animal species, and then how people are interacting with them. But it's usually contact with the infected animal and then transmission into the susceptible person.

[Sarah Gregory] And your study is about pigs. How prevalent is it among pigs?

[Andrew Bowman] Influenza is certainly an ongoing issue in pigs, and so type A influenza causes disease in pigs and it's one of those things that prevalence is a little hard to determine, because it depends on age of the pigs, location, different production systems. But we get ranging anywhere from, if we take it on the herd level, it's quite a few herds, probably. Most herds experience influenza at some point in time to an individual animal level where, depending on the production system at any given time, we may have an outbreak where most of the pigs are

infected, all the way down to where we're just doing cross-sectional surveys and we may be down to 1% of the animals are infected.

[Sarah Gregory] What are the symptoms in pigs?

[Andrew Bowman] Pigs infected with influenza show a wide range of clinical signs, and those can be anything from what we're used to as people infected with influenza—so, coughing, nasal discharge, fever, loss of appetite, to subclinical infections where we really don't see any signs of disease, where we know they're infected if we test them, but our observations of them really don't give us any indication that they are diseased at that point in time.

[Sarah Gregory] Sort of like COVID. It makes it more dangerous because they could be spreading it even though they are asymptomatic.

[Andrew Bowman] Yeah, that certainly becomes a problem for us as we're thinking about detection. And that becomes a major issue as we have animal caretakers or veterinarians who are trained to look for signs of disease, but often times if we have animals that are infected, we may not pick up on those or they may be so subtle that we don't recognize that we're in the middle of an outbreak. And so, it certainly creates a problem for us as we're trying to control it, especially if (and we know it is) one of our frontline measures is early detection of disease.

[Sarah Gregory] There's an antiviral for flu for people. Does it work on pigs, too?

[Andrew Bowman] The antivirals for people are likened for people and they are not approved for use in pigs. Certainly, it targets the virus and would work. But as we think about judicious use of the drug resources we have available to us currently, antivirals are exclusively reserved for humans.

[Sarah Gregory] Who is most at risk for getting influenza A virus from pigs?

[Andrew Bowman] So if we think about just the risk of infection, it's certainly those that are coming in contact with pigs. So if we think about on a day-to-day basis, it's animal caretakers, veterinarians, people working at harvest facilities. Folks who are in contact with pigs are the ones who are likely to become infected with swine-lineage influenza virus. The other thing to consider is that while those are the folks that are most likely to become infected, there's a different population that are most likely to have severe, or at least, complications associated with infection. And so, those are the folks that fall into the young or the elderly, pre-existing health conditions, immunocompromised, some of those folks with chronic health conditions are certainly more likely to have complications if they become infected with influenza. And so, if we have folks in those groups that are also in contact with pigs, then that's really an issue we need to think about how do we mitigate?

[Sarah Gregory] And when you say 'young', that's under five, is that right?

[Andrew Bowman] Yes, correct. Those under five are certainly the ones that are at higher risk for complications due to influenza infection.

[Sarah Gregory] And let's just clarify here, we're talking about live pigs. People can't get flu from eating pork.

[Andrew Bowman] That's correct. So influenza is going to be transmitted between live animals, and the risk is that a live animal may transmit it on to people. Normal handling of pork products

and cooking pork products would be sufficient to inactivate the virus, and really, we have little to no evidence that we have transmission of influenza occurring from handling or consuming pork.

[Sarah Gregory] You were featured on an EID podcast with me back in 2012 where you discussed another study you did on influenza A and pigs exhibited in fairs. You found that pigs that had influenza A but did not show symptoms (asymptomatic ones) were unreported in traditional swine flu surveillance programs. Has surveillance improved since then?

[Andrew Bowman] Yeah. There's the national surveillance program for influenza in pigs, and that is largely driven by symptomatic submissions through veterinary diagnostic labs. And so those subclinical pigs, they'll get missed in that. However, there's also a fair bit of active surveillance that may occur on pig farms by the veterinarians or the production staff that are trying to monitor influenza on those farms. And then there's programs like ours, where we're doing active surveillance in some of those settings that we think are key either to animals or public health or both. And so, I think there's probably a little more surveillance that's occurring, but realize active surveillance is always going to be a high resource demand endeavor. And so, how long we can sustain that, and we really have to be targeted about where we'll do that if we're really looking for those subclinically infected pigs.

[Sarah Gregory] So has anything else changed or improved in these ensuing years?

[Andrew Bowman] Yeah. So if we look across the...what has happened with influenza in pigs certainly has gotten a lot of attention, especially from livestock show organizers, fair organizers. And so, we've seen some behavior change, whether that's around how we're holding the shows, some of the signage that may occur at some of the shows, just some of the examples of that might be whether we're changing the way we bring pigs in or health requirements for pigs coming to shows, there have been some changes. Granted, some of that has been altered during the COVID era, but nonetheless, we're making some movement on how some of those strategies are being implemented at shows.

[Sarah Gregory] Is influenza A still a big problem in fairs with pigs? I mean, you did this article with EID in 2012, now it's 2022 (10 years later).

[Andrew Bowman] As we look at where are we at, ultimately, we still have about 25% of the fairs that we visit every year have pigs infected with influenza. That being said, I think some of this work that we're highlighting in this paper is moving the needle that...to maybe we don't see as high a prevalence within some of these fairs based on their changes of the way they are holding the fair. But influenza is still alive and well, and we're still detecting it every year. And even in the midst of COVID when we had major changes in the way that shows were held, and obviously it changed in the way people were coming together to hold shows, we were still able to detect influenza in the pigs during that time. And so, it's out there, it's certainly happening. And I think if we look at the number of variant cases that are being detected, even this year, we still have an active animal-human interface that's resulting in zoonotic transmission of influenza A virus.

[Sarah Gregory] How exactly are people catching this virus from pigs at fairs?

[Andrew Bowman] That's a great question, and I don't know that we have a definitive answer to that, but we certainly have the idea that when we have a large number of pigs infected with influenza, there probably is a very heavy viral burden within that barn at the fair. And so, if you have a couple hundred pigs infected with flu and they're all shedding influenza as they breathe,

as they cough, it becomes a large possibility that we're going to end up with people infected. And so, is that from them touching the pigs? Is it from them spending an extended amount of time in the pig barn where there's a lot of virus? I think all of those are certainly possibilities. If we look across the majority of the cases, people who have become infected at fairs or shows, right, it's folks who are spending a long amount of time (a prolonged amount of time) in the barns, and they either have direct or indirect contact with the pigs. And so, probably resulting in multiple ways that they are exposed to influenza while they are in those barns.

[Sarah Gregory] In your current EID article, you discuss conducting a longitudinal study before studying the effects of reducing hours of swine shows on influenza A transmission. Tell us a little bit about that and why you did it.

[Andrew Bowman] We were actively conducting surveillance that had 100 shows a year during that time period, and certainly got the idea that there were differences between the shows as to how we ended up with a different estimated prevalence at the end of the fair. And so, that led us into this longitudinal study where we decided to enroll some of our long-term participating fairs in a study where we essentially sampled every pig every day during their fairs so that we could look at influenza introduction and spread through that population during the time, all with the idea of getting to some recommendations that had been put out around shortening the exhibitions down to 72 hours. That recommendation had come out of some animal health and public health officials but had very little scientific backing to it as to why that amount of time. And so, this is where we set off to validate that recommendation and then understand what does influenza transmission look like during these shows?

[Sarah Gregory] When did you do this study and what did you find with the longitudinal piece of your study?

[Andrew Bowman] We initially conducted the longitudinal piece back in 2014 and 2015. And so, we enrolled eight fairs to start with and we followed them during 2014, and then we came back to those same eight and we followed them again in 2015—so, eight fair locations with a total of 16 fair events. So as we followed those animals over time, we realized that relatively few animals come into those shows infected (and certainly, that varies based on the show), but a relatively small number come in infected. And during the course of the fair, the virus is able to spread between the pigs and is amplified, and by the end of the fair, we can end up with a very high proportion of the pigs infected (almost all the pigs) if we have enough time for the virus to continue to transmit between the pigs. We found that if you would shorten the exhibition period, then you end up with a much lower portion of the animals infected. Now granted, most of them are probably already exposed and may run through their course of disease someplace else. But if we can get them off public display, we think we have an intervention that would improve public health by decreasing the total viral burden in a barn at a county fair.

[Sarah Gregory] Let's just clarify a little bit here. You studied the effects of the recommendation to reduce swine shows to less than 72 hours. Tell us again exactly what you found that prompted this recommendation? Why was it that specific duration of 72 hours?

[Andrew Bowman] After the large outbreak of variant cases in 2012, the Swine Exhibitions Zoonotic Influenza Working Group came together and put together a list of measures that exhibitions and those showing pigs could use to minimize influenza transmission in swine exhibitions. And one of those recommendations or mitigation strategies was to shorten it to 72 hours. And the reality is that came out of a recommendation that had been made in Indiana by

the Indiana state veterinarians and recommended those Indiana fairs shortened down to 72 hours. And while you look at the biology of influenza replication and 72 hours somewhat made sense, we really had no idea how that plays out in a county fair setting, and would that be helpful or not? And so, that was really what prompted us—the 72-hour timepoint was a combination of what makes sense biologically from influenza replication, and what did the fairs think that they could actually do, you know? You're going to have to have pigs there for some period of time to have the shows, and so what's actually feasible? And so, 72 hours was somewhat that compromise. And then we set off to really validate whether that made sense or not, and obviously there's a sliding scale there, but in our study, 72 was the recommendation that had been made and we were trying to validate that.

[Sarah Gregory] How long is a usual fair, then? That's...72 hours is three days. How long do these shows go on normally?

[Andrew Bowman] Lots of these fairs will have pigs present for up to a week. So usually, fairs are week-long events that are happening in rural communities across the US. And so, often times animals move in one weekend and move out the following weekend. And so, depending on what that schedule is, you may have some there for eight, nine, ten days, even. So as we look at that, there are certainly ways that we could shorten those down, maybe bringing in waves of animals with a clear separation in between. So we could have multiple shows occurring, but we wouldn't have all the animals there, or looking at other ways we could try to get it down to blocks of 72 hours.

[Sarah Gregory] What is the Swine Exhibitions Zoonotic Influenza Working Group? Who's involved in it? Is it vets? Public health officials? Farmers?

[Andrew Bowman] Yeah. That group includes a little bit of everybody. So we had the animal health side represented with USDA, with some state departments of Ag and some state veterinarians, some swine veterinarians who worked in the show-pig industry. And then we had public health officials, again, representing everyone from CDC down into some state and local public health departments that had been involved. And then we had groups from youth Ag education programs (such as 4-H or FFA). We also had scientific experts that were influenza experts or swine production experts to weigh in as well. So we had lots of folks representing everybody from the research side to the policy side, offering input on what do we think should be done, and then also balancing that with what do we think can be done?

[Sarah Gregory] And going back to this 72 hours, since it's only a recommended practice, were there many fairs that implemented it?

[Andrew Bowman] Correct, 72 hours is one of those strategies that's on the list that we think would positively benefit public health. But how many fairs will actually implement it is another thing. So in 2018 and 2019, after we had done these initial studies and some groups had really publicized and pushed the fairs to try to adopt the 72-hour limitation, we end up with about 20% of fairs really following that. And so, not a great uptake of it during that time period. And some of that is logistics and some of that is...it's hard to change a fair, and I often say that it's easier to change the rotation of the Earth than it is to change the schedule of the county fair. It's the way we've always done it, and it's just...it's hard to get behavior change. And so, 20% uptake is what we saw a few years after we really completed this first longitudinal study.

[Sarah Gregory] What happens to the pigs that get the flu if they have a bad case of it? If there's no antivirals, is there any treatment? You'd think farmers would really want this recommendation followed to stop their pigs getting sick.

[Andrew Bowman] Influenza in pigs is characterized as a high morbidity, low mortality disease. And so, certainly a lot of them will end up becoming ill. But as long as they don't get secondary bacterial infections, it's a fairly minor disease for them. And after that, as we mentioned, the subclinical issue where you may not be seeing disease makes it even harder to try to convince folks that we need a change if they aren't seeing the illness in the pigs. Those that are aware and have seen clinical signs certainly do play along with the idea that we could do something differently, but it's also hard to then think about how do we change the competition? Often there is a...at the county fair, there's a competition that's occurring among the pigs, and you have to rethink how that whole game is played if you're going to comply with the 72-hour recommendation.

[Sarah Gregory] Oh, I see. So it is quite complicated.

Is there anything else you want to tell us briefly about your study now and what you found?

[Andrew Bowman] Yes. As we tend to think about how we did this, it was a heavily intensive sampling. And while we talk about some of the fairs amplifying influenza to almost 100% of the pigs, we know that some of that had to do with the way that they started the fair. And so, some of those fairs did a weigh-in where it was an activity where as soon as the pigs got there, they pretty much lined them all up head to tail and took them across the scale and maybe they put an ear tag in their ear to identify them. And those sorts of activities, we found out, are probably ways to disseminate virus quickly through that population. And so, if we sit there and think about the idea that maybe one pig would give it to its neighbors and then those pigs would give it to their neighbors, certainly would amplify through the population.

But what we found is we probably amplify it even faster when we do some of those other activities, like a weigh-in, where all animals are lined up head to tail, because we found in our study that maybe a pig halfway through the line was the one that was infected and as they went through that scale, they sneezed, coughed, deposited virus on a common contact surface that all the pigs after them then came into contact with, and that's probably when they were exposed and became infected with influenza.

And so, while the 72 hours certainly helps, we have a whole menu of things that shows could be thinking about. Maybe we can't pull off the 72 hours, but we can shorten it down to, say, 80 hours, or something like that. But we could also change how we're going to do the start of the show and not spread it through the pigs as fast at the front end. So it's not a one-size-fits-all. What we're really trying to do is come up with options and provide the evidence that fairs can look at and then make scientific-based decisions that would be best for their show.

[Sarah Gregory] And I think you mentioned you went through a period in the longitudinal study where you were trying to sample every pig at every fair? Was this just in Ohio or a certain area? Or where was this done?

[Andrew Bowman] We picked fairs in Ohio and Indiana just for ease of access to us here in Columbus, Ohio, and we picked those shows that had had, at least, historic evidence of having influenza. And so, these were our likely suspect shows. Knowing that we were going to go all in on the sampling efforts, really the pitfall was if we did all of this, and we did it at shows where

we didn't have any influenza introduction. So we were sampling at shows where we thought there was a decent probability that we would end up with some influenza. And even at that rate, we had 16 fair events we ended up really with six positive events out of those 16. So even among our likely suspects, it wasn't all of them coming up positive, but it was six of them. And so, that's what we're basing these off of. And so, it was one of those strategies of it was high risk, high reward, so we had to really think about which fairs would we go after with the likelihood that influenza would be introduced there.

[Sarah Gregory] And pigs can't be very cooperative, I mean, I can't imagine they are. How did you go about obtaining these samples?

[Andrew Bowman] This was one of those things that we had been working on. Historically, the Gold Standard sampling technique (and now we've all been through COVID, we kind of know this) is a nasal swab, right? It's what we did for pigs. And restraining pigs is not a fun task. They don't particularly enjoy it, and getting a good nasal swab is pretty difficult. And so, in this study, we had worked on a different technique that we call snout wipes, we use a piece of cotton gobs and we just wipe their nose. You know, if I could get them to blow into a tissue, I'd probably take that. But in this case, we did snout wipes. So just went through the barn, and we wiped every pig's nose as we went through. So I guess you could call us professional pig nosepickers. But that's the way we did this one.

[Sarah Gregory] And that worked as well as a nasal swab?

[Andrew Bowman] Yeah. So we had done some validation work prior to this study to make certain that that would work. Sensitivity is about 83% compared to the Gold Standard, at least on an individual animal basis. So we felt pretty confident in this case as we were sampling every animal, that we would have decent power to be able to look at change through the population day over day.

[Sarah Gregory] And I'm sorry, did you say, 'snout wipe' or 'snot wipe'?

[Andrew Bowman] Snout wipe, wiping the pig's snouts. With a gloved hand and piece of cotton gauze, we wipe their snouts, trying to catch a finger in their nostrils so that you can capture whatever snot might be there.

[Sarah Gregory] Okay.

Were there notable challenges besides this technique?

[Andrew Bowman] It was a lot of getting in pens, finding the animal. And so, we tracked which animal we were sampling each time—so, reading ear tags as we were sampling pigs. A metric that you probably don't think anyone tracks is how many pigs per hour can you sample. By the end of the study, we were rocking along in about 100 pigs per hour. But we did have the issue of we needed to get it done in between shows and not affect the fair. It was a gargantuan sampling effort on the end for our staff and students.

[Sarah Gregory] Well, after all that effort, how do you hope your findings will be used moving forward?

[Andrew Bowman] I think we have really convincing data that show there's a benefit to decreasing the exhibition period. Whether they can get down to 72 hours or not, that certainly is up to each fair. But we have data that anything shorter is better, so where they can get it to is one of those things that each fair would have to decide. I think for us, it's a messaging thing of how

do we get out there? How do we talk to those in the decision-making seats and get them to understand that there are significant implications here to preventing zoonotic transmission? This isn't just potentially one individual becoming ill, right? But animal-to-human transmission is how every pandemic has started. And so, every time we have one of these transmission events at a county fair, public health is having to run that down to make certain that's not the index case for the next pandemic. And so, there really are major implications to if we can prevent some of these transmissions from occurring.

[Sarah Gregory] We know from your previous podcast that there are vaccines for pigs. How effective are they and how often are they actually used?

[Andrew Bowman] There are influenza vaccines for pigs. You know, infectivity in pigs is much like in people...how closely matched is the strain to the strain that's circulating in the pigs at the time. Obviously, we don't know what that's going to be, and the diversity of flu viruses in pigs is much greater than what we see in people. And so, it becomes pretty hard to predict which strain they are going to be exposed to. That being said, we've done some work here (and other groups have, too) where we see decent protection from vaccinating the pigs, not to the point where it protects them from getting infected, but it does decrease how much virus they shed and how long they are shedding virus (so, alterations of the transmission chain). The flip side to that is we have to consider that that might be one of those issues that's preventing us from detecting it. Maybe the vaccines are effective enough that that's what's resulting in our subclinical pigs—that they're infected and we're not seeing disease, which is great from an individual animal standpoint...it makes it difficult from a population health standpoint and early detection and how do we prevent transmission onto people. So the vaccine thing is one of those that's...it is a great tool, we just need to figure out how we can most effectively use that tool at this interface.

[Sarah Gregory] Back in 2012, you were a graduate research assistant at Ohio State University. Tell us about your job now and what's the most exciting project you've recently worked on.

[Andrew Bowman] Today, I'm an associate professor in veterinary preventive medicine. My time is split 50/50 between research and teaching. My research program focuses largely on animal-human interface. And so, we're looking at, obviously, transmission of influenza, not only on the pig's side, but we're also looking at the human side. And so, we have a cohort of youth that are showing pigs and we are looking at their responses and infections to influenza. And then, we're also looking at other pathogens. And so, last year we were involved in the first detection of SARS-CoV-2 in white-tailed deer—and so, that reverse spillover from people into an animal host—and we're trying to understand what does that look like long-term, and how might that affect human health...the long-term if we are able to maintain a virus in another animal population. So squarely situated at the animal-human interface trying to look at transmission both ways.

[Sarah Gregory] Well, it was a pleasure talking with you today, Dr. Bowman, and thank you for taking the time.

[Andrew Bowman] Yeah, thanks for having me.

[Sarah Gregory] And thanks for joining me out there. You can read the October 2022 article, Shortening Duration of Swine Exhibitions to Reduce Risk for Zoonotic Transmission of Influenza A Virus, online at [cdc.gov/eid](https://www.cdc.gov/eid).

I'm Sarah Gregory for *Emerging Infectious Diseases*.

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