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Reduction of Influenza A virus H1N2 shedding after mass vaccination of breeding females in a three site production herd

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Introduction

An outbreak of respiratory disease in suckling piglets started in December 2010 in a three site 1,200 sow farrow-to-wean facility. Influenza A virus H1N2 delta 1 cluster was isolated from nasal swabs of affected piglets. After two months of continuous respiratory disease in the suckling piglet population, a change in the influenza vaccination strategy needed to be adopted.

Currently there is little data regarding the efficacy of using a killed vaccine administered through a mass vaccination protocol in swine breeding herds. Therefore, the purpose of this on farm study was to mass vaccinate a sow herd with a commercially available, polyvalent, inactivated, adjuvanted swine influenza vaccine and monitor the prevalence of virus shedding in breeding females, suckling pigs and recently weaned pigs thereafter.

Case description

The case farm consisted of a commercial 1,200 Landrace × Large White sow farrow-to-wean unit located in Southern Minnesota. This farm was part of a three-site production system weaning 21 day old pigs into an offsite, continuous flow, 4,000 head nursery located 1.23 miles south of the sow farm.

The sow farm historically tested seropositive for porcine reproductive and respiratory syndrome virus (PRRSV), *Mycoplasma hyopneumoniae* and Porcine Circovirus type 2 (PCV-2). One dose of a multivalent autogenous swine influenza vaccine, containing an H1N2 influenza A virus, was being administered four weeks pre-farrow in breeding females. Gilts were vaccinated twice with the multivalent autogenous swine influenza virus vaccine upon arrival to an off-site gilt developer barn at 220 and 250 lbs of body weight. During lactation, piglets received a dose of PCV-2 vaccine (Circumvent PCV M, Intervet/Schering-Plough Animal Health, Omaha, NE, USA) at 7-10 days of age and at time of weaning.

Despite having received the multivalent autogenous swine influenza vaccine, the breeding herd experienced an outbreak of acute respiratory disease in suckling piglets

in early December 2010. Respiratory disease was characterized by cough ranging from light to severe which was evident in 10-21 day old piglets and lasted approximately two weeks. Shortly after the initial respiratory episode in the farrowing unit, pigs with similar respiratory signs were observed in the off-site nursery.

Swine influenza virus was suspected. To confirm, 10 nasal swabs from suckling piglets with clinical signs of cough were collected for molecular diagnostic testing by an influenza A virus matrix gene RRT-PCR and virus isolation at the University of Minnesota Veterinary Diagnostic Laboratory.

- In early December of 2010, four out of ten nasal swabs were positive for influenza A viral RNA and virus was isolated from two of the four RRT-PCR positive swabs.
- The virus was successfully sub typed and genetically characterized as an H1N2 virus grouping with the Delta 1 cluster viruses of swine.¹
- During the first weeks of February 2011, a second set of nasal swabs from 21 day old piglets were collected. Twelve (40%) out of 30 tested positive for influenza indicating that suckling pigs were still becoming infected during the lactation phase.

Based on the RRT-PCR results and the persistence of clinical signs of respiratory disease in both the breeding and nursery farms, it became apparent that the current pre-farrow influenza vaccination strategy was not working as expected.

Thus, it was decided to change the vaccination strategy from pre-farrow vaccination to a two-dose, mass vaccination in the breeding herd. The vaccine was changed from the multivalent autogenous swine influenza vaccine to a commercial swine influenza vaccine (FluSure XP, Pfizer Inc. Kalamazoo, Michigan, USA) for the following reasons.

- FluSure XP is a killed multivalent vaccine that uses amphigen as the adjuvant and contains four distinct inactivated influenza isolates: A/Swine/North Carolina/031/05 (H1N1), A/Swine/Missouri/069/05 (H3N2), A/Swine/Iowa/726H/2005 (H1N2), and A/Swine/Iowa/110600/00 (H1N1).

Martin Mohr; Cesar A. Corzo; Marie Gramer; Robert Morrison; Michael Kuhn

- The H1N1 vaccine strains A/Swine/Iowa/110600/00, A/Swine/North Carolina/031/05 belong to the gamma and delta 2 groups, respectively.
- The H1N2 strain belongs to the delta 1 group.
- H3N2 vaccine strain is a cluster 4 H3.
- The hemmagglutinin (HA) gene from virus isolated from the farm samples shared 98.8% HA gene nucleotide similarity with the H1N2 virus in the Pfizer vaccine.

Materials and methods

The change in vaccination composition and timing was accompanied by the 13 week cross-sectional sampling protocol that allowed us to monitor virus shedding in oral fluids and nasal swabs of the breeding herd and piglets. The serological response to vaccination was determined by performing hemagglutination inhibition (HI) assays against both the vaccine and outbreak strains of influenza A virus.

Results

After vaccination, there was a significant increase ($P < .001$) in HI serum-antibody titers in breeding females. Prevalence of shedding in sows and suckling piglets decreased through the 13 weeks of monitoring until no influenza-positive samples were detected in suckling and recently weaned pigs.

Discussion

The purpose of this study was to monitor changes in influenza viral shedding dynamics after a two-dose mass vaccination protocol with a multivalent commercial vaccine in all breeding females in a 1,200 sow farrow-to-wean unit. Through nasal swabs in breeding females, suckling piglets and also downstream nursery pigs, the prevalence of shedding animals was assessed over time after intervention.

- In the case herd, prevalence of nasal shedding for sows, suckling piglets and nursery pigs decreased in 5 weeks below detectable levels after the two dose mass vaccination intervention program was completed.

Prevalence of influenza A virus in the case study farm in adult females was found to be minimal which is in agreement with an earlier study² in which 60 nasal swabs from breeding females were collected in two endemically infected breeding herds without finding a positive result. A two-dose regimen of killed vaccine delivered to the entire herd significantly increased antibody titers when tested against five different strains as measured by HI. In

this case study, since sows had a significant increase in HI, we can hypothesize that piglets may have received a high concentration of antibodies through colostrum (high piglet HI) which may have played a role in reducing transmission.

Results from the cross-sectional sampling supported the observation that nasal shedding in suckling piglets decreased over time. However, by the sixth week of age (third week in the nursery), piglets became infected which can be the result of the combination of MDA decreasing yet having horizontal transmission occurring in this continuous flow population.

Overall, this case-report provides important insights into the ecology of influenza A virus in breeding farms.

- Suckling piglets are an important population for the virus to remain circulating continuously.
- Suckling piglets without adequate MDA have an increased shedding prevalence with increasing age. This suggests that by the time piglets are weaned and sent to another site, the virus will be present at seemingly high levels. Thus, shedding piglets become a potential source for on-site horizontal and regional transmission.
- In order to impact the ecology of swine H1N2 influenza virus in the breeding herd and prevent clinical episodes, effective swine H1N2 influenza vaccine strategies require use of vaccines that contain 98% or greater HA gene nucleotide similarity to field influenza viruses.
- Two swine influenza mass vaccinations of the breeding herd 3-4 weeks apart have an important role in reducing transmission dynamics of SIV H1N2. If this vaccination strategy is implemented, it is realistic to expect no Swine Influenza RNA H1N2 virus present in all ages of suckling piglets by five weeks post second mass vaccination.

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University of Minnesota Veterinary Diagnostic Laboratory
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New Ulm Regional Veterinary Center

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