Emergence of H3N2 Subtype Swine Influenza Viruses in Midwest Swine

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Summary and Implications

A prospective study was conducted to monitor the pig population in Iowa for the emergence of new subtype(s) of swine influenza virus (SIV) other than classic H1N1 subtype. During the study, an apparently new subtype of SIV, H3N2, was isolated in association with severe reproductive and respiratory clinical disease in swine operations in Iowa and southern Minnesota. At the same time, influenza outbreaks of this subtype also were reported in other states such as North Carolina, Illinois, and Texas. To date, the new subtype of SIV has been determined to be widely spread in swine operations throughout Iowa and is expected to coexist with H1N1 subtype in swine populations in the United States. A serological survey on 6-month-old finishing pigs (N=1064) from 129 herds throughout 29 counties in Iowa demonstrated that 64% of the pigs and 92.2% of the herds had serological evidence of exposure to H3N2 SIV as of June, 1999. The isolation of H3N2 subtype SIV in association with severe clinical disease brings a new perspective to the diagnosis and control of swine influenza in this country. New vaccines will be needed for effective control of H3N2 because field reports have indicated no cross protection against H3N2 subtype SIV by vaccines currently available for H1N1 strains. Consequently it is critical for diagnosticians to have rapid and accurate methods for the diagnosis and differentiation of SIV subtypes so that effective control measure can be suggested in timely manner.

Introduction

Influenza is a common respiratory disease of swine in swine-producing regions throughout the world. Besides its veterinary importance, swine influenza also poses serious public health threats. Human infections with swine influenza viruses have been documented in the United States, as well as in Europe (4,8). Pigs also are known to be susceptible to influenza viruses of both avian and mammalian origin because their tracheal epithelium contains virus receptors for both strains (6). As such, pigs have been implicated as the intermediate host for adaptation of avian viruses to mammals and as the "mixing vessels" in which human-avian virus reassortment occurs (2).

In the United States, the first influenza outbreak in swine was seen during a human influenza pandemic in 1918 to 1919 (7). Since then, classical H1N1 SIV that is genetically and antigenically similar to the type A influenza virus implicated in the human pandemic is circulating in North American pigs. Previous serological surveys conducted during 1976–1977 (5) and 1988–1989 (3) demonstrated that SIV infection was consistently highest among pigs in the north central part of the United States. These studies also demonstrated that H1 influenza viruses have been the predominant subtype circulating in U.S. swine. Seroprevalence of H1 SIV in market hogs was reported to be 20–47% in 1976–1977 and had increased to 51% in 1988–1989.

H3N2 SIV is present in swine populations in other parts of the world (7). However, the only previous evidence for infection in the United States had been a low prevalence in serological surveys (3,5) and a single instance in 1977 in which an H3N2 strain was isolated from pigs in Colorado without clinical disease (5). Thus, H3N2 strains have not been considered a significant cause of influenza in U.S. swine. However, the recent isolation of H3N2 SIV from clinically affected pigs in Quebec, Canada (1) raised the need for a surveillance program to monitor swine populations in the U.S. for the emergence of new subtype(s) of SIV. Herein, we report results of an on-going surveillance study on swine populations in Iowa, demonstrating that H3N2, new subtype of SIV has emerged in Iowa swine and become a significant cause of influenza in the Iowa swine industry.

Materials and Methods

Beginning in September, 1998, nasal swabs and/or lung samples were collected from pigs with respiratory and/or reproductive problems that were submitted to the Iowa State University Veterinary Diagnostic Laboratory. Virus isolation was attempted on these samples with embryonated chicken eggs. Isolates were submitted to the National Veterinary Services Laboratories (NVSL), Ames, IA, for the determination of subtype. Subtyping was done using an immunological procedure established at the NVSL.

Once H3N2 subtype SIV was isolated from pigs and confirmed to be present in Iowa swine populations, a hemagglutination inhibition (HI) assay was developed and used for a serological survey to assess the prevalence of H3 SIV in Iowa swine. For the survey, a total of 1,604 serum samples were collected from approximately 6-month-old finishing pigs through the Pseudorabies Monitoring and Eradication Program. These samples represented 129 swine operations (10–15 pigs per herd) throughout 29 counties in Iowa. All samples were collected during June 25–29, 1999, and tested for the presence of HI antibody against H1N1 and

H3N2 SIV. Animals with 1:40 or higher HI antibody against H1 or H3 SIV were considered positive for the respective subtype of SIV.

Results and Discussion

Outbreaks of swine influenza by H3N2 strain were observed in swine herds in northwestern Iowa and southwestern Minnesota in early December 1998. Subsequently, the virus appeared to move rapidly through swine operations in Iowa. At the time of this report, influenza outbreaks due to H3N2 have been observed in most of the swine-producing regions throughout Iowa (Figure 1). Twenty-four isolates of SIV that were obtained from clinical influenza cases between September and December 1998 were subtyped and all turned out to be H1N1. A retrospective study to characterize subtypes of SIV isolates in our repository is in progress.

The clinical picture in these cases was relatively consistent. Disease appeared as a sudden onset of illness characterized by anorexia and fever in sows and nursery pigs, with variable respiratory signs. Hyperpnea and dyspnea were more prominent than coughing. Disease manifestation was similar to classic swine influenza in the rapidity with which the illness spread through the entire group and the fact that recovery also was rapid and nearly complete within a week. Yet, an enzootic form of influenza, as in herds affected by H1N1, also was observed in some herds affected by H3N2 SIV. Sporadic abortion and occasional sow deaths also were noted in some affected groups. In other herds, no sow deaths occurred. Some herds reported subsequent reproductive problems, others did not. Spread of the disease to younger pigs also varied from herd to herd.

Swine influenza occurs commonly throughout the late fall and early winter every year, but what attracted attention in conjunction with the H3N2 infections was the fact that the outbreaks occurred in animals immunized with a vaccine that is efficacious against the classic H1N1 strains routinely found in U.S. swine. This suggests very little or no cross protection between H1N1 and H3N2 strains. As such, a new vaccine(s) is required for effective control of both subtypes.

Results of the serological survey on finishing pigs for both subtypes of SIV are summarized in Table 1. As of June 1999, the seroprevalence of H3N2 SIV was 64 and 92.2% at individual and herd levels, respectively, demonstrating that H3N2 strains of SIV are already widely spread in Iowa swine populations. It is expected that prevalence rate will continue to increase until appropriate control strategies are implemented. In comparison, the seroprevalence of H1N1 SIV was

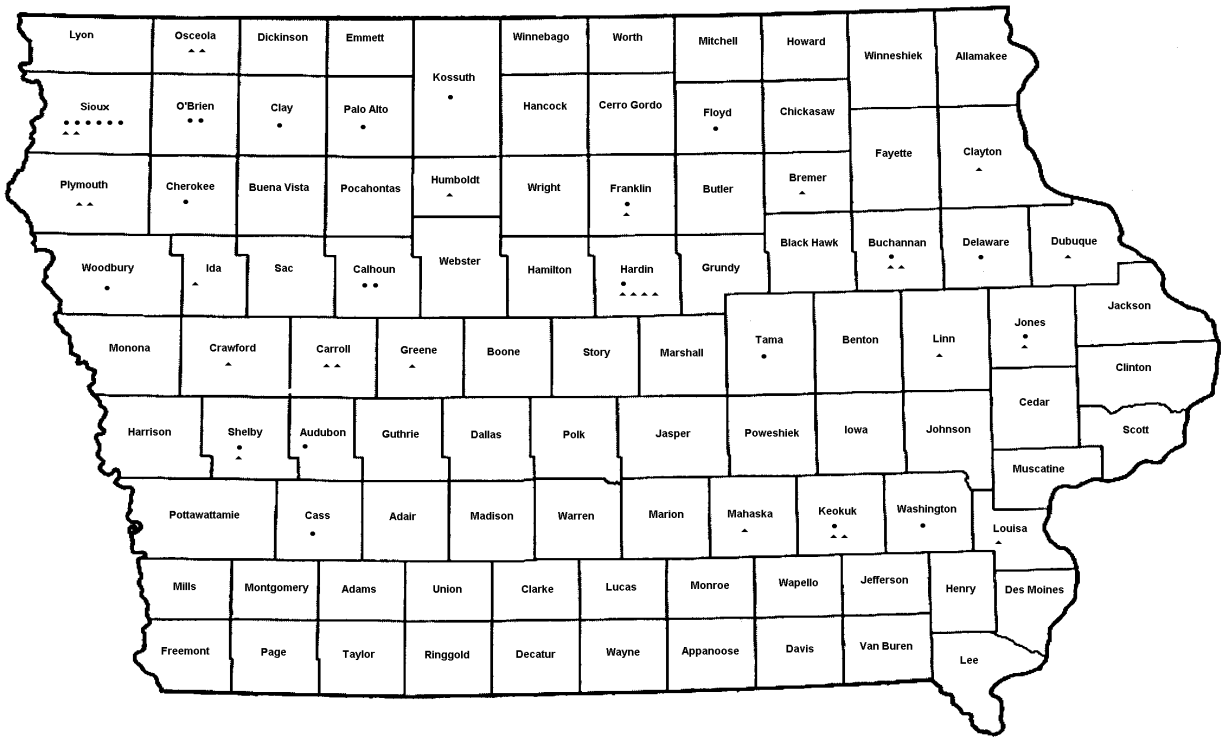

Figure 1. Geographical distribution of influenza outbreaks of H3N2 (●) and H1N1 (▲) subtype in Iowa swine. The number of each symbol indicates the number of outbreaks of given subtype swine influenza virus.

determined to be 39 and 71.3% at individual and herd levels, respectively. These prevalence rates are similar to seroprevalence rates of SIV in the north central part of the United States during the last 10 years. Approximately 30% of finishing pigs tested had serological evidence that they were exposed to both subtypes of SIV at some point of time between January, 1999 and June, 1999, indicating that both subtypes of SIV are circulating simultaneously in swine populations. It raises the need for rapid and accurate methods for the diagnosis and differentiation of SIV subtypes so that effective control measure can be implemented in time to minimize the economic impact.

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Table 1. Seroprevalence of H1N1 and H3N2 subtypes of swine influenza virus in Iowa swine populations.

County	No. of animals	No. of herds	Seroprevalence[a] of H1	H3	H1&H3
Audubon	39	3	33	46	18
Buena Vista	12	1	0	42	0
Calhoun	53	4	60	89	55
Carroll	144	11	35	88	32
Cherokee	10	1	100	0	0
Chickasaw	22	2	64	68	55
Clayton	24	2	54	46	25
Crawford	11	1	0	100	0
Davis	10	1	100	60	60
Delaware	153	12	33	67	18
Dubuque	155	13	32	33	10
Hamilton	50	4	34	56	24
Hardin	48	4	33	75	29
Henry	10	1	0	60	0
Ida	28	2	25	86	21
Jasper	26	2	27	27	4
Keokuk	55	4	31	76	25
Kossuth	76	6	21	53	9
Lyon	104	8	62	54	37
O'Brien	22	2	27	55	23
Plymouth	124	10	48	77	43
Pottawattamine	13	1	77	0	0
Poweshiek	22	2	0	14	0
Sac	47	4	51	72	45
Shelby	14	1	0	36	0
Sioux	185	15	43	72	38
Tama	12	1	92	50	42
Washington	125	10	37	79	29
Winneshiek	10	1	60	100	60
	1604[b]	129[c]	39	64	27

[a]Prevalence rates are expressed as proportion (%) of animals serologically positive for given subtype of SIV to the total number of animals tested in a given county or all counties.
[b]Total number of animals tested.
[c]Total number of herds tested.