

Survey of disease pressures in twenty-six niche herds in the midwestern United States

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Summary

Objective: To provide diagnostic and veterinary support to niche producers in order to generate information on disease pressures in niche herds.

Materials and methods: Twenty-six producers under contract with three niche-marketing companies were accepted into the program. A standardized diagnostic protocol, including serology and tissue diagnostics, was undertaken on suckling, nursery, finishing, and breeding animals. The diagnostic frequencies of diseases in niche-pork systems were compared to those in age-matched, diseased pigs submitted to the Iowa State University Veterinary

Diagnostic Laboratory (ISU VDL) or in published reports.

Results: Overall seroprevalence was lower ($P < .001$) for porcine reproductive and respiratory syndrome virus and higher ($P < .001$) for swine influenza virus in niche herds than in published data. Porcine circovirus associated disease was the most common disease diagnosed in niche nursery and finishing pigs. Compared to general ISU VDL submissions, *Mycoplasma hyopneumoniae* and porcine circovirus type 2 were detected in a higher percentage of niche pigs with respiratory disease ($P < .001$), a higher percentage of niche nursery pigs developed *Lawsonia intracellularis* enteritis ($P < .001$), and there was a

greater degree of clinical internal parasitism in niche herds.

Implications: Niche producers typically raise pigs in continuous-flow systems, without antibiotics, and in different environments than larger commercial swine operations. Results of this study indicate that these production changes can contribute to differences in the diagnostic frequency of several diseases and the ages at which diseases are clinically manifest in niche herds.

Keywords: swine, niche production, disease prevalence

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Resumen - Estudio de la presión de enfermedades en veintiséis hatos nicho en el medio oeste de los Estados Unidos

Objetivo: Proveer diagnóstico y apoyo veterinario a productores nicho con el fin de generar información sobre la presión de enfermedades en hatos nicho.

Materiales y métodos: Veintiséis productores bajo contrato con tres compañías comercializadoras de segmentos especializados fueron aceptados en el programa. Un protocolo de diagnóstico estandarizado, incluyendo diagnósticos de tejidos y serología, se llevó a cabo en animales de lactancia, destete, engorda, y pie de cría. Se compararon las frecuencias de diagnóstico

de enfermedades de los cerdos en los sistemas nicho contra las de cerdos enfermos de la misma edad enviados al Laboratorio de Diagnóstico Veterinario de la Universidad del Estado de Iowa (Iowa State University; ISU VDL por sus siglas en inglés) o en reportes publicados.

Resultados: La seroprevalencia total fue más baja ($P < .001$) para el virus del síndrome reproductivo y respiratorio porcino y más alta ($P < .001$) para el virus de la influenza porcina en hatos nicho que en la información publicada. La enfermedad asociada con circovirus porcino fue la enfermedad más común diagnosticada en cerdos de destete y finalización de las granjas nicho. Comparado con las sumisiones generales del

ISU VDL, el *Mycoplasma hyopneumoniae* y el circovirus porcino tipo 2 se detectaron en un porcentaje más alto en cerdos nicho con enfermedad respiratoria ($P < .001$), además un porcentaje más alto de los cerdos de destete de las piaras nicho, desarrollaron enteritis por *Lawsonia intracellularis* ($P < .001$), y hubo un grado mayor de parasitismo clínico interno en hatos nicho.

Implicaciones: Los productores de piaras nicho típicamente crían cerdos en sistemas de flujo continuo, sin antibióticos, y en diferentes medio ambientes que las operaciones porcinas comerciales de mayor escala. Los resultados de este estudio indican que estos cambios de producción pueden contribuir a diferencias en la frecuencia en el diagnóstico de varias enfermedades y en las edades en las que las enfermedades se manifiestan clínicamente en estos hatos nicho.

Résumé - Relevé des pressions d'infection dans vingt-six troupeaux niches dans le Midwest américain

Objectif: Fournir un support vétérinaire et diagnostique à des producteurs niches afin de générer des informations sur les pressions d'infection dans les troupeaux niches.

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Matériels et méthodes: Vingt-six producteurs sous contrat avec trois compagnies niches de marketing ont été acceptés dans le programme. Un protocole standardisé de diagnostique, incluant des tests diagnostiques sur du sérum et des tissus, a été entrepris sur des animaux en maternité, en pouponnière, en finition, et des reproducteurs. Les fréquences de diagnostic des maladies chez les porcs provenant des systèmes niches ont été comparées à celles de porcs malades du même âge soumis au Iowa State University Veterinary Diagnostic Laboratory (ISU VDL) ou dans des rapports publiés.

Résultats: Dans les troupeaux niches, la séroprévalence globale contre le virus du

syndrome reproducteur et respiratoire porcin était plus faible ($P < .001$) et celle contre le virus de l'influenza porcin plus élevée ($P < .001$) que dans les données publiées. La maladie associée au circovirus porcin était la maladie la plus fréquemment diagnostiquée chez les porcs en pouponnière et en finition, des troupeaux en niche. Comparativement aux soumissions généralement reçues au ISU VDL, *Mycoplasma hyopneumoniae* et le circovirus porcin type 2 étaient détectés à des pourcentages plus élevés chez les porcs niches avec des maladies respiratoires ($P < .001$), un pourcentage plus élevé de porcs niches en pouponnière ont développé une entérite à *Lawsonia intracellularis*

($P < .001$), et il y avait un degré de parasitisme interne clinique plus marqué dans les troupeaux niches.

Implications: Typiquement, les producteurs niches élèvent leurs animaux dans des systèmes en continu, sans antibiotique, et dans des environnements différents de celui des opérations porcines commerciales. Les résultats de cette enquête indiquent que ces changements dans le mode de production peuvent contribuer aux différences observées dans les fréquences de diagnostic de plusieurs maladies ainsi que les groupes d'âge parmi lesquels ces maladies se manifestent cliniquement dans les troupeaux niches.

Niche pork production evolved as a consequence of a variety of influences. Consolidation and industrialization led to a decrease in the number of farms and an increase in the number of pigs per farm, leaving many smaller producers seeking alternative methods of production to remain profitable.^{1,2} These smaller producers often sought to utilize production systems that reduced fixed costs and allowed for greater compensation for their efforts.^{1,2} The demand for alternative products with unique quality or social attributes, such as pigs raised “naturally” or without antibiotics, provided such an opportunity.² Producers are paid a premium for the added effort of raising pigs within the constraints of niche production systems, and the niche marketplace can reduce market risk to farmers in the highly competitive pork industry.²

The lifestyle and financial opportunities of niche pork production are attractive to many individuals, but are not without challenges. Niche producers do not enjoy the level of integrated technical and research support devoted to the large commercial production systems. Diseases that have been suppressed by raising pigs on slatted floors in well-controlled environments on multiple sites may be revived in niche herds, where pigs are often raised without antibiotics on solid floors in continuous-flow systems.

The generally smaller size of niche herds may lead to economic constraints. The cost-benefit ratio of regular veterinary support and disease diagnostics is high because of the limited number of animals at risk. As a consequence, data on disease pressures

in niche production systems is lacking. This study was part of a larger project designed to enhance the prosperity of small farms in the upper Midwest by identifying key economic variables affecting the profitability of hogs raised for niche markets and by developing an appreciation for herd-health pressures in antibiotic-free pork systems. The objective of this portion of the project was to provide diagnostic and veterinary support to niche producers in order to generate data on disease prevalence in niche pigs raised in the Midwest.

Materials and methods

Niche herd enrolment

Twenty-six niche pork producers under contract with three Midwestern niche marketing companies were accepted into the program under the following conditions: they maintained accurate production records, they retained ownership of the swine from conception to marketing, they had an established relationship with a local veterinarian with swine expertise, and the local veterinarian agreed to participate. Producers were reimbursed for all pigs euthanized for diagnostic testing, veterinary services, and diagnostic costs. Prior to enrolment in the study, producers completed a survey outlining housing, vaccination protocols, and deworming practices for each phase of production.

Tissue diagnostics

To assure a standardized diagnostic workup, specialized submission forms were developed that outlined materials to be harvested from each age group and tests to be undertaken on each sample. All samples

were submitted to the Iowa State University Veterinary Diagnostic Laboratory (ISU VDL).

Criteria to select pigs for tissue diagnostics included general ill thrift or evidence of clinical disease. The study design called for the collection of fresh and fixed tissues from five suckling, three nursery, and three finishing pigs from each site. Sections of brain, nasal turbinate, lung, heart, lymph nodes, liver, kidney, spleen, small intestine, and colon were fixed in 10% neutral-buffered formalin, trimmed, embedded in paraffin, routinely sectioned, stained with hematoxylin and eosin, and evaluated. Fresh tissues from these same pigs were submitted for bacterial culture. Nasal swabs, brain, lung, spleen, small intestine, and colon were routinely cultured on MacConkey's agar and blood agar. In addition, the following tests were performed on tissues collected from the various age groups.

Serum from five suckling pigs was pooled for testing for porcine reproductive and respiratory syndrome virus (PRRSV) by polymerase chain reaction (PCR). Rotavirus immunohistochemistry (IHC) was undertaken on sections of small intestine from these same pigs, and feces were pooled for testing by PCR for transmissible gastroenteritis virus (TGEV) and by enzyme-linked immunosorbent assay (ELISA) for rotavirus.

Tissues from three nursery and three finishing pigs were evaluated. Immunohistochemistry for *Lawsonia intracellularis* was undertaken on small intestine and colon. Sections of fresh lung were pooled for testing by PCR for PRRSV, swine

influenza virus (SIV), and *Mycoplasma hyopneumoniae* (M hyo). Testing for porcine circovirus type 2 (PCV2) by IHC was undertaken on lung and lymphoid tissue. A pig was considered to have subclinical PCV2 infection when low levels of PCV2 antigen were detected by IHC and lesions consistent with porcine circovirus associated disease (PCVAD) were not observed. A pig was considered to have PCVAD when moderate to abundant PCV2 antigen was observed in association with typical lesions.^{3,4} Niche pork data was compared to the first 200 age-matched submissions during the same time period in which PCV2 IHC was requested.

Parasitology

Skin scrapings were collected from the external ear canal of five sows, five nursery, and five finishing pigs and were evaluated for external parasites (*Sarcoptes scabiei* var *suis*) by examination of direct smears. Feces collected from five sows, three nursery, and three finishing pigs were evaluated by routine fecal floatation (sucrose solution, specific gravity 1.27). The following scale was used when assessing parasite levels in feces: 0 = oocysts or parasite ova not identified; 1 = ≤ 1 egg or oocyst per low power field (LPF); 2 = two to three eggs or oocysts per LPF; 3 = four to 10 eggs or oocysts per LPF; and 4 = ≥ 11 eggs or oocysts per LPF.

Serological testing

Sera from 14 breeding females were tested for the presence of SIV (H1N1 and H3N2) and porcine parvovirus (PPV) antibodies by hemagglutination inhibition (HI) assays and for PRRSV-specific antibodies using a commercially available ELISA (HerdChek PRRS Antibody 2XR Test Kit; Idexx Laboratories, Inc, Westbrook, Maine). Sera from five newly weaned pigs, five late nursery pigs, five mid-phase finishing pigs (17 weeks), and five market-weight hogs were assayed with the PRRS ELISA and SIV HI (H1N1 and H3N2).

Statistical analysis

Results from diagnostic testing of animals from the niche herds were compared either to ISU VDL data for the same time period or to published reports. When niche and ISU VDL results were compared, the data were matched for testing methodology and age. A chi-square test was used to compare each variable. The

level of significance was established at $P < .05$. Fecal oocyst-ova scores were compared using a one-way ANOVA (Microsoft Office Excel 2007; Microsoft Corporation, Seattle, Washington).

Results

Niche herds

Twenty-six producers from five Midwestern states (Iowa, Minnesota, Illinois, Nebraska, and Kansas) were enrolled in the herd-health component of the project. Each producer was affiliated with one of three niche marketing companies that raised pigs without antibiotics or hormones. Herd sizes ranged from 30 to > 200 sows, with an average herd size of 70 sows. A wide variety of housing facilities (hoop buildings, confinement buildings with solid or slatted cement floors, and shelters with access to dirt or concrete lots), and bedding options (straw, corn stalks) were utilized by enrolled producers. Approximately 33% of producers purchased outside breeding stock and isolated these animals for 30 days in a separate on-site facility, while the remaining producers bred and raised internal replacement stock. All but one producer utilized single-site production. All enrolled producers participated in other agricultural enterprises and were not swine-exclusive farmers.

All gestating and grow-finish pigs were housed on solid surfaces. Thirty-six percent of farrowing and nursery pigs were raised on slatted floors in confinement, while the remaining 64% were raised on solid flooring.

Vaccination

Ninety-one percent of farms vaccinated breeding animals for PPV, *Leptospira interrogans* serovars, and *Erysipelothrix rhusiopathiae*. Fifty-five percent of suckling pigs were vaccinated for *Bordetella bronchiseptica*, *Pasteurella multocida*, and *E rhusiopathiae*, while 45% were unvaccinated. Eighteen percent of suckling pigs were vaccinated for *Streptococcus suis*, while a single farm vaccinated suckling pigs for *L intracellularis*. There was considerable variability in nursery pig vaccination. Twenty-seven percent of farms did not vaccinate nursery pigs, 36% vaccinated for M hyo, and 36% vaccinated for *B bronchiseptica*, *P multocida*, and *Haemophilus parasuis*. Vaccines for *L intracellularis*, *Salmonella*, and SIV were each used on single farms. Sixty-four

percent of farms did not vaccinate finishing pigs, 27% vaccinated for *E rhusiopathiae*, while vaccines for SIV, M hyo, and *L intracellularis* were each used on single farms.

Deworming

Ninety-one percent of niche sows were dewormed with a single product or various combinations of ivermectin (45%), dichlorvos (36%), or fendendazole (27%). Suckling pigs were not dewormed on any farms. Eighty-two percent of farms dewormed nursery pigs either with ivermectin (45%) or fenbendazole (26%). Sixty-four percent of farms dewormed finishing pigs with fenbendazole (45%), ivermectin (27%), or dichlorvos (18%).

Serological testing

All serum and tissue samples were collected and evaluated from January of 2006 through December of 2007. Comparative ISU VDL data were generated from a database search covering the same time period. Due to a lack of producer compliance, a complete set of tissue and serum samples was not available from each site.

PRRS ELISA. A total of 538 serum samples collected from 22 herds were assayed by PRRS ELISA. Results are shown in Table 1. Antibodies to PRRSV were detected in at least one animal in one or more age groups in 16 of the 22 herds (72.7%) that submitted serum samples. On PRRS-positive farms, 47 of 195 sow sera (24.1%), 24 of 114 of nursery pig sera (21.1%), and 42 of 128 of finishing pig sera (32.8%) were positive. The herd PRRSV seroprevalence reported in a National Animal Health Monitoring Survey (NAHMS) survey (68.5%)⁵ was not significantly different from niche data (72.7%). When NAHMS and niche data were compared, overall individual animal PRRSV seroprevalence (47.0% versus 18.2%), individual sow seroprevalence (31.8% versus 17.1%), and individual finishing-pig seroprevalence (57.5% versus 20.3%) were all significantly lower ($P < .001$) in niche herds.

SIV HI. A total of 602 serum samples collected from 22 herds were assayed by SIV HI (H1N1 and H3N2). A single herd vaccinated for SIV, and SIV serological data from this herd, were excluded. Antibody titers $\geq 1:40$ were considered positive. Results are shown in Table 1. Of the positive samples, 366 of 415 (88.2%) had antibody to H1 subtypes, 97 of 415 (23.4%)

had antibody to H3 subtypes, and 84 of 415 (20.2%) had antibodies to both. At least one animal from each of the 21 herds had an antibody titer of $\geq 1:40$.

In a study by Choi et al,⁶ 22.8% of pigs were seropositive for SIV, with 66.7% having antibody to H1 subtypes and 33.3% to H3 subtypes. Poljak et al⁷ reported that 969 of 2020 pigs (48.0%) were seropositive for H1N1 SIV, including 794 of 1300 sow serum samples (61.1%) and 175 of 720 finishing-pig samples (24.3%). The overall seroprevalence in niche pigs (68.9%) was higher ($P < .001$) than that reported for commercial swine by Choi⁶ or Poljak.⁷ A higher percentage ($P < .001$) of niche pigs were seropositive for H1 strains (88.2%) than in the Choi⁶ data (66.7%), while a lower percentage (23.4%; $P < .001$) were positive for H3 strains than in the Choi data (33.3%).

PPV HI. Breeding-herd vaccination for PPV was reported in 82% of herds. A total of 263 sow serum samples collected from 20 herds were assayed by PPV HI. A titer of $\geq 1:256$ was considered to be indicative of field infection,⁸ and 68.4% of titers attained this level (Table 1). Positive titers were identified in 19 of the 20 herds (95%). In 17 of the 20 herds (85%), at least one animal had a titer of 1:16,384.

Tissue diagnostics

Tissue from 179 niche pigs was evaluated, including 59 suckling pigs, 66 nursery pigs, and 54 finishing pigs. The study target of submissions from 130 suckling pigs, 78 nursery pigs, and 78 finishing-pigs was not reached because there was no clinically significant disease in several herds. A summary of tissue diagnostic results for the niche herds is shown in Table 2. In addition to the listed diseases, a single case of each of the following was diagnosed in suckling pigs: bacterial septicemia, chronic arthritis, *Clostridium difficile* colitis, necrotic enteritis, *P multocida* pneumonia, peritonitis, polyserositis, *Salmonella* enteritis, and suppurative rhinitis. One case of each of the following was diagnosed in nursery pigs: abscess, *Bordetella* rhinitis, *Bordetella* pneumonia, *Cryptosporidia* enteritis, *H parasuis* pneumonia, inclusion body rhinitis, *S suis* septicemia, and ulcerative enteritis. One case of each of the following was diagnosed in finishing pigs: abscess, *Actinobacillus pleuropneumoniae*, bacterial septicemia, hemorrhagic bowel

syndrome, enteritis, megacolon, porcine dermatitis and nephropathy syndrome, and *Staphylococcus hyicus* dermatitis.

The diagnostic frequency of agents identified in niche-pig respiratory cases was compared

to that of agents identified in ISU VDL respiratory submissions during the same time period. Results are shown in Table 3.

The diagnostic frequency of *L intracell-lularis* enteritis in niche pigs was compared

Table 1: Seroprevalence of PRRSV, SIV, and PPV by production phase in 22 Midwest niche swine herds*

	No. of positive samples (%)		
	SIV	PRRSV	PPV
Sows	261/283 (92.2)	49/286 (17.1)	180/263 (68.4)
Nursery	62/149 (41.6)	11/65(16.9)	ND
Finisher	92/170 (54.1)	38/187(20.3)	ND
Total	415/602 (68.9)	98/538(18.2)	180/263 (68.4)

* Sera were tested for antibodies to PRRSV using a commercially available enzyme-linked immunosorbent assay, considered positive at a sample:positive ratio ≥ 0.4 . Samples were tested for antibodies to SIV (H1N1 and H3N2) and PPV using hemagglutination inhibition assays, considered positive at a titer of $\geq 1:40$ for SIV and $\geq 1:256$ for PPV. Target numbers of samples collected in each herd were 14 from breeding females, 10 from nursery pigs, and 10 from finishers. One herd vaccinated for SIV was excluded from SIV testing.

PRRSV = porcine reproductive and respiratory syndrome virus; PPV = porcine parvovirus; SIV = swine influenza virus.

ND = not done in these age groups.

Table 2: Number of postmortem diagnoses by production phase in a total of 179 animals included in a study of 26 Midwest niche swine herds

Diagnosis (no. of cases)		
Suckling pigs (n = 59)	Nursery pigs (n = 66)	Finishing pigs (n = 54)
Rotavirus enteritis (4)	PCVAD (11)	PCVAD (9)
<i>Escherichia coli</i> enteritis (4)	<i>Pasteurella multocida</i> pneumonia (9)	<i>Mycoplasma pneumoniae</i> (8)
Inclusion body rhinitis (3)	Ileitis (<i>Lawsonia intracellularis</i>) (8)	Peribronchiolar lymphoid hyperplasia (8)
Coccidiosis (2)	Bronchopneumonia (4)	Ascarid hepatitis (7)
<i>Clostridium perfringens</i> type C enteritis (2)	Peribronchiolar lymphoid hyperplasia (4)	<i>P multocida</i> pneumonia (6)
PRRSV (2)	Pleuritis (3)	Ileitis (<i>L intracellularis</i>) (4)
Colitis (2)	PRRSV pneumonia (3)	Bronchopneumonia (4)
	<i>Mycoplasma pneumoniae</i> (3)	PRRSV pneumonia (4)
	Trichuris colitis (3)	<i>Streptococcus suis</i> pneumonia (4)
	Enteric salmonellosis (3)	SIV pneumonia (2)
	Ascarid hepatitis (2)	
	SIV pneumonia (2)	
	<i>S suis</i> pneumonia (2)	
	<i>E coli</i> enteritis (2)	

PRRSV = porcine reproductive and respiratory syndrome virus; PCVAD = porcine circovirus associated disease; SIV = swine influenza virus

Table 3: Diagnostic frequency of agents identified in pigs with pneumonia in 26 Midwest niche herds and in the diagnostic laboratory database*

Agent	No. of diagnoses (%)		P†
	ISU VDL (n = 8408)	Niche herds (n = 41)	
PRRSV	2899 (34.5)	7 (17.1)	< .10
<i>Pasteurella multocida</i>	1870 (22.2)	15 (36.6)	> .05
SIV	1828 (21.7)	4 (9.7)	> .05
PCV2	1135 (13.5)	20 (48.8)	< .001
<i>Streptococcus suis</i>	1133 (13.5)	6 (14.6)	> .05
<i>Mycoplasma hyopneumoniae</i>	773 (9.2)	11 (26.8)	< .001
APP	170 (2.0)	1 (2.4)	> .05

* Results for pigs with pneumonia in niche herds were compared to data for age-matched animals with pneumonia submitted to the Iowa State University Veterinary Diagnostic Laboratory (ISU VDL) during the same time period.

† Chi-square analysis; $P < .05$ considered statistically significant.

PRRSV = porcine reproductive and respiratory syndrome virus; SIV = swine influenza virus; PCV2 = porcine circovirus type 2; APP = *Actinobacillus pleuropneumoniae*.

with that of *L intracellularis* enteritis in the general ISU VDL database from the same time period. All cases in which age was not listed and all niche cases were excluded from the ISU VDL calculations. The mean age (\pm SE) of pigs diagnosed with *L intracellularis* enteritis in the ISU VDL database was 19.9 ± 3.3 weeks, with a median of 16 weeks. In the ISU VDL database, only 27 of 176 pigs (15.3%) with a diagnosis of *L intracellularis* enteritis were ≤ 10 weeks of age during the study period. In niche submissions, eight of 12 *L intracellularis* diagnoses (66.7%) were in nursery pigs, while only four of 12 (33.3%) were in finishing pigs. *Lawsonia intracellularis* enteritis was more common ($P < .001$) in nursery pigs from niche herds than in the general population of pigs submitted to the ISU VDL.

Lawsonia intracellularis enteritis was not diagnosed in the three herds that reported using *L intracellularis* vaccine.

There were no significant differences between niche herds and the general ISU VDL population when overall levels of samples IHC-negative for PCV2, subclinical PCV2 infection, and PCVAD diagnoses were compared. Results are listed in Table 4. However, when the production phase in which disease became manifest is compared, a higher percentage of nursery pigs (45.8%; $P < .001$) and a lower percentage of finishing pigs (31%; $P < .001$) developed PCVAD in niche herds than did the general ISU VDL population, in which PCVAD was diagnosed in 22% of nursery pigs and 55% of finishing pigs tested.

Eight niche herds utilized M hyo vaccines. *Mycoplasma hyopneumoniae* infection was diagnosed in 25% of these herds, compared to 50% of unvaccinated herds. ($P > .05$).

All submitted skin scrapings from niche pigs were negative for mites. Fecal-flotation results are outlined in Table 5. The average parasite score in niche finishing pigs was significantly higher than in niche nursery pigs and sows ($P < .001$). During the study period, which included a total of 16,119 ISU VDL porcine tissue submissions, 10 cases of ascarid hepatitis were identified, nine of which were from niche herds, and nine cases of whipworm colitis were detected, three of which (33.3%) were from niche herds. Significantly higher rates of both ascarid hepatitis and whipworm colitis were identified in niche herds than in the general ISU VDL database ($P < .001$).

Discussion

Disease pressures in individual herds are influenced by facilities' designs and management practices, regardless of the type of production system. The relatively small number of niche herds enrolled in the project, variable disease incidence, and differences in management practices and facilities made it difficult to correlate specific disease issues with specific management practices employed in niche herds. Because of this, niche pork data was broadly compared to published seroprevalence data and the diagnostic frequency of age-matched, diseased pigs submitted to the ISU VDL. The goal of this study was to provide practitioners with general insight on the potential for relative differences in the diagnostic frequency of diseases in niche pigs compared to the general diagnostic population.

Table 4: Results of diagnostic testing for porcine circovirus type 2 (PCV2) in 26 Midwest niche swine herds and in submissions to the Iowa State University Veterinary Diagnostic Laboratory (ISU VDL) during the same time period*

	No. of nursery pigs (%)		No. of finisher pigs (%)		Total no. of pigs (%)	
	Niche (n = 24)	ISU VDL (n = 100)	Niche (n = 29)	ISU VDL (n = 100)	Niche (n = 53)	ISU VDL (n = 200)
IHC-negative†	8 (33.3)	72 (72.0)	14 (48.3)	30 (30.0)	22 (41.5)	102 (51.0)
Subclinical PCV2	5 (20.8)	6 (6.0)	6 (20.7)	15 (15.0)	11 (20.8)	21 (10.5)
PCVAD‡	11 (45.8)	22 (22.0)	9 (31.0)	55 (55.0)	20 (37.7)	77 (38.5)

* For all comparisons of niche herd and ISU VDL results, $P > .05$ (chi-square analysis).

† IHC = immunohistochemistry for PCV2 on lung and lymphoid tissue.

‡ A pig was considered to have porcine circovirus associated disease (PCVAD) when moderate to abundant PCV2 antigen was observed by IHC in association with typical histological lesions.

Table 5: Average fecal oocyst-ova scores (\pm SE) and parasite detection rates in 26 Midwest niche swine herds by production phase*

Production phase	Fecal oocyst-ova score †	No. of positive fecal samples (%)			
		Total	Ascarids	Trichuris	Coccidia
Nursery	1.9 (\pm 0.37)	12/17 (70.6)	5/17 (29.4)	5/17 (29.4)	6/17 (35.3)
Finisher	2.8 (\pm 0.29)	19/21 (90.5)	13/21 (61.9)	10/21 (47.6)	12/21 (57.1)
Sow herd	1.2 (\pm 0.18)	17/19 (89.5)	3/19 (15.8)	3/19 (15.8)	15/19 (78.9)

* Fecal flotations in sucrose solution (specific gravity, 1.27). Scores: 0 = oocysts or parasite ova not identified; 1 = \leq 1 egg or oocyst per low power field (LPF); 2 = 2–3 eggs or oocysts per LPF; 3 = 4–10 eggs or oocysts per LPF; 4 = \geq 11 eggs or oocysts per LPF.

† Average fecal oocyst-ova score in finishing pigs was significantly higher than in nursery pigs and sows ($P < .001$; one-way ANOVA).

The overall spectrum of diseases identified in niche herds was comparable with the range of illness expected in populations of swine of comparable ages reared in other types of production systems. This discussion will focus on the most prevalent diseases in niche herds, especially those that diverge significantly from general ISU VDL or published surveillance data.

The prevalence of PRRSV infection in commercial swine herds has been estimated to be as high as 60% to 80%,⁹ but well-controlled studies are lacking. The best available estimates of PRRSV seroprevalence come from a National Animal Health Monitoring Survey (NAHMS),⁵ which reports that overall, 68.5% of premises and 47% of individuals were seropositive for PRRSV, including 57.5% of finishing pigs on 63% of finishing sites and 31.8% of gestating females in 57.5% of sow herds. The herd PRRSV seroprevalence in niche production systems did not differ significantly from NAHMS data. However, the overall individual-animal PRRSV seroprevalence, individual sow seroprevalence, and individual finishing-pig seroprevalence were all significantly lower in niche herds. The lower seroprevalence in all tested age groups suggests that PRRSV does not spread as extensively throughout niche populations. This assertion is supported by trends in tissue diagnostics. PRRS virus contributed to development of pneumonia in 34.5% of ISU VDL respiratory cases, but in only 17.1% of respiratory cases from niche herds.

The consequences of PRRSV infection in a herd depend on complex interactions between virus strain, passive or active immunity, stage of gestation, and rate and intensity of contact between susceptible and infectious individuals.¹⁰ In smaller,

closed herds, which include many niche herds, there is the potential for natural elimination of the virus.¹⁰ Conversely, since only 24.1% of sows were seropositive in PRRSV-positive niche herds, this may set the stage for outbreaks of PRRS abortion in non-immune animals in the breeding herd.

The overall individual-animal SIV seroprevalence, individual sow seroprevalence, and individual finishing-pig seroprevalence were all significantly higher in niche herds than in two published reports.^{6,7} Because SIV is maintained through continual availability of susceptible pigs,¹¹ the continuous-flow systems favored by niche producers may be responsible for the higher SIV seroprevalence in these herds. Niche herds were typically seropositive for H1 strains, with fewer herds exhibiting seroconversion to H3 strains.

Lawsonia intracellularis is the most commonly diagnosed cause of intestinal disease in grower-finisher pigs.^{12,13} The average age of pigs with clinical *Lawsonia* infection in the ISU VDL database during the study period was 19.9 weeks (SE, 3.3 weeks). Since accurate age data was not available on all niche submissions, the percentages of total *Lawsonia* diagnoses reported in each production phase were compared. The proportion of *L intracellularis* diagnoses during the nursery phase was significantly higher in niche herds than in the general ISU VDL population. Factors that have the potential to influence the earlier appearance of *L intracellularis* enteritis in niche herds include lack of antibiotic exposure and use of continuous-flow operations, leading to earlier exposure of young animals to shedding pigs.¹⁴⁻¹⁷ Though not generally thought of as a nursery-pig disease, *L intracellularis* enteritis should

be a differential for nursery-pig diarrhea in niche systems. Earlier development of clinical *L intracellularis* infection also has the potential to impact timing of immunization, necessitating vaccination earlier in production. Because *L intracellularis* vaccines were used in only 11.5% of herds, there was insufficient data to correlate vaccination with the diagnostic frequency of *L intracellularis* enteritis. However, *L intracellularis* enteritis was not identified in herds that reported using *Lawsonia* vaccines.

In niche herds, PCVAD was the most commonly diagnosed disease in both nursery and finishing-pig populations. When the diagnostic frequency of infectious agents identified in cases of respiratory disease was compared, PCV2 was a significantly more common contributor to the porcine respiratory disease complex (PRDC) in niche herds than in the general ISU VDL database. Overall, niche data did not differ significantly from ISU VDL data with respect to the percentages of pigs IHC-negative for PCV2, pigs with subclinical PCV2 infections, and pigs with PCVAD. However, the diagnostic frequency of PCVAD in the production phases was almost reversed. A significantly higher percentage of nursery pigs and lower percentage of finishing pigs developed PCVAD in niche herds than in ISU VDL submissions. These findings indicate that PCVAD is an important disease in niche herds, that PCV2 is a significant contributing factor in the development of PRDC in niche pigs, and that PCVAD commonly appears in younger pigs in niche herds. As for *L intracellularis*, this has the potential to impact the timing of PCV2 vaccination in niche herds.

Mycoplasma hyopneumoniae is an important cause of respiratory disease in swine-production systems, where it primarily impacts

finishing pigs. In animals submitted with a history of respiratory disease, detection of *M hyo* by PCR was significantly higher in niche herds than in routine ISU VDL respiratory-disease submissions. The diagnostic frequency of *M hyo* in niche herds may be under-appreciated. Peribronchiolar lymphoid hyperplasia, the microscopic lesion considered to be an indicator of *M hyo* infection, was observed in 12 niche pigs that were PCR-negative for *M hyo*, suggesting that this respiratory pathogen may have been a contributing factor in up to 56% of niche respiratory cases.

A variety of practices are utilized to try to minimize clinical expression of *M hyo*, including early weaning with multi-site production, environmental control, strategic medication, and vaccination.¹⁸⁻²² Specific risk factors that may lead to the elevated diagnostic frequency of *M hyo* in niche herds include later weaning, continuous-flow production, limited temperature control, and lack of antibiotic usage. Most niche systems allow vaccination. Without the ability to control several important risk factors for enzootic pneumonia, vaccination may need to be the primary focus of *M hyo* prevention strategies in niche herds. The diagnostic frequency of *Mycoplasma pneumoniae* was lower in niche herds that vaccinated, but due to the small population size, the difference was not significant.

It was anticipated that parasites would be a more significant issue in niche herds than in conventionally raised swine. Studies have demonstrated that pigs reared in the types of facilities favored by many niche producers (dirt lots, pastures, or deep-bedded systems) typically have greater potential for internal parasitism.²³⁻²⁵ Compared to data reported by Morris et al²⁴ detailing parasite burdens in pigs raised in confinement on slatted floors, there was significantly more parasitism by ascarids, whipworms, and coccidia in niche herds.

Coccidia oocysts were identified in a high percentage of niche sow and finishing-pig fecal samples. Studies have demonstrated that detection of coccidia in the feces of finishing and adult swine is highly variable, with reported oocyst identification rates ranging from 3.1% to 94.8%.^{24,26,27} Flooring type contributed to the variability in oocyte burden.^{24,26,27} Morris et al²⁴ indicated that older swine and those on dirt lots or pasture were more often infected with coccidia, which may help to explain

the high incidence in finishing and breeding animals in niche herds. In these older populations, coccidia were typically *Eimeria* species, which are generally considered to be minimally to nonpathogenic in these age groups.²⁸ Though common, detection of *Eimeria* species in older pigs was likely of minimal clinical significance.

Considering the lifecycle of the common nematode parasites of swine, it was anticipated that finishing pigs would have the highest rate of parasitism by intestinal nematodes. The highest parasite detection rate, highest parasite scores, and the largest percentage of positive fecal flotations for ascarid and whipworm eggs were identified in samples from grow-finish pigs.

Nematode parasitism causes suboptimal production efficiency, and to a lesser extent, overt clinical disease.²⁹ The ISU VDL data suggests that overt clinical disease, as detected by nematode-associated lesions on postmortem examination (eg, ascarid hepatitis, ascarid pneumonia, or whipworm colitis), is currently uncommon. Clinical parasitism appears to be significantly more common in niche herds than in general ISU VDL submissions. Since the primary impact of internal parasitism is suboptimal production efficiency,²⁹ the higher incidence of clinical parasitism and higher percentage of positive fecal samples in all phases of production indicate that significant production losses due to internal parasitism are likely in niche herds. Though deworming was practiced in the majority of niche herds, it did not appear that this practice alone provided successful parasite control.

Prior to the start of this study, it was anticipated that agents largely eliminated from many large production systems, such as transmissible gastroenteritis virus, *Brachyspira hyodysenteriae*, and *Actinobacillus pleuropneumoniae*, might be endemically entrenched in smaller, continuous-flow niche herds. This assumption proved unfounded. Transmissible gastroenteritis and swine dysentery were not detected in submissions from niche herds. *Actinobacillus pleuropneumoniae* was identified in one animal, but the diagnostic frequency was not significantly different from that in the general diagnostic population.

The tissue diagnostics component of this study was a survey of diseases in niche herds and was intended to emphasize relative

differences in the diagnostic frequency of specific diseases in niche pigs compared to the general diagnostic population. This study was not designed to determine the comparative incidence of specific diseases in niche herds or the overall impact of disease on production efficiency. Data should not be interpreted to imply that there is more or less disease in niche herds, because comparative information on disease incidence was not collected.

Niche producers raise pigs under different production constraints and often in different environments than do larger commercial operations. This understandably leads to differences in disease pressures. This study identified a lower individual-animal seroprevalence for PRRSV, a higher seroprevalence for SIV, a higher diagnostic frequency of enzootic pneumonia (*M hyo*), a lower age of clinical *L intracellularis* infection, a greater proportion of PCV2 in PRDC cases, a younger age of clinical PCVAD, and a greater degree of internal parasitism in niche herds than in conventionally reared swine.

Implications

- Serological testing indicates that PRRSV is common in niche herds but does not spread as extensively within these populations.
- The comparatively low level of seroconversion in PRRSV-positive niche sow herds raises concern about potential for outbreaks of PRRSV-associated reproductive disease.
- Ileitis is a differential for nursery-pig diarrhea in niche herds, and these producers may need to consider administering *L intracellularis* vaccine at an earlier age.
- Vaccination for PCV2 should be considered in niche herds to control PCVAD and aid in prevention of PRDC.
- Prohibition of antibiotics and preference for later weaning and continuous-flow production may contribute to a higher rate of *M hyo* involvement in niche-pig respiratory disease.
- Internal parasitism may be an important cause of production losses in niche herds.

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