Swine practitioners need to play a major role in eliminating infectious disease from swine herds.

All in–all out pig flow can improve average daily gain and feed efficiency, prevent mortality, and reduce the severity of respiratory disease in nursery and growing–finishing facilities, p. S20.

By practicing early removal of sows, the F10 system prevents further spread of infectious agents from sows to weaned pigs, reduces labor, and improves performance, p. S20.

Compared with the three-site system, a two-site system is much easier to operate economically and appears to be just as effective, p. S20.

A strategy known as whole-herd depopulation–repopulation can eliminate chronic endemic diseases and improve genetics but should be used only when other production strategies have been exhausted, p. S21.

No other factor can affect the productivity and profitability of a swine farm as severely as exposure to an infectious disease. Bacterial and viral agents that affect weaned pigs are often spread laterally among populations of pigs with varying levels of immunity. Concurrent infection with multiple pathogens can also occur. One of the essential roles of swine practitioners is to implement strategies that reduce the effect of such pathogens. This article summarizes published data on health technologies commonly implemented to improve the performance of weaned pigs: all in–all out (AIAO) pig flow, the F10 system, multisite systems, segregated early weaning (SEW), whole-herd depopulation–repopulation, and partial depopulation (PD).

**ALL IN–ALL OUT PIG FLOW**

All in–all out pig flow has been documented to improve the performance of pigs.\(^1\) Completely emptying a room, building, or site prevents the continuous spread of pathogens from older to younger animals. AIAO flow has long been a practice of the poultry industry. After birds are delivered to the slaughterhouse, bird barns are routinely emptied, washed, disinfected, fumigated, and allowed to remain empty for a given period to reduce microbial survival outside the host. This technology was initially adopted by the swine industry to control preweaning problems with diarrhea. In the past 5 to 10 years, however, the effect of AIAO...
Although a majority of studies have concentrated on the effect of AIAO flow on the performance of finishing pigs, up to 20% improvement in growth rate and 25% improvement in FE have been reported in nursery pigs after implementation of AIAO flow.4 All in–all out pig flow can be practiced by room, building, or site. Data indicate that AIAO flow by site or airspace results in better performance than is realized if a single room is emptied.3 The piglets ideally should be within 1 week of age of each other, but 2 weeks of production can be housed together and still realize the benefits of improved performance from this technology. AIAO pig flow does not eliminate disease but does result in reduced prevalence of pneumatic lesions as well as reduced severity of intestinal disease. Conversion of large, continuous-flow facilities to AIAO facilities usually entails construction of walls to establish rooms of pigs within buildings. Each room must be individually ventilated. Another means of converting to AIAO pig flow involves reorganization of farrowing schedules, resulting in larger batches of weaned pigs completely filling a facility at one time. Although previous planning is required, the effect of AIAO pig flow on postweaning performance appears to be worthwhile.

**THE F10 SYSTEM**

The F10 system (i.e., farrowing to 10 weeks of age) is a recently developed technology to improve weaned pig performance.4 In the F10 system, sows are weaned in the normal fashion, but pigs remain in the farrowing crate until they are 10 weeks of age. The farrowing crate is then modified and converted to a nursery pen. The advantage of such a system is that early removal of sows prevents further spread of infectious agents from sows to weaned pigs, reduces labor, and improves performance. Although data are sparse, piglets raised under the F10 system apparently outperform those raised under conventional measures.4 Improvements in growth rate of 44%, 0.3% reduction in FE, and 50% reduction in mortality have been recorded.4 The disadvantages of such a system may include reduced utilization of farrowing crate space. Therefore, the system may only be applicable to producers using batch- or group-farrowing schedules. Despite this limitation, pigs raised under the F10 system are apparently capable of better performance than are those weaned in conventional nurseries.

**MULTISITE SYSTEMS**

The U.S. swine industry currently uses one-, two-, or three-site production systems. One-site systems consist of breeding, gestation, and farrowing on one site, with the nursery and finishing facility on separate sites. Recommended distances between sites range from 1 to 3 km, depending on the health status of the operation and the suspected airborne potential of various microorganisms. Two-site systems consist of breeding, gestation, and farrowing on one site, with the nursery and finishing facility on another. The main premise of both systems is that the nursery must be located on a site away from the breeding herd to prevent transmission of microorganisms from sows to offspring. This premise is the basis for SEW technology and is summarized in the Segregated Early Weaning section.

In addition to improved health status, multisite production systems have many advantages for swine producers. If the nursery and finishing facility are relocated to other sites, existing facilities can be remodeled to expand the size of the breeding herd, usually with a reduced investment. Nurseries can be remodeled into farrowing rooms, and finishing pens can house gestating sows. Swine producers commonly network together, establishing off-site weaning facilities to commingle pigs from several farms. The health status between sow farms must be similar to prevent the exposure of new diseases to susceptible pigs.

Three-site production can be costly and difficult for most small U.S. commercial swine producers to use and thus is usually reserved for breeding stock companies or large herds with 1200 or more sows. The two-site system is much easier to operate economically and appears to be just as effective. The combination of SEW and multisite production systems is beneficial to all types of procedures and results in improved efficiency of the swine enterprise.

**Segregated Early Weaning**

Segregated early weaning is a variation of medicated early weaning.3 Reports have indicated that SEW can eliminate certain pathogens and improve weaned pig performance.4 A critical component of SEW consists of hyperimmunization of sows before farrowing to provide pigs with high levels of colostral antibodies against specific pathogens, which is important to reduce transmission of microorganisms between sows and pigs during lactation. Pigs are then injected with a series of antibiotics to eliminate specific bacteria before weaning. Finally, pigs are weaned at an early age in a separate site to prevent further transmission by sows.

Recent studies have investigated the need for antibiotics. Under controlled conditions, age-specific separa-
tion from the sow may be more important than medication.\textsuperscript{7} The relationship between the appropriate weaning age and pathogen elimination has been the subject of much work.\textsuperscript{5,6} It is apparently impossible to eliminate certain microorganisms with early weaning. Such pathogens as \textit{Escherichia coli} and \textit{Streptococcus suis} may infect pigs shortly after birth (day 1) as a result of colonization via contact with mucosal surfaces or secretions or excretions of sows.\textsuperscript{8}

Transplacental transmission of \textit{Leptospira} species (the virus causing porcine reproductive and respiratory syndrome [PRRS]) and parvovirus may result in the presence of these organisms immediately after parturition. However, published data indicate an ability to eliminate pathogens if certain weaning ages are met.\textsuperscript{9} Weaning pigs at 10 days of age or younger apparently eliminates \textit{Haemophilus parasuis}, \textit{Bordetella bronchiseptica}, \textit{Pasteurella multocida}, and \textit{Mycoplasma hyopneumoniae}. The initial presence of these organisms is not detected unless weaning ages reach 15 days or more. Similarly, \textit{Actinobacillus pleuropneumoniae} may be eliminated at 16 to 18 days of age. Finally, pseudorabies virus and transmissible gastroenteritis virus are apparently eliminated by day 21 of weaning.

When they arrive at the nursery, weaned pigs should be fed diets high in milk products and plasma protein. It is critical to limit feedings to five to seven times per day during the first week after weaning. Pigs should be placed on a water-soluble antibiotic chosen based on in vitro susceptibility data. Weaned pigs should be housed in single-stage nurseries with plastic-coated flooring and ambient temperatures of 30°C to 31°C and sorted by size and sex. The vaccines and medications administered depend on the individual farm’s diagnostic data. Nasal swabs can be collected from sows and two to three sick pigs in the nursery and finishing facility and submitted to a diagnostic laboratory for culture. Based on the sensitivity patterns of bacterial isolates, specific medications can be chosen. Serologic testing is also an important tool to determine the exposure level of the breeding herd to specific pathogens that are targeted for eradication; serology also assists with the development of vaccination programs for the breeding herd.

Although performance following completion of SEW has reportedly been excellent, little information is available regarding the effect of SEW on the subsequent performance of sows.\textsuperscript{10} Data from four production units using SEW for 3 years have been published.\textsuperscript{10} Despite a weaning age of 12 to 14 days, problems with the breeding herd were minimal. After 3 years of early weaning data had been analyzed, little reduction in subsequent liveborn litter size or weaning-to-estrus interval in four commercial swine herds was found.\textsuperscript{10}

**On-Site Segregated Rearing**

Despite the success of multisite production, the ability to use such technology may be limited. It is often difficult to obtain separate farm sites because of lack of capital, overall inconvenience of the existing labor force (moving from site to site, frequent changing of clothing, and use of shower in–shower out protocols), or a high density of pigs in the surrounding area (elevated pressure of infectious disease that swine units are exposed to when area density is high). I believe that the concept of raising pigs away from sows but on the same site appears promising. If the nursery is located a short distance (200 to 500 m) from the breeding and finishing facilities and there are no connecting airspaces (hallways) between the nursery and other facilities, performance may improve. Strict segregation of labor is also essential, with only one worker allowed in the nursery at a time. Shower facilities are important; however, the routine practice of changing clothes (coveralls and footwear) before entry into rooms appears to be critical. A regular program of rodent control should also be completed monthly by a professional exterminator. Preliminary data from 1997 records kept on an 800-sow farm raising 22-kg pigs indicated reduced nursery mortality (2.5% to 1.5%), increased ADG (0.34 kg to 4.5 kg), and improved FE (1.9 to 1.5).

**WHOLE-HERD DEPOPULATION–REPOPULATION**

Whole-herd depopulation–repopulation has gained increased acceptance in the field as a strategy to improve both health and genetic performance. Although the process can be costly and difficult psychologically (it can be stressful to farmers and requires considerable forward planning, a cooperative lender, and an efficient staff), it is effective at eliminating chronic, endemic diseases while simultaneously improving genetics. Reasons to repopulate an entire farm include poor growth rate, excessive numbers of unmarketable or cull pigs, poor FE, and low heterosis. Although diseases of nursery pigs are typically not severe enough to warrant whole-herd depopulation, the concept is briefly reviewed here.

Before a depopulation–repopulation program is initiated, the present herd performance and health must be carefully evaluated. Significant chronic diseases that can lead to a decision to depopulate a herd include pseudorabies, swine dysentery, \textit{A. pleuropneumoniae} infection, and atrophic rhinitis. Because these chronic diseases usually require excessive antibiotic administration and/or vaccination programs, the amount of antibiotics and vaccines required to control or prevent a disease needs to be considered to determine whether whole-herd depopulation–repopulation is economically beneficial.
In addition to assessing herd health, the genetic status of the herd should be evaluated. Problems that indicate poor genetic performance include low liveborn litter size, low weaning weights, and excessive backfat at slaughter. Finally, because whole-herd depopulation results in severe short-term capital losses, arrangements should be made with a lending institution to provide adequate working capital.

The timing of depopulation is critical. Procedures should include the length of downtime required, season of the year, and predicted market prices. Ideally, to minimize downtime, facilities can be rented to ensure a constant flow of pigs to market during depopulation. Despite their poor health, these pigs have some market value and can be fed out on alternative facilities and sold at the proper time. This strategy allows the farmer to have some income during the repopulation period. At least 30 days of downtime are usually required to thoroughly clean and disinfect a farm to reduce the survival of pathogens outside the host and make necessary repairs to the facilities. Ideally, downtime should occur during periods of hot weather to take advantage of the bactericidal or viricidal effects of drying, high temperatures, and ultraviolet radiation. The cleanup procedure is involved and encompasses thoroughly washing the entire swine complex, including the pit. All equipment (feeders, crates, pens, ventilation equipment) must be thoroughly washed with hot (90°C to 94°C), high-pressure water and disinfected. Pits should be emptied and slats lifted to obtain access to fecal material that has built up on the underside of the concrete. Finally, a rodent control program should be implemented and maintained, ideally by a professional exterminator.

Improved performance is usually evident after repopulation. Improvements of 10% or more in growth rate and 5% to 10% improvement in FE have been reported. Other benefits include 10% to 20% increase in pounds marketed and reduced vaccination and medication costs. Problems frequently encountered during or after repopulation include mismanagement of the off-site breeding project, reintroduction of a significant disease via the purchased stock, and increased levels of specific conditions such as greasy pig disease or parvovirus infection. Such diseases are believed to arise from a low level of immunity within an immature breeding population. Overall, whole-herd depopulation—repopulation can produce both health and genetic benefits; because of its high level of economic and psychologic stress, however, it is a technology that should be used only when other options have been exhausted.

### PARTIAL DEPOPULATION

Partial depopulation consists of adjusting pig flow to interrupt horizontal transmission of pathogens from older, previously infected pigs to recently weaned pigs. PD was first used to control postweaning PRRS\(^1\); however, PD can also be used to control infected finishers.

The use of PD in controlling PRRS is based on the principle that virus circulation exists in a specific stage of nursery or finishing production but is absent in the breeding herd. Identifying the specific pattern of spread is critical for success because infection of piglets before weaning results in the introduction of viremic animals to the nursery or finishing population.

Productivity and profitability in 34 nurseries before and after implementing PD are listed in Tables I and II. Basically, PD prevents pathogen spread from sows to pigs before weaning. However, PD may be logistically difficult to implement in large herds (1000 or more sows) and requires a temporary off-site facility to house depopulated pigs. Finally, the strategy may need to be repeated every 1 to 2 years.

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**TABLE I**

Mean Differences in the Performance of Four Study Groups 12 Months Before and After Nursery Depopulation

<table>
<thead>
<tr>
<th>Group</th>
<th>No. of Farms</th>
<th>Average Daily Gain (kg)</th>
<th>Mortality (%)</th>
<th>Feed Efficiency</th>
<th>Treatment Cost/Pig ($)(^a)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Before</td>
<td>After</td>
<td>Before</td>
<td>After</td>
<td>Before</td>
</tr>
<tr>
<td>1</td>
<td>15</td>
<td>0.25</td>
<td>0.38(^b)</td>
<td>9.7</td>
<td>2.3(^b)</td>
</tr>
<tr>
<td>2</td>
<td>6</td>
<td>0.25</td>
<td>0.34(^b)</td>
<td>14.4</td>
<td>2.0(^b)</td>
</tr>
<tr>
<td>3</td>
<td>7</td>
<td>0.29</td>
<td>0.37(^b)</td>
<td>7.0</td>
<td>1.7(^b)</td>
</tr>
<tr>
<td>4</td>
<td>6</td>
<td>0.26</td>
<td>0.41(^b)</td>
<td>10.9</td>
<td>1.2(^b)</td>
</tr>
</tbody>
</table>

Compiled data 34 0.26 0.38\(^b\) 10.2 1.9 1.91 1.77 2.90 1.63

\(^a\)Injectable medication and vaccination costs/pig in U.S. dollars.  
\(^b\)\(P < .001\). 

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CONCLUSION

All of the strategies discussed can be effective in improving the performance of nursery pigs. Strategy selection depends on the input of the veterinarian, financial status of the swine operation, and ability of the producer to properly manage the system after changes have been implemented. Proper planning before a plan is executed can enhance its success, and swine practitioners should provide the information and direction producers need to realize success.

REFERENCES


About the Author

Dr. Dee is affiliated with the Swine Medicine Faculty, College of Veterinary Medicine, University of Minnesota, St. Paul. He is a Diplomate of the American College of Veterinary Microbiologists.
c. production segregation
d. all of the above

7. Transplacental transmission capabilities prevent successful elimination of ______ during an SEW program.
   a. PRRS virus c. parvovirus
   b. *Leptospira* species d. all of the above

8. The PD protocol is effective for controlling clinical PRRS in the nursery if
   a. there is no detectable viral circulation in the breeding herd.
   b. there is no detectable virus circulation in the nursery.
   c. diagnostic evidence indicates the shedding of virus from older to recently weaned pigs
   d. a and c

9. __________ is a disadvantage of the F10 system.
   a. Reduced utilization of farrowing crate space
   b. Poor growth rate
   c. Extra medication cost
   d. Reduced breeding herd efficiency because of extended lactation lengths

10. Weaning pigs at 10 days of age or younger results in elimination of
    a. PRRS virus.
    b. *H. parasuis*.
    c. *S. suis*.
    d. sarcotic mange.