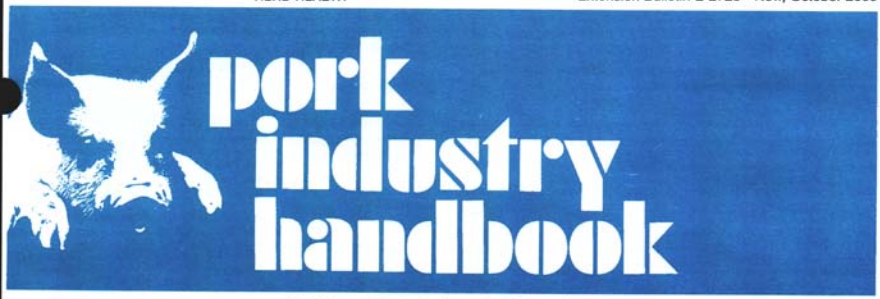

Michigan State University Extension

Disease Elimination Techniques

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When disease-causing microbes are eliminated or excluded from the growing pig, pigs perform better and have leaner carcasses and usually are more profitable. Some microbes can be reduced in levels present and/or eliminated from pigs by certain management procedures such as medication, sanitation, enhanced immunity due to aging, decreased stocking density, and/or vaccination. Multi-site rearing systems are particularly useful in this regard in that the young growing pigs are separated from the adult breeding herd, which is a reservoir of infectious agents. This fact sheet emphasizes the elimination and exclusion of microbes utilizing medicated early weaning (MEW) and isowean. In addition, the advantages of the various types of multi-site rearing systems are discussed regarding the eradication of infectious agents from the adult population. Fundamental aspects of microbe/pig interaction are first explained. Other methods of microbe exclusion and elimination that are applicable to traditional one site rearing systems are also discussed.

Origin of Microbes for the Newborn Piglet

Usually, piglets are sterile or microbe-free in the uterus of the dam. Some infectious microbes such as the Porcine Reproductive and Respiratory Syndrome (PRRS) virus may infect piglets *in utero* but not always, even in infected herds. So the most common first exposure of the piglet to microbes comes as it passes through the cervix into the vagina of its mother. As naturally-farrowed pigs pass through the vagina they become infected with microbes. When the piglet is born, more microbial exposure occurs by its contact with feces, skin of the dam, and the swine rearing facility. Some microbes grow on the skin and others are swallowed by the piglet and begin to establish themselves in the mouth, stomach, and intestines. Whether the piglet becomes diseased due to exposure to these microbes depends on the health and immune status of the sow, the overall sanitation of the farrowing facility, colostrum and milk intake, and the comfort level of the pig rearing environment (stress, temperature, dampness, etc).

Medicated early weaning and isowean are two of four methods that can be utilized to alter the establishment of the microbial flora of the newborn piglet. These techniques will be explained in the following section.

Altering the Microbial Flora of the Newborn

Hysterectomy-derived; colostrum-deprived (HDCD)

Germ-free (microbe-free) pigs can be procured surgically by opening the uterus and extracting the pigs by hysterectomy under aseptic conditions. This is the basis for deriving specific pathogen-free (SPF) pigs that are then reared in isolation either on artificial milk replacer (or cross-fostered onto surrogate nurse sows). These pigs develop an isolator microbial flora present in the environment. Pigs reared on milk replacer without colostrum often are referred to as hysterectomy-derived (or caesarian-derived) colostrum-deprived (HDCD or CDCD) pigs. It should be noted that occasionally piglets might be infected *in utero*, with viral agents in particular. If this is the case and if the piglets do not receive colostrum, it is likely they will die soon after surgery. Therefore, care must be taken that each HDCD litter is kept isolated from other pigs prior to exposure to other surgically-derived litters or introduction into a herd.

High-health status herds can be established using HDCD procedures combined with milk-replacer diets and are considered primary SPF herds. When one site and traditional two site farms are first established and maintained by proper SPF techniques, infectious disease levels may be low and pig perfor-

mance is excellent. However, eventually breakdowns of disease will occur and performance may deteriorate especially in the growing pigs (Figure 1). Even pigs in recently derived SPF herds of high health status have lower performance if they remain in the farm as compared to isowean derived pigs from the same facility. This deterioration in performance is economically important in that over 60% of operating costs are due to feed for growing pigs. Death loss (mortality rates) also may increase as the health status of such herds decreases.

Snatch Farrowed (SF)

Snatch Farrowed (SF) pigs are collected directly from the vagina at birth. When done properly, these pigs differ only from HDCD pigs in their exposure to vaginal microbial flora. These pigs are reared in isolation either on milk replacer or cross-fostered onto surrogate nurse sows.

Medicated Early Weaning

Medicated early weaning (MEW) was developed as an alternative to the use of surgical derivation as described above for the production of SPF pigs. The technique has the distinct advantage of avoiding surgery on the donor sow. In MEW, small groups of pregnant sows (near term) from one or more farms are placed in strict isolation and farrowed (Figure 2). Ideally each isolated group of sows is induced to farrow within two to four days of one another. The sows are heavily medicated both prior to and during their stay in the farrowing unit. To assure elimination of some infectious microbes, the sows may only be from 2nd or higher parities to increase the level of colostral and milk immunity. Vaccines may be administered to the sows four to six weeks prior to farrowing to further increase the levels of colostral and milk immunity. Beginning immediately after birth the piglets are administered heavy doses of antimicrobials to lessen the chance of sow-to-pig transfer of microbes. The piglets are weaned at five days of age or less into isolated nurseries well away from the farrowing unit. Often, medication continues to the piglets for several weeks after weaning into the isolated nursery.

For best results, each weaning group should have only a one to two day difference in age when placed into an all-in; all-out nursery accommodation. Subsequently, the pigs are moved to a growing and finishing unit that is well isolated away from the farrowing and nursery units.

Isowean

Isowean has a few synonyms: modified medicated early weaning (MMEW); segregated early weaning (SEW); age segregated weaning; and segregated disease control (SDC). The word isowean is derived from the words isolated weaning. The Isowean Principle denotes pigs that are weaned away, and in strict isolation, from the other age groups in a multi-site rearing system. Isowean is different from MEW because in isowean the sows are not removed from the farm and placed in isolation to farrow (Figure 3). Additionally, isowean pigs are usually weaned at an older age than MEW pigs. The weaning age of an isowean pig is dependent upon the microbial agents to be eliminated and may vary from eight days to four weeks of age. However, the variation in age of any one farrowing group should be very narrow as in MEW. In practice, a variation in age in a weaning age group should be only two to five days.

In isowean, the pregnant sows are farrowed in the source farm(s) without removal to isolation facilities. Usually, the sows are vaccinated in late gestation as in MEW but often they are not medicated. It is highly recommended that the sows be placed in an all-in; all-out farrowing room and that all sows in the room are farrowed within a four to seven day period. If bacterial or Mycoplasmal microbes are to be eliminated, the piglets are usually medicated during the suckling and post-weaning periods. At weaning, the piglets are moved to an isolated nursery and placed in an all-in; all-out room or building. As in MEW, each weaning age group of isowean pigs is placed in an isolated grower/finisher away from the isolated nursery and source farm containing the mature swine.

Table 1 lists example weaning age and antimicrobial and vaccine strategies used to produce batches of isowean pigs. Whether antimicrobials are used depends upon the infectious agent(s) to be eliminated that is(are) present in the source farm(s). If only viral agents are to be eliminated, antimicrobials may not be necessary.

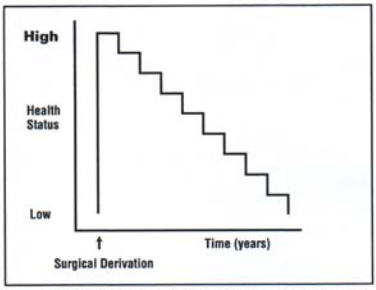

Figure 1. Degradation of health status occurs eventually in any pig production farm. The rate of degradation is dependent upon many factors including biosecurity and source of replacement breeding stock.

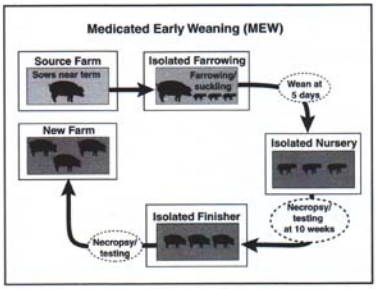

Figure 2. Medicated early weaning (MEW). Pregnant sows are farrowed in isolation in all-in; all-out rooms away from the source herd. Piglets are weaned at 5 days of age into isolated nursery accommodations away from the source herd and farrowing rooms. Piglets are reared to maturity in isolated finisher accommodations away from all other stages of production.

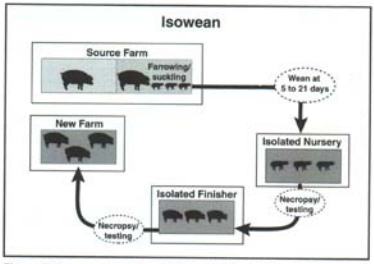

Figure 3. Isowean (modified MEW or SEW). Similar to MEW except that sows are farrowed in the source farm and not in isolated farrowing rooms or buildings. Usually piglets are weaned at 8 days or greater in age.

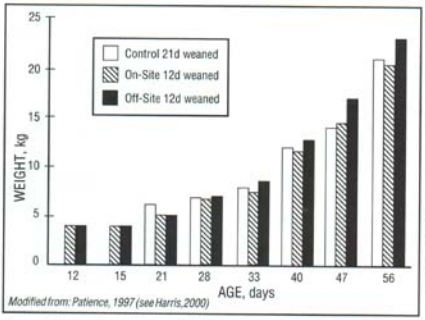

Figure 4. Comparison of littermate pig performance when weaned under three separate conditions: weaned at 21 days of age into a continuous flow nursery on the farm of origin; weaned at 12 days of age into an all-in; all-out nursery on the farm of origin and weaned at 12 days of age into an all-in; all-out nursery isolated (Isowean) from the farm of origin.

Comparison of HDCD, SF, MEW, and Isowean Pigs

All four procedures are useful for procuring batches of pigs either free of or with reduced levels of microbial pathogens. Table 2 compares their relative elimination efficacy. Isowean is by far the most economical, but it is not as efficacious as MEW especially for the elimination of *Streptococcus suis*. Medicated Early Weaning is as efficacious as both HDCD and SF methods. Isowean and MEW pigs are easier to procure in large batches as compared to HDCD and SF pigs.

All four procedures will not eliminate a microbial pathogen that is passed transplacentally from the dam to the piglet *in utero*. For this reason, it is imperative that pigs derived by any of the methods be placed in isolation or evaluated prior to directly introducing them into a herd as replacement breeding stock. If HDCD or SF pigs are to be cross-fostered, the surrogate nurse sows should be placed in isolation outside the recipient herd for two to three weeks to allow time for evaluation of any transplacental infection. Piglets born to the surrogate mothers may be used as sentinel pigs as well.

There is a greater chance of contaminating the MEW or isowean pig with an unwanted microbial pathogen during lactation as compared to HDCD or SF piglets. Experience has shown that a high percentage of MEW and isowean groups are negative for most pathogens. Still, it is important that each weaning group be reared in isolation from other weaning groups in case a microbial pathogen should infect a group of piglets. It is imperative that pigs are isolated on a recipient farm from the other age groups for several weeks prior to entry into the main farm. In some cases, it is advised that sentinel pigs be reared with the MEW or isowean pigs. The sentinel pigs would need to be from a source free of the specific infectious agents that are being eliminated by MEW or isowean.

Since MEW and isowean pigs consume colostrum and have passive antibodies, it is more difficult to know based on serologic tests when an unwanted microbial pathogen has contaminated a weaning group. The piglet may not be infected with a pathogen but contain antibodies in its serum to the pathogen received via the colostrum. Again, sentinel pigs are useful in this regard. Alternatively, the decay in

Table 1. Infectious agents eliminated by Isowean: maximum weaning age and need for medication and vaccination.

Organism	Age of Weaning	Medications		Vaccines	
		Sows	Piglets	Sows	Piglets
Haemophilus Parasuis	10	–[a]	+[b]	+	–
Bordetella Bronchiseptica	*10*	–	+[b]	+	–
Pasteurella multocida Toxigenic	8-10	–	+[b]	+	–
Actinobacillus Pleuropneumoniae	*21-28*	–	+	+	–
Mycoplasma hyopneumoniae	20	–	+[b]	+	–
Salmonella spp.	14-16				
Lawsonia intracellularis	10	–	–	–	–
Leptospira spp.	14-16	–	+	+	–
PRV	20	–	–	+	–
SI virus	20	–	–	+[c]	–
PRRS virus	14-16	–	–	–	–
TGE virus	20	–	–	+[c]	–

[a] *(-) denotes medication and vaccine not necessary; (+) denotes medication and vaccines may be required*
[b] *Medication a definite requirement particularly as weaning age increases*
[c] *Vaccines may not be necessary*

Table 2. Comparison of eradication methods used to produce disease-free groups or batches of pigs for stocking new or depopulated premises.

Agent	Surgical Derivation	Snatch Farrowing	MEW	Isowean
Pasteurella multocida	■	■	▒	▒
Myoplasma hyopneumoniae	■	■	■	■
Actinbacillus pleuropneumoniae	■	■	■	■
PRV (Aujeszky's Virus)	■	▒	▒	▒
TGE Virus	■	▒	▒	▒
PRRS Virus	■	■	▒	▒
Serpulina hyodysenteriae	■	■	■	■
Salmonella spp.	■	▒	▒	▒
Streptococcus suis type 2	■	■	▒	▨
Haemophilus parasuis	■	■	▒	▒
Bordetella brochiseptica	■	■	▒	▒
Parvo Virus	■	■	■	■
Influenza Virus	■	■	▒	▒
Leptospira spp.	■	■	▒	▒

■ Eradication very likely ▒ Eradication likely but not always ▨ Eradication not likely

serum antibody can be plotted over time and can give an indication of whether the piglet has become infected with an unwanted microbial pathogen (Figure 5) during the suckling period.

Aspects of MEW and Isowean Infectious Agent Elimination

There are many factors involved in successfully creating a MEW or isowean pig free of infectious agents that are currently present in either its mother or the pig rearing environment. These factors include: level of immunity in the dam to the infectious agent(s); level of immunity passively acquired by the piglet either via the colostrum or the milk; age of piglet at which colonization of a potential pathogen occurs; medications given to the dam and/or the piglet; and overall throughput, sanitation and biosecurity practices in the farm. Table 3 summarizes the current state of knowledge concerning these factors for the important microbial pathogens of pigs.

Sow and Piglet Immunity

If the dam has been previously infected with a microbial pathogen, it is likely that antibodies will be present in her colostrum and milk, which could aid in protecting the suckling piglet against infection. However, if the dam has never been infected and the microbial pathogen is present in the pig rearing environment (perhaps due to infection of another sow in the farrowing room!), piglets nursing non-immune sows will become infected. The degree of immunity in sows may vary depending upon parity, type of rearing system, presence or absence of the infectious agent in the various stages of production, and the nature of the infectious agent in question. In general, first parity sows and sometimes late parity sows may have low or no immunity to a pathogen. One site and traditional two site farms will tend to have higher levels of sow immunity because the housing of various age groups of swine in the same air space or in close proximity results in greater transmission and infectious rates of pathogens.

The level of sow immunity can be enhanced by intentional exposure to infectious agents during acclimatization of replacement gilts and prior to breeding all sows, plus three to four weeks prior to farrowing. Some but not all vaccines will enhance sow immunity and aid in the protection of piglets against infection during suckling.

Piglets must receive colostrum within 36 hours of birth in order to absorb protective factors (primarily antibodies). After 36 hours, the piglet's gut closes and these colostral antibodies are not absorbed into the blood any longer. The presence of antibodies in the blood is important for protection against certain types of infectious agents like *Streptococcus suis, Haemophilus parasuis* and *Erysipelothrix rhusiopathiae.*

Both colostrum and milk contain antibodies that also help protect the piglet against some enteric infections by coating the mouth, tonsils, stomach, and small and large intestine.

Piglet immunity may be enhanced by inducing the pig to produce its own antibodies via vaccination or intentional exposure to an infectious agent.

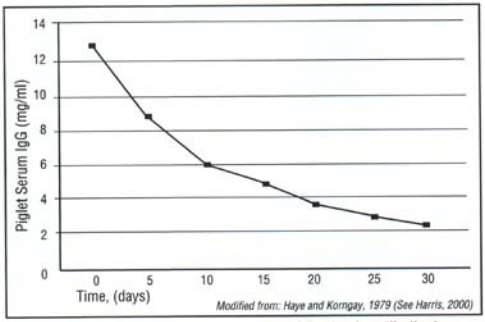

Figure 5. Decline curve for maternal antibody. The piglet absorbs antibodies from colostrum during the first 36 hours of life. The half-life of this passively acquired antibody is approximately 21 days and thus it is slowly removed from the body.

Variation in the Age of Piglets in the Farrowing Room

Ideally, each pig in a farrowing room should be of identical age. In practice, this is difficult to achieve but in the original MEW experiments, sows were farrowed in isolated farrowing rooms within a 24-hour period. A variation in the age of piglets in the farrowing room could result in a wide variation in the age at weaning (see next section), thus increasing the possibility of lower immunity levels and increased chance of infection in the oldest pigs in the weaned group.

Weaning Age

The age of the piglet at weaning (and lactation length) may be critical to successful elimination of some infectious agents (Tables 1 and 3). In general, the younger the weaning age the more likely the piglet will be weaned free of infectious agents. If a very high level of immunity can be created and

Table 3. Characteristics of important pathogens of pigs. These characteristics determine at what age a piglet may become infected with a particular infectious agent.

Characteristics of Pathogens which cause the Major Microbial Diseases						
Organism	**Earliest recorded age of detection**	**Duration of colostral immunity from exposed sows (Is colostral immunity protective against colonization)**	**Age when clinical signs are usually seen**	**Incubation period for disease**	**Other reservoirs**	**Mode of transmission**
Actinobacillus pleuropneumoniae	< 11 days	ELISA 28-30d Neutralization/CF 20-21 days (PC Fenwick) (Probably not against all types)	All ages; usu Growing/ finishing pigs	Hours variable	Flies	Aerosol Direct contact
Actinobacillus suis	2 days	?	All ages; usu. suckling and recently weaned	Days	?	Carrier pigs
Bordetella bronchiseptica	< 5 days 15 days 7 days	2-5 weeks, (May prevent lesions but not infection, Sow vaccination may decrease colonization, but still get clinical disease)	Atrophic rhinitis: 4-12 weeks, Pneumonia: 3-4 days to weaning		Most domestic and wild animals, rodents	Direct contact Fecal-oral Aerosol Dam-pig
Erysipelothrix rhusiopathiae	Suckling	Several weeks (Yes, antisera too)	Usu. 3 months to 3 years of age	24 hours	Mammals, Birds,	Pig-pig, Ingestion Skin wounds
Haemophilus parasuis	7 days	2-4 weeks (Yes)	2 weeks to 4 months			Aerosol, Direct contact, Fecal
Lawsonia intracellulare	12 weeks	6-20 weeks	About 5 days			Feces
Leptospira	In utero?	(Yes)	Breeding stock	1-4 weeks	Rodents, Dogs, Horses, Hedgehogs, Raccoons, Skunk, Opposums	Via contact with mucous membranes Venereal Transplacental Via milk (exper.)
Mycoplasma hyopneumoniae	14 days	4 weeks (2 weeks)	6 weeks or older, usu 3-6 months old	10-16 days		Direct contact Aerosol
Pasteurella multocida	20 days 21 days 7-10 days	(Probably)	Variable upon disease		Rabbits, Dogs, Cats, Cattle, Poultry, Turkeys, Goats, Sheep	Direct contact Aerosol
Salmonella	< 21 days	(Yes)	Weaned pigs < 5 months old but usu growing finishing pigs	1-3 days	Many hosts	Feces, Feed
Serpulina hyodysenteriae	Suckling pigs	(May prevent clinical signs)	All ages, usu growing finishing pigs	2 days-3 months, usu 10-14 days	Rodents, Flies, Birds, Mice	Fecal-oral
Staphylococcus hyicus	4 days	(Yes)	All ages, usu piglets and weaners	Days	Probably not important	Abrasions, Mange mites
Streptococcus suis	Day 0	(No)	Suckling to finishing, recently weaned	Hours	Rodents, Flies	Direct contact During birth
PRRS virus	Day 0	< 6 weeks	All ages	1-2 days		Transplacental Direct contact Aerosol?
Pseudorabies virus	< 1 day	4 months (Yes)	All ages	2-4 days	Dogs, Cats, Raccoons, Opposums, Rodents, Ruminents	Direct contact Insemination Transplacental Aerosol Fomites Ingestion
TGE virus	< 1 day	6-14 days (Yes)	All ages	18 hours – 3 days	Cats, Dogs, Foxes, Flies	Feces Birds Milk

Modified From: Sandra Amass, Lerman Conference, 1997 (See Harris, 2000)

maintained in the sows, then this may increase the weaning age required to eliminate a pathogen.

Medications

Administering medications to both sows and piglets may aid in the prevention of colonization of piglets by most bacterial agents (not viruses). Medications to sows may be given either via the feed or water, or by injection. Piglets must receive medications by oral dosing or injection. Oral dosing may require two to three administrations every 24-hour period. Injectable antibiotics may need to be given every 12 hours or as infrequently as every three to six days depending on antibiotics used and pathogens involved. Administering medications (particularly to piglets) may increase the weaning age required to eliminate a pathogen.

Sanitation

Overall sanitation of the farrowing room environment will determine the levels of infectious agent exposure to the young piglet. If there is a very high level of infectious agents on floor surfaces, feeding area, and in the air, then the piglet may become infected more readily and at a younger age. All-in, all-out throughput, combined with proper cleaning and disinfection, is essential for minimizing the level of infectious agents in the overall pig rearing environment.

Biosecurity

All farms must strive for a biosecure system to minimize the introduction of new infectious agents into the various pig-rearing rooms and/or sites of production. If an infectious agent (previously not found in the herd) is introduced into either the farrowing room or to sows late in gestation, there is a high likelihood that both the MEW and isowean piglets will be weaned infected with the agent primarily due to low or no sow immunity.

Exclusion of Infectious Agents by Multi-Site Isowean Production

Exclusion of Infectious Microbes via the Isowean Principle

Multi-site rearing systems rely on the Isowean Principle for the production of weaned pigs free of microbial pathogens residing in the adult population in the breeding, gestation, and farrowing site(s). The Isowean Principle can be applied to all types of rearing systems as well; however, multi-site rearing incorporates it within the system either when old facilities are redesigned or when new facilities are constructed on 'green-field' sites. One site and traditional two site farms can utilize the Isowean Principle by incorporating an isolated nursery and finisher accommodation for all or part of the weaned pigs produced. In fact, prior to the construction of the first three site system in 1988, all isowean experimental trials involving elimination of PRV, toxigenic *Pasteurella multocida*, and *Mycoplasma hyopneumoniae* were conducted by removing a portion of weaned pigs from existing one site and traditional two site farms.

The successful exclusion of an infectious agent by the Isowean Principle is dependent upon many factors. The weaning and finishing accommodations are the most important aspect of the procedure since not every weaning group is expected to be free of a particular agent or agents. For this reason, continuous flow pens, rooms, buildings, or loci are not recommended. (Note: in multi-site systems each tier of production is referred to as a site [site 1 is the breeding, gestation and farrowing tier] while each isolated location within a site is referred to as a locus). Nursery and finisher buildings that have pigs throughput on an all-in; all-out basis by locus have distinct advantages as well over systems designed with all-in; all-out by room or pen within a building. If one weaning group of pigs is infected with a particular infectious agent, the agent need not spread to other groups weaned previously or after in multiple-site isowean or NurFin (wean to finish buildings) isowean designs.

A generic list of steps to be taken for elimination of infectious agents by various multi-site isowean-rearing systems is as follows:

1. Establish procedures for isolation and acclimatization of incoming replacement breeding stock. If the infectious agent has been recently introduced into the breeding herd, it may be necessary to wait until a level of immunity has been achieved in the adults. Furthermore, it may be important to add replacement stock (negative to the infectious agent in question) to the herd immediately following a disease outbreak so that the replacements also become immune to the agent. The length of acclimatization is determined by the infectious agent to be eliminated. Ideally, in multiple source isowean systems, each batch of replacements should be exposed to the infectious agents present in all site 1 (breeding, gestation, farrowing) loci.
2. Vaccinate sows pre-farrowing with vaccines designed to prevent diseases caused by the infectious agents to be reduced or eliminated in the isowean pigs. Vaccines are available for microbes such as toxigenic *P. multocida, M. hyopneumoniae, Haemophilus parasuis, Streptococcus suis, Actinobacillus pleuropneumoniae, Actinobacillus suis*, swine influenza virus, and Pseudorabies virus. The use of live, avirulent vaccines for transmissible gastroenteritis (TGE) virus and PRRS virus are not recommended for elimination of agents by the Isowean Principle.
3. Administer medications to the sows prior to farrowing based on the infectious agents to be eliminated.
4. Establish management procedures for all-in; all-out throughput of each farrowing room.
5. Set the weaning age based on the infectious agents to be eliminated.
6. Administer medications to the piglets prior to and after weaning based on the infectious agents to be eliminated.
7. Establish management procedures for all-in; all-out throughput for each weaning group in the nursery and finishing room.
8. Maintain strict biosecurity procedures.

Tables 4 through 8 give vaccination, medication, and throughput action steps for elimination of specific infectious agents to be taken for the following multi-site production systems:

1. Three site (single locus) (Figure 6, Table 4)
2. Three site (multi-loci) (Figure 7,Table 5)
3. Two-site Isowean (Figure 8, Table 6)
4. Nursery-Finisher isowean (Figure 9, Table 7)
5. Outdoor isowean (Figure 10, Table 8).

For each type of multi-site isowean system, assume that the infectious agent to be eliminated has been introduced into all sites of all 3 stages of production. If the infectious agent(s) in

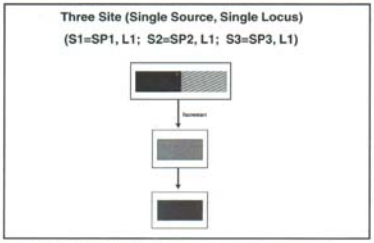

Figure 6. Three site production (single source, single locus) - Diagram indicating the stages of production on three sites.

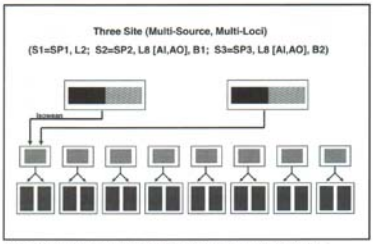

Figure 7. Three site production (multi-source, multi-loci) - Diagram indicating the stages of production on three sites.

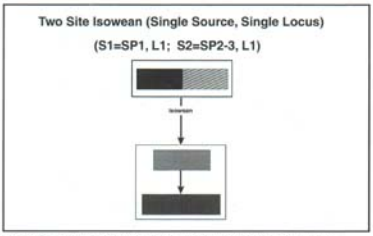

Figure 8. Two site Isowean production (single source, single locus) - Diagram indicating the stages of production on two sites but without other details regarding number of buildings per locus.

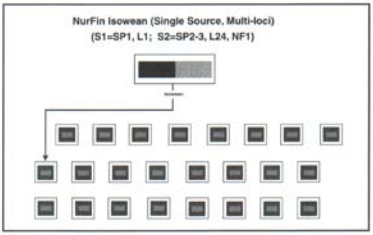

Figure 9. Nursury-finish isowean production (single source, multi-loci) - Diagram indicating the stages of production on two sites.

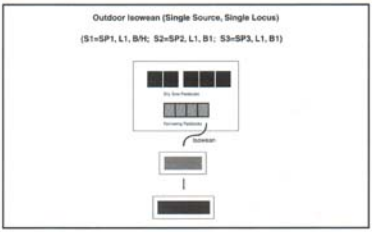

Figure 10. Outdoor isowean production (single source, single locus) –Diagram indicating the stages of production on three sites. Each site has only one locus. The site 1 locus has huts for housing sows and suckling pigs.

question have not been introduced into a particular stage of production, then the action step indicated may not be required.

Eradication of Infectious Agents from the Entire Herd

Modern-day multi-site production systems apply the Isowean Principle to exclude (or minimize levels of) infectious agents at weaning to decrease their effect on the performance of the growing pig. In multi-site isowean rearing, the adult population in site 1 loci may or may not remain infected with the pathogen(s) being excluded via isowean. Prior to the development of multi-site isowean rearing techniques in the late 1980's, eradication methods focused on elimination of pathogens from the entire herd. These methods are as follows: depopulation, cleaning, disinfecting of facilities and repopulation with high health status pigs (depop/repop); testing and removal of infected animals; increasing herd immunity; or whole-herd medication. The Jorgan Plomgaard Method has recently been developed for eradication of certain pathogens from entire multi-site isowean herds. The method is based on the work of von E. Zimmermann in Switzerland regarding eradication of *M. hyopneumoniae* from small traditional herds without total herd depopulation.

The Plomgaard Method

This technique was used to eradicate PRRS virus, *M. hyopneumoniae,* and *A. pleuropneumoniae* from a three-site farm by:

1. No replacement breeding stock for a period of three months;
2. Whole herd medication directed against *M. hyopneumoniae* and *A. pleuropneumoniae* (enrofloxacin);
3. Removal of all breeding animals less than 10 months of age and those with no serologic titers to PRRS virus and *A. pleuropneumoniae;*
4. New replacement stock free of PRRS virus, *M. hyopneumoniae,* and *A. pleuropneumoniae.*

These steps resulted in the elimination of the above three agents from site 1. The nursery and finisher buildings at sites 2 and 3 were depopulated prior to receiving Isowean pigs free of the agents.

It is likely that PRV and TGE virus could be eradicated by this method but it has not been reported as yet.

The efficacy for eradication of specific infectious agents from entire herds is presented in Table 9. Depop/repop is the surest way to eradicate infectious agents assuming a supply of

Table 4. Three site (single locus) production. Infectious agent elimination procedures with each of the three stages of production on three separate locations.

	Stage			
	1		2	3
Infectious Agent	**Breeders/Suckling**	**Age ***	**Weaners**	**Finishers**
Pasteurella multocida	Vacc/Med. **	8-10	Depopulate	Depopulate
Mycoplasma hyopneumoniae	Vacc/Med.	14-17	Depopulate	Depopulate
Actinobacillus pleuropneumoniae	Vacc/Med.	21	Depopulate	Depopulate
Streptococcus suis	Med.	5ƒ	Depopulate	Depopulate
PRRS Virus	Virus Exposure No Vaccine	5-12	Depopulate	Depopulate
PRV	Vaccinate	21	Depopulate	Depopulate
TGE Virus	Virus Exposure	21	Virus Exposure	Virus Exposure
Serpulina hyodysenteriae	Vacc/Med.	21	Medicate	Depopulate or Medicate

** Age to Isowean in days ** Vaccinate and Medicate ƒ Medicated Early Wean for best results*

From: Harris and Alexander, 1999

Table 5. Three site (multi-loci) production. Infectious agent elimination procedures with production flow all-in; all-out by locus for each batch of weaned piglets. Pigs then flow from nurseries to finishers on an all-in; all-out by locus basis. There may be one or more buildings per locus.

	Stage			
	1		2	3
	Breeders/Suckling	**Age ***	**Weaners**	**Finishers**
Pasteurella multocida	Vacc/Med. **	8-10	AI,AO ***	AI, AO
Mycoplasma hyopneumoniae	Vacc/Med.	14-17	AI, AO	AI, AO
Actinobacillus pleuropneumoniae	Vacc/Med.	21	AI, AO	AI, AO
Streptococcus suis	Med.	5ƒ		
PRRS Virus	Virus Exposure No Vaccine	5-12	AI, AO No Vaccine	AI, AO No Vaccine
PRV	Vaccinate	21	AI, AO	AI, AO
TGE Virus	Virus Exposure	21	AI, AO	AI, AO
Serpulina hyodysenteriae	Vacc/Med.	21	AI, AO	AI, AO

** Age to Isowean in days ** Vaccinate/Medicate *** All-in; All-out ƒ Medicated Early Wean for best results*

From: Harris and Alexander, 1999

Table 6. Two site Isowean production. Infectious agent elimination procedures with stage 1 production at one locus and Stages 2 and 3 on another isolated locus. The nursery and finisher buildings contain rooms with all-in; all-out throughput. The nursery and finisher buildings are usually separated from one another but on the same location.

	Stage		
	1		2 and 3
	Breeders/Suckling	**Age***	**Weaners/Finishers*** **
Site	1	2	
Pasteurella multocida	Vacc/Med. **	10	Depopulate
Mycoplasma hyopneumoniae	Vacc/Med.	10	Depopulate
Actinobacillus pleuropneumoniae	Vacc/Med.	21	Depopulate
Streptococcus suis	Med.	5ƒ	Depopulate
PRRS Virus	Virus Exposure No Vaccine	5-12	Depopulate No Vaccine
PRV	Vaccinate	21	Depopulate
TGE Virus	Virus Exposure	21	Virus Exposure
Serpulina hyodysenteriae	Vacc/Med.	21	Medicate

** Age to Isowean in days ** Medicate/Vaccinate *** Assumes Site 2 always has both nursery and finisher pig inventories constantly*

ƒ Medicated Early Wean for best results

From: Harris and Alexander, 1999

Table 7. NurFin Isowean production. Infectious agent elimination procedures with each batch of weaned pigs placed in a NurFin (wean to finish building) located in an isolated locus with all-in; all-out throughput. Temporary flooring (comfort boards), special water drinkers, and supplemental heat are provided to the newly weaned pigs for a few weeks while the building is under utilized.

	Stage		
	1		2 and 3
	Breeders/Suckling	Age *	Weaners/Finishers
Pasteurella multocida	Vacc/Med. **	8-10	AI,AO ***
Mycoplasma hyopneumoniae	Vacc/Med.	14-17	AI, AO
Actinobacillus pleuropneumoniae	Vacc/Med.	21	AI, AO
Streptococcus suis	Med.	5′	
PRRS Virus	Virus Exposure No Vaccine	5-12	AI, AO No Vaccine
PRV	Vaccinate	21	AI, AO
TGE Virus	Virus Exposure	21	AI, AO
Serpulina hyodysenteriae	Vacc/Med.	21	AI, AO

* Age to Isowean in days ** Medicate/Vaccinate *** All-in; All-out ′ Medicated Early Wean for best results

From: Harris and Alexander, 1999

Table 8. Outdoor Isowean production. Infectious agent elimination procedures with stage 1 production in an extensive pasture system with weekly farrowings all year around. Nursery and finisher buildings are placed in isolated locations.

	Stage			
Infectious Agent	Breeders/Suckling	Age *	Weaners Finishers	
Pasteurella multocida	Vacc/Med. **	8-10	Depopulate***	Depopulate
Mycoplasma hyopneumoniae	Vacc/Med.	14-17	Depopulate	Depopulate
Actinobacillus pleuropneumoniae	Vacc/Med.	21	Depopulate	Depopulate
Streptococcus suis	Med.	5′	Depopulate	Depopulate
PRRS Virus	Virus Exposure No Vaccine	5-12	Depopulate	Depopulate
PRV	Vaccinate	21	Depopulate	Depopulate
TGE Virus	Virus Exposure	21	Virus Exposure	Virus Exposure
Serpulina hyodysenteriae	Vacc/Med.	21	Medicate	Depopulate or Medicate

* Age to Isowean in days **Vaccinate and Medicate ***If AI, AO by site is not possible

′ Medicated Early Wean for best results

From: Harris and Alexander, 1999

negative animals is available and the location of the herd is such that reintroduction is unlikely. However, as compared to the other methods, depop/repop is far more expensive due to the interruption in income when no pigs are being produced or sold. Test and removal; increased herd immunity; whole-herd medication; and the Plomgaard Method are only applicable to specific infectious agents (Table 9) but are not as costly as depop/repop. For example, eradication of *Brachyspira (formerly Treponema and Serpulina) hyodysenteriae*, the cause of swine dysentery, by whole herd medication is far less costly than depop/repop or 'living with' the disease (Table 10).

Summary

When disease-causing microbes are excluded (prevented from infecting the pre-weaned pig) from the growing pig, pigs perform better and have leaner carcasses and are more profitable. Multi-site isowean pig production reduces or excludes pathogens from the growing and finishing stages of production. By use of the Plomgaard Method, pathogens may be eradicated from entire multi-site, isowean production systems.

The newborn piglet is exposed to microbes during and immediately following birth. Sometimes, but rarely, piglets are infected with pathogens *in utero*. In general, MEW and isowean are practical methods for exclusion of most pathogens. The main factors influencing the successfulness of infectious agent exclusion by MEW or isowean are: level of sow and piglet immunity, weaning age and the age variation within each weaning group, medications administered to sows and piglets, sanitation, all-in,all-out throughput, and biosecurity measures. These factors are important in the Plomgaard Method as well. In addition, the ability of the older breeding age animal to eliminate an infectious agent appears important in the Plomgaard Method.

Medicated early weaning and isowean are used to exclude pathogens from most batches of pigs. These batches of high health status pigs are used to stock new or depopulated herds. The various types of multi-site systems utilize the isowean or segregation principle to reduce or eliminate various pathogens for the grower and finisher phases of production within ongoing swine herds.

Table 9. Comparison of eradication methods for either eliminating or removing pathogens from existing pig farm operations. For one site and traditional two site farms elimination of most infectious agents is by depopulation and repopulation with high health status stock. Multi-site Isowean production decreases the need for total herd depopulation and repopulation via the Plomgaard Method.

Agent	Depop Repop	Test Remove	Increased Immunity	Medication*	Plomgaard Method**
Pasteurella multocida	■	▨	▨	▨	■
Myoplasma hyopneumoniae	■	▨	▨	▨	■
Actinbacillus pleuropneumoniae	■	▨	▨	▨	■
PRV (Aujeszky's Virus)	■	■	▨	▨	?
TGE Virus	■	▨	■	▨	?
PRRS Virus	■	?	?	▨	■
Serpulina hyodysenteriae	■	▨	▨	■	▨
Salmonella spp.	■	▨	▨	▨	▨
Streptococcus suis type 2	■	▨	▨	▨	▨
Haemophilus parasuis	■	▨	▨	▨	▨
Bordetella brochiseptica	■	▨	▨	▨	▨
Parvo Virus	■	▨	▨	▨	▨
Influenza Virus	■	▨	▨	▨	▨
Leptospira spp.	■	▨	▨	▨	▨

■ Eradication very likely
▨ Eradication not likely

* Whole herd medication in combination with rodent control and sanitation programs
* Plomgaard, 1998, as developed for multi-site isoweans herds only

Table 10. Financial impact of Swine Dysentery (SD). Four scenarios are compared: no SD; endemic SD controlled by medication; eradication with medication without depopulation; and depopulation/repopulation.

Profit Margin/100 kg			
SD-Free	**Endemic SD**	**Medication Eradication**	**Depop/ Repop**
$7.44	$1.67	$4.93	$0.07
Modified from: Polson, Marsh, Harris IPVS 1992 (see Harris, 2000)			

References

Harris, D.L. 2000. Multi-Site Pig Production. Iowa State University Press, Ames, IA (in press).

Harris, D.L. and T.J.L. Alexander. 1999. Methods of Disease Control. p. B. Straw and et al. (ed.), Diseases of Swine. Iowa State University Press, Ames, IA 50010,

Underdahl, N.R. 1973. Specific Pathogen Free Swine. University of Nebraska Press, Lincoln.

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