ORIGINAL RESEARCH PEER REVIEWED

Impact of a Husbandry Education Program on nursery pig mortality, productivity, and treatment cost

Lucina Galina Pantoja, DVM, PhD; Michael Kuhn, DVM, MBA; Thayer Hoover, DVM; Deborah Amodie, MS; Daniel Weigel, PhD; Cristy Dice, BS; Terry Moeller BS; Eric Farrand, BS

Summary

Objective: To determine if a Husbandry Educator (HE) could positively affect mortality or culling rates, productivity, and treatment costs in postweaned pigs.

Materials and methods: Two trials were conducted, each comparing nursery group performance monitored by a HE to that in groups receiving standard care (SC). Trial 1 was a retrospective analysis that compared mortality rate, end-of-nursery weight, and treatment cost before (n = 72 groups) and after (n = 83 groups) HE training at 12 nursery sites. Trial 2 prospectively compared the percentages of culls, mortality, and high-value nursery pigs and per-head treatment costs in groups randomly assigned to HE (n = 20) or SC groups (n = 20). Production outcomes were compared at the group level.

Results: In Trial 1, differences between HE and SC groups in overall mortality rate (3.12% ± 0.001% versus 3.64% ± 0.004%) and treatment cost per pig ($0.54 ± $0.06 versus $1.08 ± $0.08) were significant ($P < .001$). End-of-nursery weight was higher in HE groups (26.28 ± 0.20 kg) than in SC groups (25.51 ± 0.20 kg; $P < .05$). In Trial 2, percentage of high-value end-of-nursery pigs was higher in HE groups (93.92% ± 0.007%) than in SC groups: (91.48% ± 0.007%; $P < .001$). All values expressed as mean ± standard error.

Implication: The systematic application of husbandry practices taught and encouraged by a HE and focusing on individual pig care and execution of existing protocols can significantly improve productivity, mortality and culling rates, and treatment costs in growing pigs.

Keywords: swine, husbandry, education, nursery pig

Received: March 20, 2012
Accepted: December 4, 2012

Resumen - Impacto de un Programa Educativo de Manejo en la mortalidad de maternidad, productividad, y el costo de tratamiento

Objetivo: Determinar si el Educador de Manejo (HE por sus siglas en inglés) puede afectar positivamente la mortalidad o los índices de desecho, productividad, y costos de tratamiento en cerdos post destete.

Materiales y métodos: Se realizaron dos pruebas, cada una comparando el desempeño del grupo en destete monitoreado por un HE con el de los grupos que recibieron cuidado estándar (SC por sus siglas en inglés). La Prueba 1 fue un análisis retrospectivo que comparó el porcentaje de mortalidad, el peso al final del área de destete, y el costo del tratamiento antes (grupos n = 72) y después (grupos n = 83) del entrenamiento por un HE en 12 sitios del área de destete. La Prueba 2 comparó prospectivamente los porcentajes de desechos, mortalidad, y cerdos del área de destete de alto valor y costos de tratamiento por animal en grupos asignados al azar a los grupos HE (n = 20) o SC (n = 20). Los resultados de la producción se compararon a nivel del grupo.

Resultados: En la Prueba 1, las diferencias entre los grupos HE y SC en el porcentaje de mortalidad general (3.12% ± 0.001% contra 3.64% ± 0.004%) y costo de tratamiento por cerdo ($0.54 ± $0.06 contra $1.08 ± $0.08) fueron significativos ($P < .001$). El peso de final del área del destete fue más alto en los grupos HE (26.28 ± 0.20 kg) que en los grupos SC (25.51 ± 0.20 kg; $P < .05$). En la Prueba 2, el porcentaje de cerdos, al final del área de destete, de alto valor fue más alto en los grupos HE (93.92% ± 0.007%) que en los grupos SC: (91.48% ± 0.007%; $P < .001$). Todos los valores se expresan como media ± error estándar.

Implicación: La utilización sistemática de las prácticas de manejo enseñadas y fomentadas por el HE y el enfoque en el cuidado individual del cerdo y la ejecución de protocolos existentes puede mejorar significativamente la productividad, mortalidad y el porcentaje de desecho, y costos de tratamiento de cerdos en crecimiento.

Résumé - Impact d'un programme d'éducation de gestion d'élevage sur la mortalité des porcelets en pouponnière, la productivité, et le coût des traitements

Objectif: Déterminer si un éducateur en gestion d'élevage (HE) pouvait influencer positivement la mortalité ou les taux de réformes, la productivité, et les coûts de traitement chez les porcs après le sevrage.

Matériels et méthodes: Deux essais ont été réalisés, chacun comparant les performances de porcs en pouponnière surveillés par un HE à celles de groupes recevant des soins standards (SC). L'essai 1 était une analyse rétrospective qui comparait le taux de mortalité, le poids en sortie de pouponnière, et les coûts de traitement avant (n = 72 groupes) et après (n = 83 groupes) une formation par un HE à 12 sites de pouponnières. L'essai 2 a comparé de manière prospective les taux de réforme, de mortalité, les porcelets en pouponnière de valeur élevée et les coûts de traitement

Zoetis, Madison, New Jersey.

Corresponding author: Dr Lucina Galina Pantoja, Zoetis, 5 Giralda Farms, Madison, NJ 07940; Tel: 615-545-4292; Fax: 866-590-1504; E-mail: lucina.galina@zoetis.com.

This article is available online at http://www.aasv.org/shap.html.

Galina Pantoja L, Kuhn M, Hoover T, et al. Impact of a Husbandry Education Program on nursery pig mortality, productivity, and treatment cost. *J Swine Health Prod.* 2013;21(4):188–194.

par individu dans des groupes répartis de manière aléatoire à des groupes HE (n = 20) ou SC (n = 20). Les résultats de production ont été comparés au niveau du groupe.

Résultats: Dans l'essai 1, les différences entre les groupes HE et SC en ce qui a trait au taux de mortalité global (3,12% ± 0.001% versus 3,64% ± 0,004%) et le coût de traitement par porc ($0,54 ± $0,06 versus $1,08 ± $0,08) étaient significatives ($P < .001$). Le poids en sortie de pouponnière était plus élevé dans les groupes HE (26,28 ± 0,20 kg) que dans les groupes SC (25,51 ± 0,20 kg); ($P < .05$). Dans l'essai 2, le pourcentage de porcelets en pouponnière de valeur élevé était supérieur dans les groupes HE (93,92% ± 0,007%) que dans les groupes SC (91,48% ± 0,007%; $P < .001$). Toutes les valeurs sont exprimées comme étant la moyenne ± écart-type.

Implication: L'application systématique de pratiques de régie enseignées et encouragées par un HE et se concentrant sur les soins aux animaux individuels, et l'exécution de protocoles existants peut améliorer significativement la productivité, les taux de mortalité et de réforme, et les coûts de traitement chez les porcs en croissance.

With their limited physical reserves, newly weaned nursery pigs are the animals at greatest risk for mortality and poor performance in swine production systems. This is partly due to the adjustment from milk to solid food, environmental stressors, and adaptation to new pen mates. In addition, infectious disease continues to be prevalent in weanling pig populations, despite practices such as all-in, all-out production, high-health strategies, segregated early weaning, multisite production, and vaccination for major swine diseases. Herds infected with multiple pathogens are at greatest risk, particularly when the agents involved are highly virulent or modulate the immune system, such as porcine reproductive and respiratory syndrome virus or porcine circovirus type 2.

One of the challenges in managing pigs in the nursery phase is identifying and appropriately handling pigs with early-stage disease. Various studies have shown that subclinical or incipient disease in postweaning pigs can have an adverse effect on herd profitability, in some cases equivalent to what occurs in acute outbreaks.[1-5] Pigs that appear healthy upon superficial inspection may have early-onset or subacute disease that ultimately results in poor feed efficiency, slow growth, failure to thrive, and greater susceptibility to co-infections. Husbandry practices that help prevent early exposure and infection are critical factors in maintaining herd health.[6-8] In multifactorial syndromes such as swine respiratory disease complex, husbandry practices that mitigate non-infectious disease factors are particularly important for minimizing risk and the extent of disease and its impact on production.[6,9,10] To a great extent, the infectious, nutritional, and environmental challenges affecting weanling pigs can be offset by careful husbandry with an emphasis on daily examination of every pig in the nursery and treatment at an early stage of disease.

The Husbandry Education Program (Zoetis, Madison, New Jersey) is a commercial service delivered by coaches called Husbandry Educators. To determine if a Husbandry Educator (HE) could positively affect swine productivity and economic outcomes in weanling pigs, two large-scale multi-site clinical trials were conducted at swine production facilities operated by commercial pork producers in two regions of the United States. In both trials, outcomes for nursery groups monitored by a dedicated on-site HE (HE groups) were compared to outcomes for groups raised according to the standard care protocol in place prior to the trial (SC groups). Trial 1 compared mortality, weight gain, and treatment costs in HE and SC groups. Trial 2 compared the percentage of high-value nursery pigs, relative risk of culling, and treatment costs in HE and SC groups.

Materials and methods

Pigs were commercially owned and were managed according to preexisting protocols developed in consultation with an attending veterinarian for each production system. To ensure appropriate and humane animal treatment and compliance with industry standards for nursery housing, each participating site was National Pork Board PQA Plus certified.

The Husbandry Educator

Each trial was managed by one of two participating HEs who were full-time employees of the study sponsor. Both HEs were college graduates, trained in animal science, had pork production experience, and were PQA Plus certified. Each HE completed a DiSC Behavioral Style self-assessment (DiSC; Behavioral Styles Profile Solutions, Minneapolis, Minnesota) to define his or her behavioral style in order to facilitate communication with caregivers at the participating sites. A dedicated HE was assigned to the production site during the nursery phase to assess animal-health needs, identify opportunities for improvement, and provide one-on-one education of caregivers that emphasized early identification and management of suboptimal pigs. The HE's involvement was limited to husbandry practices and did not replace or alter the attending veterinarian's pig-care protocols or treatment recommendations. Topics that the HE discussed with the caregiver team at each site included animal welfare, handling of pigs, disease prevention (including sanitation and biosecurity), early recognition and appropriate treatment of disease, timely euthanasia, injection technique, drinking-water medications, feeder and drinking-water device adjustments (device height and pressure), placing and sorting pigs, and time management. A key role of the HE was to ensure consistent compliance with preexisting treatment protocols.

The Husbandry Education Program utilizes an individual-pig-care approach – a process for assessing the overall production environment then narrowing the focus to the individual animal.[11] The individual-pig-care approach employed a disease-severity classification system that identified pigs showing early, moderate, or advanced clinical disease and pigs that needed to be culled or euthanized (Figure 1). This classification system was implemented at every daily observation and allowed the HE to efficiently target and promptly treat sick pigs in order to facilitate prompt recovery or to ensure timely removal of underperforming pigs that would not provide an adequate return on investment. While the Husbandry Education Program was individually focused, the research was evaluated at the group level.

Trial design

The trials were conducted at multiple production sites operated by two large-scale pork-production companies located in geographically separate regions of the United States. A site consisted of a single geographic location where postweaning pigs were housed. At each site, individual nursery rooms (Trial 1) or individual barns (Trial 2) were populated with pigs born within 1 week and from a single sow source (ie, group). Production records for the 7-week nursery cycle were maintained separately

Figure 1: Coaches called Husbandry Educators (HEs) were assigned to two production systems to determine if caregiver training could positively affect mortality, productivity, and treatment costs in groups of pigs 7 weeks post weaning. Production outcomes were compared between groups of pigs raised by caregivers who provided standard care without coaching, or by caregivers who received coaching by a HE during the first 2 to 3 weeks post weaning. The HEs employed a disease-severity system that focused on encouraging caregivers to provide daily examination of every pig and trained them to differentiate sub-optimal pigs. The system classified suboptimal pigs at early (A), moderate (B), or advanced stages of clinical disease (C), or pigs requiring humane euthanasia (E). The classification system trained caregivers to determine which pigs needed an intervention and when to intervene, and allowed prompt treatment of sick pigs. The Husbandry Education program (Zoetis, Madison, New Jersey) encouraged execution of preexisting treatment protocols established by the herd veterinarian.

for each group (room for Trial 1 and barn for Trial 2). The nursery group was the experimental unit in both studies. Groups were not segregated by gender. Pigs in the HE groups were monitored for the initial 2 to 3 weeks of the nursery cycle by the on-site HE. Pigs that were raised according to the standard care protocol in place (SC group) were not monitored by the HE. Production outcomes for HE and SC groups were compared.

The HE worked with one to four caregivers at each site, a number that allowed the HE to focus on individualized training and the working styles of the on-site personnel. Therapeutic treatments were administered according to the preexisting treatment protocols at the respective sites, and individual-pig treatment was emphasized. In each trial, the same HE monitored the HE groups at all sites in order to minimize variability of husbandry interventions. Treatment costs per group were calculated as the cost of injectable and in-water medications required for acute disease therapy. Within HE and SC groups, pigs originated from a single sow source; there was no commingling of flows within groups. This approach minimized variability at each site, but resulted in a variable number of HE

or SC groups per site in order to maintain intra-group integrity of the pig population.

Trial 1. Production outcomes were compared retrospectively (before HE training) and prospectively (after HE training) at each nursery site where weanling pigs were raised for 7 weeks before moving to a finishing building. The trial was conducted from March 2008, when production records began to be collected for the SC groups, to October 2010, when records from HE groups were completed at 12 sites operated by a commercial pork-production company at a mid-Atlantic location. Pigs were continually enrolled every month throughout the study, except January 2009. Each site housed a nursery that contained multiple rooms, with each room following an all-in, all-out program. There were 83 HE groups (average 2288 pigs per group) and 72 SC groups (average 2395 pigs per group), totaling 155 groups. A minimum of three and a maximum of 12 nursery groups were evaluated by a HE at each site. Retrospective data for the same outcome parameters were obtained at the corresponding sites for a minimum of two and a maximum of nine SC groups. An attempt was made to have similar numbers of nursery groups for the HE and SC treatments at each site. Starting and closing head-count inventory, mortality rate, mean weaning and end-of-nursery weights, and mean therapeutic treatment cost per pig were determined for HE and SC groups at each site. All nursery groups were on feed for 7 weeks.

Trial 2: Production outcomes were compared simultaneously at sites under SC and HE care. The trial was conducted during a 12-month period in 2010 at sites operated by a commercial pork-production company in a Midwest location. Each site used a weaning-to-finish all-in, all-out management system. Groups of weaned pigs were matched by sow source, weaning date, and barn size, and then randomly assigned to either a HE or an SC site by coin toss. The HE and SC groups were maintained at different locations. There were 20 HE groups (average 3376 pigs per group) and 20 SC groups (average 3506 pigs per group), totaling 40 groups. Weight information was not collected in Trial 2. The number of culls and high-value nursery pigs were determined only in Trial 2. Pigs were culled during the trial if they were > 25% below the average group weight, lame, or non-castrated boars, or if they had obvious defects such as umbilical or scrotal hernias. Seven weeks after weaning (ie, end of the nursery stage at weaning-to-finish sites), the cull rate, mortality rate, high-value nursery-pig rate (starting inventory minus culls and pigs that died), rate of pigs treated individually, and medication costs per group were determined. These parameters were compared between the HE and SC groups and statistical significance of the variances was calculated. Relative risk for culling was calculated by dividing the percentage of SC cull pigs by the percentage of HE cull pigs. The number of animals needed to be raised by a HE to produce one high-value nursery pig (number-needed-to-treat) was determined according to the following formula: 1 ÷ (% SC cull pigs – % HE cull pigs).

Statistical analysis

Each trial was analyzed separately. Trial 1 parameters, except for mortality, were analyzed using a linear mixed model. Using the SAS PROC MIXED procedure (SAS 9.2, Cary, North Carolina), these parameters were analyzed with a model that considered group (HE or SC) as the fixed effect, and block (site) and the residual error as random effects. Treatment least squares means (LS means) were calculated for each group, and comparison of LS means was performed by the two-sided Student *t* test. Percent mortality was analyzed using a generalized linear mixed model (GLMM). Using the SAS GLIMMIX procedure, mortality was analyzed using a model with group as the fixed effect and block and the residual error as random effects. This analysis used a binomial error and logit link. For Trial 2, all binomial parameters were analyzed using the GLMM as described. Continuous variables were analyzed with the linear mixed approach using a model with group as a fixed effect and block (flow) and the residual error as random effects as described. All tests of treatment differences were two-sided, with statistical significance determined at the 5% level.

Results

Trial 1. Production outcomes for nursery groups in the HE and SC groups are shown in Table 1. The average weaning weights of the HE and SC groups did not differ significantly. The overall differences in mortality rate, end of nursery weight, and treatment cost were significantly more favorable for the HE groups than for the SC groups. Overall group mortality rate and treatment cost were significantly lower in the HE groups than in the SC groups ($P < .001$). The HE groups had significantly higher end-of-nursery weight than did SC groups ($P = .02$). Mean end-of-nursery weights, mortality rates, and treatment costs for HE and SC groups at each of the 12 individual production sites are shown in Table 2.

Trial 2. There were significant differences ($P < .001$) between HE and SC groups in the percentage of high-value nursery pigs (higher in the HE group) and in the percentage of culls (lower in the HE group) (Table 3). Although the percentage of pigs treated individually was significantly lower for SC groups than for HE groups, treatment cost did not differ significantly. Mortality rate did not differ for HE and SC groups (Table 3). The relative risk determined that pigs raised according to the SC protocol were 62% more likely to be culled than pigs raised under HE monitoring. The number-needed-to-treat calculation indicated that 43 pigs raised under HE care yielded one more high-value nursery pig than did SC groups.

Discussion

Results of Trial 1 indicated that a Husbandry Educator had a positive impact on mean production outcomes in nursery groups. The large number of animals evaluated over a 3-year period (March 2008 to February 2011) at multiple production sites and during all seasons of the year added validity to the outcomes in Trial 1. The number of nursery groups evaluated over the study period was smaller than expected because groups were excluded from analysis if the sow source changed during the study period. The nearly identical weaning weights in the Trial 1 groups indicated that the HE and SC groups were comparable in size and maturity at placement.

Actual stocking density was not determined for either trial and was not manipulated during the study. Size of the SC groups in Trial 1 was 4.7% larger than that for the HE groups, but this was a nonsignificant difference. The Trial 1 site-by-site comparison showed that SC groups had death losses as high as 10.44% (Site 6) and 30.41% (Site 7). These adverse mortality outcomes indicate that even swine operations experiencing episodes of high mortality rates can potentially benefit from improved husbandry practices. In contrast, the two highest mean mortality rates in HE groups were 5.38% (Site 5) and 8.62% (Site 10). At Site 10, SC groups had a mean death loss of 4.19% versus 4.66% for HE groups at the same site. However, the HE groups at Site 10 had a 0.37 kg greater mean weight and a $1.07 lower mean per-head treatment cost.

Table 1: Effect of caregiver coaching by a Husbandry Educator on mean production outcomes across 12 nursery sites (Trial 1)*

Parameter	Least squares mean ± SE		*P*†
	SC	HE	
No. of nursery groups	72	83	NA
Starting inventory per group	2395 ± 110	2288 ± 89	.05
Mortality rate (%)	3.64 ± 0.004	3.12 ± 0.001	< .001
Weaning weight (kg)	5.90 ± 0.032	5.84 ± 0.047	.88
End of nursery weight (kg)	25.51 ± 0.28	26.12 ± 0.20	.02
Treatment cost ($US)	1.08 ± 0.08	0.54 ± 0.06	< .001

* Trial 1 was a retrospective study that compared mean production outcomes in a production system located in the mid-Atlantic region of the United States. Groups of pigs weaned at approximately 21 days of age and matched by sow source either received standard care or were raised by caregivers who received coaching by a Husbandry Educator (described in Figure 1) for the first 2 to 3 weeks post nursery placement. Each group spent 7 weeks in the nursery. At the end of nursery period, production outcomes were compared at the group level across all sites.

† Trial 1 parameters except mortality were evaluated using a linear mixed model with group as the fixed effect and block (site) and the residual error as random effects. Treatment least squares means were calculated and compared using a two-sided Student *t* test. Percent mortality was analyzed using a generalized linear mixed model with group as the fixed effect and block and the residual error as random effects. $P < .05$ was considered statistically significant for all comparisons.

SE = standard error; SC= groups of pigs raised under standard care; HE= groups of pigs raised by caregivers coached by a Husbandry Educator (a coach who promoted individual pig care and employed the disease classifications shown in Figure 1); NA = not applicable.

In Trial 1 SC groups, the significantly higher mortality rate and significantly lower per-head weight were coupled with an average treatment cost per head that was double that in HE groups. HE groups at only three of the 12 Trial 1 study sites (2, 8, and 9) had treatment costs that exceeded the corresponding costs in SC groups. This indicates that relying on therapeutic treatment alone to offset the impact of clinical disease is much less effective and far more costly than implementing treatment in combination with good husbandry practices.

One limitation of Trial 1 is that even though similar management conditions existed, data from SC groups, collected before HEs were introduced, were compared with data from HE groups. Thus, it is possible that variables associated with different time periods influenced the outcomes measured. Multiple nursery groups and sites during all seasons over a 3-year period were included to compensate for these limitations.

In Trial 2, the percentage of high-value nursery pigs was higher by 2.44% in the HE group than in the SC group, a significant difference. This corresponded with a cull rate that was lower by 2.32% in the HE group than in the SC group. In contrast to Trial 1, where the mortality rate significantly favored the HE group, the mortality rate in Trial 2 was comparable for HE and SC groups. Furthermore, Trial 2 mortality rates were at least a full percentage point lower than rates in either the HE or SC groups in Trial 1. The differential in mortality rate between trials was likely due to the aggressive culling that was conducted in Trial 2, whereby underperforming pigs were removed before dying.

Although a higher percentage of HE groups than SC groups in Trial 2 received therapeutic treatment, the medication cost per group was numerically lower in the HE groups. This suggests that early recognition of acute disease in HE groups increased the frequency of therapy but reduced the overall requirement for treatment by preempting occurrence of serious or chronic disease in those groups. While not statistically significant, the higher treatment costs for SC groups ($P = .08$) further suggest that, despite aggressive culling at the Trial 2 production sites, SC groups still required substantial therapeutic intervention. Numerically lower treatment costs in Trial 2 corroborate results from Trial 1, where treatment cost per HE pig was less than half that per SC pig.

The two trials are noteworthy for the large number of groups (195 nursery groups) evaluated at 32 geographically diverse production sites for extended periods (1 to 3 years depending on the trial). Moreover, trial data were generated by two different production systems represented by the management practices used in Trial 1 and Trial 2. The large numbers distributed over time and place minimized the likelihood of statistical anomalies. Together, these results indicate that a HE working continuously at a production site for 2 to 3 weeks and focusing on training caregivers to observe postweaned pigs daily, identifying sick pigs at early stages of disease, executing treatment protocols, and repeating these processes daily, can improve the percentage of high-value nursery pigs, reduce the percentage of culled pigs and deaths, and reduce treatment costs. These outcomes occurred in herds compliant with industry standards, suggesting that focusing on caregiver education can still improve pig productivity and welfare. To the authors' knowledge, this is the first report where systematic human intervention alone has been statistically evaluated on a large scale and confirmed as a factor that favorably influenced pork production values.

Implications

- A dedicated HE who teaches and encourages caregivers to monitor nursery pigs on a daily basis and to execute treatment protocols can improve productivity, mortality or culling rates, and treatment costs.
- Good husbandry during the critical postweaning growing phase when pigs are most susceptible to setbacks can enhance the positive effects of standard production methods.
- Even well-managed swine operations can experience episodes of high mortality rates and can potentially benefit from improved husbandry practices.
- Relying primarily on therapeutic treatment to offset the impact of clinical disease is much less effective and far more costly than implementing good husbandry practices prior to disease onset.

Acknowledgments

The author acknowledges the contribution of Mark Dana of Scientific Communications Services, LLC in the writing and editing of this manuscript.

Table 2: Effect of caregiver coaching by a Husbandry Educator on mean production outcomes at individual nursery sites (Trial 1)*

Site	No. of groups (mean no. of end-of-nursery pigs)		BW kg†		% mortality (range)‡		Treatment cost ($US) (range)§	
	SC	HE	SC	HE	SC	HE	SC	HE
1	4 (19,952)	3 (10,057)	24.99	24.76	3.93 (2.73-5.18)	3.26 (2.63-4.53)	1.49 (1.33-1.83)	0.93 (0.00-1.66)
2	8 (20,094)	8 (19,199)	24.58	26.39	2.67 (2.30-3.20)	2.94 (2.26-4.53)	0.15 (0.00-0.65)	0.21 (0.00-0.74)
3	7 (3320)	12 (6488)	22.81	24.44	1.98 (1.30-2.48)	2.35 (0.74-3.90)	1.58 (0.79-2.32)	1.07 (0.31-2.12)
4	4 (9380)	6 (15,329)	25.17	26.08	3.00 (2.09-3.80)	2.57 (1.69-3.45)	0.18 (0.00-0.33)	0.10 (0.00-0.15)
5	8 (15,324)	9 (19,208)	28.12	28.25	1.80 (1.18-2.51)	3.67 (2.24-5.38)	1.33 (0.53-2.01)	0.81 (0.19-1.85)
6	5 (11,066)	5 (11,172)	28.71	26.94	5.24 (2.62-10.44)	2.66 (1.53-3.21)	1.13 (0.32-2.12)	0.48 (0.27-0.74)
7	6 (12,731)	6 (14,169)	24.08	27.71	8.33 (2.80-30.41)	2.43 (1.72-3.16)	1.01 (0.19-2.49)	0.64 (0.47-0.76)
8	4 (9720)	6 (14,314)	24.94	26.03	3.23 (2.80-3.96)	3.02 (1.98-3.51)	0.18 (0.00-0.37)	0.32 (0.00-0.55)
9	2 (4143)	5 (4413)	24.22	23.13	4.65 (4.32-4.74)	3.01 (2.00-4.14)	1.25 (1.10-1.79)	1.37 (0.10-1.92)
10	9 (21,675)	12 (27,978)	24.90	24.53	4.19 (1.99-5.94)	4.66 (3.05-8.62)	1.36 (0-2.17)	0.29 (0.12-0.59)
11	7 (17,034)	6 (14,135)	27.07	28.25	3.33 (1.85-5.25)	2.91 (2.36-4.34)	1.64 (0.93-2.23)	0.31 (0.00-0.68)
12	8 (18,252)	5 (12,439)	27.39	25.49	3.33 (2.19-4.76)	3.42 (2.64-4.23)	0.42 (0.00-0.71)	0.40 (0.35-0.45)
Total	72 (162,691)	83 (168,901)	NA	NA	NA	NA	NA	NA

* Trial 1 was a retrospective study described in Table 1.

† Mean end-of-nursery BW per group.

‡ Mean percent mortality per site (range by group).

§ Mean treatment cost per site (range by group).

BW = body weight; SC = groups of pigs raised under standard care; HE = groups of pigs raised by caregivers trained by a Husbandry Educator (a coach who promoted individual pig care and employed the disease classifications shown in Figure 1); NA = not applicable.

Table 3: Effect of caregiver coaching by a Husbandry Educator on production outcomes in weaning-to-finish sites (Trial 2)*

Parameter	Least squares means by test group ± SE		*P*†
	SC	HE	
No. of nursery groups	20	20	NA
Starting inventory/group	3506 ± 261	3376 ± 234	.17
Mortality rate (%)	2.13 ± 0.001	2.15 ± 0.002	.88
High-value nursery pig rate (%)	91.48 ± 0.007	93.92 ± 0.002	< .001
Cull rate (%)	6.05 ± 0.007	3.73 ± 0.003	< .001
Injectable treatment rate (%)	8.76 ± 0.036	9.89 ± 0.015	< .001
Treatment cost/pig ($US)	0.177 ± 0.40	0.104 ± 0.018	.08

* Trial 2 was a prospective study comparing mean production outcomes in groups of pigs weaned at approximately 21 days of age and randomly assigned to standard care groups or groups raised by caregivers who received coaching by a Husbandry Educator for the first 2 to 3 weeks post placement. Groups were matched by sow source, weaning date, and barn size. After each group of pigs spent 7 weeks post placement in weaning-to-finishing sites, production outcomes were collected and statistically compared at the group level.

† All binomial parameters were analyzed using a generalized linear mixed model. Continuous variables were analyzed using the linear mixed approach in a model with group as a fixed effect and block (flow) and the residual error as random effects. All tests of treatment differences were two-sided, with statistical significance determined at the 5% level.

SE = standard error; SC = groups of pigs raised under standard care; HE = groups of pigs raised by caregivers trained by a Husbandry Educator (a coach who promoted individual pig care and employed the disease classifications shown in Figure 1); NA= not applicable.

Conflict of interest

All authors are employed by Zoetis. Lucina Galina Pantoja, Michael Kuhn, and Thayer Hoover are veterinarians, Deborah Amodie and Daniel Weigel are statisticians, Cristy Dice and Terry Moeller are Husbandry Educators, and Eric Farrand is the Husbandry Educator manager. The Husbandry Education Program is a commercial service offered by Zoetis.

References

1. Baysinger AK, Dewey CE, Straw BE, Brumm MC, Schmitz J, Doster A, Kelling C. The effect of PRRSV on reproductive parameters in swine herds. *Swine Health Prod*. 1997;5:173–176.

2. Kausche FM, Dean EA, Arp LH, Samuel JE, Moon HW. An experimental model for subclinical edema disease (*Escherichia coli* enterotoxemia) manifest as vascular necrosis in pigs. *Am J Vet Res*. 1992;53:281–287.

3. Opriessnig T, Meng XJ, Halbur PG. Porcine circovirus type 2-associated disease: Update on current terminology, clinical manifestations, pathogenesis, diagnosis, and intervention strategies. *J Vet Diagn Invest.* 2007;19:591–615.

4. Sitjar M, Noyes EP, Simon X, Pijoan C. Relationships among seroconversion to *Mycoplasma hyopneumoniae*, lung lesions, and production parameters in pigs. *Swine Health Prod*. 1996;4:273–277.

5. Smart NL, Miniats OP, Rosendal S, Friendship RM. Glasser's disease and prevalence of subclinical infection with *Haemophilus parasuis* in swine in southern Ontario. *Can Vet J.* 1989;30:339–343.

6. Andraud M, Leon EA, Rose N, Grasland B, Justin A, Madec F. Influence of husbandry and control measures on porcine circovirus type 2 (PCV2) dynamics within a farrow-to-finish pig farm: A modelling approach. *Prev Vet Med*. 2009;92:38–51.

7. de Grau A, Dewey C, Friendship R, de Lange K. Observational study of factors associated with nursery pig performance. *Can J Vet Res*. 2005;69:241–245.

8. Larriestra AJ, Wattanaphansak S. Neumann EJ, Bradford J, Morrison RB, Deen J. Pig characteristics associated with mortality and light exit weight for the nursery phase. *Can Vet J*. 2006;47:560–566.

9. Madec F, Rose N, Grasland B, Cariolet R, Jestin A. Post-weaning multisystemic wasting syndrome and other PCV2-related problems in pigs: a 12-year experience. *Transbound Emerg Dis.* 2008;55:273–283.

10. Young B, Dewey C, Poljak Z, Rosendal T, Carman S. Clinical signs and their association with herd demographics and porcine reproductive and respiratory syndrome (PRRS) control strategies in PRRS PCR-positive swine herds in Ontario. *Can J Vet Res*. 2010;74:170–177.

*11. Individual Pig Care: Four Steps to Implementation. Available at: **http://www.thepigsite.com/focus/pfizer-animal-health/3822/pfizer-animal-health-individual-pig-care-four-steps-to-implementation**. Accessed 22 March 2013.

* Non-refereed reference.