Movement Ease for Grow-Finish Pig Cadavers On-Farm using a Sked, Deer Sled, and Modified Deer Sled

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Ella Akin, Graduate Research Assistant;
Jason Ross, Associate Professor;
Kenneth Stalder, Professor,
Department of Animal Science,
Suzanne Millman, Professor,
Biomedical Science, Vet Diagnostic and Production Animal Medicine,
Veterinary Preventative Medicine Graduate Programs,
Iowa State University,
Dr. Cassandra Jass,
Dr. John Stinn,
Iowa Select Farms, Iowa Falls, Iowa
Anna Johnson, Professor;
Department of Animal Science,
Iowa State University

Summary and Implications

The National Pork Board provides guidance about humane swine handling through the Pork Quality Assurance Plus and Transport Quality Assurance programs. While this guidance is useful, questions remain on best practices and design of handling tools with reference to moving non-ambulatory grow-finish pigs. The objective of this project was to test a sked, deer sled, and modified deer sled as physically suitable handling tools for moving grow-finish pig cadavers as a model for non-ambulatory market-weight pigs. On-farm testing was accomplished using three pig cadavers (59, 91, 98 kg) to evaluate handling tool effectiveness based on employee heart rate, force, handling tool duration, and durability. For statistical analysis, a new variable was created; change in employee heart rate (bpm) was calculated: hospital pen heart rate – baseline resting heart rate. Each employee was considered an experimental unit. Data were analysed using generalized linear mixed model methods. The sked had a greater change in employee heart rate compared to the modified deer sled. The sked required employees to use more force to move cadavers at the end of the alley compared to the deer sled and modified deer sled. Employees used less force to move each handling tool at the end of the alley and were quicker to move the 59 kg cadaver compared to the 91 and 98 kg cadavers. For handling tools, employees were able to more quickly move the modified deer sled from the home- to the hospital pen. The deer sled was the least durable, while the sked was the most durable. In conclusion, this research would not support the modified deer sled in its current form as a handling tool due to no restraints. No restraints led to cadavers sliding off the modified deer sled during movement. Furthermore, during movement cadaver legs and heads caught in alley gates, which prevented a smooth forward motion transition. This research supports the use of the sked and deer sled as practical handling tools to move grow-finish pig cadavers and show promise as useful handling tools to move non-ambulatory market-weight pigs' on-farm.

Introduction

The National Pork Board provides guidance about humane swine handling through the Pork Quality Assurance Plus and Transport Quality Assurance programs. Building on these educational programs, the Common Swine Industry Audit established criteria concerning willful acts of abuse and neglect. This topic can result in automatic audit failure and prohibits "*[d]ragging of conscious animals by any part of their body except in the rare case where a non-ambulatory animal must be moved for a life threatening situation. Non-ambulatory pigs may be moved by using a drag mat*." This audit point has provoked discussion among swine extension agents, producers and veterinarians. Discussion has included, what defines a "life-threatening" situation? Would an auditor and the producer agree on life threatening? If moved, is it in compliance with CSIA? Do drag mats work? Preliminary work concluded that a rubber farrowing mat was unsatisfactory as a drag mat for finisher pigs because it was too heavy, the pig kept sliding off and it tore very easily. These findings suggest there is an opportunity to identify other handling tools that consider practical logistics, worker safety and non-ambulatory market-weight pig welfare. Therefore, the objective of this study was to test a sked, deer sled, and modified deer sled as suitable handling tools for moving grow-finish pig cadavers on farm as a model for non-ambulatory market-weight pigs.

Materials and Methods

This protocol was approved by the Iowa State University Institutional Review Board Committee for Humans Subject Research (Approval #18-003). Due to ethical considerations, on-farm testing of the handling tools was accomplished using pig cadavers.

Animals, facilities, and cadaver tasks: This study was conducted on a commercial grow-finish site situated in Central Iowa. Three commercial crossbred (PIC) pig cadavers (59 kg, 91 kg and 98 kg) were utilized. Prior to euthanasia, body weights were collected using a weigh scale (Raytec WayPig 300; AGRIsales Inc., Ceresco, NE) and BW were rounded up to whole numbers. For cadaver tasks,

two empty pens were designated as the start (home pen) and end (hospital pen). The pens were fully slated (slat width 15.2 cm x slat gap 2.5 cm). The alley was partially slatted with a concrete center (width 13.9 cm x length 60.9 m). The distance between the home- and hospital pen was 59.2 m. The cadaver was positioned with its head towards the outside wall of the barn 3.5 m from the alleyway gate and 2 m away from the right pen divider. At the start of each cadaver task, the employee was asked to roll the cadaver onto the handling tool and move it from the home- to hospital pen. For all employees, the cadaver tasks were performed using the medium, light, and then heaviest cadaver.

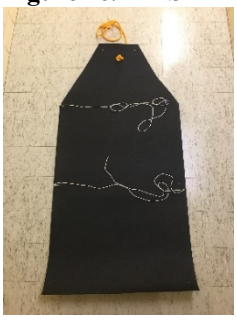
Handling tools: An HMH sked rescue system (**SKED**), deer sled (**SLED**) and modified deer sled (**MDS**) were evaluated (Figure 1).

Figure 1. Handling tools used on-farm when moving pig cadavers

Figure 1a. SKED

Figure 1b. SLED

Figure 1c. MDS



The handling tools were modified prior to being used on-farm. The modification process of the SKED, SLED and MDS took approximately 10 min, 5 min, and 35 min respectively.

Employee enrollment: Five employees participated. Employees completed a self-reported questionnaire before the start of the study (Table 1).

Table 1. Employee demographics on the commercial grow-finish farm from a study evaluating the sked, deer sled, and modified deer sled to move grow-finish pig cadavers from home-to hospital pen

	Employees				
Measure	**1**	**3**	**4**	**5**	**6**
Gender	Female	Male	Male	Male	Male
Age (yrs)	30	23	35	30	60
Height (cm)	160.2	182.9	182.9	195.6	180.3
Weight (kg)	63.5	83.9	113.4	111.1	90.7
Years *	10	1	15	30	20

*Experience measured as direct observation of or participation in working on a pig farm site

Measures: Handling tool order per employee was determined before going on-farm using a complete randomization for the first cadaver, partial randomization for the second cadaver, and the remaining handling tool assigned to the third cadaver. Each employee moved the three cadavers once per handling tool.

Exertion Force: A FGV-HXY High Capacity Digital Force Gauge (Nidec-SHIMPO America Corporation, Itasca, IL, USA) was attached to the handle to record force (kgf) applied by the employee while moving the cadaver. Each employee held his or her arms with the force gauge at waist height and pulled for five continuous seconds. Cadaver tasks were performed in two locations (1) in the alleyway immediately outside the home pen (SOA) and (2) inside the hospital pen (EOA).

Duration of cadaver tasks: Time to complete cadaver tasks was measured at four time points (s): 1) Duration to roll cadaver from home pen floor onto the handling tool. 2) Duration to restrain the cadaver onto the handling tool. 3) Duration to move the handling tool and cadaver from home pen into alleyway, defined as the handling tool being entirely inside the alley and oriented towards the hospital pen. 4) Duration to move handling tool and cadaver along the alleyway and into the hospital pen, defined as handling tool being entirely inside the hospital pen.

Employee heart rate: One researcher collected each employee's heart rate (bpm) at two different time points: (1) baseline resting heart rate in the home pen and (2) post exertion heart rate collected immediately after moving each cadaver. A pulse oximeter (Pulse Oximeter 50DL; Clinical Guard, Atlanta, GA, USA) was placed on the employee's index finger to collect heart rate. A 5-min resting period occurred between each cadaver, allowing the heart rate to return to baseline.

Durability: Durability evaluation for each tool included the presence of holes, rips and creases at the conclusion of

each cadaver task. If observed, these were counted, measured (cm) and photographed.

Statistical Analysis: A new variable was created:

Change in employee heart rate (bpm) = hospital pen heart rate – baseline resting heart rate

Employee was the experimental unit. Data were analysed using generalized linear mixed model methods (PROC MIXED) of SAS (v9.4, SAS Inst. Inc., Cary, NC). The statistical design was a complete randomized design with fixed effects of handling tool (n = 3), employee (n =5) and cadaver (n = 3). The handling tool*cadaver interaction was evaluated, but not included in the final model due to the interaction being non-significant (P ≥ 0.2). Employee data will not be presented. Statistical differences were reported when individual model main effects were a significant source of variation (P ≤0.05). Further, when an individual main effect in the model was a significant source of variation, main effect levels were separated using the PDIFF option.

Results and Discussion

***Exertion Force*:** Handling tools and cadavers did not differ for force used at SOA (P = 0.38). However, there were differences for EOA between handling tools (P = 0.003; Figure 2) with employees using more force to move SKED with cadavers than SLED and MDS (P ≤ 0.006). Employees used less force to move the 59 kg cadaver than the 91 kg and 98 kg (P ≤ 0.001; Figure 3).

Figure 2. Exertion force to move handling tool regardless of pig cadaver weight once inside the hospital pen (EOA; P = 0.003)

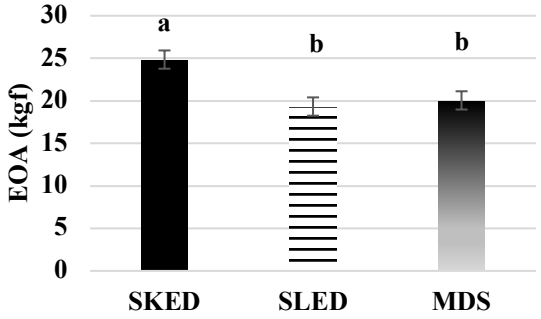


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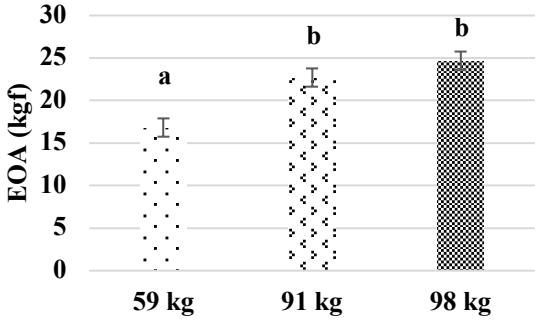
Figure 3. Exertion force to move pig cadaver regardless of handling tool once inside the hospital pen (EOA; P ≤ 0.001)



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Duration: The total duration (s) differed between handling tools (P <0.0001; Figure 4), with the MDS being the quickest to move for employees (P ≤ 0.03). Employees were quicker to move the 59 kg cadaver to the hospital pen compared to the other cadavers (P ≤ 0.0001; Figure 5).

Figure 4. Total handling tool duration (P ≤ 0.0001)

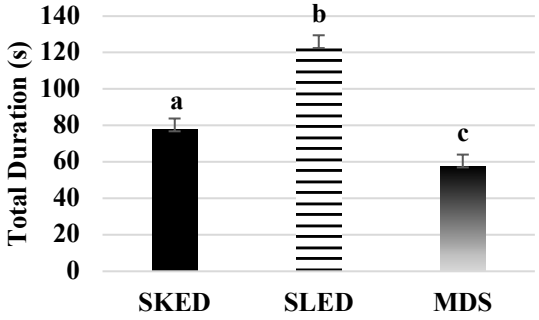

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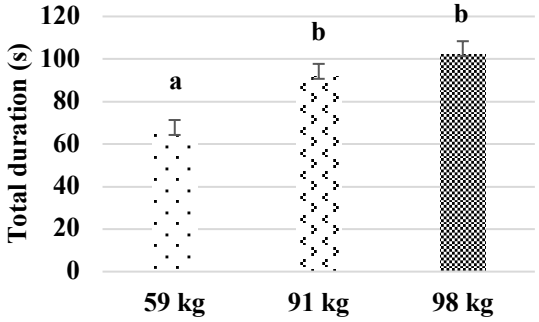
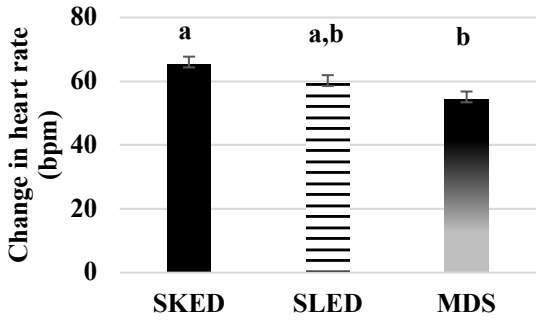
Figure 5. Total handling tool duration for the three pig cadavers (P ≤ 0.0003)



[ab]Means across the figure with no common superscript are significantly different (P < .05)

Employee heart rate: Employee heart rate did not differ between moving cadavers (P = 0.85). There was a change in heart rate when employees utilized the three different handling tools with the SKED having a larger change in employee heart rate compared to the MDS (P = 0.003; Figure 6).

Figure 6. Change in employee heart rate (bpm; P = 0.003)



[ab]Means across the figure with no common superscript are significantly different (P < .05)

Durability: The SLED was the least durable with two creases and one hole at the conclusion of the study. The SKED was the most durable with no creases, tears or holes.

Conclusion

In conclusion, this research would not support the MDS in its current form as a handling tool due to no restraints. No restraints led to cadavers sliding off the MDS during movement and with this movement cadaver legs and heads caught in alley gates. These issues prevented a smooth forward motion transition. This research does support the use of the SKED and SLED as practical handling tools to move grow-finish pig cadavers and show promise as useful handling tools to move non-ambulatory market-weight pigs' on-farm.

Acknowledgments

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