



2025 ISU JAMES D. MCKEAN **SWINE DISEASE CONFERENCE**

Gateway Hotel and
Conference Center
Ames, Iowa

Iowa State University College of Veterinary Medicine
Iowa Pork Industry Center
American Association of Swine Veterinarians, District 6

Digital Movement Monitoring: A Systems Approach to Mitigating Pathogen Transmission Risk in Swine Supply Chains

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Introduction

Pathogen movement within and between swine production systems remains a persistent challenge to health, productivity, and profitability. Movement—whether by vehicles, people, or equipment—plays a critical role in the introduction and spread of diseases such as PRRSV, PEDV, and emerging threats. Research has demonstrated a strong association between frequency of site events—including deliveries, maintenance, and personnel movement—and infection with PRRSV, PEDV, and PDCoV in both nursery and finishing phases.

In response to these risks, Pillen Family Farms adopted a digital movement monitoring platform, Farm Health Guardian (FHG), to transform its biosecurity program. This reviews a systems approach to digital biosecurity monitoring that includes milling operations, people movement, external deliveries, environmental services, and agronomy teams.

System Design

The FHG platform was initially piloted from February through May 2024 across 184 properties. During this period, 197 vehicles and 71 app users contributed data. Vehicle tracking was enabled via GPS integrations or GPS tail-light devices, while individual visits were logged through the FHG app. Biosecurity rules were embedded into the system to generate breach alerts when protocols were not followed.

Following the pilot, FHG adoption was expanded system-wide. All team members visiting more than one farm annually were required to use the application. Participation included not just internal transport teams, but contract haulers, environmental crews, and external service providers. Over 200 properties, 200+ users, and 400+ devices were actively used in the ongoing biosecurity platform to generate additional case study and biosecurity data.

Results

In total, 22,744 visits were recorded—17,789 (78%) via vehicle GPS and the remaining 22% as people movements during the 25-week pilot period. Sixteen weeks were breach-free, while the remaining nine weeks averaged fewer than three breaches each. This low breach rate demonstrates the power of real-time alerts and data visibility to improve compliance. Outbreak response time was also improved; in a disease simulation exercise, digital trace-out reports were generated within minutes—compared to days required for traditional methods involving calls, emails, and manual logs. Automated, unbiased data greatly enhanced the confidence and accuracy of these investigations.

Discussion

FHG-enabled movement data provided insights that drove tangible system improvements. One major issue identified was the inconsistency between scheduled trailer use and actual behavior. These discrepancies often resulted from trailer swaps at truck washes, which introduced potential contamination risks. The system was updated to flag breaches in real time, allowing the health team to intervene immediately. In feed milling, the software revealed instances that feed trucks had returned to high-health sites after visiting lower-health farms without sufficient downtime or sanitation. This finding prompted a re-evaluation of routing logistics and the implementation of more stringent rules for disinfection and downtime between deliveries.

The inclusion of maintenance crews, agronomy staff, and other external personnel within the digital system highlighted gaps in previously unmonitored movements. There is now greater visibility of true movement data and epidemiological connections between sites, which had gone undetected in previous risk analyses. These insights exemplify how data visualization and rule enforcement can uncover and mitigate previously hidden vulnerabilities.

Digital biosecurity monitoring transformed the biosecurity culture from reactive to proactive. The implementation of Farm Health Guardian software has elevated biosecurity practices across transport, milling, and support services. The resulting system is more transparent, adaptable, and prepared to manage the complex realities of pathogen risk in swine production. As the industry continues to face evolving threats, the integration of digital tools offers a path forward for sustainable and effective disease mitigation.