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Experiences with geofencing: Harnessing data for enhanced disease traceability

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Introduction

Disease transmission across swine production systems is heavily influenced by the movement of people, animals, feed, and equipment. Although written biosecurity plans often outline appropriate downtime, truck wash requirements, and site order, real-world compliance is difficult to measure consistently. To address this challenge, the production system adopted Farm Health Guardian (FHG), a digital movement platform that uses geofencing and GPS-based data collection to track traffic across more than 215 properties. The primary objectives were to evaluate movement compliance, identify high-risk epidemiological connections more quickly, and strengthen outbreak investigation and response through objective, time-stamped movement data.

Methods

Geofencing framework

The FHG platform integrates GPS data from a few primary sources: fleet-installed GPS units on system-owned trucks and linked trailers, a mobile app used by personnel and contract drivers, or other GPS-compatible devices that can be connected to the FHG system. Each production site, feed mill, truck wash, service center, agronomy hub, and packing plant was individually geofenced. Entering or exiting a geofenced area automatically logs a time-stamped visit, producing a comprehensive digital record of all movements across the system. Geofencing rules were configured around the system's biosecurity pyramid. Examples included human downtime requirements, two-stage wash requirements for livestock trailers returning to high-health sow farms, dedicated-flow trailer assignments, and feed truck visit order rules. The geofence triggers enabled the platform to issue automated breach alerts when a device or user violated the defined criteria.

Movement data

During an initial pilot period, 22,744 visits were recorded. Of these, 78% were truck or trailer movements captured via GPS integrations, while 22% were personnel visits recorded through the FHG app. The volume of data highlighted several inconsistencies between planned processes and actual daily execution. For transportation, geofencing revealed issues such as incorrect site order, deviations from assigned trailer flows, and frequent "audibles" at truck washes where trailers were swapped outside of protocol. In some cases, up to half of trailers scheduled for a load were not the ones ultimately used. These deviations increased the risk that a trailer previously hauling positive animals could be reassigned to a higher health farm without the required wash sequence. Within milling operations, geofencing identified repeated patterns in which feed trucks served a low-health site and then immediately traveled to a high-health farm without downtime, patterns previously unrecognized by traditional scheduling systems. Similarly, visitor and contractor movements demonstrated gaps between biosecurity expectations and field behavior, especially for individuals who entered multiple sites in a short timeframe.

Results

Disease investigations

Digitally recorded timestamps and movement histories significantly accelerated the ability to conduct epidemiological investigations. When a site reported a new outbreak, outbreak reports and trace-out functions within the FHG platform allowed investigators to specify the outbreak date and incubation window. The system then identified all vehicles, trailers, and individuals that had visited the site during the risk period. This process improved both accuracy and speed. Investigators no longer relied solely on dispatch logs, driver recollection, or manual visitor logs, which were often incomplete or delayed. Instead, geofencing provided objective, continuous movement data, allowing the investigation team to identify high-probability transmission vectors within hours rather than days. Case examples demonstrated situations in which movement data identified unexpected epidemiological connections, such as a trailer that briefly entered the perimeter of a finishing site before being reassigned to a high-health sow barn. In other instances, personnel visits that were not recorded on traditional logs appeared within the digital trace report, providing essential information on potential human-mediated spread.

Outbreak response

Following confirmation of a disease event, the digital movement records supported risk reduction and containment. Geofencing data enabled production and veterinary teams to rapidly identify potentially contaminated vehicles, people, or equipment that had contact with the affected site. These entities could then be isolated, subjected to extended downtime, or directed for enhanced cleanup procedures. The platform also allowed the team to monitor compliance with biosecurity restrictions in real time. For example, individuals associated with a positive site could be temporarily denied entry into high-health farms, and the system would generate instant alerts if a user attempted to override downtime restrictions. This capability helped maintain biocontainment and prevent secondary spread during high-risk periods.

Epidemiological value

Utilizing this software, the outbreak response team was able to identify with high confidence the source of infection in five of six outbreaks that occurred in 2025. Without the software to be able to connect sites with similar diseases or strains, it would have been almost impossible to define risk areas. With accurate identification, system processes and protocols were altered to improve overall biosecurity.

Limitations

Despite significant benefits, several limitations remain. Movements on non-owned properties such as semen courier stops, trash pickups, propane deliveries, shared parking lots, lagoon

access points, and agronomy pivots were often outside geofenced boundaries and therefore difficult to fully capture. External vehicles without GPS integration, including certain contract haulers and service companies, represented additional blind spots. Expanding geofenced areas or improving device adoption among third-party partners may help close these gaps.

Discussion

Geofencing through the Farm Health Guardian platform has become an integral component of the production system's biosecurity strategy. Real-time movement tracking has revealed critical discrepancies between expected and actual behaviors, enabled rapid and accurate epidemiological investigations, and strengthened outbreak response through objective risk identification. While gaps remain around non-owned properties and external service providers the system has substantially improved visibility into transport, milling, personnel, and contractor movements. Continued refinement of geofencing rules, user compliance, and device utilization will further enhance disease prevention and system resilience. Additionally, incorporation of accurate diagnostic data with the geofenced connections should create a powerful tool for defining disease outbreak sources and risk factors.