

## Evaluating the uses of geofencing under field conditions

Nicholas J. Black<sup>a</sup>, Ting-Yu Cheng<sup>b</sup>, Andreia G. Arruda<sup>b</sup>

<sup>a</sup>Health Systems & Planning, Franklin County Public Health, Columbus, OH.

<sup>b</sup>Department of Veterinary Preventive Medicine, The Ohio State University, Columbus, OH.

### Key Points:

- The vertically integrated structure of swine production and the network among swine facilities allow important swine pathogens to spread within and between production sites.
- This study assessed the use of a geofencing technology to monitor personnel movements within multisite production systems.
- Social network analysis indicated that employees in administrative and technical support roles are an important consideration with respect to increasing indirect connections between sites of different production phases.

### Introduction

Over the past decades, the swine industry has evolved and is currently dominated by vertically integrated multisite production systems designed for large-scale production<sup>1</sup>. This has facilitated the spread of swine diseases within and between production sites and biosecurity has been an integral part of preventing the spread of diseases in swine production systems. Technological applications, e.g., geofencing, could be of assistance by allowing producers and veterinarians to monitor biosecurity breaches caused by unauthorized employee movements among swine facilities.

### Study Objectives:

- Assess the use of a geofencing platform under field conditions within two multi-site production systems.
- Describe the social network of movements between sites and investigate site connectivity patterns accounting for employees' role.
- Identify and quantify movements between sites that are potential breaches to standard "nights down" biosecurity protocol.

### What we did

Two large multisite production systems (System 1 and 2) containing over 200 swine sites each were recruited from Ohio and Iowa, respectively. Animal health-related personnel (veterinarians, caretakers, etc.) and industry service providers (e.g., truck drivers, maintenance, etc.) of the two systems were asked to install a geofencing<sup>2</sup> application on either their personal or a supplied mobile device. The application was designed to establish virtual barriers around individual sites based on GPS coordinates, and recorded site entries when an employee crossed the barriers with an application-installed device.

Physical written entry logs were maintained by a subset of employees from System 1 for a duration ranging from 1-6 weeks, which were compared to the digitally recorded logs from the geofencing platform captured during the same period. This provided a proportion of the observations in which the geofencing technology was correct as compared to the written logs, which are commonly used by swine production systems and considered as the "gold standard".

For System 2, site entries were recorded prospectively for one month. Consecutive site entries from an individual within a single day were used to create direct movements between sites. A network structure of indirect site connections was constructed and comprised of multiple network layers corresponding to categories of employee role. Additionally, movements within System 2 were investigated for potential breaches to the company's standard operating nights down protocol.

### The results

Out of a total of 398 manually written recorded site entries from System 1, 379 (95.23%) were also digitally captured by the geofencing platform. Results from the social network analysis implied the importance of employees within administrative and support services roles with respect to increasing the indirect connections between different production sites.

In System 2 1861 total site connections were observed during the study. Of these, 12 (0.6%) were identified as potential breaches of the system's downtime guidelines where 9 of the 12 (75%) were contributed by employees from communication and information services, implying their roles in connecting different production sites pose risks of disease spread.

This study demonstrated the potential benefits using geofencing technology and its application to vertically integrated production systems.

**Acknowledgements:** The authors would like to thank BarnTools and the USDA-NIFA Capacity and Infrastructure Program.

### References:

- <sup>1</sup> McBride, W.D., Key, N., 2013. U.S. Hog Production From 1992 to 2009: Technology, Restructuring, and Productivity Growth (Economic Research Report No. 158). Economic Research Service, United States Department of Agriculture.
- <sup>2</sup> Barn360: Production Management Platform [WWW Document], 2020. BarnTools. URL <https://barntools.com/barn360> (accessed 7.7.21).