Foodborne Illness Outbreak Severity Across Geographic and Supply Chain Contamination Locations in the United States, 2009–2019

Emily Sanchez, Ryan Simpson, Lauren Sallade, Yutong Zhang, and Elena Naumova

Tufts University Friedman School of Nutrition Science and Policy

Objectives: In 2009, the Centers for Disease Control and Prevention's National Outbreak Reporting System (NORS) began collecting supply chain contamination data as part of foodborne outbreak (FBO) traceback investigations. We created an integrated FBO severity score measure and examined differences in FBO severity by geographic and supply chain contamination locations. We used 9,407 NORS records between 2009–2019 to demonstrate the utility of the proposed methodology.

Methods: The severity scores were composed of 11 metrics based on outbreak intensity and duration characteristics and metrics' completeness. Metrics were normalized (with natural log-transformation), calibrated (to 0–1 scale), and weighed (by completeness) across all recorded outbreaks. Individual outbreak scores ranged from 0 (lowest severity) to 1 (highest severity). We compared averages of severity scores across geographic (i.e., multistate and single state exposure outbreak) and supply chain contamination locations (i.e., suspected or confirmed before preparation, preparation, unknown and missing) using tobit-regression models.

Results: All FBOs reported the state of exposure; 5,500 (58.5%) reported supply chain contamination location. Multistate exposure FBOs had higher median severity scores than single state outbreaks (0.54 [0.44, 0.67] vs 0.28 [0.16, 0.41], $P < 0.001$). FBOs with reported point of contamination that occurred before preparation had higher median severity scores than all other stages (0.36 [0.27, 0.49] vs 0.26 [0.15, 0.41], 0.25 [0.13, 0.39], and 0.29 [0.16, 0.43], $P < 0.001$, for preparation, unknown and missing stages respectively).

Conclusions: Understanding an FBO's severity by geographic and supply chain contamination location helps to quantify supply chain vulnerability and improve monitoring of food safety. Identification of supply chain contamination at high level granularity and completeness is critical for developing foodborne outbreak (FBO) prediction analytics aimed to reduce both the volume and severity of outbreaks and illnesses.

Funding Sources: DoD, ODNI, NIFA, NSF, USIAD.