A comparison of four methods for detecting the July 2002 erysipelas epidemic.

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Summary

Surveillance systems (e.g., slaughter- or laboratory-based) are more sensitive and timely than the rumor mill and could greatly improve the US pork industry's ability to detect epidemics. The creation of such systems should lead to effective control mechanisms

Introduction

Microbial threats to the health of humans and livestock have increasingly captured the attention of public health officials and epidemiologists interested in the control and prevention of emerging diseases. The key to timely recognition of emerging diseases is effective surveillance. Unfortunately, broad support for surveillance activities (and other preventive practices) are often lacking in the absence of a recent crisis or imminent threat.

In July 2001 an epidemic of erysipelas occurred in the Upper Midwest of the United States. There were no surveillance systems to detect the re-emergence of known pathogens. In the absence of surveillance, the default method for recognizing an epidemic is via the "rumor mill". The rumor mill can be defined as communication pathways where talk and opinion are widely disseminated with no discernible source. It is the ad hoc discussions that take place between producers, private practitioners and diagnosticians. Our hypothesis is that surveillance systems would have performed better than the rumor mill in detecting to the erysipelas epidemic? The purpose of this project is to assess the relative performance of surveillance systems compared with that of the rumor mill. The surveillance tools not in place at the time of the erysipelas outbreak had to be reconstructed retrospectively.

Surveillance systems are evaluated based on their usefulness, sensitivity, specificity, representativeness, timeliness and other attributes. These attributes were used to compare four methods of detecting epidemics: the rumor mill, Pathfinder intelligence tool, laboratory-based surveillance, and slaughter-based surveillance. For the purposes of this project, sensitivity if based on the ability to detect, at the national level, a true health event.

Rumor mill

For the purposes of this paper, the rumor mill communication endpoint is when awareness has occurred at the national level. In the case of swine health issues, this national awareness is demonstrated by presentations at national meetings and/or recognition of the problem by the American Association of Swine Veterinarians (AASV) and the National Pork Board (NPB). The erysipelas outbreak appears to have begun around June 22, 2001 in central Iowa. During the week of July 9th pigs at several county fairs were diagnosed with erysipelas. By July 11th, several practitioners became aware of the erysipelas epidemic due to numerous remarks by

producers. The first evidence that the epidemic had reached the national level was August 15, 2001 when the AASV e-letter notified practitioners of a reported increase of pigs showing signs of erysipelas arriving at slaughter plants.
The rumor mill did in fact generate recognition of the erysipelas epidemic 4 weeks after the occurrence. It also generated a useful response evidenced by NPB's "Residue Check Stuffers" mailed out on October 12, 2001 to packers for subsequent distribution to producers. But how does it perform compared to other methods?

Pathfinder textual data mining

The mission of USDA's Center for Emerging Issues is to quickly identify, assess and respond to emerging animal health issues in order to prevent or limit the sudden and negative economic, food security, and public health effects of those issues. CEI employs a data mining software program (Pathfinder) to rapidly identify and analyze information related to disease emergence from electronic information sources.
A rash of erysipelas cases occurred at a couple of Iowa county fairs the week of July 10th, 2001. This was first reported in the July 17th Des Moines Register, posted on ProMED July 18th and AnimalNet on July 19th. The AnimalNet posting generated a hit on the Pathfinder system on July 19th.
Pathfinder is essentially a systematic monitoring of the rumor mill except that it's coverage is much broader than the more patchy web of connections between practitioners and diagnosticians. Since they both detected the erysipelas epidemic, their sensitivity is equivalent. However, we would conjecture that Pathfinder should be more sensitive in general due to greater coverage nationally and it's enhanced ability to connect cases. Since Pathfinder is at least as likely to detect a false event, its specificity is equivalent or lower than the rumor mill. The timeliness of the rumor mill depends on time of year in relation to upcoming swine meetings and the connection of affected practitioners with national organizations like NPB or AASV. The epidemic was recognized via the rumor mill in 7 weeks time (June 22 to Aug 15th) compared to 4 weeks for Pathfinder, only one week after producer reports of outbreaks at county fairs. The chief detraction of the Pathfinder system is the lack of usefulness. From the standpoint of disease prevention, it was not useful in producing a specific disease control activity. Yet, unlike the next two methods, it is operational.

Laboratory-based surveillance

Currently, veterinary diagnostic laboratory data is not routinely summarized. We contacted the university labs in Iowa and Minnesota to obtain monthly summaries of Erysipelas diagnosis for the period 2000 and 2001. For the University of Minnesota laboratory data, the highest number of diagnosis occurred in June 2001 then again in July and August 2001. For ISU, prior to the July 2001 spike, the highest levels of erysipelas diagnosis were seen in July 2000 and Jan-Feb 2001. Given the sparse number of erysipelas cases diagnosed at either lab, under real-time surveillance conditions these monthly highs would not have been sufficient to alert the pork producing community to take preventive measures. The most likely trigger would have been either the moderate rise in erysipelas cases at both ISU and MN in June or the more noticeable epidemic peak in July.

As laboratories provide a more centralized point of collecting data on affected producers, it is at least as sensitive as the local rumor mill. It is more sensitive when lab data for other States are combined or the indicator being monitored is diagnosed more commonly than erysipelas. The hard data generated by diagnostic laboratories has greater internal validity than the non-descript communications of the rumor mill so its specificity should be greater. However, the inherent biases in laboratory data must be taken into consideration. These include selection bias, inter-lab variation in test performance, lack of denominators or defined case definitions, and poor data quality.

Timeliness can not be directly assessed since data was reconstructed. However, if monitored weekly with little lag period between time of submission to summary of cases, then it should be more timely than the rumor mill. With proper dissemination to local practitioners and appropriate national coordination, lab surveillance data could be extremely beneficial in averting epidemics and lead to effective control and prevention measures. Several labs are currently developing web-based delivery systems for test results which will improve the timeliness and usefulness of diagnostic data for disease prevention.

Slaughter-based surveillance

Approximately 98% of commercially slaughtered hogs in the US are inspected by USDA's FSIS. Post-mortem inspection by FSIS VMO's leads to the condemnation of any carcass unfit for human consumption. Over 40 dispositions exist for classification of condemned carcasses. Monthly condemnation data could serve as the backbone for a slaughter-based active surveillance system.

Monthly totals of post-mortem condemnations due to erysipelas in market hogs was summarized for 1996-2002. Historical patterns show seasonal trends with peak number of condemnations occurring in winter months (November-January). As with the laboratory-based data, the July 2001 epidemic is clearly evident. However, erysipelas condemnations for January-March period were significantly higher than the 5 year historical average for those months. In all likelihood, this would have been considered an epidemic in its own right and warranted preventive measures which could have averted the July epidemic altogether.

For non-fatal conditions of finisher hogs, slaughter-based surveillance performs extremely well compared to the rumor mill and other surveillance systems evaluated in this exercise. It is the most representative with coverage of 98% of market hogs. It is the most sensitive, actually detecting a previous spike of cases 5-7 months not recognized by the other systems (rumor mill, Pathfinder, lab-based surveillance). It suffers somewhat in it's timeliness as there is at least an eight week lag from time of slaughter to data summary; although plans are underway to cut this lag time significantly.

Conclusions

Surveillance systems are more sensitive and timely than the rumor mill and could greatly improve the US pork industry's ability to detect epidemics. The creation of such systems should lead to effective control mechanisms. In this case, practitioners could have vaccinated pigs for erysipelas; producers could have been alerted to be

more watchful for clinical signs; pharmaceutical companies could have been warned so that vaccine production was ramped up; and education of producers and practitioners could have encouraged appropriate therapeutic regimens that optimize health of swine with human health risk of residues.