

PROTOTYPE DECISION SUPPORT SYSTEM FOR CONDUCTING OUTBREAK INVESTIGATIONS, RISK-BASED SURVEILLANCE PROGRAMS AND CHARACTERIZING RISK FACTORS FOR BETWEEN HERD SPREAD OF PSEUDORABIES VIRUS IN SWINE

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In 1989, a ten year effort to eradicate the pseudorabies virus (PRV) from U.S. swine populations was initiated. That effort is now well underway, and substantial progress has been made in our ability to eliminate PRV from swine herds. Lacking however, is the ability to characterize risk factors for the spread of PRV between herds. Last year alone, over 70% of all new herd outbreaks were attributed to unknown causes or area spread.

To reduce this 70% figure, several issues must be addressed: 1) an outbreak investigation protocol for consistent and comprehensive collection of new herd outbreak information by field epidemiologists must first be developed, and 2) greater uniformity must be achieved between states in regard to both outbreak investigation protocols and information collection/storage formats. Addressing these issues through an integrated information systems approach, is essential to establishing a dataset of sufficient size and depth to permit characterization of between herd spread risk factors.

Clearly we live in an era in which the ability to collect, store, and process tremendous volumes of information is unprecedented. Much of this ability is due to recent advances in computer hardware, software, and information management sciences. Information management technologies are of paramount concern to epidemiologists, for in few other disciplines does the ability to collect and assimilate large volumes of information have greater implications.

Despite widespread use of computer equipment and database systems in industry, government, and academia, the level of technology far exceeds the rate at which it has been incorporated into animal health and disease information systems. This gap will continue to widen for computer and information management sciences, both relatively new disciplines, continue to grow at almost logarithmic rates. Epidemiologists must continually stay abreast of the most recent information management theories, and continually test new strategies to improve the overall quality and accuracy of epidemiological data. In this paper, we utilize an integrated approach to prototype a pseudorabies (PRV) outbreak investigation and risk-based surveillance system that incorporates a category of Computer Based Information Systems (CBIS) known as Decision Support Systems (DSS).

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Outbreak investigations and risk factor characterization

For an outbreak investigation tool to be effective, and thus adopted, it is essential that it ask the right questions. Outbreak investigation protocols from ten major swine producing states, current scientific literature, the biosecurity section of the NAHMS National Swine Survey, and several PRV experts were consulted to develop a comprehensive set of outbreak investigation questions. An outbreak investigation questionnaire was subsequently constructed, field tested, and distributed to leading PRV experts for critical review.

The above questionnaire, was developed in an adaptive format which facilitates both data collection and transferral into a CBIS. "Adaptive format " in this case, refers to a line of questioning which changes based upon responses received. Data collection and transferral is facilitated by using a video display for data entry that is identical in appearance to the hard copy questionnaire (referred to as WYSIWYG, meaning "what you see is what you get"), and by establishing links for data storage in several mainstream database formats (Dbase, Paradox, Btrieve and ASCII).

Regulatory offices have the option of conducting investigations in either of two ways: 1) produce a hard copy version of the data entry screen (complete with adaptive format), use it as a questionnaire, and enter the data later, or 2) conduct the investigation with the aid of a laptop computer and enter data directly. The bottleneck of transferring hard copy to the database is minimized using the WYSIWYG approach. When a laptop is used, data entry bottleneck is all but eliminated. As mentioned, the data storage protocol is extremely versatile in that links to a several mainstream database structures are provided. Development and pooling of comprehensive datasets from any number of states can subsequently occur, and analyses of risk factors for between herd spread of PRV becomes a possibility.

The outbreak investigation protocol uses a modular approach to assess broad categories of PRV risks for a given swine operation. Within each module, specific lines of questioning are pursued with increasing level of detail based upon responses received. Categories upon which herd risk modules are based include: biosecurity, new herd addition protocols, environmental concerns, animal vectors, interaction with other swine producers, adjacent swine herds and dead animal disposal protocols.

Decision support systems

Assistance to field epidemiologists and producers in assessing PRV risk factors for individual herds, and to state officials in establishing risk-based surveillance programs, can be provided by incorporating DSS techniques into an integrated PRV information system. DSS is a category of CBIS originally developed to assist professionals in solving problems having large structured and unstructured components. The systems are designed to manage the structured aspect of complex problems by taking data, and extracting from it, meaningful information and relationships. The professional is subsequently free to devote time and energy into solving the more difficult unstructured component of the problem. By using DSS to distill pertinent information from investigation data and establish relationships between key facts, greater consistency and accuracy can be achieved in making decisions regarding the cause of a new herd outbreak.

A decision support system, to work in tandem with the outbreak investigation questionnaire, is currently being developed. The PRV DSS extracts key responses, identifies important relationships, and categorizes/prioritizes risks factors for a given herd to PRV

entry. The DSS will, in short, provide a risk profile of the swine operation, which can be used for determining the most likely portal of entry for PRV into the herd.

Risk-based surveillance

It states that test herds annually for PRV, a modified version of the outbreak questionnaire may be used for conducting a risk assessment. The DDS is then used to analyze the responses and establish a risk index for a negative herd. State regulatory officials can use indices to apply a "management by exception" strategy to monitoring and surveillance activities. Herds at greatest risk of infection can be targeted for additional monitoring, or for development of risk reduction strategies. Provided an accurate risk assessment methodology is available, a risk based surveillance system would be both resource and personnel efficient.

SUMMARY

A well-designed information system can greatly enhance the effectiveness of a disease control and eradication program. Using a systems approach, the quality of epidemiological data for risk factor characterization, or for decision support system development, is greatly improved. Information collected at the farm level, can be used at the state level, for constructing risk-based surveillance systems or targeting individual herds for risk reduction strategies. Through thoughtful system design, a single, comprehensive dataset, having great utility, can be established.

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