EPIDEMIOLOGICAL CONSIDERATIONS IN THE SURVEILLANCE AND CONTROL OF FMD IN SOUTHEAST ASIA

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Abstract

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If control and ultimately eradication of FMD is going to be achieved in Southeast Asia, regional co-operation between the various countries that share common borders will be required. Control programmes need to be flexible so that they can target the issues that are likely to give the greatest improvements in control with the available resources. In order to design these dynamic control programmes, communications must be strengthened, epidemiologically sound information needs to be routinely collected and analyses must be conducted. Control effectiveness should be monitored so that weaknesses in present programmes can be identified. Short-term and long-term strategies must be developed concurrently so that control programmes can readily proceed from one stage to the next.

1. INTRODUCTION

Traditional foot-and-mouth disease (FMD) control in endemic countries typically involves the implementation of phased programmes incorporating mass vaccination and various movement control measures. The goal is usually to reduce the number of outbreaks to the point where FMD-free zones can be established, maintained and gradually increased in size until the whole country or region is free.

The objective of the mass vaccination programme is to immunize a sufficiently high proportion of the susceptible farm animal population on a regular basis, such that herd immunity effectively protects the entire population. In practice, the aim should be a minimum of 80% vaccination coverage. The vaccine used should be of high quality, contain sufficient antigenic payload of the particular FMD vaccine strain(s) appropriate for the region and be safe (i.e. contain no non-inactivated FMD particles — which effectively means formalin inactivation should no longer be used). Vaccine should only be administered by trained vaccinators and attention should be given to the cold chain. Young animals should be given two vaccinations approximately one month apart, once they reach about 3 months of age (i.e. once maternal immunity has waned). From then on, they should be given a booster dose on a regular basis depending on the duration of immunity. Additional ring vaccination can be applied around the affected zone in the face of an outbreak.

The objectives of movement control measures are to prevent the introduction of infection into free areas, to ensure infection does not spread from outbreak zones, and generally to limit the movements of animals of unknown vaccination or infection status. Permission to move animals may be subject to a vaccination certificate. Quarantine stations may be established at strategic locations to observe and/or vaccinate animals of unknown status.

In addition to these measures, outbreak investigations by trained investigators can help identify weaknesses in vaccination and movement control programmes.

2. CONSTRAINTS IN SOUTHEAST ASIA

There are several constraints in Southeast Asia that are limiting the adoption of control measures against FMD. These include:

- Either insufficient vaccine is produced to meet the demand for mass vaccination campaigns or else the countries cannot afford to purchase the number of doses required.
- Movement control is extremely difficult to implement, as animal trading is viewed as a fundamental component of village-based economies.

- Government veterinary services often do not have sufficient resources to implement the measures.
- Some of the countries in the region have long shared borders with other endemic countries.
- There is generally poor understanding of the disease by farmers and traders.

3. EPIDEMIOLOGICAL APPROACH

Given the above constraints, the only way to make progress is to adopt an epidemiological-based approach that will lead to better targeting of the available resources. The motive for this approach is the premise that knowledge of disease processes can be derived from information (that is extracted from raw data via analysis) when it is coupled with experience. Experience comes from having feedback mechanisms that continually evaluate the effectiveness of existing control programmes. Hence, an epidemiological approach must be an information-based approach.

FMD is recognized as a regional problem and, therefore, will require a co-ordinated response. The establishment of the OIE Regional Co-ordination Unit (RCU) and Reference Laboratory are thus of crucial importance to the Region, as has been the case with the PANAFTOSA centre in Latin America.

Communication between field staff and national state veterinary offices as well as between countries and the Co-ordination Unit will need to be strengthened to facilitate the flow of information. It is stressed, that information flow should be two-way, so that there is both reliable surveillance data coming from the field and at the same time, field staff are kept up-to-date with the national and regional situations. Therefore, investments in improving communication systems are important, including telephone, facsimile and the emerging Internet-based technologies (e.g. E-mail, News groups and Web-based reporting systems).

In order to capture the field and laboratory investigations and allow a broad range of analyses to be carried out, an information system needs to be developed. This should incorporate a geographic information system (GIS) to permit spatial analyses to be conducted. For most of Southeast Asia, the village is the key unit of interest, therefore, data collected should primarily be at a village-level. The type of data collected should include outbreak data (data about actual outbreaks), demographic (information about the animal population in the area), spatial data (geographical co-ordinates) and information on suspected risk factors. A suggested list of data items to consider include:

- Name of village and geographical location (easting & northing or latitude & longitude)
- Dominant production system (e.g. rice crops)
- Number of animals at risk by species
- Number of animals with disease by species
- Time course of the epidemic
- Virus type and strain
- Village vaccination history
- Degree of movement of livestock
- Interaction with neighbouring villages
- When animals last came into the village
- Whether initial disease was in moved or resident animals
- Proximity to markets / transportation routes / neighbouring country border.

The same information system should be used throughout the particular state veterinary service. Wherever possible, data entry should be conducted as close to the 'front-line' as possible, whether it is the field or the laboratory. This will give the front-line staff more 'ownership' of the system and ensure the data is up-to-date. If computer networks or communications systems permit, the main database should be at a central location, but with remote access by multiple concurrent personnel provided. Such a design will ensure, that there is only one copy of the database.

It is important that negative reports as well as positive results be recorded. Historically, very little statistical 'control' information is ever documented (i.e. information about villages in the

outbreak zone that are not affected). This makes the calculation of true incidence rates extremely difficult.

Effort should be made to acquire or build national and regional GIS datasets of features such as villages (names and locations), transport corridors (roads, railways), livestock markets, border crossings etc. In many countries, these types of digital files are already available, perhaps within other Government departments. If not, there are several options for building them, including digitizing of paper maps, equipping field staff with global positioning systems (GPS) or conducting remote sensing (involving the interpretation of satellite imagery).

Assembling these national datasets may seem like a daunting task, but the long-term advantages are well worth it. Similarly, when starting out with a new database system, the rewards in terms of the ability to conduct sophisticated analyses may seem a long way off. However it is important that a start is made. Effort should go into keeping field and laboratory staff fully informed with regular feedback, so that staff enthusiasm does not diminish, especially, when it may appear that unimportant data is requested. Making data recording easy and exciting, such as through the use of well-constructed Web pages may be one solution (see Fig. 1. showing a map-based recording system).

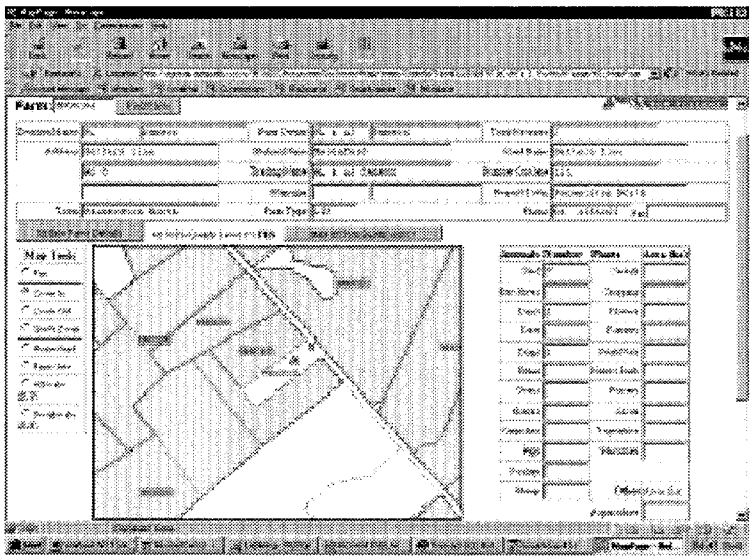

FIG. 1. An example of a map-based Web reporting system, designed for capturing information about farms in New Zealand.

When the data collected through outbreak investigations and control programme implementation is combined with the information held in the national spatial datasets, the investigative power becomes significant. The capabilities include:

- Calculation of true incidence rates or disease prevalence, as denominator data is available.
- The links between disease control activities and FMD incidence can be identified.
- Weaknesses in control programmes become obvious.
- A broad range of potential risk factors can be included in the analyses.
- Local or national economic cost–benefit studies become possible.
- Planning for future control programmes is facilitated.

4. AN EXAMPLE FROM THAILAND

Using data collected by the Department of Livestock Development (DLD), Thailand over a three year period from 1995–1997, Dr. Tippawon Teekayuwat and Dr. Dirk Pfeiffer, Massey University, have developed a prototype GIS to demonstrate the range of analyses that can be conducted when routine data is combined with national spatial datasets. Figures 2–5 illustrate descriptive, analytical and predictive capabilities.

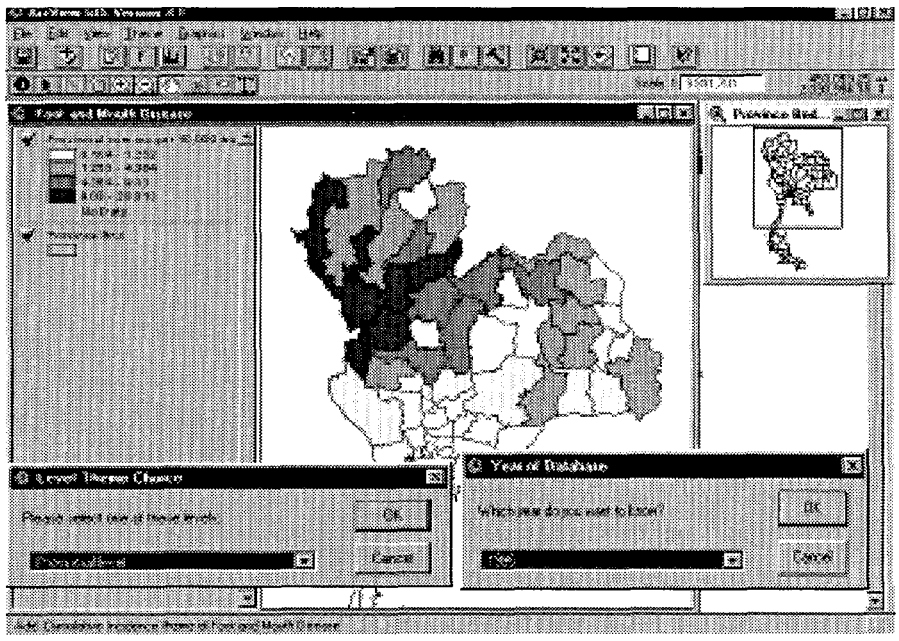

FIG. 2. Screen presenting a choroplethic map of cumulative incidence of FMD at a provincial level for a selected year.

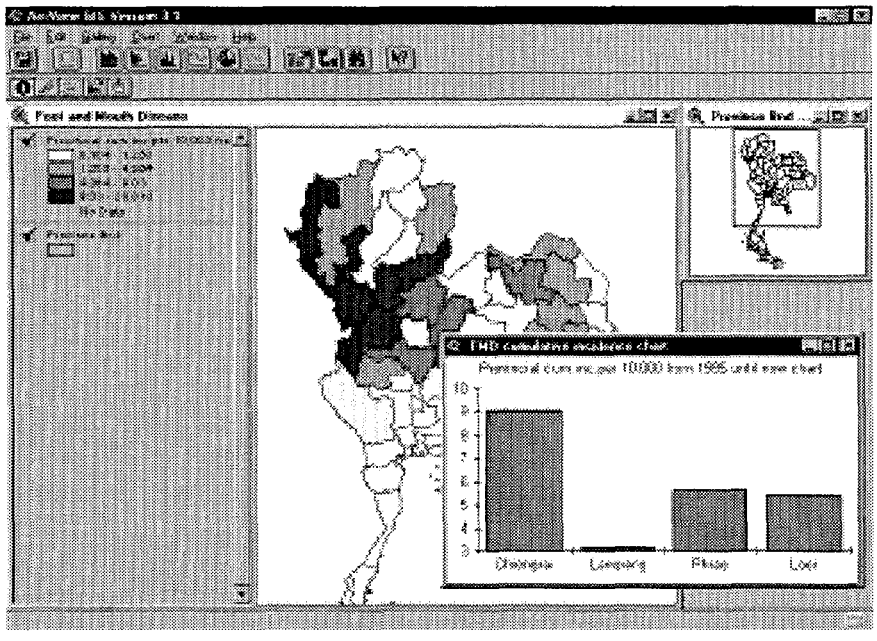

FIG. 3. Screen showing graph of provincial cumulative incidence for selected provinces.

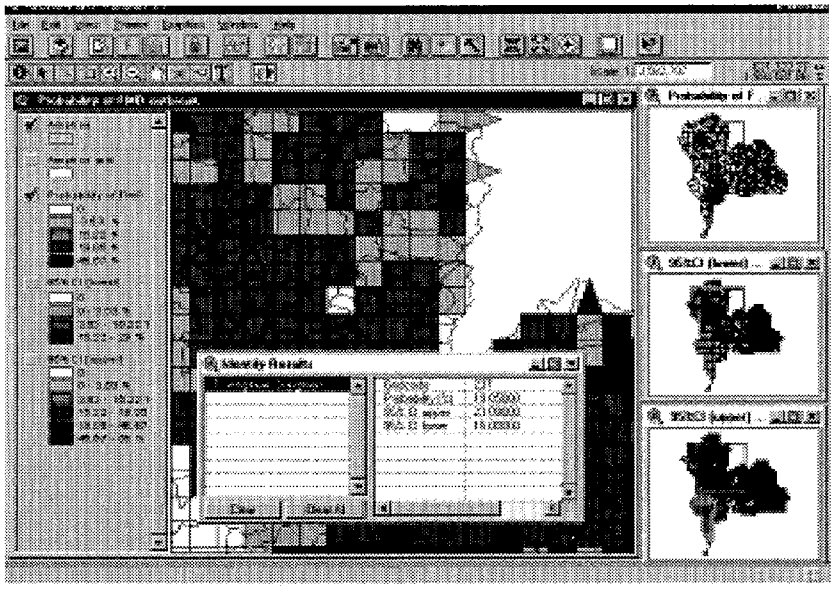

FIG. 4. Grid map of the probability of an FMD outbreak at an Amphoe level, including 95% confidence intervals, based on classification and regression tree (CART) analysis.

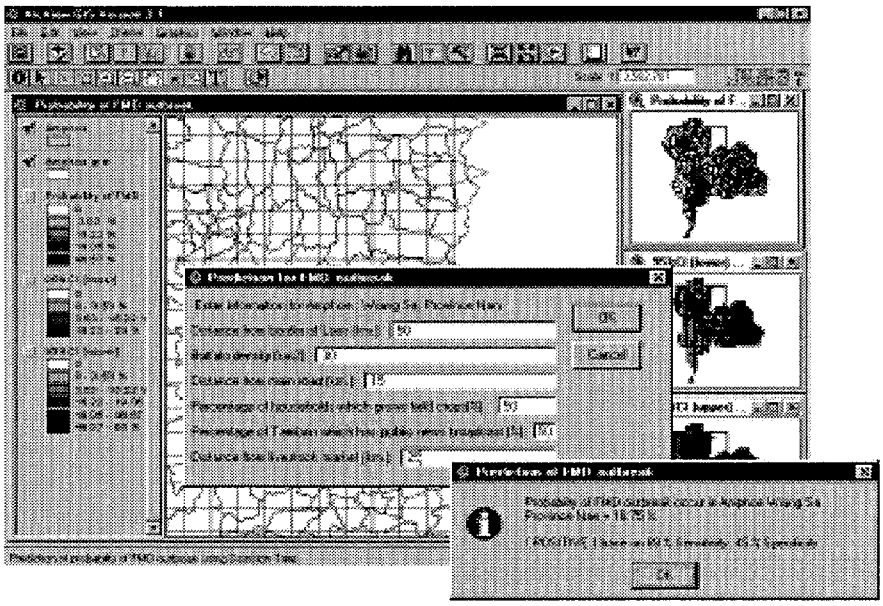

FIG. 5. Screen illustrating predictive capability. The user selects an Amphoe for investigation. The user can then examine and modify the values of the significant independent variables and the system will calculate the probability of an outbreak of FMD in the ensuing year.

5. DISCUSSION

This paper encourages an epidemiological approach to FMD control in Southeast Asia. The components of this include the OIE RCU and Reference Laboratory, improved communication and information systems. This will require some investment in the establishment of databases, communication systems and training in epidemiology for key staff. However, the payback over the medium and longer terms should be significant. The outcomes will be the ability to identify important risk factors for FMD in the various zones of Southeast Asia, the ability to target risk factors that will provide the most improvement in disease situations using existing resources and improved feedback from control activities (including the identification of successes and failures).

In order to capitalize on these benefits, control programmes must be flexible and innovative, so that different risk factors can be targeted at the different stages of the overall FMD control and eradication programme in Southeast Asia. Veterinary services must be creative in their thinking and be prepared to work with other Government Departments and Agencies. For example, some of the national datasets mentioned above, such as a village database, could serve multiple uses. Similarly, FMD control at the village level could be combined with other extension activities, e.g. haemorrhagic septicaemia (HS) vaccination.

Planning and data collection to support future operations should be conducted concurrently with the implementation of short-term control activities. In this way, 'down-time' between the various phases will be minimized, and continual progress will be more achievable. The DLD example shows that meaningful information can be extracted within 2–3 years of data collection.

In conclusion, the experiences from Latin America prove that FMD eradication can be achieved. There, the PANAFTOSA centre provided regional co-ordination and acted as the main data warehouse. In addition, it conducted viral, diagnostic and epidemiological research. Meanwhile, the countries in the region demonstrated strong national commitment to FMD eradication. Other key points are that independent quality control of vaccine efficacy was established, complete and regular vaccination coverage using trained vaccinators was implemented in various zones and movement control measures were consistently applied. As success was achieved, initially in Chile, but more recently in Uruguay, Argentina and southern Brazil, the emphasis has progressively shifted from vaccination to stamping-out. The rewards include an expanding export trade in animal products into markets that were previously closed.

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