

CHAPTER 6

THE ACTION PLAN AND RELATED ISSUES

The U.S. strategy dealing with a FMD outbreak is described in the “Foot-and-Mouth Disease Emergency Disease Guidelines,” published by APHIS in October 1991. These guidelines are the basis for the actions to be taken by the Animal Health Branch of CDFA, and APHIS offices at the national, regional and state levels.

The U.S. operates a two-tier system of defense against FMD. The first tier involves border controls of travelers and imports. The USDA defines protocols covering the importation of live animals and animal products into the U.S., and inspects imports both in the country of origin and the U.S. In recent years import policies have moved away from the concept of “zero risk” to one of risk assessment. Controls of animals and animal products are very strict, particularly in the country of origin, and it is unlikely that the FMD virus could be introduced through this route. Alternative paths through which FMD could be introduced are travelers who visited farms in infected countries; smuggling of infected animal products, particularly meat products; garbage transported in planes and ships; and economic terrorism (Heron and Suther, 1983; Forbes et al, 1994). All travelers who visited premises with susceptible animals in FMD-infected countries are supposed to go through an inspection and disinfection upon entering the U.S. There is anecdotal evidence, though, that the efficiency of these controls could be improved.

The second tier of defense is based on the surveillance and monitoring of existing herds, and rapid intervention in case of an outbreak. In such an event, the U.S. would follow a “stamping-out” policy. The major components of this policy involve slaughter and burning or burial of all infected and exposed (even though asymptomatic) susceptible animals in the quarantine area, followed by cleaning and disinfection (C&D) of all exposed premises. The action plan includes vaccination as an option when:

- The disease has not been contained within six months of the outbreak, or other appropriate time based on the situation.
- The outbreak reaches epidemic proportions—25% of the susceptible population in areas of high density livestock.
- The cost/benefit ratio of the slaughter program approaches a 1 to 2 ratio.
- FMD becomes endemic in wildlife in three or more states.
- Legal restrictions by U.S. courts prevent carrying out the slaughter program.

The most important factor in containing the spread of a FMD outbreak is rapid and efficient intervention by state and federal animal health services. The efficiency of their actions depends on four factors: (1) preparedness for dealing with an emergency, (2) early diagnosis, (3) timely and adequate access to financial as well as human and physical resources, and (4) support from other civil and military authorities, private veterinarians, processing industries—and, in particular, dairy and livestock producers.

The clinical signs of FMD are easily confused with other diseases such as vesicular stomatitis, vesicular exanthema and swine vesicular disease. Since these diseases are present in the U.S., although with low prevalence, it is likely that FMD would not be properly identified at the start of the outbreak. One of the major problems in identifying a FMD outbreak is that any farm in the nation with animals showing vesicular lesions is strictly quarantined until the field diagnosis can be verified by the Foreign Animal Disease Diagnostic Laboratory (FADDL) at Plum Island. Because of the economic losses caused by such a quarantine, it is believed that some producers do not report vesicular diseases—assuming that it is vesicular stomatitis, and that the infected animals will heal in two weeks.

The diagnosis of FMD always requires laboratory tests to differentiate it from other vesicular conditions. These tests are carried out exclusively in the Plum Island laboratory. Since all samples have to be transported to the east coast, transportation arrangements are crucial in the early confirmation of the disease. If a plane is chartered to take the samples, confirmation could be obtained in less than 24 hours but if the samples are transported in commercial carriers, confirmation could take two or three days, depending on the time of day samples are collected, flight connections and weather.

The Chief of FADDL immediately informs the emergency program staff and APHIS Veterinary Services of diagnostic results. The information is usually passed on by phone to USDA personnel in the state who, in turn, inform state officials. There is consensus among authorities of Animal Health Branch (CDFA) that this process works reasonably well, and that confirmation of a suspected case would not be delayed by breaks in the information channels.

As soon as FMD is suspected in a farm, the farmer is asked to list all movements in and out of the premises during the previous 21 days (APHIS, 1991). Studies conducted in New Zealand and The Netherlands suggest that completion of such a list is very difficult under normal circumstances and almost impossible during an emergency (Sanson et al., 1993; Nielen et al., 1996).

In Ontario, Canada, a comprehensive database containing information related to the livestock industry is being set up to reduce this deficiency (Kelton and Lissenmore, 1997; Goodall et al., 1997). This information combined with farm registration of pigs and identification of main routes of regular contacts (veterinarians, AI technicians, etc.) would be used in defining the initial quarantine area. The Netherlands has a central registration system for cattle. California should discuss with producers and the industry the means for gathering information about animal movements and routes. The

database also should contain information on routes of regular contacts such as veterinarians, milk trucks or AI technicians. The arrangements could involve a public organization, a private organization such as DHIA (dairy herd improvement association), or individual producers.

Depopulation of infected and exposed premises

Under the stamping-out policy all infected and exposed animals should be killed as soon as possible and their carcasses disposed of in a secure manner. Implementation of this policy in the high density animal conditions of the South Valley could present several problems:

- The best methods for depopulation of infected and exposed premises and of carcass disposal are uncertain.
- Timely depopulation and C&D of premises in the quarantine area may require a volume of supplies too large to be obtained on short notice.
- Resources to compensate producers for the destroyed animals may not be available in a timely manner.
- Quarantines may be difficult to enforce.

The action plan states that in disposing of infected and diagnostic animals, all precautions should be observed both to prevent disease spread and to comply with environmental restrictions. Even though Special Order 9 authorizes the governor to overrule environmental regulations following an emergency declaration, public opinion and lack of knowledge of the long term environmental impacts of alternative disposal methods could delay depopulation. It is expected that, following an emergency declaration, EPA would not challenge the state's authority. In the past, EPA has granted temporary exceptions to environmental regulations in order to deal with outbreaks of exotic animal diseases.

There has been no evaluation of the efficiency of alternative procedures of killing a large number of animals in a very short period of time and disposing of the carcasses. It is likely that several procedures would have to be used depending on the particular circumstances of each premise.

Advanced evaluation of depopulation procedures could determine the feasibility of the stamping-out policy, and reduce the depopulation time.

The greatest logistical problem of a stamping-out policy is disposing of the carcasses. According to the APHIS guidelines, burial is the preferred method and should be used whenever practical. The alternative method is burning. Burial of a large number of animals will come under the jurisdiction of state and federal environmental laws and regulations (APHIS, 1991). Burying the carcasses in the South Valley would require excavation of miles of trenches, which could not be disturbed for several years. This would impose a major cost on producers as the land would be lost for most productive uses. It is unclear at this time whether the dairies could still comply with local environmental regulations on manure disposal in the area not used in the trenches.

Burning the carcasses would require massive amounts of wood or other fuel, which would probably be difficult to acquire in a short time. Use of an air curtain, assuming that enough equipment is available, would reduce the quantity of fuel needed and the environmental impact of massive burnings but would increase the burning time. Disposal in landfills would be limited because the carcasses have to be mixed with waste in a fixed proportion, and there is also the issue of the cost imposed on local communities by faster filling of the landfill.

Since carcasses cannot be left to rot in the open, the speed of depopulation is constrained by disposal capacity—and the longer depopulation is delayed, the greater the probability of continued spread of disease. A cost-benefit analysis of alternative methods for disposal in California should be conducted to determine the optimal investment in disposal capacity.

Exposed animals showing no signs of infection should also be slaughtered, but under the USDA plan they can be diverted to human consumption or protein utilization. However, the slaughter capacity in the South Valley probably would not be enough to process the required number of animals in a timely manner. Also, a major obstacle to depopulation of exposed herds could be lack of political or financial support for killing a large number of apparently healthy animals.

Preventing indirect spread of virus

The objective of cleaning and disinfection (C&D) is to eliminate the virus from contaminated premises to prevent virus spread by indirect contacts. Two major types of C&D would have to be performed during an outbreak: (1) infected and exposed premises (farms, processing plants, slaughterhouses, etc.), and (2) vehicles and travelers.

If burning is the carcass disposal method, C&D of premises would require two sets of crews, one for operation of heavy machinery to handle burning materials and carcass disposal, and one for disinfection by hand. If burial is the disposal method, an additional set would be required because the animals have to be herded into the trenches, and each carcass has to be opened in the belly. In the event that burning with air curtain is the disposal method, the composition of the crews would be: two site coordinators, three payloaders, five truck drivers, two air curtain operators (or fire operators) and eight ground cleaners. Working 12 hours a day, such crew would need four days for C&D of a small dairy (500 cows) and 10 days for a large dairy (2,000 cows).⁷ Since most premises handling livestock and livestock products would close or reduce the scale of operation during the quarantine, labor availability is not expected to be a problem.

Cleaning and disinfection of dairy plants and slaughterhouses in the quarantine area is a very complex process. These facilities usually have several interconnected and/or sequential processes, in-

⁷ For a description of the manpower required with other disposal methods, see Appendix C.

volving various buildings. Cleaning these plants would probably involve both fumigation and disinfection. A large crew, probably a few hundred workers, would be required to complete the work in about a week. Due to the complexities of the plant design and operation, even planning the C&D process could take a few days.

While being disinfected, milk plants would receive either smaller volumes than normal or no milk at all. Milk plants in the South Valley work together to cover temporary reductions in the operation of individual plants; however, this can be maintained only for about one day of operation. Meanwhile, the supply of milk to processing plants would fall as depopulation reduces the number of milking cows in the quarantine area. The likely scenario would be an excess supply of milk in the early days of the outbreak because milk originating in the South Valley could only be consumed in the quarantine area. Then, as depopulation advances, there would likely be a deficit of fluid milk because dairies cannot be repopulated until the quarantine is lifted. In order to minimize the lost revenue and to maintain their market share, processing plants might be forced to import milk from outside the quarantine area. Advanced planning for C&D of milk plants in the area would reduce disruption to the dairy industry.

A major issue to be dealt with will be contamination of urban areas within the quarantine zone. The massive movement of virus in the air may contaminate urban areas in the South Valley. Even though FMD does not affect humans, people and vehicles moving out of the quarantine area conceivably could carry the virus and spread the outbreak. Vehicles should be cleaned and disinfected when they exit infected premises and after unloading infected animals or animal products, as well as when they leave the quarantine area. Enforcing these procedures would require the establishment of a considerable number of disinfection points in the South Valley and could become extremely expensive.

Financial resources

Availability of financial resources depends on the amounts required and the urgency of the situation. Relatively small amounts, up to \$1 million, can be accessed immediately by both CDFA and APHIS. Access to larger amounts of financial and human resources to deal with an outbreak requires state and/or federal emergency declarations. Under normal conditions, these could be issued within hours of confirmation of the outbreak. Even if problems arise, such as lack of consensus on the proposed action, it is not expected that this delay would be substantial. However, in some cases, a federal declaration has been delayed for a relatively long period of time. For example, in the 1971-1974 epidemic of Newcastle disease the emergency was declared in approximately 100 days, and in the 1983-1984 epidemic of avian influenza it took approximately 180 days.⁸

⁸ Personal communication from CDFA and Veterinary Services, APHIS.

The U.S. Secretary of Agriculture has authority to declare an emergency when a disease exists that threatens the nation's livestock or poultry industries. When the deputy administrator of Veterinary Services and the administrator of APHIS concur with the diagnosis and the proposed course of action, the assistant secretary for Marketing and Inspection Services should be notified and a Secretarial declaration of a National Emergency requested. Before the formal declaration of an emergency, federal officials cooperate where possible, but will not obligate federal funds for disease control and eradication activities (APHIS, 1991). The emergency declaration does not oblige FEMA to participate or contribute funds.

After the declaration of an extraordinary national emergency, APHIS can use up to \$10 million from the CCC. However, due to the size of dairy farms in the South Valley, this would not be enough to contain an outbreak (See Chapter 8, Estimation of the Outbreak Cost). Thus, larger amounts must be authorized either by the state legislature or Congress. The time required to obtain this authorization will depend on the capability of CDFA and/or APHIS to inform political decision makers—but, considering the speed with which FMD spreads, it is likely to be too long. As the simulations show, delay of three days in starting the eradication would have substantial negative consequences.

Factors that could delay the allocation of funds are lack of consensus on the feasibility of eradicating the disease at a reasonable cost, and lack of understanding by lawmakers and executive officers of the veterinary and economic issues involved.

Issues of payment

Under provisions of Title 9 (CFR), Part 53, the U.S. Department of Agriculture has the authority to pay up to 100% of the expenses of the purchase, destruction and disposition of animals and materials required to be destroyed because they were contaminated by or exposed to FMD. The USDA also pays for cleaning and disinfection of infected premises. Compensation payments depend on the availability of funds. (APHIS, 1991).

Indemnification payments are a necessary component of any effective control program to eradicate FMD. Three reasons are cited to justify a program of indemnification:

1. During an outbreak, slaughter is equivalent to expropriation of the animals. From the perspective of an individual livestock producer there is no veterinary or economic need to slaughter infected animals since after a short period—between two to three weeks—most would become productive again, even though some may suffer a permanent loss of productivity. Stamping-out is required to eradicate the outbreak so that both consumers and producers can share the benefits of a FMD-free country. Thus, in economic terms, depopulation is a measure taken to eliminate the externality caused by the high infectiveness of FMD.
2. The effectiveness of the eradication campaign depends on strong and active support of the entire livestock industry. Without indemnification, the industry would not collaborate in the eradication

effort, reducing the probability of success.

3. Political pressure would force the government to make indemnity payments in any case.

Even though it is agreed that the destroyed animals and materials must be paid for, it may not be clear to whom indemnity payments should be made, or what appraisal method should be used. Aulaqui and Sundquist (1979) identified six criteria to be met by an indemnification program. It should:

- Obtain full cooperation of the livestock industry.
- Be administratively feasible.
- Have payment rates and procedures that can be implemented within required time limits.
- Be economically sound in terms of appropriate cost-minimization criteria.
- Be socially and politically acceptable.
- Be flexible enough to allow for modification as the situation warrants.

Under current regulations, indemnity payments cover only the direct costs of animals and materials destroyed. It has been well documented, however, that the economic losses may exceed by several times the costs covered by the indemnity payments, as a consequence of trade disruptions (Berentsen et al., 1990). These “consequential losses” may be incurred not only by livestock producers but also by all industries linked directly and indirectly. It is impossible, however, to define and quantify consequential losses with any degree of accuracy. Therefore, they should be addressed by other measures such as those used to provide relief from natural disasters—low cost loans, tax relief, special unemployment payments, etc.

Given the expected magnitude of the consequential losses, it may be difficult for the livestock and dairy industries to return to business after the lifting of the quarantines. The industry should study the creation of a self insurance scheme to cover the indemnification of consequential losses. The basis could be a fund that would be invested in the financial markets until needed. Because of the low probability of an outbreak, the initial investment could be relatively small and constituted over a number of years.

Appraisal procedures

All animals, products and materials to be destroyed because of exposure or contamination by FMD virus must be appraised prior to the beginning of depopulation procedures. Appraisals must reflect the interests of both the owner and the state and the federal governments, and also must be consistent with market values. Owners or their representatives should participate in the appraisal process (APHIS, 1991).

In setting the indemnity payments, three problems must be considered: (1) the payments should not be so low that producers' participation is discouraged, (2) the payments should not be so high that they encourage producers to introduce susceptible animals into the quarantine areas, and (3) the payments should induce producers to maintain their animals in the premises until depopulation can be started (Aulaqui and Sundquist, 1979).

There are several methods for appraising livestock but most fall into two broad classifications: market value method and productivity method. Current legislation calls for compensation of destroyed animals and animal products on the basis of "fair market value," but this value is not defined in the legislation. At least two prices can be used in the appraisal process: prices quoted in national exchange markets for products of similar quality and grade, or local prices for other products. Since it is expected that markets and pricing mechanisms would be seriously disrupted by a FMD outbreak, prices immediately prior to the outbreak should be used.

The productivity method basically involves calculation of the discounted stream of net revenues generated by an asset. This method should be used when market prices are not readily available or markets were out of equilibrium prior to the outbreak. Since this method is more arbitrary than the market value method, the latter should be used whenever possible.

Quarantine procedures

Federal and state quarantines are one of the most effective measures for stopping the spread of highly contagious livestock diseases. When FMD is suspected, a farm quarantine should be issued by the investigating veterinarian or foreign animal disease diagnostician. When FMD is confirmed, the premises must be quarantined or, if previously in effect, the quarantine must be amended to indicate the specific disease and number of species and animals involved.

Monitoring measures should be instituted to ensure day and night compliance with the terms of the quarantine until disposal of the animals is complete and the contaminated portions of the premises have received a thorough cleaning and soaking with an approved disinfectant (APHIS, 1991). Enforcement of the quarantine would require the presence of law enforcement agents at the farm gates and at all checkpoints.

Security checkpoints should be located on all rural roads where they enter the quarantine zone. At these checkpoints, all vehicles suspected of containing farm-related products, materials, or animals should be stopped. Movements within the quarantine zone are allowed. Farm products from premises within the quarantine area but not known to contain infected or exposed animals may be marketed on a permit basis. Checkpoints should be manned 24 hours a day, and maintained for 30 days after the last infected animal is depopulated—or until the situation indicates they are no longer needed.

As soon as the first case of FMD is confirmed, every effort should be made to stop the movement of

all susceptible livestock from and within a large area. Until the extent and distribution of the outbreak can be determined, this area may include one or more states. Within seven to 14 days and after movements of all possible exposed animals have been traced, the size of the quarantine area may be reduced to an area with a radius 10 to 25 miles from the affected premises, or other distance as determined necessary (APHIS, 1991).

Such a large effort could probably exceed the resources available from local enforcement agencies and most probably would require collaboration from the National Guard. Even though the quarantines could be in place within 48 hours of mobilizing the National Guard, it is expected that three more days would be required to train the law enforcement personnel on the procedures of the quarantine. Until that time enforcement will rely on local agencies. The effectiveness of the quarantines also will depend on the availability of resources.

For further surveillance, control, and eradication, the quarantine area would be subdivided into: (1) a high-risk zone extending three to five miles beyond all known infected herds, and (2) a buffer zone extending from the periphery of the high-risk zone to the outer perimeter of the quarantine area—about 10 to 25 miles from the affected premises. Animals moving out of the buffer zone would be subject to the same restrictions as those in the high-risk zone, except for a seven to 14 day quarantine and observation period before they are allowed into non-infected areas. (APHIS, 1991).

These quarantine areas are similar to those used in other countries (Garner, 1992; Moutou and Durand, 1994; Maragon et al., 1994). In the EU two restricted areas are minimally required. The smallest area, the protection zone, has a minimum radius of 3 km around the infected premises; the surrounding area, the surveillance zone, has a minimum of 10 km (Nielen et al., 1996). In New Zealand, the high risk area—where a complete cessation of animal movements is enforced—should have a radius of 3 km while the infected area should have a radius of at least 25 km, and should include enough meat and dairy processing capacity to process all animal products originating in the area. A recent study, however, claims that the buffer zone should be expanded. Sanson et al. (1993) argue that an infected area with a radius of at least 25 km would not contain the majority of all high risk contacts in New Zealand. The information collected for this study indicates that this could also be the case in the South Valley.

Definition of the size of the high risk and the buffer zones involves a crucial trade-off. If these areas are too small, infected animals may be allowed to move to less controlled areas; however, an expansion of the controlled areas increases the manpower required to monitor all premises, and multiplies the disruption to economic activities.

In the high-risk area, security would be accomplished primarily by patrols which should stop all vehicles that might contain farm-related products, materials or animals. These patrols should be maintained on a 24 hour basis for 30 days, or for such period as deemed necessary (APHIS, 1991). Daily inspections of all non-infected herds in the high-risk zone would continue for 30 days follow-

ing depopulation of the last affected herd. Weekly inspections would then be conducted until the quarantine is released. The quarantine may be lifted from the area after the last affected premise is ready for quarantine release—120 days after its cleaning and disinfection—and all other eradication measures have been completed (APHIS, 1991). Meanwhile, animals in the buffer zone should be inspected at least twice weekly.

When FMD-suspicious animals are found, the inspection veterinarian should not visit other premises for 48 hours (APHIS, 1991). Premises adjacent to affected sites are considered exposed, and animals are considered exposed when there has been direct contact—such as over a fence, or location downwind at a distance such that airborne transmission is possible—during the preceding 10 days, or longer if circumstances dictate. Contact premises must be handled in the same manner as affected premises. Animals moved from affected premises to other premises during the 10 days preceding the onset of the disease—longer if circumstances dictate—constitute a direct contact exposure. The receiving premises must be handled in the same manner as affected premises. Premises receiving animals from affected premises 11 days to 3 weeks before the onset of the disease should be placed under quarantine and inspected daily for 21 days.

Affected premises should remain free of all susceptible animals for at least 30 days. Following this period, a few susceptible animals should be placed on the premises. If no FMD is observed after a 30 day trial period, then the quarantine may be released.

All stockyards, auction markets, sales, fairs, assembly points and other livestock points of concentration, both in the quarantine and surrounding areas as determined by an evaluation of livestock movements, should be immediately closed by state authorities.

Slaughterhouses in the quarantine area would be allowed to continue operating, but all animals on the premises should be inspected antemortem and postmortem. If FMD is confirmed in the slaughterhouse, it should cease operations immediately. After being cleaned and disinfected the plant may resume operations, but pens that contained infected animals will remain under seal for 90 days.

Controls on animal products

Animals exposed to the FMD virus but which are clinically healthy may be directed to slaughter for protein utilization, according to the APHIS plan. The feasibility of this procedure will depend on the availability of secure transport vehicles, properly located slaughter plants, and adequate processing and storage capacities. Fresh, chilled and frozen de-boned meat and meat products from normal cattle, swine, sheep, and goats—even those considered exposed to FMD virus but not showing signs of infection—can be marketed for human consumption, but only within the region under FMD quarantine. FMD virus contained in the muscle of susceptible animals is inactivated by the formation of lactic acid after death, provided the meat is not chilled or frozen immediately after slaughter. The virus, however, is not inactivated in lymph node tissue or bone marrow (APHIS, 1991). The EU

started importing South American beef treated in this manner (i.e., deboned and matured) after the 1967 epidemic in the United Kingdom, and no outbreaks have been traced to these imports in the last three decades.

The FMD virus is well protected within certain cellular components of milk. Milk from normal lactating cows, except those known to be infected with the FMD virus, may be transported from the quarantine area to officially designated processing plants. Milk marketing should be in non-livestock areas, and restricted to the quarantine area. The FMD virus is inactivated by ultra-high temperature (UHT) pasteurization (2.5 seconds at 148 degrees Celsius; 298 degrees Fahrenheit). Only one plant in the Los Angeles basin is equipped for UHT of relatively large volumes of milk. Some plants in the South Valley have a small capacity for UHT. Because of this reduced capacity, UHT is not an option unless the Chino Valley is included in the quarantine area. When UHT is not possible, regular pasteurization should help reduce virus concentration. Fluid milk from the South Valley would be allowed into the Los Angeles basin only if the outbreak included this area. Even though the volume of milk to be processed would be significantly larger, the combined capacity of the plants in both areas should be enough to process all the milk produced in the region.

Every effort should be made to avoid using milk as livestock feed. Milk from known infected cows should be treated before disposal (APHIS, 1991). Milk from adjacent dairies in the quarantine area may be moved to officially designated plants. Since the FMD virus is present in the milk before the onset of clinical signs, trucks should be cleaned and disinfected before entering and after leaving every premise in the quarantine area. Even if enough washing capacity is available, the hauling cost could increase by up to 20% due to the additional time required for C&D.

Production of certain types of cheeses such as mozzarella and cheddar in the quarantine area may continue because the virus is destroyed by the acid produced naturally in the cheese making process. Cheese manufacturing plants should be approved based on the type of process used. Marketing should also be limited to the states or regions under FMD quarantine. Cheese production absorbed 41.3% of the total milk fat produced in 1995 in the state; cheddar and mozzarella represented more than 95% of this output. Presently there is a large idle capacity for cheese production in the South Valley—over 30% of the total capacity. This excess capacity would not be enough to process the milk that cannot be used for other products such as dry milk.

The FMD virus survives in other dairy products for various periods between two weeks and six months. Continued production of these products could be allowed if they can be stored until the virus is inactivated. Availability of this option would depend on storage capacity and storage cost. (Evaluation of this alternative exceeds the scope of this study; consequently in the model it is assumed that production of all these dairy products will be halted.)

Skins of infected animals must be destroyed. Skins of exposed animals may be utilized provided they are handled in accordance with the existing regulations. The skins must be transported to an

approved establishment in a leak-proof airtight sealed container. The skins may be placed in an approved soak, or moved under supervision to a tannery for supervised processing. However, there are no such establishments in the western part of the U.S. and there might be only a couple on the East Coast. Currently, most of the hides are exported to Korea and Japan, which are expected to restrict importation in the event of a FMD outbreak. The most viable alternative would be to export the hides to plants in countries that would accept them.