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ISSN 1466-2523

Animal Health Research Reviews **8**(1); 89–103
DOI: 10.1017/S1466252307001284

Agrosecurity for concentrated animal feeding operations (CAFOs): commentary on recent planning activities

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Received 4 April 2007; Accepted 23 May 2007

Abstract

Agrosecurity has become a major concern for livestock operations. This paper reviews post 11 September 2001, American planning activities and offers commentary on issues related to these plans. A critical issue is the need for as many people as possible to be aware of plans and preparations already completed and actions still necessary. There is a sizeable disparity within the animal agriculture sector about information known and understood at different levels. Several readiness exercises have highlighted the need for better broad-spectrum communication: communication within disciplines, within agencies, across disciplines, across agencies, and most importantly everyone involved must talk with industry at all levels. The best preparation involves close coordination between law enforcement, industry, governmental agencies at all levels, academia, risk managers and communicators, veterinarians, engineers, economists, game theorists, and others. This paper features issues related to concentrated animal feeding operations (CAFOs), highlights some of the lessons learned through these exercises, and discusses a plan of action patterned after the activities of a regional agricultural jurisdictional working group.

Keywords: agroterrorism, agrosecurity, biosecurity, bioterrorism, foreign animal disease, livestock

Introduction

The term agrosecurity has many definitions and connotations so clarification is important. In this paper, the primary application is the combination of biosafety with biosecurity and security protocols to protect against potential terrorist activity involving infectious diseases of livestock. The best of these protocols will yield dual or multiple benefits by being also applicable to other emergencies, thereby increasing the attractiveness of implementation. The discussion will consider the benefits that these actions have in enhancing premises and operational security for more routine incursions, whether illegal or accidental (dual benefit). For the most part discussion relates to livestock in concentrated animal feeding operations (CAFOs), although livestock in general may be vulnerable and plant agriculture has its own set of concerns. Biosecurity in common parlance refers to practices of quarantine, cleaning, and disinfection designed to minimize potential introduction or spread of disease. Some distinguish between biosafety and biosecurity with biosafety referring to protocols for handling materials, for disinfection, and personal security to prevent infection or release of microorganisms. Biosecurity is a broader term which includes limiting access to potential pathogens and targets of those pathogens. Biosecurity encompasses protecting targets (e.g. animals, facilities, or people) from exposure to pathogens and may require dedicated security personnel to enforce restricted access. In this paper, agrosecurity will cover both ideas: (1) the biosafety measures utilized to mitigate disease spread, and (2) security for personnel, animals, and premises. Using a term such as agrosecurity acknowledges the

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https://doi.org/10.1017/S1466252307001284 Published online by Cambridge University Press

distinctive nature of biosafety and biosecurity throughout production agriculture. Care in the choice of words is vital in an area where the consequences of poor communication can be devastating. The major thrust of this discussion will relate to operator, local, and regional planning for the introduction of a foreign animal disease (FAD) but will point out issues related to international, national, or state policies that complicate planning and response. This dialogue will draw significantly upon experiences with several exercises at the regional, state, area (several states), and national levels to highlight issues of concern.

The major objectives of this paper are (i) to provide background information on the nature and importance of improved agrosecurity, (ii) to highlight areas which need improvement, and (iii) to indicate specific actions which can be taken to improve preparedness for a bioterrorist action against agriculture as well as non-intentional introduction of foreign or emerging animal diseases (FEAD). Since 2001 September 11, Americans have done a great deal to prepare for terrorist attacks in many sectors, yet a recent report from the Government Accountability Office (GAO) (2005) indicates that much remains to be done, especially in agriculture. Many of the issues raised in that analysis are still problematic. Further, a Congressional Research Service (CRS) Report for Congress updated in August 2006 (Monke, 2006) repeats some of the concerns and raises additional issues. Perhaps the greatest single problem is lack of awareness in many sectors about who is doing what and for what purpose.

Agrosecurity and homeland security directives

Agrosecurity is simply security for agriculture, which in this paper will focus on CAFOs. Agrosecurity encompasses biosecurity which is a collection of management practices designed to minimize the potential for accidental or intentional introduction or spread of an animal disease. Additional aspects include enhancing the security of the agricultural operation to prevent hostile acts of a terrorist or criminal nature. The most effective agrosecurity will prevent or minimize impact from both natural and intentional disasters in the agricultural sector.

Typical biosecurity plans protect animals against the introduction of disease and concentrate on implementation of safe animal care practices such as quarantine of animals upon arrival at the facility, segregation of sick animals, proper hygiene for caregivers, and proper disinfection. There may be restrictions on outside activities of employees; for instance, many swine operations do not allow employees to raise or care for animals susceptible to FADs apart from their employment. Premises security refers to inhibiting or controlling criminal activity whether it is vandalism, theft, or terrorism, by restricting access to the operations. Close coordination with local law enforcement is important. To this end, the Department of Homeland Security (DHS) and the Federal Bureau of Investigation (FBI) have jointly sponsored two International Symposia on Agroterrorism, the first in May 2005 and the second in September 2006.

Homeland Security Presidential Directives (HSPD) provide the authority for homeland security planning and several have been directed at protection of agriculture and the nation's food supply and are briefly introduced below.

HSPD-3 deals with communication of risk, which largely determines allocation of resources. Application for agriculture is uncertain. HSPD-4 discusses a National Strategy to Combat Weapons of Mass Destruction. The introduction of a FAD would qualify as a weapon of mass destruction (WMD), not necessarily threatening human lives but impacting property, the US economy, and disrupting the food supply and confidence in the government. An identifiable need under this directive is better intelligence and communication of that information to those working with agriculture and the food industry. In the event that there is no current perceived threat, whether at the local, state, or national level, that should be communicated as well. HSPD-5 addresses management of domestic incidents. This directive requires that all incident commands use the same structure and protocols (National Incident Management System (NIMS)). It is a step toward better communication between sectors but Buck *et al*. (2006) deem it inadequate to handle emergencies when those involved do not report to the same command structure and many may lack NIMS/incident command system (ICS) training. HSPD-7 discusses critical infrastructure identification, prioritization, and protection. The agriculture and food sector has been included in national and many state infrastructure protection plans. Agriculture fits because of the threat to the economy (>$1 trillion per year) and the number of jobs involved (18 percent of domestic employment) (USDA-ERS, 2007). Although HSPD-7 lists agriculture as critical infrastructure, there is no mandate for funding.

HSPD-8 addresses national preparedness. The intent of the directive is to strengthen preparedness and improve response, with the federal government assisting state and local governments. HSPD-8 is a companion to HSPD-5. Among the goals are improved training and preparedness for those first on the scene after an incident. For animal agriculture that includes CAFO workers, management, veterinarians, consulting veterinarians, state and federal FAD diagnosticians (FADDs) and others called upon to respond to the event. The goal of the directive is to expand existing capabilities and not merely improve existing resources. The USDA Animal and Plant Health Inspection Service (APHIS) has sponsored several exercises to address the goals of HSPD-8. Jurisdictions are encouraged to expand proficiency through local and regional efforts and expansion of mutual aid agreements. The Homeland Security Exercise and Evaluation Program (HSEEP), http://hseep.dhs.gov/, provides accessible and consistent authority for evaluation and training.

https://doi.org/10.1017/S1466252307001284 Published online by Cambridge University Press

HSPD-9 deals with defense of United States food and agriculture. Released in January 2004, the importance of food and agriculture was recognized and efforts initiated to truly improve protection for this vital sector of the economy. A strike on the food and agriculture sector could have tremendous economic and psychological impact and could significantly alter the standard of living. National compliance will require involvement by industry at all levels, by local, regional, state, multi-state, and national governmental entities and nongovernmental organizations (NGOs). A clear understanding of the potential threats, industry and facility vulnerabilities, and capabilities must continue to be developed.

HSPD-10 covers biodefense for the 21st century. This directive targets human biothreat agents more than agricultural, yet in some cases the two cannot be distinguished. Furthermore, the principles for dealing with one are often very similar to those for the other. The vulnerability of the agriculture and food sectors is recognized, but many of the details still beg resolution. The concern that an incident may create cascading international effects is applicable to the food and agriculture sectors.

Seldom are HSPD-3 and -4 considered as applying to the agriculture and food safety sector, but with the listing of agriculture as critical infrastructure under HSPD-7, it seems apparent that risk communication and development of a strategy to thwart the introduction of a FAD is as applicable as any other WMD.

The nature of the threats to livestock

Agriculture is a $1.2 trillion per year industry accounting for 18 percent of domestic employment and 11 percent of the gross domestic product (Monke, 2006). Animal agriculture is a major component of the economy for the Southern High Plains including southeastern Colorado, eastern New Mexico, southwestern Kansas, western Oklahoma, and the Texas Panhandle, accounting for an economic impact of over $20 billion per year in the Texas Panhandle alone. At the national level animal agriculture represents $123 billion per year for 2006 (USDA-ERS, 2007). Economists may use various multipliers to indicate economic impact which will yield an even greater number. Concern for the health of the industry extends beyond the owner/operators of the CAFOs to all who are knowledgeable about the agricultural contribution to the economy.

Data from the 2001 foot and mouth disease (FMD) outbreak in the United Kingdom illustrate the potential economic impact of FADs. This outbreak was estimated to have a total cost of $20 billion, with expenditures directly associated with disposal of more than 6 million diseased animals exceeding $6 billion (presumably including indemnification, cost of depopulation and disposal, and cost of cleaning and disinfection) (AVMA, 2007). Another report estimated that up to 10 million sheep, pigs, and cows were slaughtered and the loss to the food and agriculture sector was about $5 billion (Carlton, 2007). Taylor and Tricker (2006) report over 4 million animals culled at a cost of more than $8 billion. The Department for Environment, Food and Rural Affairs (DEFRA, 2002) reports slaughter of more than 4 million animals with 3 million in England of which 83 percent were sheep and 14 percent cattle. Compensation for slaughtered animals was £1.1 billion (approximately $2.2 billion), which, though not explicitly stated, does not include costs for destroying and disposing of animals or cleaning and disinfection of equipment and premises. The higher monetary estimates likely include economic multipliers to include directly impacted and indirectly impacted businesses including tourism.

A clear understanding of the potential threats is necessary to take effective preventative action. The threats may be either intentional or accidental. The major concern for livestock producers is introduction of a highly infectious FAD such as FMD. To date there has not been a documented case of intentional introduction of FMD but the cost of the outbreak is dependent upon motive only to the degree that the distribution of disease may be different. With markets becoming increasingly global, the likelihood of either type of introduction cannot be discounted. FMD is not considered zoonotic (transmissible to humans), so the impact of the disease is primarily economic and not related to human health.

Use of biological agents against animal agricultural interests has very limited historical precedent (Ackerman and Giroux, 2006). Germany, during World War I, introduced anthrax and glanders into draft animals supplied to the allies from the United States (NEWS & TERRORISM, 2005), and infected Romanian sheep bound for Russia in 1916, and reindeer in Norway (Cain, 2001; Wheelis *et al.*, 2002). During World War II Japan is alleged to have used anthrax and rinderpest against Russia and Mongolia in 1940, and plague-infected fleas in Manchuria. Terrorists have used biological weapons including the unsuccessful 1993 attempt by the Aum Shinrikyo cult to use anthrax and botulinum toxin in Tokyo, while the followers of Baghwan Shree Rajneesh in 1984 sickened over 700 Oregonians by poisoning salad bars with *Salmonella* to rig an election (Carus, 2001). Carus also mentions the introduction, by desperate New Zealand farmers, of rabbit calicivirus disease in 1997. This is not a case of terrorism, but of the illegal introduction of an agent for supposedly beneficial purposes. Documented terrorist attacks directed at animals have not occurred although some opposed to use of animals for scientific studies or in production agriculture have carried out strikes against people involved or have released animals from shelter facilities. However, biological weapons directed at agriculture are well suited to the type of asymmetric warfare perpetrated by non-state terrorist groups: they are inexpensive, may cause significant damage before detection, are readily available, and generally are safe for humans to handle.

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The mechanism and venue for introduction of a FAD depend largely upon the perpetrator involved and the goals of that person and associates. Some entities, such as sovereign nations, might desire the cover of plausible deniability, others may not care, and others, such as terrorist groups seeking public attention, will definitely want to take credit. Likely, all would have goals of wreaking economic havoc and destroying confidence in the safety and ready availability of food.

To gain a perspective on the threat, it is useful to develop an understanding of the potential magnitude of damages, both direct and indirect. The long-standing US policy for handling the introduction of FMD has been 'stamping out' (NAHEMS, 2005). The intent of the policy is to limit disease spread, destroy all infected or exposed animals, and verify absence of disease as quickly as possible to regain FMD-free trading status as determined by the World Organization for Animal Health (OIE, Office International des Epizooties). Breeze (2004) rightly suggests that current policies play into the hands of terrorists seeking to generate a lack of confidence in our government. He expands in a subsequent article (Breeze, 2006) in which he makes several suggestions to mitigate the consequences of an attack upon the food animal sector. Breeze maintains that by stipulating policies that will overwhelm resources and create a public debacle, the OIE and the USDA have inadvertently created a climate in which terrorists might reasonably consider use of biological agents against animal enterprises. The purpose of an attack upon the animal agriculture sector will be to generate disgust and horror as massive numbers of animals are depopulated and destroyed. Confidence in the nation's food supply will be undermined. Gary Weber, formerly with National Cattlemen's Beef Association, said at the 2006 FMD Summit (Larson and Loneragan, 2007) that a one percent decline in the market for beef equates to a $100 million loss.

During the United States' last experience with FMD in 1929, 'stamping out' was effective. Since then animal production agriculture has changed significantly. CAFOs have become the norm, making available to producers significant economies of scale and contributing to the reduction of the percentage of family income spent on food to less than about 10 percent (USDA-ERS, 2006). However, large feeding operations mean that the problems associated with 'stamping out' are large as well.

It is not possible to depopulate and dispose of carcasses for a large cattle feeding operation within anything approaching stated requirements. The current National Animal Health Emergency Management System Guidelines (NAHEMS) require animals to be depopulated and carcasses disposed of within 72 h (NAHEMS Guidelines, September 2005, draft). At a recent exercise in the Texas Panhandle, an earth-moving contractor indicated that if all the contractors in the region responded it would take 11 days to dig the hole needed to dispose of carcasses for a single 70,000 head feedlot. Regions of the High Plains may have several even larger feedlots within any given 10 km (6.2 miles) infection zone. The Guidelines make provision for several methods of depopulation, but the ability to depopulate a number of very large feedlots within the permitted time frame is doubtful using even the most aggressive techniques. Carcass disposal by approved means is not possible. By adhering to outdated disposal requirements, the potential for a public relations nightmare plays into the hands of terrorists much as suggested by Breeze (2004). Of course, massive numbers of dead animals will be a problem regardless of requirements for disposal, so one may question the need for massive depopulation.

Determining the probable threats involves understanding the likely sources of disease introduction, the geographic locations in which there is a reservoir of disease, who may want to attack, the objectives of the attack, and the resources available to potential attackers.

FADs are important even if terrorism is not a consideration. They are generally highly infectious and have the capacity to significantly impact the agricultural economy. Some diseases may also be zoonotic. Most western nations have implemented tighter security at their borders since the war on terror began, but many observers argue the current precautions are insufficient. To some extent adequate security will always depend upon the diligence of the receiving operation. Management must know the origin of all shipments and have a clear understanding of the shipper's credibility. Based upon historical evidence, an accidental introduction of a FAD is the most likely source of infection, so the greatest level of resources should focus upon minimizing that risk.

Psychological impact is seldom the first consideration in discussions of FAD, but many working on the United Kingdom, 2001, FMD epidemic reported that the visual impact of attempts at carcass destruction adversely affected public support of the eradication effort and increased economic devastation in the tourism industry. If large numbers of jobs are lost, mass migrations could occur, creating serious infrastructure problems for receiving communities and lost tax revenues for areas losing people. In the later part of the 20th century, extending into the beginning of the 21st century, Americans have become accustomed to a plentiful and cheap food supply. If a FAD outbreak is widespread, that would change. Although Americans would not starve, food would be less available and prices would increase.

Threat assessment and evaluation

Historically, threat assessment and evaluation have been the responsibility of intelligence, military, and law enforcement agencies. While continuation of this paradigm seems appropriate when evaluating threats involving nuclear, radiological, or some explosive devices, it seems less fitting for weapons of convenience, such as certain

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biological or chemical agents (especially those widely used in agricultural operations), targeted at the civilian population or agricultural production. USDA and state agricultural agencies have gathered intelligence through inspections for years. If those at the production stage of agriculture can now become a more significant part of the intelligence network, the nation not only may avert the introduction of an infectious disease, but possibly could also realize multiple benefits by thwarting the repeat of an incident like the 1995 bombing of the Alfred P. Murrah Federal Building in Oklahoma City. In that case the purchase of large quantities of fertilizer containing ammonium nitrate used in the truck bomb should have triggered an alert. In the past, war was waged by sovereign governments which directed armies to war against opposing armies. Today the threat is much different and requires the vigilance of all. We do not expect to see military personnel protecting our swine operations, poultry barns, dairies, or feedlots. Owners, operators, employees, and observant neighbors will do that by diligent community policing activities in conjunction with local law enforcement. In view of this proposed shift in protection mentality, the agricultural industries must be apprised of increased threats to their respective sectors; those facilities must be the first line of defense. Furthermore, it is all the more difficult to make appropriate preparations for threats that remain undefined. Although one can easily recognize the validity of a threat to agriculture, allocation of resources for preparedness requires a comprehensive risk analysis across all sectors. It is not possible to complete such analysis without adequate threat evaluation.

Working groups

Threat assessment occurs at all levels and by myriad entities. For most, the Office of Domestic Preparedness (ODP), or a regional delegate, is the agency responsible for State Homeland Security Assessment and Strategy (SHSAS). At a more local level, the jurisdictional working group (JWG) identifies risks and needs at a local or regional level, establishes response plans, and enhances emergency response planning. For the State of Texas, JWGs are patterned after the regional council of governments (COG). For example, the COG for the northern 26 counties of the Texas Panhandle is the Panhandle Regional Planning Commission (PRPC) and the JWG formed for the region is the Panhandle Regional Emergency Management Advisory Committee (PREMAC). Typically the JWG has representation from emergency management, law enforcement, fire services, emergency medical services, hazardous materials response, public works, public health, government administration, public safety communications, and health care. Often critical infrastructure is represented as well, which is the case for PREMAC.

The JWG may define and populate subgroups to facilitate the overall mission; the two most common are (1) the threat assessment working group (TAWG), and (2) the basic vulnerability assessment working group (BVWG). A TAWG has responsibility for developing and collating intelligence to identify potential threats and evaluate risks. The TAWG is generally composed of law enforcement and intelligence personnel but may include others as well. The more effective TAWGs include representatives from entities which can help define the intelligence needed. The BVWG should be comprised of individuals with a working knowledge of important events and infrastructure within the region that might be potential targets. The agricultural vulnerability assessment working group (AVWG) is a BVWG which has specialized responsibility for potential agricultural targets. For the Texas Panhandle this is the Panhandle Agrosecurity Working Group (PAWG), formed independent of the PREMAC to address a perceived need for improved preparedness for regional CAFOs. Although the PAWG still operates ad hoc, coordination and cooperation with PREMAC and PRPC is excellent.

Although DHS ODP specifies JWG, TAWG, BVWG, and AVWG as the channel to develop appropriate response to catastrophic events and existence of such entities determines eligibility for federal homeland security funding opportunities, there are other practical reasons why such working groups should exist. Each jurisdiction has unique capabilities, resources, needs, and potential targets, which local and regional people know better than anyone else. The 'top down' nature of a response to a terrorist incident is a topic of much discussion, but the reality, as seen with the attack on the World Trade Center and the Pentagon, is that the first response is local. Almost any event imaginable will require those closest and most prepared to react first.

Intelligence

America's philosophy about intelligence dates to before her independence as a nation and has been reinforced through the War of Independence, several other wars, the civil war, two world wars, and a cold war. For some classes of intelligence, that model is still appropriate. However, for threats in which civilians and not the military or intelligence agencies must do the planning and preparation, the paradigm is more of a hindrance than a help. If, for instance, there is a potential for an attack upon a swine farrowing operation, the management and employees of the operation are central. It is typical that law enforcement holds information closely, and often this is appropriate. However, those actually planning responses must receive enough information to be able to develop reasonable strategies. Unfortunately this does not happen frequently enough.

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Vulnerability assessment

Vulnerability assessment is an essential part of the overall planning process. Working group participants use this tool to identify potential targets and assess the venues for attack. Threat assessment should contribute to the process, but often does not, which is unfortunate because good intelligence on those expected to carry out the attack is vital for measuring the vulnerability of a target and the likelihood of a particular attack.

Two major assessment protocols are available: one specified by ODP and published by the National Emergency Response and Rescue Training Center (NERRTC) (available For Official Use Only (FOUO) in training materials), and the CARVER+Shock (Ryan, 2007) which has military origin and has been adapted by USDA and the Food and Drug Administration (FDA) for evaluation of potential targets within the food and agriculture sector (much information about CARVER+Shock is FOUO). Regardless of the tool used, the same fundamental questions require answers: how attractive is the target? How many people will die? How much damage will occur? How long will the incident remain in the headlines? How easy is it to attack the target? What is the shock value of the target? What is the potential for collateral damage such as cascade economic impact, lives or income lost as an indirect consequence of the attack?

The CARVER+Shock evaluates criticality (public health or economic impact), accessibility (how easy to get in and out), recuperability (ability to recover), vulnerability (how easy to attack), effect (direct loss from production), recognizability (ease of identifying target), shock (combined health, economic, psychological impacts). Many of the tools are in place. Better coordination between threat assessment, vulnerability assessment, and planning must become the norm. Evident in some of the FAD exercises has been the need for better coordination vertically between federal and state agencies with regional and local resources and impacted industries (USDA Office of Homeland Security, 2006). All need to understand the vulnerabilities, the threats, and the resources available to respond and all need to be able to work together.

Response

Effective response to the threat depends greatly upon good understanding of the threat. Some appear to deny the possibility of any attack upon agriculture and alarmists may exaggerate the threats and vulnerabilities. The problem is, at least partially, the lack of intelligence available to professionals involved in response planning, especially in the agriculture sector. Looking at FMD outbreaks around the world, it seems one must at least concede the possibility of introduction without respect to intent. Given that, it seems vital that planning proceed with the purpose of minimizing possible disease spread regardless of method of introduction. Response to the threat requires full consideration of possible sources of introduction, possible motives for introduction, and possible venues of introduction of a FAD.

Responding to an attack is different from responding to a threat. Different action is required at this point, and, for the most part, the time for planning has past. Response to a threat involved planning, taking action to minimize vulnerability and impact, and preparing for an attack. Upon attack, people have to begin doing things and it is necessary that someone be in charge and that others know who that is and how they are to respond.

The NIMS

The NIMS required by HSPD-5 provides the framework for response. The National Response Plan (NRP) and the state response plans delineate various responsibilities. All plans provide for an ICS which complies with NIMS and which is designed to permit personnel with proper ICS training to take charge of an incident. The rules are the same at the highest levels as they are at the local or regional levels; the only factors that differ are location of command post, grade level manning the posts, and resources available. The maxim is that the first person on the scene is the incident commander (IC) until replaced by someone with greater authority. Buck *et al.* (2006) expressed concern about the effectiveness of ICS and NIMS in situations where many who do not have a defined command structure will have to respond, yet the system obviously has attractive features.

Open source training materials and certifications are available through a variety of venues including DHS and USDA and may be accessed by an Internet search for ICS. It behooves everyone involved with agriculture to become familiar with the basics of NIMS and ICS. The US has already had to respond to FAD outbreaks of Exotic Newcastle Disease (END) in poultry and Bovine Spongiform Encephalopathy (BSE) in cattle. Disposal of carcasses was an issue for both cases, though with improved understanding of BSE a repeated sacrifice of large numbers is unlikely.

The Incident Command Structure includes an IC. For some situations the command is a unified command with joint commanders, for others there is a single commander. For incidents of national significance, the Secretary of the DHS is the Commander but may defer to appropriate agencies. The command structure includes nodes for (i) operations, which coordinate operational support of on-scene incident management, (ii) planning, which gathers, evaluates, and assimilates information to be provided to incident command and other branches, (iii) logistics, which is responsible for procuring and providing necessary supplies and equipment to handle the incident, and (iv) finance, which must tabulate costs and identify resources to pay for supplies, equipment, wages, salaries,

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rent, and other costs associated with the incident and response.

Depending upon the level and magnitude of the incident the highest level of command could be the state with due notification to appropriate federal authorities. Whether the state has sole responsibility or is part of a larger, multi-state response, the agency responsible for animal agriculture will have a Foreign and Emerging Animal Disease Response Plan (FEAD Response Plan) which must fit with the NRP and NAHEMS. Other players will include local and state law enforcement, local, regional, and state emergency management, the directly impacted industry, and support industries.

Industry, likely through commodity or trade organizations, must liaise with government agencies at all levels. The NIMS requires industry participation. The industry organizations are the key to effective communication between responding agencies, producers, the public, and the media. Those in the livestock industry fully recognize the interdependence of their species groups and already work closely with each other.

CAFOs

The individual CAFOs should develop plans that cover facility security, decontamination and cleaning, controlling disease spread, and business continuity. Every employee plays a role in security and stopping disease spread. Quality education is essential. Many CAFOs have plans developed and some have even exercised these. Essentially all large swine operations have very tight biosecurity requiring wash in and wash out for all employees, to prevent routine transmission of disease. It is not likely that beef cattle, dairy, or sheep and goat operations will adopt such stringent policies, but good management practices adopted by all industries and operations can reduce the likelihood of infection and spread of disease.

Difficult issues for CAFOs include how to maintain operations if not an infected premises. For the first 48 h after the disease diagnosis, officials will stop animal movements, along with other movements that could facilitate disease transmission. The 48 h time is fairly well accepted but beyond 48 h, significant problems may arise. Most CAFOs keep only 3–5 days of feed, so feed for animals will be an issue. Dairies depend on being able to ship milk on a daily basis and do not have resources for even short-term storage that has very stringent regulations. The vertical integration structure of swine production requires regular shipment of animals and holding for even a couple of days creates issues of business continuity and humane treatment of animals. Restarting movements of feed, supplies, animals, or products requires business continuity plans previously approved by USDA. The business continuity is more than ability to resume business as usual; there are significant humanitarian issues involved if operators cannot properly feed or care for animals or if they cannot move animals as necessary.

The NAHEMS Guidelines and many state plans specify possible methods for decontamination and cleaning. Identification of available equipment ought to be done prior to an event; this is often a function of an exercise. Some CAFOs have equipment on hand; typically swine operations have truck washes for complete disinfection of each truck after receipt and before shipment of animals. Personnel at swine operations typically shower in and shower out, which minimizes potential for transmitting disease. This type of disinfection presents challenges for CAFOs involving other species but likely will be necessary during an epidemic.

Communication

Communication is critical and needs to be improved. Law enforcement and other intelligence agencies need to supply information to JWGs to improve the planning process. We know through experience in several exercises and the Texas Panhandle wildfires in March 2006 that we can and must work together.

Several exercises (Tri-Partite Simulation, 2000; Panhandle Exercise, 2002; Kansas High Stakes, 2003; Aphtosa, 2004; Tripartite Equinox, 2005; USDA Office of Homeland Security, 2006; Operation Palo Duro, 2007; and others) and continued dialog between planners, industry, and state animal health officials have improved understanding of the regulatory requirements and capabilities of industry and local/regional emergency management. Many now recognize the value of including industry representatives within the incident command structure. Industry liaison within the ICP was critical during Operation Palo Duro.

National policy remains in draft form and many expect this to continue for the foreseeable future. Numerous reasons have been articulated for this, but perhaps the most reasonable is that we continue to better define responses that render plans out of date quickly. Agencies can readily modify drafts in response to changing technology and operational developments but final plans can take several years to change. Many expect the implementation and finalization of the drafts when necessary and in response to an event.

A frequent comment is that USDA needs to be more transparent about flexibility of policies. A careful reading of the NAHEMS Guidelines will demonstrate that several alternative possibilities already exist for depopulation. Recent exercises suggest that policy makers at the highest level fully recognize the need to be able to adapt to the situation as it unfolds. The major piece of essential information, absolutely always needed, is the best possible epidemiology which then drives decisions about depopulation, vaccination, quarantines, and stop movement orders. This was quite evident during Operation

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Palo Duro in February 2007 and articulated in the after action reports of many previous exercises. Epidemiology must have a high profile in both the planning and operations sections because so much else depends upon that data.

One of the best ways to improve communication is through frequent exercises. The perception is that an exercise must be expensive but this is not the case. The objective of the exercise can influence cost with functional and full field exercises being more expensive.

Table top exercises are often very good for clarifying issues and communicating policies. As a general rule, a table top exercise does not require a strict command structure. Most often the goal is to present issues and generate open discussion. If the right people are involved, a lot of learning can occur. All exercises should focus on specific issues. The breakdown of many table tops is a tendency to degenerate into group discussions with the least informed requiring the other participants to provide on-the-spot training while rehashing issues which have been resolved. One remedy for this is a rating system for exercises. Prerequisites should include completion of specified levels of ICS training, reading assignments, and homework to better prepare the participant to understand his or her role. Basic ICS competency should be prerequisite for all exercises.

Functional exercises differ from table tops in that an ICS structure is defined and nodes are populated. Participants typically play roles which mimic an actual response. Functional exercises can suffer from the same lack of participant background plus design of the ICS structure can challenge even the most expert emergency manager. It is vitally important to design nodes properly to include personnel likely to fill the assigned function; the epidemiology section must have epidemiologists with appropriate data; the economic impact section must have economists with appropriate data plus capable modelers. This is often difficult because of the competing interests and objectives represented in larger exercises, plus the people really needed in an event are likely to be busy and may not participate because of competing demands. While cross-training serves a valuable purpose, it is counter productive to have no one in a given node knowledgeable about the function of the node. Some involved in exercise design consider it inappropriate to have observers and try to find a role for everyone. Allowing observers permits those less knowledgeable or without an appropriate node to become educated without slowing down the exercise. Certainly, this places additional burdens on those responsible for the exercise, as they must control interaction by observers to enforce the schedule and keep participants on task. The return on this additional effort is the possibility of providing a training ground for observers without slowing the exercise which could be part of the exercise rating system. One strategy that seems to work well is to make all observers also recorders and evaluators.

Once an exercise is complete, there is a tendency for all to breathe a sigh of relief and express eagerness to return to normal activities. This is understandable, but what really needs to happen at the completion of an exercise is the beginning of planning for the next. People change jobs, retire, get promoted; all of which renders the last exercise obsolete within only a couple of years. One purpose of every exercise is to enhance lines of communication, but those are broken when personnel change. There must be a continuous process of renewal. A review of actions in the aftermath of the UK 2001 FMD epidemic revealed that local FMD plans existed but had not been practiced (Taylor and Tricker, 2006).

Indemnification and vaccination

Indemnification continues to be a concern. At the FMD Summit in October 2006, it was clear that it is USDA policy to pay for any taking, which includes depopulation of animals to stop an epidemic, although determination of fair market value has philosophical and legal considerations. Disposal costs have been included in the past, but not reimbursement for lost milk. The Secretary of Agriculture does have the authority to compensate for losses from infectious materials caused by a disease event (Larson and Loneragan, 2007). Presumably these payments would involve transfers from the Commodity Credit Corporation (CCC). Indemnification is an issue for essentially every exercise and USDA needs to be transparent.

Another major issue with FMD is that of vaccination. Vaccination cannot occur until identification of the strain and subtype which requires virus isolation, a process requiring days. Upon verification of type the stored antigen must be 'sent to designated production facilities abroad . . .' (APHIS, 2007; McKenna, 2006), which again requires a time frame of days. Consequently vaccination is of little value in the beginning stages of an outbreak. USDA prefers to avoid vaccination altogether and will use it only as a firewall. If used, it is planned that all vaccinated animals will be harvested or destroyed within a very short period of time. Speculation indicates the time frame may be six months. What is clear is that the USDA policy is to return to FMD FREE status as soon as possible and all actions will be consistent with that expectation. Specific language for some aspects is available in the USDA APHIS Fact Sheets: Foot-and-Mouth Disease, January 2002; Foot-and-Mouth Disease Vaccine, March 2007; Emergency Response: Foot-and-Mouth Disease and Other Foreign Animal Diseases, January 2002; and NAHEMS Guidelines (DRAFT), 2005. Unfortunately the existence of these fact sheets is not known generally to those involved in food animal production or to many government employees. To compound matters, not all key word searches lead to appropriate Fact Sheets.

https://doi.org/10.1017/S1466252307001284 Published online by Cambridge University Press

Biosecurity in various operations

Swine

Swine operations have the strongest biosecurity plans in the livestock industry, at least the commercial enterprises or CAFOs. Employees are generally restricted from raising or even having contact with animals that may carry disease detrimental to the animals for which they care. Each stage of growth takes place in an environment designed to facilitate the growth and development of the animals in an efficient and profitable manner. Health and welfare of the animals is foremost in the mind of management, partly because healthy animals are more profitable, partly because of their own concern for the humanitarian care of their animals, and partly because of public scrutiny of their operations. Animals move on regular intervals from one facility to another until they are ready for slaughter. Pigs are veritable FMD factories if they become infected. They shed the virus profusely, especially as aerosol. Many consider aerosol to be a prime route of exposure for cattle (Donaldson, 1987; Scudamore, 2002; Alexandersen *et al.*, 2003; Merck Veterinary Manual, 2005; OIE, 2002; AVMA, 2007). The biggest problem facing commercial swine producers is probably not introduction of the disease but how to maintain business continuity in the aftermath of infection of other vulnerable species.

Dairy cattle

The biosecurity for most dairies is not at the level of swine farms but is more restrictive than most beef cattle or sheep and goat operations. Dairymen depend upon shipping milk on a daily basis and business continuity for them means they have to move milk; they generally do not have adequate storage for more than one day. The current USDA indemnification policy does not include milk (Larson and Loneragan, 2007). Dairy cattle are essentially capital; they are necessary to make the product, whereas beef cattle are the product. A policy of vaccination to destroy provides no assurances to those in the dairy industry who spent a lifetime developing their stock. Advisors to the industry already promote a strong policy of quarantine upon arrival (Adams, in Larson and Loneragan, 2007) sequestering animals until two FMD cycles have passed and discouraging nose to nose contact.

Beef cattle

The highly concentrated feeding operations associated with modern beef production may house anywhere from a few thousand to more than 100,000 head in a single operation although 25,000 to 40,000 is more typical. Operations with 60,000 to 80,000 are not uncommon. Beef CAFOs provide little security, are highly exposed and often very visible. Beef cattle present the greatest challenge as far as carcass disposal is concerned, mostly because of the vulnerability of the facilities themselves, the size of the animals, and the potential to have to destroy a very large number of animals in a short time span. The beef feeding industry is probably also the most vulnerable with respect to receiving shipments of animals possibly exposed to infectious disease. Implementation of quarantine practices could be very useful in limiting disease spread but in many cases could be difficult because most feedlots are established operations with structures already in place. In many situations it would be difficult and expensive to install facilities for complete quarantine of newly arrived animals.

Sheep and goats

The industry in the United States is still in its infancy as far as numbers are concerned. Sheep and goats are problematic in that FMD infected animals often do not display symptoms. Even when characteristic lesions are apparent, they are generally mild compared to those seen in pigs or cattle. Because of this, sheep and goats can infect other animals and go a very long period of time before diagnosis. Any disease containment planning must include representatives of the sheep and goat industry.

Wildlife and exotic game

In general, the place of wildlife is not well defined. During the US outbreaks early in the 20th century, FMD was not persistent in wildlife. In sectors of the country, exotic game ranches create the potential to vector disease to livestock; however, this potential is minimal as the game animals are quarantined upon arrival within the United States. Feral hog populations are certainly a concern, but swine are quite vulnerable to FMD and in the wild are likely to succumb to predators. Fish and wildlife or parks and wildlife officials often play the role of the commodity group representatives for discussions and exercises which consider wildlife.

Preparedness for FMD

A much better understanding of the mechanics for transmission of FMD and other infectious diseases can provide vital insight to guide better preparedness. Often when no other route of exposure can be identified, it is presumed that contagion was by infected aerosol. That may be true, indeed references supporting this were mentioned previously, but some environments are not well suited to FMD viability in aerosol form. In the Texas High Plains, summer temperatures in the open often

https://doi.org/10.1017/S1466252307001284 Published online by Cambridge University Press

exceed 100 F or 38°C with relative humidity much less than 10 percent. FMD requires relative humidity in the 50 percent or above range to remain viable and prefers cooler temperatures. Does this mean that infection cannot happen during the summer in the Texas Panhandle? What implications does it have for disease management? Some working on epidemiological models do not include aerosol infection because they deem it unlikely, yet the Scudamore (2002) report from the UK epidemic attributes some infection to aerosol.

Poulin and Christianson (2006) report an on-farm eradication of FMD in China without resorting to mass depopulation or culling; only pigs with clinical signs were destroyed. Admittedly, the study was not in a region classified by OIE as FMD free and the herd was relatively small compared to US commercial swine operations. That does not necessarily negate the observation that such a strategy would be less expensive and likely perceived by the public as humane. There are practical policy considerations, but the significant question is what would be necessary for the US to develop a policy around similar practices?

We need more and better modeling of disease spread. The epidemiological models today concentrate on spread from one facility to another. Many of these models are accepted as very good representations of what is likely to happen. However, modeling of what happens within a facility is lacking. That is important because if it is possible to manage the disease such that a whole operation need not dispose of animals to halt spread, the government and industry can save billions of dollars. Until better tools exist, such management is not a reasonable option.

We need better tools, instruments, and procedures for early and accurate diagnosis of infection. Current procedures require a worker to see an animal with clinical signs. By the time the animal is obviously ill, it may have been producing and shedding the virus for several days, likely infecting many others. Samplers capable of capturing the microorganisms passively from the environment could provide a trigger for close inspection. Such devices might collect aerosols or feed and water samples. USDA and industry are very concerned about the potential for false positives, so protocols must be developed and implemented to eliminate market responses to passive testing. For beef cattle and dairy operations, testing of new animals upon arrival at the feedlot could be included in current intake processing of the animals. A rapid PCR (Polymerase Chain Reaction) or ELISA (Enzyme-Linked Immuno-Sorbent Assay) test of the animals could identify infected animals so they can be quarantined and not enter the herd. Much of this technology is currently available or could be quickly, but current USDA philosophy appears to be an impediment.

Work at the lowest levels is needed to develop procedures and protocols consistent with state and national plans and to educate communities including producers, county officials, state officials,and other stakeholders. Each community requires different education. State officials understand the potential threat diseases but may need particulars on industry practices in a region. Producers know how their operations work but may lack adequate and up to date information about disease responses. As an example, in a relatively recent table top exercise, two of the more knowledgeable producers were still operating under the outdated assumption that an infected facility would be out of service for 3–5 years. It should be obvious how detrimental such perceptions can be.

Everyone who needs to respond must have at least some familiarity with the NIMS. Producers probably do not need comprehensive knowledge and probably will never be ICs for a fully staffed incident command post (ICP) but they do need to know the lines of communication and the subsections with which they are most likely to interface.

Exercises, previously mentioned, are part of continuing education, the value of which cannot be overstated. In 2002 the Texas Animal Health Commission (TAHC) conducted the Panhandle Exercise, which was a table top. By July 2006 when the Governors Division of Emergency Management (GDEM) conducted a WMD exercise, including a FAD, only four of the group from 2002 were still available to participate. The turnover rate requires an almost continuous education and exercise regimen to maintain a reasonable level of preparedness. One of the problems with the UK response to FMD in 2001 was lack of exercise of existing plans (Taylor and Tricker, 2006).

Assessments must be conducted and the results communicated. In addition to the threat and vulnerability assessments already discussed, assessments of preparedness and interoperable communications are also essential. Interoperable communication is often associated with compatible radio frequencies but really is much more. A common language and command structure are essential. Standardization of definitions and connotations of vocabulary, at the least within the context of planning and response, is vitally important.

Hardening of targets

The concept of hardening targets simply means implementing policies and procedures that either make the target less attractive to attack or raises the cost of the attack. It may not be possible to defend a target fully but hardening may reduce the likelihood of an attack.

Best management practices can reduce animal exposures to points of contamination or infected animals. Swine operations already have strong biosecurity on premises and many dairies quarantine animals upon receipt. Few beef cattle operations currently quarantine new arrivals, but implementing segregation with no nose to nose contact with resident stock for 21 days will reduce potential for infection. Some would argue that this is not

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appropriate for a highly infectious FAD; however, when one recognizes the logistical problems of depopulating 500,000 animals and disposing of the carcasses, three things become obvious: (1) a more thorough understanding of factors affecting disease transmission is vital, (2) any steps which may slow disease progression must be at least considered, and (3) the problem requires potentially unorthodox solutions.

Just as neighborhood watch programs have been effective against crime, citizen watches can be effective in protecting agriculture. Kansas and New Mexico have implemented AGROGUARD programs, similar to the familiar neighborhood watch but adapted for rural agricultural areas, http://nabc.ksu.edu/assets/uploads/Agrobrochure.pdf. The sheriff in Randall County, Texas recently adopted the program using county rather than state or federal dollars.

Good communication with the media can be helpful. Make local and regional newspapers, radio stations, and television stations aware of preparations by local, regional, state, and federal agencies. Properly reported activities are an excellent technique for hardening targets.

Dual use solutions

Dual use or dual benefit solutions are important for at least a couple of reasons. First, the overall cost of preparing the nation to defend against all possible terrorist attacks means that some things just cannot be considered. Zhuang and Bier (2007) used game theory to optimize investment in disaster preparedness, considering both natural disasters and terrorist activity. Even a moderately fair representation of their results goes well beyond the scope of this work, but their observations include the following two points. (1) The defender must evaluate the cost effectiveness of any strategy designed to dissuade the attacker. (2) Counter terrorism intelligence is valuable in assessing the attacker's response to defensive investments. This work calls into question DHS priorities for hardening multiple terrorist targets at the expense of disaster preparedness. The authors suggest that all hazards approaches are an acceptable alternative. Their paper does not reflect upon the possibility that some hardening efforts and improved intelligence might have already changed the playing field and they do disclaim use of their model for actual numerical rankings of investment. The question which they raise and which we must soon answer is how should we most wisely spend our finite resources to both prepare both for disaster and defend against aggression? The more we can dovetail those activities, the easier the question will be to answer.

PAWG

A working group of academics, industry representatives (all major species groups in the Texas Panhandle), and local government officials has been developing a regional response which integrates into the state and national plans. The plan primarily concentrates on application to the most prevalent operations in our region: beef feeder cattle, dairy, and swine but has application to other operations such as cow-calf, stocker, and sheep and goats. The plan essentials are widely transferable throughout the Great Plains but could also have application anywhere large feeding operations occur. Some animal agriculture enterprises have well developed internal biosecurity plans; however, it is not uncommon to neglect parameters outside the operations control such as the impact of stop movement orders on grain supplies or essential personnel. The working group has progressed through education of participants to plan development to plan testing with regional table top and functional exercises, during which the value of novel approaches was recognized warranting further discussion. The best plans return rewards even if there is never a FAD epidemic. Good biosecurity is always valuable.

Representatives of West Texas A&M University (WTAMU), Texas Cooperative Extension (TCE) Amarillo, Texas Agricultural Experiment Station (TAES) Amarillo, Texas Veterinary Medical Diagnostic Laboratory (TVMDL) Amarillo (a NAHLN laboratory), TAHC, and the Texas Cattle Feeders Association (TCFA) combined in November 2005 to form the PAWG. The group has grown to include representatives from emergency management, law enforcement, environmental regulators, state health services, USDA Agricultural Research Service (USDA-ARS), local and county government, the regional COGs, Texas Pork Producers Association (TPPA), Texas Association of Dairymen (TAD), Texas Sheep and Goat Raisers Association (TSGRA), Texas GDEM, and several TCE State Extension Agents. The working group serves as the AVWG for the Texas Panhandle and works on preparation of response and training materials for use by operators and responders.

PAWG has experienced several successes. Through a joint initiative of the PREMAC and PAWG, the Randall County Sheriff modified and adopted the AGROGUARD program. In March 2006 the Texas Panhandle had the largest one day wildfire in the history of the United States, burning 930,000 acres of grassland. The networking provided through the initial PAWG meetings facilitated the response effort. This working relationship has continued and grown through successful participation in a large regional table top exercise conducted for the PREMAC by the NERRTC, a division of the Texas Engineering Extension Service (TEEX) in July 2006. NERRTC also provided a series of training programs for participants and conducted a complementary functional exercise in August 2006. The TAHC, with funds from USDA-APHIS, sponsored Operation Palo Duro conducted by staff from CNA Corp. in February 2007. That exercise tested policy at the highest levels of state and federal government, with government and industry

https://doi.org/10.1017/S1466252307001284 Published online by Cambridge University Press

representatives from four states participating. Essential ingredients for any effective response include clear and open communication and a high degree of trust. PAWG participants are working hard to strengthen those attributes. The exercise served to illustrate the difficulties inherent in indemnification for large number of animals and the nearly impossible logistics of depopulating large herds and disposing of carcasses. Another lesson learned is the importance of strong industry involvement and support.

National policy

Discussions at the close of the FMD Summit (Larson and Loneragan, 2006) bemoaned the lack of transparency by USDA. For those with access, the NAHEMS Guidelines and other documents clearly articulate many of the policies. A major problem is that many documents remain in draft form and are not easily available. The policies articulated are not well known. This hinders planning and preparation at the local and regional levels where first response will necessarily begin. The guiding documents should move to final form and adoption, or officials responsible should convey the reasons for non-formalization to those concerned with responding to a FAD event. In other words, if plans are to remain in draft, say so and explain why.

The issue of depopulation requires much more thought. During the final reporting at a recent FMD exercise, the finance section chief reported that after one week approximately $130 million had been expended. One of the participants immediately asked if that included indemnification, to which the response was affirmative. Considering that two feedlots with over 140,000 head were far along in the process of depopulation, the $130 million lacks credibility. Using a common and reasonable estimate of $1000 per head, the cost of indemnification alone would exceed $140 million. If other facilities considered as infected premises in the exercise were included, cost for indemnification alone would exceed $300 million. Additional direct costs would include depopulation and carcass disposal, clean up and disinfection, and the supplies, salaries, and wages associated with those tasks. And those are only some of the direct expenses. 'Stamping out' has been the US policy for almost 80 years and should not be abandoned without careful consideration, but one has to wonder if the United States can afford it. The concerns raised by Breeze (2004) certainly resonate.

Indemnification raises many questions. Is it right to pay only for animals which must be taken? In one sense, there must be reimbursement for a taking (Article V, Amendments, United States Constitution), but what about requiring disposal of milk because of movement restrictions? How different is that than killing uninfected animals to stop disease spread? What happens to the downstream industries? The cattle feeder may receive payment for animals destroyed, but what happens to those in all the support industries such as haulers, the packing plants, the wholesalers, and the retailers? The legal ramifications of this question go far beyond the scope of this paper or the qualifications of the author, however, it may be that no agency of the executive branch can answer this; it may require legislative or judicial action.

Vaccination policy is not as undefined as many think. As indicated earlier, it is an option of last resort for use only when officials cannot stop disease spread by other means, most notably depopulation. The time frames for determination of the specific virus subtype and activation of the appropriate vaccine do not favor use in situations where disease spread can be halted relatively quickly.

Business continuity is a major concern for all industry components. It is quite possible that infection in only one sector will stop movements and disrupt business for all sectors. For instance, infection at beef feeding operations will initiate a stop movement that will affect milk shipments and the transport of pigs and hogs. Everyone seems to understand this. The difficult problem, which remains, is how to get movement of essential items restarted without increasing the threat of disease spread. As part of the decision support, sound epidemiology will be required and without it everything will remain at a standstill or revolt will ensue.

Access to information: availability of documents and clear communication

Some of the documents essential to quality planning are too hard to get for many with a vested interest. The documents with which one should become familiar include those related to the NAHEMS and the NRP. Every state, regional, and local plan is subordinate to these. The state response plans indicate how the state animal health agency, whether in a department of agriculture or a stand alone animal health commission, plans to deal with a FAD. Most of these are management plans and not resource plans. They indicate which agencies have which responsibilities but do not identify resources. To varying degrees, local governments, and regional associations of governments, will be best prepared to provide the first line resources. When the catastrophe grows beyond local capabilities, state and national resources will enter the picture. At the local level, JWGS can identify resources and match local capabilities and needs with the state and national plans. Documents cannot adequately address every contingency; therefore, state and federal agencies need to cultivate strong communication with local responders and industry.

A counter example occurred during Operation Palo Duro when the author observed lack of communication

https://doi.org/10.1017/S1466252307001284 Published online by Cambridge University Press

by the incident management team (IMT) with local emergency personnel and industry representatives. This created a high level of frustration for all. The tendency was for the IMT to call in federal resources immediately. It is understandable for people to work in their comfort zone with what they know, but from a practical standpoint, this is irresponsible because federal resources are not immediately available. This delayed response to the epidemic irritated local responders who had already identified resources, and frustrated industry representatives because they did not know what they could and could not do. This was somewhat resolved when local and industry representatives assertively inserted themselves within the incident command post and forced interaction with the IMT members.

Operation Palo Duro demonstrated the importance of (i) readily available documents, (ii) clear understanding of the contents, (iii) the necessity for open and clear two way communication, and (iv) the importance of local and industry input.

CAFO security

CAFO security for all hazards requires valid threat assessment. To achieve this, interaction with agencies with access to intelligence including the FBI, Central Intelligence Agency (CIA), state and local law enforcement (although local law enforcement may also wish they had better access) is essential. Each CAFO should have a vulnerability assessment by someone familiar with the industry but probably not with the particular facility (to avoid bias). It is incumbent upon the CAFO to address as many of the vulnerabilities as feasible. Identifying collateral benefits for proposed CAFO actions will increase feasibility and likelihood of adoption. Management practices that reduce potential for transmission of infectious disease merit strong consideration.

While biosecurity is standard and strong in some sectors of the food animal industry, such as pig production, it is significantly less stringent in others. Some of the deficiency in operation biosecurity may result from a lack of understanding about risk by managers and veterinarians. Recently the Dean of Veterinary Medicine at the University of Pennsylvania recommended changes in the curriculum for veterinarians, in particular those planning to enter food animal practices (Kelly, 2007). Kelly suggests that food animal veterinarians need to work with others in farm operation to improve understanding of risk management, to develop the ability to monitor large herds and immediately recognize when things go wrong, and devise and implement revised biosecurity protocols. All of these suggestions will be effective in improving herd health whether by eliminating potential for destructive terrorist activity or restricting exposure of healthy animals to microbes carried by other animals or fomites.

A balancing act

The spectrum of possibilities for terrorist aggression is far too great for the intelligence, policing, and defense sectors of government to handle totally. Our citizenry must be involved. Risk analysis cannot definitively tell us for which disaster we should prepare (Ryan, 2005; Zhuang and Bier, 2007), but the process is essential for informed and responsible decisions. Ryan emphasized the importance of dealing with real versus perceived risks to ensure that we work with the important issues and not just the politically sensitive ones. Good risk analysis must ask difficult questions. It must ascertain the importance of threats other than those to human life and help determine whether all resources should concentrate on stopping human deaths at the expense of all other sectors. There is also a need to consider the costs associated with recovery.

Balancing preparation for a variety of natural and unnatural disasters requires consideration of several issues. These include the amount of damage we can endure, the economic impact, and the shock factor. Risk analysis can help answer some of these questions, but the philosophical issues depend upon the ethos of the nation. Those doing the risk analysis need better intelligence to proceed (Ryan, 2005). Perhaps the methods of game theory can augment risk analysis. The issues of agrosecurity, identification of food production and agriculture as critical infrastructure, and general concern about our response to terrorism raise serious questions. In particular, an important question is how significant agriculture and food production are considered to be compared to other infrastructure.

Policy, regulation, or law defines some participants in agrosecurity. For an FMD epidemic, USDA APHIS Veterinary Services (VS) is responsible for making decisions regarding interstate commerce, the movement of animals, depopulation, and vaccination. The Foreign Animal Disease Diagnostic Laboratory (FADDL) at Plum Island, New York, will perform the first confirmatory tests. The often repeated question is Why? The process is cumbersome although the results are very accurate. The issue here is balancing the speed of more rapid testing and the concern for the economic devastation that could result from a false positive. Breeze (2006) appropriately decries the tardiness in understanding the disease situation due to current policies and dependence upon outmoded technology and communication. Rather than continue a system of slow precise diagnosis, it would be advantageous to find a way to deal with false positives.

The National Animal Health Laboratory Network (NAHLN), which currently has 48 labs and will ultimately have 55, can begin testing once Plum Island FADDL confirms the initial diagnosis. Presumably, this transfer of testing will be to the lab nearest the disease outbreak. The National Guard Civil Support Teams (CST) can complement the capability of the NAHLN. Each CST has

https://doi.org/10.1017/S1466252307001284 Published online by Cambridge University Press

mobile PCR and BSL-3 (Biological Safety Level-3) capability which suits the units for deployment to actual facilities. An example in which the CSTs can be used to good advantage surfaced during Operation Palo Duro. In the exercise swine were not infected and one of the operations needed to move animals to another facility. To gain authorization for movement it was necessary to collect samples from a random group of animals and submit for testing. This appeared to be a very worthwhile use of the CST. Currently the CSTs are not part of the animal health response plans and are not part of the NAHLN, but they can perform this mission and should be included after proper certification.

State animal health agencies routinely deal with even epidemic size infections within their boundaries and have plans already in place. Whether they take the lead or follow USDA, they are always a critical player.

Law enforcement is included in most, if not all, plans. Depending upon the nature of the incident the FBI may have the lead or it may fall to state and local agencies. Primary responsibility generally includes enforcement of legal actions such as stop movement orders and investigation of illegal and/or terrorist activity.

Existing plans identify other agencies at the federal, state, and local levels. Others who have an interest should also be involved. The problem is too big for official personnel to handle alone. Further, response must include industry representatives who are the ones with the best understanding of their operations and needs for business continuity and rapid recovery. Most importantly, it is necessary to develop relationships among participants early and to maintain them by regular communication and readiness exercises.

Conclusions

Progress is being made and agrosecurity has improved. However, there are several aspects which require attention. All involved agencies need to maximize transparency and communication. Policies and protocols need to be readily available and interpretations need to be clear and unequivocal. USDA and other agencies must clearly articulate policies related to indemnification, depopulation, carcass disposal, and vaccination. This must occur in a forum where all who need to know these policies can easily access them. CAFO management, trade and commodity associations, local and regional governments, and essentially all who are responsible in either planning or response need to be fully informed. Everyone must recognize and acknowledge that local and regional planning is a critical aspect of preparedness.

The capability to identify accurately and quickly diseased animals is important. Chute side tests that farm personnel or consulting veterinarians can correctly apply are already a priority, as well they should be. The requirement that all actions start based upon a diagnosis from Plum Island should be discarded, after defining and practicing a plan that negates the impact of a false positive.

Good disease prevention and management urgently requires better understanding of disease transmission under all possible conditions. All must recognize this daunting task as a long-term but essential undertaking. Changes in policies on depopulation and trade status implemented through USDA and OIE are necessary to reduce the attractiveness of animal agriculture as a target for terrorists. Collaborations with other nations should be considered as part of the strategy to prevent introduction of FADs. Researchers, producers and operators need to develop management practices designed to minimize herd infection. Further, it is essential to develop schemes to facilitate research and sharing of knowledge. Finally, it is extremely important to use exercises as a part of agrosecurity training and testing.

Acknowledgments

The author acknowledges the Ph.D. students at West Texas A&M University who constantly stimulate his thoughts by always asking why and expecting thoughtful answers. He appreciates the reviewers' comments, that were valuable in producing the final version of this paper. Finally, the efforts of the editor, Carlton Gyles, were instrumental in setting the tone for this paper.

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https://doi.org/10.1017/S1466252307001284 Published online by Cambridge University Press