EMERGENCY DISEASE CONTROL

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Animal Disease Emergencies

Animal disease emergencies may occur when there are unexpected outbreaks of epidemic diseases or other animal health-related events which have the potential to cause serious socio-economic consequences for a country.

These emergencies are frequently caused by outbreaks of foreign animal diseases (FADs), which are of significant economic, trade and/or food security importance for many countries. Such diseases can spread easily and reach epidemic proportions; Biosecurity, control/management, including exclusion, requires cooperation among several countries.

The occurrence of one of these diseases may have disastrous consequences for a country when they:

- compromise food security.
- cause major production losses for livestock products
- cause losses of valuable livestock of high genetic potential.
- Raise the cost of livestock production since costly disease control measures need to be applied.
- Disrupt or inhibit trade in livestock, germplasm and livestock products, either within a country or internationally.
- Prohibit sustained investment in livestock production.
- Cause zoonoses
- Affect the environment and wild life.

The International Office of Epizootics (OIE) recognizes 15 List A diseases, most of which could also be regarded as being FADs. These are foot-and-mouth disease(FMD), rinderpest, peste des petits ruminants (PPR), contagious bovine pleuropneumonia (CBPP), Rift Valley fever (RVF), lumpy skin disease, vesicular stomatitis, swine vesicular disease, bluetongue, sheep and goat pox, African horsesickness, African swine fever, hog cholera (classical swine fever), fowl plague and Newcastle disease.

However, this list is not exclusive. Other viral, bacterial, rickettsial and mycoplasmal diseases may also be regarded as having the potential to cause animal disease emergencies under some circumstances. Indeed, they may not necessarily be infectious diseases. For example, animal pests such as the New World and Old World screwworm flies.

Benefits of Emergency Prepardness

An animal disease emergency such as an outbreak of a foreign animal disease can have serious socio-economic consequences which, in extreme cases, may affect the whole national economy. If a new disease can be recognized quickly while it is still localized and prompt action taken to contain and then progressively eliminate it, the chances of eradication of the disease are enhanced. Conversely, eradication may be extremely difficult, costly and even impossible if the disease is not recognized and appropriate control action taken before it becomes widespread or established in wildlife.

The target should always be to eliminate progressively and finally eradicate a foreign animal disease (and prove that national or zonal freedom has been regained) if epidemiological and other circumstances are favourable. The alternative approach of simply “living with the disease” through routine vaccination campaigns and/or other disease control measures will in the end prove far more costly and will be a permanent constraint to efficient livestock production systems. Furthermore, the continuing presence of a FAD in a country, even if losses are minimized by effective disease control programmes, will inhibit the opening of export trade opportunities for livestock and livestock products. Eradication of the disease *and* provision of scientific proof of freedom from the disease to a level of international acceptability will remove this constraint to international trade. Contingency plans for animal disease emergencies should be regarded as providing the key to an early effective action in the face of an emergency.

The Basics of Emergency Prepardness

The two fundamental components of animal disease emergency preparedness are the development of capabilities for:

- early warning, and

- early reaction to disease epidemics and other animal health emergencies.

These require advance preparation of both generic and disease-specific written contingency plans and standard operating procedures (SOP), the testing of such plans and training of staff; the development of capabilities at national and local veterinary headquarters, including field and laboratory services; development of mechanisms to involve other necessary government and private sector services and farming communities in the emergency response; development of the capacity to apply all the necessary resources to counter the disease in the most efficient way (including equipment, products such as disinfectants stockpile, personnel and finances); and, finally, advance establishment of the appropriate legal and administrative structures to deal with an emergency.

Early warning of diseases

Early warning enables rapid detection of the introduction of, or sudden increase in, the incidence of any disease of livestock which has the potential of developing to epidemic proportions and/or causing serious socio-economic consequences or public health concerns. It embraces all initiatives, mainly based on proven biosecurity programs, disease surveillance schemes, reporting and epidemiological analysis.

Early reaction to disease outbreaks

Early reaction means carrying out without delay the disease control activities needed to contain the outbreak and then to eliminate the disease and infection in the shortest possible time and in the most cost-effective way, or at least to return to the status quo and to provide objective, scientific evidence that one of these objectives has been attained. For this to be achieved, one of the main things needed is the development of contingency plans for generic and specific diseases.

Risk Analysis as a Component for Emergency Preparedness

Risk analysis is something that we all do intuitively in our everyday life as well as in our professional work. In animal health it has perhaps been most widely applied in quarantine procedures. Quarantine risk analyses are used in reaching decisions as to the most appropriate health conditions for imported animals and animal products and strategies for quarantine operations. It is also used in operations that have adopted the HACCP principles as a guide to prevent disease.

Risk analysis is a proactive tool that can also be used to good advantage for animal disease emergency preparedness.

Principles of Risk Analysis

Risk analysis has three components: risk assessment, risk management and risk communication.

Risk assessment

In this component the risks of an event occurring are first identified and described. The likelihood of these risks occurring is then estimated, their potential consequences evaluated and the assessment of the risk modified accordingly. For example, an exotic disease with a high risk of entry to a country but only a low risk of establishment or minimal potential socio-economic consequences would only obtain a low overall score on a risk assessment.

Risks can be assessed in a quantified, semi-quantified or qualitative way. It is indeed extremely difficult to quantify or actually put probability numbers to risks in many biological systems because of the lack of historical precedents and serious gaps in available biological data. It is recommended that qualitative risk assessments be used for exotic diseases. The risks can be described as “extreme”, “high”, “medium” or “low”, or by a simple scoring system, for example, 1-5 for the level of risk and 1-5 for the level of potential consequences.

Risk management

This is the process of identifying, documenting and implementing measures to reduce risks and their consequences. Risks can never be completely eliminated. The aim is to adopt procedures to reduce the level of risk to an acceptable level. This concept is very similar to the biosecurity that we will cover later on.

Risk communication

This is the process of exchange of information and opinions on risk between risk analysts and stakeholders. Stakeholders in this context include all those who could be affected by the consequences of risks, that is, everyone from farmers to politicians. It is important that risk assessment and risk management strategies be fully discussed with stakeholders, so that they feel comfortable that no unnecessary risks are being taken and that risk management costs are a worthwhile insurance.

Value of Risk Assesments for Emergency Disease Prepardness

The type of risk assessment that has been described will be of value for:

- determining those emergency diseases for which there is the greatest need and urgency to prepare specific contingency plans. It is recommended that contingency plans be prepared for at least the three diseases considered to be of the highest priority;
- determining where and how quarantine procedures and biosecurity border controls need to be improved
- determining how laboratory diagnostic capabilities need to be strengthened;
- planning training courses for veterinary and other technical staff and producer awareness
- determining needs for vaccine banks or preparedness
- determining needs for disinfectants stockpile.
- determining how and where active disease surveillance needs to be strengthened.

Preventing the Entry of Disease: BIOSECURITY

The old maxim that “one ounce of prevention is better than a pound of cure” is particularly relevant to exotic animal diseases and it is also the base for the biosecurity concept. Biosecurity describes the biological condition of a defined system. What is it for a herd, production unit, country or enterprise to be “biosecure”? Biosecurity is relative – it definitely does not imply freedom from all disease or even, necessarily, attaining specific pathogen free status. Biosecurity does imply that the immediate biologic environment is under some reasonable control by management.

Biosecurity at national border controls along with quarantine measures should be regarded as one of the most important functions of government veterinary services. Foreign and other exotic animal diseases can be introduced to countries in many ways. These include entry of infected animals or germplasm (semen or ova), entry of contaminated animal products or biological products

(e.g.vaccines), contaminated food waste from aircraft or ships, infected people (in the case of disease transmittable to animals), migrating animals and birds, or even by natural spread of insect vectors or by wind currents. While governments may be powerless to prevent some of the latter methods of disease introduction, the others can be considerably mitigated by good biosecurity and efficient quarantine services.

Contingency plans

It is advisable that all nations have in place well-documented contingency action plans for specific, high-priority emergency diseases, together with a series of generic plans for activities common to the various specific disease contingency plans (example: setting up national and local animal disease control centres). They also need to have resource and financial plans and proper legislative backing for all actions. These contingency plans need to be considered and agreed upon in advance by all major stakeholders, including the political and bureaucratic arms of government and the private sector, particularly livestock farmer organizations. The contingency plans should be refined through simulation exercises and personnel should be trained in their individual roles and responsibilities.

Technical Contingency Plans

Technical contingency plans should consist of four sets of documents:

1. Specific disease contingency plans that document the strategies to be followed in order to detect, contain and eliminate the disease.
2. Standard operating procedures (SOP) and biosecurity protocols that may be common to several emergency disease campaigns.
3. Practical manuals that set out zoosanitary guidelines for enterprises that may be involved in an emergency animal disease outbreak.
4. Simple job description cards for individual officers.

These plans should be written in an easy to understand language that can be understood and followed by all those who have to implement them.

AUSVETPLAN (the Australian Emergency Disease Contingency Plan) provides a very good example of how to write such plans. AUSVETPLAN can be found at www.brs.gov.au./aphb/aha/ausvet.htm

Updating Contingency Plans

Contingency plans should not be treated as static documents. They should be regarded as living documents that need to be regularly reviewed and updated. This should be the responsibility of the national animal disease emergency planning committee. In reviewing and updating contingency plans, the following factors should be taken into account:

- changing epidemiological situations, both within the country and externally
- new disease threats
- changes in livestock production systems and internal or export trade requirements
- changes in national legislation or in the structure or capabilities of government veterinary services
- Practical experiences (both within the country and in border countries), results from training or simulation exercises and feedback from major stakeholders including farmers.

Of all the current policies for emergency disease control (EDC) and Contingency Plans the Australian and New Zealand governments employ the most authoritative approach with their AUSVETPLAN, which forms the basis for plans in other countries, including Canada, the USA and Mexico, as well as the Office International des Epizooties (OIE) – the world organization for animal health.

The AUSVETPLAN classifies eligible disinfectants into four categories and specifically cites eight products by name as being particularly suitable for emergency disease control (EDC). As shown in Table 1, nearly all the disinfectants selected by the AUSVETPLAN are so called ‘basic’ chemicals. Only one – Virkon S – is a modern formulated brand.

Category	Agents cited by name in AUSVETPLAN
Oxidising agents	Calcium hypochlorite / sodium hypochlorite (bleach) **Virkon S®**
Alkalis	sodium hydroxide (caustic soda, lye) sodium carbonate (soda lime, lime, washing soda)
Acids	hydrochloric acid (spirit of salts) citric acid
Aldehydes	glutaraldehyde formaldehyde gas / formalin

Table I. Disinfectants named in the AUSVETPLAN (2000)

Key Emergency Diseases

The OIE lists 15 animal diseases as 'List A'. These are defined as 'transmissible diseases with the potential for very serious and rapid spread, irrespective of national borders, that are of serious socio-economic or public health consequences and of major importance in the international trade of animals and animal products

- African horse sickness
- African swine fever
- Blue tongue
- Classical swine fever (hog cholera)
- Contagious bovine pleuropneumonia
- Foot and mouth disease
- Highly pathogenic avian influenza
- Lumpy skin disease
- Newcastle disease
- Peste des petits ruminants
- Rift Valley fever
- Rinderpest
- Sheep and goat pox
- Swine vesicular disease
- Vesicular stomatitis

Table 2. OIE List A diseases.

Disinfectant choice

One of the most important tasks within the biosecurity scheme is the to carry out disincfection protocols aim to achieve pathogen reduction to safe levels. When establishing a disinfection protocol it is essential to choose a world proven broad spectrum disinfectant.

Biological activity/approved uses.

In the critical early hours of an emergency disease outbreak, the diagnosis may not yet have been confirmed and it is vital that any disinfectant chosen can be used 'blind' – that is that its biocidal spectrum is broad enough to cover all possible causative pathogens.

Having a single tried and tested disinfectant on hand also greatly assists the training of first responders. Since nearly all the OIE List A diseases are viral, a broad virucidal activity spectrum is crucial.

Good independent comparative data for disinfectant efficacy against emergency animal diseases are surprisingly rare, but a useful indication is the dilution level approved by governmental bodies such as the UK's DEFRA (Department of the Environment, Food and Rural Affairs) (see Table 3).

Figures supplied are based on independent verified testing (the higher the number, the more potent the product and the less required).

Disinfectant	Foot and mouth disease orders	Swine vesicular disease orders	Newcastle disease orders
Virkon S	1:1300	1:200	1:280
Calcium hypochlorite	Not approved	Not approved	Not approved
Citric acid	1:500	Not approved	Not approved
Formaldehyde/formalin	1.9	1:9	Not approved
Glutaraldehyde based formulations	1:80	Not approved	1:200
Hydrochloric acid	Not approved	Not approved	Not approved
Sodium carbonate	1:24	Not approved	Not approved
Sodium hydroxide	Not approved	1:100	Not approved
Sodium hypochlorite	Not approved	Not approved	Not approved

Table 3. UK DEFRA approved dilutions for AUSVETPLAN named disinfectants against three representative OIE List A diseases (Note: the OIE itself currently has no official disinfectant recommendations

for its List A diseases, but simply states which non-formulated basic chemicals will inactivate the causative organisms).

It can be seen that, of the AUSVETPLAN named disinfectants, only Virkon S has UK DEFRA approval for all three representative OIE List A diseases, and is effective in all cases at high dilution. For disinfectant classes not specifically endorsed by the AUSVETPLAN – such as synthetic phenols, quaternary ammonium compounds (QACs), organic chlorine release compounds, biguanides and cresols – DEFRA approvals for OIE List A diseases are few and far between.

In many cases, these products completely fail to achieve the required biocidal standard or do so only at impractically high concentrations.

The AUSVETPLAN specifically recommends Virkon S for all viral OIE List A diseases where disinfection is recognised to be important, stating 'Virkon S has outstanding virucidal properties. It is an excellent disinfectant, active against all 17 virus families".

In the United States, Virkon S was the only product approved for foot and mouth preventative biosecurity during the UK foot and mouth epidemic of 2001, and the US Department of Agriculture/Animal and Plant Health Inspection Service (USDA/ APHIS) secured rapid approval from its sister organisation, the US Environmental Protection Agency (US EPA), for additional uses of Virkon S including vehicle and footwear disinfection.

Virkon S now has US EPA official labelling for more OIE List A diseases than any other disinfectant and, during the 2001 UK foot and mouth outbreak, it was used at border controls by over 30 countries. See table 4.

Countries / authorities using Virkon® S at border controls during the 2001 UK FMD outbreak (Table 4)

Australia (AQIS)	Guernsey (States of Guernsey)	Peru
Argentina (SENASA)	Hungary (MARD)	Philippines
Barbados & St Kitts (Min of Ag)	Iceland (Min of Ag)	Romania (Nat San Vet Agency)
Canada (CFIA)	Ireland (DAFRD)	Slovak Republic
Central America (OIRSA)	Italy (MINSAN)	Slovenia (Vet. Admin. RS)
Chile	Japan (MAFF)	South Africa (Nat. Dept of Ag)
Cyprus (MoANRE)	Korea	Spain (Regional authorities)
Denmark (Min of Ag)	Macedonia	Sweden (Min of Ag)
Ecuador	Mexico (SAGAR / CICOPLAFAST)	
Estonia (State Vet Dept)	Malta (MAPH)	

Finland France (DSV) Greece (Min of Ag)	New Zealand (MAF) Northern Ireland (DARD) Norway	Taiwan (BAPHQ) Trinidad (Min of Ag) Uruguay (MGAP) UK (DEFRA) USA (USDA APHIS, USAF)

Features of an Ideal Emergency Disease Control Disinfectant

a. **Biological activity / official approved uses**
   - Government / regulatory body approved uses
   - Virucidal spectrum of activity
   - Bactericidal spectrum of activity and surfactancy (ability to penetrate / destroy bacterial biofilms)

b. **Environmental and climatic variables: effect on efficacy**
   - Effect of heavy soiling (high organic challenge)
   - Effect of temperature extremes
   - Effect of dilution (e.g. rainwater)
   - Effect of hard water
   - Effect of pH
   - Effect of other chemicals

c. **Health, safety and the environment**
   - Human health and safety issues
   - Use in presence of livestock
   - Effect on environment

d. **Practicalities of usage**
   - Contact time needed
   - Stability after mixing / preparation
   - Metal corrosion / potential for damage to buildings, equipment or vehicles
   - Suitability for contingency storage / stockpiling

Table 5: Factors to consider when selecting a disinfectant for EDC usage

In the US, the national Department of Agriculture / Animal & Plant Health Inspection Service (USDA APHIS) secured rapid approval from its sister organisation, the US Environmental Protection Agency (US EPA), for use of Virkon S as a foot-and-mouth preventative disinfectant during the UK epidemic of 2001. Virkon S now has US EPA official labelling as an approved EDC disinfectant for 7 out of the 15 OIE List A diseases (Table 6) - at least five more than any other disinfectant - and was used at border controls by over thirty countries worldwide during the 2001 UK foot and mouth disease outbreak

OIE List A disease	Causative organism	Reference test organism*	Dilution	Test country	US EPA EDC label
African Horse Sickness	Orbivirus (Reoviridae)	Avian reovirus (Reoviridae)	1:200	UK	Yes
African Swine Fever	African Swine Fever Virus (Iridoviridae)	Causative organism	1:800	UK	Yes
Bluetongue	Orbivirus (Reoviridae)	Avian reovirus (Reoviridae)	1:200	UK	
Classical Swine Fever (hog cholera)	Pestivirus (Flaviviridae)	Causative organism	1:150	UK	Yes
Contagious Bovine Pleuro-pneumonia	Mycoplasma mycoides var. mycoides	Mycoplasma gallisepticum	1:200	USA	
Foot and Mouth Disease	Aphthovirus (Picornaviridae)	Causative organism	1:1300	UK	Yes
Highly Pathogenic	Influenzavirus (Orthomyxo-	Causative	1:320	UK	Yes

Avian Influenza	viridae)	organism			
Lumpy Skin Disease	Capripoxvirus (Poxviridae)	Orthopoxvirus (Poxviridae)	1:100 1:1000	France Italy	
Newcastle Disease	Avian paramyxo-virus (Paramyxo-viridae)	Causative organism	1:280	UK	Yes
Peste des Petits Ruminants	Morbillivirus (Paramyxo-viridae)	Avian paramyxo-virus (Paramyxo-viridae)	1:100	USA	
Rift Valley Fever	Phlebovirus (Bunyaviridae)	Causative organism	1:400	UK	
Rinderpest	Morbillivirus (Paramyxo-viridae)	Avian paramyxo-virus (Paramyxo-viridae)	1:100	USA	
Sheep and Goat Pox	Capripoxvirus (Poxviridae)	Orthopoxvirus (Poxviridae)	1:100 1:1000	France Italy	
Swine Vesicular Disease	Enterovirus (Picornaviridae)	Causative organism	1:200	UK	
Vesicular Stomatitis	Vesiculovirus (Rhabdoviridae)	Rabies virus (Rhabdoviridae)	1:1600	UK	Yes

Table 6. Current Virkon S efficacy data against all OIE List A diseases

Dilutions given are maximum approved dilutions.

- *In cases where it was not possible to test against the causative organism, a related organism from the same virus family was substituted.*

Preparation: stockpiling of biocides

An bio-terrorist attack would cause major demands on emergency services and the supply of emergency resources. The only preparation for such a crisis would be the advanced stockpiling of all the resources that would be required in large amounts.

As well as antibiotics and vaccines, disinfectants will need to be stored as a contingency using proven biocides with long stability. From our unique global experience in **Emergency Disease Control** and **Biosecurity** we know that the demand for disinfectants increases dramatically in the first few hours of a disease outbreak. For example, in the Foot and Mouth Disease outbreak in the UK demand for disinfectants increased 30 times in the first 24 hours!

Without stockpiling, no government or commercial response could provide sufficient disinfectants when faced with an infectious agent bioterrorrist attack.

Follow up response: rapid delivery in large volumes

A high level of demand for disinfectants will continue for weeks after an outbreak and thus rapid global logistics are also a key part of any prepardness plan. Antec has successfully responded to emergency disease outbreaks around the world delivering large volumes of Virkon S and other disinfectants at short notice - often ahead of local manufacturers.

Environmental and climatic variables: effect on efficacy.

For a disinfectant to work on farms it must be able to penetrate organic materials such as soil, straw, milk, blood and manure, which can inactivate some disinfectants or protect micro-organisms from their effects.

Chlorine based disinfectants (such as sodium and calcium hypochlorite) and citric acid are particularly susceptible to this pitfall (as are most quaternary ammonium compounds, synthetic phenols, iodophors and biguanides).

Even hard water can reduce or destroy the activity of some disinfectants. Farmers also need to ensure that the disinfectants they use will remain active in different operating temperatures. Formaldehyde is particularly badly affected by cold and is unable to stop bacterial growth – even at double the usual dilution – when temperatures fall to 10ºC. The same applies to glutaraldehyde. Conversely, decomposition of hypochlorite disinfectants (for example bleach) is accelerated by heat.

Health, safety and the environment.

When using disinfectants, the safety of operatives, animals and consumers is paramount.

A number of basic chemicals are highly corrosive, irritant and possibly carcinogenic and the higher concentrations often required for adequate activity exacerbate these problems.

Sodium hydroxide, hydrochloric acid, the aldehydes and hypochlorites all pose a serious threat to human and animal health, requiring stringent precautionary measures and use only in depopulated livestock housing.

In addition, glutaraldehyde, sodium carbonate, citric acid and the hypochlorites are known ecological hazards, with detrimental effects on plants and aquatic life.

In contrast Virkon S has been recognised as environmentally friendly and is over 90% biodegradable.

It has no significant health and safety concerns, with the AUSVETPLAN stating only that ‘reasonable care is necessary’ during use (see Table 7).

Disinfectant	Health aspects	Environmental problems and contraindications
● Virkon S	Reasonable care necessary	
● Hypochlorites (calcium and sodium)	Toxic for eyes and skin	Strong bleach. Inhibited by high concentrationsof organic matter. Corrosive for many metals.
● Sodium hydroxide	Highly caustic for eyes and skin	Avoid contact with strong acids. Can not be used on aluminium or like alloys.
● Sodium carbonate	Mildly caustic for eyes and skin	
● Citric acid	Care needed due to irritancy	Corrosive for soft metals
● Hydrochloric acid	Toxic for eyes, skin and respiratory passages	Corrosive for many metals and concrete. Avoid contact with strong alkalis.
● Glutaraldehyde	Avoid eye and skin contact	
● Formalin solution	Releases toxic gas that irritates mucous membranes	
● Formaldehyde gas	Very toxic for mucous membranes in concentrations down to 2ppm	Can not be used in presence of water, hypochlorites or chlorides. Cannot be released to atmosphere without neutralisation. Corrosive for some metals.

Table 7. Special considerations needed when using disinfectants in the AUSVETPLAN.

Most Recent Experience from Antec International Ltd. in California, USA

California, USA, February 4th 2003.

In response to the escalating Exotic Newcastle Disease crisis in California - which has so far required the slaughter of over two million birds - Antec International has dispatched by air freight over 20 tons of Virkon S from its UK base to meet increased disinfectant demands in the troubled state. The supplies arrived in the US on Friday 31st January and will be followed by a further 100 tons sent via sea freight.

The decision to initiate emergency shipments came on Monday after Antec staff were notified by USDA* veterinarians that vital disinfectants necessary to combat the spread of Newcastle Disease were in critically short supply. Antec responded immediately and within 24 hours a shipment of 1,000 cases of Virkon S (enough to make over 1.5 million gallons of disinfectant) was on its way to the Memphis warehouse of Antec's US partner for immediate dispatch to California.

Newcastle Disease was first confirmed in California in October 2002 and rapidly spread beyond backyard flocks to affect commercial poultry operations. As of this month, it has also been detected in the state of Nevada.

While posing no danger to human health, Newcastle Disease is one of the most feared diseases of commercial poultry and egg producers. Classified as an emergency disease ("List A") by the OIE, the disease - once confirmed in a flock - can only be controlled by the slaughter of affected and potentially exposed birds.

Earlier this month Antec issued a Product Information Bulletin confirming that Virkon S can be used against Newcastle Disease at the higher dilution of 1:256 , making the world's most proven veterinary biosecurity disinfectant even more cost-effective. Virkon S is suitable for use on surfaces such as wood (the predominant construction material for poultry housing) and is appropriate for both vehicle and bootbath disinfection. With more US EPA* label claims against the OIE List A viruses than any other product, Virkon S is widely recognized globally as the disinfectant of choice for governments keen to secure their farm animal and border biosecurity.

References:

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- European Commission: Health and Consumer Protection Dictorate General – Food and Veterinary Office
- FAO - Manual of Preparation of National Animal Disease Emergencies
- OIE – Disease Cards
- EMPRES – Emergency Protection System
- Antec International Ltd. – Emergency Disease Control Biosecurity Programmes
- CEI – Center for Emergency Issues in Animal Health
- National Biosecurity Resource Center for Animal Health Emergencies
- J. GADD – Biosecurity for the 21st Century.
- Antec International Ltd. web site at www.antecint.com