Province of Saskatchewan

Malignant Catarrhal Fever Task Force

Final Report to the Saskatchewan Minister of Agriculture

December 2011

TABLE OF CONTENTS **Page**

1.0 PREFACE

Malignant Catarrhal Fever Task Force Members:

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Mandate:

To study Malignant Catarrhal Fever and develop recommendations for government and industry to effectively manage the disease in Saskatchewan.

The members of the Task Force come from a variety of backgrounds and include members of industry, government and academia. While none are "MCF experts" per se, this Task Force includes experts in animal health and livestock disease in general and key representatives from industry organizations in Saskatchewan. Therefore, the Minister and the public can be confident that the recommendations resulting from this Task Force are based on science, fact, and the best interests of livestock industries and the Province of Saskatchewan.

The Saskatchewan Minister of Agriculture created this Task Force in response to concerns voiced by industry members in Saskatchewan over the potential risk of MCF occurring in bison as a result of exposure to sheep. While MCF occurs infrequently in this province, both the bison and sheep industries are experiencing a period of growth. The expansion of these industries will undoubtedly put these two species in some degree of proximity more frequently in the future.

The Task Force first met on March 9, 2011 and agreed on the following terms of reference:

1. Perform an international literature/scientific review to understand the global science on MCF.
2. Perform a jurisdictional review to determine if any States or Provinces are currently managing MCF through policy or local/State/provincial regulation.
3. Perform a scope review to determine other, similar species to species disease risks.
4. Develop recommendations for the Minister of Agriculture and industry.

2.0 EXECUTIVE SUMMARY

Malignant Catarrhal Fever (MCF) is a disease of livestock, primarily ruminants, caused by a herpes virus. In North America MCF is primarily caused by the ovine herpes virus-2 (OvHV-2), which is carried by sheep but does no harm to the sheep. In other susceptible species such as bison, however, the virus causes fatal disease for which there is no treatment and no vaccine.

Sheep are very susceptible to OvHV-2, and it is assumed that most sheep in North America are carriers. Once infected, sheep remain carriers of the virus for life. They shed the virus mainly through respiratory secretions. Adult sheep may shed the virus periodically, especially during times of stress; however, lambs aged 6-8 months of age shed large amounts of virus and are considered the main source of virus transmission. Bison are also very susceptible to the virus but are dead-end hosts; that is, although bison may develop MCF, they do not shed the virus and thus pose no risk to other animals.

Several large outbreaks of MCF in farmed bison have been reported in the literature, which demonstrate aerosol spread of virus from sheep to bison. Although these reports typically involved either close contact between the species or large numbers of animals in feedlot settings, they are often touted as evidence for the need to create buffer zones to keep the species separated for MCF prevention. However, none of these reports contain information that justifies the need for kilometers-wide buffer zones between bison and sheep raised in non-intensive management systems.

Biosecurity in livestock production involves management practices designed to minimize disease transmission into, within, and out of groups of animals. For most modes of disease transmission, biosecurity practices can be put in place to minimize the risk of disease transmission. Aerosol transmission presents a unique challenge to livestock producers, since in most instances it is difficult, if not impossible, to control the airspace entering and exiting livestock premises. Many important livestock diseases, including MCF, can be spread over distances via aerosols. Producers of all livestock species need to be informed about relevant disease risks and become knowledgeable about management practices, which can minimize the risk of diseases such as MCF in their animals.

MCF is listed as a notifiable disease in the province of Alberta; however, this is for monitoring and information purposes only, and does not involve disease control. There is currently no policy in place in Canada related to the control of MCF.

In the USA, MCF is designated as a reportable disease. This designation is not directly related to sheep-associated MCF. The wildebeest-associated form of MCF is considered a foreign animal disease (FAD) in that country; therefore, all cases of MCF are investigated to ensure they do not involve the wildebeest-associated virus. Also, the vesicular form of MCF closely resembles several other diseases such as Food and Mouth Disease and Vesicular Stomatitis, which are also FADs. Once epidemiological investigations determine that MCF is caused by OvHV-2, no further action is taken. Following the Federal lead, many states have also designated MCF as reportable. From the available information, states also do not take further action once OvHV-2 is confirmed, though some states do take the opportunity to educate producers and provide recommendations for preventing further disease.

Fortunately, MCF is rarely confirmed in farmed bison in Saskatchewan. Typically, only one or two cases are diagnosed each year, if at all. Regrettably, concern over the *potential* for serious outbreaks, combined with a lack of understanding of this disease, can pit neighbor against neighbor, producer against producer. At issue is the transmission of virus over distances, which is poorly understood. Research into the risk of MCF in bison that are kept in varying degrees of proximity to sheep under normal production conditions is needed to address this knowledge gap.

Until such time as an effective vaccine is available, education and awareness will be key to MCF prevention. First and foremost, producers need to be aware of this disease; if they do not know the disease exists, they assuredly cannot take measures necessary for MCF prevention. It will take ongoing and collaborative efforts by the Province and by industry to ensure that bison and sheep producers in Saskatchewan remain cognizant of this disease and are provided with the knowledge and tools needed to minimize the risk of MCF in bison.

2.1 Summary of Task Force Recommendations

(The full background on each recommendation can be found in Section 6, beginning on page 27)

Recommendation #1

The Task Force recommends that the Government of Saskatchewan create a Provincially Notifiable animal disease list, which incorporates MCF as well as other livestock diseases of importance to the Province and to provincial livestock industries. This list should be created in consultation with all livestock industries in Saskatchewan.

Recommendation #2

The Task Force recommends that the Government of Saskatchewan support research into causes of mortalities in bison that are kept in varying degrees of proximity to sheep; specifically, a case-control study is recommended whereby mortalities in bison which are pastured in the vicinity of sheep are compared to mortalities in bison which have no known exposure to sheep. This research should be planned in consultation with the Saskatchewan bison and sheep industries to ensure this research meets the needs and concerns of these groups.

Recommendation #3

Given that the current funding agreement expires March 31, 2012, the Task Force recommends that the Government of Saskatchewan renew the agreement for the Disease Investigation Unit at the Western College of Veterinary Medicine (WCVM). Furthermore, the Task Force recommends that the Government of Saskatchewan work with members of the Disease Investigation unit to increase awareness in Saskatchewan about the role and utility of this unit for the investigation of unusual illness and deaths in livestock, including MCF in bison.

Recommendation #4

The Task Force recommends that the Saskatchewan bison and sheep associations develop and deliver the following initiatives for the prevention of MCF:

a. Ongoing education and awareness on MCF
b. On-farm biosecurity programming to help minimize potential for MCF
c. Development of biosecurity standards, where national standards are not already in place or under development
d. Development of best practices documents, for the prevention of MCF and other important diseases:
    i. on-farm
    ii. auction markets
    iii. livestock transporters

Furthermore, the Task Force recommends that the Government of Saskatchewan provide financial support to the bison and sheep associations in Saskatchewan to aid in the development of these initiatives. Financial support should include allowance for infrastructure, so that these associations have the capacity to deliver the above initiatives in addition to being able to effectively respond to important emerging industry issues like MCF in the future

Recommendation #5

The Task Force recommends that the Government of Saskatchewan and the Saskatchewan bison and sheep associations develop and maintain processes to ensure that MCF education and awareness continues to be a priority in the future, and that consultations with animal health experts and industry occur when livestock disease issues arise.

3.0 AN OVERVIEW OF MALIGNANT CATARRHAL FEVER

INTRODUCTION

Malignant Catarrhal Fever (MCF) has been well reviewed in the past. This review should be considered a layperson summary of some of the more important points. References, including in-depth and formal published reviews, are available on request.

MCF is a disease of livestock caused by a herpes virus. MCF differs from many of the more commonly known diseases of livestock in that it is carried by one species (mainly sheep) in which it does not cause disease, but can infect other species with the possibility of fatal disease.

There is more than one type of MCF. The classical form of the disease is seen in cattle in Africa where the virus is carried by wildebeest. This is known as wildebeest-associated MCF (WA-MCF). The virus causing the disease has been identified as the alcelaphine herpes virus-1 (AlHV-1). Although this disease is of significance on the African continent it has no relevance to agriculture in North America. The other form of the disease is sheep-associated MCF (SA-MCF) caused by ovine herpes virus-2 (OvHV-2), which is present in North America as well as the rest world. There have been reports of this virus affecting a number of species, which will be reviewed below.

It should be noted that the herpes virus family is very large and contains a number of species-specific viruses affecting many mammals. MCF is not zoonotic (it does not transmit to humans).

VIROLOGY

The MCF viruses are classified in a subfamily of herpes viruses, known as gamma-herpes viruses. All herpes viruses share several common characteristics. The virus itself has a lipid (fatty) membrane. This virus can exist outside the host for only a short period of time. The exact length of time is dependent on factors such as temperature and humidity. In general, these viruses require close contact between individuals to spread and their ability to spread on the wind or via inanimate objects such as clothing or equipment is limited.

The second common characteristic of herpes viruses is latency. When a herpes virus infects an individual, the body’s immune system clears the virus in the normal way. However, some virus hides from the immune system in nerve cells in an inactive (latent) state; some time later (months to years), when the individual is stressed or immunosuppressed, the virus can reactivate. The reactivated virus may cause disease or it may simply be shed without causing any clinical signs, potentially causing disease in other, naïve individuals.

It should be noted that there are other strains of MCF viruses that have been described. These are rare and are not currently considered a significant threat to agriculture. They include:

- Hippotragine herpesvirus-1 - recovered in culture from cells of a roan antelope, which was able to experimentally cause MCF in rabbits.

- A herpesvirus has been detected in white-tailed deer showing clinical signs of MCF and with anti-MCF antibodies, but no detectable AlHV-1 or OvHV-2 DNA. The MCF virus of white-tailed deer has been characterized by limited sequencing of its DNA, but its natural reservoir has not been identified.
- Caprine herpesvirus-2 appears to be present in some goat populations and has been associated with MCF-like lesions in a range of deer species.
- Evidence of new, species-specific MCF viruses has been found in musk ox, ibex, and gemsbok; however, the ability of these viruses to cause clinical disease has not been determined.

MCF DISEASE IN DIFFERENT SPECIES

MCF in sheep:
The virus in sheep appears to be shed in many secretions including: respiratory, intestinal and genital. The majority of lambs are infected shortly after weaning. By one year of age approximately 80% of lambs will be positive for OvHV-2. Once infected with OvHV-2, sheep remain infected for life; however, they only shed the virus intermittently for short periods of time e.g. during periods of stress. It would appear that lambs aged 6-8months of age are the main shedders of virus. The infection of MCF in sheep is without clinical signs.

MCF in cattle:
Although the link between sheep and cattle for the development of MCF is not disputed it is apparent that it is not very easy to transmit the disease. Very high quantities of virus are required to reproduce the disease experimentally. Cattle cannot transmit MCF to each other.

The disease is extremely sporadic. There are large parts of the world where cattle and sheep are kept in very close proximity and are used in rotational grazing systems. Even in these situations the disease is extremely rare. The significance of MCF to the cattle industry is negligible.

MCF in deer:
No other country has had as much experience with MCF in farmed wildlife as New Zealand. From 1979 – 1985 MCF was one of the most commonly diagnosed diseases in New Zealand deer; however, since then the incidence of disease has been falling. The disease in deer was associated primarily with stress such as recent capture, poor nutrition and transportation. An understanding of this association and a change in management to reduce stress has resulted in a significant reduction in disease.

MCF in swine:
Although there have been a number of reports of isolated cases of MCF in swine from Europe and one case from North America, these cases are extremely rare and appear to have occurred only when sheep and pigs were placed in almost nose-to-nose contact. This close proximity is something that cannot occur on the modern pig farm with even the most basic biosecurity measures. This disease does not therefore pose a threat to modern swine production.

MCF in zoological collections:
MCF has been a problem in a variety of exotic ungulate species in zoological collections due to the fact that many varied species are kept in close proximity. This model has limited value for agriculture.

MCF in bison:
Bison appear to be at least 1000 times more susceptible to MCF than cattle; that is, experimentally, it takes 1000 times more virus to cause disease in cattle than it does in bison.

There are a number of case reports documenting significant disease outbreaks in bison. In all cases of MCF in bison the OvHV-2 virus has been found. In most cases there was reported exposure of bison to sheep, but not all. It is not clear from the literature what the exact risk to bison of exposure to sheep is.

Several key documented exposures include:

Saskatoon auction market:
On November 7^{th}, 2000, 163 bison were assembled from eight farms for a sale. The bison were assembled over the 48 hours preceding the sale. On November 6^{th}, 216 sheep were assembled for transport to slaughter in Alberta. The sheep and bison were never in direct contact but shared a common airspace. Also, there was a great deal of traffic between the two animal groups. After the sale bison were transported to 11 different farms. Forty-five of the bison went on to die of MCF in the first 50 days after the sale; the last death occurred 220 days after the sale. No cases of MCF were seen on source farms and only animals from the sale developed disease.

It is assumed that the bison contracted the virus from the sheep at the auction yard and then went on to develop disease. Bison, being a dead-end host, did not transmit the disease to other animals.

Western United States:
A report was published in 2008 regarding MCF in a large bison herd that was managed in three separate sub-herds. A sheep feedlot in close proximity was filled with 20,000 six- to seven-month old lambs in early November. The bison herds were situated 1.6 – 5.1 km north or north-west of the sheep. From the middle of December through the end of May, 60 bison died of MCF (mortality rate 7.9%). The largest number of deaths occurred in the herd nearest the feedlot. All bison were then moved to a feedlot with no contact with sheep. A further 30 unconfirmed deaths were reported in these animals.

The spread of the virus in this case was against the prevailing wind. There was no evidence of human travel between the farms. The authors hypothesize that birds may have acted as a vector.

Idaho bison feedlot:
On December 12, 2002, a flock of 1375 seven month-old lambs and 375 ewes was moved into an area adjacent to 1610 bison in a feedlot. The sheep were grazed within 600m of the bison during the day and bedded only 30 m away at night. The sheep remained in this area for 19 days. Twenty-five days after the sheep left, an additional 177 bison were added to the group. Six weeks after exposure to the sheep bison began to die of MCF. Deaths continued up to 139 days after

exposure, with total losses of 825 bison (51% mortality). None of the 177 bison added after the sheep were removed developed disease.

Based on these three case reports several conclusion may be drawn:

- Large outbreaks of MCF appear to occur primarily when animals are under stressful conditions e.g. feedlots and auction markets, which involve mixing of animals and transport of animals, situations which are known to cause stress.
- MCF in bison appears to largely occur during late fall; this is probably when most lambs are at the critical 6-8 months of age. It may also coincide with stresses in bison.
- MCF outbreaks in bison are associated with close exposure to large numbers of lambs.
- Although bison-to-bison spread of the disease does not seem to occur, exposure to the virus from sheep in feedlot settings or in close contact can result in substantial losses.

The situation of MCF in bison is somewhat complex. In particular, antibodies to OvHV-2 have been found in bison herds that have not been exposed to sheep in generations; this suggests that there may be some form of MCF virus circulating in bison unrelated to exposure to sheep. Whether this virus is associated with disease is not known. There is the possibility that there are other MCF viruses circulating in the wild ungulate population that may contribute to the disease. Furthermore, antibodies to OvHV-2 have been found in healthy bison which never develop MCF, suggesting that exposure to the virus does not necessarily mean animals will develop the disease.

At this time there is no obvious vaccine development program to aid in the control of MCF. Researchers in the western United States are conducting research in this area, but there is no potential vaccine against MCF in bison on the horizon for at least the next five to ten years.

MCF IN BISON IN SASKATCHEWAN AND CANADA

MCF virus can be detected by a polymerase chain-reaction test (PCR). For most of western Canada, requests for testing are sent to Prairie Diagnostic Services (PDS) laboratory in Saskatoon. The results of all testing are recorded in their database system; this database was searched for all MCF testing of Saskatchewan bison, from 1998 to 2011.

From 1998 to 2011, testing confirmed MCF in 43 cases in Saskatchewan. The majority of these were related to the auction market incident in 2000, with 22 laboratory confirmed cases related to that outbreak in 2001. Several cases diagnosed late in 2000 were also related to this outbreak.

Other than in 2001, the number of laboratory confirmed MCF bison cases in Saskatchewan ranged from zero to four cases per year. Excepting the auction market outbreak, annual number of cases is comparable to that of Alberta (Table 1).

Table1: Laboratory confirmed cases of MCF in Canadian bison from 1998-2011

	Number of cases				
Year	**AB**	**BC**	**ON**	**SK**	**TOTAL**
1998	0	0	0	0	0
1999	0	0	0	2	2
2000	0	0	0	4	4
2001	8	4	0	24	36
2002	2	0	0	4	6
2003	0	1	0	2	3
2004	0	0	1	1	2
2005	0	0	0	1	1
2006	2	0	0	1	3
2007	2	0	0	2	4
2008	0	0	0	0	0
2009	0	0	0	0	0
2010	0	0	0	1	1
2011	0	0	0	1	1
TOTAL	14	5	1	43	63

MCF testing is also done at the laboratory in Abbottsford, BC; therefore, an inquiry was made to determine if any cases of MCF in bison had been diagnosed at that laboratory. The laboratory's database is only searchable back to 2007, and from that time until present no MCF was diagnosed in bison submissions.

It should be noted that these data (PDS and Abbottsford) relate only to laboratory submissions and, therefore, cannot be used to draw conclusions about the true incidence of MCF in bison in Saskatchewan and Canada. However, it can be concluded that MCF appears to occur infrequently and sporadically in this province and does not represent a substantial threat to the Saskatchewan bison industry as a whole.

CONCLUSIONS

A comprehensive review of the available published literature and laboratory data on MCF in bison led to the following conclusions:

- With the exception of an outbreak related to exposure to sheep at an auction market in 2001, MCF has seldom been confirmed in bison in Saskatchewan;
- The greater majority of sheep above weaning age should be considered infected with OvHV-2;
- Fattening lambs aged 5-8 months should be considered at the greatest risk of shedding the virus in large quantities;
- MCF represents a minor risk to cattle and a negligible risk to the modern swine industry;

- Bison are highly susceptible to OvHV-2. The disease appears to be universally fatal in bison;
- Bison are dead-end hosts and do not appear to transmit the virus to other bison;
- In the absence of a vaccine it is necessary for the two industries to co-exist by developing biosecurity guidelines to minimize the contact between bison and sheep (especially fattening lambs).
    - Bison and sheep should never be managed where there is direct contact between the species or where they share a common enclosed airspace.
    - Individuals should never move directly between sheep and bison without washing hands, changing coveralls and disinfecting boots.
    - Any equipment moving from sheep to bison should be cleaned, disinfected and allowed to dry before coming into contact with bison.
    - Special care is required when dealing with fattening lambs. Large lamb feedlot operations should never be situated within proximity of bison;
    - It is not possible to give an absolute safe distance between sheep and bison. The risk increases with the number and the age of sheep. The virus can travel significant distances if there is a large source of virus and the weather conditions favor virus survival. It has been suggested that birds may contribute to the long-distance spread of the virus; however, this has never been investigated or proven.

4.0 REVIEW OF AEROSOL SPREAD OF DISEASE IN LIVESTOCK PRODUCTION

INTRODUCTION

Infectious diseases of livestock can be transmitted a number of different ways. Modes of transmission include direct (e.g. nose-to-nose contact), indirect (e.g. transferred from one animal to another on equipment, clothes, etc), fecal-oral (e.g. manure contaminates feed or environment and is ingested), vector (e.g. mechanical spread by insects or by biting insects), and aerosol (e.g. airborne particles or droplets) spread.

Biosecurity in livestock production involves management practices designed to minimize disease transmission into, within, and out of groups of animals. For most of the above modes of disease transmission, biosecurity practices can be put in place to minimize the risk of disease transmission. Aerosol transmission presents a unique challenge to livestock producers, since in most instances it is difficult, if not impossible, to control the airspace entering and exiting livestock premises.

DEFINITIONS

AEROSOL: Solid or liquid particles suspended in air e.g. smoke, dust, fog.

INFECTIOUS AEROSOL: An aerosol comprising of particles, which include pathogenic microorganisms and therefore have the potential to transmit disease between individuals

PATHOGEN: Any organism or substance, especially a microorganism, capable of causing disease, such as bacteria, viruses, protozoa or fungi

PLUME: An area in air, water, soil, or rock containing pollutants released from a single source. A plume often spreads in the environment due to the action of wind, currents, or gravity.

ZOONOTIC DISEASE: Disease that can be transmitted from animals to people.

AIRBORNE DISEASE TRANSMISSION

Airborne transmission is possible with most infectious diseases; however, it is more likely to occur in certain diseases rather than others. Infectious aerosols can either originate from liquids (as droplets) or from dry matter. Droplets evaporate quickly; the remaining material is very small and light and can therefore remain airborne for long time periods. These small particles are easily inhaled and thus play a key role in airborne disease transmission.

Infectious aerosols are produced by infected animals via sneezing and coughing, with sneezing generating over twice as many particles as coughing. Infectious particles can also be exhaled through normal breathing, though in lower amounts. Aerosols can also be caused by urine splashes or spraying, such as high pressure cleaning of premises or spread of manure, or by the agitation of manure, bedding or feed. The highest concentration of aerosol particles in animal operations is found during the day when animals are most active. The concentration of infectious particles in aerosols is directly related to the "strength" of the source. That is, the higher the number and concentration of infected animals on a farm or in a region, the higher the concentration of the infectious aerosols.

Once an aerosol is generated, the survival of the infectious particle is influenced by the climate, as well as the nature of the pathogen involved. Some viruses have a protective coating (envelope), making them more resistant to environmental factors and thus able to survive longer in the air. Some pathogens survive better in lower relative humidity (RH), while others do better in higher RH. In general, all aerosols become unstable at a RH of 85% or higher (e.g. will start to settle out). Temperature is also important, as there tends to be higher concentrations of airborne particles as well as increased survival of some airborne pathogens at lower temperatures. Other things that may decrease the survival of airborne pathogens include radiation, ozone reaction products, air ions and pollutants. There is little available research on the effect of these factors since they are technically difficult to study.

How far infectious aerosols travel is influenced by climate and by methods by which particles settle out or are removed from the air. Aerosol plumes can differ significantly in both the distance and direction they travel and in the amount of time they remain suspended. Generally, longer distances are traveled in stable conditions; that is, turbulence (created by high wind speed, rough or uneven terrain, obstacles, etc) causes plumes to disperse. On the other hand, plumes may be created by turbulent conditions that can pick up and spread contaminated dust particles. Particles may be removed from the air by moisture (e.g. fog or rain), or by contact with the ground or with other objects such as windbreaks. Of course, gravity plays a major role and heavier particles are the first to be removed from the plume.

Essentially, for infectious particles to travel over long distances and survive, cool, damp, calm conditions without sunlight and flat, vegetation-free areas or water are required. Once the pathogens reach animals that are likely to be affected, whether or not disease occurs in the exposed animals depends on a number of additional factors. If only low numbers of bacteria or virus are needed to produce disease, then exposed animals are more likely to be infected. Some animals are much more likely to be infected, due to differences in species of the animal (e.g. horses vs. cattle), or differences at the animal level (e.g. stressed individuals are more likely to get sick). The probability of disease transmission also varies on the number of susceptible animals. The more animals exposed to the infectious aerosol, the more likely it is at least one of them will be infected.

AIRBORNE DISEASES OF LIVESTOCK

To date, few livestock diseases have been thoroughly investigated with respect to characteristics contributing to airborne spread, mainly because the required experiments would be technically difficult and too expensive to carry out. Most of the time, evidence for airborne transmission comes indirectly based on observed outbreaks. If disease investigations find that herd size/animal density and distance between herds to be important factors in the outbreak, then aerosol transmission is likely to be involved.

Bacterial diseases:

In any aerosol, heavier particles are the first to settle out, leaving lighter particles to be carried further downwind. Bacteria are generally much larger (0.2 – 50 µm) than viruses (<0.02 µm), and naturally settle out of aerosol plumes faster. It is likely that this is part of the reason why aerosol transmission of bacterial disease is not as frequently reported as viral disease transmission. However, bacteria aerosols can and do occur and may be involved in disease transmission. Some bacteria form spores that are particularly resistant to dehydration and can survive for a long time in the environment and in aerosols. Some examples of aerosol spread of bacteria are provided below.

Q Fever:

Q fever is a zoonotic disease that occurs worldwide and is caused by the spore-forming bacteria *Coxiella burnetii*. Ticks are the primary reservoir for this disease and spread the organism to both wild animals and livestock. Of livestock, cattle, sheep, and goats are primarily affected; however, infection has been noted in other species of livestock and in domesticated pets. Infected animals shed the organism in birth products, feces, milk and urine. This can result in contaminated dust or aerosols in which *C. burnetii* survives for a long periods, providing the potential for aerosol transmission to humans and other animals. The LD_{50} for this disease is one; that is, it only takes one bacteria to produce disease in 50% of exposed individuals, making this one of the most infectious organisms known to man.

Clinical signs of *C. burnetii* infection are abortion in sheep and goats, and reproductive disorders in cattle. In humans, acute infection may present as an influenza-like illness and/or atypical pneumonia. Abortions, stillbirth, or pre-mature deliveries in pregnant women can also occur. Long-term effects may be seen, such as chronic fatigue syndrome, hepatitis, heart disease and death.

Aerosol transmission of Q fever has been well recognized. In 1989, an outbreak of Q fever was documented in 147 people in the United Kingdom. Cases were identified up to 10 miles downwind of farm operations where *C. burnetii* was known to be a problem in livestock operations. In 1996, a town in Germany experienced an outbreak of Q fever, whose origin was traced to a large sheep farm upwind from the town. Also in 1996, an outbreak occurred in France where the source was traced to aerosol transmission from a contaminated slaughterhouse. In 2005, 144 boarding school students in Israel became sick after exposure to *C. burnetii*. Aerosol spread of the disease occurred through the ventilation system; however, the source of the disease was never determined. More recently, in the Netherlands (2009) an outbreak of Q fever was reported in persons living within 2 km of an infected goat farm. While this is not an exhaustive list of documented Q fever outbreaks in humans, the list is more than sufficient to illustrate the long-distance aerosol spread of this pathogen and highlights the risk this mode of transmission poses to public and animal health alike.

E. coli:
Escherichia coli (*E. coli*) is a bacterium that is commonly found in the lower intestine of warm-blooded animals. Most *E. coli* strains are harmless; however, some strains such as serotype O157:H7 can cause serious food poisoning in humans. This strain causes an estimated 70,000 illnesses per year in the United States and can result in hemolytic-uremic syndrome and death. *E. coli* strain K99 is a common cause of scours in calves, piglets, and lambs and can cause high death losses in severe outbreaks.

Studies have demonstrated that *E. coli* is very robust, and can live for hours in aerosols at RH > 50% and temperatures of 15°C. *E. coli* has been found up to half a kilometer downwind from swine operations.

In 2001, an outbreak of *E. coli* O157:H7 was confirmed in 23 people who attended a state fair. These cases had laboratory-confirmed *E coli* O157:H7 infection, hemolytic-uremic syndrome, or bloody diarrhea within 7 days of attending the fair. *E. coli* was found in the sawdust and rafters of the fair building and matched to *E. coli* isolated from the patients. While this outbreak involved aerosol transmission of *E. coli* in a confined environment, it does serve to highlight that airborne transmission of this disease does occur. This, combined with the fact that *E. coli* is known to spread at least half a kilometer downwind of intensive livestock production, emphasizes that aerosol transmission of this bacteria is a potential threat to human and livestock health.

Mycoplasma:
The bacteria *Mycoplasma hyopneumoniae* is the causative agent of porcine Enzootic Pneumonia (EP), a highly contagious and chronic disease affecting pigs. Clinical signs of EP include mild chronic pneumonia with a non-productive cough, rough hair coat and reduced growth rate and feed efficiency. Infection with *M. hyopneumoniae* may result in immune suppression, thereby increasing the probability and severity of infection with other debilitating diseases. In the USA, economic losses caused by this disease may exceed one billion dollars per year.

Mycoplasma strains have been found to survive up to 24 hours in aerosols at 25°C and RH of 40-50%. Viable *M. hyopneumoniae* have been detected up to 9.2 km downwind of the source.

The risk of a herd becoming infected is inversely related to the proximity of an infected farm. A study of pig farms in Quebec found that pig herds within 1.5 km of infected premises became infected over a number of years. In another study involving 55 herds that developed EP and 57 herds that did not, airborne transmission was determined to be the most probable route of infection in herds that became infected. It was determined that, in order to remain EP-negative, a farm must be at least 3 km away from an infected farm. These reports, and others, demonstrate the aerosol transmission of this livestock disease over large distances.

Viral diseases

Viruses are smaller than bacteria and consequently may travel further in aerosol plumes than do bacteria. Some viruses also have an "envelope", an outer structure surrounding the virus. This envelope has a lipid (fatty) layer which helps protect the virus from dehydration. Enveloped viruses may survive longer in aerosols and at lower RH than non-enveloped viruses. There are more examples of aerosol transmission of viral diseases in the literature than bacterial diseases. Some examples of airborne transmission of viral disease are given below.

Foot-and-Mouth Disease:

Foot-and-mouth disease (FMD) is probably the most researched livestock disease in terms of aerosol transmission of a virus. This is a highly infectious viral disease that affects both domestic and wild cloven-hoof animals (e.g. cattle, pigs, sheep, deer, etc). While adult animals rarely die from the disease, they stop eating, become lame and very ill. The virus causes a high fever for two or three days, followed by painful blisters of the mouth, nose and feet. These blisters rupture, leaving open erosions that usually heal quickly.

Throughout most of the world, FMD is considered a foreign animal disease, and its detection triggers immediate actions to stamp out the disease. Its containment demands considerable efforts in vaccination, strict monitoring, trade restrictions and quarantines, and potentially the elimination of millions of animals. Even small outbreaks of FMD cause enormous economic losses due to loss of export markets and costs associated with eradication measures.

FMD virus can survive up to 14 days on clothing and for months in meat or dairy products. It can also survive up to 200 days in manure, straw and soil as well as 398 days on wood contaminated with fat.

The FMD virus survives best at RH >55–60%. It has been calculated that at RH of 60% and a wind speed of 10 m/s, infectious virus would travel 100 km in under 3 hours. During the 2001 FMD epidemic in the United Kingdom, over 78% of cases were attributed to indirect spread, and it was believed that the majority of these cases were associated with aerosol spread between animals at distances up to 9 km. In this case, the particular strain of FMD was shed at levels far below that of other strains.

There are also substantial differences between FMD strains with respect to survivability and infectivity. Some of the more infectious strains that are shed at higher concentrations and survive longer in aerosols are believed to have traveled and caused disease up to 300 km from the source. Also, the species of animal involved is known to play a significant role in the epidemiology of the disease. For example, cattle are more likely to become infected than pigs, presumably because they have a larger lung volume and therefore with each breath they would inhale more infectious particles than would pigs. On the other hand, when pigs become infected they in turn shed the FMD virus in much higher amounts than to cattle and are more often implicated in the long-distance spread of the disease.

Infectious Bovine Rhinotracheitis:

Infectious bovine rhinotracheitis (IBR) is caused by bovine herpesvirus-1 (BHV-1) and is recognized as one of the major cattle diseases of economic importance. BHV-1 causes five distinct disease syndromes: respiratory disease; conjunctivitis (red eye), infectious pustular vulvovaginitis or balanoposthitis (genital disease in both females and males); abortions; and encephalitis (brain infections). BHV-1 is also one of the most important agents involved in the development of the respiratory disease syndrome called shipping fever.

Cattle that recover from an acute IBR infection remain lifetime carriers of BHV-1. When the virus is reactivated, e.g. during times of stress, large amounts of virus may be shed thereby spreading the virus to other animals. The main sources of infection are nasal secretions and droplets created by coughing and sneezing. The virus is also present in genital secretions, semen, fetal fluids and tissues. Since herpes viruses are enveloped viruses, they are more likely to survive for longer periods in aerosols.

Aerosol spread of BHV-1 is known to occur, but there is little available information on long-distance transmission. This is most likely due to the fact that effective vaccines for this virus have been available for decades, and consequently less emphasis has been placed on research into this aspect of the disease. However, the transmission patterns of BHV-1 are expected to be similar to that of other herpes viruses and long-distance spread of BHV-1 to naïve or unvaccinated herds is likely to occur.

Porcine Reproductive & Respiratory Syndrome:

Porcine Reproductive and Respiratory Syndrome (PRRS) is a disease syndrome of pigs that affects the breeding herd, causing reproductive losses and respiratory disease in nursing piglets. Grow-finish pigs are also affected by PRRS, resulting in poor performance and increased mortality. The virus attacks cells of the immune system which are destroyed, removing a major part of the body's defense mechanism and allowing bacteria and other viruses to proliferate and do damage. A common example of this is the noticeable increase in severity of enzootic pneumonia in grower/finisher units when they become infected with PRRS virus.

Studies have shown that aerosolized PRRS virus is more stable at lower temperatures and RH, with temperature having the most effect on virus survival. The virus is most stable at 5°C and 17% relative humidity, surviving for hours in aerosol.

PRRS is the main reason why swine biosecurity programs have become increasingly refined and scrutinized over the last 10 to 15 years. As regular biosecurity programs frequently failed to prevent PRRS outbreaks in herds with no other possible source of the virus it became evident that airborne transmission of the virus had to be involved. In Denmark, PRRS was first detected on an island, and was suspected to have been introduced via the airborne route over a distance of at least 15 km. In other parts of the world, virus transmission between herds over 28 km apart has been documented. Studies have found viable PRRS virus in the air over 9 km for the source, in concentrations high enough to cause disease. There is little doubt that aerosol transmission of the PRRS virus is one of the greatest challenges facing the global swine industry today.

Influenza:
While mainly considered an important cause of respiratory disease in humans, the influenza virus consists of several species and subtypes which can infect a broad range of animals from horses, pigs, dogs and birds to the exotics such as seals, camels, minks and whales. Some types of influenza are particular in the type of animal they infect, while other viruses have the ability to target multiple species. Animal influenza viruses are of interest because of their potential to occasionally spread to human populations, because of the potential for virus re-assortment within infected animals, or because of the value of the animals as pets or farm and ranch stock.

The main way that influenza virus is spread is through aerosol transmission. In general, aerosol spread of the virus over short distances (up to a few meters) is considered to be one of the most important routes of transmission of this disease. However, outbreaks of equine influenza (EI) clearly demonstrated that long-distance aerosol spread of influenza virus can and does occur. The aerosol spread of EI has been reported at distances of up to 8 km in South Africa (1986) and 3.2 km in Jamaica (1992). In 2007, an incursion of EI occurred in Australia with documented spread of EI over distances exceeding 15 km. Nearly 10,000 premises were infected during the course of the epidemic. Winds were predominantly from the east, which was consistent with the observed spread of EI from east to west in that country.

As animal production continues to intensify and new influenza strains emerge (e.g. the 2009 pandemic H1N1 which affected humans and pigs, and was occasionally found in other species), it is expected that air-borne spread of influenza viruses will constitute a major challenge for both public and animal health in the future.

Psuedorabies:
Pseudorabies (PRV), also known as Aujeszky's disease, is a highly contagious disease of swine caused by a herpes virus. In pigs, this disease causes reproductive problems (abortion, stillbirths), respiratory problems and occasional deaths in breeding and finishing hogs. Once infected, animals remain carriers of the virus for life. The virus occasionally affects other species, including cattle, sheep, goats, dogs, cats, mink, foxes, raccoons and rats which, when infected, invariably die. In these species, the virus causes a fatal neurological disease with rabies-like signs and severe itching. Another name for the disease in cattle is "mad itch".

The virus is shed in the saliva and nasal secretions and is spread by direct contact, aerosols and transmission by contaminated clothing and equipment. The virus can survive in humid air and water for up to seven hours, in green grass, soil, and feces for up to two days, in contaminated feed for up to three days, and in straw bedding for up to four days. Aerosol spread of the virus occurs easily at distances of 2 to 3 km.

A program to eradicate PRV in Denmark began in 1980. This provided perhaps the first evidence of long-distance aerosol spread of this virus when outbreaks continued to occur despite all other prevention measures. One particular outbreak was shown to correlate with an unusual predominance of southerly winds. In other outbreaks, the virus was reported to spread 15–40 km from northern Germany to Denmark and, in one case, 80 km.

PRV is not present in Canada. In the United States, a voluntary eradication program was established in 1989. There have been no cases of PRV in commercial herds reported in that country since 2003. However, the virus remains a problem in back-yard pigs and feral boar. Studies in Florida estimate infection rates in wild boars between 40 and 50 percent. These virus reservoirs and ability to spread over distances has seriously hampered efforts to eradicate this disease from North America.

Malignant Catarrhal Fever:
Malignant Catarrhal Fever, or MCF, is a disease of ruminants caused by a herpes virus. In North America, sheep carry the ovine strain of the virus, which causes no harm to sheep but can cause fatal disease in other ruminants. In one outbreak the virus was observed to spread up to 5 km to susceptible species. This disease is described in detail in a separate review within this report, and will not be elaborated on further here.

SUMMARY

As noted previously, airborne transmission is possible with most infectious diseases and this includes diseases of livestock. Both bacteria and viruses may be spread this way; however aerosol transmission of viral disease is more frequently reported than is aerosol transmission of bacterial disease. In general, cool, damp, calm conditions without sunlight and flat, vegetation-free areas or water are the conditions most favorable to the airborne spread of disease.

The risk of aerosol spread of disease differs with many factors besides climate and environment, most of which are difficult or impossible to study. For this reason, accurate prediction or estimation of true risk of airborne spread of diseases is not possible at this time.

This document outlines only some of the many diseases that can be spread over distances. The intent of this document is not to provide a complete and comprehensive review of all reports of airborne spread of livestock disease; rather, the intent is simply to illustrate that many livestock and zoonotic diseases can be transmitted via this route.

5.0 JURISDICTIONAL REVIEW: Summary of Policy Pertaining to MCF in North America

BACKGROUND

The government of Saskatchewan currently does not have any policy in place relative to the livestock disease Malignant Catarrhal Fever (MCF). In order to inform discussion and to help guide the development of potential recommendations, the task force undertook a jurisdictional review to determine if any States or Provinces are currently managing MCF through policy or local/state/provincial regulation.

METHODS

Fifty states and eight provinces were contacted regarding their respective policies surrounding MCF. Queries were emailed to State Veterinary Offices on March 22, 2011 and one reminder was emailed on April 15, 2011. Emails were sent to provincial Chief Veterinary Offices on March 24, 2011, and one reminder was emailed on May 4, 2011.

The following questions were asked of each state and province:

1. Is MCF a reportable or notifiable livestock disease in your state/province?
2. If yes to #1, what action (if any) does the state/province take when MCF is detected?
3. Are you aware of any other policy within your government addressing MCF? If so, please briefly describe.
4. Are you aware of any policy in place at lower levels of government (e.g. county/RM) in your state/province addressing MCF? If so, please briefly describe

Websites for each state/provincial/federal agriculture department were also searched for reportable or notifiable livestock disease lists.

In addition, the Alberta Association of Municipal Districts and Counties, the Association of Manitoba Municipalities and the Federation of Canadian Municipalities were contacted regarding their knowledge of MCF and any municipal policy relative to this disease.

RESULTS

Municipal

None of the three municipal associations contacted were aware of any policy associated with MCF within their jurisdictions.

Provincial

Emails were sent to eight provinces. Prince Edward Island was excluded for lack of commercial bison production, while the Territories were excluded for lack of commercial sheep production.

Responses were received from all provinces. Few provinces had information on provincially reportable livestock diseases located on their respective provincial agriculture department websites; however, one respondent (Dr. Hugh Whitney, Chief Veterinary Officer, Newfoundland) provided a detailed summary of provincially reportable diseases which he compiled in 2010.

Is MCF reportable?
MCF is not listed as a reportable disease in any province. In Alberta, MCF is listed as a notifiable disease (for information/trade purposes only, no control program) in farmed bison only.

What action is taken?
Alberta reported that when MCF occurs, no direct action is taken other than recording the information and monitoring the situation.

Are you aware of any other policy within your government addressing MCF?
None of the provinces that responded indicated that they were aware of any other policy addressing MCF. Alberta indicated they had printed and distributed informational posters and brochures on MCF.

Are you aware of any policy in place at lower levels of government (e.g. county/RM) in your state addressing MCF?
None of the respondents were aware of any policy at lower levels of government.

State

Emails were sent to 50 State Veterinary Offices. Responses were received from 28 states. Information on state reportable diseases was available from 38 state agriculture department websites. Information was thus obtained for a total of 45 states, either by email or from websites. No information was obtained for the states of Connecticut, New Jersey, New Mexico, Ohio or West Virginia.

Is MCF reportable?
MCF is a reportable disease in 28 states. In six of these states this policy applies only to MCF caused by the wildebeest-associated herpes virus (AHV-2). In two states, MCF caused by AHV-2 must be reported immediately, while MCF due to the sheep-associated herpes virus (OvHV-2) must be reported monthly. The remaining states did not specify virus type.

Three of the states that did not specify MCF as a reportable disease did specify that "any vesicular[1] condition" must be immediately reported; therefore, MCF in its vesicular form would be considered a reportable disease in these states.

What action is taken?
Of the 28 states that responded to our survey, 21 stated that MCF was reportable; of these, 19 provided responses to the question "What action (if any) does the state take when MCF is detected?" These responses are as follow:

Quarantine: Thirteen of the 19 respondents indicated that when MCF is suspected quarantine would be implemented. Four of these specified that quarantine would be lifted once it was confirmed that the disease was not a foreign animal disease (FAD) or wildebeest-associated MCF. Eight respondents specified that a disease investigation would be conducted and three of these indicated that subsequent action would be dependant on the outcome of the investigation but did not specify what these actions would be. One state provided no further elaboration beyond "quarantine and movement restrictions".

Education and Awareness: Five of the 19 respondents indicated that action would be taken to provide the animal owner, and in one case their veterinarian, with information on MCF, its cause and prevention strategies. One state stated that they would work with the affected farm to conduct a disease investigation and develop measures to prevent future MCF outbreaks.

Are you aware of any other policy within your government addressing MCF?
Of the 28 states that responded to our survey, 24 indicated that they were not aware of other policy related to MCF within their government. The responses for the other four states are as follow:

1. One state had policy specific to the import and ownership of wildebeest.
2. One state indicated that they provided outreach to state fairs and animal commingling sites to try to get them to implement best management practices with regard to controlling disease transmission in general.
3. One state where MCF was not reportable indicated that they provided recommendations and encourage the following of "best management practices" with regards to MCF and animals at state sanctioned, county and regional fairs.
4. One state indicated that they provided MCF education and disease prevention information to the bison and sheep industries.

Are you aware of any policy in place at lower levels of government (e.g. county/RM) in your state addressing MCF?
Of the 28 respondents, 26 stated that they were not aware of policy at lower levels of government. Two respondents stated that education and biosecurity awareness activities were conducted by industry within their states.

Federal

[1] Vesicular: the presence of vesicles, which are small blisters that occur on the skin or on mucous membranes (e.g. the lining of the mouth).

Canada: In Canada, federally reportable or notifiable animal diseases are the responsibility of the Canadian Food Inspection Agency (CFIA). MCF is neither reportable nor notifiable at the federal level. A list of federally reportable and notifiable animal diseases can be found at http://inspection.gc.ca/english/anima/disemala/guidee.shtml.

United States: In the United States, federally reportable or notifiable animal diseases are the responsibility of the United States Department of Agriculture (USDA). USDA rules specify all listed diseases as per the Office International Des Epizooties (OIE) List A Diseases are reportable. As of 2011, there were 152 federally reportable diseases on the USDA list. A full list of federally reported diseases can be found at http://www.aphis.usda.gov/animal_health/nahrs/downloads/2011_nahrs_dz_list.pdf.

MCF is listed as a federally reportable disease in the United States; however, this is relative to the wildebeest-associated form of MCF, not the ovine-associated form. When MCF is diagnosed, a disease investigation is undertaken. If AHV-2 is confirmed, exposed animals will be destroyed. If the cause of MCF is determined to be OVH-2, no further action is taken at the federal level.

SUMMARY AND DISCUSSION

In Canada, only the Alberta government has policy in place regarding MCF. The purpose of this policy is not to regulate or control the disease, but simply to monitor its occurrence.

In the United States, MCF is a federally reportable disease. In that country, the wildebeest-associated form is considered a FAD, and when AHV-2 is detected in any susceptible species (other than the natural host, wildebeest) the animals will be destroyed. However, there is no federally policy relative to the ovine-associated form, and no action is taken when OHV-2 is confirmed in susceptible species.

There is a second reason why the United States has listed MCF as a reportable disease. MCF, in its vesicular form, very closely resembles other vesicular diseases of major importance, including food and mouth disease and vesicular stomatitis. When vesicular MCF occurs, FAD investigations are carried out to rule out these other diseases.

Following the federal lead, many of the states have made MCF reportable at the state level. Again, in most cases the policy is specific to the wildebeest-associated form and no further action is taken once OHV-2 is confirmed. For those states in which OHV-2 is reportable it can be confidently assumed that the intent is not to regulate and control disease but simply to monitor its occurrence, since no state indicated that control measures would be implemented specifically for sheep-associated MCF. Monitoring the occurrence of MCF provides the opportunity to educate livestock producers about MCF and prevention strategies, activities which five states said they undertake.

It is interesting to note that one State Veterinarian expanded on their response, citing a “USDA decision to no longer respond to MCF as a “Foreign Animal Disease” due to changes in OIE recognition of the disease at the international level.” Although MCF is still listed as a reportable disease by the USDA, it is not listed on their reportable disease status list (http://www.aphis.usda.gov/vs/nahss/disease_status.htm), presumably because it no longer needs to be reported to the OIE. Some other State Veterinarians had also expanded their responses with the clarification that since MCF is federally reportable it is also reportable at the state level. These contradicting messages suggest a recent or proposed change in federal policy which has not yet been clearly communicated to the corresponding state departments.

OIE listed diseases are diseases which have the potential for very serious and rapid spread, irrespective of national borders, which are of serious socio-economic or public health consequence and which are of major importance in the international trade of animals and animal products. All countries are required to report the status of these diseases within their borders to the OIE.

Until 2005, MCF was listed as an OIE List B disease. In 2005, the OIE changed their disease list format and eliminated "A" and "B" categories and combined these into one list. At this time, MCF was removed from the list entirely. The current list of OIE reportable diseases can be found at http://www.oie.int/en/animal-health-in-the-world/oie-listed-diseases-2011.

The removal of MCF from the OIE disease list indicates decreasing global importance and impact of this disease. The wildebeest-associated form has had serious implications to cattle producers in areas where wildebeest live in great numbers, and this is the reason that MCF was originally included on the OIE list. Removal of MCF from the list suggests that the disease has become of decreased importance in recent years, or perhaps reflects the growing knowledge and understanding of this disease.

It should be pointed out that the OIE list of diseases includes a number of diseases which commonly affect livestock across Canada and for which no regulatory action is taken, for example bovine viral diarrhea virus and trichomonosis in cattle, herpes virus in horses, porcine reproductive and respiratory syndrome in pigs, and West Nile virus in multiple species. Some of these diseases have become the focus of control or eradication programs in other parts of the world. Given that sheep-associated MCF is not a serious socio-economic threat (except, of course, to individual producers affected by the disease), not of public health consequence and not of major importance in international trade, it is not surprising that there is very little policy or regulation in place addressing this disease in North America.

6.0 TASK FORCE RECOMMENDATIONS

6.1 Provincially Notifiable animal disease list

At the Province and Territory level, Reportable or Notifiable disease lists are maintained in seven provinces. The number of diseases on these lists ranges from one to over 80. The Canadian Food Inspection Agency (CFIA) maintains lists of Reportable, Immediately Notifiable and Annually Notifiable animal diseases: http://inspection.gc.ca/english/anima/disemala/guidee.shtml. MCF is not included on any Federal disease list. Among the provinces, MCF has been listed as a notifiable disease in farmed bison in Alberta since 2008; this inclusion is for information and monitoring purposes only, and no action is specified when MCF is detected.

Saskatchewan currently does not have a Reportable or Notifiable animal disease list.

Inclusion of diseases in a Provincially Notifiable animal disease list would allow the Provincial Government to monitor the occurrence of these diseases. This monitoring will provide early warning of emerging disease issues to Provincial officials, as well as allowing the Province to respond to these animal disease issues in a timelier manner. This will also improve disease status reporting to the provincial livestock industries.

One of the first questions the Task Force asked was “How many cases of MCF occur in farmed bison in Saskatchewan?” Laboratory results for MCF testing reside in the database at the Prairie Diagnostic Service Laboratories; in its current format, this database is not easily searchable and some time was required to extract the data. When data was extracted, it was often found that little detail was available on individual cases. This highlighted the need for an easily accessible, up-to-date and detailed compilation of MCF cases in Saskatchewan.

The Task Force has identified several advantages to including MCF in a Provincially Notifiable animal disease list. These include:

1. Maintain an up-to-date and easily accessible database on confirmed MCF cases in Saskatchewan;
2. Allow early identification of farms with confirmed MCF, which would facilitate the development of recommendations to prevent further cases of MCF on affected farms;
3. Allow targeted education and awareness activities to minimize the risk of further MCF;
4. Facilitate the collection of detailed case information which would contribute to the understanding of the risk of MCF relative to proximity to sheep and other factors.

The Task Force recognizes that MCF is just one of many diseases of importance to livestock producers and public health in Saskatchewan. There is an inherent danger in focusing on just one disease such as MCF, and excluding other important diseases. Therefore, a Provincially Notifiable animal disease list should not be created exclusively for MCF.

Recommendation #1
The Task Force recommends that the Government of Saskatchewan create a Provincially Notifiable animal disease list, which incorporates MCF as well as other livestock diseases of

importance to the Province and to provincial livestock industries. This list should be created in consultation with all livestock industries in Saskatchewan.

6.2 Research into risks for MCF in bison

The issue of "buffer zones" between bison and sheep was given careful consideration by the Task Force. During the course of the Task Force's activities, it became quite apparent that, given the current state of knowledge, it is impossible to quantify the risk of MCF in bison that are exposed to sheep in non-feedlot scenarios and at varying distances. Although several published reports of outbreaks of MCF causing extensive losses have been widely touted as "evidence", these reports describe situations that are either easily preventable (e.g. bison exposed to sheep at an auction market) or do not exist in Saskatchewan (e.g. sheep feedlots with 20,000 lambs). The Task Force therefore concluded that there is insufficient evidence in the scientific literature to justify placing buffer zones around sheep and bison operations for the prevention of MCF.

Much has been made about anecdotal evidence of losses from MCF due to exposure to smaller numbers of sheep. Unfortunately, this type of evidence is seldom documented. Furthermore, there exists anecdotal evidence suggesting that bison can be pastured in relatively close quarters to sheep with little, if any, negative consequences (*The Bison Review*, Western Bison Association). There is undoubtedly truth in both cases, but what makes the difference? This is the type of information that is needed to make informed management decisions regarding the proximity of bison and sheep, but this is exactly the information that is missing from the current body of knowledge on MCF.

Recommendation #2
The Task Force recommends that the Government of Saskatchewan support research into causes of mortalities in bison that are kept in varying degrees of proximity to sheep; specifically, a case-control study is recommended whereby mortalities in bison that are pastured in the vicinity of sheep are compared to mortalities in bison which have no known exposure to sheep. This research should be planned in consultation with the Saskatchewan bison and sheep industries to ensure this research meets the needs and concerns of these groups.

6.3 Continue funding and increase awareness of the Disease Investigation Unit at the Western College of Veterinary Medicine (WCVM)

Results of laboratory testing for MCF in bison in Saskatchewan indicate that MCF occurs infrequently in this province. In fact, only one or two cases per year are the norm. However, these results have a "laboratory bias"; that is, only cases that are submitted to the laboratory for MCF testing can be confirmed to have MCF. This raises the question "How many MCF cases are undiagnosed in this province because they are not submitted for testing?"

Losses due to injury and disease are everyday risks faced by all livestock producers, not just bison producers. Occasional deaths are considered a normal part of business. For this reason, isolated cases may not be submitted for testing simply because the death does not represent a loss above what is considered normal for that production system.

Producers who experienced illness or mortalities "out of the ordinary" may be more motivated to investigate the problem; however, their efforts may be hampered by financial constraints. There is currently help available for these producers through the Disease Investigation Unit (DIU), located at the WCVM. This unit works with private veterinarians to investigate unusual illness or mortalities in their client's herds.

The Ministry has a three year funding agreement, expiring March 31, 2012, with the WCVM epidemiology group to provide disease investigations for Saskatchewan's livestock industry. This agreement provides maximum funding of $50,000 annually. Provision of funding for the DIU provides an opportunity for the livestock industry to investigate possible FAD incursions, emerging livestock disease or food safety crisis early and therefore reduce the economic impact.

The DIU may currently be underutilized; although usage has increased year-over-year, the DIU has yet to use all the funds allocated to it each year. It is possible that many veterinarians in Saskatchewan are not aware of this program and thus do not access this resource. Veterinarians should be informed about this program, so that MCF outbreaks do not go undetected due to a producer's lack of resources.

Recommendation #3
Given that the current funding agreement expires March 31, 2012, the Task Force recommends that the Government of Saskatchewan renew the agreement for the Disease Investigation Unit located at the WCVM. Furthermore, the Task Force recommends that the Government of Saskatchewan work with members of the Disease Investigation Unit to increase awareness in Saskatchewan about the role and utility of this unit for the investigation of unusual illness and deaths in livestock, including MCF in bison.

6.4 Support for Saskatchewan bison and sheep industries to develop and deliver initiatives for the prevention of MCF

MCF awareness increased substantially in this province after the 2001 auction market-related outbreak. Over the ensuing years, this awareness gradually declined to the point where many producers had never even heard of the disease. This lack of knowledge of this disease means that producers are not equipped to make management decisions necessary for the prevention of MCF transmission. The first step in averting MCF outbreaks is to ensure all bison and sheep producers are aware of the risks.

Over the last 12 months education and awareness efforts by the bison and sheep associations, in collaboration with the Provincial Government, have been effectively delivered to these industries. It is important that these activities continue, so that producers remain conscious of potential for MCF transmission.

There currently are, and will continue to be, situations in this province where bison and sheep operations exist in the same area. While isolated cases of MCF have been documented to occur, to date there have been no reports of larger outbreaks on farms in Saskatchewan. This would indicate that both bison and sheep producers already manage their animals in a manner that minimizes transmission of MCF.

Strategies for MCF prevention include, but are not limited to: coordinated pasture rotation to make sure distance between the species is maximized; making sure weaned lambs (the population most at risk for shedding virus) are kept as far from bison as possible; preventing stress in sheep (to minimize virus shedding) and in bison (to improve resistance to disease); preventing direct contact between the species and not sharing equipment.

In the vast majority of cases, neighbors are able to work together on strategies to minimize the risk. In order to ensure that this remains the case as these industries grow, it is important that the respective industry associations provide producers with the necessary tools for preventing MCF. These tools include ongoing education, on-farm biosecurity programming for disease prevention and the development of "best practices" documents for the prevention of MCF and other livestock diseases of importance to these industries. Development of species-specific biosecurity standards (where they do not already exist or are not already under development) would also be beneficial.

The Task Force acknowledges that the Saskatchewan bison and sheep associations are relatively small organizations and are unlikely to have sufficient resources for development and delivery of the above initiatives. Therefore, collaboration and support from the Provincial Government will be necessary.

Recommendation #4
The Task Force recommends that the bison and sheep associations develop and deliver the following initiatives for the prevention of MCF:

- **a. Ongoing education and awareness on MCF**
- **b. On-farm biosecurity programming to help minimize potential for MCF**
- **c. Development of biosecurity standards, where national standards are not already in place or under development**
- **d. Development of best practices documents, for the prevention of MCF and other important diseases:**
    - **i. on-farm**
    - **ii. auction markets**
    - **iii. livestock transporters**

Furthermore, the Task Force recommends that the Government of Saskatchewan provide financial support to the bison and sheep associations in Saskatchewan to aid in the development of these initiatives. Financial support should include allowance for infrastructure development, so that these associations have the capacity to deliver the above initiatives in addition to being able to effectively respond to important emerging industry issues like MCF in the future.

6.5 Ensure processes for future MCF education and awareness strategies

As mentioned under 6.4, MCF awareness increased substantially in this province after the 2001 auction market-related outbreak but over the ensuing years, declined substantially. As of 2010, many bison and sheep producers were unaware of the disease. Besides academia and animal health professionals, few other people were knowledgeable about MCF. Education and awareness efforts were put in place over the last year; informational materials were produced and distributed, articles were placed in agricultural publications, and presentations were made to producers.

At the present time, due to collaborative efforts by the Ministry of Agriculture, the Saskatchewan Sheep Development Board and the Saskatchewan Bison Association, MCF awareness is Saskatchewan is once again high. It is important that these efforts continue on into the future.

As discussions over MCF progressed over the last year, became it became evident that accurate information needed to be communicated to many people besides producers, such as Rural Municipality council members and other government officials. Information was provided to individuals or groups as they became involved; however, there was no process in place to ensure that all relevant parties would be informed.

It would be difficult to predict in advance all individuals or groups that might become involved in livestock health issues, as the species, disease and issue at hand will vary depending on the circumstances. General guidelines are needed to ensure that the appropriate parties access the information necessary to inform their discussions and decisions.

Discussions and decisions around livestock health issues need to include consultations with animal health experts as well as the livestock industry that is affected. When an issue involves more than one industry, all industries must be consulted. Over the last year, as some levels of government debated the need for policy around MCF, it became clear that these consultations were not occurring. This highlighted a need for a process to ensure that when discussion and decisions regarding livestock disease issues occur at any level of government, the appropriate consultations take place.

Recommendation #5
The Task Force recommends that the Government of Saskatchewan and the Saskatchewan bison and sheep associations develop and maintain processes to ensure that MCF education and awareness continues to be a priority in the future, and that consultations with animal health experts and industry occur when livestock disease issues arise.

7.0 CONCLUSION

MCF is a disease of importance to both the bison and sheep industries in Saskatchewan. It is important to the bison industry because it is a disease for which there is no vaccine, no treatment and is ultimately lethal in animals which develop MCF. Although it does not harm sheep, the virus which causes MCF is presumed to be present in most sheep; consequently, sheep producers need also be concerned about transmission of MCF from their sheep to susceptible species.

Fortunately, MCF is rarely confirmed in farmed bison in this province. Unfortunately, the *potential* for serious outbreaks, combined with a lack of understanding of this disease, can pit neighbor against neighbor, producer against producer. At issue is the transmission of virus over distances, which is poorly understood. Observations from MCF outbreaks show that OvHV-2 can spread via aerosol over distance, and that the risk of MCF in bison varies with the separation distance; however, other factors such as the number and age of sheep and stress in either species likely play a larger role. It must be noted that *the potential of aerosol transmission is not unique to OvHV-2*; there are many other zoonotic and livestock diseases which can also be spread via aerosol, some of which are described in Section 4.0 of this report.

The creation of regulated “buffer zones” to keep the species separated has been advocated by some as a means of preventing MCF in bison. Although it is evident from the scientific literature that close contact between the species, large numbers of weaned lambs and feedlot management of either species are associated with significant mortalities in bison, there is little in this literature which supports a need for large, kilometers-wide separation distances between sheep and bison managed under non-feedlot conditions.

Until such time as an effective vaccine is developed, education and awareness will be key to MCF prevention. It will take ongoing and collaborative efforts by the Province and industry to ensure that bison and sheep producers in Saskatchewan remain cognizant of this disease and are provided with the knowledge and tools needed to minimize the risk of MCF in bison.

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