



BehaviourWorks
AUSTRALIA

Development of behaviour change strategies for animal disease surveillance and reporting

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Glossary of terms

Term	Definition
Autonomy	Independence or freedom to decide one's own actions
Behavioural Intentions	An indication of an individual's readiness to perform a given behaviour
Capacity	Actual or potential ability to perform an action or behaviour
Descriptive Social Norm	Perceptions of what other people are doing
Injunctive Social Norm	Perception of what others who are important to them would do
Perceived Behavioural Control	An individual's perceived ease or difficulty of performing the particular behaviour
Procedural justice	The idea of that fairness and quality should be embedded in the processes
Reciprocity	The social rule that we should repay, in kind, what another has provided to us
Saliency	A prominent, easily detected feature
Social capital	The degree of social connectivity including trust, reciprocity, common rules and norms
Social norms	The rules of behaviour that are considered acceptable in a group or society
Stigma	A strong feeling of disapproval that most people in a society have about something

Executive Summary

Surveillance and reporting of emergency animal diseases is fundamental not only to Australia's agricultural industry but many other industries as well. The Australian Competition and Consumer Commission agriculture commissioner Mick Keogh recently commented that Australia's primary advantage in accessing global markets is its reputation for safety and biosecurity (1).

Maintaining proof of freedom from disease in Australia and ensuring early detection of emergency animal diseases relies on a number of actions. Two of the most important actions are producer surveillance and reporting. However, there are a number of reasons why these actions may fall below the desired rate. This may be due to farm processes, receiving low priority amongst other concerns or the costs and inconveniences of monitoring and/or reporting.

BehaviourWorks Australia (BWA) were engaged to inform the development of behaviour change strategies to increase producer surveillance and reporting, BWA conducted four stages of research. These were:

- literature, policy and practice review
- focus groups with Australian producers
- analysis behavioural intentions to monitor and report
- design workshop and development of interventions.

The literature policy and practice review found that a number of important factors influenced the likelihood that producers would engage with surveillance and reporting behaviours. These include:

- individual perceptions and attitudes towards biosecurity and reporting of emergency animal diseases
- costs and inconveniences
- social norms and social networks
- the saliency of the personal risk to producers (which can increase likelihood to surveil and report)
- the credibility of sources of information
- balanced incentives that are associated with specific behaviours
- involving producers in relevant decision-making and allowing two-way communication (to engage producers in collaborative efforts to prevent disease outbreaks)
- the coordination and consistency of information (to ensure that producers are clear about what actions are required)

- the transparency of processes (which provides producers with more confidence in reporting systems)

The biosecurity literature identifies opportunities for supporting producers to manage and report biosecurity threats and many of these strategies have a basis in models of behaviour change.

Three focus groups were also conducted, covering the sheep, cattle and pig industries in Australia. The themes that emerged generally reinforced the findings of the review outlined above. In particular:

- the importance of credible and reliable information
- that the severity and duration of clinical signs of disease informed producer decisions
- the prohibitive costs of veterinary services
- stigma and lack of knowledge
- perceived low importance of surveillance and reporting
- lack of financial and labour resources
- familiarity with diseases
- concern that there was not enough support from government.

Survey questions (informed by both the literature, policy and practice review and the focus groups) were then developed to measure behavioural intentions and a number of variables known to influence them. Data were collected on:

- past and current monitoring and reporting behaviours
- attitudes towards monitoring and reporting
- injunctive social norms (perceptions of what behaviours are approved of or disapproved of by others)
- descriptive social norms (perceptions of how other people actually behave)
- perceived behavioural control (how much influence over a behaviour an individual believes they have)
- perceived risk of an emergency animal disease outbreak
- trust in relevant authorities and institutions
- responsibility for monitoring and dealing with emergency animal disease outbreaks
- intentions to perform monitoring and reporting behaviours.

The survey was conducted with 200 Australian producers from the sheep, beef, dairy, and pig industries. Analyses were run to determine which factors significantly predicted behavioural

intentions to monitor stock and report to either government or private agents. Four behavioural intentions were measured, these were:

Factor 1: Behaviours related to reporting to government

1. Call the government hotline within a day if you suspect there might be an emergency animal disease.
2. Report clinical signs of disease of an emergency animal disease to a government vet within a day of noticing them.

Factor 2: Behaviours related to monitoring and reporting without government

3. Monitor for clinical signs of emergency animal disease on your property over the next 3 months.
4. Call a private vet within a day if you notice clinical signs of an emergency animal disease in your livestock.

The analyses found that significant predictors of behavioural intentions related to government were:

- Organisations that were perceived as responsible for dealing with emergency animal diseases; Animal Health Australia, Livestock Biosecurity Network, livestock agents, and Industry Representative Bodies.
- Perceptions that the Department of Agriculture and Water Resources can be trusted to follow the best available science and effectively communicate with producers.

These findings indicate that perceptions of responsibility and as well credible information and clear transparent communication are key factors in determining if producers will alert government to suspicious clinical signs of disease.

For behavioural intentions not related to government, significant predictors were:

- personal responsibility for dealing with emergency animal diseases
- perceived behavioural control
- close proximity to preferred vet
- descriptive social norms.

These findings highlight several key considerations and also reinforce the findings from the review. Namely, that knowing what to do and taking responsibility for the required actions is an important precursor to acting. Furthermore, the behaviours being the accepted and normal practices in community networks reinforces the importance of the behaviour and the expectation from others

that it will be performed. And lastly, that the logistical issues and associated costs of investigating clinical signs of disease can act as an inhibitive barrier to producers performing the desired behaviours.

Following the analyses of behavioural intentions, the results were presented to a design workshop for the purpose of informing the development of behaviour change interventions. A group of stakeholders discussed the results from the literature, policy and practice review, the focus groups and the analysis of behavioural intentions. The main themes extracted by the participants were then used to inform the designing and planning of interventions.

The outcomes of the design workshop were the development of potential interventions. These included but were not limited to:

1. changing perceptions of risk
2. building relationships between livestock producers and vets
3. supporting producers with poor access to vet services.

Overall, this research has identified a number of key considerations in thinking about targeting producer surveillance and reporting behaviours, in particular concerning emergency animal disease. The research reinforces the importance of clear communication, engaging stakeholders, and aligning understanding of behavioural drivers with interventions.

Next steps will involve further refinement of the proposed interventions with producers from a range of sectors, and developing appropriate evaluation frameworks for assessing their effect on behaviour.

1. Introduction

The Department of Agriculture and Water Resources sought the delivery of actionable analysis and strategies to target and improve the surveillance and reporting of emergency animal disease (EAD) in Australia. There was concern that while surveillance by producers is encouraged, this may not be prioritised given other more urgent concerns such as debt and/or drought. The Department's experience and research has largely indicated that top-down programs imposed on producers may not achieve the desired outcomes. Thus, further top-down awareness campaigns may not be a desirable way forward.

The Department sought to change the perception of livestock producers and owners (and those who work with livestock) regarding the risk of emergency animal diseases, and to encourage them to participate in surveillance activities. To underpin the next phase of their efforts, the Department sought evidence-based research to inform effective alternative strategies. This includes a strong emphasis on results and outcomes rather than inputs and processes.

BehaviourWorks Australia was contracted to develop behavioural interventions informed by:

- a review of existing behavioural research
- the opinions of policy professionals
- data obtained from focus groups comprising producers from the dairy, beef, pork and poultry sectors
- a survey of producers' attitudes, beliefs and intentions in relation to surveillance and reporting of emergency animal diseases. (This also included an exploration of enablers and barriers to the desired behaviours.)

The research was conducted in four phases, outlined in the next section.

Report Outline

This report will cover the four parts of the project.

1) Literature, Policy and Practice Review

First, a literature, policy and practice review was undertaken. This review helps to understand the problem and the behaviours of interest, including the context and history of the problem. Gaining a solid understanding of the target audience is also critical here. The review also highlights and discusses past attempts at addressing the problem, including things that have worked or not worked.

2) Focus Groups

The second section of the report describes three focus groups that were conducted. Conducting focus groups with “those that do” and “those that don’t” perform the behaviours of interest, the observations and findings will highlight a range of key differences that influence the behaviour from the perspective of the target audience, and will provide a more strategic foundation for the choice of intervention approach.

3) Analysis of Attitudes, Beliefs and Intentions

Data from an online survey of Australian famers was analysed to understand which factors are most important when thinking about interventions for the target behaviours and audience. The third section of the report presents findings from a predictive analysis of that data, and was informed by the literature, policy and practice reviews, along with the findings from the focus groups.

4) Design Workshop and Proposed Interventions

A design workshop was held with key stakeholders to plan potential interventions. The workshop used the findings from the data analysis to inform the development of targeted interventions.

2. Literature, Policy and Practice Review

Methods

A review was undertaken to capture the current body of literature regarding producers' surveillance and reporting of animal disease, with particular attention paid to emergency or notifiable animal diseases. The focus of the review was producers' surveillance and reporting behaviours. However, it is important to note that these behaviours occur within the sphere of general biosecurity attitudes and behaviours. Thus, the context of biosecurity attitudes and behaviours is provided at the beginning of the review and referred to where appropriate throughout.

The academic literature was searched to identify any peer-reviewed research and grey literature (unpublished) was also searched. In addition, authors known to research or publish material on producers' attitudes and behaviours relating to animal disease surveillance and reporting were identified and contacted for relevant documents. Policy documents regarding animal disease and surveillance across all Australian states and territories were also sourced. Furthermore, different strategies initiated by states or territories and industry groups were identified. Key contacts in each of the states and territories, as well as key individuals in a range of livestock industries (both extensive and intensive), were identified and contacted to report on current and/or past practices. Any measures or impressions of efficacy were sought on programs that had been implemented, as well as lessons learnt.

Academic literature search strategy

In July and August 2015, a comprehensive search of the following databases was undertaken: ProQuest, PsychInfo, CENTRAL (Cochrane Library), and Scopus. Search terms included combinations of the keywords; surveillance, biosecurity, animal health, prevention, disease recognition/reporting, disease freedom, emergency animal disease, notifiable disease, producers, producers and vets. References of identified papers were searched for relevant articles and authors known to research on the topic were searched for separately.

Representatives from the following organisations and groups were contacted for the Practice Review:

- Australian Pork Ltd
- Animal Health Australia
- Australian Veterinary Association (Canberra-based Veterinary Affairs Manager)
- Australian Lot Feeders' Association
- Wool Producers Australia
- Australian Livestock Markets Assn
- University of Western Sydney
- University of Melbourne
- The University of Sydney
- Queensland Principal Veterinary Officer (Surveillance)
- Livestock Biosecurity Network (LBN); TAS, SA, NT
- Community biosecurity group, SA
- Charles Sturt University.

A summary of the literature, policy and practice review is presented in the following sections.

Introduction

Reporting of livestock diseases, in particular emergency or notifiable diseases, is a critical component of ensuring disease management and proof of freedom for the Australian livestock industry.

In Australia, surveillance for livestock diseases is the responsibility of the state and territory governments. General surveillance is the process whereby a livestock disease is noticed by someone. This person, directly or indirectly, informs or alerts a veterinarian or another person with animal health knowledge. The veterinarian then investigates the problem (which may include a laboratory investigation) and provides a diagnosis. In the case of a notifiable disease, the jurisdictional CVO and the Australian CVO will then be notified (see Figure 1)(2).

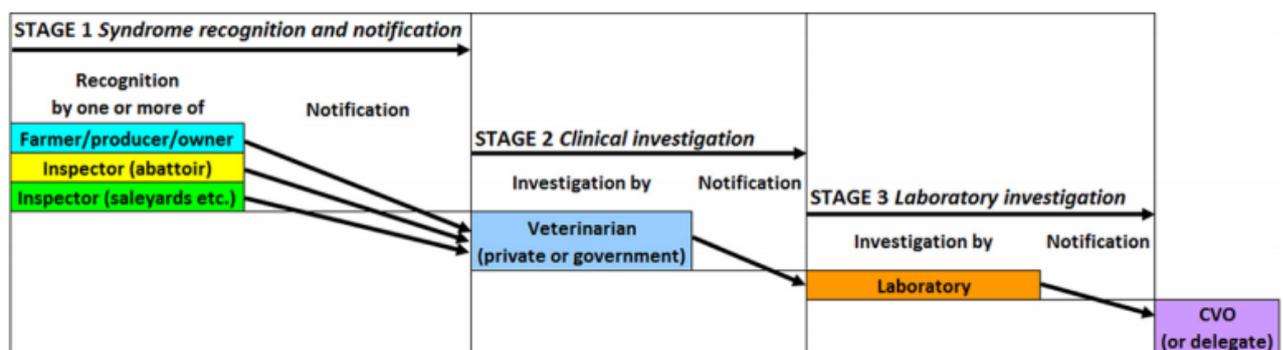


Figure 1: Diagram representing stages of surveillance and reporting showing stakeholders and roles. Sourced from Martin 2015 (2)

Due to Australia's expansive area, large distances result in a high livestock to veterinarian (vet) ratio, and regular veterinary assessments of production animals on farms is not a viable surveillance option. Thus, the system heavily relies on the producer to report ill-health, suspicious clinical signs of disease and deaths. However, producer reporting rates are not always high enough (nor reporting timely enough) to ensure early detection and adequate management of disease outbreaks.

It can be challenging to convey the importance of disease surveillance to producers as it only constitutes a small part of their business and the benefits are not always readily apparent. In addition, considering all the potential risks that producers contend with, disease outbreaks are not usually a priority. For example, out of a number of potential risks, including drought, bushfire, flood and economic downturn, only 16% of producers thought that disease outbreak was the greatest risk to their farm (3). It is also important to acknowledge that livestock production is a business where a number of external factors (such as market price or customer demands) can also influence decision-making processes. Therefore, it is crucial to engage producers and encourage their cooperation to ensure that disease risks are adequately identified, reported and managed. This is emphasised by

the results of a study of overseas foot-and-mouth disease (FMD) outbreaks which found that (in outbreaks where data was available) over half were discovered as a result of a producer alerting a private veterinarian or the authorities to a problem in their herd (4). Thus, early detection relies heavily on the diligence of producers' reporting.

Prompt reporting is crucial because delays in detection can be very costly. Assuming a 21-day detection delay, a simulation based on an outbreak in California found that each additional one-hour delay in detection led to the slaughter of an additional 2000 animals and an additional economic loss of \$565 million (5).

The surveillance and reporting of diseases in livestock is increasingly important in Australia due to a range of growing biosecurity challenges which include: globalisation; growth in tourism which increases passenger movements; free trade agreements (with an increased focus on exports which increases cargo movements); the potential for agri-terrorism; climate change which can add to the spread of pests and diseases; a shortage of biosecurity experts; and the physical and financial constraints for border interception and surveillance activities (6).

Also, while Australia remains free of many animal diseases due to its isolation, when there is a disease outbreak its effects can be severe. For example, in August 2007 Australia experienced its first ever outbreak of equine influenza. The outbreak lasted five months, affected more than 70,000 horses, spread over 280,000 km², and cost the government more than A\$350 million before it was successfully controlled and the virus eradicated.

Thus, surveillance and monitoring is one of the most important activities of any government animal health service. At the Australian Government level, livestock disease control policies focus on a number of areas, including information and awareness programs, emergency animal disease response policy and border controls. Furthermore, funding for research and education programs assist in informing policy and program design. These surveillance and monitoring activities support key biosecurity strategies and targets, primarily towards maintaining market access. However, maintaining the balance between biosecurity risks and trade objectives is a key challenge when developing policies, guidelines and programs. To help achieve these goals, biosecurity risks are managed across a continuum (offshore/pre-border; at the border and onshore/post-border) and there is a focus on strengthening partnerships with stakeholders (6, 7) in order to share this responsibility.

Below, a summary of the literature, policy and practice reviews is presented which is organised by key themes. The literature review summarises the key behavioural academic literature relevant to

producers' surveillance and reporting behaviours. That review is complemented with a policy and practice review which seeks to establish approaches taken towards improving surveillance and reporting behaviours, and provide insight into how these have worked, or not worked, in practice. Whilst the area of animal disease surveillance and reporting is expansive and there is extensive literature and policy relating to this, the summary that follows is specifically focused on aspects of livestock producer behaviour.

Biosecurity behaviours

For producers, biosecurity includes a wide set of behaviours designed to prevent the introduction and spread of infectious animal disease. Biosecurity behaviours include but are not limited to: disinfecting, maintaining boundary fences, checking for strays, restricting visitor or vehicle movements, ensuring all machinery brought onto the property is cleaned, good husbandry, ensuring purchases are from reliable sources, inspecting flock or herd regularly and ensuring compliance with regulations (8). The nature of biosecurity behaviour varies according to the different type of livestock being raised and production system.

Although producers generally have positive attitudes towards biosecurity, their engagement with biosecurity behaviours has been variable. The majority of United Kingdom (UK) producers believe that on-farm biosecurity is more cost-effective and more time efficient than treating disease on-farm (9). There are also some behaviours that producers report regularly engaging in. For example, isolating sick animals was the most common biosecurity measure reported (9). Australian research has also associated regular biosecurity behaviours with other conscientious behaviours such as reporting contacting a vet in a disease event (3). However, while producers reported a number of practices they consider useful they also admitted that there are a number they do not regularly utilise, including: running a closed herd, buying stock from known health status farms and testing animals after they had been moved onto the farm (9).

Producers in the UK who dismiss biosecurity measures tend to attribute biosecurity risks to the collective or external bodies such as the federal government (10). For example, the most common reasons given for outbreaks included inadequate border control and ineffective policies and regulations. Also, whilst producers generally report positive attitudes towards the importance of biosecurity this does not necessarily translate into desired behaviours. There are a number of reasons for this discrepancy including motivation, business decisions, availability of information and feelings of responsibility.

For example, while disease outbreak is acknowledged as a high threat at a national level, at a personal level producers perceive the risk as low (3). Furthermore, in England some biosecurity

measures are viewed as unnecessary because they aim to stop the 'silent spread' of disease (11) and the impact of preventative measures can be difficult to see. In addition, British producers' perceived knowledge of specific biosecurity strategies and their importance (which may also be influenced by personal or community experiences with diseases) has demonstrated a very strong impact on their biosecurity behaviour (12).

Producers often report seeing biosecurity risks as existing somewhere in the system that is beyond their control (e.g. feral animals on public land, or gaps in national quarantine measures) (3). Thus, some producers may feel that the responsibility for biosecurity belongs with the authoritative bodies who have control over those risks, rather than at the farm level. Australian producers who do not adopt on-farm biosecurity practices cited a number of reasons for this, including having no need on their property, and a lack of information and support (13). In addition, the majority of small-scale producers tended to engage in higher-risk practices such as trading at saleyards and undertaking minimal on-farm biosecurity measures (13). Business characteristics such as size, staffing, and type of livestock production also influenced the type of biosecurity practiced in North America (14). Unfortunately, there is no research that directly evaluates how biosecurity attitudes and behaviours relate to reporting behaviours, and for reporting emergency animal diseases in particular.

The literature reviewed suggests that are many factors that influence general biosecurity behaviours and the context in which these behaviours occur is also important. It is necessary to bear in mind that these factors may not directly predict willingness to report, especially in relation to emergency animal diseases. However, positive attitudes and willingness to engage with biosecurity behaviours and programs may be a useful precursor to producers' willingness to report.

The following themes from the review are divided into Section A (producer beliefs, behaviour and knowledge) and Section B (existing policy, programs and practices designed to encourage producer reporting).

Surveillance and reporting

A: Producer Beliefs, Behaviour & Knowledge

Although producers may agree with the importance of disease surveillance in principle, there are a number of barriers to optimal reporting behaviours.

The knowledge, attitudes and behaviour of individual producers are critically important in determining the probability that disease on their properties will be detected by general surveillance behaviours (2). Likewise, the attitude of the producer to notifying a veterinarian or an authoritative body of the presence of disease on the property is determined by many factors. One factor is that

the producer's level of knowledge about the disease and its likely consequences for the farm (and more widely within Australia) will inform their risk assessment and what they feel are appropriate responses. Another factor is whether producers feel that they can manage the risks themselves and/or they fear potential control measures (such as quarantine) or have negative attitudes toward control measures. In a survey of Australian producers, 80% thought that they had enough experience to know when to call in a vet. However, only 45% believed that they could identify an emergency animal disease (3). United States producers generally believed that they know whom to contact, but there is greater uncertainty in identifying the clinical signs associated with serious cattle diseases or in knowing that certain cattle are at greater risk of having disease (15).

Reporting to authoritative bodies also involves some complexities such as: trust in the veterinary services to make the right diagnosis, manage the disease, and look after the interests of the farmer; poor past experience; lack of trust in the reporting procedures; uncertainty about the notification process; and trust in government in general (2, 16). Economic considerations such as the cost of calling a veterinarian out to examine livestock (17) versus the economic value of the animals also play a part in the decision process (pers comm: Livestock Biosecurity Network regional officer). Producers also report that there is guilt and shame associated with reporting disease on their property, and worry about what other producers will think (15).

Producers are, however, motivated to engage with biosecurity with the aim of controlling disease. The benefits of this are seen as avoiding livestock mortality and related replacement expenses, livestock morbidity, increased veterinary expenses, and business interruption (18). However, there are also a number of barriers including time, labour, management, capital constraints, cost and below-cost indemnity reimbursement (18). Thus, it is important to bear in mind that there are a number of diverse considerations that contribute to how producers make biosecurity decisions relating to surveillance and reporting.

Emergency animal diseases

Emergency animal diseases are often thought of differently from endemic diseases as they do not typically occur as frequently (many are exotic to Australia) and thus do not fit easily into a biosecurity routine. Producers feel that they have more control over endemic diseases than emergency animal diseases on their own farm (19). There is also some evidence (from a study in the UK) that producers who live in areas where there is a high risk of a particular disease view biosecurity in terms of that particular disease (20). Similarly, in an Australian study, some pig producers undertook different biosecurity practices because of the perceived increased risk of

disease during an outbreak (21). Therefore, it may be that salient diseases and experiences influence the understanding and interpretation of biosecurity and related behaviours.

Attitudes towards responsibility for emergency animal diseases are also important. For example, in a sample of sheep producers, all said that the government should primarily be responsible for exotic disease (11). With notifiable diseases in particular, producers feel that the government has a strategic responsibility to protect the agricultural industry and therefore coordinate the provision of advice and information, and to pay for disease controls. Furthermore, when producers do not have a say in the protection measures they feel they should not have to contribute financially (11).

Logistics and Economics

There are of course practical considerations that contribute to producers' decisions to contact a vet or report diseases. An Australian study found that in the case of a significant disease event, the distance from the nearest vet was the only significant predictor of whether a producer consulted a vet (3). Interviews indicated that UK producers also hesitate before calling a vet due to the costs of travel (22). Another Australian study found that producers do call vets for advice, but the main reason for subsequent visits not occurring was due to either the problem being resolved over the phone or due to the prohibitive cost of the visit (23). Producers have also reported that they would be more willing to engage with veterinary services if they were able to receive free advice that could inform their decisions. Therefore, there is a risk that producers will not pursue necessary actions for more complex events or events that require veterinary attention.

These decisions occur within the context of the producer's business and the impact on their business is an important consideration. Perceived effect on business during the past five years of severe outbreaks of animal diseases has a significant effect on behaviour (12). This might suggest that producers who have experienced the effects of disease outbreaks in the past are more likely to use biosecurity sources of information and apply more biosecurity measures on their farms. In addition, ease of implementation and cost were the most important factors in determining the likelihood of implementing preventative measures (11). Also, in making such decisions, the value of the livestock becomes a substantial factor in the equation. For example, biosecurity officers working with producers have reported that as sheep are worth less than the cost of the vet, it makes more economic sense to kill the sheep rather than pay for a vet visit (pers comm: Livestock Biosecurity Network regional officer). Thus, the costs and benefits of investigating clinical signs of disease or mortality are important considerations in producers' decision-making.

Economists who have written on biosecurity have argued that for profit-maximising producers, their investment in biosecurity controls and reporting will be suboptimal unless adequate financial

incentives exist. The willingness of individual producers to invest in protection measures is also undermined by the potential for other producers to free-ride off their actions (24). Given this economic understanding of behaviour, there is a role for government intervention via mechanisms such as compensation schemes.

However, the actions of government can undermine biosecurity control by getting the incentives wrong. For example, if producers are fully compensated for the impacts of an outbreak, they may be less likely to invest in biosecurity controls or report suspicious symptoms, since a good deal of the direct costs of the outbreak will be borne by the taxpayer. Thus, one argument is that the transfers from government to private producers should be set at an amount less than full compensation so that producers have a financial motive to prevent disease outbreaks. It has also been argued that as the prevalence of infected animals declines, the marginal benefit of further reducing the prevalence also declines while the marginal cost of identifying and controlling the disease increases, thereby making it financially unattractive to fully eradicate the disease (25). Furthermore, as endemic diseases are by nature more common than emergency animal diseases, there is a greater economic incentive for producers to engage vets to help manage endemic diseases, rather than the low likelihood of an emergency animal disease.

It is important to consider, however, that while financial incentives may be important in overcoming free-rider behaviour, behavioural approaches offer a more complete understanding of human motivation. Moreover, the non-financial motivations identified in the behavioural literature may interact with financial incentives (such as compensation) in unanticipated ways.

Risk perception

In order for producers to report diseases, they must understand the risk context that surveillance and reporting occurs within. However, as already noted, producers do not necessarily perceive the risk as occurring on their farms. Rather, producers see the proximity of disease risk as far from themselves. It has been found that producers' attitudes towards disease risk are strongly associated with their attitudes towards how to manage disease, and thus the likelihood that they will report. One of the main predictors of reporting behaviours is the attitude towards the behaviour (26) as well as concerns for maintaining the health of the animal.

For most Dutch producers, endemic diseases are perceived to occur 'once every 3 months' (24.5%) or 'once every year' (42.2%) on their farms; whereas for emergency animal diseases, the perceived probability of occurrence was 'once every 10 years' (48.5%) or 'once every 50 years' (36.4%) (19). This is important in terms of how prepared producers are to identify clinical signs of emergency animal diseases. In a study of risk management strategy adoption by pig producers, almost half of

the producers (46.9%) believed that compared to other risks, an epidemic would have a very high impact on economic farm performance, whereas only 22.7% of the producers considered this the case for endemics (19). The producers who believed in a greater impact of animal diseases on farm economic performance also believed that diseases occurred more frequently. These producers had also experienced substantial losses in the past due to animal diseases (19). Similarly, a French study found that producers' attitudes and risk perception are also influenced by past experiences, with diseases that producers have experienced in the past being more likely to be seen as serious (16). Thus, both past experience and expectations of impact influence how producers view the risk of disease outbreaks.

Overall, producers who perceive disease risk as high are more likely to be better informed about diseases. However, even when disease risk is perceived as high, not all incidences may be reported due to lack of trust, unsatisfactory previous experiences and financial costs (16). Thus, surveillance and reporting actions are contingent upon risk perception and perceived behavioural control¹.

Disease recognition and thresholds for reporting

Experience is also relevant in that it can be difficult for producers to identify the clinical signs of emergency or notifiable diseases, especially when they may not have seen these diseases for many years, or ever. Producers tend to look for things that are already in the area so they are not necessarily looking for things that they have not seen for years. Furthermore, with an unfamiliar disease, producers may not even know what clinical signs of disease they should be looking for. More alarmingly, often if there has not been a case of the disease in the country for many years, both producers and vets are inadequately prepared to identify clinical signs of disease quickly (27).

In addition to being able to identify clinical signs of disease, producers also need to feel that they are capable of taking the required action, or this will result in inaction (16). Belief in self-efficacy and injunctive social norms about monitoring and reporting behaviours (that is, beliefs about which behaviours are approved/disapproved of by others) have a strong influence on attitudes towards surveillance and reporting (22). On the other hand, there are producers who do not report because they feel that they can manage the risk. European producers who said that they would not report immediately are more likely to justify their attitude through citing the belief they can control the outbreak themselves (28). Producers may also feel that they will have time once an outbreak is reported (or they hear about a disease) to take appropriate measures (11). Producers in England and

¹ This means the producer's perception of whether they possess the internal and external resources necessary to perform the behaviour 30. Terry DJ, & O'Leary JE. The theory of planned behaviour: The effects of perceived behavioural control and self-efficacy. *British Journal of Social Psychology*. 1995;34(2):199-220..

Wales also expressed frustration over the expectation that they can control disease risk, especially when they perceive a lack of control over imported products (22) and unfair retail demand for assured products to be as cheap as non-assured imported products (22).

In addition to other behavioural factors, reporting may also be hampered by uncertainty about which clinical signs of diseases need to be reported and at what threshold (e.g. number, combination or severity). That is, lack of knowledge or ability to detect clinical signs of disease is another barrier against reporting (31). For example, Dutch poultry producers did not understand why they should report clinical signs of disease that they interpreted as being linked to other diseases or other causes (31). Because it can be difficult to differentiate clinical signs of disease of endemic and emergency animal diseases, this may also result in delays in reporting clinical signs of disease.

Furthermore, many disease events are considered normal as long as they remain sporadic and under a 'threshold' proportion in the herd, which ranged among interviewed producers from 1.5 to 5% a year (16). For example, in a French study, most producers were confident in diagnosing events such as abortions themselves, identifying common causes including accidents or feed-, medication- or health-related issues. Thus, they did not feel obliged to report them (16). Likewise, a study in Western Australia found that despite producers recording what researchers considered to be a significant number of livestock deaths over the previous 12-month period, none had contacted a private vet or the local government office (32).

The severity of clinical signs of disease can also play a role in reporting (33). In a Canadian study, the number of animals affected, unusually high mortality rates and uncertainty about cause were all factors that prompted producers to report clinical signs of disease (34). Producers were often motivated by wanting to know the cause of the disease, however, a negative experience with delayed results or unconfirmed diagnoses could decrease the chance of reporting in the future, whereas a positive experience encouraged participant learning and improved confidence (34).

Because individual surveillance efforts can be difficult, another useful approach is syndromic surveillance which (through producer collaboration) looks for changes in health information that may indicate a need for further investigation (29). However, for syndromic surveillance to work, producers still need to be able to identify clinical signs of disease or indications of ill-health and be able to report them. Likewise, removing barriers and disincentives for producers to participate also remains necessary (29). In addition, any epidemiological data that is collected should be meaningful for all stakeholders, including producers, veterinarians, researchers and government (29).

Producer Networks

Producers engage with a number of social networks that influence their surveillance and reporting attitudes and behaviours. The social network or community structure that producers belong to (i.e. what others within their peer group are doing) and the way they generally see the livestock industry may also influence the adoption of preventive measures (9). Producers in a New Zealand study generally agreed that their top source of information was high-achieving producers (42).

However, there are also aspects of social networks that can inhibit reporting behaviours. Producers from the United States reported that feelings of guilt and shame over being the one to report a disease discourages them from reporting potential clinical signs of disease (15). There is stigma attached to being the first farmer to report and respondents feel that other producers may think that they had done something wrong (27). In one study of Dutch producers, a total of 40% of producers and 49% of vets indicated that reporting a suspect situation, when retrospectively this was false alarm, had a very negative consequence for the financial situation of the farm and was worse than missing a possible case of emergency animal disease (27). On the positive side, most producers (57%) indicated that they would report much faster a suspicious clinical situation where there was a strong relationship between a farmer and the vet (27). Producers who would not report immediately are much more likely to believe that their reputation would be adversely affected if they were to report a suspicion (28). These findings are very informative regarding the social pressures producers perceive and the decision-making processes that producers undertake.

Inter-farmer cooperation is important in effective implementation of biosecurity practices (8). Thus, producers who believe that they will receive a benefit from cooperation and who have strong social capital² are more willing to cooperate than those that do not (29, 45). For example, producers with stronger social capital were more likely to adopt a Countryside Stewardship Scheme (44) and benefits of capitalising on social capital have also been observed in producers' irrigation schemes in Sri Lanka (46). However, in some places the lack of internal cohesion and collaborative effort within and between the stakeholders responsible for farm-level biosecurity has been criticised (10).

² Social capital refers to the degree of social connectivity of a farmer and includes trust, reciprocity, common rules and norms 43. Pretty J, & Ward H. Social capital and the environment. *World development*. 2001;29(2):209-27.

It can have both positive and negative effects: social capital can enhance business through better networks, but it can also inhibit business as a result of obligations within the network 44. Mathijs E. Social capital and farmers' willingness to adopt countryside stewardship schemes. *Outlook on agriculture*. 2003;32(1):13-6..

The relationship between vet and producer

Vets have consistently been identified by producers as trusted sources of information and advice and may provide a channel for increased engagement with producers.

English producers reported relying on vets (due to their perceived trust, credibility and experience) for risk assessment and advice regarding control measures for diseases (11). Yet vets do not always see themselves as the primary sources of information and advice on biosecurity (8). Indeed, a number of veterinary respondents in England noted that their businesses did not have enough resources or expertise to provide biosecurity support to their clients (8).

Comparing reports from producers and vets, there appears to be a discrepancy between how producers view vets and how vets view their own services. Similarly, vets in a French study over-estimated cost and inconvenience as barriers to reporting (16). Interestingly, the majority of English vets felt that their clients were not willing to, or could not afford to invest in biosecurity measures or had no interest in instigating these measures (8). On the other hand, producers perceived that vets had very little interest in biosecurity (8). Thus, the disconnect between vets and producers in terms of priorities and capability may need to be addressed.

Participation in surveillance programs by vets could also be increased if official bodies provided technical support, training and information on the results of the differential diagnosis protocol (16). Vets who have participated in surveillance activities reported doing so due to monetary compensation, interest in surveillance, perceived value of the program and access to additional diagnostic laboratory services, as well as generating information that could be fed back into the system (34). From a veterinary perspective, knowledge of the desired behaviours for proper surveillance could be used to aid communication and facilitate support for the uptake of intervention measures (22). In Australia, approximately half of vets reported having contact with their local government veterinarian less than once a year, and only 42% either had the disease emergency hotline stored in their mobile phone or had memorised the number (17). Thus, whilst vets are an important source of information and advice, a number of vets possess knowledge gaps that could prevent effective surveillance activities.

Demographics

Numerous studies have shown that producers at different life stages make different management decisions. For example, younger producers with large herds and few dependents are more likely to comply with an eradication program. Whereas, a study of older Flemish producers found that those with no successors were less likely to implement changes in their management systems (93, 94). A British study found that education, experience and cognitive abilities are all variables which have a

significant impact on the decision making process and are often linked to the age of the decision-maker (12). Membership to a livestock health scheme is also associated with decisions to apply general biosecurity measures (unspecified) (12).

There are also regional differences in producer behaviour. For example, QLD producers were more likely to contact the government department if they saw unusual clinical signs of disease in cattle than NSW producers. However, this difference was attributed to the presence of the Local Land Services in NSW (7). These differences, including the reporting authority, need to be taken in account if surveillance and reporting behaviours are to be consistent across jurisdictions.

B: Existing Disease Reporting Policy, Programs and Practices

Individual campaigns

Both government and industry have engaged in awareness and education campaigns directed at individual producers, and a range of materials exist from brochures to websites. One government report identified over 50 biosecurity awareness programs nationally, although the majority of these were plant related (35). These campaigns range from providing broad-level biosecurity information to information about particular diseases, and programs to encourage reporting. Campaigns aimed at individual farmer awareness include: 'spot the difference', 'look, check, ask a vet' (36), and disease-specific efforts, including the distribution of pamphlets outlining clinical signs of transmissible spongiform encephalopathies (e.g. mad cow disease). These programs are specifically aimed at individual surveillance and reporting behaviours but generally do not provide the rationale or adequate motivation beyond 'doing the right thing'. However, published risk management guides on planning for an emergency animal disease outbreak highlight the risks for individual businesses and outline how to plan for such an emergency animal disease event (37). Furthermore, South Australia is considering a policy which places emphasis on farm biosecurity and declaration of disease status at the time of transactions (pers comm: Department of Agriculture and Water Resources). Through incentivising good practice based on a code of practice and disease risk ratings, this approach would leverage market incentives to enhance biosecurity practices.

As part of the practice review, a veterinary consultant in the pig industry commented that for these campaigns to be effective they need to be highly visual and clearly demonstrate what the producers should look for (pers comm: veterinary consultant). Smart phone apps have also been trialled in Australia to create awareness and receive biosecurity alerts (38) and producers have reported these as useful, although some have met with difficulties regarding the appropriate reporting authority. Further to this, some industry representatives reported that inconsistent information regarding

appropriate reporting channels (or instances where this differs across states) may impede effective reporting behaviours (pers comm: sheep industry representatives).

A report by Kruger 2009, *Engaging in biosecurity: Gap analysis*, recommended that education should also create awareness amongst the target group of the personal impact of biosecurity threats—for example, damage to their immediate environment and/or their business (35). Thus, it was recommended that campaigns mention why information is relevant for the individual as well as creating awareness of the reporting process and how to use it (35). Supporting this recommendation is the finding of one Australian study where participants were more likely to get their horses vaccinated against the Hendra virus if they were worried about themselves or their family members getting Hendra virus (39). Evidence of a distinction between risk judgements on a societal level and a personal level (40) means that people will not necessarily draw personal inferences (which influences motivation to perform desired behaviours) from more general social views, as highlighted in the *Risk Perception and Ability* section of this report (41) and by the literature discussed earlier (3).

Informing and educating producers

Education and awareness about surveillance and reporting processes is the necessary first step to ensure that stakeholders have adequate information and an understanding of appropriate behaviours, including surveillance and reporting. Policy documents often comment on the key considerations and approaches that should be taken in raising awareness and educating, including appropriate communication channels. For example:

- During an outbreak, a clear strategy presented in plain English will build stakeholder and public confidence (74)
- Clear information about compensation policies can be provided to alleviate stakeholder concerns about eligibility (74).

Principles to guide a communication strategy include; (74)

- Provide information in an accessible, regular and consistent way
- Use multiple communication methods
- Involve people who producers and rural communities know and trust to assist in communicating key messages
- Include good news stories
- Communicate reasons behind decision-making.

A report regarding small landholders in Australia also emphasised improving the availability and accessibility of information and advice. This can be done by utilising a combination of direct and indirect communication methods, and tailoring the type of information and style of delivery to either hobby farmers or producers (75).

An important feature of education is providing the rationale for why surveillance and reporting are important and how they affect not only individual producers but industry as a whole, and the country. Providing rationales has been associated with people considering tasks to be more important (76). However, research has also found that a rationale by itself does not increase self-determination or engagement (77). Thus, rationales are most effective when they are accompanied by facilitating autonomy-supportive conditions (i.e., non-controlling language, acknowledging negative feelings) (76). Research into biosecurity motivators in Irish dairy producers found that producers were most likely to identify health or animal related factors as primary motivators for biosecurity practices (78).

Education and awareness can be directed at individual producers, communities or industries. The Reasoned Action Approach suggests that individuals can be targeted through attitudes (e.g. highlighting discrepancies in perceived risk) and social norms (e.g. pointing out what other people are doing or what respected figures would do) and perceived behavioural control (e.g. ensuring the person has the capacity to perform the behaviours). Information on biosecurity and emergency animal diseases is sought by producers at two distinct levels: general information that keeps producers informed of what is happening within the industry, and specific information required by producers in the event of a biosecurity or EAD problem (7). Groups or communities can be targeted through social norms and their sphere of control. The impact of an intervention will be, in part, determined by how many individuals or groups are affected.

Education campaigns can also combat the negative connotations associated with some biosecurity activities. For example, there is a strong negative perception of consequences such as quarantine and there may be an opportunity to potentially broaden the public's understanding of what biosecurity is and the risks it protects Australians from. In *Australian Quarantine: A shared responsibility*, Nairn (1996) recommended reframing the scope of quarantine through an ongoing and nationally coordinated awareness campaign. Such a campaign would emphasise the continual quarantine checks (pre-border, border and post-border), the importance of protecting animal industries, a partnership approach leading to shared ownership and responsibility (by governments, industry and the general public); and the principle of manageable risk (79). This approach

acknowledges the multiple roles that exist in biosecurity and the highlights the scope and relevance of biosecurity activities.

It is also important to consider differences between industries when providing information and developing programs, as it is likely to be most effective when it is relevant to the individual. Producers within the intensive farming industries (e.g. pigs, poultry, dairy and feedlots) tend to inspect their animals at least daily. In extensive industries, some producers in Australia may see their stock as little as 40 days per year (36). Achieving a significant increase in the number of times that stock are examined may be difficult because it will impact on farm management practices and place an economic impost on producers (36).

There is ample research from multiple fields that has highlighted the key aspects of good educational information. These include: specific, timely and relevant to the target audience. Specific information such as direct recommendations are more persuasive than general information (80). Making the relevance of the information explicit—by providing information that outlines why the target population might be vulnerable to the problem and describing specific actions that can help alleviate the problem and how the target population are capable of engaging in the desired behaviours—is more likely to be effective (81, 82). There has been extensive work on the relationship between information, feedback, education and behaviours which demonstrates that information needs to be relevant to the behaviours performed and the information needs to be available at the correct time. The source of educational information is also important as there are two key aspects that contribute towards source credibility: expertise and trustworthiness (for example, occupational experience) (83). Furthermore, people are more likely to process ‘in-group’ messages, that is messages that come from people viewed as part of the industry or community who are similar in some way to the audience (83). For example, one Canadian study found that including producers as facilitators improved the uptake of an environmental farm project (84). Thus, carefully constructing information is crucial for it to be relevant and persuasive to the audience.

Sources of information

Sources of biosecurity information could be categorised as vets, producers’ media, national media, private sector, government agencies and other producers (10). As mentioned previously, producers frequently report that they consider vets who have expertise in biosecurity to be reliable and preferable sources of information (8, 67), as vets are seen as impartial advisors. The majority of producers would implement a control program if recommended by their private veterinarian (22). In a UK study, producers also trusted information from research papers/journals and the Department of Environment, Food and Rural Affairs (DEFRA; UK) (9). In one UK study, recommendations from the

government would only influence 20% of producers' decision-making to implement control measures positively, while more producers would implement measures if legislation was passed (22). Some felt that if biosecurity was so important it should be mandatory for all producers. Producers also mentioned they would respond if their direct customers demanded control measures and if financial incentives or penalties were introduced (22).

There is a need to communicate risk according to how it is perceived; cultural values can affect risk perception and risk communication (68). One-way models of communication may not engage producers, whereas local forums and governance receive positive endorsement. Producers desire specific advice for their circumstances and would prefer to approach an expert who knows the risks in their area, however, specialist advice and specialist vets are difficult to access.

Accessibility of information and engagement with different communication channels differs between types of producers. For example, a study in Sweden found that producers with larger herds who received their main income from farming were generally better informed about disease outbreaks (67). It was suggested that these producers were better connected with farming networks and more comprehensive sources of information (67). Evidence from an outbreak of Porcine Reproductive and Respiratory Syndrome in Sweden also demonstrated that media was not sufficient to reach all producers (67).

Producers' engagement with biosecurity information is also associated with their behaviour. The more useful the producers perceive sources of biosecurity information (i.e., attending open days, monitor/demonstration activities; consulting government information sources; consulting representatives of research & educational organisations) the more likely they are to exhibit stronger biosecurity behaviour (12). Producers highlighted that they like to attend meetings on farms to gain new information. In one UK study producers were more likely to attend meetings if they had a higher prevalence of lameness in their stock (69), indicating that this is one way that producers seek information. The accessibility and reliability of the source of information is very important for farmer engagement, but there are also factors such as their own biosecurity issues or questions that influence how and when producers seek information.

The information that producers want in response to reporting is the cause of the disease, and information on how to stop the spread of the disease within their herd (15). They also feel that this is an important contribution to the wellbeing of their livestock and their management.

There is also a difference between people who use media channels to gain information as opposed to those who use it for risk information (40). Research has found that mass media (e.g. TV) primarily

has an influence on perceptions of societal but not personal risk (40, 41). There are certain conditions under which personal risk judgements may be influenced by mass media, for example, when a convincing case is presented and the individual identifies there is an application to themselves (41). It should also be noted here that research in this field has largely been done on the general population while producers who have some investment and interest in biosecurity concerns may respond differently.

Information is also available to producers via their relevant industry groups and organisations. Some industry organisations, such as Meat and Livestock Australia (70) and the Livestock Biosecurity Network (71), provide a high level of detail about what producers should do to protect against the introduction and spread of disease (7). Australian Pork Limited also provides information through its Australian Pork Industry Quality Assurance Program (APIQ). The APIQ standards cover management, food safety, animal welfare, biosecurity and traceability (72). Training is also provided for producers. However, not all livestock industries have quality assurance programs and, in addition, awareness communication through industry organisations relies on individual producers being involved with such organisations. Furthermore, the significant differences that exist between intensive versus extensive farming mean that producers require specific information on biosecurity practices relevant to them. Generic or irrelevant information is likely to be dismissed by producers.

The NSW government established programs aimed at increasing knowledge and awareness of biosecurity risks and management, however, information is not readily available for biosecurity management at a producer level. Producers need specific information on what they should do, what the processes are and where they can access this information (pers comm: state CVO). Whilst there is information on emergency planning and how to identify an emergency animal disease (7), there appears to be a gap between available resources and how producers access information which may be due to a lack of awareness, difficulty finding relevant information or lack of motivation. Whilst overarching information on the aims and responsibility of biosecurity is useful to raising overall awareness of biosecurity, specific information relevant to producer actions and behaviours is also needed, and needed in a format that is easily accessible to producers.

As a whole, the federal, state and territory governments and industry bodies vary considerably in the level of detail provided for on-farm biosecurity management (7). Although not directly related to surveillance and reporting, an example of how inaccurate or variable information can reduce trust in official organisations is the Farm Biosecurity website (www.farmbiosecurity.com.au) – a website to which many government agencies refer producers. The website indicates that new stock should be quarantined for a time period that allows for clinical signs of disease to present, however, the

recommended quarantine period varies substantially between different jurisdictions and sources (7). Provision of variable information decreases the trust that producers have in official information sources. The recently established Biosecurity Incident National Communication Network (NCN) is responsible for producing nationally consistent public information in response to biosecurity incidents (73), however, inconsistent information about biosecurity remains a significant problem.

Communication channels

Current strategies by the Australian Government have included website updates to create more outwardly focused user-friendly interfaces. For example, Outbreak.gov.au focuses on prevention and preparation (pers comm: Department of Agriculture and Water Resources). This is complemented by a small but growing social media presence, with twitter posts and Youtube videos. For example, there has been a twitter campaign that tracked a dog from the UK, to highlight the importance and appropriateness of border processes (pers comm: Department of Agriculture and Water Resources). Some campaigns have included a behavioural emphasis, for example, a Victorian campaign focussed on “what is a good diet for pigs?” rather than solely focusing on trying to stop people from swill feeding. Other campaigns appeal to national pride and working together (pers comm: Department of Agriculture and Water Resources). Although these campaigns do not directly relate to surveillance and reporting, they provide some insight into the communication of biosecurity messages to target audiences.

Following the *One Biosecurity* report, the Australian Government supported the proposal to enhance communication effectiveness and also agreed to reform communication with trading partners (85). Recommendations by Hernandez-Jover (2014) included disseminating general information through mass-media outlets such as *Land*, *Country Life* or ABC radio, and disseminating information required by producers to manage on-farm biosecurity or EAD incidents through local level stakeholders that producers trust (7).

Identifying the most appropriate channels, including relevant industry groups such as AgForce, is crucial to ensuring that information reaches the audience (52). Social media is also a useful avenue to reach people, for example mediums such as Facebook and Twitter can help develop platforms for formal networking and also encourages communication and sharing of information. Another useful approach to ensuring biosecurity messages reach the target audience is to ‘piggy-back’ biosecurity messages onto more popular topics or events (52). Comments from industry biosecurity representatives report that past communication approaches were inadequate as the message was not clearly reaching the audience (pers comm: industry biosecurity member).

A key decision in any intervention, particularly communication approaches, is the appropriate delivery method. Ideally the messenger would be someone who has the respect and trust of the target group (52). In some circumstances it may be important to reassure producers that vets (or other channels of information) are reliable sources of information; for example, some producers may feel that local vets do not have specialised knowledge in their industry and therefore do not recognise the vets' value (pers comm: pig industry veterinary consultant).

Communication approaches should also seek to provide more than top-down information. The Waterwatch Program, a program that engages volunteers in monitoring the health of local waterways, is considered highly successful due to the networks created. In particular, the national Waterwatch conferences, where participating organisations or communities such as schools can collaborate and raise awareness, also provides networking opportunities (86). Waterwatch in West Gippsland (VIC) was evaluated against key engagement objectives and was found to have increased community awareness and understanding of water issues and to have engaged volunteers, but there was limited evidence of the community becoming involved in water management decisions (39). Producers also have networks (e.g. Landcare) that may be utilised for the purpose of communication, and such programs can provide more than just information but also networking and industry-building opportunities.

In *Farm biosecurity practices and the management of emergency animal disease*, Hernandez-Jover (2014) found that the frequency with which producers were contacted by government, or industry representatives at the individual level (rather than a faceless authority) was important towards building trust (7). It is also important to encourage communication and trust that allows for two-way communication. This means that online methods of communication which are important for reaching a wider audience need to be balanced with personal interactions. Whilst individual contact has also been noted as important for the uptake of recommended practices, research in the education field has indicated that both online and face-to-face interactions are effective for education and willingness to participate (87, 88). However, another study found that students were generally more positive about face-to-face courses compared with online courses (89). There appears to be little definitive evidence regarding the best communication method, especially in regards to engaging producers. However, it may be important to consider individuals' preference (and resources) for online versus face-to-face engagement when designing engagement strategies. Evaluation of the effectiveness of different communication approaches is important to establish evidence in this area.

Another issue is the consistency in the communication of information across differing government and industry stakeholders. A more consistent approach would help clarify producers' understanding of the expected on-farm biosecurity practices (90). Variation in recommended practices or biosecurity measures may increase the likelihood of selective preferences by the farmer rather than defined priority behaviours (91). As such, inconsistent content can also function as a barrier to behavioural engagement of producers. Although there is a Biosecurity Incident National Communication Network to provide consistent information relating to outbreaks (92), this may only be accessed during outbreaks and therefore may not influence ongoing behaviours.

The strategy and policy documents reviewed have highlighted that important aspects of implementing any new strategy include maintaining two-way communication, developing relationships, encouraging questions and discussing concerns, and taking feedback seriously. Keeping key stakeholder groups informed and discussing changes to programs, whether management related or technical, is important to maintaining the support of stakeholders and target groups. This also allows for continually valuing people's efforts and reminding them that their support is making a difference. However, it should be noted that this review identified limited evidence on the efficacy of specific programs and, as a consequence, literature was drawn upon from other areas. It is thus unclear how these aspects may function in animal disease surveillance and reporting behaviours.

Coordination and evaluation of programs

Individuals, industries, state and territory governments and the Australian Government all play a role in biosecurity. How their respective roles are organised and coordinated contributes to how well strategies are implemented and how effective they are. In the report *Farm biosecurity practices and the management of emergency animal disease*, Hernandez-Jover (2014) recommended improving collaboration and coordination across stakeholders involved in EAD planning and implementation (7). This was also reflected in *One Biosecurity* which recommended "greater consistency in the administration, auditing and response to non-compliance of co-regulators; reduced regulatory burdens for businesses that maintain an excellent track record of compliance with co-regulatory agreements and a wider adoption of co-regulatory arrangements" (6). It was found that Australian stakeholders believed that existing strategies for communicating EAD information were ineffective in achieving the desired changes in producer recognition and reporting practices (7). In explaining why current strategies were ineffective, a lack of coordination in the messages communicated to producers was raised as a key issue (7). The review committee of *Australian Quarantine: A shared responsibility* recommended that whilst monitoring and surveillance programs are essential they require increased national coordination (79).

All jurisdictions at the state and territory level run passive surveillance operations using their own staff and harnessing the efforts of private practitioners (62). The number and type of investigations varies according to local resources and practices. Consequently, data collection, quality management and storage differ substantially across the country. Improved coordination of these efforts would benefit a national surveillance and reporting program.

As maintaining high biosecurity standards is a multi-stakeholder and ongoing activity, there can be flow-on effects from changes in one area. For example, the negative impacts of resource and staffing constraints have been noted by government stakeholders. One of the significant consequences of these resourcing and staffing constraints is that it is difficult to monitor and evaluate the effectiveness of EAD communication and programs (7). Assessing the effectiveness of biosecurity strategies, and in particular the uptake and application of information by producers, as well as changes in surveillance and reporting behaviours, is crucial to ongoing monitoring and management of programs and the lack of evaluation remains a significant gap in biosecurity engagement programs (35).

Encouraging engagement and participation

Although producers report engagement with numerous farming networks, including those that relate to biosecurity, there has been some criticism of the failure of current biosecurity programs to effectively engage key stakeholders. Such programs have tended to involve one-way, top-down communication or information supplies (35). The authors of policy and strategy documents have recommended a shift from communication programs to participatory programs (which have greater potential to be longer-term and self-sustaining) to improve impact and effectiveness (35). However, proper and thorough evaluation of such programs is required to establish their performance and effectiveness.

It was also reported during an interview with a Livestock Biosecurity Network regional officer that intergenerational producers (those whose parents/grandparents were also producers) are more difficult to engage and change behaviour (pers comm: Livestock Biosecurity Network regional officer). However, capitalising on strong producer networks may assist in overcoming this barrier. And it was again reiterated that biosecurity concerns are often not at the top of producers' priorities with personal matters (such as debt) often taking priority. Thus, identifying an engagement strategy that acknowledges and respects producers' competing priorities may be helpful.

Guidelines were developed by the Australian Department of Agriculture, Fisheries and Forestry (now the Department of Agriculture and Water Resources) in 2012 which outline in detail how to effectively engage target groups, and which highlight positive behaviours that enable engagement.

These behaviours include being responsive and building relationships and networks with stakeholders, and the importance of reciprocity (47). Reciprocity refers to the social rule that we should repay, in kind, what another has provided to us—that is to say, to return some of the treatment that has been received (48). Compliance with reciprocity norms requires trust that the compliance will be reciprocated by others (49). For example, the transmissible spongiform encephalopathy (TSE) surveillance disease assurance program (which pays the producer for vet, transport and lab fees) will also provide other tests if a TSE disease is not found. This type of program demonstrates how reciprocity can be part of an engagement strategy. It is also important that producers feel that their time is valued, for example, ensuring that communication and engagement opportunities are maximised, and that producer input into strategy is valued (6).

It is worth highlighting that although substantial investment has been made to understand the barriers to surveillance and reporting of animal diseases, there remains a lack of effective and meaningful engagement that encourages changes to surveillance and reporting behaviours (35). Important shortcomings of campaigns include the following assumptions: that knowledge transfer is easy, that education or awareness campaigns will motivate empirically rational decisions, that the producer's specific social/cultural context is not important, and failure to acknowledge producers' already extensive knowledge (3). Thus, the complexity of producer engagement on this issue requires a comprehensive understanding of the context in which decisions and behaviours occur. Engagement also relies on the purpose and rationale of the program being clearly articulated and conveyed to producers. As mentioned earlier, there are some logical biosecurity practices that are endorsed by industry or government (such as vaccinations and screening tests for new stock). However, if the rationale for reporting disease (for example) is not clearly outlined to individuals, it may be difficult to engage participation (7). Note that such a rationale should also address the balance between costs and benefits.

A number of other factors can also hinder the development of an engagement strategy. Engagement strategies can be resource intensive and, if not conducted properly, risky. Some issues that have been noted include: confusion about the practicalities of key messages and how implementation should work, information that seems out of date due to environmental or contextual changes, appropriate and relatable authority figures and biosecurity procedures not being timely or easily accessible to target groups (52). These barriers can be exacerbated by organisational factors such as short funding cycles, lack of expertise in—or even familiarity with and knowledge about—engagement, and high staff turn-over (47). Producers may not be aware of services that have recently been re-established, so a lack of communication about the availability and costs of a government vet consultation and diagnosis may also be a barrier to producer reporting (66).

Furthermore, a state CVO commented on a perceived gap between government expectations of particular behaviours on individual farms and the lack of specific advice and services available to producers to help them enact such behaviours (pers comm: state CVO). A common feature of many government biosecurity campaigns and programs is the expectation that producers will act in the national interest, without individual benefits being highlighted. This may be because individual benefits for the producer can be hard to identify and communicate. Furthermore, producers may feel exploited in that there is little support for endemic diseases but high expectations for emergency animal diseases (pers comm: state CVO). Thus, it may be important to try to communicate the benefits for all producers (whether they supply domestic and international markets) since all Australian producers benefit from the surveillance activities that maintain Australia's disease free status. Reports from industry members also highlight that a focus on regulation and compliance can create a hostile environment and some state-based approaches have alienated particular producers because of difficulties with trust and past experience.

As part of interviews for this study's practice review, it was reported that the success of the national tuberculosis (TB) program was in part due to the procedural justice nature of the program, in that it was applied to everybody (i.e. everybody was sampled) (pers comm: NSW Department of Primary Industries (DPI)). The opinion was that there was no disincentive if everybody suffered the same fate (pers comm: NSW DPI). The disincentive to report in other contexts exists because the consequences are only seen apply to those who have reported, for example farms being quarantined (pers comm: NSW DPI). Thus, those who do not report are not seen to suffer any consequences. This relates to the concept of procedural justice, ensuring that fairness is applied equally during all processes. There is evidence that when there are stronger perceptions of fairness that people are more compliant (50, 51). This is a very important consideration when trying to engage producers and increase participation in programs. There is also the free-rider problem that occurs in gaining the cooperation required for provision of collective goods benefiting large groups of individuals (49). The benefits of providing a collective good are not exclusive to those who contributed to the provision effort. However, evidence from the literature suggests that individuals will resist the temptation to free ride if they can mutually agree on how the costs of providing the collective good will be shared between individuals and if they are able to credibly assure one another of their commitment to comply with that agreement (49).

Community engagement

In a report on how to develop biosecurity engagement guidelines, Kruger 2012 identified a number of key considerations, including social enablers, mechanisms and barriers (47). Mechanisms included utilising community champions, face-to-face contact, sense of community and place, social networks

and relationships, and two-way communication. These mechanisms highlight the benefits of directly involving the community (52) and taking advantage of existing community networks. With social enablers, there may also be opportunities to extend or replicate successful programs such as Weed Spotters or Waterwatch to include more community or industry members in biosecurity surveillance (35). However, it should be noted that there are important differences with these programs, namely that they take place on public property.

Research into pest control also found that simple local cooperative efforts, such as signing up to receive pest outbreak alerts from a regional pest coordinator, are more popular with producers than formal, larger scale efforts, such as participating in a county-wide effort to coordinate the placement of pest predator rest and breeding habitat (45). Whilst also emphasising the broader context of why biosecurity is important, such strategies also utilise community networks to emphasise the notion of being a 'good' neighbour or community citizen, or that 'doing the right thing' contributes to the greater good (35). However, the disincentive against personal consequences (e.g. quarantine, slaughtered livestock, loss of genetics) and attitudes that some measures are 'imposed' upon producers may still work against appeals to the common good (8). Research has identified that with behaviours that are perceived to involve personal sacrifice, self-interest becomes a strong predictor of intention to engage that behaviour (53). For influencing environmental behaviours this required reversing the sacrificial perspective and repositioning the behaviours as leading to a better life (53). However, research has also reported that intention to perform collective pro-environmental behaviour depends on personal norm (moral obligation), ascribed responsibility, and awareness of consequences for oneself, for others, and for the biosphere (54).

The importance of personal sacrifice behaviours and self-interest as factors influencing reporting is reinforced by comments from a Livestock Biosecurity Network regional officer which suggest that a reduction in stigma is required, possibly through using respected disease-reporting champions (pers comm: Livestock Biosecurity Network regional officer). Further suggestions include the use of local case studies of past incidents to provide a guideline of how soon producers should call a vet (pers comm: industry biosecurity member).

There are two main types of stigma, and much of the research in this area has come from health and mental health fields. However, many of the aspects of stigma can be seen to apply to biosecurity and producer behaviours. Self-stigma refers to internalized stereotypes or assumed public attitudes (55). This type of stigma can result in people not seeking assistance or information when appropriate. Public stigma occurs when large segments of a population agree with negative stereotypes (55). This

can lead to various types of discrimination or the removal of self-determination (e.g. an authority makes decisions for that person).

There are successful examples of programs challenging stigma, particularly in the health sector. For example, personalising substance use can be done using champions. Champions may be a key community member, an advocate for those trying to overcome substance use, or someone who has been affected by problematic substance use (56). Social contact has been seen to have a significant effect on decreasing stigma. Therefore, using champions as a means of communication between the campaigner and the community, or increasing contact with stigmatized groups, is highly recommended (56).

Projects have also targeted producers' active participation in programs. For example, the South Roxby Project in western Victoria required sheep producers to pay an annual fee of \$180 to participate in group learning activities, receive a monthly newsletter and access a limited number of individual consultations with a farm consultant (57). However, despite incentives to take full advantage of the scheme, adoption of strategies ranged from 20-50% (57). Furthermore, the extension program 'Grain & Graze' (targeted at mixed-farming systems) engaged producers through farm research activities, demonstration trials, field days, workshops and publications (58). In this program, only 40% of producers adopted some recommended practices over the course of the program (59). Thus, it is important to understand producers' motivations for engaging with programs and consider what the producers will gain from participation. For example, the MacKinnon Project offers a range of services including farm management consultancies, farmer training programs, contract research and post graduate training programs (60). This program also offered free veterinary services to attract participation.

Understanding how and why producers want endemic and emergency animal disease concerns to be dealt with is also an important step in developing effective programs. For example, in one Australian report it was identified that there was a groundswell of support for Bovine Johne's disease (BJD) to be dealt with differently from the way in which it has been over the past 12 years (61). The report stated that there was general support for BJD to be addressed under a common biosecurity approach for endemic diseases, with less emphasis placed on an individual disease. Thus, for at least some producers and some diseases, there is support for a broader approach rather than individual responsibility. This may involve a shift away from government regulation in managing endemic diseases such as BJD, by recognising the role of the producer as the interested and empowered decision-maker (61). This approach would place the responsibility on the seller to provide the herd-health information sought by the buyer, whose interests are protected by Common Law (61).

Thus, producer engagement and participation is a multi-faceted process that needs to consider the motivations, interests, costs, benefits and structures of relationships in order to be successful. While it has been reported by some industry members that successful programs include payments and incentives to offset inconvenience and risk (e.g. risk of quarantine) (pers comm: industry biosecurity member), it should be noted that this alone is not enough to ensure engagement or participation. Broader support could also be provided for producers to engage with more technology and better surveillance opportunities through the provision of the National Broadband Network (NBN) and better phones and connectivity. However, there is little evidence available regarding how this could be done or the likely uptake of such a program.

‘Smart surveillance’ is one way to improve monitoring that reduces the burden on individual producers. Smart surveillance involves the monitoring of stock aggregation points so that large numbers of animals from various properties can be inspected at a single point in time and space (62, 63). Saleyards, abattoirs and knackeries may also provide convenient and cost-effective opportunities for targeted surveillance (62). However, it is likely that this would not capture all signs of illness.

Authorities and official reporting procedures

Authorities contribute to the environment in which producers make decisions about surveillance and reporting. Broadly speaking, governments and the animal and public health communities create a climate that impacts willingness to report animal diseases (34).

Factors that are important in encouraging engagement with health officials include the approachability and accessibility of the government personnel, and their helpfulness and willingness to listen (3). United States and French studies found that scepticism of government programs and negative past experiences inhibit participation (15, 16). Producers report that surveillance programs are externally imposed tools and externally imposed systems for risks that producers do not feel concerned about.

Whilst producers feel that there is a need for a strong government role in surveillance programs, they also feel that motivation for producer participation is weak due to the lack of sanctions for not participating, and what they feel is perceived lack of government efficacy (16). In some circumstances, bureaucratic surveillance systems may backfire in that they encourage compliance rather than participation in the overall aim (which is most commonly early detection). In addition, some surveillance actions are seen as time-consuming, impractical or compensating for bureaucracies that aren’t doing their part (8).

Also, a drawback of strong government programs is that if producers completely trust authorities to detect and deal with an outbreak they may be less inclined to manage risk themselves. Producers' motivation and willingness to engage with biosecurity behaviours can also be compromised if they feel that others (other producers and the government) are not contributing, therefore negating their own efforts (9, 22). Supporting this, a UK study found that producers there appeared to have little faith in the efficacy of farm-level biosecurity measures in the absence of government restrictions on public access to farmland and border security adequate for preventing illegal imports that pose a disease risk (8). Or, similarly, producers not being able to alter the condition of poor boundary fences which are their neighbours' responsibility (9). Thus, acknowledging the multi-stakeholder nature of biosecurity is important.

United States cattle producers have reported that they believe the government is at least partially responsible for producing safe products (i.e. meat free from disease), with some also saying that private industry should bear some responsibility (22). There is also a common belief among Dutch pig producers and farmer unions that notifiable diseases are the primary responsibility of the government who should therefore bear the costs (27).

Increased transparency in both the reporting process and what to expect in the time between when a report is made and a farm is declared free of the disease would be helpful in both preparing producers and veterinarians for the process, and for building and maintaining trust among all the stakeholders involved. A discussion of compensation would also contribute towards this (15, 27, 64). Producers express frustration at the prospect that they may lose control of their business (27) if a disease is identified on their property, and clear communication about potential future actions would help to alleviate some of this anxiety. However, it should also be noted that producers expected to lose some of their autonomy for improved biosecurity in the UK (8) and have in some cases expressed that biosecurity measures should be mandatory (10).

During outbreaks, there is a government outbreak website (www.outbreak.gov.au) as well as an emergency animal disease hotline and local call centres that producers can access. However, producers expressed the need for a web-site that they could regularly visit to check the progress of the notification, or a phone number that they could call (indicating that they are either not aware of the above resources or that the resources do not contain the information producers are seeking). The need for comprehensive information using regular newsletters (that touch on several subjects in a short and concise way) has also been suggested (22).

Transparency and confidence in the information shared are prerequisites for controlling animal disease outbreaks. Currently, however, producers are hesitant in using formal channels (for example, through veterinary or government processes) because they feel that these sources of information are not up to date or reliable (27) and they view them in a negative light (10). Producers who deal with cross-border systems also expressed frustration at having to manage two different systems (pers comm: industry biosecurity member). It is also important to note that currently producers do not receive much feedback on their surveillance and reporting behaviours.

Another key barrier to producer engagement with authorities stems from low levels of trust in government following the cessation of extension services and free government services (7). In the past, governments provided a range of veterinary services, such as laboratory testing services, free of charge or at subsidised rates (65). The *One Biosecurity* report commented that withdrawing services and support to producers, while 'economically rational', communicates to producers a lack of care about their industry, and therefore exacerbates distrust towards government departments (6). A further comment was made by a state Chief Veterinary Officer (CVO) and also by DPI that these experiences left producers feeling abandoned (pers comm: state CVO and DPI). The relationships between authority and reporting bodies, communities and individual producers are fundamentally important to ensuring that recommended practices are taken up and barriers to reporting behaviours are minimised.

Conclusions

There are many factors that influence producers' biosecurity behaviour (including willingness to monitor for and report disease). These include: individual perceptions and attitudes towards biosecurity and reporting of EAD, community norms and social networks, institutional governance structures, farming sectors, and landscape and spatial constraints. However, the literature suggests that compliance with biosecurity practices is often apparent when:

- the risk of outbreaks is perceived to be high and likely to have serious impacts for producers on a personal level
- there are credible incentives and disincentives associated with specific behaviours
- producers are connected to local networks and community organisations
- producers are involved in relevant decision-making
- easy access to trustworthy and relevant information and expertise is available.

The biosecurity literature also identifies opportunities for supporting producers to manage and report biosecurity threats, and many of these strategies have a basis in models of behaviour change.

The policy and practice review indicates that biosecurity strategies have been implemented at the national, state and regional levels, and that considerable efforts have been made in recent decades to create a cohesive biosecurity surveillance and reporting network which also supports the education and engagement of producers. A number of strategies and programs have been employed at different levels and with varying rates of success. This has been in part due to:

- inconsistent approaches across jurisdictions
- A lack of coordination between programs
- challenges in engaging producers and using appropriate communication channels, translating information and knowledge, and communicating risk and priority behaviours
- differences in how surveillance data are recorded, analysed and reported in different jurisdictions.

To further address gaps in understanding around how effective policies and practices are, more detailed data is required on practices that have been implemented, including uptake and participation, implementation difficulties, changes that were required, and measures of success. Currently, this lack of information makes it difficult to inform what best practice would look like.

However, key considerations for the implementation of strategies and programs include:

- identifying the needs of different populations and industries in terms of the specificity and relevance of information provided
- communicating risk in the way that it is perceived (i.e. at the individual level)
- making risk salient and relevant to the audience
- ensuring that information is specific, timely and relevant to the audience
- providing consistent and coordinated information
- using appropriate channels of communication
- choosing carefully the source of information (e.g. trusted authority)
- ensuring authoritative bodies are approachable and accessible
- developing relationships, networks and two-way communication
- valuing input by producers
- capitalising on existing surveillance and reporting systems
- increasing the ease with which producers can engage
- leveraging current practices and behaviours
- emphasising fairness in processes
- making processes clear and transparent

- highlighting how multiple roles contribute to the outcome and emphasising reciprocity
- balancing external incentives to monitor and report with individual responsibility
- ensuring that policies are not unintentionally creating disincentives or reduced individual responsibility.

It is important to note that the literature, policy and practice findings presented in this review are abstracted from a wide variety of national and international farming and biosecurity contexts. Contextual factors such as the type of farming sector, farming culture, and property characteristics are likely to bear on what types of interventions are possible and acceptable to producers and other stakeholders. Therefore, considering the views of all relevant stakeholders (such as producers, government policy professionals, biosecurity researchers and experts, farming sector representative bodies and organisations, and veterinarians) provides a systems-wide understanding of biosecurity behaviours relevant to Australian contexts. From this knowledge, and that garnered from this literature review and stakeholder interviews, a range of strategies can be developed for trial in the field.

3. Focus Groups

Methods

To investigate common themes and issues pertinent to how producers relate to surveillance and reporting of animal disease, focus groups were conducted. Groups were selected, in part, through convenience sampling. To ensure timeliness and adequate recruitment numbers, focus groups were included at the end of an established meeting. Focus groups were organised with help of industry contacts. Three groups were chosen for inclusion. One in rural South Australia with sheep/cattle producers who had formed a community group to discuss collective issues and concerns. Another was conducted as part of a group meeting for Wool Producers Australia in Sydney with participants from all states and territories across Australia. The third was conducted as individual interviews rather than focus groups due to logistic difficulties. The pig producers who were interviewed were contacted with the assistance of Australian Pork. These groups were internally homogenous but were selected to provide a sample of industry and geographic locations across Australia.

Participants were informed that the purpose of the study was to collect information on attitudes towards animal disease surveillance and reporting, in particular emergency or notifiable diseases. Semi-structured focus group questions (see Appendix 1) were used to run the sessions which lasted for approximately 30 – 45 minutes.

The focus group sessions and interviews were recorded, and transcribed. Qualitative analysis was conducted to identify key themes.

Table 1: Focus group characteristics

<i>Group</i>	<i>Location</i>	<i>Number of participants</i>	<i>Date</i>
<i>Sheep and cattle producers</i>	Orroroo, SA	17	17/11/2015
<i>Sheep producers</i>	Sydney, NSW	12	19/11/2015
<i>Pig producers</i>	Multiple	5	2 – 5/12/2015

Focus Groups: summary of data

Sources of Information

Sheep and cattle producers reported that they preferred online sources of information, including emails, websites, and online journals. The ease of access and how quickly producers could access information was a key factor in their source choices.

However, some producers noted that their internet access could be intermittent and a hardcopy of collated information on sheep and cattle diseases that they could look through, including appropriate steps to take, would be helpful.

Community of practice meetings to discuss issues were described as very useful, both in terms of information sharing and support.

Producers also reported using abattoir feedback to alert them to a limited number of disease issues. However, the timeliness of this feedback varies across states and some states (WA) do not receive any feedback.

Industry groups such as Animal Health Australia were reported as reliable sources of information, while some producers said that they would contact state government departments for updates, however, others said they would be reluctant to contact the government. All producers reported trusting their private vet, even when they acknowledged that private vets were still bound to report notifiable diseases. Some producers would also call upon retired vets and experienced producers as informal sources of advice. These informal channels were usually part of preliminary investigations before calling a vet.

When to share information

Regarding when producers would share information regarding clinical signs of disease they have noticed in their livestock, most cattle and sheep producers reported that they would share information (including within their community group) when they had noticed a problem in their own stock. They noted that they were responsive and that there was not a lot of pre-emptive activity other than their general biosecurity practices.

However, a small number of sheep producers stated that the regulator or government vet would be the last person they called due to the perceived consequences.

Decision thresholds

When deciding whether to take the next step in disease reporting, whether to a local vet or a government vet, a threshold for seeking further assistance or information existed. Most producers considered the severity and the length of time of clinical signs of disease.

Some producers, who also noted that they lived a number of hours away from a vet, said a disease had to be major otherwise the cost of getting a vet onsite was prohibitive. Through this discussion, most producers acknowledged that there was a considered process where the costs had to be weighed up to see if it was worth it. Producers stated that it is hard to tell what clinical signs of disease were going to be serious. If other producers in their area had been affected, they were more likely to do something about it.

Barriers and challenges

When discussing barriers and challenges to good biosecurity practices and willingness to report, producers often returned to the term 'apathy' to describe why some producers were not vigilant regarding biosecurity or emergency animal diseases.

Sheep producers also reported that there are a lot of producers who do not report. The reasons provided for this include: cost, stigma, lack of information, lack of knowledge, reluctance to deal with problems even though they inhibit profitability, perceived low importance of reporting, the suspicion that regulation will cost more than dealing with the disease in-house, inter-state differences, and lack of resources to be familiar with all diseases.

Another notable barrier that was identified was that producers were bombarded with too much information. Keeping up to date takes a lot of time for a group that is time poor. Alongside this, producers also expressed frustration at increasing expectations on producers. One producer stated that "they shouldn't expect producers to be vets".

Although most producers reported that they knew the reporting processes for emergency animal diseases, they also said that they were unsure how effective these were as they had not been tested. There was uncertainty amongst the producers about how well reporting processes and responses to emergency animal disease outbreaks would work when tested.

In further elaboration of this point, sheep producers reported some suspicion of regulations as the government was perceived to be pulling out of this space and funding drying up. Sheep and cattle producers also perceived that governments had moved away from providing services and now levies were largely paying for the programs. There was a general perception that the government would wait until there was a proven problem before coming on board. Further comments by sheep producers regarding lack of government involvement included a statement that there could be potential difficulties in managing disease outbreaks once there was a confirmed case because 'the horse had bolted'. They perceived that it was difficult for the government to understand what was happening because they hadn't been involved. It was noted that this extended beyond biosecurity to

other issues such as drought. From this perception, some sheep producers felt that it might be best to leave industry to regulate diseases itself. They thought that industry regulation might help with consistency of regulation (for example, across states and territories), therefore creating consensus within industries and removing duplication.

Furthermore, sheep producers expressed frustration at the differences between states (and the lack of a state alliance) which resulted in fragmentation, making things very difficult. For example, sheep producers reported that they could not get national recognition of a sheep alliance, or one for Ovine Johnes Disease. Producers claimed that different animal health legislation couldn't be reconciled between different states. Sheep producers also stated that when this had been tried in the past, some states would agree to collaborate and use consistent approaches but would then go on to do what they had done before. As one producer stated "the challenge is federation".

When asked if there were types of producers more likely to not inspect their stock for diseases, sheep producers said that there was no trend, it could be from the largest to the smallest producers. With some, they thought it was a lack of education and awareness. Sheep and cattle producers stated that it was impossible to achieve a secure farm perimeter because there was always someone who didn't think it serious.

[Benefits of surveillance and reporting / opportunities to improve](#)

The community group of sheep and cattle producers said that were ways that they could be more proactive. Their group meetings were a good start but they would like more information on what else they could be doing. They expressed interest in accessing grants that could look at other potential problems and working more collaboratively as a producer community to enhance their biosecurity.

Sheep producers said that whether they had positive experiences or not was dependent upon on the disease and the outcomes. For example, if there is a disease that is wiping out their flock, then reporting a disease and getting the vet involved can help. Thus, getting answers through the reporting process can provide reassurance that the outcomes might not be as bad as you think. A number of producers said that it was better to know than not to know, including receiving diagnoses. Some producers just wanted to get the process over and done with and they were more inclined to do this if the process was viewed as timely and relatively easy.

There is also the benefit to the industry as a whole for providing proof of freedom, which is important for all producers. It formalises the information that's available and can be an avenue to notify others of outbreaks and be notified of other outbreaks.

A final comment was that the technique of the vet needs to be high if producers are going to feel confident to call them in and pay for their services and to continue using them. Thus, the reputation of the vet is very important.

Responsibility

Sheep and cattle producers felt that biosecurity responsibility should be shared with the wider community and that everybody needs to be involved for it to be effective.

There was also an impression that industry could play a mediating role between government and producers, including lobbying the government. Producers felt that this was an important role that was not currently consistent across different areas.

Sheep producers reported that individual properties should take responsibility for their own biosecurity. However, they also noted that past management and eradication programs that have been successful were state and federal (e.g. the lice eradication program in Beauford VIC, Brucellosis national program, and the national TB program, and the anthrax outbreak in Victoria where there was a plan in place and officials knew who to isolate and the incident was out of the news in seven days.)

The general impression of sheep producers was that producers can manage small outbreaks of manageable diseases on their farms but the real risk is an EAD outbreak which is more likely to come from overseas and this is beyond the producers' control. Sheep producers felt reliant on government to regulate this aspect and believe that government needs to take ownership on serious diseases, especially if market failure is a possibility.

Impressions of the most important factor for emergency animal diseases

Sheep and cattle producers thought that there needed to be a greater awareness in the district and the country, and better communication between all stakeholders. Bringing better awareness and education to all producers (especially young producers) was also viewed as important, whether through phone calls at home, courses or other methods. Sheep and cattle producers also felt that capitalising on local vet knowledge was important as they know the area and know what's going on between the DPI and the government.

The group of sheep producers only thought that it was most important to maintain state and federal government investment and manage levies and funding. They felt that while producers have to contribute as an industry, the general population also needs to contribute.

Conclusions

The focus groups revealed several important findings, many of which reinforced the literature, policy and practice review.

There was a divide between producers who wanted online resources and those who preferred hard copies (largely due to network coverage in their area), this reinforces the important of aligning communication approaches with producers' preferred sources of information which may be different for different groups.

Furthermore, the trustworthiness and credibility of the source was again highlighted as important. However, an important comment was that some producers found it difficult to keep up-to-date with all the information, they felt that they were overloaded. Yet, on the other hand, some producers wanted more information, particularly on how to be proactive. Thus, leveraging sources that producers are already using may help producers access and understand the relevance of the information.

In terms of when to speak to someone about clinical signs of disease, the severity and duration of clinical signs were generally what prompted producers to share information (most likely with neighbours in the first instance). Greater distance to vet services was reported as a prohibitive factor unless the clinical signs of disease were very severe.

The reasons provided for why producers do not report include: cost, stigma, lack of information, lack of knowledge, reluctance to deal with problems even though they inhibit profitability, perceived low importance of reporting, the suspicion that regulation will cost more than dealing with the disease in-house, jurisdiction differences, and lack of resources to be familiar with all diseases. Many of these issues raised in the focus groups reflect findings from the literature, policy and practice review.

The idea of reciprocity was touched upon, with producers concerned that government was neglecting services and funding while their expectations of producers were increasing. Perceived lack of coordination and differing policies across jurisdictions were also a source of frustration and confusion. However, producers saw benefits in reporting. In particular, being able to get answers and the clear benefits to the industry as a whole were prominent answers. Overall, producers thought that there needed to be a greater awareness of the issues and better communication.

4. Analysis of Attitudes, Beliefs and Intentions

Methods

Survey design

Following analysis of the data collected from the focus groups, questions were developed based on the themes identified and (where appropriate) using the language of producers. These questions were reviewed against established questionnaires and theoretical frameworks (in particular, the Reasoned Action Approach (95)) to ensure adequate coverage and detail for the areas of interest.

Nine topics of interest were identified. These topics were as follows:

- past and current monitoring and reporting behaviours
- attitudes towards monitoring and reporting
- injunctive social norms
 - perceptions of what behaviours are approved of or disapproved of by others
- descriptive social norms (perceptions of how other people actually behave)
- perceived behavioural control (how much influence over a behaviour an individual believes they have)
- risk perception
- trust
- responsibility
- intentions to perform monitoring and reporting behaviours.

For a list of the questions, see Appendix 4. The questions were piloted with select representatives from intensive and extensive industries. The market research company (KG2) contacted 978 producers and invited them to participate.

A sample of Australian livestock producers were selected through a panel company, KG2. A computer-assisted telephone interview (CATI) was conducted in March 2016 to survey 200 producers from the sheep, cattle and pig industries.

Participants

The sample was a regionally proportional random selection of livestock producers across the sheep, cattle and pig industries. KG2 contacted and invited 978 producers to achieve 200 interviews (a participation rate of 20.4%). This participation rate was better than expected, compared with similar previous studies.

Overview of Statistical Procedures

Cluster Analysis

The type of producer (e.g., cattle, sheep, pig) and selected demographic and property characteristics were used to develop a typology of producers in the sample population. This was done to ascertain whether the type of livestock under production was an appropriate way of viewing farmer subgroups or whether demographic and property characteristics were also important to differentiate subgroups in the population. Thus, a cluster analysis³ was performed to understand how producers in the sample might be segmented in such a way that can inform subsequent comparative analyses between groups (see Appendix 2 for description of the statistical analyses).

Regression analyses

Multiple regression analyses were undertaken to gain an understanding of which attitudes and beliefs predicted intention to perform the behaviours of interest. Multiple regression examines the relationship between several variables and an outcome variable, in this case what attitudes and beliefs predict intention to monitor for and report emergency animal diseases.

More specifically, regression analysis helps understand how the level of intentions change when any one of the predictors is varied, while the other predictor variables are held constant. Multiple regression allows us to ask the question 'what is the best predictor of intentions to monitor and report emergency animal diseases?'

³ Cluster analysis is the process of grouping a set of cases in such a way that cases in the same group / cluster are more similar (based on the included characteristics) to each other than to those in other groups.

Results

Demographic and descriptive statistics are presented below, and a discussion of the results and their implications follows. For information on statistical analyses and presentation of statistical results, please consult Appendix 3.

Table 2: Demographics

			Range
State		N (%)	
	NSW	52 (26.0)	
	QLD	45 (22.5)	
	SA	29 (14.5)	
	VIC	54 (27.0)	
	WA	20 (10.0)	
		M (sd)	
	Years earning living as a farmer	38.81 (13.93)	1 – 81
		N (%)	
	Which livestock do you keep on your farm		
	Beef cattle	53 (26.5%)	
	Dairy cattle	32 (16.0%)	
	Beef / sheep	52 (26.0%)	
	Sheep	50 (25.0%)	
	Pigs	13 (6.5%)	
		M (sd)	
	Product used for domestic consumption	57.38 (36.09)	0 – 100
	Product used for international export	38.27 (35.20)	0 – 100
	Distance to preferred vet	70.26 (92.53)	1 - 600
	Property size (hectares)	4887.57 (20113.10)	30 – 260,000
		N (%)	
	Gross annual income of business		
	Less than \$250,00	66 (33.0)	
	\$250,000 - \$500,000	52 (26.0)	
	\$500,000 - \$1m	36 (18.0)	
	More than \$1m	34 (17.0)	
	Don't Know	7 (3.5)	
	Prefer not to answer	5 (2.5)	

Most producers were from Victoria and New South Wales, with a significant number also from Queensland. Western Australia only amounted to 10% of the sample, while the Northern Territory and Tasmania were not represented. The majority of producers had beef and/or sheep livestock (pigs were a minority) with most going to domestic consumption.

The average distance to preferred vet was approximately 70km. Distance to preferred vet was negatively associated with likelihood of calling a vet when noticing clinical signs of emergency animal diseases ($r = -.28$). Thus as distance increased, likelihood of reporting to a vet decreased.

Cluster Analysis of demographic characteristics

A cluster analysis was run to identify subgroups within the sample of producers based on key demographic, property and livestock characteristics.

Six clusters were identified. These are:

Table 3: Definition of Cluster Groups

	Livestock type	Property size	Income level	Import / Export	Distance to vet	Gender
Cluster 1	Mostly dairy producers	Smallest		More exports	Closest to vets	
Cluster 2	Most pig producers		Highest income	Lowest exports	Furthest from vet	
Cluster 3	More sheep producers		Lowest income			
Cluster 4	More Sheep & Beef producers	Largest	Lower income		Further from vet	More females
Cluster 5	Most Sheep & Beef producers			More exports		
Cluster 6	Most Beef producers		Lower income	More exports		

Cluster 1 mostly composed dairy farmers, this cluster also had the smallest property sizes, tended to be closer to vets and had more exports.

Cluster 2 was mostly pig producers, this group also had the highest income and were furthest from the vet.

Clusters 3 – 6 all involved sheep and beef producers but are differentiated on the other characteristics of the clusters. Cluster 3 had more sheep than other livestock types and also had the lowest income amongst the groups.

Cluster 4 had more sheep and beef producers and the largest property size. This cluster also had a lower income, was further from the vet and had more female respondents than the other clusters.

Cluster 5 had the most sheep and beef producers of all the clusters and exported more than cluster 4. Cluster 6 had the most beef producers, less sheep producers than Cluster 5, a lower income and more exports.

Past experience with emergency animal diseases

A minority of producers reported having an experience with an emergency animal disease (12%). Of these producers, most contacted their vet in the first instance, followed by their neighbours and their state department of primary industries. The majority of these producers reported within the

first 24 hours (63.6%). Reasons provided for not reporting were: “contacted by the department – left it to them” and “the government came to me”.

If you suspected an emergency animal disease outbreak today...

When producers were asked to think about what they would do if they suspected an emergency animal disease outbreak in their livestock today, 99.5% of producers would talk to someone about it. A large majority (85.5%) would speak to their vet, 14.5% to their state department of primary industries, and 6.5% to their neighbours, while 4% would speak to the Department of Agriculture and Water Resources. The majority of producers would report the suspicious clinical signs of disease within the first 24 hours (64.5%). Other producers would get a second opinion before reporting (17.5%), or would monitor their animals until they were sure before reporting (15%), only 1% said that it would depend on the severity of the disease.

Behavioural Intentions and Factor Analysis

Four behavioural intentions were measured:

- Call a private vet within a day of noticing clinical signs of an emergency animal disease in your livestock.
- Monitor for clinical signs of emergency animal disease on your property over the next 3 months.
- Report clinical signs of an emergency animal disease to a government vet within a day of noticing them.
- Call the government hotline within a day if you suspect there might be an emergency animal disease.

Overall, producers reported that they were more likely to call a private vet and monitor for clinical signs of emergency animal diseases. They were less likely to report clinical signs of disease to a government vet or government hotline.

To better investigate the behavioural intentions, a factor analysis was performed on the four behavioural intentions (BI).

Two factors were identified; *behavioural intentions related to government agencies*, and *behavioural intentions related to private business (without a role for government)*.

Factor 1: Behaviours related to reporting to government

1. Call the government hotline within a day if you suspect there might be an emergency animal disease.
2. Report clinical signs of disease of an emergency animal disease to a government vet within a day of noticing them.

Factor 2: Behaviours related to monitoring and reporting without government

3. Monitor for clinical signs of emergency animal disease on your property over the next 3 months.
4. Call a private vet within a day if you notice clinical signs of an emergency animal disease in your livestock.

The two factors were moderately correlated ($r = 0.28$), indicating that there is a moderately strong relationship between the two factors of behavioural intentions but it is not an overly strong relationship. This means that behavioural intentions related to government and those not related to government are not strongly associated, that is, participants did not see these two sets of behaviours as overly similar.

When looking at the differences in BI between the different clusters identified (see Figure 2 below), it is clear that Clusters 4 and 5 have lower intentions both with and without government. Clusters 1, 2 and 5 have the lowest intentions related to government and Clusters 3, 4 and 5 have the lowest intentions not related to government. This means that there are characteristics that differ between producers who have high intentions to perform monitoring and reporting behaviours and those who have lower intentions. For example, Beef and Sheep producers reported lower intentions not related to government than pig producers.

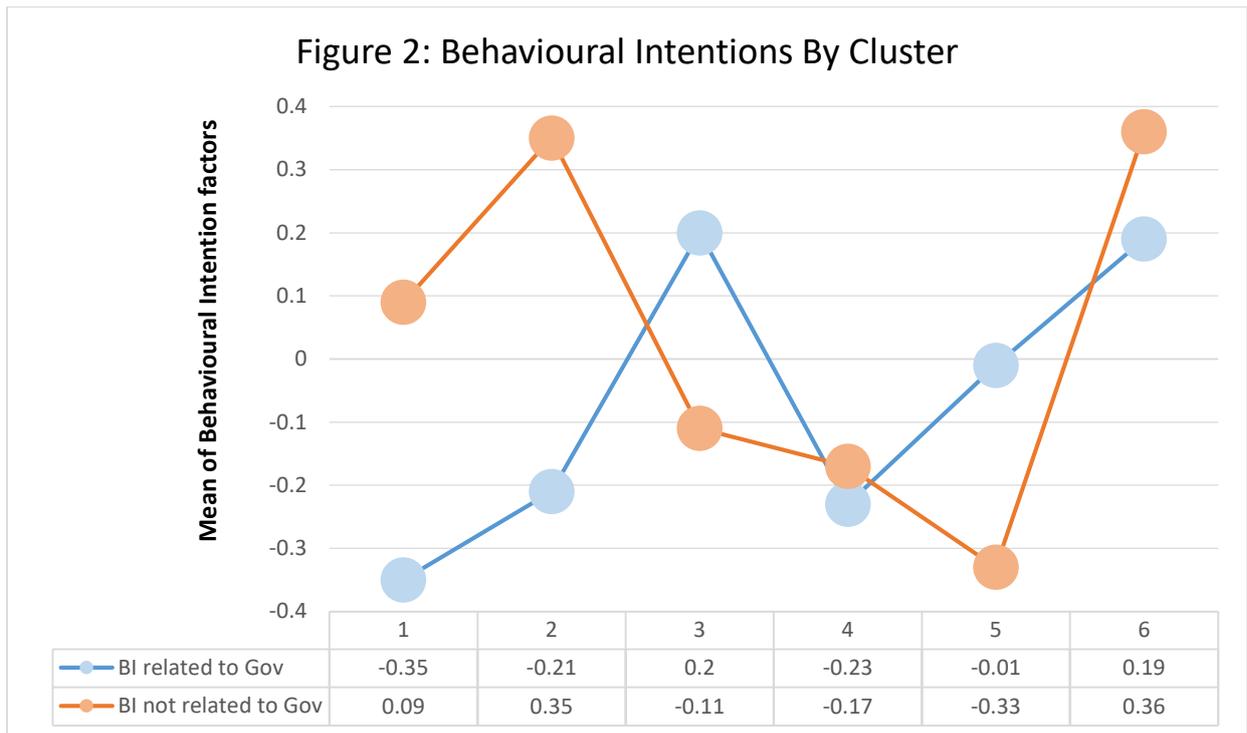


Figure 2: Behavioural Intentions by Cluster

Clusters	1	2	3	4	5	6
	Dairy, closest to vet, smallest property, higher % export	Pigs, furthest from vet, highest income, lowest % export	Sheep, lowest income	Beef & Sheep, more females, largest properties, further from vet, lower income	Beef & Sheep, higher % export	Beef, lower income, highest % export

Confidence in ability to identify emergency animal diseases

Producers were asked to rate their confidence in their ability to identify different emergency animal diseases (see Appendix 3 for a list of diseases). Overall, confidence was fairly low and was only moderately correlated with a general item that asked producers to rate their confidence to recognise emergency animal diseases. This indicates that when asked to rate their general ability producers may be slightly over-confident in their capability to recognise clinical signs of emergency animal diseases. However, it could also be that producers are confident that they can identify generally suspicious clinical signs of disease but do not have disease-specific knowledge.

Competency to deal with emergency animal disease outbreaks

Local vets were scored highest for their competency, while the Department of Agriculture and Water Resources were scored lowest. There were moderate to strong relationships between measures of competency for different individuals and organisations, and perceptions of how responsible those individuals and organisations were in monitoring and dealing with emergency animal diseases.

Responsibility

When asked to rate the responsibility of different stakeholders for monitoring emergency animal diseases and for dealing with emergency animal diseases, producers rated themselves as most responsible for both behaviours. Thus, participants acknowledged the pivotal role that the producer plays in surveillance activities. While producers were rated as slightly more responsible for monitoring than dealing with emergency animal diseases, the federal and state government departments, along with industry bodies and AHA/LBN were rated as more responsible for dealing with emergency animal diseases rather than monitoring for them.

Table 4: Responsibility for monitoring and dealing with emergency animal diseases
Scale range 0 – 10 (not at all responsible – totally responsible)

	Monitoring ED M (sd)	Dealing with ED M (sd)
You	9.06 (1.39)	8.87 (1.67)
Producers in your district	7.52 (2.69)	7.51 (2.48)
All land owners	6.85 (2.82)	6.90 (2.67)
Animal Health Australia / Livestock Biosecurity Network	7.26 (2.63)	7.79 (2.29)
Industry Representative Bodies (e.g. Meat and Livestock Australia)	7.09 (2.63)	7.42 (2.41)
The Federal Government Department of Agriculture and Water Resources	7.07 (2.77)	7.71 (2.33)
Customs and Border Security Agencies	7.38 (3.01)	7.40 (2.81)
Primary Industry Departments in State Governments	7.30 (2.70)	7.86 (2.32)
Local Government / Councils	5.28 (3.11)	5.81 (2.90)
Livestock agents	6.58 (3.11)	6.73 (2.80)

Attitudes towards the Department of Agriculture and Water Resources

Respondents generally had average to slightly above average attitudes towards the Department of Agriculture and Water Resources. The Department of Agriculture and Water Resources was most trusted in terms of providing easily accessible and useful information on emergency animal diseases. The Department was rated lower in terms of making good management decisions and dealing with producers affected by emergency animal diseases in a fair and equitable manner.

Perceived risk

Producers rated an emergency animal disease outbreak as very likely to have a large impact on their farm business, however, they saw the risk of emergency animal diseases developing on other properties as higher than occurring on their own. There were no differences between the producer clusters in terms of their risk perceptions of a possible outbreak occurring on their farm or the likelihood of how big the potential impact would be.

Reasoned Action Approach of Behaviour

The Reasoned Action Approach is a theoretical framework which specifies four subjective factors that influence behavioural intentions (95). These are;

- perception of what others who are important to them would do (injunctive social norms)
- perceptions of what other people do (descriptive social norms)
- perception of whether they possess the internal and external resources to perform the behaviour (perceived behavioural control)
- attitudes towards the behaviour.

Social norms

Producers reported that they thought most producers in their district would expect them to report clinical signs of emergency animal diseases as soon as they were found. There was a lower but still relatively high mean (6.98) for rating the belief that most other producers (whom producers respect in their district) would regularly monitor their livestock. The mean was below average for ratings of whether agencies expect too much of producers when it comes to monitoring and reporting.

Producers also rated moderately highly that most producers think that other producers in their district would report emergency animal diseases when found. These results indicate that producers perceive a social norm to exist for monitoring and reporting suspicious clinical signs of disease. They believe that these behaviours are expected of them by other members of their community and that the expectations placed upon them are not unreasonable. Thus, it is considered the normal thing to do.

Perceived behavioural control

Producers generally reported that they know what they are required to do and are confident in their ability to recognise emergency animal diseases. Producers were less confident that they would be able to manage the threats of an emergency animal disease outbreak before it became serious.

Confidence in the ability to recognise and know what to do in a case of an emergency animal disease was lower in Clusters 3, 4 and 5. Thus, producers are confident in their behavioural control relating to monitoring emergency animal diseases but not for dealing with an emergency animal disease outbreak. As noted earlier, it is also possible that producers are over-confident in their ability recognise EAD, for when asked if they could identify signs of particular diseases, they were less confident.

Attitudes towards monitoring and reporting of emergency animal diseases

Producers reported that regular monitoring of their livestock was a good way to avoid financial losses and that this helps government regulators do their job. Producers generally disagreed that

there is negative stigma associated with finding disease in their livestock or that other producers would think badly of those who report emergency animal diseases. This indicates that fear of stigma and consequences is not likely to represent an inhibiting factor to surveillance and reporting. This is in contrast to literature which has identified stigma, and especially the fear of first reporting, as a significant barrier. This finding reinforces that producers recognise surveillance and reporting behaviours as important activities that benefit the whole industry.

Regression Analyses: Predicting Behavioural Intentions

Behaviours related to government

The regression analysis for behavioural intentions related to government revealed relationships with two key areas: trust and responsibility.

Specifically, producers who trusted the Department of Agriculture and Water Resources to follow the best available science and to communicate effectively with producers about emergency animal disease issues were more likely to endorse intentions related to government. These are key to a good deal of the literature regarding land-owner cooperation. Producers need to trust who they are required to collaborate with and they want clear communication and honest dealings. Views that the Department of Agriculture and Water Resources can be trusted to follow best-practice in a fair manner increase the likelihood that producers will report suspicious clinical signs of disease to the government.

Furthermore, those who rated the following organisations (AHA/LBN, livestock agents and industry representative bodies) as more responsible for dealing with emergency animal diseases were also more likely to report behavioural intentions related to government. Responsibility of the above organisations was strongly correlated with responsibility of the Department of Agriculture and Water Resources to deal with emergency animal diseases. This indicates that there may be some confusion between the roles that government and non-government institutes play.

These regression results indicate that producers need to trust the Department of Agriculture and Water Resources especially in the advice that they're giving, including the accuracy of information and method/time of communication. Including producers in the development of strategies designed to help them monitor their stock on their properties is a necessary starting point for building effective, collaborative relationships.

Behaviours not related to government

The regression analysis for behavioural intentions not related to government highlighted four important areas:

- responsibility

- perceived behavioural control
- distance to vet
- injunctive social norm.

These findings highlight that **when individual producers feel responsible for dealing with emergency animal diseases in their livestock, they are more likely to engage in behaviours related to monitoring** and following up with a private vet when suspicious clinical signs of disease are detected.

Secondly, perceived behavioural control was identified as important, especially in terms of producers reporting that they know what to do if they suspect an EAD, thus indicating that a clear line of action is important. Thus, **producers who reported that they knew what they should do were more likely to monitor their livestock and to engage a private vet.** However, this does not relate to behaviours that relate to government, for example, calling the hotline or a government vet. Therefore, it is also necessary to ensure that what producers believe are the correct actions align with official steps. This item was lower in clusters 3, 4 and 5; these clusters include predominantly beef and sheep producers and lower incomes. This may be due to rural locations and distance to vets and its associated cost. To increase perceived behavioural control, a farm trial of biosecurity surveillance actions/procedures that demonstrates how easy it can be for producers may assist. Alternatively, access could be provided to other resources (e.g., information about identifying diseases most likely to occur in the livestock).

The distance and cost of veterinary services is another important factor in producers' behaviours related to monitoring and reporting. **The greater the distance to preferred vet was, the less likely producers were to report intentions to monitor and report to a private vet.** This finding was also highlighted in the review and focus group parts of this report. Thus, convenience and cost of investigating suspicious clinical signs of disease acts as a barrier to more remote producers. Strategies to address access could involve (i) resourcing and skilling producers to a level that enables them to identify clinical signs of disease in their stock without the need to consult with a vet in the first instance, and (ii) using communications technology to connect veterinary expertise with remote producers.

Finally, social norms were also highlighted as important, specifically the item referring to 'most producers in your district who you respect regularly monitor their livestock'. This is evidence that the desired surveillance behaviours are the 'norm' as the perception is that this is a common and accepted behaviour. If social norms are related to behavioural intentions, **intervention strategies that capitalise on social rewards of approval and social sanctions of peer disapproval are likely to**

be effective. For example, using social networks to communicate information and provide support. The use of field days (where producers come together on farm) to communicate “role model stories” describing behaviour change successes is another option.

5. Design Workshop

Following the data analysis stage of the project, a design workshop was held where the evidence accrued was presented. A design workshop allows for collaborative discussion and facilitates collective decisions about suitable approaches to behaviour change interventions. Including key stakeholders in the design process is important in designing approaches that are appropriate, realistic and achievable.

Nine stakeholders attended the design workshop (in addition to three BehaviourWorks staff). There were seven staff from the Department of Agriculture and Water Resources, one representative from state government, and one representative from the Livestock Biosecurity Network.

The design workshop was facilitated to explore the review, focus group and data analysis results to ensure that participants understood the results. Reflections and insights were documented. The group was then divided into small groups to work on designing interventions. This involved taking an insight from the results and turning this into a potential intervention. Groups were also provided with a framework to match behaviour change tools to variables that influence behaviour (see next page).

Groups were provided with the following criteria to help guide the development of their intervention:

- what
- who
- why
- how
- what does success look like and how would it be measured?
- required resources
- next steps

An important step for many of the interventions proposed will be to engage producer representatives to comment on their content and implementation. Furthermore, once the implementation process has been clearly defined, an evaluation framework should also be developed for each intervention.

Where relevant and feasible, interventions should also be tailored for clusters identified by the research. For example:

Cluster 3: Sheep, lowest income

Emphasise financial benefits of strategy and education as this cluster reported the lowest confidence in identifying EADs and knowing what to do if they suspect one.

Cluster 4: Beef and Sheep, largest property size, further from vet, lower income

Focus on remote access and self-sufficiency.

Cluster 5: Beef and Sheep, higher exports

Focus on communicating stories about trade partner requirements and questions, examples of markets lost through not meeting surveillance needs or providing information.

The outcomes of the design workshop were the development of potential interventions. These included but were not limited to:

1. changing perceptions of risk
2. building relationships between livestock producers and vets
3. supporting producers with poor access to vet services.

Further work will be undertaken to develop these interventions. Next steps will involve further refinement of the proposed interventions with producers from a range of sectors, and developing appropriate evaluation frameworks for assessing their effect on behaviour.

6. Conclusions

The research conducted in this report has highlighted several key considerations for planning and implementing behaviour change strategies targeted at producers' surveillance and reporting behaviours.

Firstly, producers express explicit concerns regarding:

- the surveillance and reporting behaviours expected of them
- funding and reciprocity
- the logistics and costs of veterinary services
- a perceived lack of support for emergency animal diseases.

There are also a number of lessons from the behavioural science literature which have informed our understanding of how to target producers' monitoring and reporting behaviour:

- the role of social norms and perceived behavioural control
- attitudes towards both government and non-government organisations as important factors
- that feelings of responsibility demonstrate interesting relationships with behavioural intentions
- perceptions of individual responsibility are important for intentions to monitor and report to private vets
- seeing government organisations as responsible was important for intentions to report to government (which reinforces that coordination between all responsible organisations is important)
- transparency of processes and clear, fair communication is needed to alleviate the concerns of producers.

Characteristics of context that positively influence reporting behaviour were also identified, including:

- when the risk of an outbreak is perceived to be high
- surveillance advice that is perceived as relevant and important
- the personal impacts on the producer are significant
- there are incentives to monitor and report
- producers are connected to local networks.

These findings informed the development of five intentions through the design workshop. These were:

1. mapping and clarifying the roles of responsible authoritative bodies
2. changing perceptions of risk
3. building relationships between livestock producers and vets
4. increasing support to producers with poor access to vet services
5. establishing producer syndromic surveillance networks.

Whilst the design of these interventions were directly informed by the findings in this report, there are important considerations when implementing behaviour change strategies that are worth reiterating here, including:

- identifying the needs of different populations and industries in terms of the specificity and relevance of information provided
- communicating risk in line with the way that it is perceived (e.g. on the individual level)
- making risk salient and relevant to the audience
- ensuring that information is specific, timely and relevant to the audience
- providing consistent and coordinated information
- using appropriate channels of communication
- choosing carefully the source of information (e.g. trusted authority)
- ensuring authoritative bodies are approachable and accessible
- developing relationships, networks and two-way communication
- valuing input by producers
- capitalising on existing surveillance and reporting systems
- making it easy for producers to engage
- leveraging current practices and behaviours
- emphasising the fairness of processes
- making processes clear and transparent
- highlighting how multiple roles contribute to the outcome and emphasising reciprocity
- balancing incentives to monitor and report with individual responsibility
- ensuring that policies do not unintentionally creating disincentives or reduced responsibility.

These findings should inform any interventions developed. In addition, any intervention should be further developed and refined with all important stakeholders in mind, and consultation undertaken

where appropriate. Likewise, the design and implementation of relevant evaluation methodologies will likely benefit from the participation of relevant authorities, organisations and individual producers.

7. References

1. Bell N. ACCC commissioner names biosecurity as Australia's key competitive advantage in global market: The Weekly Times; 2016 [1/7/2016]. Available from: <http://www.weeklytimesnow.com.au/agribusiness/accc-commissioner-names-biosecurity-as-australias-key-competitive-advantage-in-global-market/news-story/a991de2399cc35d42ace6663a401a155>.
2. Martin P, Langstaff I, Iglesias R, East I, Sergeant E, & Garner M. Assessing the efficacy of general surveillance for detection of incursions of livestock diseases in Australia. *Preventive Veterinary Medicine*. 2015;121(3):215-30.
3. Palmer S, Fozdar F, & Sully M. The effect of trust on West Australian farmers' responses to infectious livestock diseases. *Sociologia Ruralis*. 2009;49(4):360-74.
4. McLaws M, & Ribble C. Description of recent foot and mouth disease outbreaks in nonendemic areas: Exploring the relationship between early detection and epidemic size. *The Canadian Veterinary Journal*. 2007;48(10):1051.
5. Carpenter TE, O'Brien JM, Hagerman AD, & McCarl BA. Epidemic and economic impacts of delayed detection of foot-and-mouth disease: a case study of a simulated outbreak in California. *Journal of Veterinary Diagnostic Investigation*. 2011;23(1):26-33.
6. Beale R, Fairbrother, J., Inglis, A., Trebeck, D. One Biosecurity: A working partnership. The Independent Review of Australia's Quarantine and Biosecurity Arrangements Report to the Australian Government. Australia: 2008.
7. Hernandez-Jover M, Higgins V, Bryant M, Rast L, & McShane C. Farm biosecurity practices and the management of emergency animal disease. Australia: Charles Stuart University, 2014.
8. Gunn G, Heffernan C, Hall M, McLeod A, & Hovi M. Measuring and comparing constraints to improved biosecurity amongst GB farmers, veterinarians and the auxiliary industries. *Preventive Veterinary Medicine*. 2008;84(3):310-23.
9. Brennan ML, & Christley RM. Cattle producers' perceptions of biosecurity. *BMC veterinary research*. 2013;9(1):71.
10. Heffernan C, Nielsen L, Thomson K, & Gunn G. An exploration of the drivers to bio-security collective action among a sample of UK cattle and sheep farmers. *Preventive veterinary medicine*. 2008;87(3):358-72.
11. Garforth C, Bailey A, & Tranter R. Farmers' attitudes to disease risk management in England: a comparative analysis of sheep and pig farmers. *Preventive veterinary medicine*. 2013;110(3):456-66.
12. Toma L, Stott AW, Heffernan C, Ringrose S, & Gunn GJ. Determinants of biosecurity behaviour of British cattle and sheep farmers—A behavioural economics analysis. *Preventive veterinary medicine*. 2013;108(4):321-33.
13. Schembri N, Hernandez-Jover M, Toribio J-A, & Holyoake P. On-farm characteristics and biosecurity protocols for small-scale swine producers in eastern Australia. *Preventive veterinary medicine*. 2015;118(1):104-16.

14. Delabbio J. How farm workers learn to use and practice biosecurity. *Journal of Extension*. 2006;44(6).
15. Delgado AH, Norby B, Scott HM, Dean W, McIntosh WA, & Bush E. Distribution of cow–calf producers’ beliefs about reporting cattle with clinical signs of foot-and-mouth disease to a veterinarian before or during a hypothetical outbreak. *Preventive Veterinary Medicine*. 2014;117(3–4):505-17.
16. Bronner A, Hénaux V, Fortané N, Hendrikx P, & Calavas D. Why do farmers and veterinarians not report all bovine abortions, as requested by the clinical brucellosis surveillance system in France? *BMC veterinary research*. 2014;10(1):93.
17. East I, Wicks R, Martin P, Sergeant E, Randall L, & Garner M. Use of a multi-criteria analysis framework to inform the design of risk based general surveillance systems for animal disease in Australia. *Preventive veterinary medicine*. 2013;112(3):230-47.
18. Melyukhina O. Producer incentives in livestock disease management: a synthesis of conceptual and empirical studies. Draft Report. OECD Conference Centre, Paris, France: 2016.
19. Valeeva N, van Asseldonk M, & Backus G. Perceived risk and strategy efficacy as motivators of risk management strategy adoption to prevent animal diseases in pig farming. *Preventive veterinary medicine*. 2011;102(4):284-95.
20. Enticott G, & Vanclay F. Scripts, animal health and biosecurity: The moral accountability of farmers' talk about animal health risks. *Health, Risk & Society*. 2011;13(4):293-309.
21. Hernández-Jover M, Taylor M, Holyoake P, & Dhand N. Pig producers’ perceptions of the Influenza Pandemic H1N1/09 outbreak and its effect on their biosecurity practices in Australia. *Preventive veterinary medicine*. 2012;106(3):284-94.
22. Ellis-Iversen J, Cook AJ, Watson E, Nielsen M, Larkin L, Wooldridge M, et al. Perceptions, circumstances and motivators that influence implementation of zoonotic control programs on cattle farms. *Preventive veterinary medicine*. 2010;93(4):276-85.
23. East I, Martin P, & Anderson M. A survey of large animal practice veterinarians: Their response to producer contact and familiarity with emergency animal diseases.
24. Gramig BM, Horan RD, & Wolf CA. Livestock disease indemnity design when moral hazard is followed by adverse selection. *American Journal of Agricultural Economics*. 2009;91(3):627-41.
25. Bicknell KB, Wilen JE, & Howitt RE. Public policy and private incentives for livestock disease control. *Australian Journal of Agricultural and Resource Economics*. 1999;43(4):501-21.
26. Espetvedt M, Lind A-K, Wolff C, Rintakoski S, Virtala A-M, & Lindberg A. Nordic dairy farmers’ threshold for contacting a veterinarian and consequences for disease recording: Mild clinical mastitis as an example. *Preventive veterinary medicine*. 2013;108(2):114-24.
27. Elbers A, Gorgievski-Duijvesteijn M, Van der Velden P, Loeffen W, & Zarafshani K. A socio-psychological investigation into limitations and incentives concerning

- reporting a clinically suspect situation aimed at improving early detection of classical swine fever outbreaks. *Veterinary microbiology*. 2010;142(1):108-18.
28. Vergne T, Guinat C, Petkova P, Gogin A, Kolbasov D, Blome S, et al. Attitudes and beliefs of pig farmers and wild boar hunters towards reporting of African Swine fever in Bulgaria, Germany and the Western part of the Russian Federation. *Transboundary and emerging diseases*. 2014.
29. Brugere C, Onuigbo DM, & Morgan KL. People matter in animal disease surveillance: Challenges and opportunities for the aquaculture sector. *Aquaculture*. 2016.
30. Terry DJ, & O'Leary JE. The theory of planned behaviour: The effects of perceived behavioural control and self-efficacy. *British Journal of Social Psychology*. 1995;34(2):199-220.
31. Elbers A, Gorgievski-Duijvesteijn M, Zarafshani K, & Koch G. To report or not to report: a psychosocial investigation aimed at improving early detection of avian influenza outbreaks. *OIE Revue Scientifique et Technique*. 2010;29(3):435-49.
32. Hawkins C. Baseline assessment of producer reporting in the Midlands (Perth, WA: Department of Agriculture, Western Australia). 1999.
33. Mörk M, Lindberg A, Alenius S, Vågsholm I, & Egenvall A. Comparison between dairy cow disease incidence in data registered by farmers and in data from a disease-recording system based on veterinary reporting. *Preventive Veterinary Medicine*. 2009;88(4):298-307.
34. Sawford K, Vollman AR, & Stephen C. A focused ethnographic study of Alberta cattle veterinarians' decision making about diagnostic laboratory submissions and perceptions of surveillance programs. 2013.
35. Kruger H, Thompson L, Clarke R, Stenekes N, & Carr A. Engaging in biosecurity: Gap analysis. Canberra: Australian Government: Bureau of Rural Sciences. 2009.
36. East I. Options for Enhancing General Passive Surveillance in Australia. Unpublished work.
37. Animal Health Australia. Preparing your business to survive: Risk management planning for an emergency animal disease outbreak. April 2014.
38. Network LB. New smartphone technology revolutionising livestock biosecurity management [3/11/2015]. Available from: <http://www.lbn.org.au/2015/03/31/new-smartphone-technology-revolutionising-livestock-biosecurity-management/>.
39. Dhand N, Schembri, N., Wiethoelter, A., Toribio, A., Kung, N., Moloney, B., Sawford, K., Wright, T., Field, H., Taylor, M., editor Drivers and barriers for the uptake of a new Hendra virus vaccine for horses in Australia. Proceedings of the 5th Australian Stream Management Conference; 2015; Merida, Yucatan, Mexico.
40. Coleman C-L. The Influence of Mass Media and Interpersonal Communication on Societal and Personal Risk Judgments. *Communication Research*. 1993;20(4):611-28.
41. Tyler TR, & Cook FL. The mass media and judgments of risk: Distinguishing impact on personal and societal level judgments. *Journal of Personality and Social Psychology*. 1984;47(4):693.

42. Sligo F, & Massey C. Risk, trust and knowledge networks in farmers' learning. *Journal of Rural Studies*. 2007;23(2):170-82.
43. Pretty J, & Ward H. Social capital and the environment. *World development*. 2001;29(2):209-27.
44. Mathijs E. Social capital and farmers' willingness to adopt countryside stewardship schemes. *Outlook on agriculture*. 2003;32(1):13-6.
45. Stallman HR, & James HS. Determinants affecting farmers' willingness to cooperate to control pests. *Ecological Economics*. 2015;117:182-92.
46. Uphoff N, & Wijayarathna CM. Demonstrated benefits from social capital: the productivity of farmer organizations in Gal Oya, Sri Lanka. *World Development*. 2000;28(11):1875-90.
47. Kruger H. Biosecurity engagement guidelines: How to develop an engagement strategy including a monitoring and evaluation component. Australia: Australian Department of Agriculture, Fisheries and Forestry, 2012.
48. Gouldner AW. The norm of reciprocity: A preliminary statement. *American sociological review*. 1960:161-78.
49. Marshall GR. Farmers cooperating in the commons? A study of collective action in salinity management. *Ecological economics*. 2004;51(3):271-86.
50. Greenberg J. Employee theft as a reaction to underpayment inequity: The hidden cost of pay cuts. *Journal of applied psychology*. 1990;75(5):561.
51. Tyler TR. Procedural fairness and compliance with the law. *REVUE SUISSE D ECONOMIE POLITIQUE ET DE STATISTIQUE*. 1997;133:219-40.
52. Kruger H, Stenekes N, Clarke R, & Carr A. Biosecurity engagement guidelines: principles and practical advice for involving communities. Australia: Commonwealth of Australia, 2012.
53. Corbett JB. Altruism, self-interest, and the reasonable person model of environmentally responsible behavior. *Science Communication*. 2005;26(4):368-89.
54. Gärling T, Fujii S, Gärling A, & Jakobsson C. Moderating effects of social value orientation on determinants of proenvironmental behavior intention. *Journal of Environmental Psychology*. 2003;23(1):1-9.
55. Dryden T, & Vieu-Robson A. Anti-Stigma Addiction Campaign Secondary Analysis: Best Practices and Recommendations.
56. Evans-Lacko S, London J, Little K, Henderson C, & Thornicroft G. Evaluation of a brief anti-stigma campaign in Cambridge: do short-term campaigns work? *BMC public health*. 2010;10(1):1.
57. Larsen J, Vizard A, Counsell D, Scrivener C, Hygate L, & Ware JW, editors. Linking Australian woolgrowers with research-the South Roxby Project. Proceedings of the 5th International Sheep Veterinary Conference, University of Stellenbosch, South Africa, 21-25 January, 2001; 2001: Bayer AG.
58. Graze G. Welcome to Grain and Graze 2 [3/11/2015]. Available from: <http://www.grainandgraze2.com.au>.

59. Price R, & Hacker R. Grain & Graze: an innovative triple bottom line approach to collaborative and multidisciplinary mixed-farming systems research, development and extension. *Animal Production Science*. 2009;49(10):729-35.
60. Faculty of Veterinary Science Research Areas: The Mackinnon Porject 2016 [10.03.2016]. Available from: <http://research.vet.unimelb.edu.au/services/mackinnonproject.html>.
61. Animal Health Australia. BJD - Where to from here? A fresh approach to the management of Johne's Disease in cattle: management plan for cattle production conditions. 2015.
62. Paskin R. Animal Disease Surveillance in Australia: Thoughts on a National Approach. 2014. Unpublished work.
63. Koh LP, & Wich SA. Dawn of drone ecology: low-cost autonomous aerial vehicles for conservation. *Tropical Conservation Science*. 2012;5(2):121-32.
64. Hopp P, Vatn S, & Jarp J. Norwegian farmers' vigilance in reporting sheep showing scrapie-associated signs. *BMC veterinary research*. 2007;3(1):34.
65. Frawley PT. Review of rural veterinary services. Commonwealth of Australia, Canberra. 2003.
66. Congdon H, Davis, Z., Harrison, C., Nitscke, S. Producer engagement in surveillance and reporting of sheep diseases: A case study of barriers and opportunities in South Australian Regions. Canberra: 2015.
67. Nöremark M, Lindberg A, Vågsholm I, & Sternberg Lewerin S. Disease awareness, information retrieval and change in biosecurity routines among pig farmers in association with the first PRRS outbreak in Sweden. *Preventive Veterinary Medicine*. 2009;90(1–2):1-9.
68. Fischhoff B. Risk perception and communication unplugged: twenty years of process. *Risk analysis*. 1995;15(2):137-45.
69. Wassink GJ, George TRN, Kaler J, & Green LE. Footrot and interdigital dermatitis in sheep: Farmer satisfaction with current management, their ideal management and sources used to adopt new strategies. *Preventive Veterinary Medicine*. 2010;96(1–2):65-73.
70. Meat and Livestock Australia. On-farm risk management Australia [cited 2015 3/11/2015]. Available from: <https://www.mla.com.au/Meat-safety-and-traceability/On-farm-risk-management>.
71. Livestock Biosecurity Network. Farm Biosecurity Australia [03/11/2015]. Available from: <http://www.lbn.org.au/>.
72. Limited AP. APIQ Information: Program Outline [05.01.2016]. Available from: http://www.apiq.com.au/index.php?option=com_content&view=article&id=16&Itemid=82.
73. Australian Government. Biosecurity Incident National Communication Network 2016 [10.03.2016]. Available from: <http://www.outbreak.gov.au/about/biosecurity-incident-national-communication-network>.

74. Buetre B, Wicks S, Kruger H, Millist N, Yainshet A, Garner G, et al. Potential socio-economic impacts of an outbreak of foot-and-mouth disease in Australia. Canberra: ABARES research report, 2013.
75. Maller C, Kancans R, & Carr A. Biosecurity and small landholders in peri-urban Australia. Canberra: Australian Government: Bureau of Rural Sciences, 2007.
76. Reeve J, Jang H, Hardre P, & Omura M. Providing a rationale in an autonomy-supportive way as a strategy to motivate others during an uninteresting activity. *Motivation and emotion*. 2002;26(3):183-207.
77. Deci EL, Eghrari H, Patrick BC, & Leone DR. Facilitating internalization: The self - determination theory perspective. *Journal of personality*. 1994;62(1):119-42.
78. Sayers R, Good M, & Sayers G. A survey of biosecurity-related practices, opinions and communications across dairy farm veterinarians and advisors. *The Veterinary Journal*. 2014;200(2):261-9.
79. Nairn M, Allen P, Inglis A, & Tanner C. Australian Quarantine: a shared responsibility. Canberra: Department of Primary Industries and Energy; 1996.
80. Greene K, Rubin DL, & Hale JL. Egocentrism, message explicitness, and AIDS messages directed toward adolescents: An application of the theory of reasoned action. *Journal of Social Behavior and Personality*. 1995;10(3):547.
81. Rogers EM. *Diffusion of innovations*: Simon and Schuster; 2010.
82. Petty RE, Unnava RH, & Strathman AJ. Theories of attitude change. *Handbook of consumer behavior*. 1991:241-80.
83. Blackstock KL, Ingram J, Burton R, Brown KM, & Slee B. Understanding and influencing behaviour change by farmers to improve water quality. *Science of the Total Environment*. 2010;408(23):5631-8.
84. Robinson GM. Ontario's environmental farm plan: evaluation and research agenda. *Geoforum*. 2006;37(5):859-73.
85. Australian Government: Department of Agriculture and Water Resources. Review of Australia's quarantine and biosecurity arrangements: Australian Government preliminary response to "One Biosecurity".
86. Thomson D. National Needs and Gap Analysis of Community Engagement in Waterwatch. In: Heritage DoEa, editor. Canberra 2004.
87. Min SJ. Online vs. face - to - face deliberation: Effects on civic engagement. *Journal of Computer - Mediated Communication*. 2007;12(4):1369-87.
88. Cortese J, & Seo M. The Role of Social Presence in Opinion Expression During FtF and CMC Discussions. *Communication Research Reports*. 2012;29(1):44-53.
89. Johnson SD, Aragon SR, Shaik N, & Palma-Rivas N. Comparative analysis of learner satisfaction and learning outcomes in online and face-to-face learning environments. *Journal of interactive learning research*. 2000;11(1):29.
90. Enticott G, Franklin A, & Van Winden S. Biosecurity and food security: spatial strategies for combating bovine tuberculosis in the UK. *The Geographical Journal*. 2012;178(4):327-37.
91. Moore DA, Merryman ML, Hartman ML, & Klingborg DJ. Comparison of published recommendations regarding biosecurity practices for various production

animal species and classes. Journal of the American Veterinary Medical Association. 2008;233(2):249-56.

92. Government A. Biosecurity Incident National Communication Network 2015 [18.12.2015]. Available from: <http://www.outbreak.gov.au/about/biosecurity-incident-national-communication-network>.

93. Vanhonacker F, Verbeke W, Van Poucke E, & Tuytens FA. Do citizens and farmers interpret the concept of farm animal welfare differently? Livestock Science. 2008;116(1):126-36.

94. BVA. Biosecurity: Challenges of disease control at every level. Vet Rec. 2005;157:461-4.

95. Fishbein M, & Ajzen I. Predicting and changing behavior: The reasoned action approach: Taylor & Francis; 2011.

8. Appendix 1: Supplementary summary table of reviewed articles

Citation/Article	Participants / Study method	Outcome	Correlates or predictors	Main Findings
Brennan 2013 (9)	UK cattle producers. Interviews and Questionnaire	Attitudes and behaviours relating to biosecurity		Themes identified; prevention, within-farm management, general security, pathogens/diseases, indirect/direct contact between premises,
Bronner 2014 (16)	French cattle producers and veterinarians. Interviews	Reporting behaviours	Motivations and barriers	Brucellosis was perceived by most producers and veterinarians as a serious disease, particularly when they had experienced brucellosis in the past. Abortion (as defined by producers and veterinarians) was considered a normal event as long as it remained sporadic and under a “threshold” proportion in the herd, Producers and veterinarians weighed the benefits and costs of both reporting abortions and conducting a differential diagnosis.
Brugere 2016 (29)	Producers, particular focus on aquaculture sector Review	Reporting behaviours	Epidemiology, producers’ decision making and motivations, technology, diagnostic tests, syndromic surveillance.	The long-term sustainability of surveillance will necessitate overcoming producer and institutional inertia, i.e. their reluctance to change. This will mean addressing the psychological, organizational, and political barriers that have become ingrained in the behaviour of producers and institutions.
Delabbio 2006 (14)	North American producers. Interviews	Biosecurity practices	Stages of biosecurity and contextual factors	Practicing biosecurity involved three stages; orientation to biosecurity responsibilities, established routine, and thoughtful approach to new experiences. Although it is the workers who maintain and practice biosecurity, management’s commitment to biosecurity had a significant effect on the workers’ practice of biosecurity, this was directly affected by the type and

Citation/Article	Participants / Study method	Outcome	Correlates or predictors	Main Findings
				availability of resources and by positive and negative feedback by management on the worker's biosecurity-related actions.
Delgado 2014 (15)	U.S. cattle producers. Questionnaire: Hypothetical biosecurity scenarios	Symptom reporting of Foot and Mouth Disease (FMD)	Behavioural beliefs	Prior to an outbreak, the majority of producers agreed that requesting veterinary examination would result in positive consequences, such as stopping the spread of disease, improving the productivity and profitability of their operation, and making them feel better about how they manage their cattle. Once an outbreak of FMD had been detected, producers were less likely to agree with many of these positive personal consequences, particularly if they had prior experience with the federal brucellosis program. These results suggest separate targets (personal versus regional or national level benefits) for communicating the benefits of reporting depending on the disease situation.
East 2013 (17)	Australia. Multi-criteria analysis framework	Likelihood of disease occurrence	Likelihood maps for introduction/ exposure and establishment/ spread	The final 'risk' maps performed well, although not perfectly, against known historical outbreaks in Australia of the studied diseases, which occurred mainly in areas where a high likelihood of occurrence was predicted. Combination of eight individual disease risk maps allowed identification of regions that were consistently found to be a high risk across all or a majority of diseases.
Elbers 2010a (27)	Dutch Government policy makers, veterinary associations, board members of pig farmer unions. Focus groups	Classical swine fever outbreaks	Reporting behaviour Feelings and economic consequences to reporting Barriers to reporting Opinions on national regulation	Producers lacked knowledge of clinical signs. Public opinion and social norms were identified by producers as significantly influencing their practice of biosecurity. Producers held the opinion that the control measures applied by government officials in The Netherlands are long and tedious. Producers were dissatisfied with officials' attitudes if they spent most of the time writing instead of personally talking to the producers. Common to all the producers was the belief that disease prevention measures launched by government authorities were not consistent and hence not fair. They felt that the government was often giving priority to trade and economic interests.

Citation/Article	Participants / Study method	Outcome	Correlates or predictors	Main Findings
				Producers were hesitant in using formal channels because they felt that these sources of information were not up to date or reliable.
Elbers 2010ba (31)	Dutch policy makers, veterinaries, poultry producers. Focus groups, interviews and questionnaires	Improving early detection of avian influenza outbreaks	Difficulties and barriers to reporting clinically suspect situations	Six themes emerged identifying factors that hinder the reporting of a clinically suspect situation: lack of knowledge and uncertainty about clinical signs of AI; guilt, shame and prejudice; negative opinion of control measures; dissatisfaction with post-reporting procedures; lack of trust in veterinary authorities; lack of transparency in reporting procedures and uncertainty about the notification process.
Ellis-Iversen 2010 (22)	UK cattle producers. Interviews	Intent to control zoonoses		None of the interviewed cattle producers had implemented programs to control zoonosis and less than 50% had an intention to do so. Cattle producers had general positive attitudes towards controlling zoonosis on the farm and felt a responsibility to deliver safe products. However, intent was often hindered by lack of belief in self-efficacy and unsupportive social norms and producers without intent felt that advice through their private veterinarian would be the most effective motivator.
Enticott 2011 (20)	UK producers. Interviews	Understanding of animal health risks: bovine tuberculosis (bTB)	Attitudes towards bTB perceptions of biosecurity; and the social impact of bTB.	Producers view bTB as a predictable event. Producers seek to avoid blame and emphasise control over the events. Some producers try to produce a narrative which establishes bTB as a health risk that producers can do nothing about.
Espetvedt 2012 (26)	Nordic dairy producers. Questionnaire	Detection of mild clinical mastitis	Intentions, attitudes, social norms	The most important predictor of behavioural intention was the attitude towards contacting a veterinarian or taking a milk sample. The most important behavioural beliefs were to achieve a quick recovery for the cow and maintaining a healthy herd. Perceived social pressure and control of the behaviour was of less importance.

Citation/Article	Participants / Study method	Outcome	Correlates or predictors	Main Findings
Garforth 2013 (11)	English sheep and pig producers. Interviews	Disease risk management and compliance	Attitudes	<p>Most producers felt they were doing enough, few felt they should be doing more and all had what seemed to them sound reasons for not complying with practices they had not implemented. Most non-compliance was explained by producers' seeing practices as irrelevant to them, impractical, or unnecessary. Favourable measures were easy to implement and cheap.</p> <p>The overwhelming view on disease control advice is that advice from their vet is more credible than that from other sources: vets' knowledge is locally contextualised, they are there for immediate one-to-one advice, and they working the farmer's interest.</p> <p>When it comes to exotic diseases, all said Government should be responsible.</p>
Gunn 2008 (8)	Great Britain sheep and cattle producers, vets and auxiliary industry. Farmer focus groups Veterinary questionnaire Industry interviews	Attitudes towards biosecurity improvement	Attitudes and behaviours	<p>Producers; positive aspects of biosecurity included prevention and good husbandry. Negative aspects included disinfection and bureaucracy. Important biosecurity issues identified; border controls, personal actions, disease eradication/surveillance, public access to farmland.</p> <p>Vet behaviours; disinfecting/washing, leave car away from livestock areas. Industry identified barriers; lack of time/cost, lack of facilities on farms, lack of cooperation, lack of knowledge, lack of education to change attitudes, impractical measures, no appreciation of risk.</p>
Heffernan 2008 (10)	UK cattle and sheep producers. Questionnaire	Biosecurity behaviours	Cognitive, emotive and contextual factors	<p>Most participants cited the most desirable/useful biosecurity measure as 'none'. The 'occasional' or 'as needed' contact with veterinary surgeons is unlikely to be sufficient to support a messaging framework built largely around delivery by veterinary surgeons.</p> <p>The majority of producers desired compulsory bio-security regulations, this was often explained by lack of trust in other producers.</p>

Citation/Article	Participants / Study method	Outcome	Correlates or predictors	Main Findings
				Endemic diseases were associated with 'bad farming', while epidemic diseases were associated with external factors.
Hernández-Jover 2012 (21)	Australian pig producers. Questionnaire	Biosecurity practices	Perceptions of the Influenza Pandemic H1N1/09 outbreak	A higher adoption of practices was observed among large than small herds. Only 2.9% of respondents reported a reduction in pig sales during the outbreak. However, approximately one third of producers reported being financially and emotionally stressed, 38.2% were distressed about the health of their pigs and 16.7% about their own health. The most important sources of information were APL (93%), veterinarians (89%) and the state Department of Primary Industries (DPI) (75%). The first two considered the most trusted sources of information. Television, radio and other producers were considered more important sources of information by small herds and veterinarians by larger herds. Producers believed that the H1N1/09 outbreak was better managed by the pork industry (89.9%) than by the health authorities (58.8%), and the on-going communication with APL was the main strength of the outbreak management.
Hopp 2007 (64)	Norwegian sheep producers. Questionnaire	Reporting scrapie associated symptoms	Attitudes	Willingness to report was dependent on the Government taking the economic responsibility for the control programme. Knowledge of clinical signs, as well as blame and concerns for the destruction of the flock also influenced willingness to report.
Martin 2015 (2)	Australian livestock diseases. Modelling	Evaluating general surveillance for livestock disease.	Disease detection	Regional median probability of detecting FMD on a single farm was 23–52%. Regional median time elapsed before FMD was detected was 20–33 days. Recognition of disease by small landholders was important for overall detection.
McLaws 2007 (4)	Epidemiological review of Foot and Mouth Disease cases globally	FDM outbreaks	Country characteristics and responses	Stamping out and movement restrictions, with or without vaccination were the control measures applied for all epidemics. FMD was most commonly detected initially in cattle (17/24 epidemics). In at least 2 epidemics, pigs or sheep were infected first, but clinical signs went unnoticed until cattle became infected. Approx. half of the

Citation/Article	Participants / Study method	Outcome	Correlates or predictors	Main Findings
				epidemics were detected as a result of a farmer alerting a private veterinarian or the authorities to a problem with their animals. Reasons for delay included initial misdiagnosis of disease, deliberate concealment of sick livestock by producers, mild clinical signs in small ruminants, and failure of the laboratory to isolate the virus.
Mork 2009 (33)	Swedish dairy producers. Questionnaire	Reports of disease events	Symptom and herd characteristics	54% of all disease events in the producers' data were reported as veterinary treated. Willingness to contact a veterinarian for a case of clinical mastitis depends on factors such as severity of the case, single-cow characteristics (e.g., parity), herd situation and availability of alternative treatment.
Noremark 2009 (67)	Swedish pig producers. Questionnaire	Porcine reproductive and respiratory syndrome (PRRS) outbreak	Herd size Media Information sources Knowledge and awareness	The results indicate that the information efforts during the outbreak, and the mentioning of the outbreak in media, were not sufficient to bring the message across to all producers: one out of ten producers was not even aware that there had been an outbreak of PRRS. Herd size was significantly related to both awareness and information retrieval. Proximity to the outbreak was an important motivator for producers to seek information.
Palmer 2009 (3)	Australian sheep and cattle producers. Questionnaire	Consulting an animal health professional in the case of dead or sick livestock.	Attitudes and beliefs	Distance from vet was the only significant predictor of whether a farmer consulted a vet in the case of a significant disease event. Government advisor approachability explained the most variance between producers who would or would not consult an animal health official for concerning symptoms. Biosecurity practices, adequate service provision by local vet and distance to vet predicted consultations for recent disease events.
Sawford 2013 (34)	Ethnographic study of Canadian cattle veterinarians. Interviews	Submitting cases to a diagnostic laboratory	Participation in surveillance programs	Diagnostic laboratory case submission by participants was biased toward cases in which multiple animals were affected and test results were of direct consequence to clinical case management. Broader economic factors, including the cost of diagnostics relative to the value of individual beef cattle and decreasing government support for laboratory diagnostics, limitations of diagnostic laboratory testing, and

Citation/Article	Participants / Study method	Outcome	Correlates or predictors	Main Findings
				decreasing veterinary presence on farms, together translated into a decline in case submissions to diagnostic laboratories over time.
Schembri 2014 (13)	Australian pig producers. Interviews and questionnaire	Biosecurity practices	On-farm characteristics	The majority of small-scale producers tended to engage in higher risk practices such as trading at saleyards and undertaking minimal on-farm biosecurity measures. Motivations to keep pigs, and to a lesser extent herd size impact the types of on-farm biosecurity protocols undertaken.
Sligo 2007 (42)	New Zealand dairy producers. Interviews	Mapping socio-spatial knowledge networks	Risk, trust and knowledge networks	The producers were constant users of interpersonal and print information from numerous sources, and monitored their incoming data in the light of strategic needs, reflecting their roles as both farming practitioners and business owners.
Stallman 2015 (45)	Missouri agricultural crop producers. Questionnaire	Cooperation with pest control measures	Beliefs, attitudes and networks	Producers who believe that they will receive a net benefit, have farms similar to their neighbours'', are active members of a community organization, have positive contact with agricultural extension agents, and are concerned about the effect that pesticides may have on the environment are more willing to cooperate.
Toma 2013 (12)	Great Britain cattle and sheep producers. Questionnaire Modelling	Biosecurity behaviours	Access to information and services. Attitudes	Behaviours were significantly influenced by producers' perceived importance of specific biosecurity strategies, organic certification of farm, knowledge about biosecurity measures, attitudes towards animal welfare, perceived usefulness of biosecurity information sources, perceived effect on business during the past five years of severe outbreaks of animal diseases, membership in a cattle/sheep health scheme, attitudes towards livestock biosecurity, influence on decision to apply biosecurity measures, experience and economic factors.
Vanhonacker 2008 (93)	Flemish citizens and producers. Questionnaire	Perception of farm animal welfare	Perceived importance and beliefs	The main differences were found in the importance attached to animals' ability to engage in natural behaviour and in aspects which require some basic understanding about production conditions and the way livestock is reared. Furthermore, citizens evaluated the current state of farm animal welfare rather negative with mean evaluative belief scores for almost all aspects below the mid-point of the scale, while a much more positive image was present among producers.

Citation/Article	Participants / Study method	Outcome	Correlates or predictors	Main Findings
Valeeva 2011 (19)	Dutch pig producers. Questionnaire	Risk management strategy adoption	Perceived risk and strategy efficacy	Endemic diseases and epidemic diseases were regarded as an operational risk and catastrophic risk, respectively. For both disease categories, producers valued on-farm biosecurity measures as a significantly more effective risk management strategy than animal health programs. Perceived benefits in terms of strategy efficacy in reducing risks of animal disease was the strongest direct predictor of the adoption of risk management strategies.
Vergne 2014 (28)	Pig farms and wild boar hunters in Bulgaria, Germany and Russia. Questionnaire	Reporting of African Swine Fever	Attitudes and beliefs	Producers: expectation of prompt test results, concerns for adverse effect on their reputation and belief that they could control the outbreak themselves were associated with producers' willingness to immediately report suspected cases Hunters: lack of reporting attributed to being unaware of the possibility to report
Wassink 2010 (69)	UK sheep producers. Questionnaire	Footrot (FR) and interdigital dermatitis (ID)	Ideal management and adoption of new strategies	Producers satisfied with current management reported a prevalence of lameness $\leq 5\%$. These producers caught and treated lame sheep within 3 days of first seeing them lame, and treated sheep with FR and ID with parenteral antibacterials. Producers dissatisfied with their management reported a prevalence of lameness $> 5\%$. These producers practised routine foot trimming, footbathing and vaccination against footrot. Whilst 89% of producers said they were satisfied with their management of FR over 34% were interested in changing management. Producers identified veterinarians as the most influential source for new information.

9. Appendix 2: Focus Group Questions

Focus Group Questions

- Where do you get new information on animal diseases?
- What influences where you get your information and what makes it relevant to you?
- If animals are unwell in their herd or flock, when would farmers in your district call a private or government veterinarian?
- Have you had an experience in the past where you did/did not report illness you noticed in your livestock?
- Do you know how to report cases of suspected exotic diseases?
- What do you think are the advantages and disadvantages of the current disease reporting programs?
- How did you feel about the responsibilities of reporting disease? (Who bears the most responsibility?)
- What has worked in the past or in other places to protect agriculture from the introduction and spread of disease?
- Who/what influences your decision to report illness in your livestock?
- Do other landowners follow reporting procedures? (What type of landowners?)
- Of all the things we discussed, what to you is the most important?
- Is there anything important we haven't discussed about surveillance and reporting?

10. Appendix 3: Statistical Analyses

Cluster Analysis

Cluster analysis is an exploratory data analysis tool which aims at sorting different objects into groups in a way that the degree of association between two objects is maximal if they belong to the same group and minimal otherwise. Given the above, cluster analysis can be used to discover structures in data without providing an explanation/interpretation. In other words, cluster analysis simply discovers structures in data without explaining why they exist.

The cluster analysis was run in SPSS. Missing value imputation was performed for farmers' income and domestic and international exports. However, after imputation there were still 4 missing values across the analysis, with a final N = 196. One outlier on the variable of property size was winsorised from a value of 260,000 to 76,000 to ensure that the outlier did not have an undue effect on the clusters. There

A frequency analysis was run on the clusters to ensure that they were roughly evenly distributed across the six cluster groups. To understand the differences between the clusters, ANOVAs were run to look at differences across continuous variables and K-W non-parametric tests were run to distributions across dichotomous variables. This information was used to identify the clusters.

Regression Analyses

Multiple regression analyses were run in SPSS version 22. Due to the large number of possible variables that could have been included in the analyses, bivariate analyses (correlations) were first performed. Variables that demonstrated a significant correlation with the outcome variables, were then included in the multiple regression analyses.

For *BI related to government*, these correlations included:

- Attitudes towards the Department of Agriculture and Water Resources (DAWR)
- Responsibility for monitoring; other farmers, AHA/LBN, industry representative bodies, DAWR, Customs and Border Security, DPI, local government, livestock agents
- Responsibility for dealing with EAD; other farmers, all land owners, AHA/LBN, industry representative bodies, DAWR, Customs and Border Security, DPI, local government, livestock agents

For *BI not related to government*, these correlations included:

- Distance to preferred vet
- Confidence to correctly identify, anthrax, mad cow disease FMD and botulism
- Perceived behavioural control
- Injunctive social norms
- Descriptive social norms
- Attitudes towards monitoring and reporting of EAD
- Perceived competency; yourself, industry organisations
- Responsibility for dealing with EAD; yourself, all land owners

The data were checked for the assumptions of a multiple regression.

Independence of observations, indicating that the observations between groups were independent, was observed for both models.

Partial regression plots indicated that there a small amount of variance from linearity of residuals in both models but this was not significant enough to violate the assumption. Similarly, there was some heteroscedasticity in both models, this indicates that there was some variance in the spread of scores across the levels of another variable. However, again this was not significant enough to violate the assumption.

The assumption of no multicollinearity holds that scores on one predictor variable should not be excessively related with scores on another predictor variable. Inspection of Tolerance and VIF collinearity statistics showed that multicollinearity was not an issue in either of the models.

There were no significant outliers in the models and the residual errors were approximately normally distributed.

11. Appendix 4: Descriptive statistics and regression analyses

Past experience with emergency animal diseases

Have you had an experience with an emergency animal disease in the past?

Yes: 24 (12.0%)

When you realised there was an ED outbreak, who did you contact?

	N (%)
Your vet	14 (7.0%)
Other farmers in the district	
Neighbours	7 (3.5%)
Relatives / friends	
Department of Agriculture and Water Resources	3 (1.5%)
Animal Health Australia emergency hotline	
State Department of Primary Industries	6 (3.0%)
Stock health management	1 (0.5%)
State farming consultant	
Meat and Livestock Australia	
Cattle Council of Australia	
Sheepmeat Council of Australia	2 (1.0%)
Australian Pork Limited	
Wool Producers Australia	
Livestock Biosecurity Network	
Australian Lot Feeders Association	
Did not contact anyone	2 (1.0%)
Don't know	

When did you first report it?

	N (%)
Immediately	9 (40.9%)
Within 24 hours	5 (22.7%)
Within 3 days	2 (9.1%)
Within a week	2 (9.1%)
More than a week later	1 (4.5%)
Incidentally (e.g. part of a survey, culture check)	3 (13.6%)

Would you talk to someone about it?

Yes: 99.5%

No: 0.5%

Who would you contact about it?

	N (%)
Your vet	85.5%
Other farmers in the district	0.5%
Neighbours	6.5%
Relatives / friends	1.5%
Department of Agriculture and Water Resources	4.0%
Animal Health Australia emergency hotline	0.5%
State Department of Primary Industries	14.5%
Stock health management	0.5%
State farming consultant	0.5%
Meat and Livestock Australia	0
Cattle Council of Australia	0
Sheepmeat Council of Australia	0
Australian Pork Limited	0
Wool Producers Australia	0
Livestock Biosecurity Network	0
Australian Lot Feeders Association	0
Would not contact anyone	0.5%
Don't know	0.5%

When would you report it?

	N (%)
Immediately	81 (40.5%)
Within 24 hours	48 (24.0%)
You would monitor your animals until you were sure before reporting	30 (15.0%)
You would get a second opinion before reporting	35 (17.5%)
Don't know	2 (1.0%)
Depends on severity of the disease	2 (1.0%)

Behavioural Intentions

Scale range 0 – 10	M (sd)
Call a private vet within a day if notice clinical signs of an emergency animal disease in your livestock.	8.90 (2.12)
Monitor for clinical signs of emergency animal disease on your property over the next 3 months	7.47 (3.05)
Report clinical signs of an emergency animal disease to a government vet within a day of noticing them	7.45 (3.17)
Call the government hotline within a day if you suspect there might be an emergency animal disease	7.41 (3.11)

Confidence in ability to identify emergency animal diseases

Scale range 0 – 10	M (sd)	Correlation with “You are confident in your ability to recognise ED” M=7.21 (2.60)
Transmissible Spongiform Encephalopathy	2.03 (2.36)	.20
Screw-worm fly	2.69 (3.25)	.24
Anthrax	3.29 (3.04)	.31
Botulism	4.20 (3.40)	.36
Mad cow disease	4.55 (3.33)	.32
Foot and Mouth Disease	5.36 (3.13)	.35

Competency of individuals and organisations to prevent an emergency animal disease outbreak

Scale range 0 – 10	M (sd)
Yourself	6.71 (2.45)
Local vets	7.81 (2.22)
Industry organisations	6.16 (2.41)
Animal Health Australia	6.22 (2.47)
State Department of Primary Industries	6.33 (2.52)
Department of Agriculture and Water Resources	5.63 (2.66)
Other farmers in your district	6.18 (2.16)
Stock Health management	6.57 (2.22)

Correlations between ratings of competency and responsibility

Competency	Responsible for monitoring EAD	Responsible for dealing with EAD
Yourself	0.34	0.27
Other farmers	0.26	0.10
AHA	0.32	0.18
Industry organisations	0.36	0.29
State DPI	0.34	0.29
DAWR	0.37	0.24
Livestock agents	0.15	0.18

Attitudes towards the Department of Agriculture and Water Resources

Scale range 0 – 10	M (sd)
DAWR can be trusted to:	
Provide easily accessible information on emergency animal diseases	6.91 (2.09)
Provide the most useful information on emergency animal diseases	6.87 (2.03)
Follow the best available science in managing emergency animal disease issues	6.77 (2.17)
Respond effectively to emergency animal disease risks in your district	6.70 (2.06)
Provide timely information on emergency animal diseases	6.68 (2.11)
Communicate effectively with producers about emergency animal disease issues	6.66 (2.11)
Make good management decisions regarding emergency animal disease issues	5.98 (2.27)
Deal with producers affected by emergency animal diseases in a fair and equitable manner	5.84 (2.44)

Reasoned Action Approach of Behaviour

Injunctive social norms

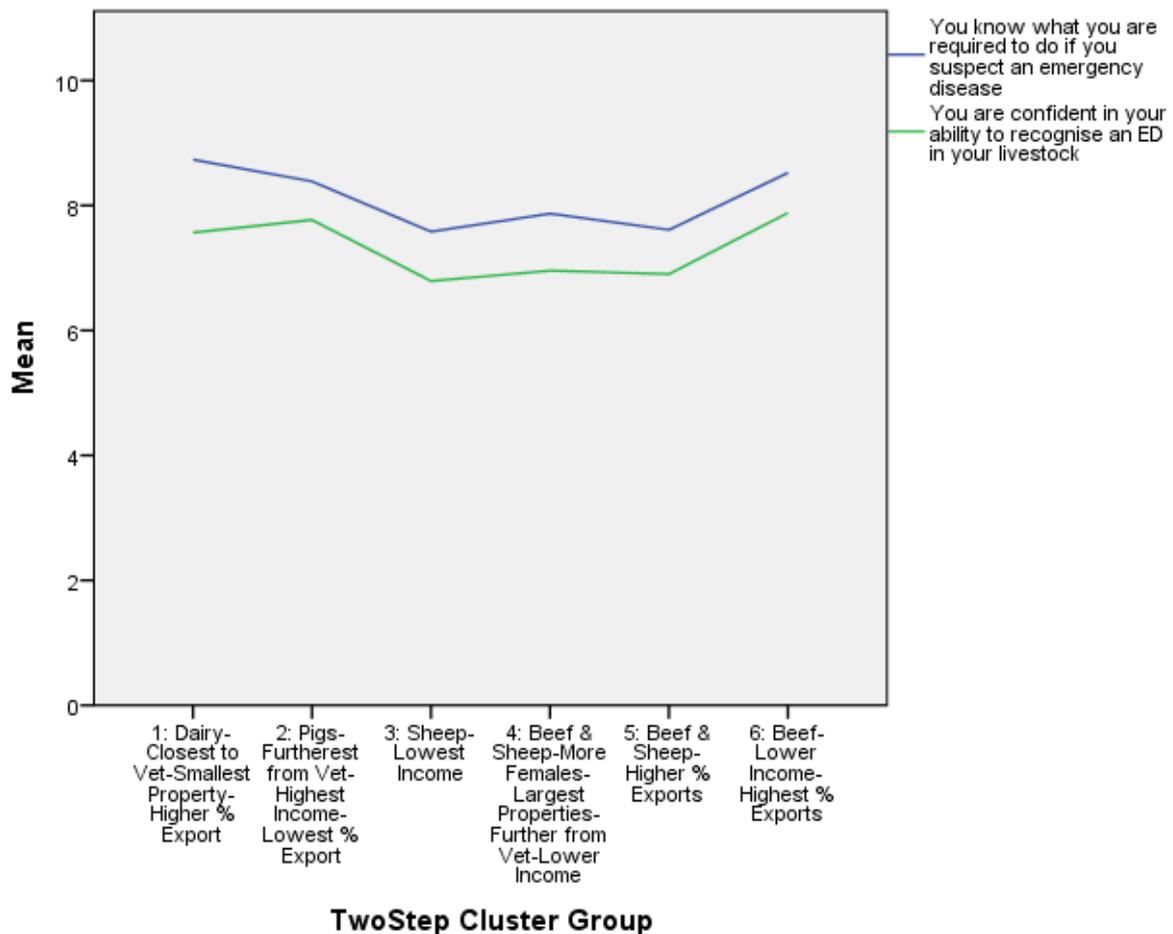
Scale range 0 – 10	M (sd)
Most producers in your district would expect you to report clinical signs of emergency animal diseases as soon as you see them in your livestock	8.82 (1.49)
Most producers in your district who you respect regularly monitor their livestock for clinical signs of emergency animal diseases	6.98 (2.60)
Reporting agencies expect too much of you when it comes to monitoring emergency animal diseases in your livestock	4.90 (3.15)

Descriptive social norms

Scale range 0 – 10	M (sd)
Most producers in your district would report emergency animal diseases when they find them in their livestock	7.56 (2.00)

Perceived behavioural control

Scale range 0 – 10	M (sd)
You know what you are required to do if you suspect an emergency or notifiable disease	8.08 (2.15)
You are confident in your ability to recognise an emergency animal disease in your livestock	7.21 (2.60)
If there was an emergency animal disease outbreak on your farm, you would be able to manage the threats on your own before they became too serious	5.61 (3.19)



Attitudes towards monitoring and reporting of emergency animal diseases

Scale range 0 – 10	M (sd)
Regular monitoring of your livestock is a good way for you to avoid any financial losses resulting from emergency or notifiable diseases	8.65 (1.95)
Reporting suspicious clinical signs of disease that you notice in your livestock helps government regulators do their job.	8.06 (2.17)
Expecting you to monitor your livestock for emergency animal diseases is not a good biosecurity strategy because other producers don't do it enough	4.70 (3.19)
Farmers in your district will think badly of you if you report an emergency animal disease	3.74 (3.39)

Perceived risk

Scale range 0 – 10	M (sd)
An emergency animal disease outbreak would have a large impact on your farm business	9.24 (1.66)
There is very little risk of an emergency livestock disease outbreak originating on your property	7.65 (2.49)
There is very little risk of an emergency livestock disease outbreak originating outside your property	6.48 (2.57)

Regression model for predictors of *BI related to government*.

The overall model was significant $F(5, 134) = 7.908$, $p < 0.001$, explaining 23% of the variance.

	Standardised beta coefficient	t	Significance
<i>Responsible for dealing with ED – AHA /LBN</i>	.287	3.026	.003
<i>Responsible for dealing with ED – Livestock agents</i>	.251	2.838	.005
<i>Responsible for dealing with ED – Industry Representative Bodies</i>	.209	2.155	.033
<i>DAWR trusted to follow the best available science in managing ED issues</i>	.350	3.335	.001
<i>DAWR trusted to communicate effectively with producers about ED issues</i>	.280	2.648	.009

Regression model for predictors of *BI not related to government*.

The overall model was significant $F(4, 160) = 10.424$, $p < 0.001$, explaining 19% of the variance.

	Standardised beta coefficient	t	Significance
<i>Responsible for dealing with ED – Yourself</i>	.251	3.436	.001
<i>You know what you are required to do if you suspect an ED</i>	.188	2.612	.010
<i>Distance to preferred vet</i>	-.216	-2.995	.003
<i>Most producers in your district who you respect regularly monitor their livestock</i>	.194	2.637	.009

12. Appendix 5: Farming and Biosecurity CATI Survey

Welcome to the Farming and Biosecurity Survey

Farming and biosecurity

This survey aims to understand the factors that play a role in the monitoring and reporting of animal disease by farmers in Australia.

We value your opinions and input on this important issue. The survey will take approximately 20 minutes to complete.

(Make sure you are talking to the key decision maker on the farm).

Demographics

1. **How many years have you been earning a living as a farmer?**
2. **Which of following livestock do you keep on your property?** (multiple answers allowed)
 - a) Beef Cattle
 - b) Dairy Cattle
 - c) Sheep for Meat
 - d) Sheep for wool
 - e) Pigs
 - f) None of above – *terminate survey*

Ask for each type of livestock kept from Q2:

How many are in your herd or flock of...

- a) Beef Cattle
 - g) Dairy Cattle
 - b) Sheep for Meat
 - c) Sheep for wool
 - d) Pigs
-
3. **How far, in kilometres, is your farm from your preferred vet?**
 4. **Are you a member of any of these organisations?**
 - a) Your State Farming Organisation
 - b) Meat and Livestock Australia
 - c) Cattle Council of Australia
 - d) Sheepmeat Council of Australia
 - e) Australian Pork Limited
 - f) Wool Producers Australia
 - g) Livestock Biosecurity Network
 - h) Australian Lot Feeders' Association
 - i) Australian Livestock Markets Association
 - j) Other (please specify)

5. What proportion of your farm stock goes to domestic consumption or international export? (Must add to 100%). **NOTE: It is possible that the producer may not know if their produce is being consumed locally or overseas.**

- a) Domestic market
- b) International export
- c) Don't know

6. Would you be the main or joint decision maker on your farm regarding how disease among your livestock is monitored and how an outbreak was managed?

- a. Monitoring of livestock disease
- b. Management of disease outbreak

- a) Main decision maker/
- b) Joint decision maker/
- c) Not decision maker **Terminate survey if no to monitoring and management?**
- d) Don't Know **Terminate survey if don't know to monitoring and management?**

We are going to ask you some questions about emergency animal diseases. These are diseases that would have a national impact if a severe outbreak occurs that require a national emergency response. We will also be asking about monitoring and reporting of these diseases

8. Using a scale of 0 to 10 where 0 is not at all confident and 10 is absolutely confident, how confident are you that you would be able to correctly identify the following diseases in your livestock. (Read out diseases. Only ask about diseases relevant to the sort of livestock being produced. E.g. only ask about Swine Fever if produce pigs.)

	0	1	2	3	4	5	6	7	8	9	10	DK
	Not at all										Absolutely	
	Confident										Confident	
Classical Swine Fever												
Newcastle Disease												
Screw-worm fly												
Transmissible Spongiform Encephalopathy (TSE)												
Anthrax												
Mad cow disease												
Foot and Mouth Disease												
Hendra Virus												
Australian Bat Lyssavirus												
Botulism												

9. How often do you conduct the following to monitor or inspect your livestock for disease? Would it be ... (Read out)

	1	2	3	4	5	6	DK
	Every Day	Once a Week	Once a Month	Few Times a Year	Once a Year or Less	Never	
Visual check of animals during the normal course of your livestock management							
Detailed inspection of animals that seemed less healthy							
Have vet inspect your animals							
Detailed inspection of a random sample of animals							
Detailed inspection of all livestock							
Other?							

10. In the past year, how often are each of the following biosecurity practices conducted on your farm to minimise disease? Would it be ...

	1	2	3	4	5	DK
	Continually	Most of the Time	Occasionally	Rarely	Never	
Check stock for emergency animal diseases before they are transported off your farm						
Check incoming stock for emergency animal diseases						
Keep records of health status of stock						
Isolate new stock						
Restrict access to property						
Inspect livestock before purchase						
Control feral animals						

11. On a scale of 0 to 10 where 0 means “strongly disagree” and 10 means “strongly agree”, to what extent do you agree with the follow statements: (Include Don’t know option)

	0	1	2	3	4	5	6	7	8	9	10	DK
	Strongly Disagree										Strongly Agree	
<p>You know what you are required to do if you suspect an emergency or notifiable disease</p>												
<p>Farmers in your district will think badly of me if you report an emergency animal disease</p>												
<p>Regular monitoring of your livestock is a good way for me to avoid any financial losses resulting from emergency or notifiable diseases</p>												
<p>Most producers in your district would expect you to report clinical signs of emergency animal diseases as soon as you see them in your livestock</p>												
<p>You are confident in your ability to recognise an emergency animal disease in your livestock</p>												
<p>Expecting me to monitor of your livestock for emergency animal diseases is not a good biosecurity strategy because other producers don't do it enough</p>												
<p>Reporting suspicious clinical signs of disease that you notice in your livestock helps government regulators do their job.</p>												
<p>Reporting agencies expect too much of you when it</p>												

comes to monitoring
emergency animal diseases in
your livestock

Most producers in your
district who you respect
regularly monitor their
livestock for clinical signs of
emergency animal diseases

Most producers in your
district would report
emergency animal diseases
when they find them in their
livestock

If there was an emergency
animal disease outbreak on
your farm, you would be able
to manage the threats on
your own before they
became too serious

12. If you suspected there was an emergency livestock disease outbreak in your livestock today, who would you first contact about it? (Do not read out)

- a) Your vet
- b) Other farmers in the district
- c) Neighbours
- d) Relatives/friends
- e) Federal Department of Agriculture and Water Resources
- f) Animal Health Australia Emergency Hotline
- g) State Department of Primary Industries
- h) Stock Health Management Consultant
- i) Your State Farming Organisation
- j) Meat and Livestock Australia
- k) Cattle Council of Australia
- l) Sheepmeat Council of Australia
- m) Australian Pork Limited
- n) Wool Producers Australia
- o) Livestock Biosecurity Network
- p) Australian Lot Feeders' Association
- q) Australian Livestock Markets Association
- r) Other (Specify)
- s) No one/ Would not report it

12a Do not ask if said "No one/you would not report it" at Q12

Which of the following best describes when you would be likely to report it to authorities?

- a) Immediately
- b) Within 24 hours
- c) You would monitor your animals until you was sure before reporting
- d) You would get a second opinion before reporting
- e) Don't know (Do not read out)
- f) Other (Specify)

12b Ask ONLY if said "No one/would not report it" at Q12)

Why would you not report it to authorities? (open-ended)

13. On a scale of 0 to 10 where 0 is 'very incompetent' and 10 is 'very competent', how competent do you believe the following individuals and organisations are, in their potential to prevent an outbreak of an emergency animal disease?

	0	1	2	3	4	5	6	7	8	9	10	DK
	Very Incompetent											Very Competent
You												
Local vets												
Industry organisations												
Animal Health Australia												
State Department of Primary Industries												
Federal Department of Agriculture and Water Resources												
Other farmers in the district												
Stock health management consultants												

13a On a scale of 0 to 10 where 0 is 'very incompetent' and 10 is 'very competent', how competent do you believe the following individuals and organisations are, in their potential to manage an outbreak of an emergency animal disease?

	0	1	2	3	4	5	6	7	8	9	10	DK
	Very Incompetent											Very Competent
You												

Local vets
 Industry organisations
 Animal Health Australia
 State Department of
 Primary Industries
 Federal Department of
 Agriculture and Water
 Resources
 Other farmers in the district
 Stock health management
 consultants

14. On a scale of 0 to 10 where 0 is 'strongly disagree' and 10 is 'strongly agree', to what extent do you agree that the Federal Department of Agriculture and Water Resources can be trusted to

	0	1	2	3	4	5	6	7	8	9	10	DK
	Strongly Disagree										Strongly Agree	
Make good management decisions regarding emergency animal disease issues												
Follow the best available science in managing emergency animal disease issues												
Communicate effectively with producers about emergency animal disease issues												
Respond effectively to emergency animal disease risks in your district												
Deal with producers affected by emergency animal diseases in a fair and equitable manner												

Animal Health Australia /
Livestock Biosecurity Network

Industry Representative Bodies
(e.g. Meat and Livestock
Australia)

The Federal Government
Department of Agriculture and
Water Resources

Customs and Border Security
Agencies

Primary Industry Departments
in State Governments

Local Government / Councils

Livestock agents

17. Using the same scale of 0 to 10 where 0 is 'not at all responsible' and 10 is 'totally responsible', how responsible do you think the following organisations should be for dealing with an emergency animal disease outbreak among livestock.

	0	1	2	3	4	5	6	7	8	9	10	DK
	Not at all Responsible										Totally Responsible	
You												
Farmers in your district												
All land owners												
Animal Health Australia / Livestock Biosecurity Network												
Industry Representative Bodies (e.g. Meat and Livestock Australia)												
The Federal Government Department of Agriculture and Water Resources												
Customs and Border Security Agencies												
Primary Industry Departments in State Governments												

Local Government / Councils

Livestock agents

18. Thinking about your farming business going forward, on a scale of 0 to 10, where 0 means "extremely unlikely" and 10 means "extremely likely", how likely are you to do the following?

	0	1	2	3	4	5	6	7	8	9	10	DK
	Extremely Unlikely										Extremely Likely	
Monitor for clinical signs of emergency animal disease on your property over the next 3 months												
Call the government hotline within a day if you suspect there might be an emergency animal disease												
Call a private vet within a day if notice clinical signs of an emergency animal disease in your livestock.												
Report clinical signs of an emergency animal disease to a government vet within a day of noticing them												

19. Have you had any personal experience in managing an emergency animal disease?

- a) Yes
- b) No
- c) Don't know

19a (Ask ONLY if answered Yes at Q19)

**What emergency animal diseases have you managed for your livestock in the last ten years?
(Multiple responses allowed. (Open-ended))**

Ask Q 19b-19h only if answered yes to at least one disease at Q19a

19b How did you discover the disease?

- a) During visual check of animals during the normal course of business
- b) During a detailed inspection of animals that seemed less healthy
- c) During a visit by your vet
- d) During a detailed inspection of a random sample of animals
- e) During a detailed inspection of all livestock

f) Other (specify)

19c When you recognised there was the possibility of disease in your livestock, which, if any, of the following people or organisations did you contact in the first 24 hours? (Do not read out. Multiple answers allowed)

- a) Your vet
- b) Neighbours
- c) Federal Department of Agriculture and Water Resources
- d) Animal Health Australia Emergency Hotline
- e) State Department of Primary Industries
- f) Stock Health Management Consultant
- g) Industry Association (e.g MLA, Sheepmeat Council ...)
- h) Other (Specify)

19d Which of the following best describes when you first reported it to authorities? (Do not read out)

- a) Immediately
- b) Within 24 hours
- c) Within 3 days
- d) Did not report it
- e) Other (Specify)

19e Do not ask if “did not report it” at Q19d.

Which authority did you first report it to? (More than one response allowed. Do not read out)

- a) Federal Department of Agriculture and Water Resources
- b) Animal Health Australia Emergency Hotline
- c) State Department of Primary Industries
- d) Other (Specify)

19f Only ask if said “I did not report it” at Q19d.

Why did you not report the outbreak on your farm? (Open-ended)

19h Do not ask if “Did not report it at 19d

On a scale of 0 to 10 where 0 is not at all well and 10 is extremely well, how well did [Authority mentioned at Q9c] handle the outbreak on your farm that you reported? (Only ask about authority/ies mentioned at Q19c. Do not read out)

0	1	2	3	4	5	6	7	8	9	10	DK
Not at all Well										Extremely Well	

Federal Department of
Agriculture and Water
Resources

State Department of
Primary Industries

Other :

Other

19g On a scale of 0 to 10 where 0 is a very badly affected and 10 is not affected at all, how badly was your business affected by the outbreak on your farm?

0	1	2	3	4	5	6	7	8	9	10	DK
Not at all Well										Extremely Well	

19h Would you do anything differently if confronted with an emergency animal disease among your livestock today? (Open-ended)

To finish, I just need a few pieces of information about you

Farming and biosecurity

21. What is your age?

1. 18 - 25
2. 26 - 30
3. 31 - 35
4. 36 - 40
5. 41 - 45
6. 46 - 50
7. 51 - 55
8. 56 - 59
9. 60 - 65
10. over 65

22. Gender (Not asked but recorded).

1. Female
2. Male

23. Where is your farm(s) located)

1. Queensland
2. New South Wales
3. Australian Capital Territory
4. Victoria
5. South Australia
6. Western Australia
7. Northern Territory

8. Tasmania

24. What is the total land area of your farm? *(Re-code into bands and generate averages)*

25. About what proportion of your total household income comes from farming? *(Re-code into bands and generate averages)*