Farmers' attitudes to disease risk management in England: a comparative analysis of sheep and pig farmers

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Abstract (302 words)

The UK Department for Environment, Food and Rural Affairs (Defra) identified practices to reduce the risk of animal disease outbreaks. We report on the response of sheep and pig farmers in England to promotion of these practices. A conceptual framework was established from research on factors influencing adoption of animal health practices, linking knowledge, attitudes, social influences and perceived constraints to the implementation of specific practices. Qualitative data were collected from nine sheep and six pig enterprises in 2011. Thematic analysis explored attitudes and responses to the proposed practices, and factors influencing the likelihood of implementation. Most feel they are doing all they can reasonably do to minimise disease risk and that practices not being implemented are either not relevant or ineffective. There is little awareness and concern about risk from unseen threats. Pig farmers place more emphasis than sheep farmers on controlling wildlife, staff and visitor management and staff training. The main factors that influence livestock farmers' decision on whether or not to implement a specific disease risk measure are: attitudes to, and perceptions of, disease risk; attitudes towards the specific measure and its efficacy; characteristics of the enterprise which they perceive as making a measure impractical; previous experience of a disease or of the measure; and the credibility of information and advice. Great importance is placed on access to authoritative information with most seeing vets as the prime source to interpret generic advice from national bodies in the local context. Uptake of disease risk measures could be increased by: improved risk communication through the farming press and vets to encourage farmers to recognise hidden threats; dissemination of credible early warning information to sharpen farmers' assessment of risk; and targeted information through training events, farming press, vets and other advisers, and farmer groups, tailored to the different categories of livestock farmer.

50 Keywords: animal disease risk; adoption; biosecurity; communication; policy; veterinarians;
51 biosecurity; prevention.

1. Introduction

England's climate lends itself to the production of grass (4.8 m hectares) and crops (4 m hectares), primarily winter cereals, supporting 5.4 m cattle, 14.3 m sheep and 3.6 m pigs (Defra, 2011). Sheep production is the most extensive system using both the less productive uplands and also lowland grass for finishing lambs in a stratified system involving regular movement of sheep and lambs between farms (Fogerty, et al., 2012; Harvey and Scott, 2012). Pig production is more intensive, although comprising both indoor and outdoor systems, with either combined breeding and finishing units or separate enterprises (Lewis and Grayshon, 2012) again requiring movement across businesses.

Animal disease outbreaks have recently made headlines and the threat of disease is diverse and changing (POST, 2011). Some diseases are endemic, others characterised by specific outbreaks with new diseases arriving from expanding trade and climate change. The impact ranges from a small set-back in production to a devastating infection leading to widespread culling and every disease contracted affects farmers' returns.

To reduce the risk of animal disease, and its impact and cost, the UK Department for Environment, Food and Rural Affairs (Defra) identified key factors contributing to disease risks on farms and the mitigation measures needed (Table 2). Understanding whether farmers could be encouraged to adopt such measures is not comprehensive (Collier, et. al., 2010). Previous work in Europe identified that size of enterprise influences the adoption of biosecurity measures. Small and/or hobby farms generally lack appropriate biosecurity measures whereas commercial and larger businesses tend to have higher biosecurity measures associated with higher awareness and recognition of risk (Ribbens, et al., 2008; Nöremark, et al., 2009 & 2010; Valeeva, et al., 2011). Enterprise type is also an influence, with higher

77 levels of biosecurity in pig enterprises (Boklund, et al., 2004) and less in sheep enterprises
78 (Nöremark, et al., 2010).
79
80 However, farmer characteristics, including motivations and attitudes, also affect decision
81 making on farms. There is evidence that farmers give more weight to biosecurity than animal
82 health programmes (Valeeva, et al., 2011). Yet research in Denmark (Kristensen & Jakobsen,
83 2011) suggests that even legislation on biosecurity plans does not always lead to uptake if
84 benefits are not perceived. Farmers are strongly influenced by practice and implement what is
85 familiar (Casal, et al., 2007). This is partly down to lack of awareness (Racicot, et al., 2012)
86 but also confusion from inconsistent and contradictory information (Moore, et al., 2008).
87 Furthermore, lack of understanding limits effectiveness of implementation (Racicot, et al.,
88 2011 & 2012). Cost is also an influence (Fraser, et al., 2010) with farmers needing evidence
89 of effectiveness before implementation (Gunn, et al., 2008). There is also a feeling that both
90 responsibility for biosecurity and cost should be shared and the way forward involves
91 Government and industry including farmers and vets. There is also a need to build trust
92 amongst stakeholders (Benjamin, et al., 2010; Gunn, et al., 2008; Hernández-Jover, et al.,
93 2011).
94
95 The study reported here examined factors encouraging and discouraging adoption of
96 measures to mitigate disease risk, in order to determine policy levers and engagement
97 strategies most likely to lead to risk reducing behaviours, overcome embedded resistance and
98 encourage farmers to adopt these measures. We focus on sheep and pig enterprises, diverse
99 sectors where the former are perceived as less concerned about biosecurity (Hovi, et al.,
100 2005) whilst the latter are perceived as extremely biosecurity conscious.
101

What follows outlines study method, results relating to understanding disease risk, Defra's mitigation measures, farm assurance, health plans and who should bear responsibility for disease control, before concluding what influences intentions and behaviours including awareness, knowledge, experience and attitudes, and implications of the findings for policy.

2. Method

The research involved face to face interviews with a sample of farmers running livestock enterprises. Most recent research in this area has used quantitative methods of data collection (mainly postal questionnaires) and analysis including summary descriptive statistics (Benjamin, et al., 2010), factor analysis (Boklund, et al., 2004), logistic regression (Ellis-Iversen, et al., 2010), Theory of Reasoned Action (Garforth, et al., 2006), Theory of Planned Behaviour (Jan, et al., 2012) and rating scales (Jansen, et al., 2010). We used the ability of qualitative methods to provide complementary insights to an understanding of human behaviour, using as their raw data the words in which participants in semi-structured, in-depth, face-to-face interviews articulate their knowledge, perceptions and feelings.

Interviews took place between February and April 2011 in three areas of England (south west, central southern, and Welsh Borders) providing good coverage of enterprise types, scales and systems. The focus was on farmers who were likely to be non-compliant with some of the disease risk reducing practices of interest to Defra. The study covered cattle and poultry (not reported here) as well as pigs and sheep (Garforth, et al., 2011). Interviewee selection was based on a commercial telephone database and local knowledge through veterinary practices, to achieve an agreed quota of participants (see Table 1) in each sector.

[TABLE 1 about here]

128 Interviews were semi-structured. Where farmers operated more than one site, the interview
129 focused on the site where the interview was conducted. Farmers were asked about
130 interventions for reducing disease risk from: new diseases being brought onto farm by
131 introduction of infected animals; disease being brought onto farm by visitors; new disease
132 being brought onto farm from neighbouring farms; spread/multiplication of disease on the
133 farm; introduction of new diseases onto farm by other animals; diseases propagating or going
134 undetected; and disease spreading from their farm to other farms.
135
136 [TABLE 2 about here]
137
138 Each was specified in the interview schedules in terms of practices relevant to the enterprises
139 (Table 2). Data gathered were largely qualitative, although information on the business and
140 the area that might affect attitudes to disease risk mitigation was also obtained. Nine sheep
141 farmers were interviewed and six pig farmers; interviews lasted 45-75 minutes, were audio-
142 recorded and transcribed.
143
144 To help analysis, a framework was developed from literature on the influences on farmers'
145 decisions regarding animal health and husbandry (Figure 1). This identified factors expected
146 to affect the intention to carry out actions to reduce, or manage, disease risk. Drawing on
147 studies that have applied the Theory of Reasoned Action (TRA), Theory of Planned
148 Behaviour (TpB) (Azjen, 1985) and the Health Belief Model (HBM) (Rosenstock, 1964) in
149 the field of animal health and farmer decision making (e.g. Garforth, 2011; Ellis-Iversen et
150 al., 2010; Jansen, et al., 2009; Garforth, et al., 2006), we expected farmers' behaviour in
151 respect of disease risk management would be influenced by: their *knowledge* of specific
152 practices; their *attitudes* to specific practices (including their assessment of benefits, costs

and risk) and to disease risk management in general; their view on the *efficacy* of practices in reducing disease risk (which, in TpB terms, are reflected in 'outcome beliefs' and attitudes) and of disease risk management; their *previous experience*, and that heard from others, of specific practices; their *perception of their ability* to put specific practices into effect, and their perception of *factors that constrain* their ability to put specific practices into effect (which, in TpB terms, relates to 'Perceived Behavioural Control'; and in HBM, to 'self-efficacy') which may include *current habitual behaviour*; their perception of what *other farmers in similar situations are doing* with respect to disease risk management; and their perception of what *other people important to them would think* about their doing or not doing specific practices ('subjective norms' in TpB). The framework was used to code transcripts, as we looked for phrases reflecting the above factors .

[FIGURE 1 about here]

Emerging themes from the analysis were presented to a workshop of 22 people representing a range of stakeholders (including Defra, the British Veterinary Association (BVA) and the National Farmers Union (NFU)). The outcomes of the workshop, reported elsewhere (Garforth et al., 2011), broadly validated the findings and helped inform the discussion, below, of the policy implications of the study.

3. Results

Overview

The interviewees felt that they are doing all that makes sense towards disease risk reduction. 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. This is brought out in the analysis below of current behaviour in relation to intervention practices for reducing disease risk listed in

Table 2. All quotations are verbatim extracts from the transcripts; reference numbers by each quotation indicate the interviewee (see Table 1).

All sheep farmers felt they had a good understanding of disease risk control while only three of the six pig enterprises said they had a good understanding (Table 3). This understanding comes from experience rather than any specific training. A typical response from a larger pig enterprise was: 'I've been working with them for years'. [KA030]

Farm Assurance Schemes and Flock/Herd Health Plans

Just over half the enterprises belonged to Farm Assurance Schemes with the larger enterprises more likely to be members. The prevailing view among scheme members is that the only reason for joining is to gain market access. Those not needing a market channel requiring Farm Assurance do not join, perhaps because they have a strong reputation in a niche or local market: 'We felt our name spoke for itself. We want to sell our produce as [*farm name*] additive free pork and not from anyone else' (KA020). Others cite cost, lack of financial return and hassle of paperwork and inspections as reasons for not joining. No scheme members mentioned enhanced biosecurity or disease control as a benefit – it was just something they had to do to sell their produce.

One of the smaller pig producers summed up reasons for scepticism about Farm Assurance voiced in varying degrees by the other non-members:

> I can't see what scheme would help me. We are a small producer and the cost of joining is prohibitive. And there are many schemes that have been discredited. I'm not sure of the Little Red Tractor. And Freedom Food. We do our own thing and say that you can come and see what we do at any time. We

participate in ‘Open Farm Sunday’ and have open days so I don’t think I need to join anything or be accredited. … The schemes are quite unclear. You can put a stamp on a piece of meat but what does it mean. I don’t know if the average consumer understands what you are selling. [KA027]

Five of the sheep enterprises had flock or farm health plans because it is a requirement of the assurance scheme they belong to; for all but one, the plan was drawn up by or with the help of their vet. One of them said they look at it; the others suggested it was for the benefit of the vet or scheme inspectors:

[Do you have a health plan?] Yes, but don’t ask me where it is. *[Do you review it?]* Sitting around chatting about it over lunch, we’re always reviewing things and we constantly change. We don’t write it down, we just do it. We have one somewhere because we’re supposed to have one. [KA016]

Those without a plan either didn’t know what it is, or felt it wasn’t necessary (‘because we know every sheep’ [PA006]), or that it was associated with assurance schemes:

[Do you have a health plan?] No; because I'm not farm assured so I don't know whether I'm meant to have one or not [KA026]

With pig farmers there is a clear divide between the three largest enterprises, who have a health plan, and the others who do not. These plans are there, not to comply with assurance as in the sheep enterprises, but because the farmers’ recognition of the importance of having a systematic, agreed way of addressing health issues:

It is just what we do. If we see some pens aren’t doing well we call the vet and he’ll say put a bit of this in the water. If we find a mortality we don’t worry

but if we find more than one it is investigated. The plan is drawn up by the vet and reviewed over the phone. It is not part of the scheme. [KA030]

Practices to reduce disease risk

Responses to questions relating to the practices listed in Table 2 are summarised in Table 3.

[TABLE 3 about here]

The interviews provide rich data on what farmers are, and are not, doing, and their reasons. As Table 3 shows, much of the 'non-compliance' is explained by farmers' seeing practices as irrelevant to them, or impractical, or not necessary. Some apparent 'compliance' is not because of concerns over animal disease risk but for other reasons. For one sheep enterprise, for example, sourcing from well-known suppliers was for convenience rather than disease risk reduction. Several interviewees said, of hygiene on farm, that keeping things clean is normal good husbandry and not something they do specifically to reduce disease risk. Some distinguished between what they try to do and the compromises they have to make from time to time. With the pig enterprises, there was a distinct pattern relating to size of operation: larger, more intensive enterprises are more likely to comply than smaller ones.

Responses on using optimal disease control tools such as vaccines recommended by a vet gave interesting insights into farmers' use of veterinary advice. Although they generally regard vets as credible sources of information and guidance, they do not automatically follow their advice. With vaccination, most seemed to take a calculated risk. A prevailing attitude among the sheep farmers, with respect to bluetongue, was that there would be time after hearing bluetongue is around to vaccinate and so the cost of routine preventive vaccination is

not justified. Some were also concerned about the stress to sheep of vaccination. One also mentioned a widespread view that as most sheep farmers are vaccinating the risk is reduced, making it less important for them to vaccinate.

With some practices, the extent of compliance varies. All but one of the pig farmers, for example, take action to keep rodents away from their pigs ranging from having cats to using rodenticides. None felt it feasible to keep large mammals, such as deer and foxes, away.

Responsibility for advice and disease control

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 workin the farmer's interest. Nevertheless, some recognised that Defra has a role in providing advice.

Of the nine sheep enterprises, five said Government should bear the cost of controlling both endemics and exotics with four saying farmers should pay for endemics as part of normal costs of running a good business. As for advice, vets are seen as more credible than Defra but one interviewee suggested that if farmers have to pay for advice, many will not seek it and so Defra should continue the practice of disseminating advice. One sheep farmer pointed out that providers of advice have their agendas so the farmer has to assess the relevance of advice for them:

> Vets are quite good at giving advice but you always have this feeling that they will try and sell you something more than you need or more expensive. So anything a vet tells you, you need to take with a pinch of salt. Obviously respect what they say because they are experts. [PA06]

Another echoed the link between cost and responsibility, in respect of paying for advice:

> I wouldn't mind paying but I would want a say in how it was going to be spent because Defra have no idea, it's like all Government bodies, they've got no idea on how money is spent other than they go on and spend it willy nilly. [KA26]

When it comes to exotics, all said Government should be responsible. Several referenced the strategic nature of their industry, in terms of food security, in justifying this insistence on Government paying for advice and control measures in respect of exotics.

Pig enterprises had differing views on organisations who are potential sources of advice and information. Some saw a role for Defra to act as a universal source of advice with others seeing Defra becoming marginalised because producers can turn to several sources for their information needs. One larger enterprise with one of the younger respondents (40-49 years), felt the industry has advice on endemics covered but that Defra has a role in relation to notifiable diseases:

> If you look at important organisations to the pig industry, you have BPEX [British Pig Executive], the NPA [National Pig Association], the trade association with a powerful voice, Pig World magazine, the Pig Veterinary Society and individual vets. Defra has a role there but, in terms of endemic disease, pretty small. If you have a notifiable disease, you deal with Defra because they set the rules and how you deal with it. [KA29]

Another larger enterprise (run by an interviewee of 60-69 years) felt Defra should have a role in advice but that it is out of touch:

> Defra aren't in touch with the industry. The NFU have a livestock committee but they are not really in touch. It is pig farmers who are very much in touch with the whole system and we network with them. I suppose Defra should give the advice as they have overall control. [KA30]

Others highlighted the role of vets in advice, another larger enterprise suggesting:

> I think vets in the main are on the ground with the expertise and experience and local knowledge. I think the Ministry should have a big input into that … we work closely with one of their vets … and I will pick the phone up and talk to him quite regularly. [KA28]

The two smaller enterprises felt that Defra should be the body responsible for both advice and disease control, one volunteering:

> I think Defra, during foot and mouth, were very good. I looked on the website every day to see what was going on. They would be the people I would turn to for policy advice, the NFU as well. [KA27]

4. Discussion and conclusions

Figure 1 shows factors from recent research on farmer decision making on animal health matters, thought likely to affect intention and behaviour for disease risk management. Discussion will be structured around these, with several themes emerging.

Knowledge and awareness of practices

Livestock farmers feel they understand risk control measures well. However, the fact that someone knows about a measure and understands what it is designed to do does not make it more likely that they will implement it. Indeed, comments on the measures suggest that assessment of efficacy and practicability are much more important. Knowledge and awareness is obviously a necessary, but far from sufficient, condition for implementation. Views on the credibility of the science underpinning the recommendation of measures were mixed. Most thought the science was sound, though some questioned how science was translated into recommended measures for farmers.

Attitudes to disease risk

Interviewees recognise that disease risks can be managed by good husbandry and reduced through implementing measures that are practical for each individual. However, disease cannot be avoided entirely. This is not seen as fatalistic but as realistic: one can take precautions to reduce risks, but the nature of livestock keeping is that disease will occur now and again. Furthermore, some risks cannot be controlled by farmers as the lack of effective control of risks by people off farm, including lorry drivers and people using public footpaths across farms, can undermine their efforts. Attitudes to risk are informed by previous experience, as in the comment in Table 3 on scab being transferred among sheep on moorland. The interviews show that farmers' compliance with recommended practices is strongly influenced by attitudes to disease risk. Those who feel a particular risk is serious and manageable are more likely to try to reduce it if they feel that the costs are justified.

Many farmers also associate risk with the current local disease status. If, for example, a neighbour is known to have a transmittable disease, they are likely to take additional precautions. The fact that the disease may have been present but undetected in the neighbour's stock for months does not necessarily translate into readiness to prevent such unseen threats from entering the herd or flock. There is a similar attitude tovaccination as several said they had stopped vaccinating against some diseases because the risk was low but they would consider starting again if the disease increased in the area.

Similar views came from a question on what they would do in the event of an exotic disease outbreak: several said they would deploy measures widely promoted during previous outbreaks, including disinfectants, restricting movements of people onto and off the farm, and spraying vehicles. Several referred to luck – 'keeping fingers crossed' and 'touching wood' – and the sense of doing what one normally does, only more intensively.

Many of the biosecurity measures viewed as unnecessary are aimed at reducing the risk of this 'silent spread' of disease. To be effective, they must be done routinely even when it appears there is no threat, for example isolating bought-in animals and separating species. This suggests there is a difference in risk perception between farmers and Defra and the veterinary profession. This has two implications: it highlights the important responsibility of vets (both public and private), and of farmers, to ensure surveillance functions well so that threats become visible as early as possible; and it suggests an area where education and communication are needed to enable farmers to recognise the 'unseen' risk of disease. Within these responses, there is a mixture of farmers accepting a slightly higher level of risk than perhaps Defra would like, and farmers balancing risk against the inconvenience and expense of more extreme measures.

374

375 **Attitudes to disease risk management practices**

376 Attitudes to disease risk measures seem strongly linked to attitudes to disease risk itself.
377 Many interviewees base their decisions on implementing specific practices on their personal
378 assessment of trade-offs between risk, efficacy and cost. Typical was this sheep farmer's
379 explanation of his decision not to vaccinate against bluetongue:

380 > Vaccines are a good thing, I couldn't manage without them but the less you
381 > jab animals is good. You have to weigh up whether it's worth doing or you
382 > take a risk and probably this year, I'm going to take the risk and not do it. If I
383 > was further east, I might do it a bit more. [KA26]

384

385 Another common theme was questioning the efficacy of practices, not because of the
386 underlying science or theory but because they cannot be implemented or because other
387 factors intervene. Scepticism was expressed by one of the larger pig enterprises in respect of
388 action to reduce the risk of salmonella:

389 > When people talk about salmonella control it's a farce. .. let's not be naïve
390 > enough to think that because we have got a salmonella control programme it is
391 > going to make any difference because it doesn't. [KA28]

392

393 The practices most commonly applied were those regarded as common sense or part of good
394 husbandry. They included vaccination, being selective over sources of new animals, keeping
395 new animals separate from existing stock on arrival, and cleaning buildings between batches.
396 These practices were adopted where returns seemed to justify it. However, other practices
397 did not make sense for individuals. Double fencing, for example, was rejected by most
398 including this sheep farmer with a smaller flock:

> Double fencing? No, if I've got one fence that works I think I'm doing well. Avoid grazing on fields next to neighbours? No, I don't think that is practical for us … Double fencing, a load of rubbish. [KA13]

Perceived farm constraints and ability to implement measures

Many interviewees referred to a feature of their enterprise when explaining why they had decided it was unnecessary or impractical to adopt one or more of the proposed measures. Features making a measure unnecessary include geographical isolation and the protection from neighbouring stock afforded by boundary roads and watercourses; those making a measure impractical include the construction or layout of buildings, lack of space, and fragmentation of the holding into parcels.

Some saw trade-offs between tighter disease risk management and values important to them, particularly welfare, as seen in the earlier comment about bluetongue vaccination. One pig farmer felt they could not do any more to prevent disease transmission from wildlife without compromising their commitment to running an open system:

> Without boarding up, I don't know what I could do. We have a big thing about health and welfare. We would like to run them outdoors but you can't here because we are on clay. In the winter it's under water. What we do is make it as easy as possible. If we start boarding up, it would cause problems and compromise welfare. [KA20]

Apart from these farm level constraints, two themes emerged regarding their ability to implement measures: ease of implementation and cost. For the former, specific practices that

make sense are not implemented because they are time-consuming and, for the latter, it is perceived they are not justified by the cost.

Previous experience

Livestock farmers' disease risk behaviour is strongly influenced by experience of practices that have worked or not, of farm diseases, of working with animals and of the organisations they deal with.

If a practice does not work, or seems to makes things worse, farmers are quick to change, even if the change is one that others might regard as idiosyncratic. As one of the larger pig enterprises said about cleaning housing between batches:

> We found out quickly that the worst thing to do was pressure wash and disinfect between batches because we found they built up immunity. Now, we clean out and have foot dips but we don't pressure wash. [KA20]

Farmers' experience of organisations can work either for or against compliance and relates to credibility. This is clearly seen in comments on Defra's role in providing information on disease. Some regard Defra as having done a reasonable job on information and advice, for example during Foot and Mouth outbreaks, and see it as a credible and useful source. Others, with less positive experience of Defra , are more likely to regard their advice as unhelpful or less relevant than that from other sources. This was expressed by colourful anecdotes including one from an Oxfordshire sheep farmer:

> If you ring Defra, you might just as well ring Thames Water. There's never anybody there that knows anything about it and by the time they find

447 somebody we could be two months on before you hear anything back. So, I've
448 not got a great deal of faith in Defra. [KA26]
449
450 **Inertia and habit**
451 There was frequent reference to farmers having found a pattern of disease risk management
452 practices that works, but no strong indication that they are keeping to a pattern because of
453 inertia. Indeed, most referred to occasions, often recent, where they had changed. Inertia or
454 continuing habitual behaviour does not seem a strong driver of the use or non-use of specific
455 measures. Farmers are willing to be convinced to use measures they currently do not, but
456 need supporting advice from credible sources such as a vet whose opinion they trust.
457
458 **Exposure to sources of information**
459 Most interviewees do not go out of their way to search for new information. Those that do,
460 keep up to date through the farming press, or through vets. No interviewees mentioned farm
461 assurance schemes as sources of advice. One farmer with a smaller sheep enterprise
462 mentioned using the Internet for information.
463
464 A consistent theme was using the vet to check advice from other sources, whether local, in
465 the mass media and Internet, or from national organisations. Some vets are proactive in this
466 field. One farmer with a smaller sheep enterprise, when asked about sources, replied:
467 Local vet practice. I phone them first. We go to regular health-based meetings
468 with them. We pick up interesting points. [KA13A]
469

Those more exposed to sources of information are in a better position to choose a particular measure. But the influence of that exposure is always mediated by farmers' assessment of relevance, an assessment often made after referring to the vet for information and opinion.

Social influences

Literature on farmer uptake of new technology often identifies 'other farmers' as a major source of new ideas. Here, other and neighbouring farmers hardly figure. In fact, a strong theme from the interviews was that what others are doing and saying has little influence on what the interviewees do for disease risk management. They rely on their experience and ideas of what is sensible. The exception is the few less experienced interviewees who mentioned specific other people in the sector who they regard either as role models or with superior knowledge to them. Smaller enterprises were also more likely to discuss disease measures with others, whether smaller or larger enterprises. One farmer with 80 ewes put this in the context of needing reliable advice when something goes wrong:

> I find the vet not the easiest person to contact when we need him. For example, this week we had a sick sheep and we phoned and he didn't even answer. That's no good. [KA14]

Even among these smaller enterprises, the ones who had been keeping animals for a long time were also not particularly interactive with others. There was also little sense of interviewees being influenced by how they think others would view their carrying out or not of disease risk measures (the 'subjective norm' of the TpB). Several referred to carrying out measures because they represent good practice but these seemed related more to personal values than to a need to conform with others' views.

Attitudes to sources of advice

Although the credibility of sources was not identified in the framework, it comes through as a strong theme in the interviews. Vets are seen as the most credible and reliable source on disease and disease risk management, providing more farmer-focused advice than government. The following comment represents their views:

> If Defra say something you take it quite seriously but you might not take it so seriously if you think they're trying to tell you [to do] something you're already doing. If the NFU told you or maybe an assurance scheme or you read it in the Farmers Weekly, you'd be much more willing to take up that strategy. [PA06]

Overall then, the study farmers accept that action taken on farm can reduce the risk of endemic disease breaking out among their animals. Most also feel they are doing all they can to minimise such risks. The measures most commonly implemented are vaccination, policies for sourcing new stock, and separation of new from existing stock. The measures least commonly implemented are staff and visitor management policies, and staff training. Some measures are widely regarded as common sense, such as good hygiene and having a sensible system for manure disposal, rather than as disease risk measures. Pig enterprises put more emphasis than sheep enterprises on controlling wildlife access, and on staff and visitor management. Members of farm assurance schemes are more likely to have health plans but, for most, this is seen as a scheme requirement rather than a useful disease risk measure.

Interviewees see themselves as already making rational decisions, based on circumstances, on what to implement, irrespective of what others are doing. There is great confidence in their

knowledge built up over years. In contrast, less experienced farmers, those with higher levels of agricultural education and those managing large units, are more likely to be proactive in looking for up-to-date information on livestock disease. This suggests some complacency in the self-reported levels of knowledge and understanding.

Farmers clearly place great importance on being able to access authoritative information relevant to them, which most see as available from vets – principally their local vet but also a local 'Defra vet' (a vet with the former State Veterinary Service, now the Animal Health and Veterinary Laboratories Agency) whose opinion they respect. Information that is general and appears as released to all is more likely to be ignored at best and, at worst, to reinforce attitudes that advice from central sources is not relevant or practical to the individual. Farmers look to vets to interpret and contextualise information and advice received.

Many farmers also obtain information on disease risk and management from the farming press; they see this as up-to-date and relevant. Scientific findings related to animal disease are generally trusted but not always seen as practical with some wanting more relevant and practical guidance.

The reliance of most interviewees on vets for risk assessment and advice on control measures for diseases is based on trust, credibility and previous experience. Relevant here is the current trend in England towards concentration of farm vets into fewer, larger practices, which enables practices to have specialists for different systems capable of giving the sort of targeted information and advice that farmers value and the scale to be able to devise and offer training courses to develop skills and confidence among farmers to make better informed decisions.

Most farmers accept they should pay part of the costs of disease risk advice for endemics and that they should bear the cost of measures they voluntarily implement to address risk factors. With exotics, however, and notifiable diseases in particular, they feel Government has a strategic responsibility to protect agriculture from external disease threats and should, therefore, coordinate the provision of advice and information, and pay for disease controls. Furthermore, with no say in the design of measures to protect against exotics or tackle any outbreak, they feel they should not contribute towards costs.

The specific attitudes and behaviours reported here are formed by the policy, economic, institutional and disease history context in which sheep and pig farmers in England operate. Further research in other industrialised economies is needed before their validity in other settings could be assessed. However, as these findings are consistent with prevailing socio-psychological analytical frameworks, similar themes may well emerge elsewhere.

Policy implications

There is no current specific plan or policy linking the measures promoted by Defra to compensation or to insurance premiums. However, under the rubric of 'Responsibility and Cost Sharing', Defra is consulting on how future costs of addressing disease outbreaks should be shared between industry and government and has established the Animal Health and Welfare Board for England to advise on this (http://www.defra.gov.uk/ahwbe/ 18/12/2012). It is, therefore, relevant to consider the implications of the study findings for future policy. While it is hard to identify 'quick fix' policy levers to encourage farmers to implement more disease risk measures, possible ways forward centre on information and communication.

570 (1) Risk communication Where farmers are not implementing measures that others suggest
571 are beneficial in reducing disease risk, this indicates a gap in their understanding of the level
572 of risk their animals are exposed to. This suggests one way to encourage farmers to consider
573 applying more measures, or applying measures more stringently, revolves around risk
574 communication. This should be tailored to situations faced by different enterprises and
575 involve local vets, who are widely regarded by livestock farmers as the main players in
576 interpreting and filtering information from national bodies. The farming press should also be
577 used to enhance risk communication to farmers.
578
579 (2) Disease surveillance Farmers' assessment of disease risk and their implementation of risk
580 reducing measures are influenced by recent incidence. This reinforces the importance of
581 effective surveillance to provide early warning about disease threats. Livestock farmers need
582 to be aware of both local and national situations. An important message is that of incubation
583 time in relation to animal movement and isolation of incoming stock. Dissemination of
584 credible early warning information through the farming press and vets will help sharpen
585 farmers' assessment of risk and have an effect on the implementation of disease risk
586 measures. Credibility is vital: the science on which recommended measures are based must
587 be credible and clearly articulated, and the measures must be seen as realistic (i.e. cost-
588 effective, have a significant impact on the risk they are designed to address and not subverted
589 by factors outside the farmer's control).
590
591 (3) Targeted information and advice Perhaps the main message emerging is that information
592 and advice livestock farmers receive needs to be relevant to their situation to be taken
593 seriously. Differences between large operations with many paid employees and small-scale,
594 part-time enterprises run by family labour and interacting with relatively local input and

595 output markets, should be reflected in the information that is put out on disease risk
596 measures. The relevance of measures varies with species and production system, as does the
597 affordability of measures because of different levels of profitability and future prospects.
598 Defra could, perhaps, do more to fine tune their advice so that it is informed by an awareness
599 of the different situations in which farm animals are kept.
600
601 Events run by vets are generally seen as offering practical advice and an opportunity to gain
602 new knowledge, particularly in relation to disease threats. Subsidised training events would
603 be one way of providing more bespoke information and advice to specific categories of
604 livestock farmers. Farmer groups are another opportunity for exchanging ideas and accessing
605 advice. Consultancy companies providing benchmarking services, which often cover animal
606 welfare and health and financial aspects, are a third group. In summary, the key is
607 communication which is up-to-date in terms of risk threat, targeted and delivered through
608 trusted sources for both advice provision and training.
609

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616

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736 **Tables**

737 Table 1. Pig and sheep farmers interviewed by size, age and county
738

Reference	Enterprise	Size	Category	Age of interviewee	County
PA006	Sheep	25 ewes	smaller	50-59	Somerset
KA009	Sheep	1600 sheep	larger	no response	Berkshire
KA009A	Sheep	600 ewes	larger	60-69	Warwickshire
KA013A	Sheep	30 ewes	smaller	30-39	Oxfordshire
KA013	Sheep	100 ewes	smaller	60-69	Hampshire
KA014	Sheep	80 ewes	smaller	20-29	Wiltshire
KA016	Sheep	300 ewes	larger	50-59	Shropshire
KA023	Sheep	52 sheep	smaller	50-59	Devon
KA026	Sheep	150 ewes	smaller	50-59	Oxfordshire
KA011	Pigs	30 finishers	smaller	50-59	Oxfordshire
KA020	Pigs	120 pigs	larger	60-69	Oxfordshire
KA027	Pigs	10 sows	smaller	50-59	Hampshire
KA028	Pigs	300,000/year	larger	40-49	Norfolk
KA029	Pigs	500,000/year	larger	40-49	Norfolk
KA030	Pigs	3,500 finishers	larger	60-69	Hampshire

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742 Table 2. Disease risk intervention practices included in interview schedules

Practice	Enterprise
Practices to avoid new diseases being brought onto the farm by introduction of infected animals:	
• *Livestock isolation units for animals brought onto the farm:*	
o keep newly acquired animals separate for a period before they join established groups in the flock/herd	Both
• *Strict replacement sourcing policies:*	
o when you buy animals from a new flock, always ask about the disease status of that flock	Sheep
o knowing the disease status of the herds where you buy pigs from	Pigs
o trusting the owner to tell you about new diseases in his/her herd	Pigs
• *Number of legal and tested movements onto farm ranked by risk of source:*	
o buying sheep from a few well known suppliers, versus buying them from different places such as markets, auctions, etc.	Sheep
o buying pigs from a few well known suppliers	Pigs
• *Reduce contact with wildlife in fields and in livestock sheds:*	
o taking specific action to keep wildlife out e.g. raised troughs, special fencing	Sheep
o practice regular rodent control	Pigs
Practices to avoid disease being brought onto farm by visitors:	
• *Staff and visitor management policies*	
o taking action (e.g. putting-up signs) to prevent visitors touching animals without your knowledge	Sheep
o providing staff/visitors with designated clothing before entering your pig unit	Pigs
Practices to avoid new disease being brought onto farm from neighbouring farms:	
o avoiding grazing on common land	Sheep
o minimise contact between livestock on neighbouring farm premises (outside units only)	Pigs
Practices to avoid spread/multiplication of disease on the farm:	
• *Slurry and manure management, treatment and disposal*	Both
• *Hygiene on farm*	
o taking specific action to keep your animals clean	Sheep
o neonatal disease control: hygiene in lambing areas/separation/cleansing/disinfection/afterbirth disposal/rearing lambs separately	Sheep
o always clean and disinfect barns between batches	Pigs
• *Using optimal disease control tools including treatments and vaccine as recommended by a vet*	
o vaccinating against bluetongue	Sheep
o check and act on ZNCP scores	Pigs
Practices to avoid spread/multiplication of disease on the farm, <u>and</u> introduction of new diseases onto farm by other animals:	
• *Reduce disease risks of multi-species farming*	
o have tools and clothing only used for the sheep/pig unit and not for other enterprises	Both
Practices on farm to avoid diseases propagating or going undetected:	
• *Farmer/keeper training in disease management*	
o offer external training to your staff	Both

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744

745 **Table 3 Compliance with recommended practices to reduce animal disease risk on farm**

Practice	Sector	Comply (number)	Not comply (number)	Sample comments
Isolate new stock	Sheep	7	2 (impractical, not necessary)	'In ideal circumstances we would try to isolate them from the rest but obviously sometimes that's not practical if you haven't got much grass' [PA06]
	Pigs	4	2 (irrelevant)	'We breed our own; we are pretty closed [but when we buy in] we always separate new stock' [KA27]
Sourcing policy	Sheep	7	2 (impractical, not necessary)	Impractical 'because they come from markets in North England' [KA09] We are nowhere near as vigilant as we are with cattle. Sheep aren't a big problem disease-wise' [KA023]
	Pigs	3	3 (irrelevant, not necessary)	'we only deal with people we have dealt with before' [KA27] 'The pigs don't belong to us, they are on contract … they come to us to be grown on' [KA30]
Reduce contact with wildlife	Sheep	0	9 (impractical, not important)	'No you can't. Unless you shoot all the wildlife you can't do anything about it' [KA26]
	Pigs	5 (rodent control only)	1 (impractical)	'It's very difficult to properly fence in an outdoor unit to keep out wildlife … I don't think it is a huge risk other than if the wild boar population exploded, then obviously there would be more pig diseases' [KA29]
Staff / visitor management policy	Sheep	4 (try to comply)	5 (irrelevant)	'as much as we can .. when they're out in the field and people pass through the field there's not much you can do about it' [KA09] 'we are very isolated here' [KA23]
	Pigs	3	3 (not necessary)	'We don't have visitors or customers. That is what we have always done' [KA20]
Avoid common grazing	Sheep:	2	3 (not relevant) 4 (can't avoid using it)	'The times when we have had scab in the past, they always caught it on the moor from other sheep … if there's a problem there you are going to pick it up' [KA23]
Avoid contact with neigh-bouring stock	Pigs:	1 (double fence) 1 (unspecified)	2 (not relevant) 2 (not practical)	'not relevant; my neighbour's sheep are fenced in' [KA27] 'if you run outdoor pig systems, straw based systems, like we do, in open and naturally ventilated buildings, can someone tell me how I can prevent salmonella entering?' [KA28]
Slurry/manure management	Sheep	1	8 (not necessary)	'There's limited scope; we clean out the sheds once a year and then spread on the ground' [PA06]
	Pigs	1	5 (not necessary)	'Scrape it off when we move the huts then clamp and compost it for a year before spreading' [KA30] 'if there is something like dysentery we would be really careful' [KA29]
Hygiene on farm	Sheep:	9 (to some extent)	0	'I don't wear gloves to lamb because I find I just haven't got enough feel' [KA16]
	Pigs:	4	2	'All the growing units are washed out between batches' [KA29]

Practice	Sector	Comply (number)	Not comply (number)	Sample comments
Optimal disease control	Sheep:	1	8	'If we did see that the problem [bluetongue] came back, naturally we would soon vaccinate for it' [PA06]. 'Not only does it [not vaccinating] save money it also saves stress on the sheep' [KA026]
	Pigs:	3	3	'I'm on the phone to [the vets] every day. We liaise on a daily basis and they come here once a week' [KA28]
Reduce risk of multi-species farming	Sheep:	0	9	
	Pigs:	2	4 (not relevant)	'It is part of our internal rules to keep good separation of species. We look at that with the vet'
Staff training	Sheep:	1	8	'I'd say our that our knowledge was sufficient to keep disease risk to a minimum' [PA06]
	Pigs:	3	3	'We have done, but our pig man has been with us 25 years' [KA30] 'It's not really relevant; we are self-taught and we help each other [KA27]

746 Source: Interviews 2011

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749 **Figure caption**

750 Figure 1 Analytical framework linking factors that influence farmers' disease risk

751 management behaviour

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