Factors influencing veterinary surgeons' decision-making about dairy cattle vaccination

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Abstract

The use of vaccines in the cattle industry is widespread; however there is limited published guidance for use by decision-makers such as farmers and vets. To best support vets in advising dairy farmers on the optimisation of vaccination strategies it is important to understand how and why vets make decisions about recommending the vaccination of cattle.

The objective of this study was to explore in-depth farm animal vets' motivators and barriers to the implementation of vaccination strategies on British dairy farms. Semi-structured interviews were conducted with fifteen vets.

Results indicated that vets have a positive attitude towards the use of vaccination and have few barriers to advising its implementation. Vets appear to group farmers into three 'character types'. This characterisation influences the vet-farmer relationship and how the vet communicates with the farmer. Vets required evidence of disease, or a risk of disease as a motivator to advise vaccination. However, this seemed to be sometimes overruled by a risk averse attitude; resulting in vaccination being advised 'just in case'. Crucially, the need for resources to support and build on the

vet-farmer relationship is highlighted as an area requiring further exploration in order to optimise vaccination strategies on-farm.

Introduction

The role of the vet[1] in cattle vaccination is different to that of vets and health professionals in companion animal, equine and human health. In these situations the health care professional administers the vaccine and the vaccination schedules are generally pre-defined, and are often the same for all recipients (NHS, 2016, Day and others, 2010). In contrast to this, in the British farming industry farmers generally administer the vaccines themselves. They must also make additional decisions encompassing logistics, cost and which vaccines to implement. Currently, a number of farm practices offer vaccination services through para-professionals to reduce some of these logistical and time pressures. There are currently no nationally agreed or compulsory vaccination schedules for cattle in Britain to guide farmers in their decision-making. With the exception of diseases such as Bluetounge and Schmallenberg, the majority of vaccines licensed in Britain target endemic diseases. Due to the endemic nature of these diseases they can all pose a risk to an unprotected herd. But, as suggested by Paton (2013), it would be difficult, costly and not necessary for every farmer to vaccinate for every disease.

[1] This article uses the more colloquial term 'vet' instead of veterinary surgeon. This was done to improve readability and to reflect the term most used by the interviewees who participated in this study.

Vets are perceived by farmers to be involved throughout the vaccination decision-making process (Richens and others, 2015) and are perceived to be trusted advisors on vaccination, as well as other disease control topics (Brennan and Christley, 2013). It can be assumed that an effective and trusting relationship between a farmer and their vet would make it easier for farmers to navigate the long list of vaccines available (NOAH, 2016). If a vet advises a farmer to vaccinate, previous research shows that farmers report to be inclined to vaccinate (Richens and others, 2015). The vet is a major influence on dairy farmers' decision-making but not the only one, and the decision to vaccinate is conducted in a stepwise manner with perception of risk of disease and number of other vaccines already used also contributing to the decision-making process (Richens and others, 2015). Given the reported importance of vets' opinions to farmers when making vaccination decisions, answering the question as to which factors influence vets to recommend vaccination is crucial.

Previous research can offer a useful insight into the question of vets' vaccine related decision-making. For example, in a discussion group study of vets' opinions on dairy cattle vaccination, Cresswell and others (2013) highlighted a concern regarding variation in vaccination advice from vets. The authors suggested that this was partly the result of a lack of evidence-based information, making it difficult to present a common approach to veterinary vaccination advice. Cresswell and others (2013) also highlighted that their study was a starting point and that further

research was needed to understand vets' perceptions of dairy cattle vaccination.

In order to fully understand stakeholders' perceptions of vaccination a method and philosophy that allows the collection of rich and detailed data is required, allowing participants to frame their responses by what is important to them (Christley and Perkins, 2010). Similarly, Chambers and others (2014) discussed the need for inclusion of social science in vaccination studies, an area which has been widely utilised to examine decision-making in human vaccination (Hobson-West, 2007).

This study follows research investigating the attitudes of dairy farmers towards vaccinating their cattle, and therefore aimed to use qualitative methods to explore the factors influencing vets' decision-making when giving advice about dairy cattle vaccination to farmers.

Materials and methods

This study is reported following the Consolidated Criteria for Reporting Qualitative Research (COREQ) guidelines (Tong and others, 2007).

Veterinary practice sampling frame

Recruitment of participants was undertaken by purposive sampling (Bryman, 2012) of mixed and large animal vets from a database of practices held by the School of Veterinary Medicine and Science at the University of Nottingham. The database contained contact details and

practice information of the majority of veterinary practices (n= 4526) in the UK.

For the purpose of this research to be eligible for inclusion in the study the interviewed vets needed to involved in the clinical care of dairy cattle as part of their job. Due to the nature of the database utilised for recruitment it was not possible to determine which veterinary practices employed vets who treated dairy cattle specifically. Therefore at this stage to be eligible for inclusion in the study vets had to be employed by a veterinary practice listed in the database as either a 'mixed' or 'large animal' practice, or stated they treated 'cattle'. When each practice was contacted eligibility was checked more specifically. Practices were excluded if they were not located in Great Britain. Each practice was allocated one of six regions based on their address for logistical reasons. Within these regional lists practices were randomly sorted through the use of a random number generator.

Recruitment of vets

Recruitment of vets took place between January and April 2014. Veterinary practices were contacted from the start of each randomly sorted regional list, ensuring that at least one practice from each region was involved in the study. Practices were excluded at this stage if they did not have dairy farm clients. A farm or mixed animal vet who was involved in treating dairy cattle from each practice was invited to participate in the study. A mixed animal vet was defined as a practitioner

who worked with farm species as well as other species. Upon contacting each practice the person who answered the phone was asked if there were any eligible vets available to be invited to participate. If no eligible vets were available then a better time to call back, or an email address was requested to send further information. Recruitment continued until analysis indicated thematic saturation (i.e. no new themes emerged) was reached (Mason, 2010).

Data collection

Semi-structured interviews were conducted, either face-to-face or by telephone, between January and April 2014 by the lead author. A question guide (available on request) was used and topics included the role of vaccines, information sources, farmers' attitudes towards vaccination, vaccine distribution, and vaccine efficacy. At the start of each interview each participant was requested to respond using experience from their dairy clients and considering dairy practice as far as possible. Questions were developed through discussion with farm animal vets, with colleagues, and through reflections on the authors' research experience. The questions were trialled with a farm animal vet and amendments were made to improve the flow of questions. No financial incentives were offered to the participants, however lunch was provided by the interviewer.

Data analysis

The audio recordings were transcribed verbatim by external transcribers. The transcripts were anonymised and checked against the recordings, then imported into qualitative data analysis software (NVivo 10, QSR International) for thematic analysis (Braun and Clarke, 2006). To assess the robustness of the coding framework (Barbour, 2001) a sample (8/14) of the transcripts were coded independently by a second researcher (ZH). Analysis of the first interviews started prior to the later interviews being conducted. Data collection ceased after the fourteenth interview to allow thematic saturation to be assessed. Thematic saturation had been found to have been reached, therefore no further interviews were undertaken.

Results

In total 14 interviews were carried out with 15 participants. The median interview length was approximately 51 minutes (range 32-77 minutes). One interview was conducted by telephone and the remainder were conducted at the participants' workplaces.

Seven vets reported they were mixed vets, and eight identified as farm, or large animal vets. Ten of the participants were employed as assistants and five were partners in their practice. There were nine male and six female vets interviewed. Four participants had been graduated for five years or fewer and five had been graduated for over ten years. The proportion of the participants' time that was spent working with dairy clients, as opposed to other clients, varied from 'mostly dairy' to 'mostly beef, with some dairy'.

Two main themes will be discussed here. Firstly, 'Rationale for vaccination' encompasses how vets made decisions about whether to advise vaccination or not. Within this main theme, six sub-themes will be described. Secondly 'The vet-farmer relationship' encompasses two sub-themes- how participants perceived their role on-farm, and the tendency of vets to 'group' farmers into character types.

1. Rationale for vaccination

The vets interviewed in this study had broadly similar attitudes towards dairy cattle vaccination. There seemed to be minimal variation between vets in the steps involved in decision-making when discussing dairy cattle vaccination in general.

The participants were positive about the use of vaccines but were also keen to stress that vaccines were only part of the solution when it came to disease control on dairy farms. Nevertheless, vets took into account the potential effort required to implement other disease control measures.

> *With vaccine, I know that's not – it's not the whole picture, but it is a big part of that and [farmers] like to be able to do something proactive and it's a lot easier for them to give them a jab of vaccine than have to change their whole farm management or build a new shed or something like that. (Vet 3)*

When discussing how vaccines were used the participants described the potential uses of vaccination in two different ways- for control of disease

already present in a herd and for prevention of the effects of a disease not already present in the herd.

Response to a disease outbreak

Reaction to an outbreak or diagnosis of a disease seemed to be the main reason why the use of vaccination was advised by a vet. The need for a diagnosis, or confirmation of a herds' disease status, suggests that vets require evidence to help support their decisions.

Well [I would advise vaccination] if we've diagnosed a problem, whatever infectious disease on the farm at that time and there's a vaccine available. (Vet 7)

Prevention of a disease outbreak

When asked specifically what the role of vaccination was in disease control, many of the participants discussed the use of vaccines in the prevention of disease. Vaccination was seen by vets as an 'insurance policy' for farmers; it was perceived to be better for farmers to protect their herd and spend money, because the wider impact of an outbreak would cost much more.

[The role of vaccination is] preventing disease on the farm in the first place really and I think it's about trying to explain to your clients the actual potential cost of a disease outbreak. (Vet 13)

Vets advised the use of vaccination for prevention of the effects of disease based on perceived risk. The participants appeared to be risk averse when

it came to vaccination strategies- especially when it came to naïve herds. There was a sense of fear and worry when discussing the reason to vaccinate. Vets reported a concern that if they advised against vaccination there may be a disease outbreak for which they could be held responsible. Two vets independently and spontaneously discussed a case where a farmer had sued their vet because of an outbreak of disease in their herd.

> *At the same time, we don't want to have undue risk. The famous case is the farmer that tried to sue the vet for three million because he hadn't advised IBR vaccine. Thankfully he was able to go back through his records and say, 'Well actually I did', and it was settled out of court, but that could have went the other way. What if he'd never kept that record? What if he'd lost? What position would that put vets in then? 'Oh gosh. He was sued for three million. I just better vaccinate for everything.' (Vet 15)*

If the tables were turned and the farmer asked their vet if they could stop vaccinating, then the vets perceived they would have an honest discussion with the farmer about the risks. However, the advice would likely be against stopping. The potential negative outcomes of not vaccinating appeared to weigh heavily in the vets' decision-making.

The way vets described their decision-making around whether to advise implementation of a vaccine was almost as if they were stuck in a 'catch-22' situation.

And either way you can't argue against it, 'cause if they're all negative it's a risk, and if they're positive they need to vaccinate. (Vet 14)

Barriers to the implementation of vaccination

Few barriers were identified in the analysis to the implementation of vaccines on dairy farms. If a farmer remained keen to vaccinate, even in the absence of the vet perceiving a specific risk, then vets would not challenge the decision. More commonly, a major barrier to vaccination uptake was perceived to be the farmer themselves- vets were keen to vaccinate but if the farmer was not aware of a problem, nor perceived a risk, then they were thought unlikely to be motivated to vaccinate.

[If you could] force the farmers to keep better records as well as it's impossible to talk to them about what you perceive to be a problem, if they don't perceive it to be a problem, if they don't keep records of the number of calves with pneumonia or whatever, and compare it to other farms. Because if they don't know it's a problem, they're not going to want to do anything about it. (Vet 11)

Cost-effectiveness

The term 'cost-benefit', as used by the participants in this study, could be described as weighing up the outlay of the cost of the vaccines with the financial, production or health benefits of using those vaccines. The theme of 'cost-benefit' was present throughout the interviews as both a reason for and a reason against advising farmers to vaccinate. Vets perceived that farmers did not understand the potential cost-benefit of

implementing vaccination and saw this as a barrier for farmers to initiate vaccination. Vets mostly perceived the benefits of vaccination to outweigh the cost.

> *Obviously, they see the bill for the vaccine, they don't see the money that they haven't lost because they don't have BVD raging in the herd. (Vet 2)*

If it was perceived that the cost of the vaccine outweighed the risk of a disease outbreak or the efficacy of the vaccine then vets were less likely to advise it. Communicating cost-efficacy messages to farmers was perceived to be difficult.

Use of information sources

The interviewees felt well informed on vaccination and were aware of resources they could access. The vaccine's summary of product characteristics (SPC) and colleagues were the first ports of call, but for information on updated protocols and new vaccines vets mostly relied on pharmaceutical industry representatives. Although there was an air of pragmatism about the information they were given this was still perceived as a beneficial relationship for advice- especially regarding 'off license' use of vaccines.

> *The drug companies are always visiting us to talk to us about [vaccines] and usually keep us up to date with new developments and things. When we do phone them for queries and things, they're always available, so generally pretty good and, as I say, we've got so many leaflets and*

booklets and internet and all sorts of stuff to go for reference now, that we're pretty well informed. (Vet 9)

When asked about if and how their knowledge had changed since graduation, participants felt their knowledge and confidence in discussing vaccination had improved with experience over time. The inclusion of vaccination in dairy cattle in the undergraduate curriculum was perceived to be limited.

*I think I wasn't that confident to begin with when you're vaccinating. Like you learn f*** all about vaccination don't you at uni? …And they tell you all about these diseases and what type of virus they are and what their incubation period is and then you come out to the big wide world and there's all these drug companies that are trying to sell you things and you don't really know whether you should be using them or not. (Vet 1)*

The confidence to discuss vaccines with farmers seemed to be linked to how informed the vet felt.

But certainly I don't feel confident enough pressing too hard [for farmers to vaccinate], because if I start getting questioned too much I can't answer, then the whole argument falls apart, even though I can say why it is beneficial. (Vet 8)

<u>Outside influences on veterinary vaccination advice</u>

Outside influences on cattle vaccination were perceived by participants to have both beneficial and detrimental effects. Vets saw pharmaceutical

sales representatives as useful sources of information. This was contrasted with the perceived detrimental influence of outside sources of information that farmers may consult.

> *Well it makes it a bit more complicated with us sometimes if there is a breakdown because obviously you don't automatically go, 'Oh you should be vaccinating for that', and if the farmers then turn around and say, 'Well I am', you know, you've got no record of that or no sort of way of working round. So I think it would be more useful if it was coming through us and then it might be that they'd be more likely to come to us for advice about it rather than just going to the ag merchants and just buying a vaccine and, you know, going on that, that that would be a miracle cure. (Vet 12)*

National and other disease control initiatives, such as for BVD (Scottish Government, 2015), seemed to focus the vets' efforts and support the vets' advice to vaccinate. Initiatives such as these were perceived as encouragement for farmers to consider vaccination and disease control. The government's influence was not perceived to be directly related to the participants' decision-making process for cattle vaccination; however, government input was acknowledged to be important for a national control scheme.

2. Vet-farmer relationship

The relationship and communication between the vet and their farm clients was an important theme when discussing advice and implementation of vaccines. More specifically, this relationship defined

how conversations around vaccination started and also helped define the role vets perceived they had on farm.

> *The way it was explained to me… is that unless the farmer perceives the vet to be credible, in other words unless the farmer believes that the vet can do the job and knows what he's talking about and is honest, he won't listen to your advice anyway. So all the herd health planning, all the sort of meetings and everything you can have, it's worth nothing if the famer doesn't actually believe that what you're talking about is correct. (Vet 15)*

Role of the vet

When asked about who usually initiated discussions about vaccination many of the vets claimed it was themselves. Often vaccination was discussed in response to the diagnosis of a problem on farm. The route to the diagnosis varied but there was a consensus that in order to convince clients to vaccinate there needed to be evidence of a problem.

> *If we've picked something up, generally most of our farmers are quite receptive to our suggestions. (Vet 3)*

The type of veterinary practice that the participants worked in appeared to have an influence on the relationship vets described with their farmers. Some of the participants perceived that their farmers used their practice because of the 'hands off' nature of the practice. These were the farmers that were perceived to be 'stuck in their ways' and the more proactive farmers were more likely to use a specialist farm animal practice.

… most of the farmers who aren't with [practice] and are with us because, generally, they want to be left alone and [practice] are very much into their preventative and always been on the farm, and I think their pricing, rather than paying for a visit and what have you, they're so much per month, and it's involving all these things. And a lot of the farmers we have are old-fashioned and traditional and the last thing they want is someone interfering. (Vet 8)

The amount of time that vets could allocate to being on farm was raised as an issue by the participants. Time for discussion and getting on farm was perceived to be a positive factor in encouraging farmers to vaccinate. However, a lack of available veterinary time was seen as a barrier to initiating on-farm discussions.

It's just it's difficult being in a mixed practice when you've got to consult in the morning, do ops, consult in the afternoon, and here especially our main like financial input is from the small animals. So it's really difficult to find time all together or even individually to sit down and actually try and push the farm side… (Vet 11)

If the farmer only called their vet for 'fire-fighting', or was not perceived to be able to afford regular routine fertility visits then communication seemed to be more difficult. In those situations vets perceived their clients had no interest in or time for communication beyond the task in hand.

[Discussion about vaccination] doesn't really happen. I mean because I'm not TB testing yet, that's our main sort of way of getting onto the farms. So you know, when you're going out to see sort of sick cows and stuff, you are just treating. You don't particularly have too much time for chatting about other things. (Vet 12)

Type of farmer

Vets tended to group farmers based on their perception of their clients' attitudes and characteristics. The participants appeared to place their clients in one of three categories. Firstly is the farmer who is perceived to be proactive, engaged and in some cases thought to be one step ahead of the vets. These farmers were often already vaccinating against BVD, IBR and leptospirosis.

I mean there is a range of farmers and a range of clients right through to, you know, exceptional proactive farmers who are just awesome. Just I'm in awe of. I mean I've got a couple of guys who they just think, 'What's the next thing I can improve? What's the next thing we're going to sort out?', and stuff. (Vet 10)

Most farmers were thought to belong to the second group, where farmers were perceived to be receptive to advice and change. However, this group generally required a level of prompting from the vet to motivate them to vaccinate their cattle and required ongoing reminders and encouragement. Vets felt they needed evidence to convince these farmers

to change. Nevertheless, once they had taken on board the advice they would not need further encouragement.

> *But I think on the whole most of them – you know if we actually test them and they've got a result there saying that, "You've got an issue with this" and if they've got the clinical picture that fits it as well on the farm, then they would be quite receptive to suggesting vaccine. (Vet 3)*

The third group of farmers had almost been given up on by participants. These farmers were perceived to be reluctant to change and disengaged with the vet.

> *Now that may be different for another practice's farmers. I find that our farmers are… old school is the wrong phrase but they are… as I say, it's not so much reactive as inactive. (Vet 6)*

In summary, vets were motivated to advise vaccination to their clients and perceived few barriers to doing so. There were, however, concerns around the consequences of not advising vaccination which resulted in a risk averse approach by some participants. Vets described different 'types' of farmer and different vet-farmer relationships. This impacted on communication styles adopted, and, eventually could impact on farm vaccination practice.

Discussion

Literature searching suggests that this study is the first of its kind in investigating vets' attitudes towards dairy cattle vaccination.

The decision-making regarding vaccination appeared to be similar across the participants. This appears contradictory to findings by Cresswell and others (2013) who recorded that vets, when presented with the same hypothetical scenario, showed considerable variability in the advice prescribed. Cresswell and others (2013) suggested this variability was partly the result of a lack of evidence-based information and that decision-making was largely influenced by experience, training and other sources, which differed between vets. However, since the participants in the current study were not given a specific scenario to advise on, it is not possible to directly compare results. Nonetheless, participants appeared to be united in a motivation to advise vaccine implementation where they perceived a need.

The variability in advice from farm to farm may reflect the diverse population of dairy farms present in Britain, with different farmer attitudes to risk and disease control and different prevalences of disease within and between herds. Variation in clinical veterinary opinions for disease interventions has been found previously, highlighting concerns surrounding the profession's ability to provide a united approach to disease control (Higgins and others, 2014). It could be hypothesised that without a clearly communicated aim for disease control that is supported across the veterinary profession and dairy industry, there cannot be a united approach.

The risk averse stance (vaccination just in case) that participants took towards vaccination seemed to be related to the participants' concern over the consequences of not advising vaccination. This approach may potentially result in the over-prescription of vaccines on dairy farms. There is evidence of a similar risk averse approach in other areas of the profession, for example to the use of perioperative antibiotics in companion animal surgery, where 80% vets surveyed agreed that 'If I am not sure if antibiotic prophylaxis is needed, I tend to give it' (Knights and others, 2012). Unlike in humans, many of the cattle diseases we vaccinate for are endemic in Britain. Therefore the risks of disease could be said to outweigh the risks of potential adverse effects of vaccination. However, the over-prescribing of vaccines adds to farm expenditure in an already challenging agricultural financial climate. There is currently no evidence that over-use of vaccination in cattle is detrimental to the health of cattle or to people consuming food animal derived produce, to the extent of that of antimicrobial resistance. Further information on suspected lack of efficacy and adverse events relating to cattle vaccines can be found in the Veterinary Medicines: Pharmacovigilance Annual Review 2014 (Veterinary Medicines Directorate, 2016).

Results showing the need for evidence prior to advising vaccination is in agreement with previous findings by Cresswell and others (2013). However the risk averse attitude of vets in advising vaccination was not something described in Creswell's study. Our findings suggest that vets are stuck between two mind-sets. On the one hand, vets feel the need to

justify their advice with the use of evidence of disease whilst ensuring a cost-effective strategy. On the other hand, vets are worried about the consequences of not advising, or advising against, the use of a vaccine. This contradiction is possibly partly a conflict between wanting to do what is best for their client and fear of the consequences if the advice does not lead to better production and animal welfare. This situation may also be propagated by the lack of national policy or a cohesive industry aim for the use of vaccination.

Describing the reasoning behind their advice and including the farmer and their goals in those decisions, may help vets reduce the anxiety surrounding the consequences of not recommending a farmer to vaccinate. Research has shown farmer personalities differ widely and different approaches may be needed for different communication efforts (Jansen and others, 2010a, b). It is possible that some farmers will prefer to be given explicit instructions and will follow their vet's advice regardless of the reasoning and evidence base. Results from a concurrent study conducted with dairy farmers revealed that the advice of vets is trusted. Farmers are reportedly inclined to vaccinate if their vet recommends that they do so, though there are other factors contributing to their decision-making and not all farmers will choose to vaccinate, or continue vaccinating (Richens and others, 2015). Although both farmer and vet require evidence of a disease on a farm, or risk of disease entering a farm prior to implementing a vaccination strategy (Richens and others, 2015), the perception of the vets in the current study was that

farmers' awareness of these issues was low. This suggests that the risk perceptions of farmers and vets differ, or that their priorities for the farm differ. Similar findings have been described by a study by Shortall and others (unpublished observations) investigating barriers to biosecurity on dairy farms. Therefore effective communication between vets and farmers, and a trusting relationship is vital when discussing vaccination and other disease control tools.

Cost-effectiveness was a recurring theme; however, how cost-effectiveness decisions were made was unclear. This suggests that improved data on farmers' costs and savings through controlling or eradicating disease would provide vets with better evidence to advise farmers. It appears that cost was more of a concern to vets than has been found with farmers (Cresswell and others, 2014, Richens and others, 2015). This may be linked to the vets' need to justify any vaccination advice with as much evidence as possible. Farmers generally perceive that if vaccination is recommended, it is needed, and do not require further justification. This is not unexpected as the financial cost of vaccines is a minor factor in farm expenditure, considering other more significant costs such as cattle feed. Despite this, and especially with current milk prices, there have been concerns raised by the veterinary profession that dairy farmers are stopping vaccines in order to save money (Farmers Weekly, 2016).

When exploring where practitioners felt their knowledge about vaccination originated from, many cited experience in practice and that education surrounding cattle vaccination at university was sparse. However, farmers may ask about vaccination protocols when new graduates are on farms, particularly following disease testing or during an emerging disease outbreak. It therefore follows that decision-making around vaccination and disease control on farms should be emphasised in the undergraduate veterinary curriculum. Cresswell and others (2013) showed that there was a difference in vaccination advice given by vets in practice versus final year students. This difference could be attributed to a lack of knowledge of cattle vaccination and the absence of clinical experience to determine the advice and information relevant to a particular farm. It appears that vaccination in companion animal practice is perceived to be somewhat easier, possibly due to the more prescribed nature of the vaccination schedules (Day and others, 2010). This would suggest that cattle vaccination in the undergraduate curriculum needs to include how to assess a farm's disease status and biosecurity risks- finding the evidence to advise vaccination and practically and effectively communicating the recommended protocol. When considering that vets in practice appeared to receive much of their information about vaccines from pharmaceutical representatives, it is possible that some of the knowledge gained may be subject to bias, something that could be potentially avoided in a university setting.

Themes similar to those discussed in this paper have been highlighted as challenges facing the farm animal veterinary profession previously. Lowe (2009) discussed veterinary education, the value and price of veterinary services, and the demand for and access to veterinary services, in his assessment of the farm animal veterinary profession. Since the publication of the Lowe Report (2009) there do still remain challenges in the communication and provision of preventive medicine services (Ruston and others, 2016). Nevertheless, there does appear to be a move towards advisory roles and a change in how veterinary businesses are run. As found in the current study, the vet-farmer relationship is vital in this era of change and there is still an important role for the veterinary profession in the farming future (Statham and Green, 2015).

It was the aim of this study to investigate a broad range of opinions using a method that allowed the collection of rich and detailed data. Due to the nature of purposive recruitment and semi-structured interviews the authors acknowledge that there may have been an element of self-selection of, and response 'bias' from, participants. At the start of each interview each participant was asked to respond to the questions using experience from their dairy clients and considering dairy cattle as much as possible. It was considered inevitable however, that participants' experiences and responses could not be entirely in isolation unless they solely worked, and had only ever worked in dairy practice. It could be argued that this is a more realistic situation; decision-making is rarely undertaken in isolation without the influence of previous experience and

knowledge. Although interviews were carried out until saturation point (Mason, 2010) was reached, the aim was not to produce results representative for the whole British veterinary population but to explore in-depth farm animals vets' motivators and barriers to the implementation of vaccination strategies on British dairy farms. Therefore caution must be used when applying the findings to the veterinary profession as a whole.

In conclusion, a trusting relationship and effective communication between vet and farmer is crucial in order to optimise vaccination strategies on British dairy farms. This study would suggest that those charged with uniting the veterinary profession around vaccination strategies are faced with a number of pressing issues. These include the risk perceptions of vets and farmers and the need for further information on disease prevalence. Most crucially, perhaps, is the need to support and build on the vet-farmer relationship, for example through provision of increased time and resources to enable vets to discuss disease prevention and control with clients.

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Patient consent

Written consent was obtained prior to face-to-face interviews and verbal consent was recorded prior to telephone interviews. All interviews were audio recorded.

Ethics approval

The study received ethical approval from the School of Veterinary Medicine and Science Ethics Committee, The University of Nottingham.

Competing interests

The authors declare there are no competing interests.

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