

VETS' DECISIONS ON ANTIBIOTIC DRY COW THERAPY

Understanding veterinarians' prescribing decisions on antibiotic dry cow therapy

H. M. Higgins^{*1}, S. E. Golding[†], J. Mouncey[‡], I. Nanjiani[‡] and A. J. C. Cook[§]

^{*}Institute of Veterinary Science, University of Liverpool, Cheshire, CH64 7TE, United Kingdom.

[†] School of Psychology, University of Surrey, Guildford, Surrey, GU2 7XH, United Kingdom.

[‡] Westpoint Veterinary Group, Dawes Farm, Warnham, West Sussex, RH12 3SH, United Kingdom.

[§]School of Veterinary Medicine, University of Surrey, Guildford, Surrey, GU2 7TE, United Kingdom.

1 Corresponding author: Dr Helen Mary Higgins. Institute of Veterinary Science, University of Liverpool, Leahurst Campus, Chester High Road, Neston, Cheshire, CH64 7TE, United Kingdom. h.higgins@liverpool.ac.uk. +44 (0) 7833 597 029 ; +44 (0) 151 795 6368

INTERPRETATIVE SUMMARY

We identified 3 themes that together captured how veterinarians' justified disparities between their personal preferences, involvement in decision-making and prescribing behaviors. They were: prioritizing responsible antimicrobial prescribing; the impact of a veterinarian's experience on their ability to influence farmers; veterinarians' perceptions about the risk and complexity of implementing selective dry cow therapy. A fourth theme captured veterinarians' suggestions for facilitating selective dry cow therapy. Our findings can be used to inform future initiatives and interventions aimed at changing clinical practice and reducing antibiotic use. The results are expected to be of interest to a wide range of stakeholders including governments, retailers and pharmaceutical companies.

ABSTRACT

In the UK, blanket antibiotic dry cow therapy (BDCT) is commonly prescribed. An alternate strategy is selective dry cow therapy (SDCT) whereby a teat sealant is given instead of an antibiotic to cows with a low probability of infection. Switching from BDCT to SDCT can significantly reduce antibiotic use. The aims of this study were to explore how veterinarians (vets) rationalised their prescribing decisions for mammary treatments at drying off, and the barriers and motivators they perceived to implementing SDCT. Face-to-face interviews were conducted with 20 purposively recruited vets from 6 practices in England, UK. The data were analysed qualitatively using an inductive thematic analysis. The majority of participants stated a personal preference for SDCT because it constitutes more responsible antibiotic use. On the majority of farms, the prescribing decision was taken by a senior veterinarian and BDCT was prescribed. Less experienced vets expressed a desire to be more involved in the decision-making process. The first theme, *prioritizing responsible antimicrobial prescribing*, encapsulated the difficulties vets expressed engaging with farmers, conflicts of interest and vets' determination to take action. The second theme, *the impact of a vet's experience on their ability to influence farmers* focused on the specific challenges faced by less experienced vets and the importance of vets being both trusted by farmers and being knowledgeable. The third theme, *vets' perceptions about the risk and complexity of implementing SDCT* revealed markedly different levels of concern and fears about adverse outcomes with teat sealants versus antibiotics. There were also differences in perceptions about how difficult SDCT is to implement in practice. The last theme, *vets' suggestions for facilitating the introduction of SDCT*, was wide ranging and provided useful insight from a veterinary perspective into ways to facilitate SDCT. Initiatives that seek to alter vets' perceptions of the risks associated with switching to using SDCT are likely to prove useful in facilitating change. Our results also suggest that it is vital for senior vets to take a leading role in facilitating farms to implement

SDCT. Less experienced colleagues may benefit from more help from senior vets in order to gain the trust of farmers and to become more involved, more quickly, in herd-level preventive medicine. Vets must work together and take a united approach to reduce antimicrobial use.

KEY WORDS: Antimicrobial resistance, facilitating behavior change, trust and risk perception, prescribing decision

INTRODUCTION

A commonly employed strategy to aid mastitis control in the UK is the infusion of an intra-mammary antibiotic in all quarters of all cows at the point of drying off (Biggs et al., 2016). This approach is often referred to as blanket antibiotic dry cow therapy (**BDCT**). The aim of BDCT is to cure any pre-existing intra-mammary infections (**IMI**) and to prevent the acquisition of new IMI over the dry period.

An alternative strategy is selective dry cow therapy (**SDCT**) whereby a judgment on the probability of an existing IMI is made for each individual cow. This probability is based on the clinical history, somatic cell count and mastitis records. Treatment is informed by this probability, such that cows with a low probability of an IMI do not receive antibiotics. Instead, these cows are commonly prescribed an internal teat sealant (**ITS**) to prevent new IMI occurring. Cows with a high probability of IMI receive antibiotics either alone, or in combination with an ITS.

A major advantage of SDCT is that it uses fewer antibiotics and hence constitutes more responsible antimicrobial prescribing. Antibiotic use is an accepted driver of antimicrobial resistance (**AMR**) and global concern over AMR is escalating, with human deaths worldwide from AMR predicted to rise from 700,000 to 10 million per year by 2050 if action is not taken to address the problem (O'Neill, 2014). Many scientists believe that that unnecessary and inappropriate use of antibiotics in animals contributes to the problem of AMR in both humans

and animals (O'Neill, 2016). There is therefore an increased need for veterinarians (vets) to robustly justify their antibiotic prescribing decisions. Thus, while it has not been proven that using SDCT instead of BDCT reduces AMR, nonetheless, SDCT constitutes a more appropriate approach. Some milk buyers now expect SDCT and some countries, such as The Netherlands, have banned BDCT (Ministry of Economic Affairs, 2014). These actions reflect the growing global concern.

The literature suggests that numerous clinical and non-clinical factors may influence veterinary antibiotic prescribing decisions in general (De Briyne et al., 2013, Gibbons et al., 2013, Mateus et al., 2014). Clinical factors that influenced prescribing decisions included diagnostic test results and clinical signs, knowledge of pathogens and antimicrobial spectrum of activity, and ease of drug administration (De Briyne et al., 2013, Mateus et al., 2014). Antibiotic prescribing choices were also influenced, however, by non-clinical factors such as economics, time, and relationships. Vets were more likely to prescribe if they felt the farmer expected them to prescribe antimicrobials, or if they wanted to avoid being called back again (Gibbons et al., 2013). Prescribing decisions were also influenced by previous treatment decisions of colleagues, perceptions of the client's willingness or ability to pay for treatment, length of consultation, and beliefs about how compliant the client would be in administering the treatment plan (Mateus et al., 2014). The study by Mateus et al. (2014) was in the context of small animal practice and while it is generically informative, it is not possible to relate the findings directly to the dairy industry and BDCT. The studies by De Briyne et al. (2013) and Gibbons et al. (2013) were in the context of cattle practice but they explored clinicians approaches to prescribing in general rather than in a specific clinical scenario. To our knowledge, therefore, there are a lack of studies investigating the prescribing decisions of vets in the specific context of dry cow therapy. We hypothesize that the prescribing context will have a major influence on the importance of the different factors. This is because, for example,

if vets have previously heavily advocated antibiotics for a given clinical condition then farmer expectations and demands for antibiotics may be markedly different to a clinical condition where antibiotics have not previously been encouraged. Another example of the importance of the specific prescribing context is withdrawal periods. Withdrawal periods are not relevant in companion animal practice but they are often an important factor influencing the choice of drug in production animals.

The aims of this study, therefore, were to explore how vets rationalize their prescribing decisions for mammary treatments at drying off in dairy cattle and to identify the barriers and motivators that vets perceive to implementing SDCT. Furthering our understanding on these issues will help to reduce the use of antibiotics by informing future initiatives and interventions that will be effective at changing clinical practice.

MATERIALS AND METHODS

Data Collection

Purposive sampling was used to recruit 20 vets with a wide range of clinical large animal experience from 6 practices in the South of England. The inclusion criterion was vets providing healthcare to dairy cattle during their normal working hours. Voluntary signed consent was obtained from each participant.

The sample size and sampling strategy was typical of this type of qualitative research study, which allows for identification and understanding of key concepts through flexible, in-depth discussion with participants. Qualitative research necessarily requires a smaller dataset than, for example, a questionnaire study, to enable deeper exploration of the issues, and is not designed for drawing inferences that are representative of a wider population (unlike

probability-based sampling). Rather, it is especially useful for generating new insight and allows for social and psychological interpretation of data (Braun and Clarke, 2006).

Individual face-to-face interviews lasting 20-45 minutes were conducted by HMH between 1 December 2014 and 31 January 2015, at the participants' workplaces. A semi-structured qualitative interview schedule was used (see Appendix). The interviewer ensured that all questions on the interview schedule were addressed, but allowed the discussions to be flexible according to the direction of conversation.

The schedule covered the following main areas: personal preferences for prescribing, reasons for any differences between their actual prescribing decisions and their preferences, and exploring perceptions about barriers and motivators to SDCT. Participants were encouraged to talk broadly about any aspect of the subject. Demographic information about the vets and their current involvement in prescribing mammary treatments at drying off were also gathered.

Data Analysis

Interviews were transcribed verbatim and analyzed using NVivo software (QSR International, version 10) by HMH and SEG. An inductive thematic analysis was conducted across the entire dataset, following the 6 phases described by (Braun and Clarke, 2006). The initial analysis (phases 1 and 2) resulted in 93 codes. These were sorted into 6 potential themes, at which stage several codes were merged or discarded (phase 3). Refinement of the candidate themes at the level of the coded data extracts and the entire dataset (phase 4) resulted in 4 themes. These were then further refined and defined (phase 5), and together they summarized the key features of the dataset. Throughout this process, repeated reference was made back to the transcripts to check the strength of evidence.

RESULTS

Demographics

There were 13 males (65%) and 7 females (45%). Mean number of years qualified was 7, with a range of 4 months to 25 years. Position within the practice was: 7 senior vets (100% male); 7 assistants (4 males; 57%); 6 new graduates, i.e. within their first year post qualifying (2 males; 33%). The majority (18 / 20) worked full-time. There were 3 vets who held postgraduate qualifications specializing in cattle.

Current Prescribing Involvement, Decisions and Preferences

Vets' were asked for the number of farms for which they were personally involved with deciding which mammary treatments cows receive at drying off. Table 1 presents a contingency table for this number distributed by the categorical variables "position within practice" and "prescribing strategy" i.e. what they were actually currently prescribing on their farms. Senior vets were making the decision on more farms than either new graduates or assistants and most commonly prescribed BDCT.

The majority of participants stated a personal preference for SDCT, usually on the grounds of responsible antimicrobial prescribing. For senior vets, this personal preference often differed from their actual prescribing decisions on the farm. Less experienced vets expressed a desire to be more involved in the decision-making process.

Table 1. The numbers of farms for which vets were personally involved with deciding what intra-mammary treatments cows receive at dry-off

Position	Prescribing strategy		Total number of farms
	BDCT (%) ¹	SDCT (%) ¹	
Senior vets (n=7)	55 (71)	22 (29)	77
Assistant vets (n=7)	5 (83)	1 (17)	6
New graduates (n=6)	0 (0)	0 (0)	0
Total number of farms	60 (72)	23 (28)	83

¹Row percentages

Themes

In total, 4 themes emerged from the analysis. (1) prioritizing responsible antimicrobial prescribing (2) the impact of a vet's experience on their ability to influence farmers (3) vets' perceptions about the risk and complexity of implementing SDCT (4) vets' suggestions for facilitating the introduction of SDCT. Please note, in the quotations below we have anonymized the text where necessary.

Theme 1. Prioritizing Responsible Antimicrobial Prescribing

Many participants described difficulties engaging with farmers who do not perceive the need to change:

It's all very well fighting fires when they crop up...the farm wants to know what you do about it. But if you are just trundling along, there isn't a perceived problem, then it's more difficult, isn't it? You need to find a way in. And I, personally, have found that difficult.

Furthermore, perceptions about the success of dry cow therapy were often limited to the context of the individual farm, and consideration of the wider context of AMR was lacking:

If they [farmers] know that's how they do it and there's been no problems with it, then why change to anything where potentially you could be risking their health and mastitis levels in their herd? Why change something if it's not broken?

Thus, the global issue of AMR was sometimes not perceived as important enough to drive through changes in current practice. This was recognized as applying to both vets and farmers:

And to be fair, that's not just the farmer mind-set, there's very much a vet mind-set as well. If there are things that aren't causing an issue, it can be difficult to prioritize them as things that need to change. But obviously, I think the antibiotic argument is worth fighting over.

Prioritizing responsible antimicrobial prescribing was considered difficult by one participant due to conflicts of interest and concern over upsetting clients:

They [farmers] are paying for our services, and our business does depend on them. If they say, 'I'm staying on blanket,' I wouldn't say, 'I'm not going to prescribe your tubes.' So they [farmers] do have an influence on it. And more so than external pressure.

On this issue, another participant acknowledged that the motivation and determination of vets was also important:

We prescribe the medication, don't we, and you could play hardball and say, "Right, I'm not going to prescribe it this way.". I refuse fluoroquinolones and I guess that works because you're quite firm about it and there's often just as good or an even better choice than fluoroquinolones. You could argue that with the dry cow treatments. So maybe my attitude is

another factor as well. I'm sure if I wanted it to happen - strongly wanted it to happen - then you could make it so.

Theme 2. The Impact of a Vet's Experience on Their Ability to Influence Farmers

Unlike the senior vets, who were already fully involved in dry cow prescribing, participants who were assistants expressed a desire to become more involved with the decision-making process on farms. However, they had trouble with this:

The thing is [vet X] - don't tell him I said this - but he's a very good vet and people like having him. And it can be quite difficult as an assistant getting your foot in through the door permanently...hopefully one day that will change

The importance of the trust that senior vets held was clear:

But clients really trust them [senior vets]. And so decisions are often better communicated down through them.

For some assistants, a hurdle to implementing SDCT related to a lack of knowledge and confidence in their own abilities and knowledge, especially where this contravened current local practice:

Maybe it's knowledge, on my part, stopping me [discussing SDCT with farmers], you know, how to best implement it. Like nobody in this practice, I don't think has done it. So getting that going...putting your foot out there, so to speak.

I guess from experience of rejection of my suggestions. But then also I feel like sometimes I don't give myself a chance. I'm self-deprecating...So confidence, yes, can play a part

Further complicating matters for the less experienced participants was the issue of charging for their advice:

How do you charge for that time when you are not confident in what you are doing, especially if it's not what everybody else is doing?

While some assistants described having regular opportunities to discuss clinical cases, this was not always the case, and this was mooted as a barrier to them transitioning to a position of trust in the eyes of their clients:

What inhibits us from making that change [to more involvement in herd health management] is the opportunity to discuss clinical stuff with senior colleagues. So mentorships, clinical discussions really lack in this practice

The importance of being knowledgeable, confident, experienced and trusted all at the same time was expressed:

And the thing that worries me is that by the time I'm in that position where I've built the relationships [with farmers] and I've got the experience, my knowledge will be out of date and I'll be like, oh damn it! If only I'd been able to put things in place when I first started...

Theme 3. Vets' perceptions about the risk and complexity of SDCT

Many participants expressed concerns over the risks of adverse outcomes with SDCT, either due to iatrogenic infections when using ITS alone, or due to misclassifying infected cows and hence failing to treat them. They often used vivid language:

And I suppose fear of it causing a disaster on the farm is maybe one of the limitations in why it's not brought up [in discussion]. In that, I think cows will die.

Some participants recalled damage to the reputation of ITS due to a spate of deaths when ITS was first launched, and this was something that still influenced participants' thoughts about the use of ITS:

Some people were putting this thing [ITS] in a bucket of water to try and heat them up so they were easy to administer...and you'd get outbreaks of dead cows...certainly those were always playing at the back of your mind.

Memories of iatrogenic infections were also commonly raised as a hurdle to overcome:

But we're just up against those anecdotal stories of, "Ah well, we tried it [ITS] on its own and now that cow's dead." And if it happens once it's trying to get the trust back to do it. Really tricky, but probably the way forward, isn't it?

If severe adverse reactions have occurred with ITS in the past on a farm, communicating to a farmer that it is their technique that needs to change was perceived as problematic:

It's trying to get that understanding with the client that it's not the ITS that's done it, it's you. So actually your cows are dead and it's your fault.

In contrast to this, other participants had only positive things to say about ITS, for example:

It [ITS] is the only pharmaceutical product that I've ever been really excited about. The difference I think it's made is extraordinary. People don't know what it used to be like [before ITS].

In this context, the point was also raised that using antibiotics instead of ITS can also cause problems:

But you can still kill cows with antibiotics.

A reason that was commonly given for not prescribing SDCT was a lack of reliable data, making it difficult to identify uninfected cows. Furthermore, the farmer's ability to reliably administer ITS and perceptions about how complicated SDCT is to implement were often raised by participants as key factors in their decisions over whether to discuss and implement SDCT with clients:

Some I'm struggling to engage with them to do a proper dry-off technique. I wouldn't trust them to do it, and do it properly.

I prefer the blanket dry cow therapy approach. It's simple and farmers don't make mistakes. Simplicity works, I find, on the farms.

In contrast, other participants were more positive about farmers' abilities to implement SDCT:

Once you've got the processes in place and you've got a herdsman with more than three neurons between his ears – and they do exist – then it's not hard to make them tick. And they can do it for themselves; they don't need handholding.

Theme 4. Vets' Suggestions for Facilitating the Introduction of SDCT

Several suggestions were raised by participants for promoting the uptake of SDCT. The need for a widespread commitment to SDCT by all vets was raised several times:

I think a united approach from vets is where it has to come. And helping the farmers to make that decision as well. So it's, I suppose, joint decision-making with them.

I think if we were all going to say, yes, let's deal with this, if it was a team effort then you wouldn't feel like you are going out there against the crowd, so to speak.

In addition, a need for increased discussion of SDCT by vets with farmers was raised. Participants felt that placing more emphasis on the benefits of not using antibiotics, such as the reduced risk of residue failures, may be helpful. Some participants described discussing SDCT as part of a herd health planning approach, which they viewed very positively. In this respect, some participants acknowledged that they themselves could be taking more action, for example:

It's really easy to blame the farmers and blame the cows and everything, but actually I think a lot of it starts at home. Make sure it's part of the herd health planning process, and that it's at least been discussed with clients. I can't guarantee, though, on our 25 dairies it's been discussed.

Conducting a trial of SDCT on a small number of cows within a herd, with careful monitoring, was also proposed as a way to reduce the initial risk, build trust, and prove safety and efficacy in the specific farm context:

Sometimes more than anything it's actually seeing is believing. So saying let's experiment and do our own little trial on the farm to get them to see it that way. Rather than going in all guns blazing...Slowly and surely wean them off it.

Several participants mentioned the value of farmer workshops and commented that if farmers hear that it has worked on other farms this can be very motivating:

If the neighbor's done it and it's worked for them, I think that's a very powerful form of proof for a farmer. Hearsay is quite powerful.

There were also proposals relating to external pressures, although this was usually viewed as being a last resort:

The ultimate one is going to be legislation, but I'd prefer it if it didn't get to that stage. I prefer to use the carrot rather than the stick.

Nonetheless, it was also acknowledged that external pressures can be highly influential:

Blanket dry cow therapy should really be regarded as yesterday's medicine...But it won't happen until we are obliged to do so by external forces rather than science.

Another comment in this context was:

Sometimes I think leaving medicines on farms isn't a good thing in that respect [responsible antimicrobial use]. Maybe we should go and administer dry cow therapy, make the decisions and administer the drugs ourselves. I don't know...

Other suggestions proposed by participants were: clinical guidelines for implementation and standard operating procedures; cost-benefit analysis tools, availability of affordable diagnostics (especially a rapid cow-side test for more accurately identifying uninfected cows); economic incentives; scare stories about antibiotic use creating resistance issues on farms; industry-led initiatives, especially if timed to coincide with a veterinary-led initiative.

DISCUSSION

In keeping with the existing literature (De Briyne et al., 2013, Gibbons et al., 2013, Mateus et al., 2014), it is evident from our results that, for vets, the clinical decision to implement (or attempt to implement) SDCT is complex and farm-dependent, involving numerous factors. A key finding from our study is that the issues appear different for vets at different stages of their career.

New graduates (within 1 year of qualifying) are, understandably, primarily concerned with consolidating basic clinical skills and herd management decisions, such as implementing SDCT, are therefore not their priority. In contrast, assistants showed a real enthusiasm for being involved with decisions about dry cow therapy. Assistants felt, however, that they were struggling to gain the trust of the farmer. Numerous studies have reported that vets are farmers' most trusted advisors (Jansen et al., 2010, Fisher, 2013), but it is widely acknowledged that trust is difficult to win and easily lost (Kasperson et al., 1992, Klostermann et al., 2005). Furthermore, the trustworthiness of an information source is key in clinical decision-making (Marshall et al., 2013). Gaining and retaining trust in a human medical setting has been shown to be dependent on a variety of factors, including the physician's communication style, and the patient's perceptions of the consultation itself (Hall et al., 2001, Croker et al., 2013). In contrast to human medicine, however, there appears to be a paucity of literature attempting to understand how vets in their early careers can best gain the trust of farmers. Thus, while in human medicine it may be that communication styles and patient's perceptions of the consultation are important, it remains to be ascertained if these factors play a role, and if so to what extent, in a veterinary setting. In the specific context of SDCT, it is arguably especially important for vets to have the trust of the farmer, due to historical severe adverse reactions to ITS and a pervading distrust amongst some farmers about the safety of ITS. We propose that

senior vets will need to play a major role in helping less experienced colleagues gain the trust of farmers. This is likely to take a proactive effort on their behalf to both seize and generate opportunities for assistants to shine. It will also require acquiescence between vets; nobody wants to be out-shone, especially when senior vets have worked hard themselves to gain the farmer's trust. Assistants may also lack knowledge and confidence in their abilities, which makes it especially difficult for them to implement changes in clinical practice when vets that are more senior are not actively promoting SDCT themselves. It should also be acknowledged that for some countries outside the UK, the structure of veterinary practice and the delivery of veterinary services may be very different, and hence not all our findings will be generalizable. Furthermore, the dairy industries across the world vary considerably with respect to many factors; not least herd size and access to veterinary medicines and laboratory testing. Hence, our findings may not be transferable to all contexts.

Senior vets were primarily involved with the prescribing decision on SDCT, but their decisions on the farm often differed to their personal preferences. Their responses in our study suggest that they may keep prescribing BDCT as a way of managing risk and uncertainty; to protect themselves, their relationship with the farmer, and the animals against possible negative outcomes. Over-treating patients as a way of managing clinical uncertainty and avoiding potential conflict with patients has also been highlighted in human medicine as a reason that doctors may prescribe against prescribing guidelines (Tonkin-Crine et al., 2011, Broom et al., 2014). Marked differences existed in senior vets' perceptions of both the risk and complexity of SDCT. To our knowledge, there is no data proving that adverse reactions when ITS was first launched reduced its use. However, fear over adverse reactions when using ITS alone featured highly in the thoughts of many participants, and our data supports the notion that memories of deaths when ITS was first launched played an important role in vets decisions over whether to attempt to introduce SDCT. Risk perception is known to drive behavior (Brewer et al., 2007,

Barcenilla-Wong et al., 2014) and changing veterinary perception of the risks associated with SDCT may well be fruitful. Unlike some other countries, in the UK, when prescribing mammary treatments at dry-off, the veterinarian delegates control over the administration of the treatment, while retaining responsibility for the outcome. This needs to be taken into account when understanding the prescribing decisions of UK vets. In some instances, risk perception appears to prevent clinicians from even having a discussion with farmers about the possibility of SDCT. However, in the light of escalating global concern over AMR (WHO, 2014, O'Neill, 2016) we argue that, as a bare minimum, SDCT should be discussed with all farmers and dry cow therapy choices reviewed on a regular basis. Given that all antibiotics are prescription-only medicines, it is ultimately the choice of the veterinarian whether or not to prescribe them. There is, however, a potential conflict of interest between prioritizing responsible antimicrobial prescribing and losing clients. This highlights the need for vets to work together and take a united approach (Tisdall et al., 2016) because if all vets strongly advocate SDCT, farmers will be unable to change to a different veterinary practice in order to continue with BDCT and hence the risk of losing a client is avoided. However, getting all vets to agree to promote SDCT may be problematic. There was one vet in this study who stated a personal preference for BDCT primarily because it is simpler to implement and mistakes are less likely to happen. Furthermore, while the remaining vets stated a personal preference for SDCT it is potentially possible that some may have given this answer because they thought this was the answer they should give, rather than it reflecting their true belief. There are several possible reasons why vets may not support SDCT, which might include, for example, ambivalence, disillusionment, disinterest and apathy.

Legislation was suggested by some of the participants in this study and it can be effective in reducing antibiotic use in the dairy industry as illustrated by the recent banning of BDCT by The Netherlands in 2013 which has reduced the use of dry cow antibiotics in this

country by approximately 28% (Lam et al., 2016). A disadvantage of legislation, however, is that it may evoke concerns among farmers and vets about increased levels of clinical and subclinical mastitis (Scherpenzeel et al., 2014) resulting in a lack of co-operation and enforcing legislation may be non-trivial. In fact, in The Netherlands there is evidence to suggest that udder health has not deteriorated since BDCT was banned (Santman-Berends et al.)

CONCLUSION

When considering how best to facilitate a change from BDCT to SDCT, we propose a multifaceted approach that clearly recognizes that the issues hampering this change are markedly different for vets at different stages of their career. Vets must work together to promote switching to SDCT where appropriate, and senior vets must lead.

ACKNOWLEDGEMENTS

Our thanks go to all the vets who participated in this study. This research was funded by the University of Surrey.

REFERENCES

Barcenilla-Wong, A. L., J. S. Chen, and L. M. March. 2014. Concern and Risk Perception: Effects on Osteoprotective Behaviour. *Journal of Osteoporosis* 2014:10.

Biggs, A., D. Barrett, A. Bradley, M. Green, K. Reyher, and R. Zadoks. 2016. Antibiotic dry cow therapy: where next? *Veterinary Record* 178(4):93-94.

Braun, V. and V. Clarke. 2006. Using thematic analysis in psychology. *Qualitative Research in Psychology* 3:77-101.

Brewer, N. T., G. B. Chapman, F. X. Gibbons, M. Gerrard, K. D. McCaul, and N. D. Weinstein. 2007. Meta-analysis of the relationship between risk perception and health behavior: The example of vaccination. *Health Psychology* 26(2):136-145.

Broom, A., J. Broom, and E. Kirby. 2014. Cultures of resistance? A Bourdieusian analysis of doctors' antibiotic prescribing. *Soc Sci Med* 110:81-88.

- Crocker, J. E., D. R. Swancutt, M. J. Roberts, G. A. Abel, M. Roland, and J. L. Campbell. 2013. Factors affecting patients' trust and confidence in GPs: evidence from the English national GP patient survey. *BMJ Open* 3(5).
- De Briyne, N., J. Atkinson, L. Pokludova, S. P. Borriello, and S. Price. 2013. Factors influencing antibiotic prescribing habits and use of sensitivity testing amongst veterinarians in Europe. *The Veterinary record* 173(19):475.
- Fisher, R. 2013. 'A gentleman's handshake': The role of social capital and trust in transforming information into usable knowledge. *Journal of Rural Studies* 31(13-22).
- Gibbons, J. F., F. Boland, J. F. Buckley, F. Butler, J. Egan, S. Fanning, B. K. Markey, and F. C. Leonard. 2013. Influences on antimicrobial prescribing behaviour of veterinary practitioners in cattle practice in Ireland. *The Veterinary record* 172(1):14.
- Hall, M. A., E. Dugan, B. Zheng, and A. K. Mishra. 2001. Trust in Physicians and Medical Institutions: What Is It, Can It Be Measured, and Does It Matter? *Milbank Quarterly* 79(4):613-639.
- Jansen, J., C. D. M. Steuten, R. J. Renes, N. Aarts, and T. Lam. 2010. Debunking the myth of the hard-to-reach farmer: Effective communication on udder health. *Journal of Dairy Science* 93(3):1296-1306.
- Kasperson, R. E., D. Golding, and S. Tuler. 1992. Social distrust as a factor in siting hazardous facilities and communicating risks. *Journal of Social Issues* (48):161-187.
- Klostermann, B. K., G. B. Slap, D. M. Nebrig, T. L. Tivorsak, and M. T. Britto. 2005. Earning trust and losing it: adolescents' views on trusting physicians. *Journal of Family Practice* 54(8):679-687.
- Lam, T. J. G. M., R. J. Wessels, and J. Jansen. 2016. RESET the mindset on antibiotic usage in dairy cows. Pages 80-82 in *Proc. Proceedings of the 29th Congress of the World Association for Buiatrics*, Dublin, Ireland.
- Marshall, A. P., S. H. West, and L. M. Aitken. 2013. Clinical credibility and trustworthiness are key characteristics used to identify colleagues from whom to seek information. *Journal of Clinical Nursing* 22(9-10):1424-1433.
- Mateus, A. L., D. C. Brodbelt, N. Barber, and K. D. Stark. 2014. Qualitative study of factors associated with antimicrobial usage in seven small animal veterinary practices in the UK. *Preventive veterinary medicine* 117(1):68-78.
- Ministry of Economic Affairs. 2014. Reduced and Responsible Use: Policy on the use of antibiotics in food-producing animals in the Netherlands. Ministry of Economic Affairs, Available at <https://www.government.nl/documents/leaflets/2014/02/28/reduced-and-responsible-use-of-antibiotics-in-food-producing-animals-in-the-netherlands> Accessed 16 September 2016.
- O'Neill, J. 2014. Antimicrobial Resistance: Tackling a crisis for the health and wealth of nations. HM Government and Wellcome Trust, Available at <http://amr->

review.org/sites/default/files/AMR%20Review%20Paper%20-%20Tackling%20a%20crisis%20for%20the%20health%20and%20wealth%20of%20nations_1.pdf Accessed 16 September 2016.

O'Neill, J. 2016. The Review on antimicrobial resistance: tackling drug-resistant infections globally. Final report and recommendations. . HM Government and Wellcome Trust, Available at http://amr-review.org/sites/default/files/160525_Final%20paper_with%20cover.pdf Accessed 16 September 2016.

Santman-Berends, I. M. G. A., J. M. Swinkels, T. J. G. M. Lam, J. Keurentjes, and G. van Schaik. Evaluation of udder health parameters and risk factors for clinical mastitis in Dutch dairy herds in the context of a restricted antimicrobial usage policy. *Journal of Dairy Science* 99(4):2930-2939.

Scherpenzeel, C. G. M., I. E. M. den Uijl, G. van Schaik, R. G. M. Olde Riekerink, J. M. Keurentjes, and T. J. G. M. Lam. 2014. Evaluation of the use of dry cow antibiotics in low somatic cell count cows. *Journal of Dairy Science* 97(6):3606-3614.

Tisdall, D. A., D. C. Barrett, and K. K. Reyher. 2016. Developing a multifaceted, collaborative, practice-wide approach to responsible medicines use on farms. Pages 123-124 in *Proceedings of the 29th Congress of the World Association For Buiatrics*, Dublin, Ireland 2016.

Tonkin-Crine, S., L. Yardley, and P. Little. 2011. Antibiotic prescribing for acute respiratory tract infections in primary care: a systematic review and meta-ethnography. *The Journal of antimicrobial chemotherapy* 66(10):2215-2223.

WHO. 2014. *Antimicrobial resistance: Global Report on Surveillance*. World Health Organization.