Exploring farmer attitudes towards the vaccination of cattle against bovine tuberculosis

Damian Maye, Charlotte-Anne Chivers, Gareth Enticott, Theo Lenormand, Sarah Tomlinson

1. Countryside and Community Research Institute, University of Gloucestershire
2. Cardiff University
3. Kingshay veterinary group

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Exploring farmer and stakeholder attitudes towards the vaccination of cattle against bovine tuberculosis

Damian Maye[1], Charlotte-Anne Chivers[1], Gareth Enticott[2], Theo Lenormand[1], Sarah Tomlinson[3], Holly Shearman[3]

[1] Countryside and Community Research Institute, University of Gloucestershire, Francis Close Hall campus, Swindon Road, Cheltenham, GL50 4AZ
[2] Cardiff University, Glamorgan Building, King Edward VII Avenue, Cardiff, CF10 3WA
[3] Kingshay veterinary group, Bridge farm, West Bradley, Glastonbury, Somerset, BA6 8LU

Final Report for Defra for the following research project:

'Social research project to understand farmer current/ future attitudes to cattle and badger TB vaccination in Britain'

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Contact persons for the report:

Professor Damian Maye (dmaye@glos.ac.uk) and Dr Charlotte-Anne Chivers (cchivers@glos.ac.uk)

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Aims and Objectives

This report assesses farmer attitudes towards a cattle bTB vaccine, and the potential influence of different behavioural incentives to promote vaccine use. To meet this aim and support Defra, Welsh Government and Scottish Government in their respective cattle vaccination strategies, the research has **three research objectives**, as follows:

1. To examine farmer attitudes, influences and decision-making processes to explore how attractive they find the potential future deployment of a cattle vaccine;
2. To identify risk factors and enablers that could influence and trigger change in farmer decision-making, including potential impacts that deployment of cattle vaccination might have on other bTB biosecurity behaviours; and
3. To assess how vaccinating cattle against bTB might impact the ease of cattle trading both within the UK (intra-trade) and internationally (export).

Methodology

Three hypothetical policy scenarios relevant to England and Wales were developed to examine attitudes to cattle vaccination amongst farmers and industry stakeholders. Each scenario reflected a different model of delivery: mandatory (state-led), individual farmer-led, and collective (via local vaccination companies). We conducted six workshops with cattle farmers in Bakewell, Frome, Louth, Whitchurch, Pembrokeshire and Ruthin, alongside 35 in-depth interviews with industry stakeholders, which included representation from England, Wales and Scotland. During the stakeholder interviews, we also gathered views on how a vaccination roll-out might affect trade. We used the EAST framework (making choices easy, attractive, social and timely) to analyse the findings, as we hypothesised that triggers which fit under these constructs would affect attitudes towards cattle vaccination.

Results

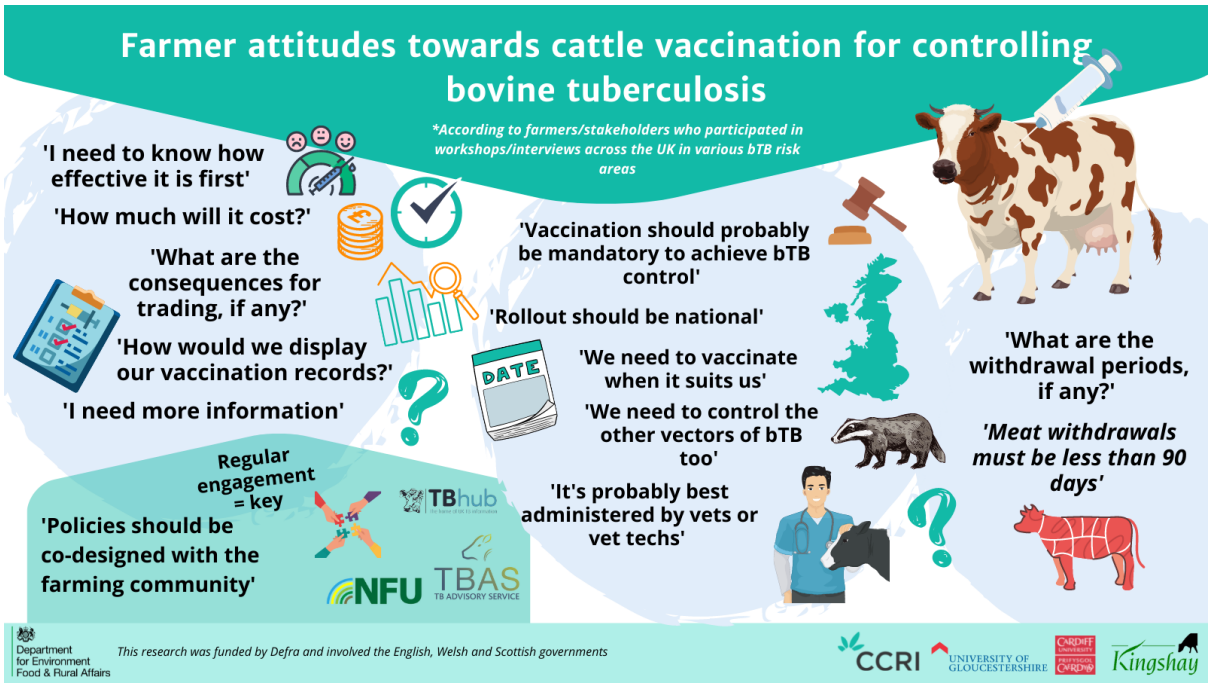
Farmers and agricultural stakeholders were, in principle, generally supportive of cattle vaccination, and supported an effective, trade barrier-free vaccine. Indeed, many interviewees reflected that cattle vaccination was seen as 'the holy grail' of bTB control but was always 'five years away from development'. There were discussions throughout the workshops and interviews relating to a need for clearer, continuous messaging surrounding policy and the evidence base surrounding cattle vaccination. It also appears that a vaccination rollout is likely to be successful once there is clear information surrounding the following:

- Vaccine efficacy;
- Consequences for existing trading relations;
- Vaccine costs (including any meat withdrawal);
- Flexibility in the timing of vaccination delivery; and
- Clear and accurate information on the vaccination status of livestock.

Involving farmers throughout the process of policy design is also important so that they are given the opportunity to raise concerns and practicality issues.

The most popular scenario under which vaccination of cattle could work according to both industry stakeholders and individual farmers was the mandatory scenario, though several adjustments were needed. Firstly, they believe that vaccination should be universal; if not immediately, there should be a gradual shift to a national roll-out in order to control bTB. Secondly, participants suggested that it would be unfair to expect farmers to pay towards any mandatory vaccination but expressed some willingness to pay towards a voluntary vaccination, though this could result in the vaccination of some [herds/animals] but not others.

The key findings from this research are summarised in the infographic below:



Policy implications

These results have the following policy implications to enhance the take-up of a cattle bTB vaccine:

1. Mandatory approaches to vaccination

There was significant support for mandatory vaccination amongst workshop participants and interviewees. The support for a mandatory approach was because of its apparent fairness: there would be no favouritism, all farmers would be in the same position, and it would simplify trading relationships. For these participants, the potential impact that vaccination could make to bTB incidence meant that it was too important to be left to chance: there was broad acceptance that a voluntary approach would lead to a scattergun approach to vaccination which was not seen as desirable. Thus, whilst a mandatory approach was not ideal, it was acceptable. Nevertheless, acceptance of a mandatory approach was set against a range of conditions. These included: a vaccine needs to be effective; it must not interfere with the day-to-day running of the farm; and that it was the Government's responsibility to deliver it. The extent to which these conditions are likely to be met will determine the extent to which a mandatory approach will be successful. Thus, if the 90-day meat withdrawal cannot be reduced, there will be significant resistance against vaccination amongst farmers producing beef. Given that any vaccine is likely to be imperfect, and involve trade-offs

between disease freedom and the freedom to farm, this highlights the need for consensus building between the government and farming industry (see below for further details).

2. Incentives to vaccinate

The incentives that are likely to encourage voluntary action reflect the conditions under which mandatory vaccination is deemed acceptable. High vaccine efficacy, for example, makes a vaccine attractive to farmers who want to take steps to reduce their risk to bTB voluntarily, whilst also acting as a condition for a mandatory approach. Reducing testing and enhancing compensation were seen as relatively important incentives.

3. Communications and engagement

Farmers at the research workshops exhibited interest in the progress towards a cattle vaccine. Their interest reflects the potential impact bTB has on their businesses and their hope in a solution that has been promised for many years. The research has highlighted the need for early engagement with farmers to help them understand the challenges facing vaccine development and the likely trade-offs they might need to take. In fact, some farmers attending our workshops interpreted this research as a consultation event, highlighting the level of interest in vaccination. If the government hope to roll out a vaccination strategy by 2025, they have three years from now to mobilise a strategic programme of communications in collaboration with vets and the other stakeholder types interviewed during this study. There needs to be a concerted effort to provide 'drip' messaging, as existing research has found that simple, repeated messages delivered using a range of approaches are most likely to be taken up by the community. Policymakers should take this opportunity to open up transparent dialogue with farmers during these few years, resulting in wider uptake and acceptance when the vaccine is introduced.

The following recommendations are suggested as a way of addressing these policy implications:

1. It is **too early to recommend a mandatory or voluntary approach to vaccination given there exist a number of uncertainties relating to its use**. For either approach, the following information will be required:
    a. **Clear information on vaccine efficacy;**
    b. **No consequences for existing trading relations;**
    c. **Clear information on vaccine costs (e.g., meat withdrawal);**
    d. **Flexibility in the timing of vaccination delivery;**
    e. **Clear and accurate information on identifying the status of (un)vaccinated livestock**

2. **Policy co-design**: The decision to vaccinate will involve farmers making decisions that are likely to involve significant trade-offs between disease freedom and trade/economic productivity. As there are still many uncertainties around the technical aspects of vaccination (e.g., efficacy) it is difficult to design the most effective policy and incentives to help overcome them. As soon as there is clear understanding of the technical limits to a bTB cattle vaccine, **farmers and farming organisations should be involved in a process of policy co-design** in order to identify the most appropriate ways of delivering the vaccine.

3. **Early and on-going engagement with the farming community**. To help farmers and their organisations to prepare for policy co-design, and understand the technical challenges of

vaccination, they need to be engaged in the development of the vaccine. This should include **regular communication about vaccine trials and progress reports** published in the agricultural press. It should also include **meaningful engagement in the scientific process of evaluating the candidate vaccine (CattleBCG) and candidate companion Detect Infected among Vaccinated Animals (DIVA) skin test (DST-F)**. If commercial confidentiality issues allow, this could include inviting farmers to the trial farms where farmers have given their informed consent, and a dedicated website created to show how the bTB vaccine is being trialled. This could also provide a way of gathering ongoing feedback about farmers' preferences for how the vaccine should be delivered using different forms of interactivity and choice experiments.

Introduction

Bovine tuberculosis (bTB) is one of the UK's most challenging animal diseases, costing the UK taxpayer in excess of £150m per annum (Defra, 2020). The disease has serious socioeconomic consequences for cattle farmers due to the slaughter of infected animals and restrictions on livestock movements.

Cattle vaccination is potentially the most viable long-term solution for tackling bTB: it is familiar to farmers who already use vaccines for a range of cattle health challenges; it can be delivered by trusted farm advisers such as vets; and farmers have indicated a willingness to pay for a bTB cattle vaccine (Bennett and Balcombe, 2012). Responding to the Godfray Review (2018), which called for an acceleration of cattle vaccine technology, Defra is working to make a deployable cattle vaccine available by 2025. Whilst vaccines are common to livestock farming, social research has nevertheless shown how the decision to use them varies between farmers (Cresswell et al, 2013). The aim of this report has therefore been to assess farmer attitudes towards a cattle bTB vaccine, and the potential influence of different behavioural incentives to promote vaccine use[1].

To meet these aims, and support Defra, Welsh Government and Scottish Government in their respective cattle vaccination strategies, the research has **three research objectives**, as follows:

1. To examine farmer attitudes, influences and decision-making processes to explore how attractive they find the potential future deployment of a cattle vaccine;
2. To identify risk factors and enablers that could influence and trigger change in farmer decision-making, including potential impacts that deployment of cattle vaccination might have on other bTB biosecurity behaviours; and
3. To assess how vaccinating cattle against bTB might impact the ease of cattle trading both within the UK (intra-trade) and internationally (export).

Previous research examining farmers' attitudes to cattle (and badger) vaccination (e.g., Enticott et al., 2014; Maye et al., 2017) has highlighted how meaningful understandings of farmers' attitudes to cattle vaccination require methodological approaches that are able to:

- capture farmers' views on vaccines that do not currently exist;
- capture farmers' views on vaccines that have limited/no evidence that they reduce bTB incidence;
- are sensitive to the political dimensions of bTB and decisions about badger culling; and
- acknowledge forthcoming changes to the way farmers receive state funding through the animal health and welfare pathway.

To meet this brief, participatory workshops with farmers were used to explore specific cattle bTB vaccination scenarios and assess different behavioural influences to vaccination. Research was conducted in England and Wales, covering high, edge and low-risk TB areas in England and high and intermediate TB areas in Wales. The workshops were combined with a series of interviews with cattle industry stakeholders across the UK.

The report is structured as follows: firstly, we explain the methodological approach, including how the participatory workshops and stakeholder interviews were designed and delivered, sampling

[1] Vaccination to protect against bTB also includes vaccinating the wild badger population. A separate report from this project examines farmers' current and future attitudes towards badger vaccination (see Chivers et al., 2022).

procedures, and data analysis. Secondly, results are presented, focussing on farmers' and stakeholders' general reactions to vaccination scenarios and the specific behavioural influences that inform their reactions to vaccines. The final section of the report discusses policy implications, including ways to support farmer and cattle industry uptake and acceptance.

Methodology

Conceptual and Analytical framework

Three hypothetical policy scenarios were developed to examine attitudes to cattle vaccination amongst farmers and industry stakeholders. Each scenario reflected a different model of delivery (individual, state, collective). In this sense, the scenarios were realistic for England and Wales in that they drew on previous cattle vaccination research and were based on familiar policy arrangements, cognisant that Defra may, for example, approach cattle vaccination using non-regulatory (individualistic) approaches like its current approach to promote responsible cattle purchasing and risk-based trading.

- Individual (voluntary) responsibility: This approach relies on individual behaviour, with financial incentives / penalties in place to 'nudge' behaviour. It reflects the common / existing approach to current TB control measures. In the scenario we included some elements which we expected to be 'easy' (the freedom for farmers to do it themselves), but others which were less attractive (a complicated vaccination process, for example). The key point is that farmers could choose whether to vaccinate their cattle or not to assess how they respond to this possible scenario.

- Government responsibility: In contrast to the market-based individual model, this mandatory scenario relies on regulatory implementation with free-roll out and penalties for not complying. The decision to vaccinate is effectively taken out of the hands of farmers in this more top-down government-led model. What makes this approach potentially attractive is that it comes at no financial cost to farmers, but the mandatory approach may not be socially acceptable.

- Voluntary (collective) responsibility: This scenario tests reactions to an industry model like the one used for badger culling (i.e., local farm industry companies are formed). Potential attractiveness relies therefore on involving trusted industry bodies, with no financial penalties for not vaccinating, plus the social component of collective participation (i.e. farmers not having to do it alone, instead working together to vaccinate and protect their cattle from bTB).

Whilst these scenarios were realistic in that they reflected current modes of policy delivery familiar to farmers, it was made clear to research participants that the scenarios did not represent any policy intentions that Defra had regarding cattle vaccination, or a consultation of farmers' preferences.

Analysis of responses to these scenarios drew on **the EAST framework** (Behavioural Insights, 2014)[2]. EAST refers to the main motivational influences in human behaviour: making choices easy, attractive, social and timely. The project mapped existing research relating to cattle vaccination and farmers' biosecurity behaviours onto the EAST framework to develop a set of general hypotheses to 'test' with farmers and cattle industry stakeholders:

[2] For further details about EAST see: https://www.bi.team/publications/east-four-simple-ways-to-apply-behavioural-insights/ (accessed: 04.07.2022).

- **Easy:** default settings, such as mandatory vaccination, remove the decision to vaccinate from farmers.
- **Attractive:** financial or other incentives/disincentives. Attractiveness may also make default settings acceptable, such as vaccine efficacy.
- **Social:** organising the delivery of vaccination by people/organisations that were well-known and trusted
- **Timely:** matching vaccination schedules to the farming calendar.

The rationale and main contributions of each cattle vaccination scenario to the EAST framework are summarised in Table 1.

Table 1: Rationale and main EAST components for cattle vaccination scenarios

		Individual (voluntary)	Government	Voluntary (collective)
Rationale		Relies on individual behaviour – common / existing approach to TB.	Relies on regulatory implementation with free-roll out – penalties for not complying.	Local companies similar to the badger culling groups formed, relies on industry bodies – no financial penalties.
Easy	+	Farmer can do it themselves	State-led (+/-)	Don't have to do it alone (collective)
	-	Process is complicated and slow	Distrust in governmental bodies	
Attractive	+		Free-of-charge for farmers within a 3-month window	No financial penalties for not vaccinating
	-	The vaccination process is relatively complicated and slow		Must pay for vaccination
Social	+	Doing it alone		Doing it together
	-	Doing it alone	Mandatory	Doing it together
Timely	+			
	-		Only choose timings within a 3-month window	

Research Design

Below we introduce the case study sites, the procedures for participant recruitment, and summarise how the workshops were designed and analysed.

Workshops: Case study locations and participant recruitment

We conducted six workshops with cattle farmers in Bakewell, Frome, Louth, Whitchurch, Pembrokeshire and Ruthin in March and April, 2022 (Table 2). The locations were chosen to reflect a range of TB areas (a mix of high/high risk and intermediate / edge and low risk), including two sites in Wales. The study sites were areas that the research team had worked in previously, which meant good access to local farmer networks and auctioneers. One project partner is part of a large veterinary partners group, with excellent links with the TB Advisory Service, and led on the recruitment of farmers to each workshop, using their network of active and engaged vets in each area. Farmer participants were recruited initially through these existing contacts in each area, with workshop flyers also promoted using social media and via local NFU contacts.

Table 2: Cattle vaccination workshop locations and farmer recruitment

Location	bTB status[3]	Participant numbers
Bakewell, Derbyshire	Edge area	10
Frome, Somerset	High-risk area	16
Louth, Lincolnshire	Low-risk area	12
Whitchurch, Shropshire	High-risk area	13
Pembrokeshire, SW Wales	High TB area	25
Ruthin, NE Wales	Intermediate TB area	6

The workshops were organised at venues known and trusted by the local farming community, which in most cases was the local livestock market, but workshops were also held in a local veterinary practice (Whitchurch) and a local hotel (Pembrokeshire), both used regularly used by farmers for meetings. The workshops generated a lot of interest from the farming community, reflected in the generally high attendance across the workshops, besides Ruthin, which recruited lower numbers due to overlap with the start of the lambing season. Participant numbers overall were strong and the sample reflects a good distribution across the workshops and in terms of farm size and bTB prevalence. The majority of farms and farmers attending had some level of experience with bTB on their farm (Appendix 1), bar Louth (a low-risk area). In Pembrokeshire, the very high number of participants reflects successful promotion but also, as participants in other areas noted too, the level of interest to discuss a potentially important method to deal with bTB control in future. Three of the four areas in England (Bakewell, Frome and Whitchurch) had some level of involvement in the badger cull (organising a local culling group and/or in contact with others involved in the process).

[3] Based on TB hub risk map https://tbhub.co.uk/preventing-tb-breakdowns/bovine-tb-risk-map/ (accessed: 04.07.2022).

Interviews: stakeholder recruitment

The interview sample was purposive – the aim was to provide good coverage of the cattle industry from a trading perspective. A total of 35 stakeholder interviews were completed between April and June 2022, including auctioneers, farming union representatives, vets, badger cull company (BCC) directors and pedigree breeders (see sample characteristics section for further details). One group interview was completed (with three participants) to consider international trade (UK perspective). Stakeholders were recruited by identifying a list of the stakeholder types we needed to reach in order to reflect the cattle industry and trade, including perspectives from England, Wales and Scotland. As there is currently no plan to roll out vaccination in Scotland, Scottish stakeholders were asked to comment on them in the context of England and Wales, whilst providing any insights they had on how vaccinating cattle in England and Wales may affect trading between the devolved nations. The team then used a combination of their own knowledge and contacts within the sector, combined with internet searches to draw up a list of potential interviewees. For auctioneers and vet practices, we contacted those in or around where the farmer workshops were taking place, in part for efficiency, but also to target representatives in different TB risk areas. During the interviews, the researchers also adopted snowballing by asking participants to suggest further interviewees. Policy advisors in Defra, Welsh and Scottish government connected to the project also provided contacts to fill gaps in the sample. This was particularly valuable when recruiting interviewees in Scotland and those with an international trade/export perspective.

Research methods: workshop and interview design

Workshop format

The project used participatory workshops to encourage farmer participation in scenario exercises. The aim was to activate a dialogue within each group about vaccination futures. The workshop was designed to allow most time to discuss the scenarios and associated triggers. Each workshop followed the same format. Each started with the participants and researchers introducing themselves – for the farmers this involved each saying a few words about their farm and a brief summary of their TB history; for the researchers this involved briefly explaining our research background and emphasising our role as researchers who are not part of Defra. Prior to starting this round of introductions, participants were also asked to complete a short pre-workshop questionnaire (this recorded general information about their farm, TB history, etc.).

After the initial round of introductions, each workshop started with two warm-up exercises:

1. A round-table discussion to gather participant **views towards vaccines in general**, including whether they use other vaccines to prevent other diseases on their farm
2. Participants were then asked to **list key hopes and concerns surrounding cattle vaccination** on post-it notes. Farmers then read them out, with the researchers clustering them to identify key themes (see examples in Figure 1).

These exercises were intended to get participants thinking about cattle vaccination and TB. They achieved this goal, as in many cases a range of issues were highlighted, sometimes reflecting general frustrations and tensions about the disease and the ongoing attempts to manage it.

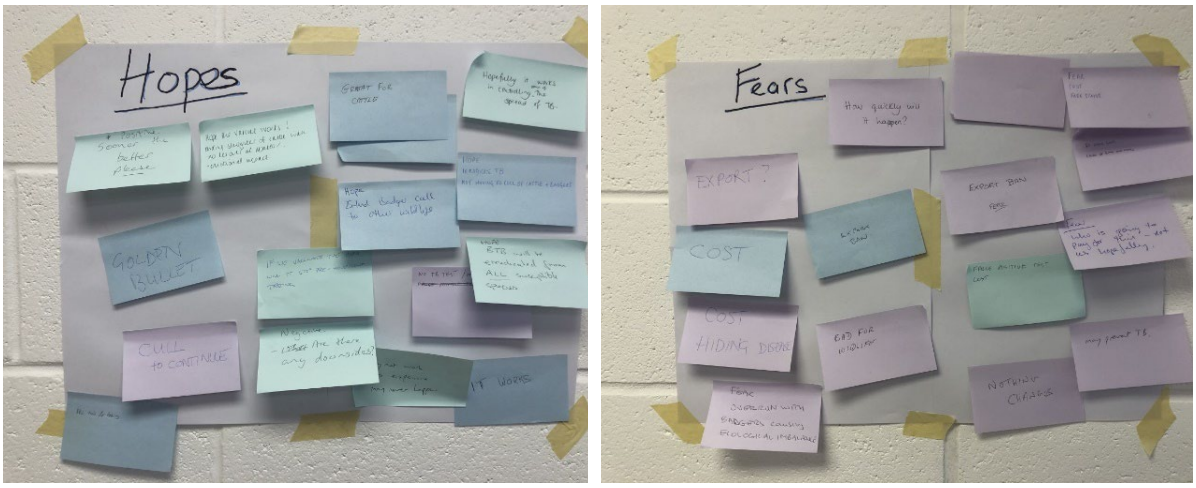


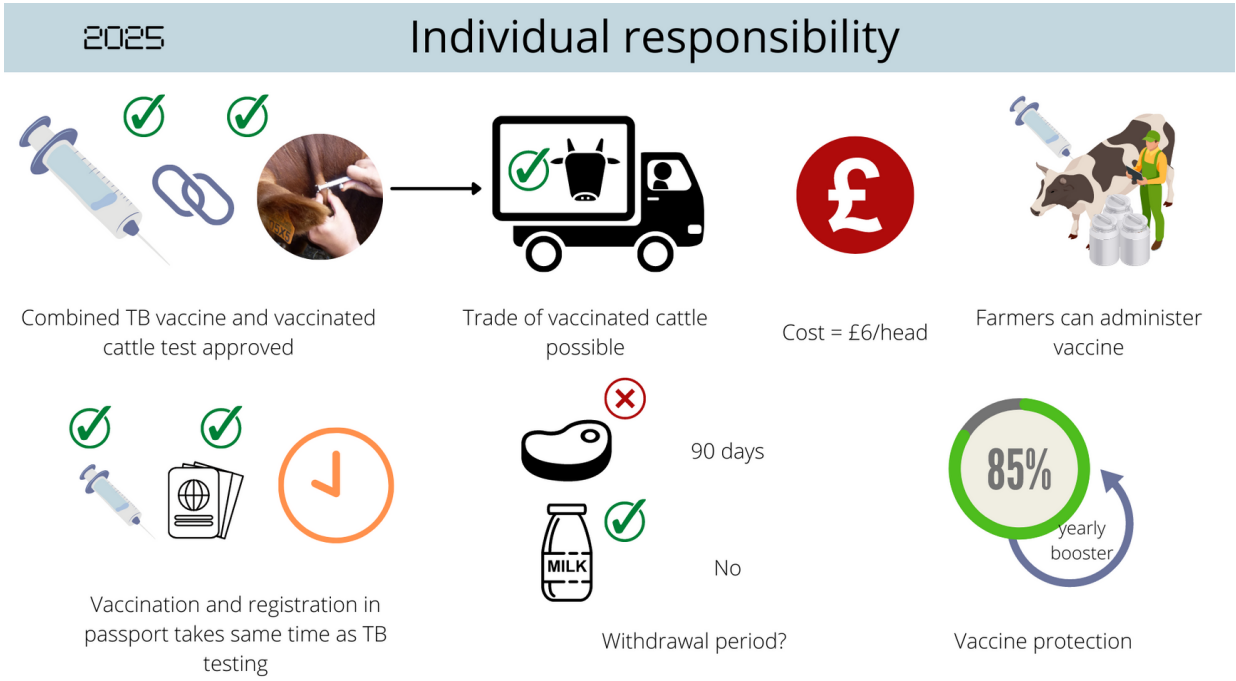
Figure 1: Hopes and concerns for cattle vaccination exercise (example from Whitchurch workshop)

After the warm-up exercises, the workshops then shifted into the main discussion, with each of the three scenarios discussed in turn. For each of the three scenarios, a written statement accompanied by a visual aid was prepared to describe the scenario. The visual aids were used as prompts and contained illustrations representing each key component within the scenarios. One of the workshop facilitators read out each scenario, and a copy of the visual aid for the given scenario was handed out to all participants. A larger copy of the visual aid for each scenario (A0) was also available on the wall behind the facilitators. Below, by way of example, is the text and visual aid that was read out and shown to farmers for scenario 1, individual responsibility:

Scenario 1: Individual responsibility – text (read aloud to farmers):

> *"Defra/Welsh government have received approval to use a cattle vaccine for TB and a DIVA test to distinguish between vaccinated and infected animals. This will allow continued international trade of livestock and food products between the UK and other countries.*
>
> *The cattle vaccine is available to all and the Government is encouraging farmers to vaccinate animals over 8 weeks of age. The vaccine costs £6/head and farmers can vaccinate their animals themselves. The vaccination process is relatively complicated and slow – it would take roughly the same amount of time as it takes to complete your TB test. Annual booster vaccines are also required. All vaccinated cattle must be recorded within CTS/BCMS, the passport and would be publicly available (e.g., on ibTB).*
>
> *The vaccine is 85% protective overall. There will be a 90-day meat withdrawal on the vaccine and no milk withdrawal".*

Scenario 1: Individual responsibility – visual aid (handouts were provided to farmers):



As we moved into the second and third scenarios some aspects remained consistent, including the meat withdrawal period of 90 days, the approval of a DIVA test, the possibility to trade, and overall vaccine protection (85%). The scenarios varied in terms of how the programme was delivered (governance model) and variables linked to cost and administration. The schedule used by facilitators for the cattle vaccination workshops, which includes the full text for each of the three scenarios used, is available in Appendix 2. A copy of the three visuals used in the workshops (summarising core triggers for each) is available in Appendix 3.

Participants were given time to consider each scenario and were then asked a series of questions by the facilitators. This started by asking initially for general reactions to the scenario – what was their gut reaction to what they had heard and read and elements they liked and did not like so much. More specific prompts then asked about EAST triggers covered in the scenario and acceptable thresholds (e.g., a vaccine with 85% efficacy, cost thresholds).

Once the three scenarios were discussed, a final exercise was introduced to summarise (on post-it notes) key triggers/themes discussed during the workshop. This was a way to summarise key themes and to check no important points were missed. Discussions were lively across all six workshops; as a result, facilitators had to manage the room carefully to ensure all farmers had ample opportunities to express their views. All six workshops lasted for at least 2 hours. The workshops ended by thanking farmers for their time and participation, with farmers in the English study regions reminded to attend, if possible, the follow-workshop to discuss badger vaccination (see accompanying report: Chivers et al, 2022).

Interview design and format

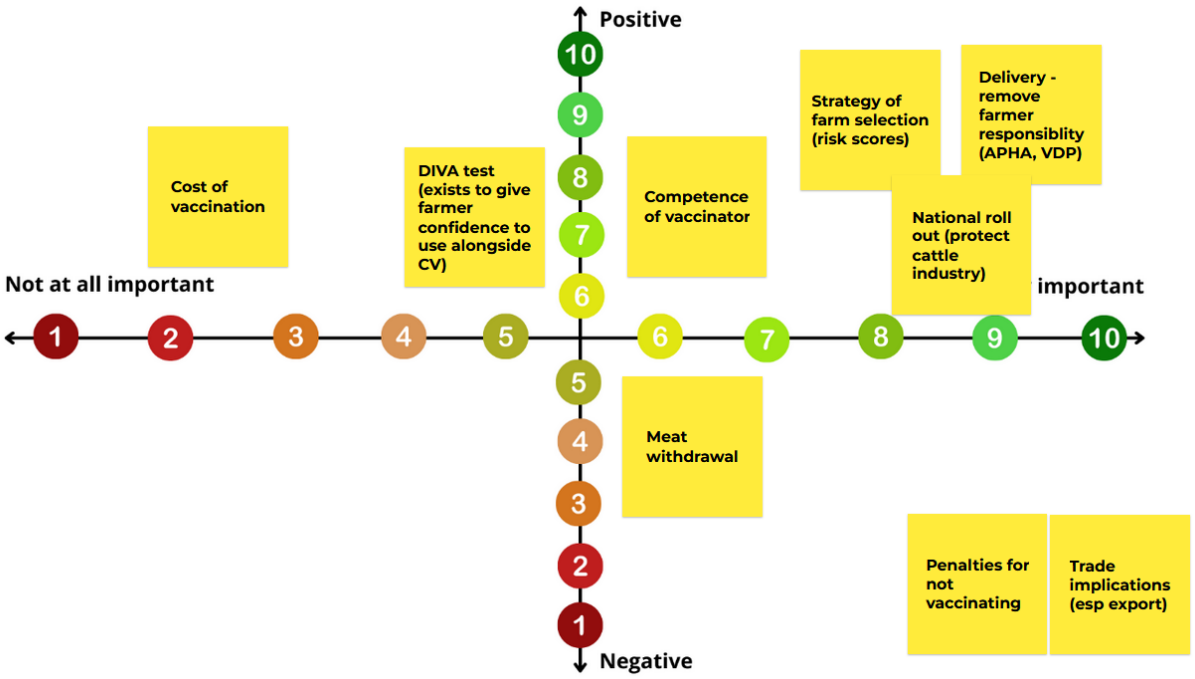
With a range of industry views covered in the sample, we designed the interview protocol to have flexibility to allow interviewers to cover issues relevant to various stakeholder perspectives (e.g., auctioneers) whilst maintaining consistency across the interviews. We opted to use the same three

scenarios as those presented to farmers to assess reactions and viewpoints from different stakeholders. This also allowed the research team to draw comparisons between the stakeholder interviews and farmer workshops. All interviews were recorded. The interviews were a mix of face-to-face interviews and online (via Zoom or Teams). Interviews lasted between 40 minutes and 1 hour.

Below is an outline of the interview protocol:

1. General questions to understand the profile and role of the interviewee and their organisation in relation to cattle trade and bTB, as well as to get **unprompted views about the main ways in which TB affects cattle trading** and the **potential of cattle bTB vaccination** to control the disease.
2. Discussions surrounding the **three scenarios** (the same ones used for the farmer workshops, see above), with a particular emphasis in identifying for each **how the situation would affect their industry and cattle trade.** As per the cattle workshops, it was emphasised that the scenarios are hypothetical and designed to prompt reactions to that scenario and specific triggers within them.
3. During the interview, the researcher and interviewee wrote down **key points that were important in relation to cattle vaccination and trade** on post-it notes. The **final exercise was participatory**, with interviewees asked to place these post-it notes on a grid to indicate their relative importance and the extent to which they are positive or negative. For online interviewees, this was done using Jamboard (Figure 2). 10-point scales were used to allow participants to place importance on each factor, though these were used for illustrative purposes to generate further conversation. This was a useful way to **identify important triggers and themes** for each participant.

Figure 2: Example grid used in the cattle trade interviews to gauge the relative importance of factors surrounding the roll-out of a cattle vaccination.



Data analysis

The six workshops resulted in over 12 hours of audio recordings, with more than 70 farmers attending in total. Once these recordings were transcribed verbatim, in-depth thematic analysis and manual sentiment analysis was conducted using NVivo 12 Plus. This was used to identify key narratives surrounding cattle vaccination alongside general understandings of how farmers reacted to each scenario. Manual sentiment analysis was used to assign individual workshop discussions as 'positive' or 'negative'. This coding resulted in a total of 3758 references, reflecting the high level of detail gathered during the workshops.

The 35 interviews resulted in over 30 hours of audio recordings. Once these recordings were transcribed verbatim, in-depth thematic analysis and manual sentiment analysis was conducted using NVivo 12 Plus. Sentiment analysis was used to determine how stakeholders responded to each scenario (negative or positive), and transcripts were coded to identify themes related to each scenario and wider influencing factors, particularly with a view to determining consensus or disagreement between stakeholders/types in relation to the scenarios and cattle trade implications.

Results

Sample characteristics

Participants were asked to provide their main farming enterprise. Most participants were beef or dairy (43.5% and 40.6%, respectively), with some beef and dairy farmers (10.1%) and mixed livestock enterprises (5.8%). Most workshop participants (78%) have had at least one bTB breakdown on their farms, with a quarter having been in restrictions for more than 12 months (see Appendix 1 for further detail).

Most workshop participants' seldom buy-in cattle, with 71% buying less than yearly. Those who buy in cattle regularly (up to monthly) were beef finishers. Most participants (69%), however, sell cattle at least once a year. The majority of participants (83%) already administer at least one type of vaccine, with the most common being for respiratory diseases or BVD. The majority of English participants came from a region which has experienced badger culling.

In terms of interview data, we interviewed a wide range of stakeholders across the cattle industry, representing different trade perspectives (Table 3). As well as ensuring a good distribution by stakeholder type, the sample reflects participant perspectives from England, Wales and Scotland, and organisations which represent the UK as a whole.

Table 3: Cattle industry interviews by stakeholder type

Stakeholder type	England	Wales	Scotland	UK	Total
National farming organisation representatives[4]	4	2	0	1	7
Local farming organisation representatives	6	2	0	0	8
Veterinarians	4	2	0	0	6
Auctioneers	2	0	2	1	5
Regulation, assurance, advice[5]	0	0	2	3	5
Pedigree breeders	2	0	0	0	2
Supermarkets	0	0	0	1	1
Trading bodies	0	0	0	1	1
Total	**18**	**6**	**4**	**7**	**35**

[4] Not all 'national farming organisation' representatives are from the National Farmers' Union. This category represents all stakeholders from bodies and associations which represent farmers at a national scale.
[5] 'Regulation, assurance and advice' include a range of entities including those responsible for regulating trade, assurance schemes, and broad advice. Stakeholders in this group were categorised due to the similar roles they would play under a vaccination roll-out, as well as to maintain anonymity of the organisations that participated in this research.

Attitudes towards cattle vaccination: overall sentiments

Farmers and agricultural stakeholders were, in principle, generally supportive of cattle vaccination, and supported an effective, trade barrier-free vaccine. Indeed, many interviewees reflected that cattle vaccination was seen as 'the holy grail' of bTB control but was always 'five years away from development'. For example:

> *'I remember 20 years ago, when I was in university, reading an article that said vaccination is five years away… so I'm sceptical that it'll happen by 2025, but on the other hand, we have to do something'.*
>
> – National Farming organisation representative, Wales.

In terms of the three scenarios presented during the interviews and workshops, mandatory vaccination was the scenario with the most potential according to participants, largely because it was perceived to be easiest to administer (see figure 3). Whilst there were several 'negative' sentiments surrounding this scenario, most were constructive, with suggestions surrounding how to make this approach feasible. This indicates that once certain concerns are alleviated and changes made to increase the ease of delivery, this scenario may have potential according to farmers and stakeholders. Their preferences were, however, for vaccination to be rolled out nationally rather than targeted at specific areas. Farmers and stakeholders felt that the mandatory scenario was most likely to result in success and emphasised the need for it to be free and administered by vets or APHA (who would need to be given appropriate resources). Clear messaging and evidence of efficacy was also seen to be important.

A contrasting scenario, which involved individual responsibility and voluntary vaccination, was perceived negatively overall. One reason for this was the belief that vaccination needed to be undertaken 'properly' by trained vets or APHA (see p33-37). Stakeholders expressed concern about how motivated farmers would be to undertake vaccination on a voluntary basis, particularly where they are expected to pay towards the vaccine.

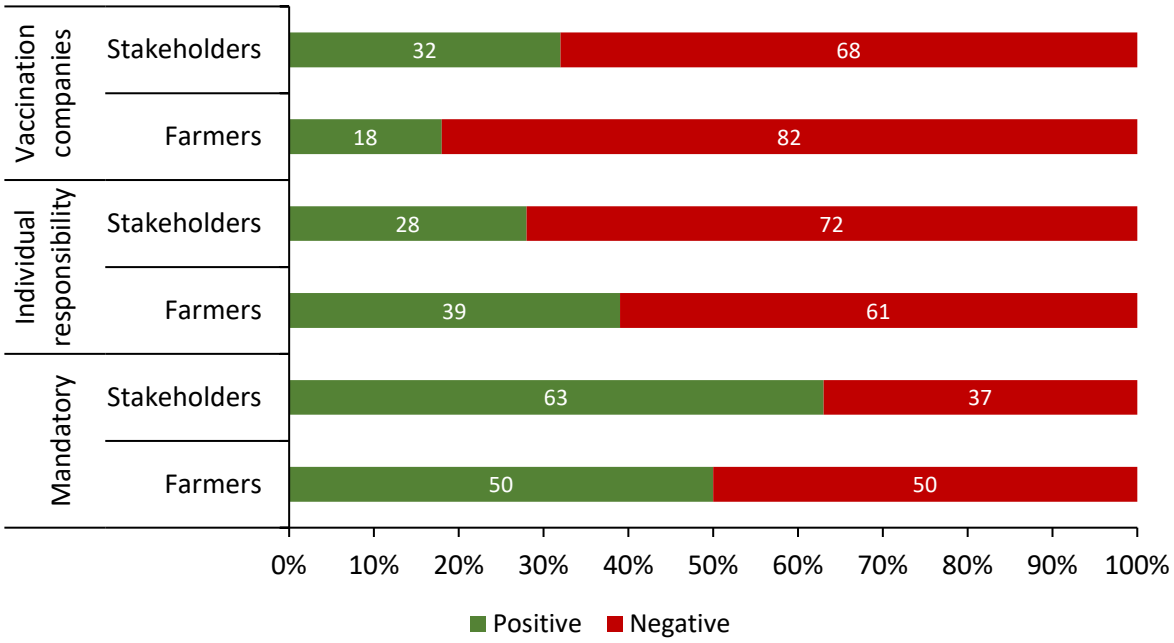


Figure 3: Results from manual sentiment analysis surrounding each scenario, with stakeholder interview and farmer workshop data presented separately.

The vaccination company-style scenario received widespread rejection across the workshops and interviews (figure 3) largely because of the perceived amount of work this would involve and experiences of running badger culling companies. The negative sentiments surrounding this scenario were of rejection, with participants less willing to consider ways of improving the scenario as they did with the other two due to the scenario being viewed as wholly unrealistic:

> *'P1: - No, no, no - That makes me feel quite ill... [room makes sounds of approval] - so bad! (…) The stress that would cause - for no rewards. I've just spent the last four years of my life doing that and I would definitely not, no…sorry*
>
> *Facilitator: Could you explain why?*
>
> *P3: It would not work, all of it won't work. It's an enormous amount of work to get people signed up and we're tired. It's [culling] been a nightmare, so stressful. You wouldn't believe the amount of work. And not paid.... [2 further participants express exasperation, stress]'.*

- Bakewell farmer workshop.

A minority of participants responded relatively positively towards all three scenarios, usually due to having had extensive bTB breakdowns. For example: '*We are losing hundreds of cows every year, if 85% of them survived, yeah, that's a hell of [an improvement]*' (Ruthin farmer workshop, LRA). This indicates that current levels of bTB has led to some farmers welcoming a vaccine even if the protection rates are lower than ideal, with participants preferring to save some cattle rather than none.

General concerns surrounding cattle vaccination

The following sections provide more detailed insights into why farmers and stakeholders held certain views towards cattle vaccination, including why they may be reticent in terms of uptake until certain issues are resolved, which include trade concerns, the DIVA test and wildlife control. We begin by examining farmer and stakeholder views towards trade, given the need to resolve trade uncertainties before any vaccination programme will become appropriate.

Perceived implications of cattle vaccination on trading

We gathered views from both stakeholders and farmers surrounding what they believe might happen in terms of trade should cattle be vaccinated against bTB. The key finding is that there is a clear lack of clarity from the government and other organisations surrounding the potential implications for trade. As a result, participants expressed a need for clear messaging and further investigation by the government before any vaccination roll-out.

Due to the lack of messaging or information from the government regarding cattle vaccination, discussions surrounding the trade of vaccinated cattle were characterised by uncertainty and apprehension, with one of the most significant fears surrounding how it may detrimentally affect trade. These uncertainties are examined here by exploring the perceived implications of vaccination on:

1. **Exporting various livestock products outside of the UK**: Uncertainty around whether other countries will trust the DIVA test to detect infected cattle amongst vaccinated animals. Ongoing post-Brexit negotiations are also leading to wider uncertainty surrounding the future of trading with EU member states: 'H*ow does Brexit play into all of this? We don't really know what international trade is going to look like, so it's really difficult to know who we're going to be trading with'* – National farming organisation representative, England (interview 19).
2. **Trading between devolved nations:** uncertainty around whether all UK nations will use the same vaccination strategy – risk of creating a two-tier market/complexity when trading/potential refusal by Scotland to trade with, e.g., Wales.

Potential impacts of cattle vaccination on international exports

Conversations surrounding the international trade of vaccinated cattle were characterised by **confusion and apprehension**, with some stakeholders and farmers insinuating that it was an **inappropriate topic to ask them about whilst there is little information available** surrounding future international trade agreements:

> *'It is quite a leading question from government to ask us what the impacts on trade might be, and I can see why they would want to understand that because if we as retailers were to say, hey, you absolutely can't do this, because we won't get any milk on our shelves, we won't have any meat on the shelves, there would be absolute uproar. And, actually, that would then mean that government would go; okay, then well, we won't do this because actually we're not going to be able to feed people. So, by asking that leading question, it's almost giving them a green flag to say go ahead and do it because actually we'll be all right, the retailers are fine with it. We're almost being seen as a scapegoat and (…) we are not here to be the scapegoat as a retailer'.*
>
> – Supermarket, UK.

The above quote also shows a distrust towards the government by the supermarket representative in question. Going forwards, Defra may wish to engage in discussions with supermarkets as key stakeholders, particularly when navigating the trade side of things.

The overarching narrative across all conversations surrounding trade was that there needs to be a **concerted effort by government to seek clarity, make agreements, and share information** with farmers and stakeholders in terms of any trade barriers prior to any vaccination roll-out. The following quote illustrates the majority view that it would take several years to gain clarity around trading:

> *'There needs to be a whole load of work done there to understand what these markets are? Because looking at the existing export health certificate, I'm sure that has something in there around TB, and meat from animals, there may be something in there about vaccination. It might be just purely political and could give them an excuse to stop the British exporting'.*
>
> – National farming organisation representative, England (interview 19).

Several other participants, who were supportive of vaccination overall, supported the view that clarity on trading is needed:

> *'Vaccination has got to be positive because it's hopefully going to eradicate bovine TB. So it's a big tool in the toolbox, isn't it? That's really important, and a fantastic step forward. But when we do it, we've also got to manage the ability for our farmers and our community to continue the food supply chain, we've got to ensure that the impact on the ability to move and trade animals is not affected or it's only affected as little as it possibly can be. Because if you're vaccinating, presumably you're vaccinating to prevent an animal catching TB rather than vaccinating to cure TB. So once they're vaccinated, then they're in an awful lot safer place than they are today, aren't they? So, the two biggest things will be: one, the ability to continue trading as we know it; [and] secondly, that the vaccination details are accessible through an electronic downloadable database'.*
>
> – Auctioneer, UK.

Some farmer participants appeared nervous of cattle vaccination due to the perception that it is not the right time whilst uncertainty surrounding trade persists since the completion of Brexit:

> *'P1: I've always been told that vaccination wasn't possible because we exported so many animals, but is this true? Since Brexit, it's painful to export anything. [Another participant agrees]*
>
> *P2: It's gonna generate automatically a two-tier market, straightaway...'*
>
> Frome farmer workshop.

Some participants, mostly from national and local farming organisation representatives, held the view that Europe would not import vaccinated cattle if they were then classed as 'having bTB': *'At the moment, no other countries will import the vaccinated stock, that's as I understand it. I think it's going to be a major hurdle'* (local farming rep, Wales). Others, meanwhile, believed that trading will continue once trust in the DIVA test is built. One participant was completely against the idea of vaccinating cattle due to the implications it could have for trade, stating that we should be able to reduce bTB without the need for vaccination:

> *'I think we have to try and find a way to avoid using cattle vaccine. Because it's like putting a sticking plaster on an animal disease that we've not otherwise been able to deal with. Because perhaps we're trying to hug too many trees. Right. The rest of Europe has been able to deal with TB. Why can't we? Yeah, yeah, we often if we have to go down a road where we can get a vaccine at work. So hey, look, we've got two years of experience for medical science of research to do with vaccination. So if we can make it work, I would support it but it will completely close our doors for export'.*
>
> – National farming organisation representative, England.

Some participants were concerned that countries outside of the EU would refuse to import vaccinated cattle if it means the meat is no longer classed as 'bTB free':

> *'The UK has a TB free status even though we've got cattle breaking down across the system, because basically, they're not going into the meat and then into the food chain, so we could lose that. We lose our export potential to all sorts of places like America and China and Canada and all sorts, we really don't want. That's a flipping DEFRA job to sort that one out, but we definitely don't want to lose our exports. I mean, we've gone with Brexit now so we can trade with whoever we want when we want, can't we [sarcasm]!'.*
>
> – Local farming organisation, England.

Farmer participants were also concerned about the implications of England, Wales, and Northern Ireland losing its (anticipated future) 'TB-free' status upon vaccinating their cattle:

> *'If we suddenly bTB vaccinated the whole country, then all of a sudden, surely that's going to affect our export market because we'll lose our TB free status. Now even though, you know as it stands, we haven't actually got TB free status at the minute because there's TB capital going through abattoirs all the time, which is only because of the pickup lesions, if they don't pick up lesions they're classed as TB free, but that isn't necessarily the case. But as the law states, which is question if we vaccinate, how would that affect our markets because from a beef point*

of view, you know, we just got managed to get over BSE, and we don't want to mess it up anymore. Do we? Interesting point there, the ex-MP for this area 10 years ago, thought it'd be a good idea to help farmers, he'd link TB to the increasing numbers of TB in the Asian population of Birmingham. And did we have to slow him down hard, because if the general public thought they can get TB from milk or beef, it would make BSE seem like a walk in the park. So, we do have to be very careful from a messaging point of view here'.

– Whitchurch farmer workshop.

Again, this reiterates the importance of building trust in DIVA testing, both amongst UK farmers and stakeholders and within the countries we export to. Several participants (n = 9), however, pointed out that if live exports were no longer possible, this may not be hugely detrimental, as the live export market with the EU has shrunk. The ability to trade cold meats was, however, seen as of great importance.

'As far as export of cattle is concerned, I don't think we send very much beef abroad, I think there are some, there's some cow meat that goes abroad. And you know, if, as a consequence of vaccinating our cattle, those products could not be exported, it might have a detrimental effect on trade. The thing that we export most of our lands, we export 30%, into mainland Europe'.

– Auctioneer, England.

In addition, others believed that trading would become easier as trust in the vaccine builds over time:

'I think in the short term, I think it would hamper trade because there would be misunderstanding about it. And mistrust, and cattle could be seen as dirty, but I think in the long term if it works as well as you say in this scenario, then I think it will only improve trade as confidence builds in buying a vaccinated animal over an unvaccinated one but the previous caveats with regard to meat withdrawals, you know, and that headache'.

– Vet, Wales.

Views towards trading vaccinated cattle between the devolved nations

Many participants referred to a **need for clarity surrounding how vaccinating cattle may affect trading between the devolved nations of the UK**, due to the different policy approaches used by each nation in the past. Overall, most participants suggested that an **integrated, nationwide approach is needed to avoid complications** when trading between nations and to avoid creating a two-tiered market:

'If the rules are different in different regions, then you still have that problem of higher risk animals moving to a lower risk area. I mean, if, if the vaccination came in in England first and animals were moving to Scotland, then actually, it would be lower risk than the current situation where they're moving without a vaccine. So it would improve the situation. But actually you might get a situation where the risk of Scottish cattle lends up being higher than the risk of English cattle, there may need to be restrictions going in the other direction'.

– Vet, England.

If a vaccination became mandatory across the devolved nations, some participants doubted that this would make a great difference to trading, again, as long as there was a reliable test:

> *'I'm not sure if it'll make much difference, to be honest. Because we've got a pre-movement test. And as long as they've got that clear test, I think farmers are quite happy. If you've got it says a compulsory vaccine. Everybody, we're in the same boat anyway. So there wouldn't be say if Wales had vaccine programme and England didn't that would make it total complicated sort of thing. And would farmers want to buy cattle from Wales in England? I don't know. I think it potentially could have a huge impact the vaccine. Especially if there's cross border difference'.*
>
> – Local farming organisation representative, Wales.

There was particular concern amongst some farmers and stakeholders surrounding whether Scotland would accept vaccinated cattle: *'Scotland wouldn't have cattle from here because they're free of TB and they wouldn't want our cattle'* (Auctioneer, England).

Overall, it appears that a **consistent approach to vaccination and collaboration** between the devolved nations is likely to foster positive trading relations.

A key trading concern: the need for clear messaging for fostering trust in the implications of vaccination and DIVA testing on trade

Another key concern amongst participants was the importance of **building trust in a test which can accurately detect infected among vaccinated cattle**. DIVA testing is able to offer this, but **many participants had received little to no information** surrounding its efficacy, and as a result, lacked trust in it, despite this trust representing a prerequisite for any vaccination roll-out:

> *'There's the fear of false positives, many of my members fear the false positives, especially on gamma, so avoiding that is paramount. There is a perception that the tests are very poor. Our members have experienced occasions when they've had to break after they've purchased animals that have been pre-movement tested, they've brought them onto the farm, they've post movement tested them, and then those animals have gone down with a full herd test. And so quite rightly, they question the value of the previous tests. I have a case at the moment where the farmers have had numerous clear skin tests, but they've just gone down on gamma. And because of the gamma blood test rate of false positives, they're within the false positive rate of gamma for the size of the herd that they have. So there's a lot of apprehension about testing in general'.*
>
> – National farming organisation representative, Wales.

As illustrated in the above quote, distrust and misunderstandings surrounding the accuracy of current tuberculin skin tests for bTB may create an increased barrier amongst farmers when attempting to build trust in the DIVA skin test, as past experiences are likely to feed into how readily farmers build trust in this approach. This indicates a need for clear, consistent and continued messaging from Defra when promoting DIVA testing and cattle vaccination through, for example, workshops, social media campaigns, and advice/guidance. In addition, participants stated a need for clarity surrounding

whether other countries would accept the DIVA test as a reliable approach for detecting infected among vaccinated cattle:

> *'I think the overall impact will be very negative on an international trade, because I think everybody will run gently a little scared about a DIVA test on the international market. So those that are producing primary breeding stock will find that the demand for their breeding stock or the value of their breeding stock is potentially reduced'.*
>
> – Local farming organisation, England.

The above quote also alludes to a **lack of trust in and understanding of existing bTB tests**, which indicates that building trust in DIVA testing may be difficult without evidence and clear messaging. This lack of trust in previous tests also meant that stakeholders and farmers stated that DIVA testing would have to be proven as extremely accurate to encourage uptake:

> *'The DIVA test has GOT to be deemed 99.8% accurate. And the vaccination has preferably got to increase its efficiency to high 80s, 75 isn't good enough'.*
>
> – Local farming organisation representative, England.

Again, this appears to be due to distrust towards the accuracy of the existing skin test, and past experiences with other mandatory vaccines:

> *'Facilitators: The assumption is that the specificity [of the DIVA] is more or less the same as a skin test today.*
>
> *Participant: So that's not brilliant.*
>
> *Veterinary facilitator: The specificity is brilliant in the skin test, it's 99.98%, which, as tests go, is pretty damn good.*
>
> *Participant: false positives is good, false negatives is very bad. The point you make is a valid one. I'm just about old enough to remember brucellosis vaccine that we were forced to [do] that was compulsory I think. It was a vaccine called S19. And there were odd cattle that reacted to that vaccine, inconclusives, that had to go to slaughter, young animals that you just got in calf for the first time, always a bone of contention that, I can just remember that from the late 1960s'.*

- Whitchurch farmer workshop.

A UK-wide assurance, regulation and advisory body explained that the DIVA test must be accepted not just by farmers and the UK, but also by export markets, including the EU:

> *'I would be very suspicious of the efficacy of the test because, how do I differentiate? (…) The test being 100% accurate, the Diva. I don't know I don't know how good it will be. But let's take another example of that, how this works in disease control, infectious bovine rhinotracheitis IBR is a disease, which is export certification, and you can vaccinate, there is an IBR vaccine which is Gene deleted, so there was a diva test. And yet that is not trusted by the EU. They will not allow semen from IBR vaccinated bulls, whether they're with a gene deleted vaccine, or the old conventional one, they don't trust the diva test. It's not only going to be a good test, it's got to be a convincingly good test. That's not necessarily the same thing. Okay'.*
>
> – Assurance, regulation, advice stakeholder, UK.

The above quote refers to the roll-out of the IBR vaccine, which appears to have affected the views of pedigree breeders in particular, due to becoming unable to trade semen for a period upon vaccination. The rollout was championed and marketed to reduce losses and improved growth rates; however, vaccinated cattle then tested positive for IBR (British Blue Cattle Society, 2021). Farmers were left unable to export live cattle or germinal products (e.g., semen and embryos) which had tested positive as a result of vaccination (see British Blue Cattle Society, 2021; Iscaro et al, 2021). This appears to have led to reduced trust amongst these participants, who would need a high level of reassurance that vaccinating will not affect their ability to trade:

> *'Yeah, so I suppose it sits there as to the export market, how big an export market is there for the cattle anyway. (…) I think there will be, when we start looking at a lot of the breeding stock, and where we've sent animals abroad for breeding, a lot of them are wanting disease free. I think a lot of that would be around, can I 100% differentiate between an animal that is potentially carrying the disease or potentially infected versus an animal that is vaccinated? And I think that will be your Crux for any kind of international trade. Because if you look at some of the IBR marker vaccines, because we can do that and can show that that is 100% associated with that marker vaccine. It's almost worth a conversation with some of the bull studs, breeding facilities, because they have really strict intakes into those. So, a lot of farmers prefer the herds to be free. And then there's blood samples to show that the animals themselves are free. So almost avoiding a lot of vaccines, because they would rather bring them in free. And it's very easy to then go where actually they're 100% clean of these diseases rather than being associated with any kind of vaccine''*.
>
> – Vet, England.

Uncertainty fed in here too, with participants concerned about their ability to trade bull studs and semen upon vaccinating their cattle:

> *'I don't know what the ramifications are for semen being exported, imported. I don't know what the ramification is on selling the bull to Europe or even flying a bull over to Canada or somewhere where the Herefords are. I just, I can't help you with that dynamic of the trade'.*
>
> – Regulation, assurance, advice stakeholder, UK.

Some participants believed that DIVA testing and/or vaccinating would restrict trading with the EU, however, they did not necessarily perceive this as a significant challenge if they can continue trading across the UK: *I would give up the export market because the UK market is plenty big enough in return for not having two weeks of hell every year for me and the family.* (Pedigree breeder, England). A few participants placed more importance on having access to DIVA testing for trading than on vaccination itself, as protection rates garnered from vaccinating mean little if there is no robust test for providing negative tests as a result:

> *'I have to say, for me, I think the DIVA test is the more interesting thing. And I think that as a test itself, it will be really nice to think that that is a better test than we currently have. And it differentiates from vaccinated animals and non-vaccinated animals. But actually, if it's a test that is better, that would be probably a more significant move in TB control than maybe the vaccine'.*
>
> – Local farming organisation representative, England.

Based on the uncertainties conveyed during trade-related conversations, it is not appropriate to make statements on how trading may be affected by vaccination of cattle. This requires further research

and investigation. The opinions on potential impacts were nearly always caveated by stakeholder interviewees with uncertainty regarding the technology and associated testing regime. What the responses indicate then is a **clear need for communications from Defra and the devolved administrations to reassure farmers and industry stakeholders that they will be able to continue trading as usual with vaccinated cattle**.

Exploring attitudes towards cattle vaccination through the EAST framework

The following sections examine, in more detail, how and why farmers and stakeholders responded as they did to the hypothetical scenarios we presented, using the EAST framework to organise and interpret the findings. Table 4 provides an overview of the factors identified as affecting attitudes towards cattle vaccination during the farmer workshops and stakeholder interviews and how they map onto the EAST framework.

Table 4: Overview of themes relating to cattle vaccination relative to the EAST framework.

Easy (e.g., default settings)	Attractive (e.g., incentives)	Social (e.g., organisation)	Timely (e.g., at the right time)
Vaccine efficacy / effectiveness	90-day meat withdrawal	Trust in the government	Universal vaccination rather than targeted
Mandatory vs. voluntary	Reduced testing requirements	Role of farmer organisations	Timing of vaccination
Vaccine delivery	Adjustments to compensation		Flexibility in the approach (timeliness)
Recording vaccination status	Direct cost of vaccination		
	A perceived need to control wildlife vectors of bTB first		

Making vaccination easy

In this section, we provide in-depth findings which correspond with what might make cattle vaccination easy (or difficult). Firstly, we explore reactions to a default setting, where vaccination would be mandatory. We then examine some of the factors that may make mandatory vaccination easier to accept. These include:

- Vaccine efficacy and effectiveness;
- Whether vaccination should be mandatory or voluntary;
- Who should vaccinate cattle on the ground (delivery); and
- How vaccine status should be recorded.

Vaccine efficacy and effectiveness

Before we consider who should vaccinate cattle and whether it should be mandatory, it was important to firstly understand whether farmers and stakeholders believed that vaccination itself will be efficacious and effective. Where vaccination is not perceived as efficacious, this will make any roll-out difficult, regardless of the model used.

Throughout the workshops and interviews, it became clear that regardless of the vaccination strategy used, stakeholders and farmers require clear, transparent messaging surrounding the vaccination. This relates to evidence surrounding the efficacy of the vaccine itself, information justifying the approach used, and reassurance around the reliability of measures used to differentiate between vaccinated and unvaccinated cattle (e.g., through DIVA testing).

> *'We're going to need good comms to do this. And actually, that's one of the negatives you hear: 'oh the BCG vaccine is 100 years old'. Well, that doesn't matter if it works! As long as you get the comms right, I think we're pushing on an open door here'.*
>
> – Pedigree breeder, England.

Based on current understandings of the protection rates offered by the bTB vaccine in cattle, we set a protection rate of 85% across all three hypothetical scenarios. Conversations surrounding this percentage were mixed between participants. Whilst many responded positively, with a few even suggesting they would accept a lower protection rate, others argued that a higher protection rate is needed before the vaccine should be rolled out. Some participants had unrealistic expectations of the protection that cattle should gain as a result of vaccination against bTB due to perceptions (whether correct or incorrect) that other vaccinations (e.g., BVD) are more effective than the 85% suggested in our scenarios. In terms of stakeholders, most views aligned with those of farmers. A few did, however, question whether farms would still have to shut down if they had vaccinated their cattle; if not, the protection rate was seen as of little significance.

A few participants also made comparisons against human-administered vaccines, e.g., the recent COVID-19 vaccines. As a result of Covid-19 vaccine experiences, these participants were reluctant to believe protection rate percentages until the vaccination had been rolled out. For example:

> *'It is hard to trust, isn't it? Because, like you said, with the tests, you know, a bit random. So we have no kind of trust in that. And it's the same with COVID vaccines, and I've been vaccinated by the way, I sound like an anti-vaxxer. But in the start, we were told that the efficacy was so high you wouldn't pass COVID on once you've been vaccinated. But you know, the further it goes along, you realise that most of that's not true, you do pass it on just as easily, and so on. So, with this, having a figure now, it's kind of hard to trust that that is going to be as simple as that'.*
>
> – Ruthin farmer workshop.

Some stakeholder participants also suggested that 85% protection is not high enough to justify a mandatory roll-out and that more evidence is needed prior to accepting a given figure:

> *'To make all this a legal requirement when we're the vaccine is 85% effective, I think will be impossible, there'll be a massive, massive rejection from the industry and as an organisation, we wouldn't support that. But then we can support the vaccination trials and to see where we*

are. But you can't go straight into this without more scientific studies based on what's available'.

– National farming organisation representative.

Both farmers and stakeholders referred to a need for more evidence surrounding how vaccinating cattle will control bTB, alongside evidence surrounding DIVA testing. In some cases, this evidence may already exist, indicating that there needs to be greater energy placed on dissemination and clear messaging. Many of these conversations related to a need for information surrounding the technical aspects of vaccinations:

'For us to make a decision, I think we need to know the science. If an animal has got TB anyway, and you've vaccinated, so if the animals contracted TB from its mother, through milk in the first 12 weeks of life, and then you vaccinated at month four or five or six, does that mean that the animal won't ever exhibit signs of TB? Does it mean that it will, but yet it's expressive, the bacteria becomes less because it's been vaccinated. What is the science behind that vaccine, and then you can sort of sort of come up with a plan of well, in that scenario, you could do away with pre-movement testing, but you still need to go to annual test, or, you know, how does given that vaccine affect the industry and the animals sort of life? Because otherwise, without that information, we're sort of making assumptions'.

– Regulation, assurance, advice stakeholder, UK.

Farmers across the workshops were also in need of further evidence to encourage vaccine uptake whilst reiterating that this evidence should be presented to them by someone they trust:

'I just want to hear advice from a scientist as opposed to a politician. I think we're miles behind. I don't think 2025 is at all realistic.

Um, I'm still quite muddled about the fact that I don't know the science behind it. I think if I knew the science evidence behind it, then I could say to you, we would definitely do something. Can I say that if I don't know the scientific evidence?'

- Pembrokeshire farmer workshop.

Participants in Louth held strong debates surrounding acceptable protection rates. This is likely due to the LRA status in the area, which made some participants slightly less willing to accept an 85% protection rate, likely due to some participants having less experience with bTB; instead of focusing on the protection gained, they based their arguments on the '15% left without protection'. Other Louth workshop participants who had travelled from further afield from a nearby HRA contested this view due to having had repeated bTB breakdowns and thus greater recognition of how detrimental the disease is to farming businesses. In agreement with many other participants from across the workshops, these participants felt that 85% protection is far better than no protection. These participants were generally those who have experienced or observed bTB cases on or near their holdings, or because they have closed herds. The following quote demonstrates how 85% may be acceptable to some but not to others:

'I think it would significantly lessen the risk though. So a herd like ours, that's totally closed. If it was 85%, it's significant. Whilst Bovela [BVD vaccine] is 99% protective, the BVD vaccines are very protective in a different way, it's much more than this. BVD, and partly because of the way the disease works are predominately because [inaudible] it's very quick and so you're not going to get the same protection, as this. My feeling is a bit of a mixed bag, if it's a completely

closed herd, it will give you significant peace of mind, if you have nobody on your borders, or you don't think you've got an infection in your area. If you think there's still infection in the wildlife in your area, and it's still bringing it repeatedly back in and you are still left with a TB test and go down with a TB test, we're not going to be spending £6 a head if there's TB out there in the wildlife'.

- Louth farmer workshop.

The above quote, however, suggests that some farmers may be less accepting of lower protection rates whilst there is a perception that wildlife vectors of bTB are not being controlled. Some stakeholders also shared this view; that where protection rates are not perceived as sufficient for fostering bTB control, that badger culling will need to remain an option:

'If it is 85%, people would turn around and say "well, therefore we need culling", but then that's pre-judging the fact that do we know we can trade. Because if people can vaccinate the cattle, and trade as normal, then why wouldn't you? But when there's the other kind of stuff from culling that isn't talked about, not allowed to be talked about because TB cattle related, but it's in terms of other kind of wildlife. You know, just the fact that [TB in] the population of badgers, is unnaturally high'.

– National farming organisation representative.

Other participants, for example, in Pembrokeshire, suggested that protection rates lower than around 75% would deem the vaccination unfeasible for controlling bTB. This view, whereby protection rates below a certain figure would render the vaccine unfeasible, was also held by many stakeholders. For example, the lowest acceptable protection rates according to interviewed pedigree breeders was 70-75%. When discussing trade, however, stakeholders including buyers and auctioneers, argued that a protection rate lower than 85% may pose problems for trading due to this being less attractive to buyers:

'Suddenly the great leveller that vaccination is no longer the great leveller, it becomes less finite in its ability to improve trade for those farms that maybe are in a high-risk area, or who've had TB in the past. If industry questions the usefulness of something, then the impact on trade is as though it had never been vaccinated. (…) If I take a vaccine with 85% protection, then I'm basically saying to my buyers, I am protecting my stock. If I take a vaccine with just 65%... It's a very difficult sale to a buyer'.

– National farming organisation representative, Wales.

The same participant recognised that many farmers will try anything due to a desperation to reduce their risk of experiencing repeated bTB breakdowns:

'Don't get me wrong, I still think that even at a lower efficacy my many of my members will want to take it up because they'd want to protect their stock as best they can. So I'm not seeing for a second that that that level of protection would suddenly negate people using it. It's just that when you're talking directly about an animal's attractiveness at market, that's where it changes. I think the vast majority of farmers even at 50% would probably take a punt on a vaccine, simply because they've got nothing else that they can do, but that's very different to you know, taking animals to market with 50% protection - it doesn't have the power to improve the animals' status'.

Having unpicked the varied discussions surrounding acceptable protection rates for a cattle vaccine, it appears that most farmers would accept 85% as an initial rate as long as they are still able to trade, and where the vaccine is free at the point of delivery. However, some may not immediately accept this, providing further impetus to make any roll-out mandatory. It appears that previous experience with bTB has an impact on whether participants accept an 85% protection rate; whilst those who have experienced repeated breakdowns will likely vaccinate regardless of the protection garnered due to a willingness to 'try anything', those who are less aware of the risks of bTB breakdowns had higher expectations.

Again, clear messaging is key when communicating with farmers about protection rates. The below quote uses examples of successful clear messaging to explain that messages surrounding vaccination should be simple, clear, backed up by evidence, and piloted with farmers to ensure they are clear:

> *'We need simple, clear messaging, rather than loads of trials and things. If the simple messages are true, if people really want to dig into the scientific information, it's always there, because it's true. I think if those messages are presented clearly, and tested so that people that farmers are going to understand them, because those messages can be piloted on farmers, I think simple clear messaging would be the way forward, a very small number of points just repeated over and over and over a bit like they did with COVID, whether the messaging was right or wrong, the messaging that came out was very blunt and crude: wear a mask, wash your hands stay at home, but people did understand it, and they knew what it meant. It was then down to whether they believed the evidence, but I think they at least understood what was being asked of them even if they didn't like it or believe in it. There's been some good examples of clear messaging with regard to say the five-point plan for lameness. Now farmers have got that message. And when you're actually on the farm, you can have that nuanced discussion, but the clear messaging is don't foot trim sheep. And that message is got through even though it's crude, and not well nuanced, but I think you could have clear messaging like that coming out on the bTB vaccine'.*
>
> – Vet, Wales.

Mandatory or voluntary vaccination

Many participants across all five farmer workshops supported the notion that a vaccination rollout should be mandatory, due to agreement that all farmers need to vaccinate their cattle to 'get on top' of bTB. In total, 26 of the 34 stakeholder participants provided support for a mandatory approach. All vets, auctioneers and trading bodies were supportive of a mandatory approach to cattle vaccination. National and local farming organisations and regulation, assurance and advice-related organisations were more mixed, but the general consensus was supportive of a mandatory approach. The only stakeholder participants who did not fully support a mandatory approach were pedigree breeders and the supermarket interviewee. Farmer participants in the five workshops broadly supported a mandatory approach, with a few exceptions and caveats. Workshop participants in Frome appeared the most supportive of a mandatory vaccination rollout.

As explained from pages 48-49, many farmers and stakeholders appear so frustrated by a perceived lack of bTB control that they believe there needs to be a concerted effort by all. According to participants, this effort will **require government intervention**:

'I'm at my wit's end after 25 years of being shut down, it's happened for all my working life. I am just sick of it. And we come to these things, I've had to cull my herd as well as badgers. Something more draconian needs to be done to sort it out so that we can overcome it'.

- Farmer participant, Frome workshop.

Across the farmer workshops and stakeholder interviews, there was general consensus that any **mandatory vaccination roll-out should be national, free at the point of delivery, and include flexibility** in terms of when vaccination happens:

'I don't see how you could do it any other way. We couldn't do it on a voluntary basis. I think I would have had mandatory vaccination for COVID and I'm sure lots of people have drawn parallels with that. But if you're going to get on top of any endemic disease, you've got, everybody's got to join. Otherwise, you'll end up with reservoirs of infection that haven't been tagged'.

– Auctioneer, England.

Many participants exhibited frustration that bTB is not under control in England, concluding that a mandatory, national approach is needed to tackle the problem. The following participant drew on their cull experiences to explain that gaps in uptake will not eradicate bTB:

'I am more concerned about everybody. [Other participant: Yeah!], like the badger cull- So what is, is this really doing? Where I live. We've got an 800-acre farm in the middle of a whole group of us who doesn't do it, so then these badgers just come into ours. This would be exactly the same with vaccination, everyone needs to do it, but with no cost, if we're going to implement it properly. That could work, but if half of us did it and half of us didn't, it'll be wasted time, again'.

– Frome farmer workshop.

Some farmer and stakeholder participants also suggested that vaccination should be mandatory rather than voluntary, if there is evidence that the vaccine will be effective:

'The reason that Johne's has crept through in the past, and they've changed the rules now, is that some people didn't treat the animals…they are going to be at greatest risk, those that have TB in the first place and if we don't do them because it's voluntary and difficult, are we just creating an ongoing thing? You kind of ***feel like you have to go for it all****, in which case, the 90-day withdrawal might be an issue for you, especially if they have to be bTB tested still at the abattoir. And we know that that's a bit hit and miss at the best of times, but we don't want it to come back and show that it doesn't work. If we're going to go down the route of vaccinating, we have got to believe that it is working. And* ***if we're missing the risky animals, will it look like it's not working even if it is****?'*

- Louth farmer workshop.

Some participants also believed that by making vaccination mandatory, this could reduce the need to undertake pre-movement tests, and eventually move away from having to shut down. Other participants supported a mandatory approach but suggested that this should be relatively light-touch and delivered by vets rather than the government (see pp. 30-37).

There were, however, some participants which pushed against a mandatory approach in the initial period of introduction, with participants in the Whitchurch workshops, alongside farming organisation

representative interviewees, suggesting that vaccination could become mandatory over time, but once certain issues had been addressed, largely relating to a perceived need for evidence surrounding efficacy, clarity surrounding trading, and general messaging. The following quote illustrates one of the stronger negative stances towards immediate universal vaccination:

> *'You can't make it a legal requirement and compulsory, with the amount of information that is available at the moment. You're potentially* ***restricting our members from trading****, because there will be a resistance to buy vaccinated cattle from hotspot areas where there's not the same resistance to buy tested clear cattle at the moment, and we're not paying compensation again. To make all this a legal requirement when the vaccine is 85% effective, I think will be impossible, and there'll be a massive rejection from the industry and as an organisation, we wouldn't support that, but we would* ***support the vaccination trials*** *to see where we are. But you can't go straight into this without* ***more scientific studies*** *based on what's available'.*
>
> – National farming representative, England.

A trading body (UK-wide) also suggested that vaccination could initially be voluntary, with a set date where it becomes mandatory:

> *'You could introduce it as voluntary with a clear statement that it's going to be* ***mandatory from a certain date****. I think to be effective, you've got to get to a mandatory point. (…) Ironically, for us, the cleanest thing to do is make it mandatory, where everyone's treated the same and there's no pussyfooting around. (…) It could have a* ***transitional period of time****, where they do it where the government pay for it to start with and then ease it out over time, with farmers stating to pay once it* ***becomes the norm****. Have you also spoken with Red Tractor, there could be an option there where red tractor make it mandatory*?'
>
> – Trading body, UK.

Some participants across the workshops and interviews were against a mandatory approach, either due to a political stance which conflicts with draconian approaches, due to a belief that social pressure and the benefits of vaccination alone will result in widespread uptake, or because there needs to be clear evidence and data of the resulting protection from bTB. The main stakeholders which held these views were some pedigree breeders, some farming organisation representatives, and the supermarket we interviewed:

> *'The mandatory route is a bit directive, isn't it? And we've never had a directive in that way. There would need to be* ***real engagement with the industry to understand all of the consideration and variables for going down a mandatory route****, and what it would mean for a processor from a due diligence and paperwork perspective, when animals are being moved from a farm to a factory or an abattoir. And how does it link in with BCMS, or the livestock information service? How does the vaccine passport link into the supply chain? Also, is it right for a farmer is a criminal because he or she hasn't had a vaccine for TB, or because their vaccine has lapsed? That doesn't happen in any other industry, as far as I know. For example, in the equine industry, you vaccinate your horse against flu but it's not mandatory, but if you're competing your animal, then you have to show that your horse is vaccinated because we don't want flu being passed around the equine industry, but it's not mandatory'*.
>
> – Supermarket, UK.

Whilst there was some deliberation, with some participants supporting a voluntary approach due to compulsory interventions being seen as 'draconian', the majority of interviewees and workshop

participants concluded that a mandatory approach, whether immediately implemented, or over time, is the best way to ensure vaccine uptake across the country.

Vaccine delivery: who should administer cattle vaccines?

Workshop and interview participants held several conversations surrounding who should administer a cattle vaccine. This topic consisted of conversations which refer to both ease of vaccination and the trust (social) side of things. The idea of farmer-led vaccination under the individual responsibility scenario and the possible role of veterinary technicians in administering cattle vaccines as part of the vaccination company scenario prompted lively discussions, even though the overarching models were not popular or perceived to be easy. Below we summarise the discussions about who should administer cattle vaccines. Across the three scenarios we captured a wide range of views.

Amongst stakeholders, **vets and/or veterinary technicians were the most accepted potential vaccinators**. Many were also receptive towards the idea of APHA vaccinating cattle, assuming they were resourced properly, with trusted known vaccinators. The responses overall were: APHA (n = 13), vets or vet techs (n = 11), 'not' farmers (n = 7), farmers (n = 5), 'not' APHA (n = 6), 'not' vets (n = 3). In the farmer workshops, **vets and veterinary technicians were also the most popular option** for administering vaccines. APHA were also considered an option, but again, only where they are sufficiently resourced to deliver the vaccinations. Some farmers were concerned about the **time burden placed on whoever vaccinates cattle**, particularly on farms with a high turnover of livestock, resulting in a need for regular administration of vaccines.

Veterinarian/vet-tech-administered vaccination

Vets make regular trips to farms for routine visits, and are generally trusted and known to farmers (Richens et al, 2016; Bard et al, 2019). Across both the workshops and interviews, participants were receptive towards the notion of vet-administered vaccination, though there were concerns relating to cost and the time pressures vets are already facing. For vets to vaccinate cattle efficiently, many participants placed importance on using local trusted contacts and making it easy for farms to vaccinate alongside other herd health checks and/or other vaccinations or routine treatments:

> *"Maybe it should **be local vets - farmers like routine, they like seeing the same people** and I think seeing people you know is important…having a different random APHA person turning up all the time, would just, especially if you're aiming to do like cattle coming on every four weeks and you're waiting for a different APHA person to come out. If you've got a routine vet who comes every week that we all know... yeah".*
>
> – Auctioneer, England.

Pedigree breeders were also more likely to favour vet-led vaccination, again due to wanting to ensure that the vaccine is administered correctly. These participants were likely more sensitive to this than other farmers due to the high-value of their stock; as a result, they were also more willing to pay towards vaccination (see also pp. 43-45):

"[I would want it to be] my vets practice rather than a government appointed third party, because that would just ***lead to the lowest qualified, cheapest available people*** *turning up. I want someone who's* ***at least affiliated with my vet practice****, because I have a choice over which vet practice I choose. And I choose one that's very good".*

– Pedigree breeder, England.

Workshop participants agreed with these views, with trust coming up consistently. In addition, vets were also favoured because of a perception that whilst they may place some trust in APHA, they believe that they don't have the resource to vaccinate cattle directly at present:

'You can ***have a conversation with your vet****, whilst if you try and talk to the APHA you're not guaranteed to get any answers, especially not when* ***they're busy with avian flu****. That was a big issue. I sit on calls about avian influenza and fair play to APHA, what they've suddenly had to do deal with, that's probably why we've got all these zones still in place, because* ***it's literally the resource of trying to do everything****. So, to throw this in, it would need a* ***massive injection of resource*** *just to focus on this to actually get it done. And* ***where do they find these people?'***

- Louth farmer workshop.

Some participants also believed that vets would be more flexible in terms of timings than an APHA representative could be:

"I would get Defra or APHA to tender it out to somebody else, possibly your local vet, then it's a bit more ***farmer friendly****. And you can* ***fit it in with other jobs.*** *Because if APHA comes, they'll want a specific date, and if you're worming cattle, why don't you vaccinate them at the same time? Make it as simple as you can. Just keep it simple****, don't have a two-tier system [mandatory]****. Simple works!"*

– Local farming representative, England.

The only concerns surrounding vet delivery of vaccinations, shared by some farmers and vets, related to costs, vets themselves feeling that they do not have the time (though less bTB testing could free them up for vaccination instead), or a concern that vets will be blamed if there is a bTB outbreak post-vaccination. In response to the cost side of things, some participants suggested that should bTB testing continue, if vaccinations could be carried out simultaneously, this may cost little more time and resource due to vets already visiting the farm:

'When you've got the vet coming on farm anyway, that's actually not going to cost the government much more compared if they are going to pay another visit for him to come back. So do a TB test, and as things get passed they get vaccinated'.

- Frome farmer workshop.

Overall, **vets and/or veterinary technicians were the preferred vaccinators,** largely due to their trusted status' within farming communities; this indicates that as well as being an 'easy' trigger, who vaccinates cattle is also an important 'social' trigger.

APHA administration

As aforementioned, whilst participants accepted that APHA may organise a vaccination roll-out, many participants rejected the idea of APHA representatives delivering vaccinations due to lack of trust and a perceived (or real) lack of resources, largely due to the realisation that APHA are already busy with other controlled diseases, notably avian influenza. These resource constraints also led to concern surrounding whether APHA could offer enough flexibility when coming to vaccinate.

> *"Yeah, I'm sure they could do it, they've done a lot of TB testing. And so long as they have the resources to do it, I have no concerns whatsoever with APHA delivering it. My only concern would be will they be given a sufficient budget to do it? I mean, if they have, yeah, of course, they will. I've no doubts at all that they'll deliver it and deliver it very well"*
>
> – National farming representative.

Some participants were so concerned about APHA's apparent lack of resource that they questioned their ability to organise the administrative side of vaccination, let alone vaccinating cattle themselves:

> *'Facilitator: How do you feel about APHA running a vaccination programme?*
>
> *Participant: No chance.*
>
> *[Lots of nodding around the room]*
>
> *Participant: I think you're gonna have to have APHA run it, because they have the information on all the cattle and they run the TB testing, so they've got no option. They'll need to keep control anyway. Especially if they're paying compensation. They're not that give that out to somebody else.*
>
> *Facilitator: Why are others not so keen on APHA?*
>
> *Participant: They're already overstretched as it is, they're busy with avian flu. You know, can it not be something where it's a more vet led? Because every farm has got a vet'.*

- Whitchurch farmer workshop.

Many stakeholders agreed with the above, citing resourcing concerns. Most vets, however, also pointed out that vets are also extremely busy. As a solution, they proposed that veterinary technicians should be able to vaccinate cattle.

Overall, it appears that **if APHA were resourced sufficiently, they would be the second preference for vaccinating cattle after vets**, according to the farmers and stakeholders we interviewed.

Farmer-administered vaccination

The individual responsibility scenario prompted much discussion during the stakeholder interviews and farmer workshops surrounding whether farmers should vaccinate cattle. We gathered mixed views; whilst some believed it would be easier to allow farmers to vaccinate where they are provided with sufficient training, others were sceptical, arguing that farmer-led vaccination may result in failed vaccination attempts, e.g., due to inappropriate storage, risk of fraudulence, timings, and the capability and availability of farmers to administer the vaccines themselves.

Some farming organisation representatives explained that farmers already vaccinate for other diseases, thus should be trusted to vaccinate against bTB. Training and record keeping was a key trigger for making farmers suitable for vaccinating themselves:

> *"Provided it was administered in the same way as any other vaccine that farmers already administer, then they **should be trained to do it**. (…) I suppose my concern would probably be in terms **of record keeping, you would need really stringent rules** around recording when the vaccine was given so that you know your withdrawal periods, for example"*
>
> – Local farming organisation representative, England.

Some farmer participants held this view too, citing logistical reasons why farmers may be best placed to vaccinate, particularly when they have a high turnover of cattle:

> *'P13: Would it be a bad thing for that animal to be vaccinated perhaps a month before it's got its annual top-up? Has it got to have two jabs within the same 12 months, is that acceptable? And if so, **the only way of getting around it is by enabling the farmer to vaccinate** those calves at the 8-week point.*
>
> *P9: It's **not financially viable for vets when you calve** all year round, because they're going to come for a couple here, a couple there, it's not going to work'.*

- Pembrokeshire farmer workshop.

Stakeholders were generally more reticent than farmers about the appropriateness of farmers vaccinating cattle, largely due to concern around whether farmers would vaccinate accurately enough:

> *"I would have quite a few concerns about farmers administering the vaccine. You know, **how many hours can the bottle be open for** and things like that. I could think of plenty of farmers that would probably maybe even, including myself, that you know, if it says the bottle can be only open for five hours. But actually, they'll think, well I've left it seven hours because would it really make that much difference? So, **administering the vaccine would make me a bit nervous**".*
>
> – National farming organisation representative, Wales.

This was a view shared by several farmers across the workshops, indicating that farmers themselves recognise that their peers may not be equipped to vaccinate for themselves:

> *'P1: My problem would be compliance. **Getting everyone to administer it properly**, every year. If it's going on BTS, **how do you confirm that they've definitely had the vaccine**? There's nothing to say that they've not squirted it in the air, or its still in their fridge, or the fridge broke*

*and the **vaccine doesn't work** or something. **Why can't the vet do it and the government**... the farmer pays six pounds a head and the farmer gives the vet a pound for doing it?*

P2: and we could certify that it's definitely had it, same as a certified TB test. Are vets going to want to do that bearing in mind how little money you make out of TB testing now?'

- Whitchurch workshop.

In addition, a couple of stakeholders were worried that some farmers may commit fraudulent activities surrounding bTB vaccination:

> *"I think you have to be really careful about that, farmers administering vaccines, because there's almost an incentive for fraud. And that's me sounding like a very sceptical individual"* – Vet, England.

Overall, it appears that **farmers are not the best placed for vaccinating cattle**; even if just a small minority of farmers administered the vaccine incorrectly, this could have a detrimental impact on the ability of a vaccination roll-out to control bTB. There are also implications for trade in terms of accurate recording of vaccinated and unvaccinated cattle and whether trading bodies and auctioneers would trust farmers to have vaccinated their cattle.

Recording vaccination status

Participants in both the workshops and interviews supported the idea of there being a simple way of recording vaccination status amongst cattle. As most participants supported an immediate or eventual move towards mandatory vaccination, however, recording may become less of a requirement over time as it may be assumed that over time, all cattle would eventually end up vaccinated under this scenario, negating the need for records. This may not be achieved for several years after a vaccination roll-out, however, so ways of recording vaccination status remain important.

Workshop participants showed a **willingness to display their vaccination statuses**, as this is something that they already do in many cases. A couple of participants were concerned by a digital-by-default approach, questioning the ability of certain farmers to keep up with these technologies.

Most participants across the workshops and interviews were relatively content with the idea of recording vaccination status on livestock passports, iBTB, the Livestock Information System (LIS), or the Cattle Tracing System (CTS) on the understanding that whichever platform is used, that it is kept simple and easy to use. Some also suggested that vaccination status could be recorded on ear tags for ease:

> *'If we're not all vaccinating, then there needs to be an easy way to identify animals that are vaccinated. Potentially, that's an ear tag. You'd need to be able to see that information easily because I don't know how many people would spend time rifling through the paperwork. And you know, it's just very clear and simple to make sure you don't buy [unvaccinated cattle] by accident. I think if the vaccination proved after 3-4 years that incidence was going down, then trading should get better for everybody'.*
>
> – National farming organisation representative, Wales.

Some participants, including the auctioneer below, were keen to begin using LIS due to its perceived ability to record several types of livestock information. They were, however, less trusting of CTS due to a perception that it does not record movements effectively.

> *'We're just about to change from the movement service to the new Livestock Information Programme (LIP). And the LIP is going to have basic animal details attached. Other things like farm assurance, which is the red tractor TB status, so that you can you can read a passport or a barcode. And it will tell you that all these things that are there are there at the moment. BCMS does one thing, it just records the movements badly. But it doesn't have these extra add ons that we are led to believe that when the new system comes out, you can add these various things to it'.*
>
> – Auctioneer, England.

Auctioneers were particularly vocal about the need to keep clear records among vaccinated cattle:

> *'Our **buyers around the ring will want to know vaccination dates** or time validity left on tests, one or the other. That would have to be delivered through a **database that we could all access electronically**, we will not accept the complete mess that bovine TB is in, where you have requests for risk-based trading and all the rest of it, but government don't deliver any database that anyone can rely on. Then when it's set up, you would need to integrate it into, I would suggest, the **livestock information programme** which is being launched for sheep at the end of this month and then for cattle later on - you want this to tag on to that, in my opinion'.*
>
> – Auctioneer, England.

Some participants also referred to recording vaccination data when discussing whether vaccination should be mandatory; where clear records are kept, a few farmer participants suggested that this could enable vaccination to be voluntary as buyers would be able to decide for themselves whether to purchase unvaccinated cattle. However, as also explained elsewhere in this report, there was a perceived risk expressed by several participants that this could result in a two-tier market:

> *'It just worries me that you've got to write down on your passport has been vaccinated. Because does that mean we're gonna end up seeing unvaccinated and vaccinated cattle in the market? At different prices? That would worry me'.*

- Whitchurch farmer workshop.

According to some workshop participants (e.g., in Whitchurch), the need to accurately record vaccination status provided further evidence that farmers should not vaccinate cattle themselves due to a risk of misinformation:

> *'When you put it on the passport, it's not just his loss [if the vaccine is administered incorrectly], because it's going on the passport, isn't it? If they can't get the jab into the animal, will they bother to get the passport altered?!'*

- Whitchurch farmer workshop.

In summary, most participants were willing to have their cattle vaccination statuses recorded on a public platform as this is not something they are unfamiliar with. The key premise is that the chosen platform is clear and simple.

Making vaccination attractive

This section considers how different incentives and/or aspects of the vaccination process make vaccination (un-)attractive to farmers. Our key findings are:

- Vaccine withdrawal periods make a cattle bTB vaccine unattractive;
- Reduced bTB testing makes vaccination attractive;
- Enhanced compensation makes vaccination attractive;
- Low cost of vaccines make them attractive; and
- Vaccinating cattle may be more attractive when participants feel wildlife vectors of bTB are 'under control'.

A 90-day meat withdrawal

A significant barrier to making vaccination easy and attractive was the 90-day meat withdrawal period included in all three scenarios[6]. This was **consistently perceived as difficult by both stakeholders and farmers across all discussions**, with most stakeholder participants (n = 24) being explicit when describing their concern. **All vets, auctioneers, and local farming organisations alongside most farmer participants shared negative views towards the proposed withdrawal period**. This was due to concerns that a 90-day withdrawal period could have **significant repercussions for trading and their logistics**. The views of pedigree breeders, regulation, assurance and advice organisations, and the interviewed supermarket were mixed. This was one of the largest themes across the workshops and interviews and a **key trigger to consider before rolling out any vaccination programme.**

Timing appears key here, with participants suggesting that they would need to vaccinate at certain times depending on their livestock, trading plans, and management styles. For example, several participants questioned whether cull cattle or beef finishers should have to vaccinate cattle. The following quotes provide a summary of how stakeholders reacted to the idea of a 90-day meat withdrawal, with themes largely relating to trading, timings, and associated costs:

> *"That could be a bit complicated. If you can't get your windows right for the meat withdrawal, it could add on a lot of cost when you're trying to sell, and that's not very good, either, then for our carbon footprint. There probably be variation between breeds, so native breeds are slower maturing. So is that an advantage or a disadvantage, if you're trying to get through a 90-day meat withdrawal, it all depends"*
>
> – National farming representative, Wales.
>
> *"The withdrawal period of 90 days is going to be quite an issue for me. I mean, 90 days is a very long time... From a practical point of view, I mean, I sell store cattle, most farmers, finishing farmers who buy cattle off me, will probably want to finish them in 90 days or less. They're certainly not going to want to have a 90-days withdrawal period. I think 40 days, that's the maximum withdrawal period which would be acceptable"*
>
> – Cull director, Wales.

[6] 90-day meat withdrawal period is based on the current guidance from the Veterinary Medical Board (VMD) (see TBhub, 2022: https://tbhub.co.uk/ (accessed: 29.08.2022)).

Beef farmers expressed particular concern surrounding timing, as a 90-day meat withdrawal was seen as impractical for their enterprises. Most dairy farmers, meanwhile, were indifferent due to the lack of a milk withdrawal period (see TB Hub, 2022). The 90-day meat withdrawal period was seen as of particular concern under the mandatory scenario, as farmers would be forced to vaccinate even if it has a detrimental impact on their businesses:

> *'Are we presuming it's a whole herd that's mandatory, so that means you can't sell any meat for three months; that's the bit that worries me, having beef [room agrees]. I think that's the case for everybody in this room with cull cows. Surely, they must realise that if it's mandatory, you can't have a 90-day meat withdrawal? We'd be taking a quarter of our salaries and holding it back for 3 months, well half in the first year if you have to vaccinate twice!'*
>
> – Whitchurch farmer workshop.

Whilst the majority of participants stated that a 90-day meat withdrawal was one of the biggest barriers to vaccination uptake due to the difficulties it would cause them when trading, a few were farmers less concerned due to how their businesses are set up or due to other existing withdrawal/holding durations (e.g., under Red Tractor). Organic farmers were also particularly concerned by a 90-day meat withdrawal due to an (incorrect) perception that they are expected to double these periods as part of their certification. In reality, however, the Soil Association only requires doubled meat withdrawal periods for antibiotics, not for vaccinations (Soil Association, 2019).

Some farmer participants made suggestions surrounding acceptable withdrawal periods, with Whitchurch participants suggesting 30 days, in-line with antibiotic withdrawal periods. A couple of farmer workshop participants suggested that if there were a 90-day meat withdrawal, it would need to be under a voluntary approach so that farmers could decide whether they could work around this. As discussed by several participants, however, there was a nervousness that unless everyone vaccinates, there will be no bTB control, thus rendering this suggestion unfeasible if bTB control is to be achieved rather than tokenistic vaccination of some cattle (see ps 30-33). This concern around vaccination being mandatory links to trust in the government, indicating that farmers are worried about a rollout which is imposed without sufficient research, which could leave farmers in a worse position than before.

A couple of participants, including the auctioneer below, questioned whether there would be measures in place should farmers need to slaughter their cattle during the withdrawal periods:

> *'Who's going to compensate the farmers if an animal has to be slaughtered within the 90 days? So presumably, if governments are doing this government and making a law, they will compensate at open market value. Any animal that is slaughtered for any reason, has to be slaughtered for any reason within the 90-day withdrawal period, you know, it could happen. You know, animal breaks a leg or they do something else. And at present, if they can get them, get them slaughtered them on farm and get them to an abattoir in less than an hour, then they get paid for the meat. I would ask that question, if it's 90 days, we need an assurance that we can export that meat. And if we can't, then it will have a massive impact on the value of the product. You will then get a two-tier market, if we can export it, and it is the same as it is now. I don't see that being a problem. The 90 days is an interesting one'.*
>
> – Auctioneer, UK.

In summary, a **90-day meat withdrawal would not be well-received** by most farmers and stakeholders. If this is unavoidable, **any vaccination roll-out should be flexible** enough to allow farmers who trade regularly to vaccinate at times that work best for their businesses.

Incentivising vaccination by reducing bTB testing requirements

Several participants across all five workshops and in many interviews (n = 16) suggested that a **reduced need to test for bTB upon vaccination would encourage vaccination uptake** as this, in turn, would result in fewer breakdowns and associated pressures on the business and farmers' wellbeing alongside reducing time burdens:

> *'Having to do the test every 60 days when we do a lot of cows, it's dangerous! You always get an animal that slips, no matter how well you try to do it, you will always cause stress, when everyone's already pushed enough with other problems on farm, like staffing shortages. If you could save a couple of months by vaccinating it would give people a bit more breathing space'*.
>
> - Whitchurch farmer workshop.

The main tests participants believe could be reduced included pre- and/or post-movement testing amongst vaccinated cattle. In most workshops, there was also a general consensus amongst farmers that if vaccination were mandatory and delivered by all, there would be no need for long-term testing:

> *'My hope is that we can trade freely again, read a breeding herd, we used to sell a lot of stock bulls, a lot of pedigree cattle. If everybody was vaccinated, there's no need for testing. Save us a lot of time. I suppose that we can trade with farmers, which they were they were happy to buy until last government stopped selling them'.*
>
> – Pembrokeshire farmer workshop.

Several workshop participants also argued that current testing and breakdown regimes are too strict due to the perception that farms are being shut down due to just a few reactors, or because of false positive tests:

> *'A lot of the cattle you take away haven't got TB anyway, very few have. Sometimes there's 1000 cattle coming from the slaughterhouse and they only find one with TB. So the logical thing to do would be replaced one with the other. You start vaccinating, then once an animal is vaccinated, we no longer need to test it'.*
>
> - Pembrokeshire farmer workshop.

National farming organisations, on the whole, also supported reduced testing for making vaccination more attractive due to the costs associated with testing:

> *'Oh, that will be a big win. I mean, yes, that would be, that would be a very good by-product to this, wouldn't it, less testing. If you're testing annually, or every six months, in a number of cases, I mean, that is just a costly business. If you're vaccinating, and you can then go on to say testing is every couple of years, that will be a positive. And that would be a potential driver to encourage take up.'*
>
> – National farming representative, England.

Meanwhile, the quote below indicates that reduced testing as a trigger would be more attractive to certain farmers than to others, depending on their set-up:

> *'It's an interesting one, because [less testing] potentially makes it a little bit more attractive. The concern is, but actually for some, there's real different models. A lot of our dairy farmers are closed dairy farms, who actually would probably benefit more from the vaccine because you've got a static population that you're wanting to protect disease in, and actually, the risk is higher, because you've got an older population that is just sort of staying static. Do I want to be reducing the number of times I'm doing surveillance? And, actually, those people wouldn't be doing that much post or pre movement testing anyway. So actually, the incentive for them is less for it, because I can guarantee my calf rearers will do more pre and post movement testing, than the people down the beef chain, because there's much more movement on those ones, but it may be less appropriate for them to be vaccinated'*.
>
> – Vet, England.

In summary, a **reduced requirement to test cattle for bTB upon vaccination represents a key 'attractive' trigger** according to both farmers and stakeholders, though there was some recognition that this may not be a possibility until the vaccination has been in place for some time.

Using bTB compensation to incentivise vaccination

Both workshop participants and stakeholder interviewees were asked to respond to potential compensation-related triggers, including:

- Whether farmers who do not vaccinate their cattle should no longer receive any compensation; and
- Whether farmers who **do** vaccinate their cattle should receive increased compensation based on accurate valuation of their reactors

Stakeholders shared mixed views surrounding whether farmers should no longer receive compensation. Whilst some believe that unvaccinated cattle should no longer be eligible for compensation as this will act as a trigger to push them to take up the measure, others contested the use of compensation as a 'stick':

> *'It'd be fans to a flame. I just think you'd make things worse. Yeah, it's just a fight that I don't see any minister going for, I certainly don't think they want that fight with the NFU'*
>
> - Pedigree breeder, England.

In terms of using compensation as an incentive rather than as a stick, some participants suggested that those who do vaccinate their cattle should receive an accurately valuated level of compensation should they come down with any reactors. For example:

> *'If you get subsequent reactors [after vaccinating], and you could prove the animals been vaccinated, and there was another layer of compensation on top, it would just be another cherry on top, and it would encourage people to do it, because commercial guys will weigh up the cost of additional testing against the cost of the vaccine and cost of the labour to see if it's gonna be worthwhile'.*
>
> – Auctioneer, Scotland.

Similar to the stakeholder interviews, farmers' views were mixed in relation to how compensation could be used as a trigger, as it could be framed as either a carrot or as a stick:

> *'P13: If you've got that threat of not having any compensation, then people would be fairly accepting.*
>
> *P6: Or another scenario maybe is going to be if you increase the compensation to more realistic levels, you would get a higher uptake'.*

- Frome farmer workshop.

In Whitchurch, participants suggested that providing higher compensation to those who vaccinate could be a clear incentive to uptake:

> *'Well, or even you just base it on cattle valuations, you get x percent higher than if you're not vaccinated. And then if you are vaccinated and you still have a breakdown, you get a higher value [than those who aren't]'.*

- Whitchurch farmer workshop.

Other participants disagreed with compensation being used as a trigger due to it being only a small part of the cost inflicted on farmers when they have a bTB breakdown:

> *'Compensation to the individual animal is not the cost of going down with TB. The cost is you can't sell where you normally sell, or you got to get them all in in the middle of the summer. I think there has to be a benefit to if you vaccinate'.*
>
> – Louth farmer workshop.

Overall, it appears that there is **some potential to use compensation as a trigger, though there were contestations surrounding whether it should be used as a 'stick' or a 'carrot'** to encourage uptake of the vaccine.

Cost of vaccines

The individual responsibility and vaccination company scenarios both included a £6 payment by farmers for vaccination. This was entirely rejected by all participants when discussing the vaccination company scenario due to the lack of other EAST triggers but was subject to further discussion under the individual responsibility scenario, which had triggers which were more accepted amongst participants. Whilst some farmers appear to express (a somewhat reluctant) willingness to pay towards cattle vaccinations due to the recognition that a successful vaccine may save them money through a reduction in bTB breakdowns, other farmers stated that they believe the government should subsidise vaccines to ensure widespread uptake. There was a view held amongst most participants that mandatory vaccination is not conducive to paying for vaccination, with paying only seen as fair where vaccination is voluntary. However, participants recognised that this may then result in a two-tier market, with some farmers vaccinating and others not.

Amongst stakeholders, 12 accepted that farmers could pay £6/head for vaccination, whilst 17 rejected this trigger, particularly if the rollout were mandatory. This was, in part, due to concern that the cost itself (£6) is not the only cost of vaccinating; administering treatment in cattle can involve significant

upheaval, resulting in herd stress and resulting injury and loss of productivity. The long withdrawal periods associated with this vaccine also impose an immediate cost for farmers due to the implications for trading.

Several stakeholder and farmer participants also shared a view that it isn't fair for farmers to pay for vaccinating cattle whilst the government have not got the wildlife side of things under control; there was a sense of unfairness surrounding these conversations, with farmers feeling that they are being treated as scapegoats in the bTB control debate. There were also some conversations surrounding the wider fairness of the government asking farmers to pay for vaccinations, for example because of the money which will be saved by the government as a result of less bTB testing requirements (if that became the case):

> *'P1: This is going to save the government a lot of money because they're not going to pay so much compensation and also for TB. Less testing is gonna save money so they should do it free.'*
>
> - Frome farmer workshop.

The above quote also indicates that farmers in the Frome workshop must believe that the vaccine will have some efficacy for reducing bTB rates as they believe the costs to the government will reduce over time as a result of vaccination.

Several participants, however, contended that farmers would pay the proposed £6/head if the vaccine were made available to them, proven to work, and delivered by a trusted administrator at a time which suits their business needs. For example, all pedigree breeders expressed a willingness to pay towards vaccination, likely due to the high value of their stock. Other stakeholders were more mixed in their views, with most explaining that willingness to pay for vaccination would depend on several other factors (e.g., if other EAST triggers were met, they may be willing to pay).

In Frome, workshop participants questioned whether there would be other triggers to encourage uptake, for example, no longer being shut down for having a reactor, being eligible for real-cost compensation, and a reduction in the requirement to test for bTB:

> *'At the moment, obviously, we're TB testing, and there's no cost involved except for time. Yet this is gonna cost you £6 a head, which I would have thought would be subsidised? Because we're testing free of charge at the moment, it just costs us our time. So then why would we pay if you've still got to test?'*
>
> – Frome farmer workshop.

The view that people may pay towards vaccination if they were able to undertake bTB testing less often as a result was also held by some stakeholders, though there was still an undertone that the government could subsidise vaccination due to the savings they'll make in other bTB-related areas:

> *'I think you could get away with £6/head if you could scrap all TB testing. Because, with the best will in the world, isn't that what we're hoping to achieve by vaccinating cattle? The cost to the government in veterinary costs, pay-outs for TB reactors and administrative burdens, I dread to think what it's costing them'.*
>
> – Trading body, UK.

Several participants, however, seemed to show some willingness to pay due to the recognition of the benefits that may result from vaccinating cattle and where an easy, attractive approach is used:

'P5: Yeah, it opens up a whole new market and it takes a massive amount of stress out of our business. So I'd say £4-5 [noises of agreement from another participant]

P3: (…) I agree with what you're saying with regards to the trials and the evidence, and getting everyone informed. But that's what's gonna make me want to do it, not whether this is free or £6, if I'm honest. If the evidence is there, and the communication and people and I trust the system and the logistics, then I would be willing to go into it. Whether it is free or £6? This is not a lot of money. If it was 60 pounds, it would be a bit different'.

– Ruthin farmer workshop.

'Well, there's nothing there which looks is like a showstopper from my point of view, the cost looks reasonable the fact it is a vaccine you can use to target whether it's a vaccinate or positive is just quite as important.'

– Regulation, assurance, advice – Scotland.

In summary, the following factors may result in some willingness by farmers to pay towards cattle vaccination:

1. **A clear, simple approach to vaccination**, which isn't mandatory (note: most participants supported a mandatory, nationwide approach, so this contradicts their wider views); and
2. Where the **requirement to carry out bTB testing is significantly reduced or eliminated** completely.

A perceived need to control wildlife vectors of bTB prior to vaccinating cattle

Participants in the farmer workshops repeatedly referred to a perceived need to control badger populations throughout the discussions. Farmers believe that whilst there are infected badgers, this may not result in bTB control, even where cattle are vaccinated:

'P1: Badgers have no natural predators culling them, so something will have to happen in the future. Because otherwise the badger numbers will just increase and be the same as we've got now. When you've got overpopulation of anything: humans, rats, whatever, diseases spread much quicker. So we need to keep the number of badgers reduced. Farmers go out and shoot badgers because there's no solution -noise- (…)

P2: If we vaccinate cattle, we'll still have 15% that are susceptible. If you have any badgers around which are out of control that haven't had any sort of vaccination or culling regime, that's a risk'

- Frome farmer workshop.

Participants often referred to badger vaccination as well as culling. However, our accompanying report (Chivers et al, 2022) examines badger vaccination in detail, finding widespread rejection of the approach. Many participants suggested that cattle vaccination should take place in conjunction with (epi-led) badger culling. There were also some stakeholder participants who supported ongoing culling alongside cattle vaccination:

'Culling has been taking place in areas in Derbyshire, so to now mid kind of flow, switch to vaccination. we know culling is working, so that policy needs to continue to get the badger population down. And I think just having vaccination of cattle, unless there's some miracle now

in terms of the vaccine that's coming out. And it is far more effective than what supposedly has been for the last few decades because as long as I've been farming, the vaccines always been 10 years away'.

– National farming organisation representative, England.

Some interview participants also questioned whether there is a need to control other wildlife vectors of bTB, including deer (see Chivers et al, 2022).

In summary, until farmers are confident that vaccination will control bTB in cattle, some are likely to push for continued culling in certain areas (e.g., HRAs) due to the perception that badger control is needed in conjunction with vaccination.

Making vaccination of cattle social

In this section, we examine how the organisation of vaccination can promote social acceptance. The main finding here is that lack of trust in government and APHA is a disincentive to vaccinate. Other social forms of vaccination (e.g., creating vaccination companies) were also not associated with willingness to vaccinate. A summary of the 'social' findings is as follows:

1. Current distrust towards the government, largely due to a lack of clear messaging, makes vaccination unsocial; and
2. Farmers reject the idea of social organisation of vaccination, e.g., through vaccination companies.

Trust in the government

Farming participants in England and Wales expressed distrust towards their respective governments due to a perceived lack of action towards eradicating bTB, a lack of clear messaging, and the perception that policymakers are unaware of the intricacies of bTB. The participant below, for example, was sceptical as to whether the government truly has a political will to eradicate bTB due to competing agendas:

'P1: I don't know if it's being cynical, but the fact that we've got TB in cattle in the UK, keeps the herds number relatively low as well. And it fits in with the green agenda and the carbon agenda, and they don't want to see too much cattle in the UK. So it's actually benefiting the government that we're losing our cattle…that's going down a different path though.

(…)

P2 [farmer and NFU representative]: It's getting to the point now that I'm getting phone calls asking me to go out on farm when APHA is going to be there because these people are so worked up and so on edge about the whole situation. They don't trust them (…), it's just not a healthy way of working'.

– Ruthin farmer workshop.

Workshop participants mentioned that vaccination has been offered as a 'future' option by government for several years, with a feeling of frustration that it has not arrived and that they have been shown little to no evidence surrounding its potential efficacy. Some referred to Covid vaccines to evidence how rapidly a vaccination programme can be rolled out if will is there to do it:

> *'Py: So I think it's just the frustration, take COVID, which they developed in a weekend? I'm 43, and as long as I've been alive, there's this carrot been dangled of a vaccine. Okay. And they say they're doing some trials, but it just doesn't feel that it's getting any closer. So, TB's costing the government millions of pounds every year. Farmers, plus the emotional side, why are we getting no further with this? Everybody's so hung up on what we should do about saving the badger but actually what about the cows? And what about actually trying to find a workable solution to it?*
>
> *Facilitator: Do other people share that concern?*
>
> *Px: Yeah, we've been promised a vaccine, six years down the line for the last 30 or 40 years.*
>
> *(…)*
>
> *It's got to be the whole package of events that will convince us that government is serious on doing this, and will help us out on doing this as well, it can't be completely funded by us farmers, like they've done with the TB cull. You know, we funded that–all ourselves.'*
>
> - Whitchurch farmer workshop.

The above conversation gives a good overview of the feelings of distrust in government expressed by many participants across this research, indicating the **need to more clearly set out longer-term eradication plans, which take into account the practicalities of vaccinating** to build farmer and industry trust in a cattle vaccination strategy.

Social organisation of vaccination

This trigger explores the social environment under which a vaccination programme may be successful; as previous research has found, appealing to farmers' social norms and giving farmers opportunities to build social capital are often key triggers for farmer behaviour. During this project, the voluntary scenario and the vaccination company scenario were both considered to explore this.

Giving farmers' social agency to organise vaccination of cattle through the creation of vaccination companies could help to promote the cultural ownership of solutions to bTB. In doing so, farmers may be more motivated to vaccinate, as the organisation would be led by farmers for farmers. However, workshop participants and interviewees were very sceptical about the effectiveness of such an arrangement.

Firstly, concerns were based on farmers' and stakeholders' similar direct and indirect experiences of running badger culling companies. Directors of badger culling companies cited the volume of work associated with this approach. In fact, soon after facilitators read out the title of this scenario some workshop participants (e.g., in Frome) reacted by telling facilitators to 'save their breath'. Stakeholders

felt this option would be difficult to sell to farmers on the back of the experience with organising local companies for badger culling. This aligns with the following quote from the Frome farmer workshop:

> *'P6: No. We've just proved that we all have different agendas with the dairy and the beef. We've got that one. Yeah, unfortunately, not all farmers are going to get along. So therefore, to have a company that agree in the first place, will be harder. So, you're best just to get this one out of the equation, full stop.* (…)
>
> *P9: It's just a cheaper solution for government, basically'.*
>
> – Frome farmer workshop.

Participants also believed that asking that 80% of farmers in an area signed up was both difficult and insufficient for achieving bTB control:

> *'P8: You need to get a lot more than 80% signed in otherwise you are powerless.*
>
> *Facilitator: So you think it's an unrealistic model?*
>
> *P8: It's the same people doing it ain't it, it's the same people as the culls doing the work again. And then we still got 20% that's not, it's not very good.*
>
> *P10: You have to do, you have to get every farm signed up. That's what we want [farmer points to the mandatory one] [sounds of agreement from other farmers in the room]'*

- - Frome farmer workshop.

Making vaccination timely

In this section we consider how the timeliness of vaccination is connected to willingness to vaccinate. Relevant factors include:

- The need for universal vaccination rather than targeted approaches; and
- The need for flexibility to fit in with the farming calendar.

Universal vaccination

Whilst scrutinising the scenarios, many stakeholder interview participants (n = 15) concluded that a vaccination roll-out should be national from the beginning of any rollout. However, other (n = 9), stated that cattle vaccination should begin in targeted areas. These findings align closely with those from the farmer workshops, where a national approach emerged as the 'easiest' approach. The tendency to support a national roll-out by most participants related to a perceived risk of creating a two-tier market, a sense of fairness, and the desire to make a concerted effort to control bTB.

Those who argued that a vaccination rollout should be national were concerned that a regional, targeted approach would result in cross-contamination. In addition, several stakeholder and farmer participants stated that targeted vaccination could create a two-tier cattle market, creating administrative and logistical complexity for trading:

'The topography of the country (…) means there is a very clear migration of bTB from west to east. I think because of that, because of the natural migration, we have to go national, because otherwise you've got to have a very good system in place to trace vaccination status, and then you've got to rely on the source herd passing on the information. I would imagine that most farms, when they come to do that vaccination, they'll make sure that it fits in with another protocol, like before they turn them to grass or when they're vaccinated with something else. If the vet says that it's okay to use two vaccines at the same time, I think national is the only way to do it. Otherwise, I can see it becoming an absolute nightmare for the government to police and for farmers to ensure they're vaccinating animals. If you've got animals that are vaccinated at different times or not vaccinated on your holding and you then need to have boosters... I can see it all being very messy'.

– Regulation, assurance, advice representative, UK.

'What if we want to sell breeding stock outside of the vaccinated area, is the market then going to be shut to us? Are farmers outside of that region going to want to buy our stock?'

– Whitchurch farmer workshop.

Stakeholder participants who supported a targeted, national roll-out believed that vaccination should begin in high-risk areas as part of a roll-out; targeted areas would, therefore, only be used initially (to pilot delivery) as part of a national scheme:

'I'd want to see it happening if it's happening and I'm in the first area that there's going to be a continuation of that policy until all areas have done. If it's just a look at an area to see what happens, that I wouldn't be quite so comfortable with. So I'd want to think that it's part of a rolling programme, that's going to cover the entire country, that's how I'd look at that'.

– National Farming Union representative, England.

One stakeholder in Scotland was keen for an initial roll-out in selected areas before going more national:

'I'm hoping that the government would start doing some trials. And I would hope that they would do some trials in the highly infected areas. Yeah. And in the very, very low, infected areas'.

– Regulation, assurance, and advice representative, Scotland.

The supermarket interviewed for the research argued that if an initial rollout happened in targeted, high risk areas only, that it should be mandatory:

'So, if you are a high-risk area […] it does need to be mandatory. And with it being mandatory, here are all the things that we're going to invest in to enable that area, that hotspot area to have their vaccine on an annual basis. Might the other bit that I would be interested to know does that mean? So, if we're doing the ongoing vaccine, for hotspot areas, for example, that means they don't have to do pre movement testing'.

– Supermarket representative, UK.

Meanwhile, farmers in the Louth workshop suggested that if a rollout were to be regionally targeted, it would be best to begin in an LRA. This was due to concerns that if farmers were to experience bTB reactors after vaccinating in an HRA, they may lose trust in the vaccine itself. As a result, these farmers

contended that initial efforts should occur in LRAs to build trust, before being rolled out nationally. Most other workshops, however, concluded that any vaccination rollout should be national either immediately, or over time.

The timing of vaccination and the need for flexibility

Stakeholder (n = 12) and farmer participants in all five workshops shared concerns relating to the timing of cattle vaccination, as this could have a profound impact on farm business operations. Participants across the workshops stated that they would need to be able to vaccinate at certain times to fit around their existing livestock movements.

According to participants, one adjustment needed within the mandatory scenario was the three-month window for vaccination, which was seen as too inflexible:

> *'Is it the same three-month window throughout the country or is it staggered? And how does that fit in with workload? The three months being OK depends on the time of year, like in Spring they're busy lambing, so can it be done in Autumn when they're [the cattle] coming in?'.*
>
> – National farming organisation representative, England.

Whilst the mandatory scenario was the most accepted scenario presented in this study, the timing side of it warranted it completely unrealistic for some:

> *'That isn't going to happen because you're going to destroy the rest of their business! [room agrees] This scenario has potential but is not workable as it is now because you have to work to the area, the biggest problem I have with the TB sector, in this country, is we have one national TB policy even though there are huge differences in farming across the country, so if you have the pleasure of doing an outdoor TB test for your herd, it is truly horrific for the animals and people involved. This scenario would have to be worked on to make it much more viable, it has to be convenient time to the farm, not just a convenient time for APHA. The idea would have to work when you were already doing something'*.
>
> – Louth farmer workshop.

Other stakeholders made suggestions as to when the timing of vaccination would be most timely. As previously mentioned above, an ideal time would be when cattle are already in and being treated for other diseases:

> *'We have a period of time by which people have to tag their calves after birth. It's one thing putting a tag in, but it's another thing then injecting it or doing something else a month later or two months later. So all of the logistics, as far as I'm concerned with trade, if you can have a logistical solution to avoid preventing the ability to sell livestock. So how do we overcome that, then? Though I am OK with the 90-day meat withdrawal - we have Red Tractor farm assurance where at present, they have to have been at a minimum of a 90 days on the last holding, to make sure that they are farm assured. Most of the feeding people buy their cattle and feed them for just over 90 days to make sure that they're not in breach. So I would see this as just another thing where they would say, to be sure, we'll keep our cattle 90 days for farm assurance and for the TB jab'.*
>
> – Auctioneer, national (UK).

Farmer participants agreed with the above, expressing the view that there is regional variation and the need to recognise that many farmers have other operations to consider, e.g., sheep:

> *'It's got to be seasonal and it will depend for different people which three months of the year and depending on the area, because if you're in a beef area, fine, but I've got sheep, March, April, May, so I don't fancy your chances of doing the whole area in one go'.*
>
> – Pembrokeshire farmer workshop.

Discussion and conclusion

This report provides a rich qualitative assessment of farmer and cattle industry attitudes towards future deployment of a cattle vaccination, including risk factors and enablers and assessment of impacts on cattle trading, although this latter component is heavily caveated because of current uncertainties regarding the vaccine itself, the DIVA test and wider issues related to Brexit.

Returning to the report objectives, the first of which concerned farmer attitudes towards cattle vaccination, we found that farmers and indeed wider industry stakeholders were generally supportive of cattle vaccination. For the second objective, the research used three anticipatory scenarios (industry-led, individual farmer-led and collective farmer organisation), each with specific triggers to identify possible thresholds to support acceptance (related to vaccine cost, for example). The report shows most support for the mandatory scenario in both the farmer workshops and the stakeholder interviews – thus we find a clear preference for a state-led, mandatory approach, but the responses suggest some modifications to the way this approach should be delivered. Most significant is the request for a national roll-out (rejecting the regional approach in the scenario).

A second key factor was that the vaccine should be free – the logic of this is to support and encourage high uptake among the farming community. This does not imply that farmers rejected paying for a vaccine - some farmers expressed a willingness to pay under the voluntary (individual) scenario. However, the third local vaccination company scenario was roundly rejected by research participants – this was less because of specific EAST triggers designed to support uptake and more about a general rejection of this governance model based on recent experiences of organising badger culling. Farmers and farming organisations do not appear willing to support such an approach in future given significant resource and investment required from participating farmers.

The third research objective concerned impacts of cattle vaccination on cattle trading – what we found in relation to this is general support for effective, trade barrier-free vaccination of cattle, but significant uncertainty regarding the vaccine itself, the implications on trade and realistic timelines. The general message is that much work is still needed to set out cost benefit analysis to farmers (the research may exist, so this may be more about communication) and realism about the timeframe needed, particularly for international trade (genetics, for example). In fact, there were discussions throughout the workshops and interviews relating to a need for clearer, continued messaging surrounding policy and the evidence base surrounding cattle vaccination. Vaccination rollout is likely to be successful once there is clear information surrounding the following:

- Vaccine efficacy;
- Consequences for existing trading relations;
- Vaccine costs (including any meat withdrawal);

- Flexibility in the timing of vaccination delivery; and
- Clear and accurate information on vaccination status of livestock.

Involving farmers throughout the process of policy design is also important, so that they are given the opportunity to raise concerns. Indeed, participants in one of the workshops (Whitchurch) were reluctant to draw conclusions or give certain answers surrounding their willingness to vaccinate due to ongoing uncertainty surrounding the potential efficacy of the vaccine and how vaccination may affect trading. Further work is needed to investigate farmer willingness to uptake cattle vaccines once some of these issues are addressed. There is also a clear need for further activities, similar to the workshops carried out for this project, to communicate and involve farmers and the cattle industry in deliberative policy design processes. Several participants thanked us for gathering their views and giving them a platform to explain their hopes and concerns. This is a positive message, but underscores realisation that organising these events also creates a level of expectation in the farming community, which requires follow-on communication work at a policy level to build support for the policy and a sense that farmers' views are listened to and acted upon. We use these insights below to set out more detailed implications for policy to support uptake of cattle vaccination.

Policy implications

These results have the following policy implications to enhance the take-up of a cattle bTB vaccine:

1. Mandatory approaches to vaccination

There was significant support for mandatory vaccination amongst workshop participants and interviewees. The support for a mandatory approach was because of its apparent fairness: that there would be no favouritism, all farmers would be in the same position, and it would simplify trading relationships. For these participants, the potential impact that vaccination could make to bTB incidence meant that it was too important to be left to chance: there was broad acceptance that a voluntary approach would lead to a scattergun approach to vaccination which was not seen as desirable. Thus, whilst a mandatory approach was not ideal, it was acceptable. Nevertheless, acceptance of a mandatory approach was set against a range of conditions. These included: a vaccine needs to be effective; it must not interfere with the day to day running of the farm; and that it was the Government's responsibility to deliver it. The extent to which these conditions are likely to be met will determine the extent to which a mandatory approach will be successful. Thus, if the 90-day meat withdrawal cannot be reduced, there will be significant resistance against vaccination amongst farmers producing beef. Given that any vaccine is likely to be imperfect, and involve trade-offs between disease freedom and the freedom to farm, this highlights the need for consensus building between the government and farming industry (see below for further details).

2. Incentives to vaccinate

The incentives that are likely to encourage voluntary action reflect the conditions under which mandatory vaccination is deemed acceptable. High vaccine efficacy, for example, makes a vaccine attractive to farmers who want to take steps to reduce their risk to bTB voluntarily, whilst also acting as a condition for a mandatory approach. Reducing testing and enhancing compensation were seen as relatively important incentives.

3. Communications and engagement

Farmers at the workshops exhibited interest in the progress towards a cattle vaccine. Their interest reflects the potential impact bTB has on their businesses, and their hope in a solution that has been promised for many years. The research has highlighted the need for early engagement with farmers to help them understand the challenges facing vaccine development and the likely trade-offs they might need to take. In fact, some farmers attending our workshops interpreted this research as a consultation event, highlighting the level of interest in vaccination. If the government hope to roll out a vaccination strategy by 2025, they have three years from now to mobilise a strategic programme of communications in collaboration with vets and the other stakeholders interviewed during this study. There needs to be a concerted effort to provide 'drip' messaging, as existing research has found that simple, repeated messages delivered using a range of approaches are unlikely to be taken up by the community. Policymakers should take this opportunity to open up transparent dialogue with farmers during these few years, resulting in wider uptake and acceptance when the vaccine is introduced.

The following recommendations are suggested as a way of addressing these policy implications:

1. It is **too early to recommend a mandatory or voluntary approach to vaccination given there exist a number of uncertainties relating to its use**. For either approach, the following information will be required:
    a. **Clear information on vaccine efficacy;**
    b. **No consequences for existing trading relations;**
    c. **Clear information on vaccine costs (e.g., meat withdrawal);**
    d. **Flexibility in the timing of vaccination delivery;**
    e. **Clear and accurate information on identifying the status of (un)vaccinated livestock.**

2. **Policy co-design**: The decision to vaccinate will involve farmers making decisions that are likely to involve significant trade-offs between disease freedom and trade/economic productivity. As there are still many uncertainties around the technical aspects of vaccination (e.g., efficacy) it is difficult to design the most effective policy and incentives to help overcome them. As soon as there is clear understanding of the technical limits to a bTB cattle vaccine, **farmers and farming organisations should be involved in a process of policy co-design** in order to identify the most appropriate ways of delivering the vaccine.

3. **Early and on-going engagement with the farming community**. To help farmers and their organisations to prepare for policy co-design, and understand the technical challenges of vaccination, they need to be engaged in the development of the vaccine. This should include **regular communication about vaccine trials and progress reports** published in the agricultural press. It should also include **meaningful engagement in the scientific process of evaluating the vaccine and Diva test**. This should include inviting farmers to the trial farms, and a dedicated website to show how the bTB vaccine is being trialled. This could also provide a way of gathering ongoing feedback about farmers' preferences for how the vaccine should be delivered using different forms of interactivity and choice experiments.

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Appendix 1: Cattle vaccination workshop participants (farm profile and bTB history)

Proforma Cattle Workshops									
Completed Proforma:		69							
Total farm area (ha):									
Minimum	9	Median	160	Average	218	Maximum	1080		
Main farming enterprise (number):									
Beef	30	Dairy	28	Dairy and beef	7	Mixed livestock	4		
%	43.5	%	40.6	%	10.1	%	5.8		
Number of cattle:									
	Heifers	Steers	Cows	Calves	Bulls	Non-Specified			
Median value	80	25	150	50	3	2			
Income from cattle (%):									
Average:	87%	Median:	100%	Non specified by 37% of participants					
Purchase cattle:									
Monthly	10%	Yearly	17%	Less than yearly	39%	Never	32%	Non-Specified	0%
Sell cattle:									
Monthly	43%	Yearly	26%	Less than yearly	10%	Never	4%	Non-Specified	0%
TB status:									
Never had TB	22%	Single TB event	13%	Had repeated / multiple events	26%	Currently under TB restriction	14%	Been under restricti-on for over 12 months	25%
Cattle vaccination (on farms of research participants):									
Leptospir-osis	Respirat-ory diseases	Clostrid-ial disease-s	Mast-itis	Lungworm	BVD	Ringworm	Pne-umo-nia	Clostrid-ial	Salmon-ella
10%	57%	29%	1%	26%	51%	4%	1%	29%	12%
Enteritis	IBR	None or Non-specified							
32%	1%	17%							
Participants in a cull area:									
Yes	42%	No (excluding Wales)		16%		Welsh Participants (No)		39%	

Appendix 2: Schedule for cattle vaccination workshops, including scenarios

Welcome and Introductions

As participants enter, ask them to read information sheet, sign informed consent form, write their name on a label, and complete the pro-forma.

WORKSHOP BEGINS

Who is in the room - facilitators

Who is in the room – participants

- Where you farm / type – very briefly

Background to project

- Aims
- Funders

Cattle bTB vaccination workshop schedule

Time (minute)	Activity
10	Participants enter workshop, grab coffee/snack, add nametags, complete characteristic pro-forma
5	Participants go around the room and introduce themselves using just 2 sentences (name, farm type, headage, TB experience)
5	Introduction to the workshop – setting the context
15	Initial discussion surrounding existing approaches to cattle-administered vaccines (proactive vs reactive). How much evidence (both scientific and otherwise) do farmers need to persuade them to vaccinate?
20	First scenario – light voluntary touch
20	Scenario 2 – public regulation/government-led
20	Scenario 3 – industry-led approach
15	Participatory activity (list of triggers and score their importance)
5	Summary and close

Introductory Questions

We are here to find out your views about a cattle vaccine for TB. But before we get into that, first of all we'd just like to get some views from you about vaccines in general, for other diseases that you might want to prevent on your farm.

Thinking about cattle vaccination for TB, what is your one main hope and expectation about a cattle vaccine?

- (could be: freedom from TB; eradication; etc etc)

What is your biggest concern surrounding cattle bTB vaccination?

- (could be: trade; timeliness; trust to deliver; efficacy; wildlife…)

Scenario Exercises

OK, that's great – what we want to do now is explore your hopes and concerns in some detail in relation to some specific scenarios about cattle vaccination. We are going to read out some ways (also on handouts) in which cattle vaccination might be delivered in future, and provide you with some details on the vaccine itself. We are interested in what you make of each of these scenarios, and what you think is the best way for vaccination to take place in future. The scenarios do not represent Defra/Welsh Government policy intentions, but they are realistic based on previous policies – so your comments will be useful in helping them formulate its approach in future.

SCENARIO 1

OK, so here's the first scenario (handout text and info sheet)

"Defra/Welsh government have received approval to use a cattle vaccine for TB and a DIVA test to distinguish between vaccinated and infected animals. This will allow continued international trade of livestock and food products between the UK and other countries.

The cattle vaccine is available to all and the Government is encouraging farmers to vaccinate animals over 8 weeks of age. The vaccine costs £6/head and farmers can vaccinate their animals themselves. The vaccination process is relatively complicated and slow – it would take roughly the same amount of time as it takes to complete your TB test. Annual booster vaccines are also required. All vaccinated cattle must be recorded within CTS/BCMS, the passport and would be publicly available (e.g. on ibTB).

The vaccine is 85% protective overall. There will be a 90-day meat withdrawal on the vaccine and no milk withdrawal.

<u>Key Questions – use as probes</u>

In this situation, what would you imagine yourself doing?

Would you vaccinate your herd? Explore reasons why.

- Which animals would they vaccinate (all/groups?)
- When would they start (first, later/ time of year)
- Explore ease/hassle factor and effect on decision - which triggers within this scenario act as enablers?

How do you feel about farmers vaccinating their own animals for TB?

- Explore risks and barriers

How would you feel about using a vaccine with 85% efficacy?

- Explore thresholds - what efficacy is too low?
- Explore appropriate level of efficacy

How do you feel about having your vaccination status known to other farmers?

- Appropriate to show on ibTB?
- Appropriate to show at market?
- How feel about farmers being responsible for recording this information?

SCENARIO 2

Here is the second scenario we'd like to discuss with you:

"Defra and the Welsh Government have shifted their cattle vaccination strategy and announced a government plan to vaccinate cattle in targeted areas in England and Wales. Your area is the first to be selected.

The APHA have been given the task of coordinating and delivering a vaccination programme. You will be contacted by the APHA and given a 3-month window in which you must present your cattle for vaccinating (legal requirement). Vaccination will be free of charge.

Vaccination is mandatory. Any cattle not vaccinated would not be eligible for TB compensation if they became a reactor. Refusal to vaccinate will be a criminal offence and will result in prosecution and a fine in the first instance.

The vaccine is 85% protective overall. Farmers buying cattle in to the area will be responsible for vaccinating them within a four-week window.

<u>Key Questions</u>

In this scenario, how would you feel about being the first to vaccinate your cattle whilst other areas have no vaccination?

- Explore preferences of going first or waiting?
- Explore perceptions of trade issues
- Should farms in vaccinating areas be allowed to buy cattle from non-vaccinating areas?

How would you feel about APHA and the Government being in control of vaccination?

- Would you trust them to do a good job?
- Who would be better to do it?
- What role do you think your own vet should play?

If cattle are not vaccinated, is it fair not to provide compensation if they subsequently get TB?

How do you feel about mandating cattle vaccination?

- Should farmers who refuse to vaccinate their herds be penalised?
- What would be the best sanctions and penalties?

SCENARIO 3

Here is the third scenario we'd like to discuss with you:

"After a further year Defra and the Welsh Government have revised their approach to vaccinating cattle.

The plan involves the formation and licencing of local cattle vaccination companies similar to badger culling companies [in England]. These companies will be led by local farmers and vets who, in consultation with the farmers and vets in their local area, will develop a vaccination plan for the area to meet the needs of local farmers. A licence for cattle vaccination will be provided so long as 80% farmers in the area commit to vaccinating their cattle.

Vaccination will be delivered by each farmer's own veterinary practice. Farmers will be responsible for paying for the vaccine and the cost will be affordable to you.

The farming union in your area will assist in the creation and management of the groups. Vaccinating your cattle will result in 85% protection overall.

You are free to decide whether you vaccinate your cattle; there are no financial penalties for not taking part.

Key Questions

How would feel about farmers' organisations organising cattle vaccination in this way?

- Would farmers commit to vaccinating in this scenario?
- What would you see as the main advantages/disadvantages?
- Would you trust them to deliver this scheme effectively?
- What is the most appropriate way for ensuring everyone would participate?
- Who do you think would want to be involved in running it?
- Would you want to help out?

If TB is controlled in cattle, what should happen to badgers?

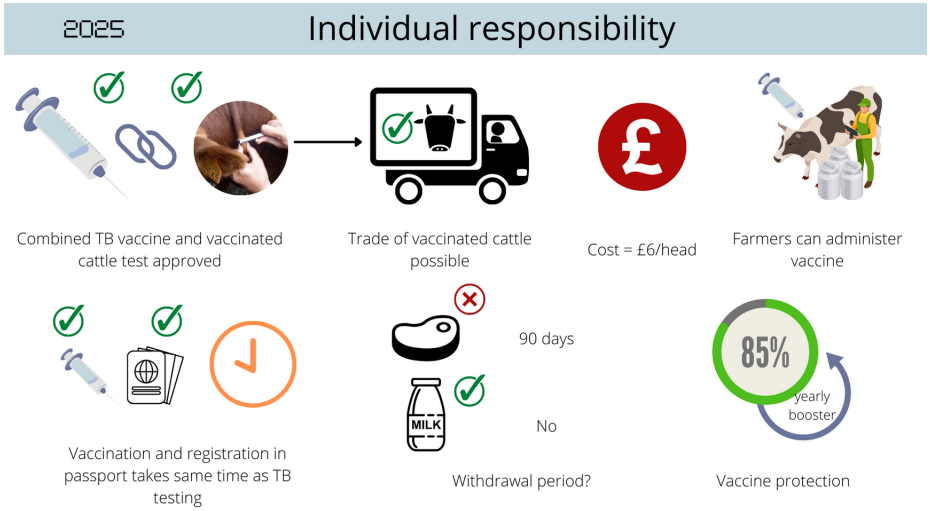
Final Questions and Exercise

Thanks for all your answers. To finish off we want to do one more thing.

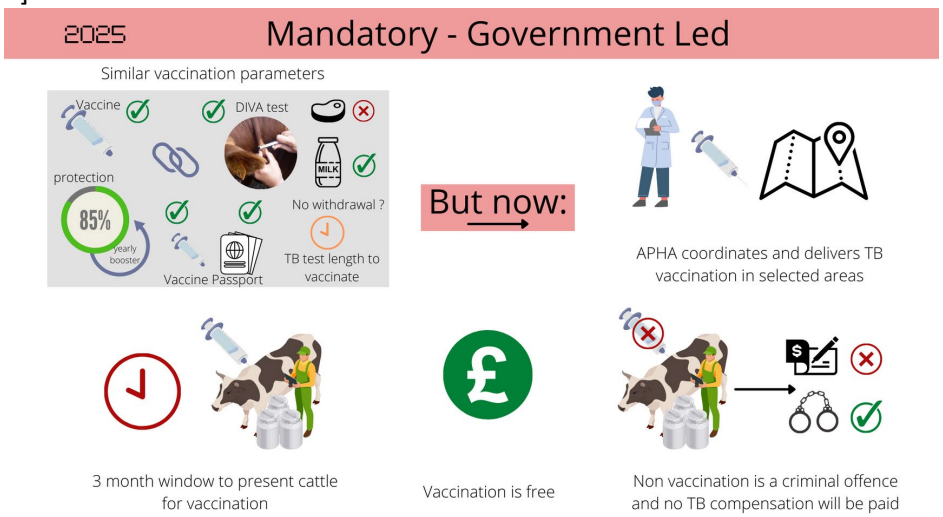
Whilst you have been giving us your feedback, we've been putting onto post-it notes the key points that you have raised. To finish off, we'd like you to place these on this paper to indicate how important they are to you. If we have missed anything, please write it on another post-it note. We want you to agree on where these should go collectively, so the best way to do this is to go through them one by one.

Appendix 3: Visuals aids for cattle vaccination workshops / interviews (a. individual responsibility; b. government responsibility; and c. voluntary responsibility)

A].



B].



C].